

electronics

DECEMBER • 1956

A MCGRAW-HILL PUBLICATION • PRICE 75 CENTS



In This Issue

**INDEX TO
ELECTRONICS
ARTICLES**

for 1956

Ultraviolet Checks
Color Phosphor Dots



NEW HERMETIC POWER COMPONENTS

**HIGHEST RELIABILITY
FOR MILITARY AND
INDUSTRIAL USE**

Listed below are just a few of the 50 new stock items in the United hermetic power series. These MIL-T-27 power components add to the 200 other hermetic stock items of filter, audio, and magnetic amplifier types.

Through the use of proven new materials and design concepts, an unparalleled degree of life and reliability has been attained, considerably exceeding MIL-T-27 requirements. Test proved ratings are provided, not only for military applications but for industrial, broadcast, and test equipment service (55°C. ambient).

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



MIL-T-27 RATINGS IN REGULAR TYPE

INDUSTRIAL RATINGS IN BOLD TYPE

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

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

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



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

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



A FEW TYPICAL LISTINGS OF FILTER REACTORS.

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

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

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

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



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

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



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

No. Type	Sec. V. C.T.	Approx.* DC volts	MA DC	Choke No.	MA DC	Choke No.	Case
H-110	1050	380	275	H-75	385	H-77	MB
	1200	465	250	H-75	350	H-77	
H-113	2500	1050	280	H-77	340	H-77	5¼ x 6 x 7
	3000	1275	250	H-76	300	H-76	
H-115	3500	1500	265	H-77	350	H-77	8¾ x 6½ x 8
	4400	1900	225	H-77	300	H-77	
H-117	5000	2125	900	H-79	1100	H-79	13½ x 11 x 14½
	6000	2550	800	H-79	1090	H-79	

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

UNITED TRANSFORMER CO.

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

CABLES: "ARLAB"

electronics

DECEMBER • 1956

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ULTRAVIOLET CHECKS COLOR PHOSPHOR DOTS—Color tube dot patterns are inspected under ultraviolet excitation at Sylvania Electric's Seneca Falls plant. Hand-held Black Light Eastern Mineralite excites blue-green phosphors as shown in circle insert (see page 190).....COVER

SHOPTALK 2

FIGURES OF THE MONTH 8

INDUSTRY REPORT 9

U. S. Orders More Missiles.....	9	Parts Determine Set Design.....	20
Mil-Reps Become Big Business.....	9	Small Firms In Electronics.....	20
Industry To Hit \$22 Billion.....	10	Europe Has Engineers.....	22
Engineers' Pay Rises.....	12	Commercial Labs Pay Off.....	22
Islands Attract Electronics.....	12	Picture Tube Sales Up.....	24
Business Briefs.....	14	FCC Actions.....	24
VOA Expands Service.....	14	Scopeless Radar.....	26
Electronics Speeds Research.....	16	Financial Roundup.....	26
Recorders Aim For Color.....	16	U. S. And British Exports.....	26
Transistor Business Rises.....	18	Meetings Ahead.....	28
Military Electronics.....	18	Industry Shorts.....	28

ANNUAL INDEX, VOL. 29 64A

CROSSTALK 137

FEATURES

Electronics in the IGY Program	138
By David A. Findlay	
Transistorized Indicator Measures Jet Exhaust	143
By George H. Cole	
Video Switching for TV Broadcast Centers	146
By E. B. Pores	
Microwave Refractometer Predicts Propagation	150
By C. M. Crain and C. E. Williams	
Push-Pull Transistor Servo Amplifier	155
By R. T. Henszey	
Radio System Controls Railroad in Venezuela	158
By B. Sheffield	
Document Processor Reads Coded Dots	164
By Raymond L. Fortune	

CONTINUED ON NEXT PAGE

Transistorized Regulated Power Supply	169
By Manfred Lillienstein	
Storage Tube Projects Radar PPI Display	172
By Harry W. Gates	
Scatter SSB Technique Uses Power Klystron	176
By George M. W. Badger	
Transistor Flip-Flops Have High Speed	180
By A. K. Rapp and S. Y. Wong	
Radar Performance Nomograph (Reference Sheet)	182
By Edward A. Wolff	
Universal Response Curves (Reference Sheet)	184
By Herman I. Leon and Howard Weinberger	

ELECTRONS AT WORK..... 186

Communications Car Tries SSB.....	186	Germany's First Radio Telescope.....	194
Upper Atmosphere Clutter.....	186	Direct Reading Pulse Counter.....	194
Electrogastrograph Diagnosis.....	186	By C. N. Williamson	
Computer Evaluates Water Table.....	188	Atlantic Cable Inaugurated.....	196
Magnetostriction Filter.....	188	Detecting Thin-Wall Pipe Flaws.....	204
Compatible Single Sideband.....	188	Curved Passive Reflector.....	206
The Front Cover.....	190	By Edward Bedrosian	
Simplified Broadcast Receiver.....	190	Heat Sensing Cell.....	208
Transistor Telephone Exchange.....	192	Transistor Ringing Converter.....	216
Square Loop Ferrite Memory.....	192	Pertinent Patents.....	218
		Portable Record Player.....	220

PRODUCTION TECHNIQUES..... 228

Laminated Waveguide Twists.....	228	Quick-Drying Resist.....	248
Watchmakers Assemble Relays.....	230	Cutting Nonlinear Screws.....	250
Disks Identify Tube Defects.....	236	Filling Aircraft Antennas.....	256
Tree Holds Wire Spools.....	240	By Leon Hillman	
Rack Stores Tote Trays.....	242	Machine Inserts Forty Parts.....	264
Wire-Twisting Setup.....	246	Assembly Tray.....	272
		Hot Staking of Eyelets.....	274

NEW PRODUCTS..... 278

LITERATURE..... 348

PLANTS AND PEOPLE..... 362

NEW BOOKS..... 384

THUMBNAIL REVIEWS..... 387

BACKTALK..... 389

INDEX TO ADVERTISERS..... 449

SHOP

► **IN THIS ISSUE** . . . To help readers find articles that we have published in the last twelve months, we have augmented our index service. Starting on page 64A, there appears the regular index of all technical articles, an author's index, the *Industry Report* index, and a separate topical index of all feature articles with a short summary of each.

The job of preparing the 1956 annual index involved typing, alphabetizing and numbering 2,241 index cards. This job fell to editorial assistant Barbara Hearst after the cards had been cross-indexed by assistant editor Dave Findlay.

The amount of work involved did not bother Barbara half as much as did the constant fear of dropping a stack of cards after putting them in alphabetical order.

A second fear was the development of a delicate but discernible unladylike muscle in her arm as a result of operating the card-numbering machine.

Incidentally, for readers who need them, we have cumulative indexes for the years 1930 through 1939 and 1940 through 1949, stapled together, available for one dollar.

► **COMING SOON** . . . When we received a manuscript entitled "All-Transistor Electromagnetic Guidance System" it sounded like a good guided missile story. Partic-

electronics

December, 1956 Vol. 29, No. 12



Member ABC and ABP

TALK

ularly since it was written by an Air Force officer.

The article will appear soon, under a slightly different title, but don't look for military secrets. The "missile" being guided is a feed cart for a large chicken farm.

The ingenious system was designed by author Knight while a civilian and before Uncle Sam called him back to active duty.

► **WHITE SHEETS . . .** Technical editors visiting plants involved in design of electronic equipment sometimes see the trees and not the whole forest. They see engineers and discuss with them the circuits and techniques of equipment under development; these matters make the meat of technical articles that appear later in issues of **ELECTRONICS**.

Because they concentrate on technical information editors do not always appreciate the plant layout of engineering facilities, the environment in which design work is done. It remained for a cartoonist to remind us about the forest. Visiting a plant, he saw it differently from us, and his drawing, shown here, has impact and a novel twist. . . .

Engineers and draftsmen are not the only people who deal in "white sheets." For many years we have used a special white sheet. One attaches to every manuscript immediately on receipt. On one side of it staff men record their



"Oh lovely, pure white sheet . . . what strange, new, wonderful development will you bring forth today?"

reviews and comments for assay by the Editor, and recommend acceptance or rejection.

After acceptance, the other side of the white sheet becomes a master for the various bits of information such as estimated length of text, size of drawing and photographs, relative importance

of the various illustrations and other details that later act as guides to people in the layout and production departments.

This side of the white sheet is blank when an editor is assigned an accepted manuscript to work on. So his reaction might very well be just like that of the engineer.

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*Reg. U.S. Pat. Off. (NO BATTERIES — ELECTRONIC CONTROL)



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**FOR THE
ENGINEER
SCIENTIST
RESEARCH WORKER
TECHNICIAN**

The January 1957 issue of **TECHNIQUE** commences volume eleven of our journal of instrument engineering, and includes the following articles:—

“The New Portable Picture Transmitter (D-770)”
“The Use of Magslips in the Recording of Infra-Red Absorption Spectra”.

Every quarter, **TECHNIQUE** brings to its readers interesting and informative articles on Muirhead precision electrical instruments and how they are serving in the fields of research, industry and education. Maybe some of these applications provide the answers to your own problems. We shall be pleased to mail copies to your address regularly.



TECHNIQUE

A JOURNAL OF INSTRUMENT ENGINEERING

VOLUME ELEVEN

NUMBER ONE

JANUARY 1957

234/C

The scope of **TECHNIQUE** is reflected in the diversity of its cover illustrations. The cover of this issue depicts an essential component of our complete range of Synchro Test Gear.

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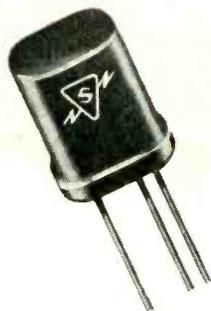
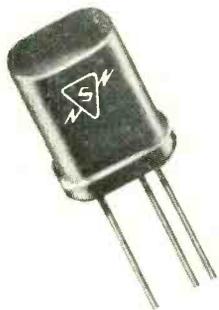
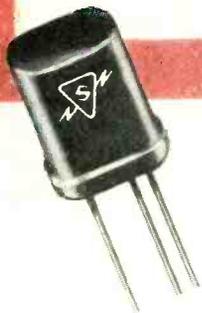
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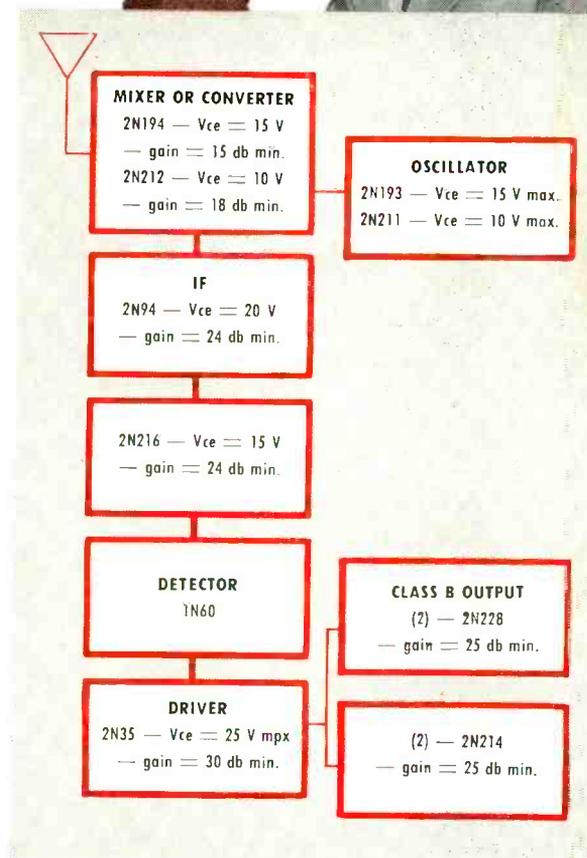
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Sylvania's experience in volume manufacture of NPN alloy junction transistors assures uniformly high quality—amazingly few line rejects.

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Check this block diagram. It outlines the stage-by-stage choice which is afforded the designer. Mixer-oscillator or converter stage is a matter of desired balance between sensitivity and signal-to-noise ratio. There's a choice of IF for most economical design based bandwidth, power supply, and required output.

For complete details write on your company letterhead. Address Dept. M20R.



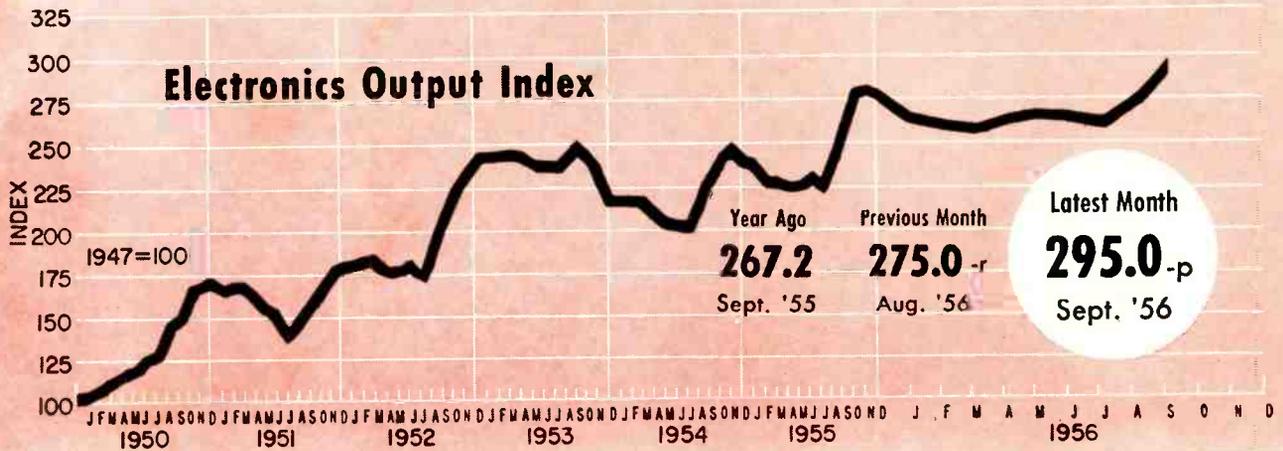
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LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

ELECTRONICS — December, 1956

Want more information? Use post card on last page.



FIGURES OF THE MONTH

	Latest Month	Previous Month	Year Ago
RECEIVER PRODUCTION			
(Source: RETMA)	Sept. '56	Aug. '56	Sept. '55
Television sets, total	894,211	612,927	939,515
With UHF	96,785	90,419	140,022
Color sets	nr	nr	nr
Radio sets, total	1,319,189	990,845	1,302,350
With F-M	nr	nr	27,313
Auto sets	349,790	198,087	511,278

	Latest Month	Previous Month	Year Ago
RECEIVER SALES			
(Source: RETMA)	Sept. '56	Aug. '56	Sept. '55
Television sets, units	763,881	566,158	978,838
Radio sets (except auto)	756,345	681,152	753,068

	Latest Month	Previous Month	Year Ago
RECEIVING TUBE SALES			
(Source: RETMA)	Sept. '56	Aug. '56	Sept. '55
Receiv. tubes, total units	44,432,000	43,948,000	47,588,000
Receiv. tubes, value	\$35,093,000	\$34,507,000	\$34,596,000
Picture tubes, total units	1,249,624	1,099,605	1,202,430
Picture tubes, value	\$21,709,064	\$19,628,837	\$22,867,851

	Quarterly Figures		
	Latest Quarter	Previous Quarter	Year Ago
INDUSTRIAL TUBE SALES			
(Source: NEMA)	2nd '56	1st '56	2nd '55
Vacuum	\$7,680,250	\$8,754,054	\$9,832,751
Gas or vapor	\$2,983,488	\$3,394,059	\$3,365,008
Magnetrons and velocity modulation tubes	\$16,254,025	\$15,136,522	\$13,193,395
Gaps and T/R boxes	\$1,238,469	\$1,455,558	\$1,677,574

	1st '56	4th '55	1st '55
MILITARY PROCUREMENT			
(Source: Defense Dept.)	1st '56	4th '55	1st '55
Army	\$40,490,000	\$48,477,000	\$2,833,000
Navy	\$28,700,000	\$20,378,000	\$43,147,000
Air Force	\$124,828,000	\$131,938,000	\$133,503,000
Total—Electronics	\$194,018,000	\$200,793,000	\$179,483,000

	Latest Month	Previous Month	Year Ago
BROADCAST STATIONS			
(Source: FCC)	Oct. '56	Sept. '56	Oct. '55
TV stations on air	509	507	473
TV stations CPs—not on air	114	113	110
TV stations—new requests	56	54	35
A-M stations on air	2,969	2,958	2,788
A-M stations CPs—not on air	121	106	110
A-M stations—new requests	282	276	235
F-M stations on air	528	527	539
F-M stations CPs—not on air	20	19	14
F-M stations—new requests	9	9	9

	Latest Month	Previous Month	Year Ago
COMMUNICATION AUTHORIZATIONS			
(Source: FCC)	Sept. '56	Aug. '56	Sept. '55
Aeronautical	51,826	50,641	44,183
Marine	59,073	58,432	52,908
Police, fire, etc.	21,346	21,153	19,153
Industrial	31,957	31,146	26,357
Land transportation	9,164	9,141	8,078
Amateur	152,463	150,565	139,628
Citizens radio	20,715	19,997	13,530
Disaster	330	330	319
Experimental	740	730	661
Common carrier	2,418	2,412	2,001

	Latest Month	Previous Month	Year Ago
EMPLOYMENT AND PAYROLLS			
(Source: Bur. Labor Statistics)	Sept. '56	Aug. '56	Sept. '55
Prod. workers, comm. equip.	404-100-p	397,100-r	389,700
Av. wkly. earnings, comm.	\$76.92 -p	\$75.76 -r	\$74.34
Av. wkly. earnings, radio	\$74.15 -p	\$73.75 -r	\$70.30
Av. wkly. hours, comm.	40.7 -p	40.3 -r	41.3
Av. wkly. hours, radio	40.3 -p	40.3 -r	40.4

	Latest Month	Previous Month	Year Ago
SEMICONDUCTOR SALES ESTIMATES			
	Aug. '56	July '56	June '56*
Transistors, Units	1,315,000	885,000	1,131,000

	Latest Month	Previous Month	Year Ago
STOCK PRICE AVERAGES			
(Source: Standard and Poor's)	Oct. '56	Sept. '56	Oct. '55
Radio-tv & electronics	370.6	389.0	428.9
Radio broadcasters	457.0	484.9	486.9
p—provisional r—revised nr—not reported			
*1955 not available			

FIGURES OF THE YEAR

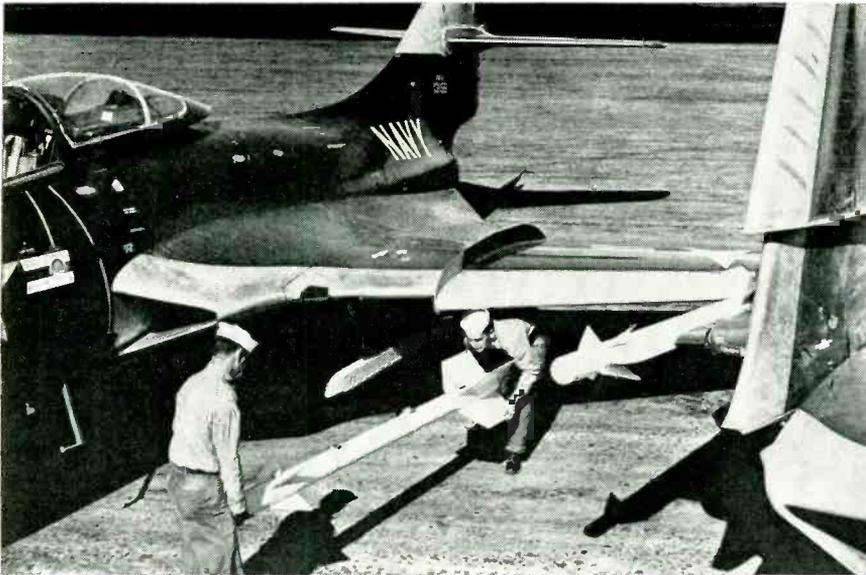
Television set production	9,535,896
Radio set production	4,603,599
Television set sales	5,405,052
Radio set sales (except auto)	347,436,000
Receiving tube sales	8,087,352
Cathode-ray tube sales	7,680,781

TOTALS FOR FIRST NINE MONTHS			1955 Total
1956	1955	Percent Change	
5,229,271	5,760,506	- 9.2	7,756,521
9,535,896	9,949,620	- 4.2	14,894,695
4,603,599	5,149,977	-10.6	7,421,084
5,405,052	3,942,676	+37.1	6,921,384
347,436,000	347,668,000	± 0	479,802,000
8,087,352	7,680,781	+ 5.3	10,874,234

INDUSTRY REPORT

electronics—December • 1956

U. S. Orders More Heat-Seeking Missiles



SIDEWINDER with infra-red guidance system is loaded aboard Navy plane as . . .

Electronics firms share \$30 million for heat-seeking missile now operational with Sixth Fleet

NEW contracts totaling some \$31 million for the production of guidance and control units for its new air-to-air guided missile, Sidewinder, have been awarded to electronics firms by the Navy.

Two Navy squadrons possessing a Sidewinder capability already have been deployed with the fleet. Attack Squadron 46 is on the USS Randolph with the Sixth Fleet in the Mediterranean area and Fighter Squadron 211 is aboard the USS Bon Homme Richard with the Seventh Fleet in the Western Pacific.

► **Awards**—The contracts, in the approximate amount of \$14 and

\$17 million, were awarded to Philco Corp. and General Electric.

They include both Navy and Air Force requirements for the missiles. Funds were authorized by the Congress in the fiscal year 1957 budget.

Cost of the missiles is less than originally estimated because of consolidation of Navy and Air Force requirements, and also because during the development of Sidewinder by the Navy, every effort was made to keep the missile simple and readily producible.

► **Use**—Rear Admiral F. S. Withington, chief of the Navy's Bureau of Ordnance, said that Sidewinder represents a new approach to weapons systems for defense against supersonic aircraft. The new missile has very few moving parts and no more electronic com-

ponents than an ordinary radio. It uses an infrared guidance system. The simplicity of the missile makes it possible for Navy men to handle and assemble it without undergoing specialized technical training.

► **Companies**—Sidewinder was developed by the Naval Ordnance Test Station, China Lake, Calif. under the direction of W. B. McLean, technical director, who originated the concept of the entire weapons system. Philco Corp. was awarded the first production contract for the missile.

Other industrial concerns connected with the Sidewinder program are the Avion division of American Car and Foundry, which produced experimental missiles used in the research and development program, Eastman Kodak Co. and the Bulova Research and Development Laboratories.

Mil-Reps Become Big Business In Electronics

Defense Department recognizes service as growing and permanent part of military electronics

TECHNICAL representative service that was born after World War II as a stop-gap aid to supply technical manpower to the military for increasingly complex weapons systems, has bloomed into a permanent and sizable business for the

electronics industry. Its permanence as far as the military is concerned is indicated by the fact that the Defense Department has recognized the service and will soon put out policy directives to provide uniform policy guidance for technical representative service contractors.

► **Firms**—About 25 electronics manufacturers have separate divisions set up to provide tech rep services to the military. In addition, numerous electronics firms supply technical manpower to the military as a part of contract overhead and not as a separate service.

Latest electronics manufacturer to go into the tech rep business across the board is Du Mont. Two electronics firms do the bulk of the business in the tech rep field and have the largest number of men in the field, possibly over 75 percent.

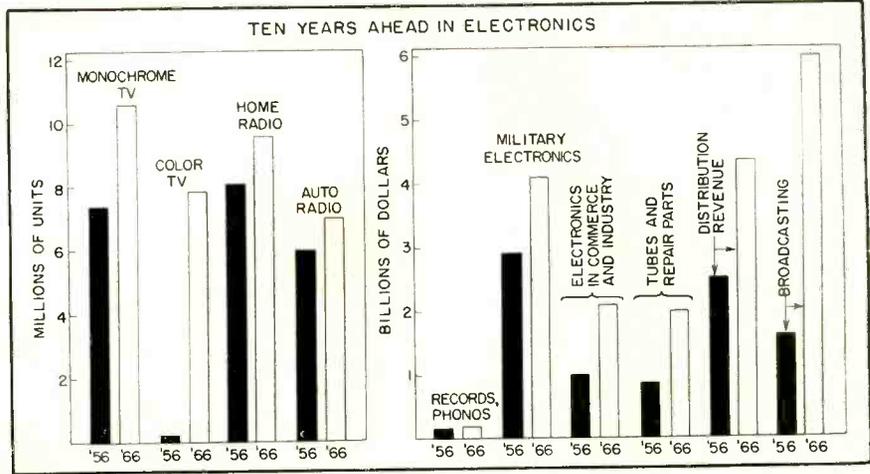
► **Cost**—it is estimated that the Department of Defense spent \$65 to \$70 million last year for tech rep services, not including amounts spent as part of overhead in equipment contracts. Over 75 percent of this amount went to electronics technical representatives.

As a rule of thumb, the military estimates that it costs about \$10,000 a man per year to secure the services of tech reps. This is the contract price and not tech rep salary. According to the Department of Defense tech rep contractual rates range up to \$18,000 a man per year with a normal range of between \$12,000 and \$15,000.

► **Use**—Air Force is the biggest user of tech reps and spent over \$40 million last year. Army, mainly through Signal Corps, is estimated to have spent over \$10 million on tech reps in 1955 and Navy's bill surpassed \$5 million.

Not counting personnel supplied with equipment as a part of contract, there are between 7,500 and 8,500 technical representatives working with the military.

U. S. tech reps have been stationed in nearly every nation outside of the iron curtain.



Industry Heads Toward \$22 Billion

By 1966 all segments of electronics business will have increased, doubling present total volume

FROM an \$11.5 billion industry at the present time the electronics industry in the U. S. will grow to more than \$12.25 billion next year, will surpass \$15 billion in 1960, exceed \$18 billion by 1963, and in 1966, will be an industry with sales and revenues totaling more than \$22 billion. This is the latest prediction of F. W. Mansfield of Sylvania, chairman of RETMA's statistical policy committee.

► **TV**—In 1955, the public purchased 7,456,000 sets, and 1956 sales may fall only a few thousand sets short of this mark. The dollar volume of set sales this year will be approximately \$966 million at factory-door value. By 1960 set sales will total 8.2 million annually, representing a volume of more than \$1.1 billion. In 1966, the unit sale should total 10.6 million sets, with a factory value of \$1.4 billion.

► **Color**—Sales of color sets to the public in 1956 were estimated at 150,000. In 1957 color sales may increase to 250,000. By 1960 the public will be buying 2.2 million color sets a year, 5.1 million in 1963, and 7.9 million color sets in 1966, when black-and-white sales will have declined to 2.6 million. These estimates are predicted on the assumption that the average

value per set, at the manufacturer's level, will decline to \$325 in 1957, to \$220 in 1960, \$170 in 1963, and to \$150 in 1966.

► **Radio**—Sales of home radio sets will total about 8.1 million units, with a total factory value of \$162 million, for 1956. In 1957, 8.5 million sets will be sold at a value of approximately \$162 million. Set sales will surpass 9 million sets annually between 1960 and 1966. The public will buy 9.6 million home radios with a value of \$182.4 million in 1966.

Auto radio sales will range from 6 million to 7 million over the next ten years, with 1956 sales totaling 6 million units valued at \$120 million. By 1966, it is expected 7 million auto sets will be sold at a volume running to \$150 million.

► **Phonos**—Sales of recorders, phonographs, and other entertainment devices should rise from \$160 million this year to \$165 million in 1957, to \$185 million by 1966.

► **Military**—The government is spending approximately \$2.9 billion annually for electronics equipment, and next year the figure is expected to exceed \$3 billion. By 1963 defense buying of electronics products will amount to nearly \$3.8 billion and, by 1966, the total should be in excess of \$4.1 billion.

► **Industrial**—Electronics in commerce and industry will show a greater percentage gain in the next decade than any other area

(Continued on page 12)



miniaturized **CERA-MITE*** capacitors for transistor radios

TRIED AND PROVEN in thousands of transistor radios, Sprague's miniaturized line of Cera-Mite* disc capacitors is building an enviable record of trouble-free service in the field.

Mass production of a standardized line of the five popular capacitance values in the new smaller 50 volt d-c sizes assures continued high quality.

Two widely separated plants, one at Nashua, New Hampshire, and another at Grafton, Wisconsin, assure our customers of a dependable source of

supply to meet production schedules.

Complete technical data on Cera-Mite capacitors for transistor applications is given in Engineering Data Sheet 6121. Write (on your business letterhead, please) for your copy to the Technical Literature Section, Sprague Electric Company, 35 Marshall Street, North Adams, Mass.

• • •

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

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ELECTRONICS — December, 1956

Want more information? Use post card on last page.

11

in which electronics products are used, according to Mansfield. In 1956 sales of electronics equipment to commerce and industry will fall just short of \$1 billion while next year it will be substantially over the billion-dollar mark. By 1963, the total will be well above \$1.6 billion and by 1966, it will approach \$2.1 billion.

► **Parts**—Sales of tubes and other parts for repair of electronic equipment will amount to \$844 million in 1956, and next year are expected to increase to \$944 million. The total by 1963 is expected

to be substantially in excess of \$1.5 billion and by 1966 will be close to \$2 billion.

► **Distribution**—Revenues created by the sale of end products through channels of distribution are expected to be nearly \$2.5 billion in 1956 and 1957, advance to about \$3.6 billion in 1963 and \$4.3 billion in 1966.

► **Broadcasting**—Television and radio broadcasting revenues amounted to more than \$1.9 billion in 1956 and should build up to \$6 billion by 1966.

Engineers' Pay Takes Big Jump

Salary increases in past year average 8.6 percent compared to 4.5 percent in 1955

ENGINEERS and other professional employees in the electronics industry and U.S. industry as a whole now are earning about 8.6 percent more than they earned last year, according to a survey by the American Management Association. This overall average increase in annual compensation for the year ending in May 1956 compares with an increase of about 4.5 percent for the previous year.

The percentage rise in engineers' salaries from 1955 to 1956 is higher than that for any other executive and specialized group surveyed by AMA. For example, AMA's survey of manufacturers' field salesmen shows their earnings increased an average of 3.5 percent in the same period. More than three-fourths of field salesmen surveyed earned between \$5,000 and \$15,000 last year.

► **Coverage**—The study covers more than 31,400 engineers, scientists, and administrative employees in 49 different activities at five levels of responsibility. Most of the positions studied are technical or highly specialized in nature, ranging from design engineer in electronic engineering to machine and tool designer.

► **Experience**—Engineers with less

than one year of experience are earning a median salary of \$5,300 a year, regardless of area of specialization, the survey shows. The next higher category of engineers, with experience ranging from one to three years, has a median salary of \$6,500 a year.

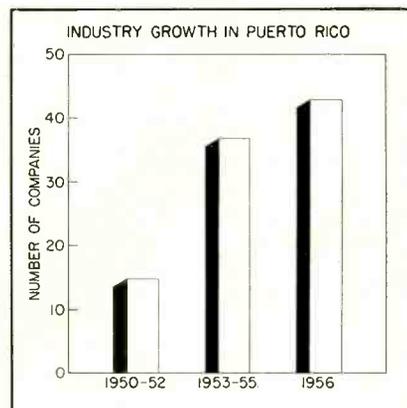
The highest salaries reported in the survey are being paid to certain nonmanagement specialists in research and exploration with some administrative duties. In a few cases these individuals are earning as much as \$19,000 a year. Physicists and mathematicians with similar administrative duties are not far behind, with average salaries up to \$15,000 a year.

► **Bonuses**—Top pay range of technical and profession personnel tend to overlap with those of middle management executives the survey indicates. However, the engineers and scientists are much less likely to receive bonuses than are the members of middle management. Less than a fourth of the employees in this survey received bonuses last year, compared to nearly half for middle management personnel.

► **Change**—Despite the healthy increases in compensation, a smaller proportion of scientists and engineers are working in industry, compared to those in government work, according to the National Science Foundation. Last year, 67.5 percent of the nation's engi-

neers and scientists were in industry, compared to 72 percent in 1951. In 1955 some 21.5 percent were in government work while in 1951 the proportion was 13.5 percent. About 11 percent were in education in 1955 compared to 14.5 percent in 1951.

Islands Attract More Electronics Firms



Puerto Rico gains more electronics manufacturers. Hawaii and Jamaica beckon to the industry

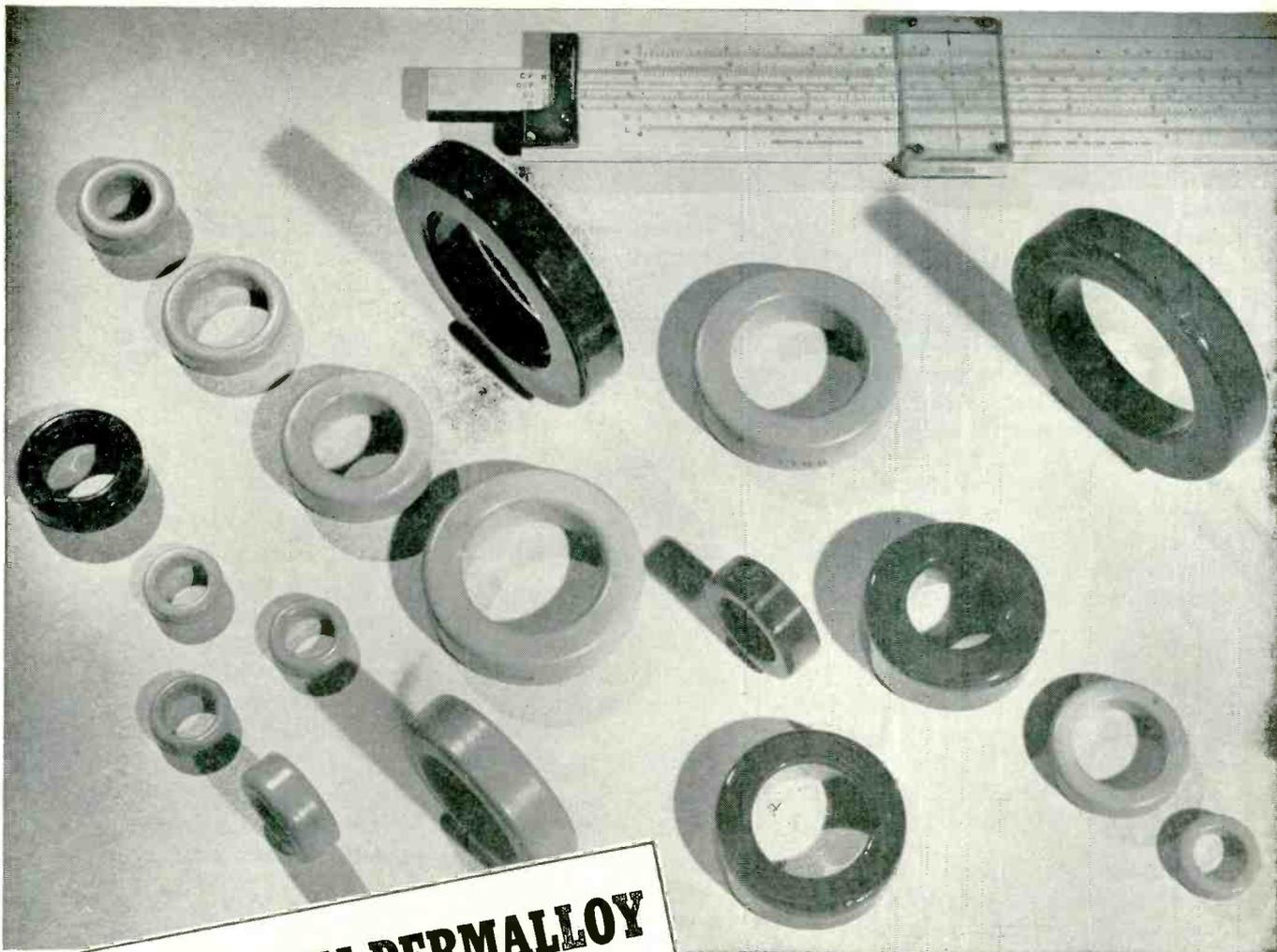
GROWTH of the electronics industry in Puerto Rico has reached a total of 37 electronics and electrical firms in operation with six more scheduled to begin operation. In July 1955, there were 34 manufacturers and a year earlier there were only 21.

► **Firms**—Federal Telephone and Telegraph, an IT&T subsidiary, has organized Federal Carbide as a Puerto Rican subsidiary to make selenium rectifiers, starter switches and other electronic components. IT&T already has two communications companies in Puerto Rico and a distributing company for commercial and home consumer products.

A GE division, the wiring devices department, plans to manufacture switches at Ponce, P.R. In May of this year GE's first island plant was inaugurated and another has opened since then.

► **Hawaii**—Establishment of an electronics industry in Hawaii started this year. What is called

(Continued on page 14)



MOLYBDENUM PERMALLOY POWDER CORES

(New technical data now available)
Write for Bulletin PC-104B, dated October, 1956

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

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

- ★ Manufactured in a full range of sizes—from 0.500" diameter to 5.218" in all permeabilities.
- ★ Furnished temperature stabilized, including wide range stabilization (-65° F to +185° F), for many types.
- ★ Available from stock in most popular types due to additional manufacturing facilities.

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.

For Bulletin—ADDRESS DEPT. E-612

WSW 632B

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Hawaii's first electronics plant has been formed. The company will manufacture rebuilt picture tubes. It estimates that about 8,000 picture tubes need replacing annually in Hawaii.

It is estimated that more than two percent of Hawaii's people are engaged in communications and electronics, mainly in the broadcasting end of the business. Installations of the Navy, Army, Air Force, Department of State, CAA, FCC, FBI, RCA, Mackay, Globe and private airways installations cover the islands. On the island of Maui, the U.S. Bureau of Standards maintains one of its frequency broadcasting stations.

Although the islands have only a half million population, there are 14 a-m and 3 f-m stations and 5 tv stations. There are about 150 to 200 radio engineers, about 1,500 technicians and maintenance people and over 2,000 operation and administrative personnel.

► **Market**—Puerto Rico's main electronics market is the U.S. Total annual shipments to the mainland are about \$10 million.

The island itself is a sizable market and is continuing to grow. There are 130,000 tv sets in Puerto Rico today with 60,000 in San Juan alone.

By the year 1960, an estimated 300,000 sets will be in use. U.S. set makers have captured the bulk of this market.

In fiscal year 1955, value of shipments of radio and tv sets including chassis reached nearly \$7.4 million.

In recent months an electronics firm has been established to rebuild tv picture tubes. The company expects the picture tube replacement market to reach 20,000 units a year by 1960.

► **Jamaica**—The government of Jamaica, B.W.I. recently substantially liberalized its industrial income tax laws and import duties in a move to stimulate capital investment on the island by U.S. electrical and electronics manufacturers. Several companies are reported to have moves in the planning stage.

Business Briefs

► **Sales** approximating \$1 billion for 1956 and substantially in excess of this figure for 1957 were forecast for General Dynamics by president John Jay Hopkins. Net sales for the first nine months reached \$691.0 million compared to \$506.1 million in the same period in 1955. The company has a backlog of unfilled orders totaling \$1.8 billion, the highest in its peacetime history

► **Magnetic tape systems company**, Davies Laboratories, was acquired by Minneapolis-Honeywell to provide instrumentation systems in the high-speed data-handling field

► **Transistor manufacturer**, Beckman Instruments, is negotiating for a major increase in its long-term loans for further expansion of plant facilities. Plans are to increase present long-term loans of \$3.4 million by \$5.6 million for a single loan of \$9 million. The company spends over 10 percent of sales on research and development

► **Elecom computer manufacturer**, Underwood Corp., plans to sell \$5 million of debentures for working capital, research and engineering, plant expansion and development of new products

► **West Coast firm**, Sierra Electronic Corp. of San Carlos, Calif., was acquired by Philco Corp. in a move to expand its research, engineering and development facilities. Philco also acquired the Bendix home laundry equipment business of Avco

► **Disbursement** of \$7.5 million will be made to the more than 70,000 shareholders of the Television-Electronics Fund, the largest annual distribution in the fund's 8-year history

Voice Of America Ups Service

Hours of programming have been increased five-fold since 1954. Expenditures drop 50 percent

VOICE of America, one of the most powerful radio voices in the world, has stepped up its number of broadcasts and cut down on equipment expenditures.

► **Programs**—Every 24 hours the Voice of America, a part of the U. S. Information Agency, broadcasts nearly 145 hours of programs comprised of 55 hours in original and 89 hours of repeat broad-

casts. In 1954 daily program hours totaled 31.

Today nearly half, 70 hours, of the daily broadcast are beamed to Europe and 23 hours of these programs are in Russian. The Far East gets 34.5 hours of VOA broadcasts a day and the Near East, South Asia and Africa get nearly 20 daily. The remaining time goes to Latin America and world-wide areas.

► **Equipment**—Between 75 and 100 transmitters handle Voice of America broadcasts. This includes facilities rented when additional coverage is required. The master control

(Continued on page 16)

HOW TO GROW CRYSTALS . . . *Automatically*

. . . NEW KAHLE MACHINES
ARE SPECIALLY DESIGNED AND BUILT
TO ECONOMICALLY PRODUCE **HIGH QUALITY**
SEMICONDUCTOR CRYSTALS

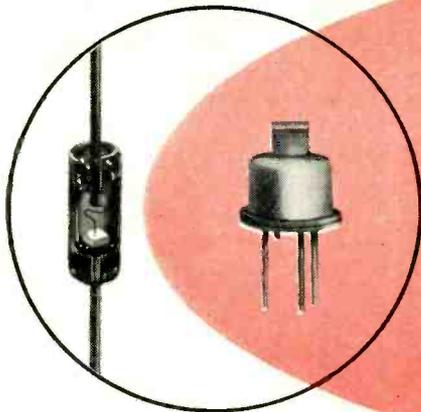
"Know How" gained from over a quarter-of-a-century's experience enables Kahle to solve the most critical problem in semiconductor production . . . the growing of the crystal. It is crystal uniformity that governs semiconductor reliability and operation . . . truly, here is a task where **no compromises** are possible!

To meet these stringent requirements, Kahle Machines produce single crystals by the withdrawal of a germanium or silicon seed from a crucible primed with a molten mass of similar metal. Precise controls are constantly maintained over the rotating seed to insure its uniformity. Crucible holders are completely adjustable and incorporate provisions for a variety of sensing elements, plus a window for an optical pyrometer. The unit's traversing mechanism is vibration-free.

A single lever quickly lowers the seed holder to the starting point . . . standard Machine types handle up to 5 lbs. of metal. Vulnerable Machine points are made of stainless steel and are fully water-cooled to improve efficiency. Interchangeable heads can accommodate either RF or resistance heating elements . . . Machine #2901 illustrates the use of resistance heating and is available with Radiomatic temperature control as shown. Machine #2650 illustrates the use of RF heating. Automatic programming can be supplied.

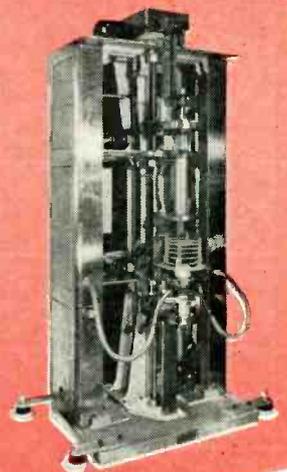
Because production requirements differ, Kahle offers the specialized engineering services necessary to design and build "customized" Machinery and Equipment for every semiconductor application from lab samples to full scale mass production. When you need production equipment . . . "Call-on-Kahle."

Write for technical information; please specify your application or problem.



CRYSTAL GROWING MACHINE #2901 — 10" PULL

CRYSTAL GROWING MACHINE #2650 — 32" PULL



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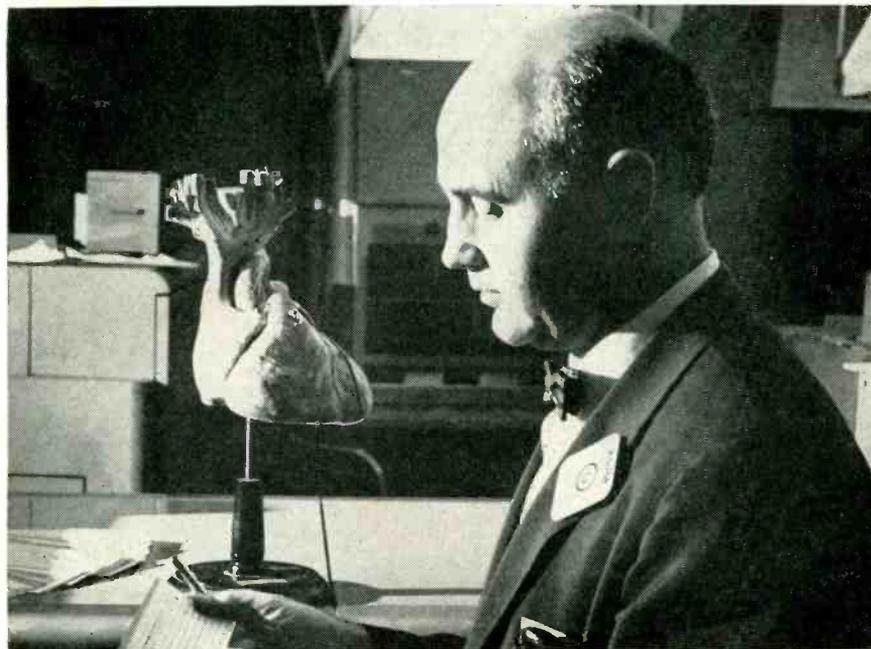
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center in Washington D. C. feeds programs to 30 short-wave transmitters in the U. S. Some \$14.4 million was spent by VOA in fiscal 1956 for this broadcasting service.

► **Cost**—The United States has spent over \$45 million on the acquisition and construction of radio facilities for the Voice of America

since 1950. The trend in spending has dropped sharply since 1953 when a record \$22.5 million was expended. In fiscal year 1956 which ended in June, \$1.5 million was spent on additional radio facilities, nearly 50 percent less than the \$2.9 million spent in 1955. In 1954 expenditures totaled \$4.9 million.



CARDIOLOGIST, IBM card, heart model and computer (in background) combine forces to fight heart disease while . . .

Electronics Speeds Heart Research

Electronic controls and instruments are providing doctors with new information

COMPUTERS, oscilloscopes, blood pressure recorders and a host of other electronic devices are being used at an ever increasing rate by the medical profession to provide faster and more accurate information about the human body, its functions and its maladies.

► **Show**—At the recent IRE conference on electrical techniques in medicine and biology, a number of papers were presented on electronic instruments used in the medical field. Papers covered subjects ranging from an electronic artificial respiration control to a cathode-ray cardiograph.

► **Computer**—Electronic computers are being used to reveal new knowledge of heart diseases, early detection and relief. In a cooperative effort by the Lockheed missile division and Dr. Travis Winsor of the Nash Cardiovascular Foundation in Los Angeles, computers allow analysis of the human heartbeat in terms of harmonic content.

The heart's total activity is made up of many contractions, flutters, valve actions and other motions. The combined frequencies and amplitudes of these motions is the harmonic content. The computers make it possible to describe and record in mathematical terms all the heart's activities.

► **How**—Electrodes attached to the patient's body feed minute electrical pulses to an oscilloscope

which pictures the heart oscillations. Carefully timed photographs are taken of the heartbeat wave as it sweeps across the face of the scope.

Enlarged photographs of a portion of the heart pulsation, covering only one-tenth of a second, are segmented into approximately 80 points from which the harmonic content is determined. The data is put on punched cards and fed into the IBM 650 computers. Tabulations produced by the computers show any deviation in the patient's heartbeat when compared with former records.

Video Tape Recorders Aim for Color

Ampex expects to ready color unit by next April. NBC uses taped video on network show

ENGINEERING progress on a color version of the Ampex video tape recorder may result in a prototype unit for demonstration at the 1957 NARTB convention. The big factor in this progress, according to the company, is the demand for such a unit; present demand is for black-and-white equipment.

► **Compatibility**—The color recorder is expected to use the same rotating-head technique, tape and operating speed as the monochrome version. It will be possible to playback color tape on a monochrome machine for black-and-white pictures.

► **Public Showing**—A 2.5-minute portion of an NBC network color show has been broadcast from a tape recorded on the video tape recorder developed by RCA. Playback speed of the tape was 20 feet per second.

► **Other Developments**—Minnesota Mining's Mincom Division is engaged in developing a prototype color video tape recorder based on the model developed by Bing Crosby Enterprises, which it took over. The new version will have improved heads, slower tape speed and a modular packaging. It will

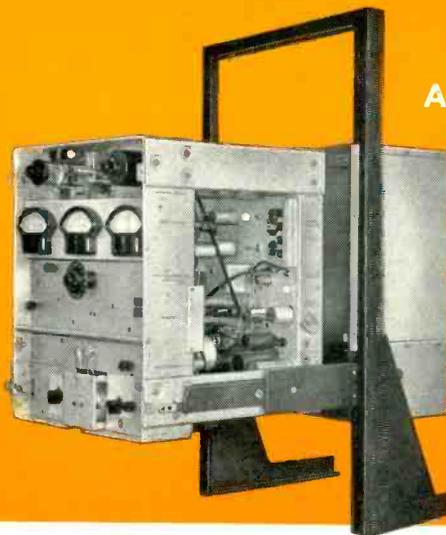
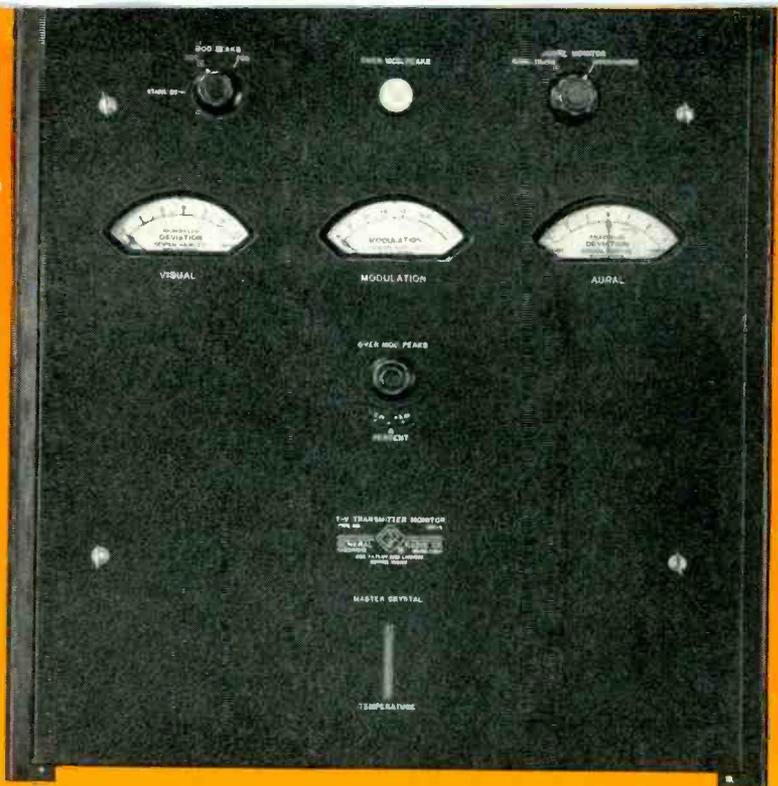
(Continued on page 18)



All New

TV Transmitter Monitor

... the most complete equipment ever designed for monitoring and testing TV transmitters



Advanced Mechanical Design

Everything — initial installation, operation and maintenance — can be done from the FRONT of the rack.

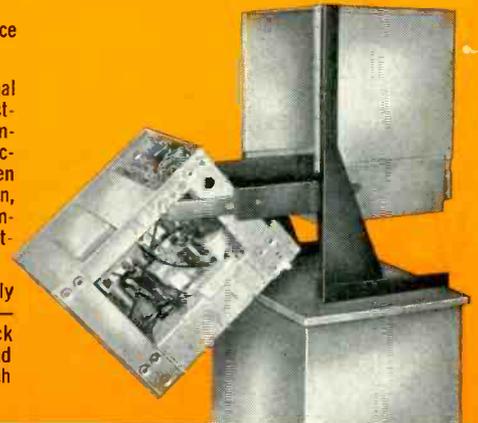
Entire chassis slides out of relay rack into extended operating position tilts for access to rear or bottom.

All tubes, internal circuit adjustments, cables, and plugs are within easy reach.

Unique chassis marking is so comprehensive that most maintenance can be performed without need of instruction book or circuit diagram.

Flow lines showing signal paths between tubes, adjustments and test points immensely simplify circuit tracing — Red-Amber-Green color code flags attention, clearly marks relative importance of various adjustments.

Key voltages are conveniently checked by panel meters — pin jacks permit rapid check against normal current and voltage values printed at each test point.



Type 1184-A TV Transmitter Monitor, \$2650

- ... for Black and White or Color, VHF and UHF Channels 50 to 890 Mc
- ... meets or exceeds all new FCC Color-TV Standards and Provides for Additional Functions Not Yet Required

Video, aural and intercarrier frequency deviations, modulation information, and other operational data required by the FCC are provided with a degree of excellence never before attained. In addition, this instrument makes possible tests that speed transmitter adjustments, maintenance, and trouble shooting, saving many hours of valuable engineering time.

Continuous audible monitoring against loss of either carrier, and continuous meter monitoring of f-m noise on the visual carrier are important new conveniences. The complete intercarrier sound-detection system is typical of the additional operating aids and functions built into this instrument — the response provided is identical to that of an intercarrier-type receiver, making possible realistic correlations of transmitter performance with receiver listening tests.

Reliability is far beyond normal requirements for laboratory-type electronic instruments. Conservative tolerances take into consideration the effect of time on components and

the possible tightening of FCC specifications, they permit use of "off-the-shelf" tube replacements and provide for non-critical adjustments, insuring reproducible measurements.

☆The master crystal oscillator is the most stable, least critical type so far developed . . . ☆Circuit demands on tubes and components are conservative to increase reliability . . . ☆High r-f voltage levels are used to reduce noise problems and to insure freedom from r-f tuning effects . . . ☆Frequency multiplication per stage is kept to moderate values . . . ☆High-level metering circuits do not require extra-sensitive external meters and fragile, ballast-type heater regulators . . . ☆Power rectifiers are replaceable tube types . . . ☆The highly efficient new crystal oven maintains internal temperatures constant within a few hundredths of one degree C; sensitive oven relays have been eliminated, and the temperature control circuit is free from the effects of thermostat resistance.

All in all, this is the finest instrument for monitoring TV transmissions ever to be made available. You may obtain this new model through your TV transmitter manufacturer as part of your transmitter package, or directly from General Radio.

G-R TV and Broadcast Monitors are used by twice as many a-m broadcasting and TV stations as all other makes combined

GENERAL RADIO Company

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Write for Complete Specifications

WE SELL DIRECT
Prices are net, FOB Cambridge or West Concord, Mass.

probably have five channels—three for color, one for luminance and one for sync.

Currently, Mincom is marketing a wide-band video tape recorder for instrumentation applications. Its response is within ± 2 db from 5 cps to 2.0 mc. Units have been delivered to Westinghouse, Wright Field and Evans Signal Lab. One is under construction for Tempco Aircraft Corp. of Dallas.

Transistor Business Multiplies Rapidly

Production, sales, applications may soon cut into receiving tube sales volume

INCREASED growth of transistor production, sales and applications so far this year is causing both elation and concern among some tube manufacturers in the electronics industry. If the present growth rate continues it won't be long before the receiving tube has really stiff competition.

► **Estimates**—The generally accepted estimate of transistor production for 1956 at the middle of the year was around 12 million units. Now estimates have risen to 13 million for the year and to 30 million for 1957. One manufacturer estimates that transistor sales will increase by over 4,000 percent in the next 9 years. That would put production at over 500 million units by 1965, equalling present receiving tube output.

► **Figures**—RETMA's figures show how fast transistor output has grown this year. For the first eight months, 6.9 million of the devices worth \$19.7 million were produced compared to 1.7 million worth \$6.3 million in the first eight months of 1955. Thus, in just one year transistor output has increased 400 percent.

► **Pricing**—Some manufacturers feel that the rate of transistor sales growth will be governed largely by unit price and that as long as tubes can be made at lower

Military Electronics

► **Infrared monochromator** that detects and measures heat radiations of airborne targets, designed and manufactured by Servo Corp. of America, was delivered to the French Air Ministry for aircraft and missile design, and aircraft defense

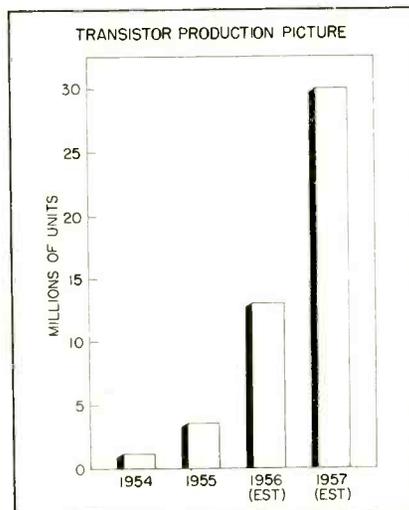
► **Navy awarded Hoffman Labs** a \$22-million contract for 6,001 units of the ARN-21, airborne portion of the TACAN air navigation system. The contract represents the company's largest undertaking and boosts its military backlog to \$43 million

► **Army Ordnance awarded contracts** totalling \$35 million to Raytheon for the production of military electronic equipment developed by the company. A 1-million sq ft plant in Andover, Mass is being converted to handle the contracts

► **FLAC (Florida Automatic Computer)** has been developed by ARDC and RCA for faster reduction of missile flight test data at the Missile Test Center in Florida. The computer is capable of 1,750 arithmetical computations per second and has a memory of 4,096 words of 48 "bit" capacity

► **Automatic ground control intercept system, AN/GPA-37**, developed by GE and ARDC, solves the intercept problem automatically in the event of enemy air attack, then transmits the necessary command information for automatic utilization by airborne weapons

► **Helicopter with radar** that detects a low-flying enemy plane more than twice as far away as a shipboard radar is undergoing flight tests for Navy evaluation. It uses AN/APS-20E airborne search radar supplied by GE



cost they will hold their own. RETMA's figures already indicate that average value of transistors has dropped. In 1955 the average factory value was about \$3.20 while today it is about \$2.80. One manufacturer recently lowered the average price of its transistors about 8 percent to slightly above \$2.00 per unit. The present average value of receiving tubes, according to RETMA statistics, is about 80 cents.

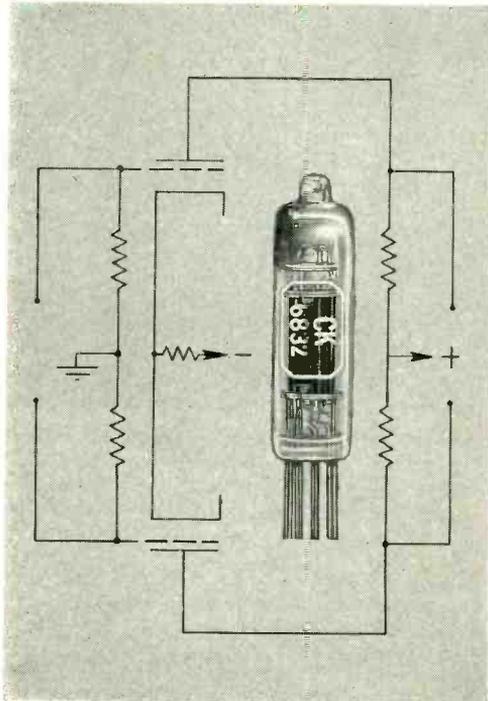
► **Step-Up**—Increase in transistor production this year has been brought about to a large extent by

(Continued on page 20)



A new and important

RELIABLE SUBMINIATURE TWIN TRIODE CK6832



The **FIRST SUBMINIATURE TUBE** designed for precision D. C. Amplifier and Computer Service

The Raytheon CK6832 is a subminiature version of the popular and brilliantly successful CK5755. In addition to the reliability and ruggedness for which Raytheon Subminiatures are famous, this expertly designed, precision produced tube features:

LOW MICROPHONICS

Vibration output at 40cps, 15G 10 mVac

Extreme ELECTRICAL STABILITY

$E_{1b} - E_{2b}; E_f$ 6.3V to 5.9V 0.3V

Extreme MECHANICAL STABILITY

$E_{1b} - E_{2b}$ after 400 to 600G shock . . . 0.5V

LOW GRID CURRENT

3×10^{-8} A

FINE BALANCE between sections

plate current balance 0.15 mA

All of the above are maximum ratings



SPECIAL TUBE DIVISION

RELIABLE MINIATURE AND SUBMINIATURE TUBES • VOLTAGE REFERENCE TUBES
VOLTAGE REGULATOR TUBES • PENCIL TUBES • NUCLEONIC TUBES

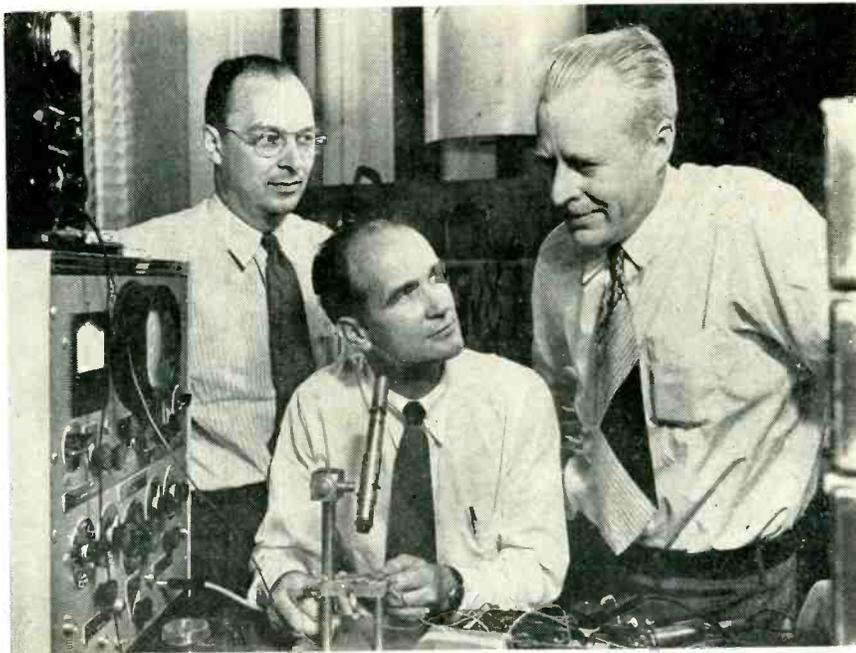
NEWTON, MASS.: 55 Chapel St. • Bigelow 4-7500
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CHICAGO: 9501 Grand Ave., Franklin Park • TUxedo 9-5400
LOS ANGELES: 5236 Santa Monica Blvd. • NOrmandy 5-4221

increasing use in home equipment. RETMA recently estimated that transistor portable radios represented about 19 percent of total portable production during the first 7 months of this year.

In auto radios made during the first 9 months of this year about 4 percent were transistorized, according to RETMA estimates. By year's end the rate could reach 30 percent.

Motorola recently announced that all of its radios supplied to Ford, Chrysler and American Motors for 1957 cars are being equipped with its new power transistor. The company has two facilities in Phoenix, Arizona that are turning out 8,000 transistors a day. A third plant to double this capacity is under construction.

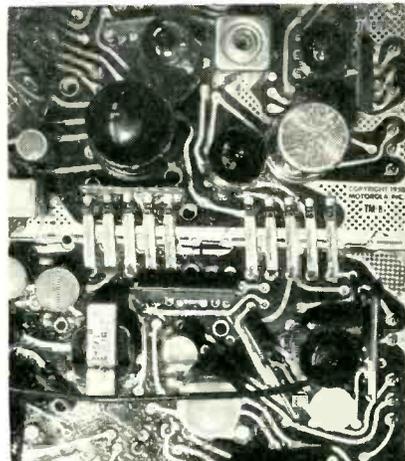
Delco Radio of General Motors hopes that approximately 30 percent of its production for 1957 models will use transistors.



Nobel Prize in Physics for 1956 was awarded to John Bardeen, William Shockley and Walter H. Brattain, shown (left to right) at Bell Telephone Laboratories in 1948 with apparatus used in the first investigations that led to the invention of the transistor. The trio received the \$38,653 award for "investigations on semiconductors and the discovery of the transistor effect"



PACKAGED circuits are inserted in plated circuit boards at Motorola. Finished chassis, right, shows how



Small Business Looms Large In Electronics

Industry has high proportion of small firms. U.S. pushes small business aids

IMPORTANCE of small business in the electronics industry shows in latest census figures. There are over three times as many manufacturers with less than 100 employees in the electrical machinery industry which includes electronics as there are companies with 100 or more employees. There are almost as many manufacturers with under 20 employees in the classification as there are of all other sizes put together.

There are 3,973 manufacturing establishments which produce electrical machinery and electronics in the U. S. Of these, 1,817 have from 1 to 19 employees; 1,118 have from 20 to 99 employees and the remainder, 1,038 establishments, have 100 or more.

► West—Nearly 50 percent of the

(Continued on page 22)

Parts Determine TV Set Design

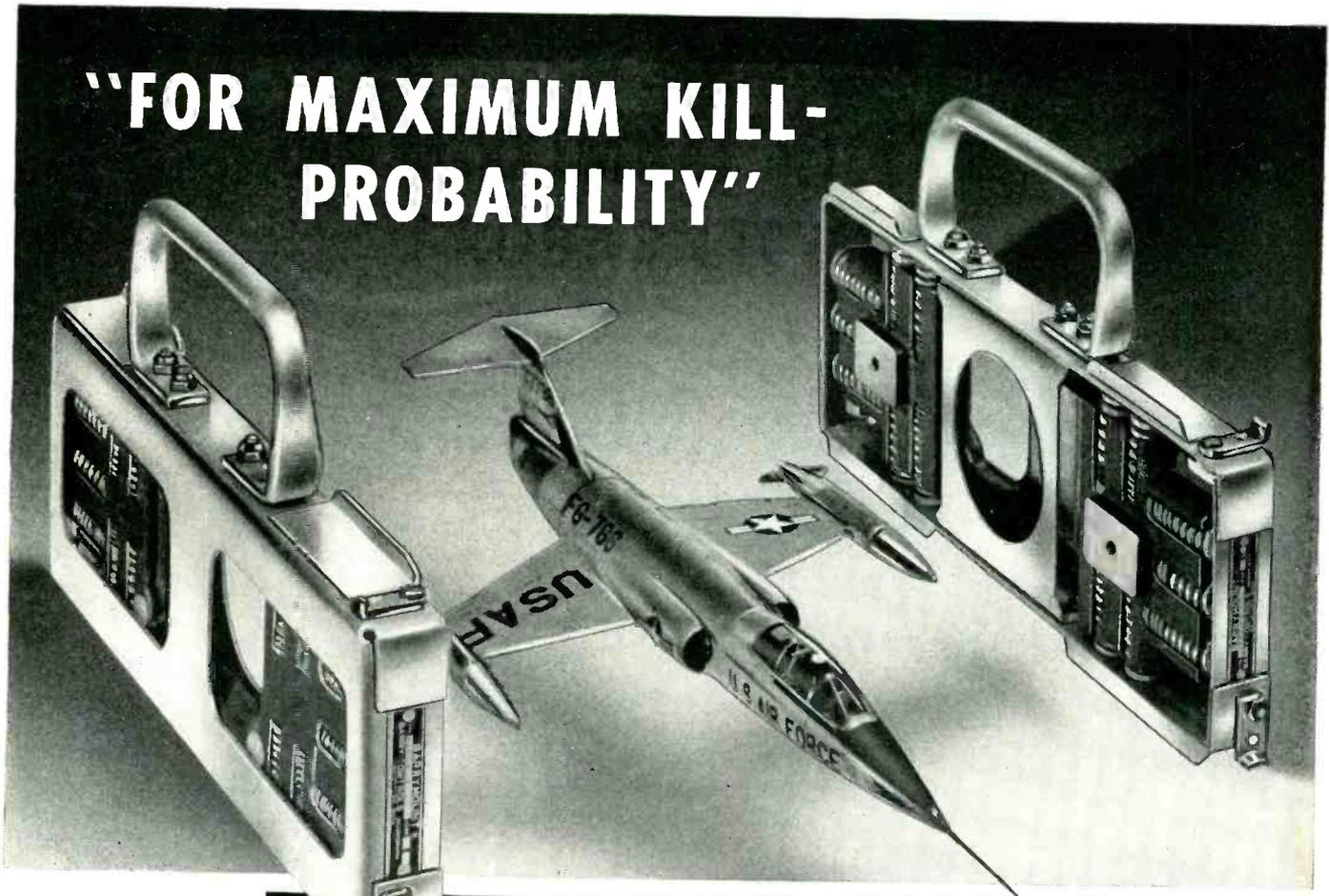
New receiver to cut costs through group units and new dip-soldering method

TELEVISION sets that combine a complete plated-circuit chassis and packaged circuits are coming off the line at Motorola. Chassis area is decreased 20 percent and 97 separate parts are combined into 17 group units reducing conventional

wiring by 90 percent.

The new development is the result of cooperative engineering effort between Motorola and Centralab, manufacturer of the PEC assemblies. A special engineering group was established by the two firms in 1955 to work on the development. The project, with close integration between the companies and their engineers, was finished in a year.

"FOR MAXIMUM KILL-PROBABILITY"



Starfighters' Fire-control Radars Use Barry's NEW Integral* Mounting Systems

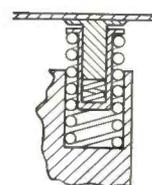
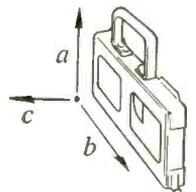
In the most advanced airplane of its type ever developed — Lockheed's F-104A Starfighter — Barry's new Integral* Mounting Systems are solving the toughest combination of shock, vibration, and sustained-acceleration problems ever posed by jet aircraft. Literally a "missile with a man in it", the F-104A demands that equipment mounts give superior performance, in less space, and at lighter weight than ever before.

Here's how Barry's Integral* Mounting Systems are meeting this demand in the production models of the Starfighter.

In a space only 12¾ x 5¾ x 1-13/32" on each side of a 150-pound load . . . a pair of units weighing less than three pounds each . . . provides adequate vibration isolation at 4g sustained acceleration in all radial directions . . . passes all shock-test requirements of this supersonic fighter . . . performs reliably through wide temperature and altitude ranges . . . and provides positive, quick-release attachment to the airframe to satisfy Lockheed's requirements for "plug-in" electronics-system components.

Here's the way this system works.

Helical springs designed to function in their axial direction only are grouped about the load attachment points so as to provide controlled resistance to movement along the *a* and *b* axes. For the *c* axis, resistance is provided by the slightly tapered side flanges of the mounting frame working against the displacement of all the load-carrying springs.



Damping adjustments (see diagram), completely independent of the stiffness of the load-carrying springs, provide design flexibility for obtaining desired natural frequency, transmissibility at resonance, and degree of vibration and shock isolation.

Write for THO-5 containing a full exposition of this All-Angl Integral* Mounting System.

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Designed specifically for the environment performance requirements. Built specifically for the equipment. You can save time, space, and trouble by bringing your shock and vibration problems to us. Call your Barry sales representative.

electronics manufacturers in the Los Angeles area employ less than 50 employees. Only about 25 companies employ 500 or more workers.

► **Overall**—Importance of small business to U.S. manufacturing as a whole has increased in the past ten years. The number of operating manufacturing establishments in the 20 to 99-employee size class increased 8 percent between 1947 and 1954 to 10,000. In the 100 and over class, the number of plants increased by 10 percent to 3.5 thousand. In the electrical machinery and electronics group, there was a 30-percent increase in number of companies with more than 100 employees.

► **Encouragement**—Having such a high proportion of small businesses, the electronics industry keeps an interested eye on government actions that affect small com-

panies. Recent recommendations by the President's Cabinet Committee on Small Business have been followed closely.

Among other things, the committee has recommended that the taxes imposed on business corporations be modified by reducing the tax rate from 30 percent to 20 percent on incomes up to \$25,000. The 52-percent rate on corporation income in excess of \$25,000 remains. It has also recommended that the same accelerated depreciation be allowed on purchases of used machinery and old buildings that is now available on new property.

The military is also pushing aid to small business. In an effort to increase the utilization of small business with technical capability in research and development, the ARDC has established a new procurement agency known as the Executive for Small Business.

trained with industry experience. The annual availability of over 11,000 specialists is shown in the right-hand column.

► **Costs**—Hiring a man through this method runs around \$2,200 which compares with the U. S. average of about \$2,000.

Commercial Labs Make R&D Pay Off

Number of labs has increased four-fold since 1940 as federal and industry research expand

BEFORE 1940 there were only about 150 commercial research labs in the U.S. Today there are about 600.

Expansion of government research accounts for much of the increase along with military work since World War II. Commercial laboratories have spent approximately \$35 million annually for scientific research and about \$4 million for basic research. The Federal Government contracted with commercial laboratories for about half of their total research expenditures and industry sponsored the remainder, except for a small portion from trade associations, foundations and universities.

► **Fields**—According to a survey of commercial research labs by the National Science Foundation, chemistry appears to be the most common field of activity, followed by engineering and physics. However the report points out that one of the most dramatic changes of the past ten years has been a general expansion into new fields of electronics and solid state physics. Most of this work has been for immediately applied research, with basic research accounting for little more than 10 percent of total activity.

Of total personnel in the commercial laboratories doing research and development in 1953, 42 percent or 1,180 were scientists and engineers and 22 percent or

(Continued on page 24)

Industry Taps Europe For Engineers

Search for talent abroad costs companies about the same as search in U. S.

TREND toward overseas recruitment of engineers by U. S. industry is indicated in the operation of D'Agastino Associates, foreign recruiters of technical personnel.

► **Technique** — Interested companies contact the recruiting organization stating their needs. Resumes and other pertinent per-

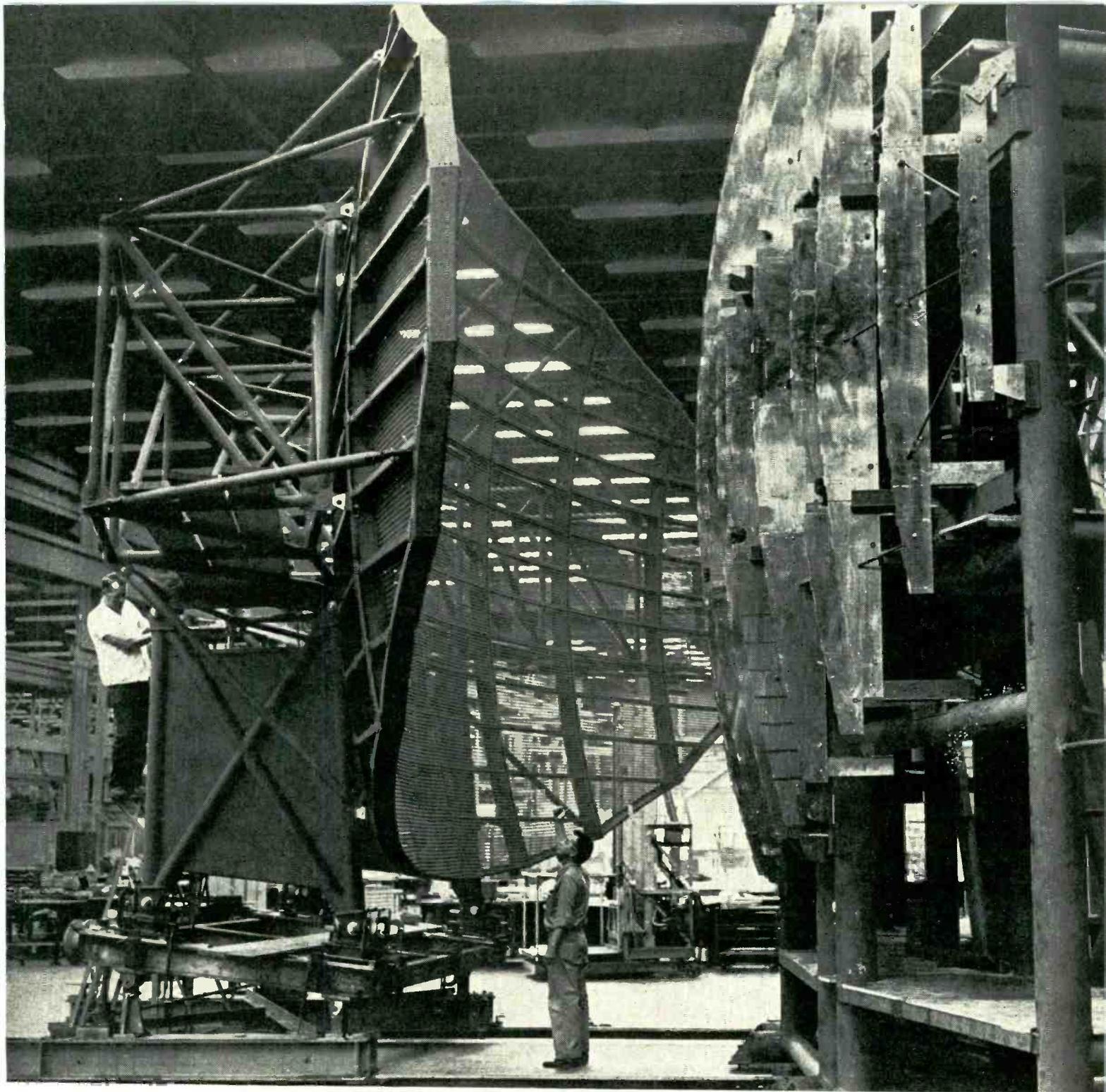
sonnel information, gathered by a network of the recruiter's overseas offices, are submitted and likely candidates chosen for follow-up and eventual employment.

► **Supply**—Surveys made by the recruiting organization covering the availability of engineering manpower in thirteen countries are shown in the chart. These specialists are all English speaking, interested in coming to the U. S. for employment and are university

AVAILABLE POOLS ACCORDING TO PROFESSIONAL CLASSIFICATION

	P	C	E	Met	Eng	Mat	T
Austria	X		X	X	X	X	300
Belgium		X		X			200
Denmark	X	X	X		X	X	250
Finland		X			X		100
France	X	X	X	X		X	750
Germany	X	X	X	X	X	X	5,000
Britain	X	X	X	X	X	X	750
Ireland	X				X		1,500
Italy		X	X		X		200
Dutch	X	X	X		X	X	600
Norway		X	X	X	X		500
Sweden	X		X	X	X	X	750
Swiss	X		X	X	X	X	200

P = Physics, C = Chemical, E = Electronics, Met = Metallurgy, Eng = Engineer, Mat = Math, T = Total.



PRECISION JIG (RIGHT) GAGES ACCURACY OF HUGE ANTENNA SURFACE TO 1/100 OF AN INCH—PROOF THAT LARGE OR SMALL . . .

General Electric Antennas Are Engineered to Give Your Radar System Top Reliability and Accuracy

Backed by more than two decades of experience and proven reliability, General Electric antennas are thoroughly engineered to your specific needs.

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614 were supporting personnel.

► **Charges**—Business practices, including rates charged or cost determination in commercial labs, are not standardized, according to the study, although procedures are fairly uniform. Overhead rates vary from 15 to 400 percent of direct costs with no apparent relation between the size of the overhead rate and the equipment need or the nature of the research to be accomplished.

One laboratory determines cost by charging a flat rate of \$1,700 per month for each full-time researcher with a Ph.D. degree who works on the contract. This includes all costs except special equipment and travel.

Another laboratory has devised a system by which personnel are classified into four categories. Costs including overhead and equipment normally used have been worked out for each type approximately as follows: key scientific personnel, \$10.45 per hour; scientific and technical, \$8.45 per hour; personnel, \$4.70 per hour and foreign scientific personnel \$6.45 per hour.

Picture Tube Sales Hold Unit Volume

Despite a possible decline in tv set production, replacement tube sales will boost volume

EXPECTED leveling off of tv set sales in the last quarter of this year will not keep picture tube sales from establishing new volume records in 1956. Tube output in the first nine months of this year still exceeds that of the first three quarters of 1955 when a record number of sets were sold and picture tube output was at an all time high.

Cumulative picture tube sales for the first nine months of 1955 totaled 7.6 million units compared to 8 million units for the period this year.

► **Renewal**—Behind high c-r tube output in the face of a set sales

FCC Actions

► **Instituted** preliminary hearing on allocations for frequencies above 890 mc. Comments to be filed by Jan. 7, 1957

► **Proposed** changes in rules affecting motor carrier, railroad and Gulf coast radio users upon petition of industry groups

► **Pondered** tightening regulations on interference resulting from growing popularity of wireless microphones, phonograph oscillators, radio-controlled garage-door openers and various radio-controlled toys

► **Brought** industrial radio under Conelrad rules already covering broadcast, aviation, public safety, amateur, land transportation, citizens and disaster services

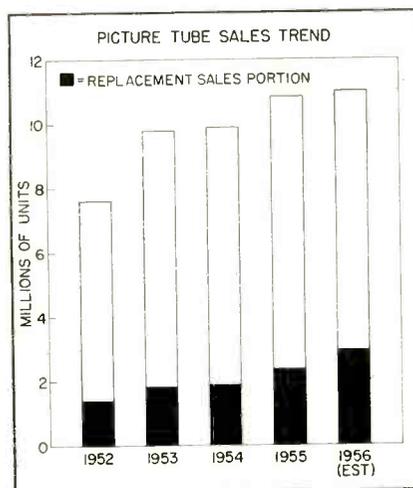
► **Recorded** petition to split present 200-kc vhf aeronautical flight test channels to 100-kc and eventually to 50 kc, thus providing aircraft manufacturers possible additional facilities

► **Authorized** tv broadcasters to transmit test signals during program time for the period ending Jan. 15, 1957

► **Invited** interested manufacturers to demonstrate automatic radiotelegraph call selectors for cargo ships not later than Mar. 1, 1957

► **Called** for comments on proposal to ease operation of industrial radio by heavy construction and manufacturing users where population is sparse

► **Assigned** Channel 26 plus to Shinglehouse, Pa.



decline is the growing replacement market for picture tubes. This year, it is estimated that replacement sales will represent 25 percent of total industry sales of cathode-ray tubes. This represents a 4-percent increase since 1955 and nearly 7 percent since 1953. At the present rate, picture tube renewal sales will exceed initial sales to set manufacturers in about five years.

► **Value**—Although screens have grown larger, prices have continued to drop. This year the

(Continued on page 26)

PERKIN

Tubeless Magnetic Amplifier Regulated DC Power Supplies

PERKIN

Over 15,000 units in operation

PERKIN

WHERE DEPENDABLE PERFORMANCE COUNTS—SPECIFY PERKIN

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Typical Standard Unit:
MR532-15A Power Supply
2-36 Volts @ 15 amps



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PERKIN EXPERIENCE

Since 1932, Perkin power supplies have been selected for the nation's most critical projects, such as 1300 Model PR-748 and 680 Model RA-91C units for the Signal Corps, the NAUTILUS, VANGUARD, and in current missile projects. For the AEC, Perkin has provided three units, 0-60V @ 1000 amps ea., 6 units, 0-100V @ 2000 amps ea., 18 units, 0-100V @ 3000 amps ea., etc. This experience is the hidden value built into every Perkin standard DC Power Supply.

PERKIN FACILITIES

Perkin facilities have been doubled in the past year, with additional expansion planned in the near future. Perkin has over 200 people in its organization... manufactures its own transformers... fabricates sheet metal... utilizes the most modern manufacturing equipment... resulting in efficient and economical production techniques which are passed on to you in reasonable prices. In addition, Perkin offers a wider range of units... immediate delivery from stock.

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Perkin power supplies represent the latest design thinking of the nation's top specialists in the field. Entirely without tubes, vibrating contacts or moving parts, these units have earned for Perkin leadership in the tubeless magnetic amplifier regulated DC Power Supply field, based on technical proficiency.

If you are building a new plant or laboratory, write or wire Perkin or our nearest representative for quotations. Catalog information is also available upon request.

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average value is down to about \$18 per tube compared to \$24 in 1953.

Part of the reason for the decline this year has been increased production of smaller tubes for portable tv sets. It has been

estimated that production of all tv portables, including 17-inch models, could account for 24 percent of this year's production compared to 5 percent of total set production in 1955.

showing for the first nine months of the year. Net profits for the 26 firms in the nine month period totaled \$231.4 million compared to \$267.4 million in the first three quarters of 1955, a decline of 14 percent.

► **Profits**—Here are the net profit reports of additional companies in the electronics field, for the fiscal periods indicated:

Company	Net Profit	
	1956	1955
Am. Bosch Arma 9m	\$3,385,438	\$2,971,878
Beckman Inst. 12m	1,744,856	1,322,050
Bell & Howell 9m	1,111,040	1,194,665
Bendix 9m	15,464,552	19,778,666
Controls Co. Of Am. 9m	719,741	664,445
Daystrom 6m	1,116,000	930,000
Electronic Spec. 6m	96,720	
General Dynamics 9m	21,076,298	13,754,390
Gen. Inst. 6m	35,561	*10,796
Hoffman 9m	1,101,474	934,292
Kay Lab 9m	150,515	*44,834
Litton Ind. 12m	363,336	168,244
Magnavox 3m	790,333	564,807
Minn. Mining 9m	27,202,398	24,967,380
Motorola 9m	4,817,964	4,885,848
Nuclear Instr. 12m	177,222	103,820
Penn-Texas 9m	4,316,000	
RCA 9m	27,893,000	30,995,000
Siegler 3m	272,559	192,399
Sparks-With. 12m	363,336	168,244
Stewart-Warner 9m	4,650,288	4,345,959
Sylvania 9m	10,958,617	9,556,210
Unitronics 9m	326,860	211,584
Van Norman 9m	549,023	469,309
Vestinghouse 9m	*1,399,000	43,833,000

*Loss

How U.S. and Britain Compare in Exports

Overseas business is on the rise in Britain while in the U.S. volume declines

ALTHOUGH the U.S. exports twice as much electronics equipment (in dollars) as Britain does, our exports have declined since 1954 while theirs are rising rapidly.

► **Volume**—British electronics exports have increased substantially every year since 1950. The value of exports for the whole radio industry in Britain for 1956 is estimated at \$112 million, an increase of \$20 million over 1955 exports.

The largest percentage increase since 1950 in British exports has been in sound reproduction equipment. Communications equipment, transmitters, navigational aids and industrial equipment account for 63 percent of British exports.

(Continued on page 28)



ENEMY movements are heard but not seen with . . .

Scopeless Radar Used By Army

Field-tested set gives infantrymen a portable radar to spot night fighters, tanks and trucks

PORTABLE radar having a maximum range of 6,000 yards has been built for the Army. It provides mobile ground forces with local battle surveillance of enemy movements in smoke, darkness or fog.

► **Operation**—By eliminating a cathode-ray tube and substituting audible signals, lightness and ruggedness are attained. The set produces sounds of distinctive character when contact is made with a vehicle or soldier, thus permitting the operator to detect enemy movements. It distinguishes a vehicle from moving personnel and indicates whether a single vehicle moves on track treads or wheels. It can detect a man walking a half-mile away and provides elevation and range data.

► **Size**—The set is self-contained in a drum-shaped metal case, 14 inches high and 14 inches long. The low power needed by the set

is supplied by a lightweight motor generator that is easily transportable on foot by one member of a two-man observation team. The combined weight of the set and generator is about 85 pounds.

► **Orders**—Already field tested for over a year, the set was originally developed and produced by Sperry Gyroscope working with the Signal Corps Engineering Laboratories, Fort Monmouth, N. J., and the Army Electronic Proving Ground, Fort Huachuca, Arizona. Signal Corps has contracted with Sperry for more of the units of later improved types.

Financial Roundup

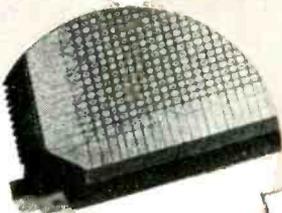
THIRD quarter profits for 26 firms in the radio, tv, electrical equipment field were down two percent compared to last year's third quarter, according to a survey by the First National City Bank of New York. Net profits for the quarter totaled \$80.8 million compared to \$82.4 million in 1955. This decline lowered the industry's



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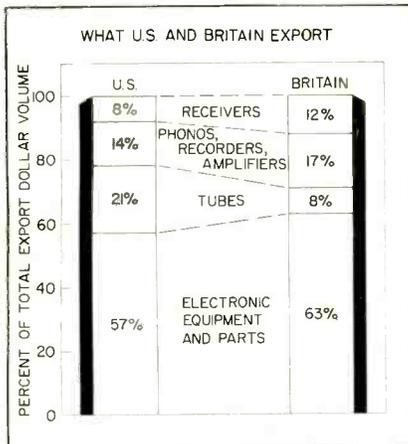
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► **Wane**—U. S. overseas sales declined from \$276.4 million in 1954 to \$268.6 million in 1955. For 1956, a further decline in the total may be in prospect.

Accounting for last year's decline was the substantial decrease, in tv set exports, a drop of \$6.6 million. A further decline is expected this year. Our best percentage increase is in crystal diodes and transistors which rose from \$19,542 in 1954 to \$401,576 in 1955.

► **Specialties**—Compared to the U.S., a larger portion of British electronics exports has consistently been devoted to domestic receivers, sound equipment, and commercial and industrial equipment and parts. Only in cathode-ray tubes and receiving tubes has the U.S. maintained a larger sales portion. In 1956 it is estimated that Britain will export about \$9 million in c-r tubes and receiving tubes. U.S. exports of c-r tubes alone approach \$16 million and receiving tubes add another \$38 million.

► **Sidelight**—Problem that some foreign customers have in purchasing U.S. electronic equipment was pointed out recently by one engineer in *Wireless World*. He told British engineers that "If you see an instrument in *ELECTRONICS* that would halve your testing time or do a particular job three times as accurately in half the time, don't despair in getting it. There are only 37 separate steps of paper work between needing it and having it on your bench".

Industry Shorts

► **Two-year** research program on the use of rhenium in electronic tubes has been started at Battelle Institute under Air Force sponsorship.

► **Iran** police force has placed nearly \$1.5 million in contracts with Redifon of London, England for supply and installation of a complete radio communications system.

► **Color** tv for the British public is 7 to 10 years away, according to the

Meetings Ahead

Nov. 26-30: Third International Automation Exposition, New York Trade Show Bldg., New York, N. Y.

Nov. 29-30: IRE, PGVC Annual Meeting, Fort Shelby Hotel, Detroit, Mich.

Nov. 29-30: Operations Research Conference, SAM, Hotel Commodore, New York, N. Y.

Dec. 3-4: Midwest Symposium On Circuit Theory, IRE, Michigan State University, East Lansing, Mich.

Dec. 5-7: Second IRE Instrumentation Conference & Exhibit, Biltmore Hotel, Atlanta, Ga.

Dec. 10-12: Eastern Joint Computer Conference, IRE, AIEE, ACM, Hotel New Yorker, New York, N. Y.

Dec. 19-20: RETMA Symposium On Applied Reliability, Bovard Hall, University of Southern Calif., Los Angeles.

Jan. 14-16: Symposium On Reliability & Quality Control In Electronics, IRE, NBS, ASQC, Statler Hotel, Wash., D. C.

Jan. 23-25: IRE, Symposium On Very Low Frequency Waves, NBS, Boulder Labs, Boulder, Colo.

Jan. 28-29: Symposium On Microwave Ferrite Devices & Applications, IRE, Engineering Societies Bldg., New York, N. Y.

Jan. 30: Electronics In Aviation Day, IRE, IAS, RTCA, Sheraton Astor Hotel, New York, N. Y.

Feb. 7: Annual Mid-Winter Symposium Aircraft Instrumentation, New York ISA, Garden City Hotel, New York.

Feb. 7: IRE Operations Re-

search Symposium, University of Penn. Museum Lecture Hall, Philadelphia, Pa.

Feb. 7-8: 1957 West Coast Convention of the Audio Engineering Society, Ambassador Hotel, Los Angeles, Calif.

Feb. 14: Symposium On Recording Of Heart Sounds, IRE, University Of Buffalo Medical School, Buffalo, N. Y.

Feb. 14-15: Conference On Transistor Circuits, IRE, AIEE, Philadelphia, Pa.

Feb. 26-28: Western Joint Computer Conference, IRE, AIEE, ACM, Statler Hotel, Los Angeles, Calif.

Feb. 26-28: Joint Military-Industrial Guided Missile Electronic Test Instrument Symposium, Redstone Arsenal, Huntsville, Ala.

Mar. 18-21: IRE National Convention, Waldorf-Astoria Hotel, New York Coliseum, New York, N. Y.

Apr. 8-11: British Radio And Electronic Component Show, Grosvenor House and Park Lake House, London, England.

Apr. 9-10: Annual Industrial Electronics Educational Conf., IRE, Armour Research, Ill. Institute of Technology, Chicago, Ill.

Apr. 11-13: Southwest IRE Regional Conference & Electronics Show, Shamrock Hilton Hotel, Houston, Texas.

Apr. 14-16: IRE PGTRC National Symposium on Telemetering, Philadelphia, Pa.

April 15-17: Tenth Annual Conference for Protective Relay Engineers, A&M College of Texas, College Station, Tex.

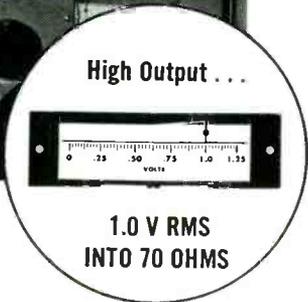
head of the new Sylvania-Thorn color tv laboratories recently opened in England.

► **Marine** division of Pye in Cambridge, England will equip 15 Russian trawlers with its latest electronic fishfinder.

► **Business** will be using 2,000 computers by 1958 and 5,000 by 1960, according to E. W. Grabbe of Ramo-Wooldridge.

► **More** than 10,000 engineers, technicians and members of the public attended the IRE Convention in Toronto, Canada.

HIGH Output (1.0 v. RMS into 70 ohms)
WIDE Range (2-220 Megacycles. All At Fundamental)
 and
CONSTANT OUTPUT
 (Fast Acting AGC)



SPECIFICATIONS

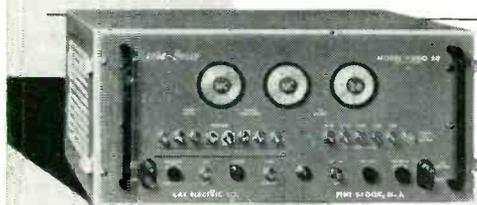
- Range:** Fundamental frequency 2 to 220 mc., continuously variable in 10 switched overlapping bands. Direct reading frequency dial calibrated to $\pm 2.0\%$.
- RF Output:** 1.0 v. RMS into 70 ohms, metered. Flat within ± 0.5 db over widest sweep and frequency band.
- Sweep Width:** Continuously variable to $\pm 30\%$ of center frequency to maximum of at least 30mc.
- Sweep Rate:** Continuously variable 10 to 40 cps; also locks at line frequency.
- Attenuator:** Switched 20, 20, 10, 6, and 3 db plus continuously variable 6 db.
- Power Supply:** Electronically regulated 105 to 125 v. A. C. 50 - 60 cycles

NEW
KAY
Vari-Sweep

ALL-ELECTRONIC HIGH LEVEL SWEEPING OSCILLATOR OR, (with sweep off) CONTINUOUSLY TUNED CW SIGNAL SOURCE

- Operates On Fundamental Frequency, Therefore Stable Narrow-Band Sweeps
- 1.0 v. RMS (into 70 ohms) Output Flat to ± 0.5 db Over Widest Sweep
- Output Automatically Held Constant (AGC) Over Complete Range
- Variable Sweep Width (to 30 mc. PLUS) — Variable Center Frequency
- Direct Reading Frequency Dial Accurate To $\pm 2.0\%$
- Sweep Repetition Rates Down to 10 cps

Price: **\$695.** FOB Plant



NEW KAY *Marka-Sweep* MODEL VIDEO 50

Combined Video and IF Sweeping Oscillator with Marks
SPECIFICATIONS

- Frequency Range:** Continuously variable, 50 kc to 50 mc.
- Sweep Width:** Linear, continuously variable, 4.0 mc to 50 mc.
- Sweep Rate:** Variable around 60 cps; locks to line frequency.
- Amplitude:** 1.0 v, peak-to-peak, into nom. 70 ohms. Flat within ± 0.5 db over widest sweep.
- Attenuators:** Switched 20, 20, 10, 6 and 3 db, plus continuously variable 3 db.
- Markers:** Eight sharp, pulse-type, crystal-positioned, internal and external markers.
- Price:** **\$695.00** F.O.B. Factory. Substitute markers, \$10.00. Additional markers, \$20.00 each.

KAY ELECTRIC COMPANY Dept. E-12
 14 MAPLE AVENUE PINE BROOK, N. J. CAldwell 6-4000



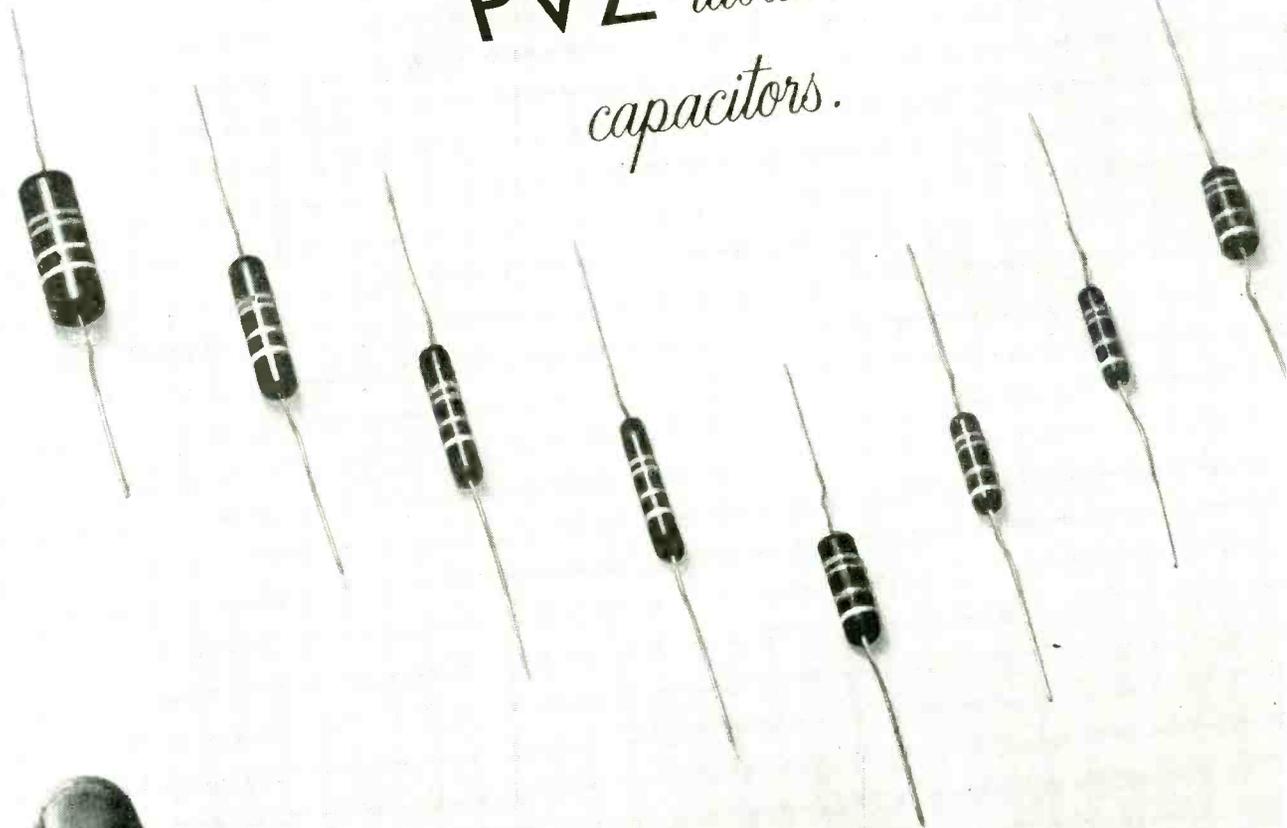
CAPACITORS

Announcing

A high quality line of paper capacitors.

General Electric's molded

PVZ *tubular
capacitors.*



A new line:

General Electric's molded PVZ* tubular capacitors operate from -55 C to $+125\text{ C}$... yet are moderately priced

The new General Electric molded PVZ paper tubular capacitors meet the electronic designer's need for a high-quality line that offers, at a moderate price, characteristics similar to "K" of MIL-C-25A.

- Price of the units is less than one-half that of a comparable metal-clad tubular.
- They are designed for a minimum of one year's life, operating at 125 C , rated voltage.
- Insulated bodies are easy to locate in the chassis, and provide protection from other parts or ground.
- They are small, both physically and electrically, in order to aid equipment miniaturization.
- They are solid—resistant to shock and vibration.

In general, you will find these molded PVZ paper tubular capacitors suitable for use where you might normally expect to find either 85 C or 125 C metal-clad tubular capacitors; in computers, missiles, telephone equipment, and

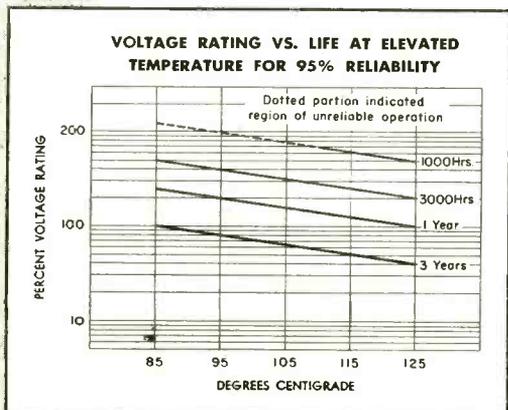
other high-grade military and commercial electronic equipment.

Microfarad ratings extend *down* to .00047 uf—100 to 400 volts; *up* to .15 uf—100 volts, .1 uf—200 volts, .068 uf—300 volts, and .022 uf—400 volts. Capacitance ratings are available with $\pm 20\%$, $\pm 10\%$, $\pm 5\%$ tolerances.

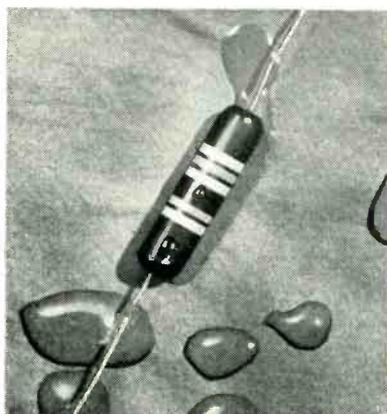
In many instances, the units are physically smaller than equivalent metal-clad tubulars, especially if the metal-clads are insulated. PVZ capacitors range in size from .175" diameter x $\frac{5}{8}$ " long to .375" diameter x $1\frac{1}{16}$ " long. Nine different sizes are offered to accommodate the various ratings.

READY NOW: Stocks of most sizes and ratings of General Electric's new PVZ capacitors are on hand, ready for shipment. If you would like to receive technical data on the new line get in touch with your local G-E Apparatus Sales Office or write to the General Electric Company, Section 442-43, Schenectady 5, N. Y.

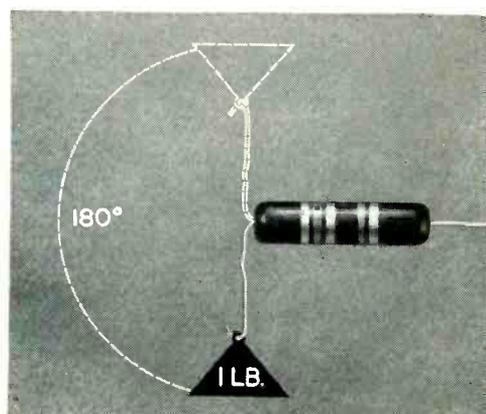
*A General Electric Trade-mark.



OPERATES FOR 1 YEAR AT 125 C Molded PVZ capacitors are designed for a minimum of one year's life at rated voltage and 125 C operation. Curves shown above are typical of performance.



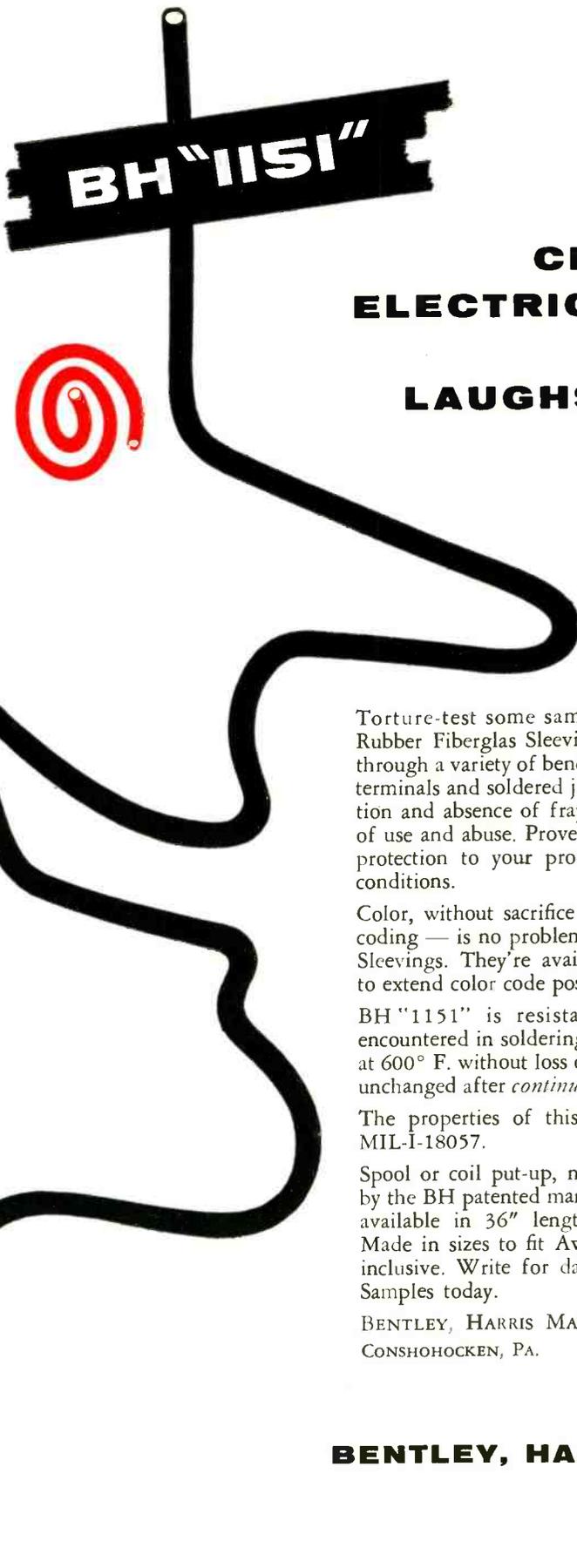
EXCELLENT HUMIDITY CHARACTERISTICS Molded PVZ capacitors withstand stringent humidity tests, thanks to a combination of high-grade case material and carefully-controlled molding techniques.



HIGH LEAD BEND RESISTANCE The new capacitors withstand one-pound-vertical-pull test moving the body of the unit 90° , then 180° in the opposite direction, then back 90° , to the original vertical position.

Progress Is Our Most Important Product

GENERAL ELECTRIC



**CLASS H
ELECTRICAL SLEEVING
THAT
LAUGHS AT BENDS**

Torture-test some sample lengths of BH "1151" Silicone Rubber Fiberglass Sleeveings for electrical insulation. Put them through a variety of bends and twists. Use them to cover bumps, terminals and soldered joints. Then check the insulating protection and absence of fray of BH "1151" even under that kind of use and abuse. Prove to yourself its ability to give complete protection to your product, even under the most strenuous conditions.

Color, without sacrifice of strength — for circuit tracing and coding — is no problem when you standardize on BH "1151" Sleeveings. They're available in 8 basic colors. Tracer stripes to extend color code possibilities are available on special order.

BH "1151" is resistant to the high spot temperatures encountered in soldering. It will sustain 15 consecutive minutes at 600° F. without loss of flexibility or strength. And it remains unchanged after *continuous* operation from -90° F. to 400° F.

The properties of this outstanding product are covered by MIL-I-18057.

Spool or coil put-up, now widely preferred, is made possible by the BH patented manufacturing method. BH "1151" is also available in 36" lengths, or short pieces on special order. Made in sizes to fit Awg or B&S bare wires from 24 to 5/8" inclusive. Write for data sheets and free Production Testing Samples today.

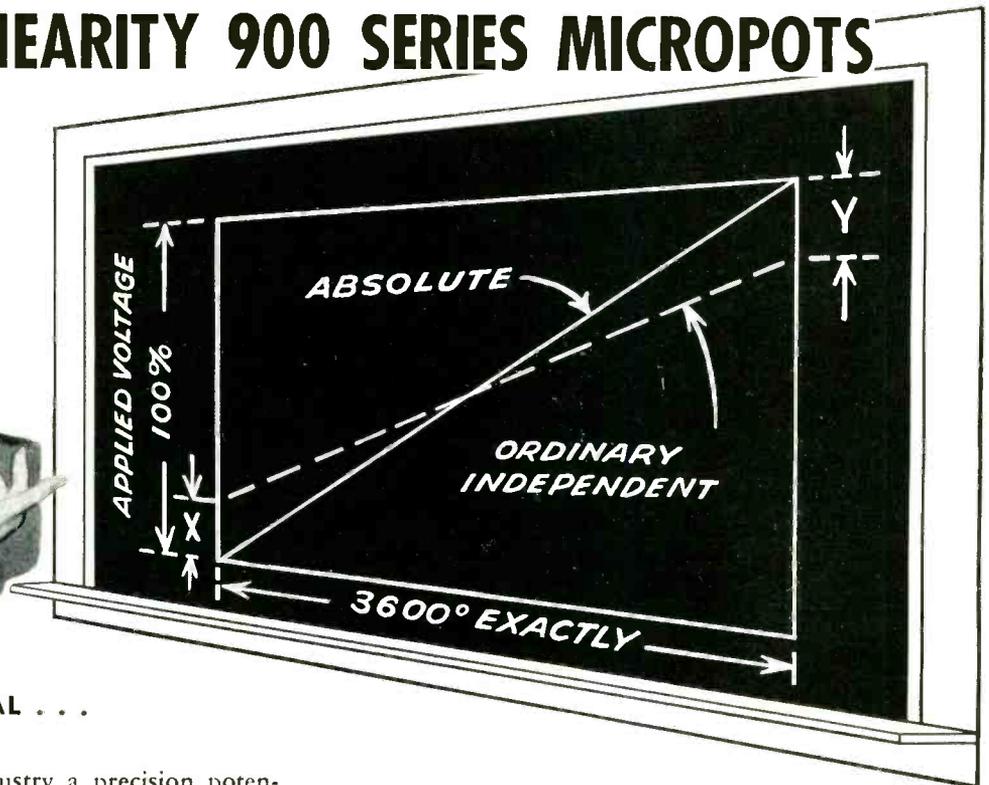
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CONSHOHOCKEN, PA. TELEPHONE: CONSHOHOCKEN 6-0634

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*Fiberglass**
SLEEVINGS

*BH Non-Fraying Fiberglass Sleeveings are made by an exclusive Bentley, Harris process (U.S. Pat. Nos. 2393530; 2647296 and 2647288). "Fiberglass" is Reg. TM of Owens-Corning Fiberglass Corp.

NO TRIMMING NECESSARY WITH BORG ABSOLUTE LINEARITY 900 SERIES MICROPOTS



BORG ACHIEVES THE IDEAL . . . ABSOLUTE LINEARITY

Borg offers the electronics industry a precision potentiometer with Absolute Linearity inherent in the pot itself. It requires no trimming of any kind!

THE END OF UNCERTAINTY

Embodied in Borg's new 900 Series 10-turn and 3-turn Precision Potentiometers are exclusive advantages that provide this high degree of accuracy. You get from zero to 100% of applied voltage over exactly 360° (or 1080°) of shaft rotation.

This means no such parameters as electrical rotation tolerances, end resistance or jump-off resistance need be considered error in output. Many doors, formerly closed to electronic design engineers, are now opened by Borg Absolute Linearity.

ORDINARY INDEPENDENT LINEARITY

Note the line marked "Ordinary Independent" on the blackboard diagram. This line is unable to go to zero and 100% of applied voltage because of X and Y known as end resistances. Therefore, trimming is required to compensate for the potentiometer errors of end resistances X and Y.

Now, note that the line marked "Absolute" goes through zero applied voltage output at zero shaft rotation and through 100% applied voltage output at 360° of shaft

rotation. This is the reference line for absolute linearity and is inherent in the Borg 900 Series potentiometer. Thus Borg achieves absolute linearity without trimming of any kind.

SIMPLICITY ASSURES RELIABILITY AND ACCURACY

Simplicity of the Borg 900 Series Micropot affords greater accuracy and reliability. It eliminates such possible sources of error as trimming errors, unstable trimming, resistances, etc. Another Borg advantage simplifies assembly and reduces possibility of error. The Borg CCW mechanical stop is set up to provide a phasing point. This exclusive advantage reduces field replacement to the purely mechanical process of attaching leads and phasing from the present stop.

ABSOLUTE LINEARITY REDUCES COST

The accuracy and reliability of your equipment is improved with a Borg 900 Series potentiometer which also effects a savings in time and money. Your cost is lowered by eliminating trimming resistors and the technically trained labor competent to install them.

Many other advantages of the Borg 900 Series can help solve your potentiometer problems as they are now doing in all types of equipment from jet engines to steel mills.

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THE GEORGE W. BORG CORPORATION
JANESVILLE, WISCONSIN



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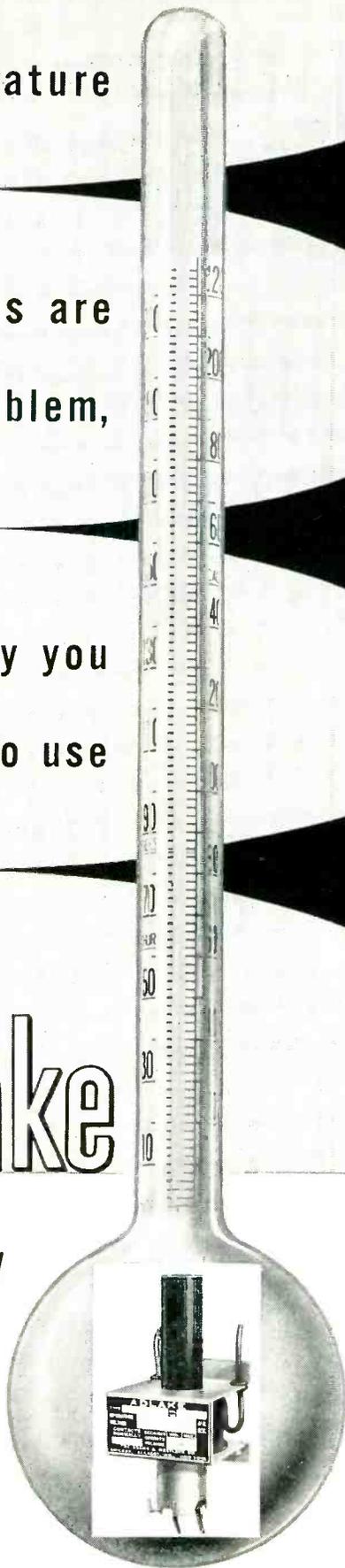
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Adlake

mercury
relays



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

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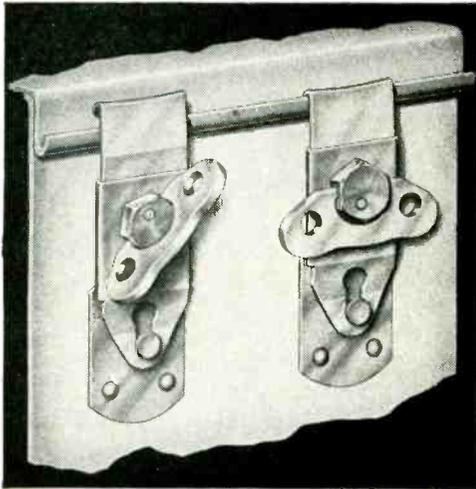
**Microwave and Power Tube Operations,
Section PT-54, Waltham 54, Mass.**

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

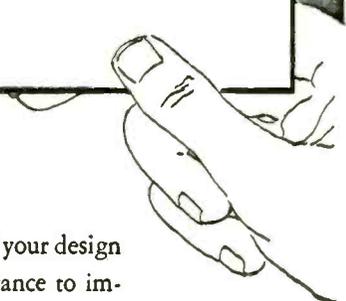


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File: **Simmons LINK-LOCK**



When the **armed forces** needed a positive, high-strength fastening device for instrument housings, transit cases, and storage boxes, Simmons developed LINK-LOCK. This *brand-new* device doesn't use springs, yet works with fingertip pressure through a unique mechanical arrangement: the vertical sliding latch is moved in and out of locking position by a disc rotated with a wing nut. The fastener is immune to low temperatures, is easy to operate even with arctic mittens, furnishes up to 450-lb. pull-down pressure. Open or closed, it lies flat against the side of the case it fastens.



LINK-LOCK may be the answer to your fastening problem. If your design involves heavy fastening pressures, watertight sealing, high strength, resistance to impact, ask about LINK-LOCK. Simmons can furnish it with special engagement-latch details, or for operation by bolt or screwhead instead of wing nut. Write for LINK-LOCK DATA SHEET today. It gives complete details and dimensions. A Simmons engineer will be glad to work with you on your fastening problems.

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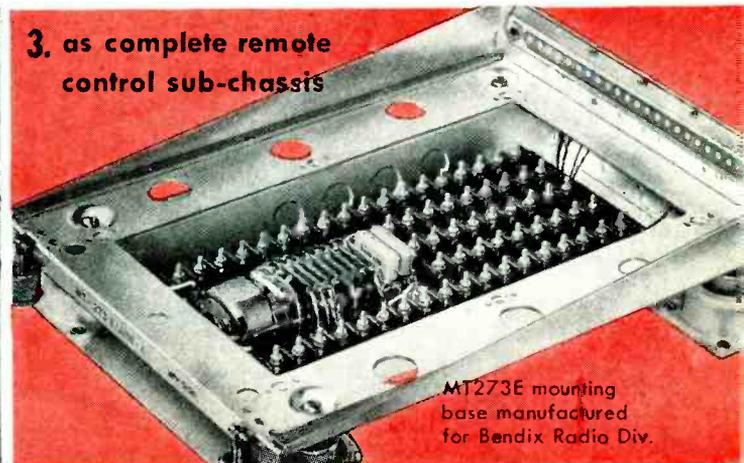
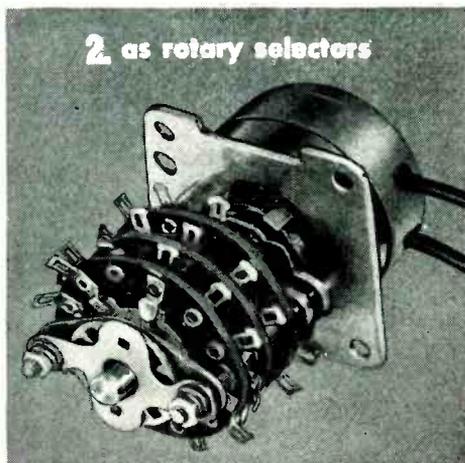
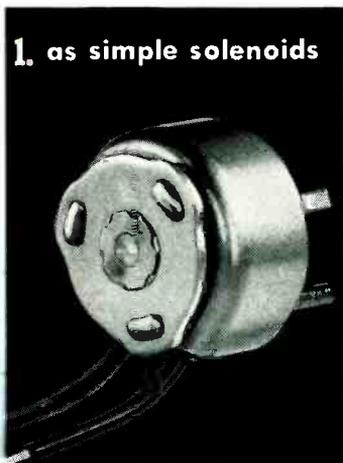
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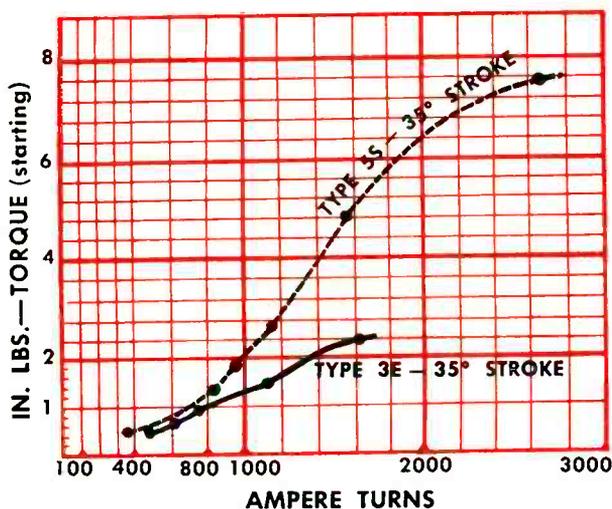
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rugged, compact units that meet the most stringent MIL specs

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Oak rotary solenoids give you exceptionally high torque... instantly on application of power. Whether your installation requires a simple solenoid, rotary selectors with switch sections, or a complete remote control sub-chassis unit, OAK will completely engineer and manufacture to meet your individual requirements.

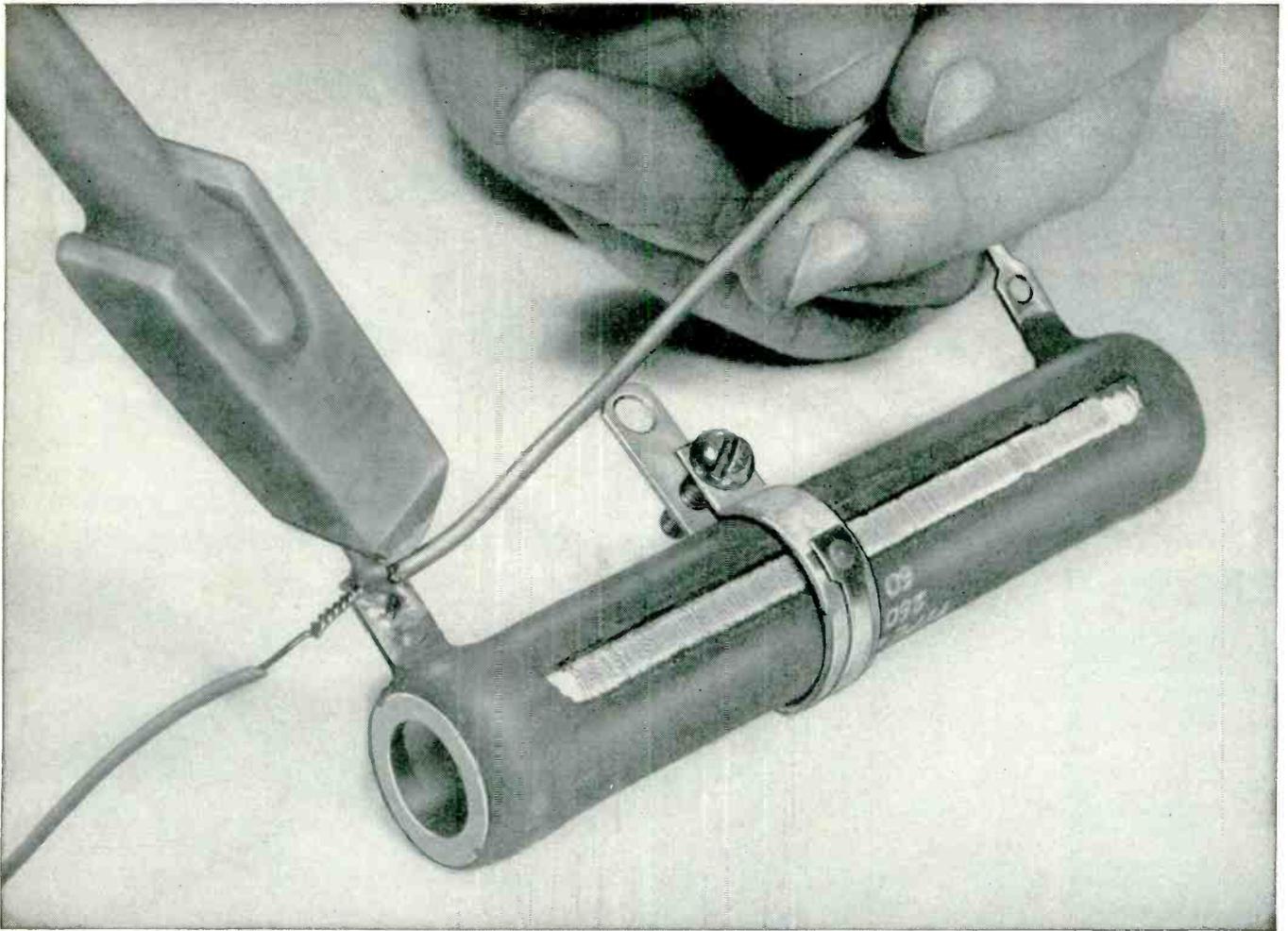


send for descriptive brochure with layout sheets

*Solenoids manufactured under license of G. H. Leland, Inc.



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Four modern plants manufacturing switches, vibrators, tuners, choppers and rotary solenoids.



Why "Dutch Boy" activated rosin core solders give perfect joints nearly every time

"Practically no poor joints..."

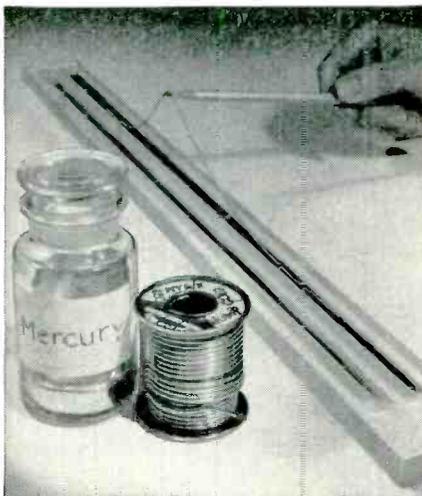
"50-60% more joints per pound..."

"Twice as many chassis wired in a day"

This is what users of "Dutch Boy" activated Rosin-core Solders are saying, today. For National Lead Research has come up with new answers to many old soldering problems.

Take "skips"... the trouble-making breaks in flux core continuity that lead to poor joints, interrupt production, raise reject percentages. Previously these breaks just couldn't be detected prior to use.

Not so, now! National Lead's new mercury bath test shows up "skips" like a sore thumb. In this inspection technique, 18" samples from each batch of cored wire are laid in a mercury bath. Presto! Solder dissolves, leaving entire core afloat, intact, visible. Even a tiny defect is reason enough for National Lead to withdraw the batch from shipment. You never see it.



New "Dutch Boy" mercury bath inspection does away with trouble-making "skips" in core continuity of rosin core solders.

*Sold under trade term "35-B"

**Sold under trade names "Hyoz" and "Nuaz"

Other new solder, flux developments

To speed solder flow and increase coverage... new "Dutch Boy" Activated Rosin Flux*. To prevent "bridge-over" in printed circuits... a highly refined "Dutch Boy" solder, of low melting point and high surface tension. To speed capillary rise and flow... a specially designed "Dutch Boy" non-corrosive solder-flux combination.**

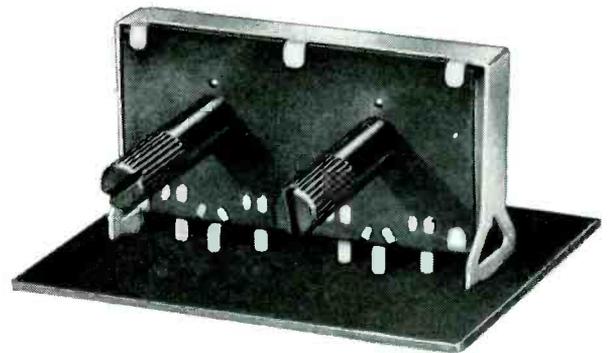
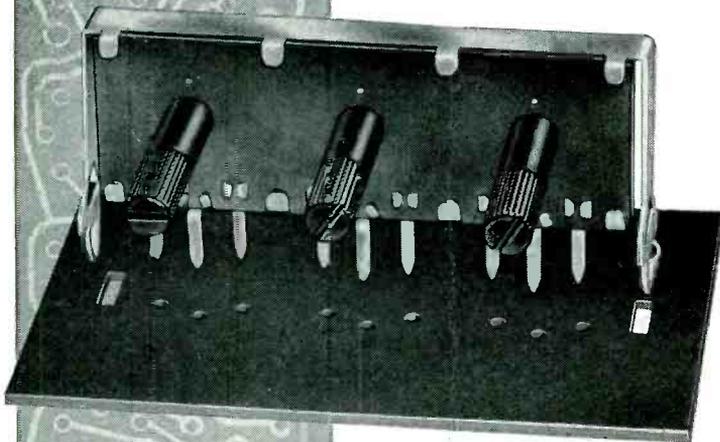
You may want to look into these developments. Or perhaps you need some special solder alloy or flux. National Lead solder specialists will be glad to help. Just write or call National Lead Company, 111 Broadway, New York 6, N. Y.

Dutch Boy[®]
SOLDER AND FLUXES



MULTIPLE VARIABLE RESISTORS *designed specifically* for PRINTED CIRCUITS

SNAP INSTANTLY INTO PLACE—REMAIN FIRMLY LOCKED



Illustrations are actual size—note compact multiple units

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Wide shoulders provide rugged support.
No mounting hardware, no separate support needed.
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5. Mounts upright with shafts parallel to printed panel, eliminating need for shaft protection during panel solder immersion.
3. Available in 2-control units (Series X52) or 3-control units (Series X53) as illustrated.

Many other types of controls available for your printed circuit and automation needs.

A CTS control can be tailored to your specific requirement. Let CTS SPECIALISTS help solve your current control problems. Write or phone today.

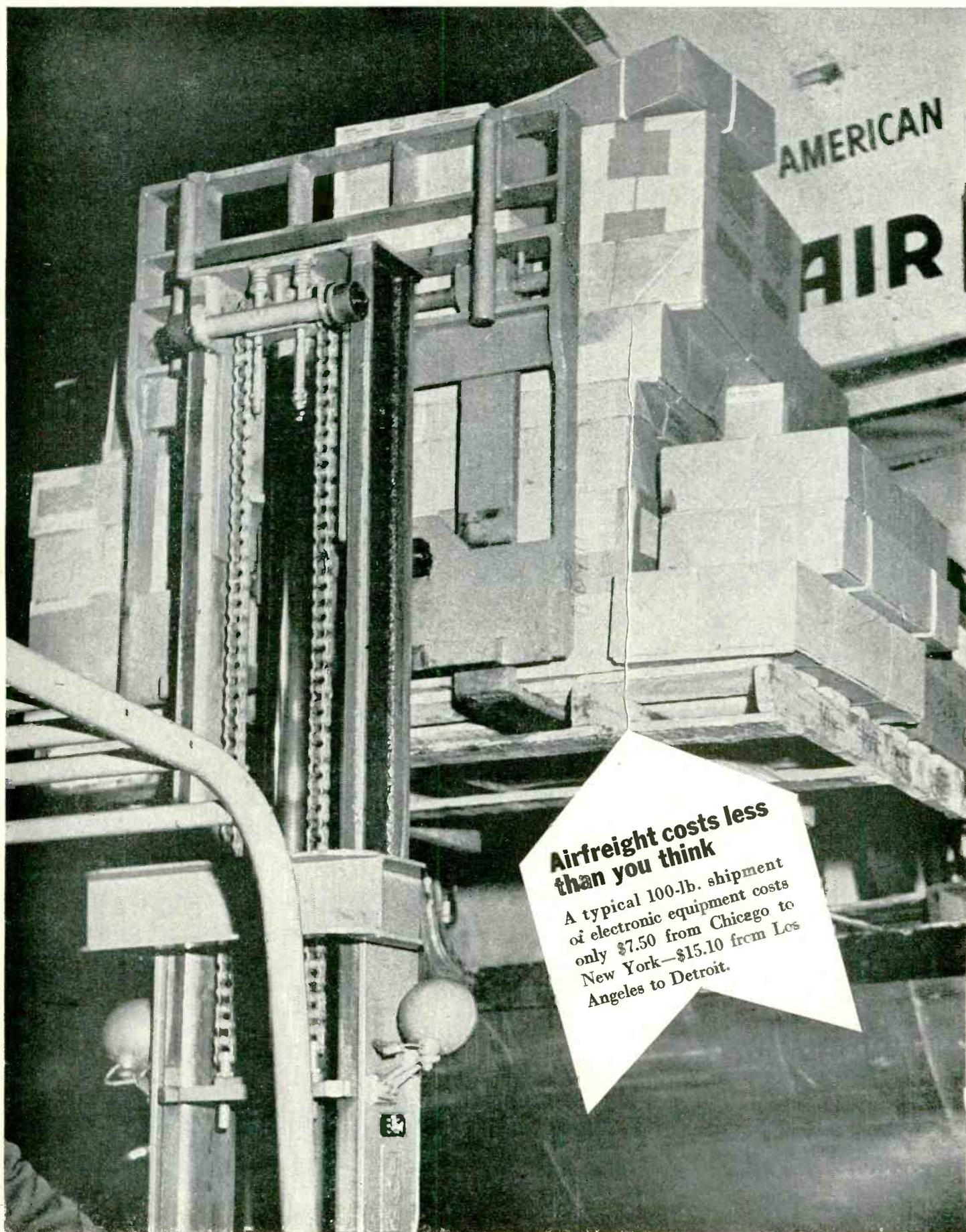


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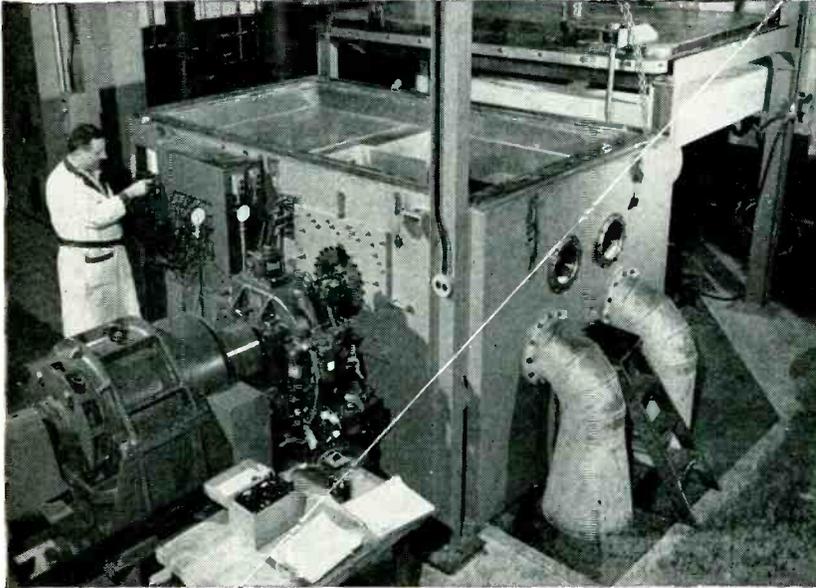
First with scheduled airfreight, American today has the largest, most experienced personnel force . . . most modern handling facilities. Is better able to solve shipping problems . . . provide dependable on-time deliveries.

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carries more cargo than any other airline in the world

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simulates flight 23 miles up



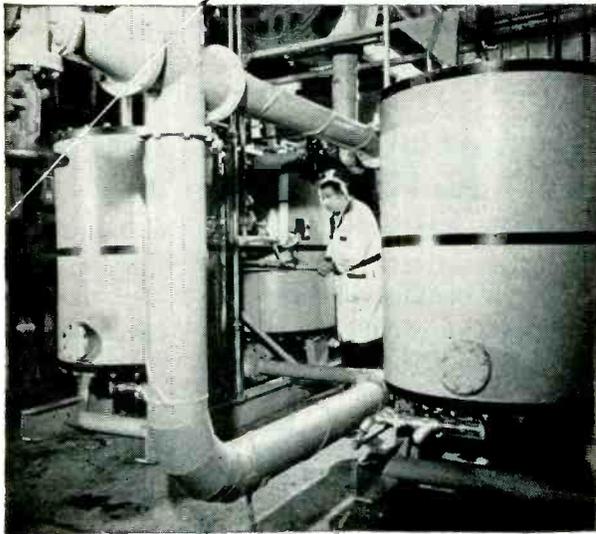
Since temperatures drop below -80°F ., air in this test chamber must be DRY

● Electrical equipment for aircraft, product of Westinghouse Electric Corp. at Lima, Ohio, must meet every possible hazard encountered in flight and on the ground. Their laboratory must be able, therefore, to simulate those conditions—even the 80 degrees below zero found 120,000 feet up.

Air at that altitude is DRY, so this Westinghouse laboratory dehumidifies the air blown through this test chamber to a -100° dewpoint. No chance that frost will form and cloud up test results.

For maximum economy in operation, the air is first "rough dried" by a refrigeration unit to 38° dewpoint. Then two BWC-1500 Lectrodryers remove the remaining vaporous moisture to a -100° dewpoint. Tests can be continued day after day, as these driers can be kept on-stream without interruption.

Whether you're DRYing experimentally or on production, there are Lectrodryers to handle the task. For literature on DRYing, write Pittsburgh Lectrodryer Company, 359 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).



▲ Test chamber, showing motors for driving equipment on test inside.

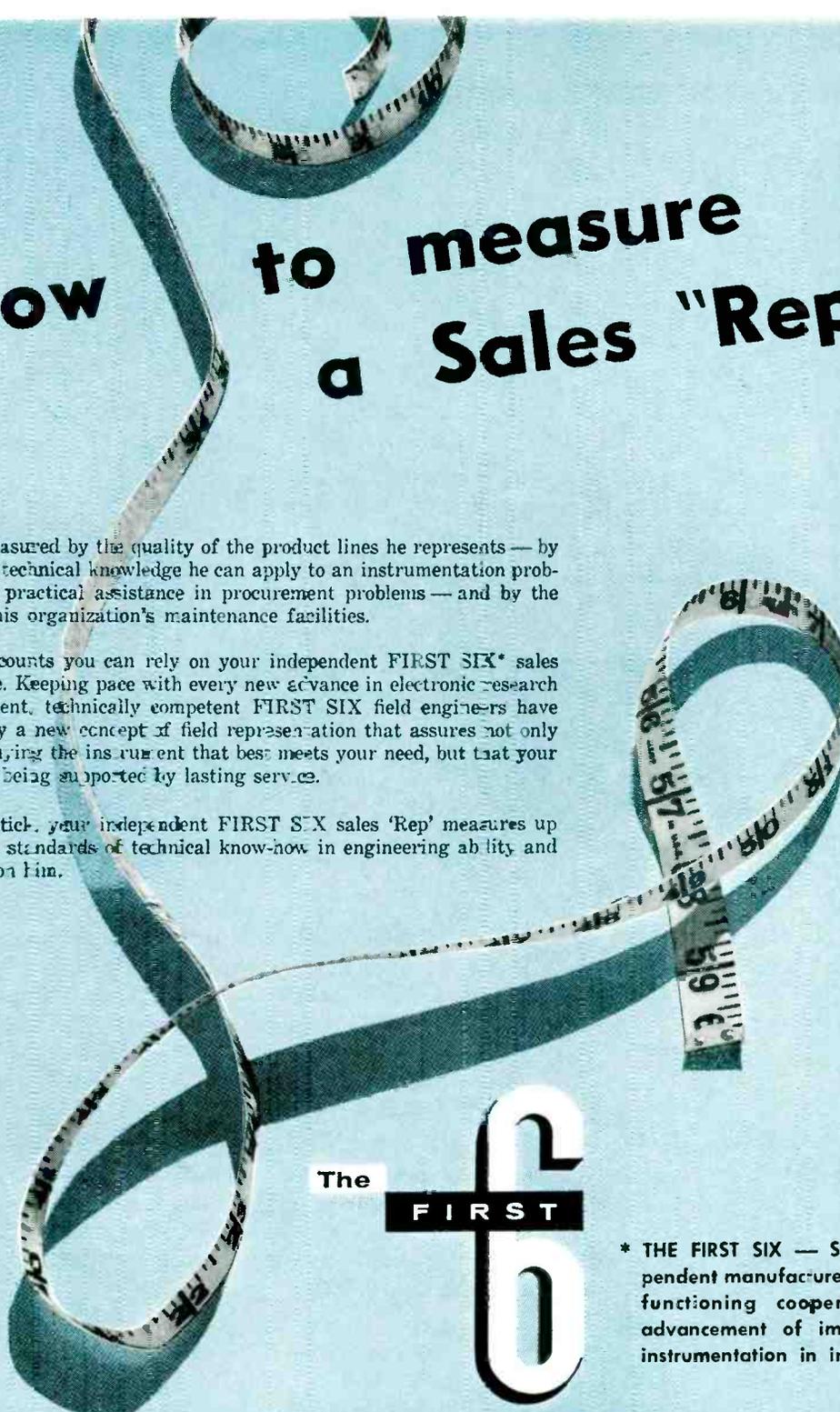
◀ After the two refrigeration units have dropped the dewpoint to 38° , these two Lectrodryers* take it down to -100°F .

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

**LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS**

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* REGISTERED TRADEMARK U. S. PAT. OFF.



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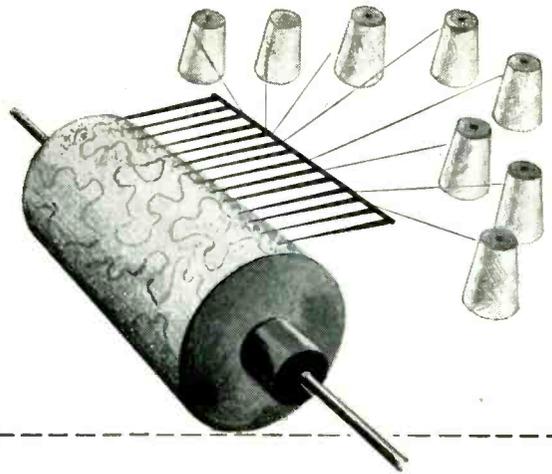
Syracuse, N. Y.

YEWELL ASSOC., INC.

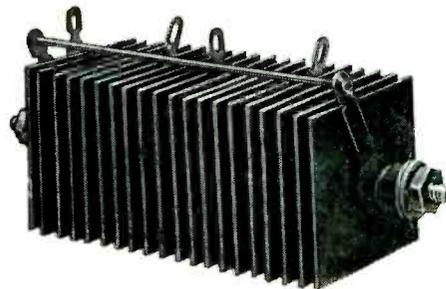
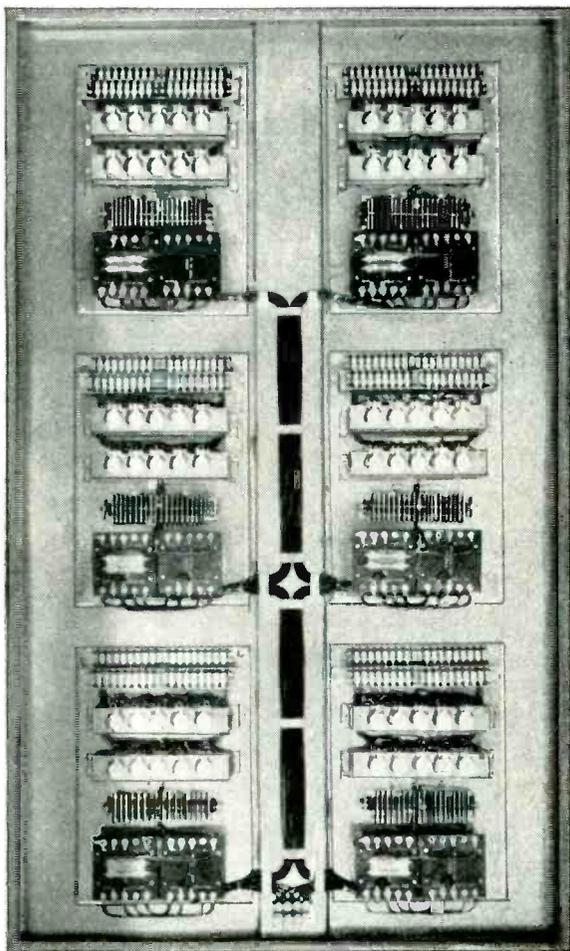
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*"puts the finger" on
automatic rug machinery
with the aid of*



RADIO RECEPTOR SELENIUM RECTIFIERS



Guiding the 120 electric clutches that act as automated fingers in a new rug tufting machine is a Warner control panel whose key components are six Radio Receptor rectifiers. These fingers "feel" the rug pattern on a revolving roll, send information to the control station from which actuating impulses are relayed to clutches controlling yarn feed.

A Radio Receptor customer for many years, Warner Electric Brake & Clutch Co. utilizes RRco. selenium rectifiers in this application and many others because long experience has proved they can depend upon them for continuous and heavy duty, without fear of costly breakdowns.

If you have a problem in rectification, do as many fine companies do in the United States and throughout the world — Specify RRco. selenium rectifiers. Millions are in service in almost every possible type of circuit. Would you like our most recent literature? Please write section E-19.



Semiconductor Division
RADIO RECEPTOR COMPANY, INC.

Radio and Electronic Products Since 1922

240 WYTHE AVENUE, BROOKLYN 11, N. Y. EVergreen 8-6000

OTHER PRODUCTS OF RADIO RECEPTOR: Germanium and Silicon Diodes, Dielectric Heating Generators and Presses, Communications, Radar and Navigation Equipment.

CP recommends...



Styroflex^{*}
COAXIAL CABLE



Spirafil^{*}
COAXIAL CABLE



Foamflex^{*}
COAXIAL CABLE

**-for Superior Transmission
Line Performance in All Commercial
and Military Communications**

After two decades of rigid and semi-flexible transmission line production, CP as National Distributors for Phelps Dodge Copper Products Corporation, recommends Styroflex, Spirafil and Foamflex cables *exclusively!*

Service-proven in all segments of the industry, these superior high frequency cables are rapidly winning top-favor among engineers for AM, FM, TV, Pulse and many other services.

Let us tell you why we have changed to Styroflex, Spirafil and Foamflex cables. When you have the facts, as we have, you too will make the change.

*Products of the
Phelps Dodge
Copper Products
Corporation



Communication Products Company • Inc
Main Office and Plant: Marlboro, New Jersey—Tel. FReehold 8-1880

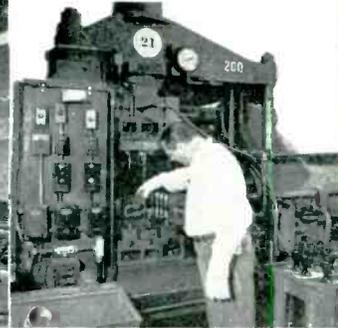
Pacific Coast Branch: 120 Santa Barbara Street, Santa Barbara, California—Telephones: WOODland 2-1712 and 1714

IN A HURRY GOT PROBLEMS NEED EXPERT HELP ?

Spacious new MPc plant houses design, engineering facilities . . . tool room and molding departments of exceptional capacity to assure prompt and efficient handling of the largest and smallest jobs.

COMPRESSION MOLDING

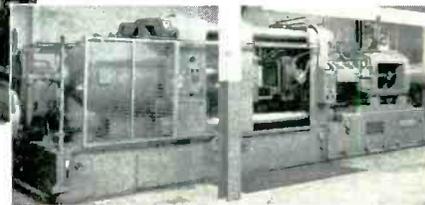
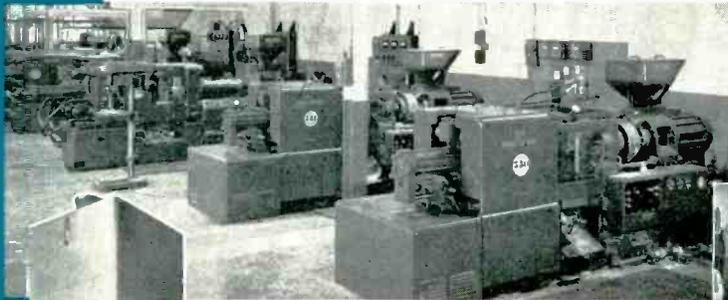
Unsurpassed press facilities provide economical solutions for the most complex requirements. Working pressures: 20 to 3000 tons. Platen areas: 18" x 16" to 192" x 84". Maximum Press Openings: 19" to 117". Preform press capacity: 8000 lb. per hour. Advanced electronic preheating equipment.



Compression molding division includes such extraordinary equipment as this side angle press, capable of producing highly complicated parts.

INJECTION MOLDING

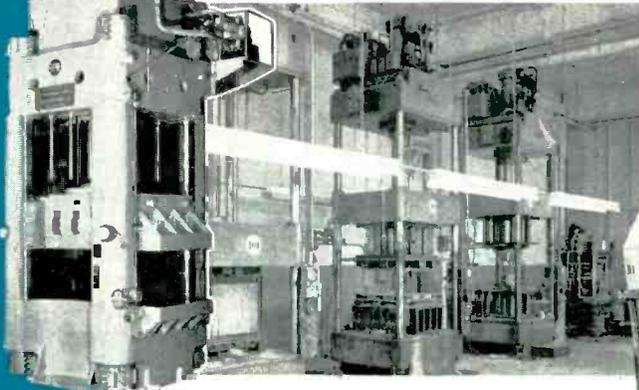
Battery of newest type presses ranging from 4 oz. to 80 oz. make possible efficient handling of wide variety of jobs.



Daddy of them all is this giant 80 oz. injection press. Special cooling equipment provides for low-cost high-speed operation.

REINFORCED POLYESTER MOLDING (FIBERGLASS)

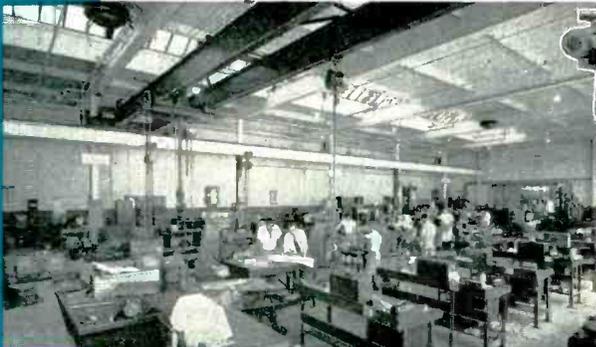
Working pressures: 50 to 3000 tons. Platen areas: 18" x 16" to 192" x 84". Maximum press openings: 19" to 117".



Fiberglass reinforcements are produced by the use of modern semi-automatic preform equipment.

MOLD MAKING

The MPc tool room is equipped with the newest types of machine tools . . . such as this radial drill . . . and has a 10-ton fully motorized overhead crane for handling heavy molds.



Product designers and purchasing agents are invited to submit specifications, plastic products or problems for study and quotation.

Write Dept. I for brochure.

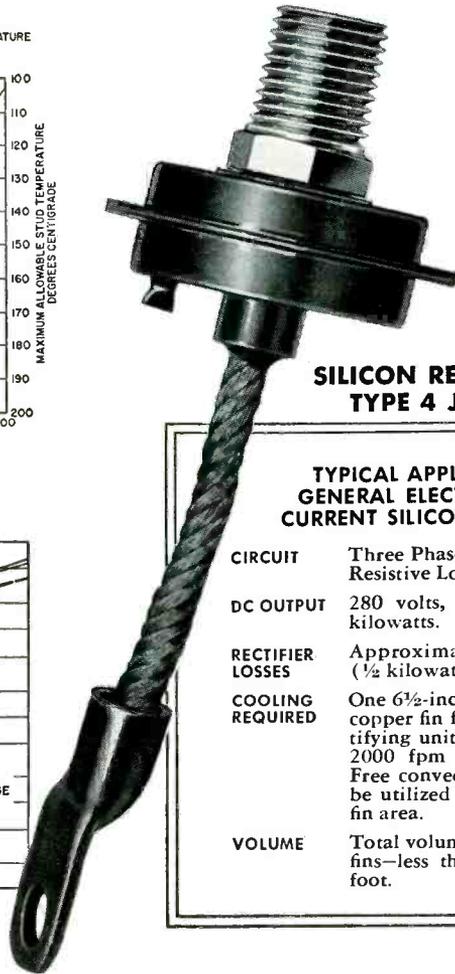
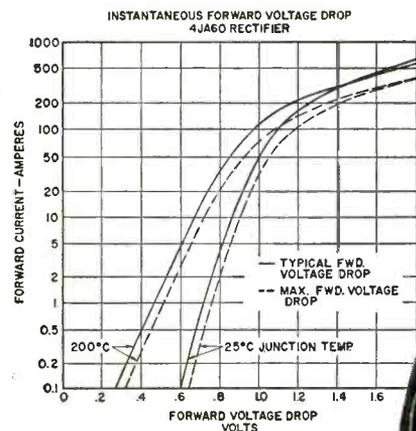
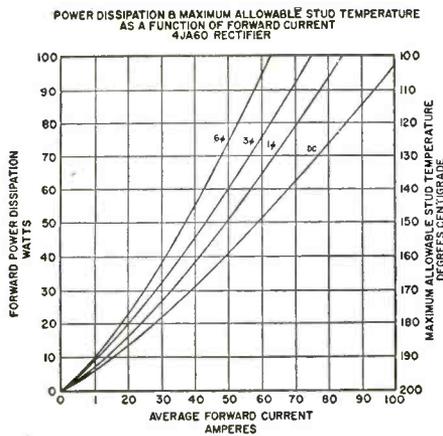
MOLDED MPc PRODUCTS

Division of Admiral Corporation

P. O. Box 338, West Chicago, Illinois • Telephone: West Chicago 1140

DESIGN PROBLEM:

More Rectifier Power per Dollar?



**SILICON RECTIFIER
TYPE 4 JA60**

**TYPICAL APPLICATION
GENERAL ELECTRIC HIGH
CURRENT SILICON RECTIFIER**

- CIRCUIT** Three Phase Bridge Rectifier, Resistive Load.
- DC OUTPUT** 280 volts, 215 amperes, 60 kilowatts.
- RECTIFIER LOSSES** Approximately one percent ($\frac{1}{2}$ kilowatt).
- COOLING REQUIRED** One 6 $\frac{1}{2}$ -inch square $\frac{1}{4}$ " thick copper fin for each of six rectifying units when used with 2000 fpm 30°C forced air. Free convection cooling may be utilized by increasing the fin area.
- VOLUME** Total volume of rectifiers and fins—less than $\frac{1}{3}$ of a cubic foot.

High Current SILICON RECTIFIERS, available now, cost less than other rectifying devices!



High Capacity Silicon Rectifiers—with rating up to 85 amps at 300 volt operating levels—now cost no more than other junction type rectifiers. These high-efficiency silicon rectifiers are produced using the alloy technique developed by General Electric research. Extended life tests show no deterioration in rectifier characteristics when operated at full rated condition.

All-Welded Seal for Trouble-Free Service. With the large area silicon element hermetically sealed within a steel housing, General Electric Silicon Rectifiers are immune to troubles caused by moisture, vibration, dust, or corrosion. They may be mounted in any position; and have a safe temperature range greater than any of the other junction-type units. Their "plumbing type" stud fitting assures fast cooling through heat sink connections.

Work Anywhere. General Electric Silicon Rectifiers can be

used in *any* rectifier application. They are being installed now in many applications including:

- Arc Furnaces
- Cathodic Protection
- DC Motor Supply
- Magnetic Devices
- Shop DC Supply
- Welding Equipment

All General Electric Silicon Rectifiers meet rigid military requirements. They are now available in four voltage ranges. For detailed application engineering information, consult your General Electric representative, or write to *General Electric Company, Semiconductor Products, Section X4126, Electronics Park, Syracuse, New York.*

Progress Is Our Most Important Product

GENERAL  ELECTRIC



NEW Stock-Control System

based on

VEEDER-ROOT

Vary-Tallies

saves time...

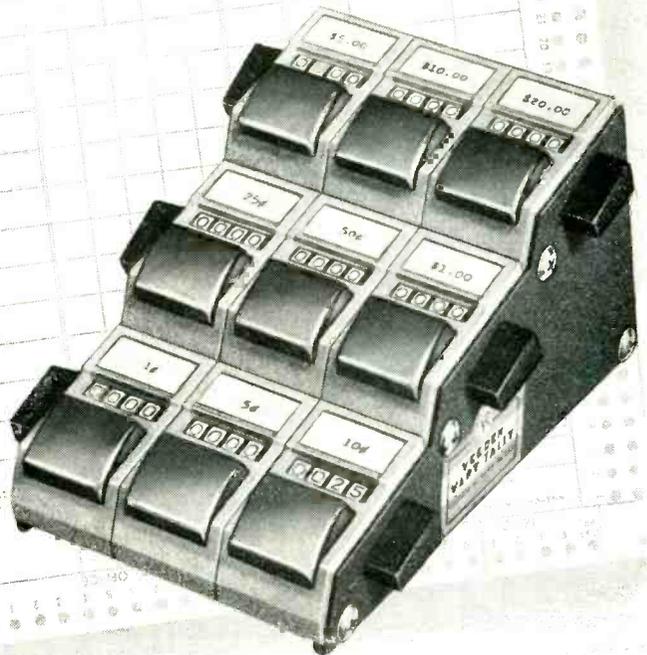
speeds production...

stops errors

Manufacturers of skirts (or skis) can speed and simplify their stock-keeping, accounting, and payroll records with simple punched-card systems based on Vary-Tallies. A leading skirt-maker, for instance, always has complete command of several variations of styles, sizes and colors simply by lifting out the cards for any of these classifications . . . and recording them on the Vary-Tally. This gives him an instant accounting on any account, without pencil tallies, scratch marks, or telltale marks on the goods.

In time-checking, this manufacturer has tallied 420 items on 80 orders in 4½ minutes. *His best previous time was 40 minutes.* No copying . . . nothing but the final totals on the counter-faces.

What Production Systems Inc., Waltham, Mass., is doing for the garment industry with its "Quik-Pik" System . . . you can do for yourself with a similar system based on Vary-Tallies. And you can count on Veeder-Root to help you. Write:



Hartford, Conn. • Greenville, S. C. • Chicago
New York • Los Angeles • San Francisco • Montreal
Offices and Agents in Other Principal Cities



VEEDER-ROOT INC.

"The Name that Counts"



ULTIMATE IN
TOROIDS
FILTER NETWORKS
MAGNETIC
AMPLIFIERS

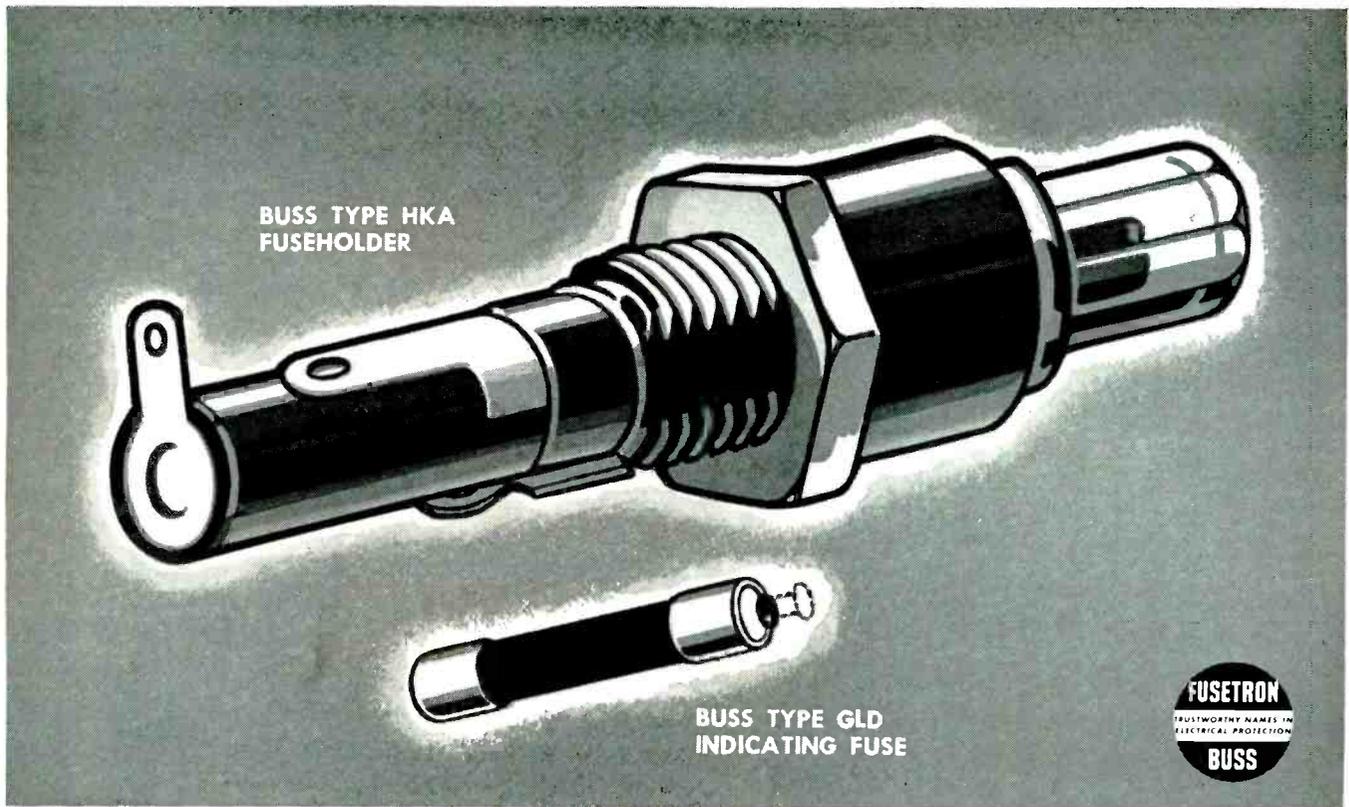
When you "team up" with C-A-C, you have at your disposal an outstanding engineering staff...backed by facilities of the world's largest exclusive producer of toroidal components.

COMMUNICATION
ACCESSORIES COMPANY

Hickman Mills, Missouri • Phone Kansas Citv, South 1-5111

A Subsidiary of the
Collins Radio Company

C-117



New! BUSS FUSEHOLDER and FUSE

Lamp Indicating • Signal Activating

**FLASHES A LIGHT • RINGS A BELL • TRIPS A RELAY
OR GIVES OTHER SIGNALS • TO TELL YOU WHEN
AND WHERE A FUSE BLOWS!**

Wide Application. Anywhere that it is desirable to have a visible or audible signal to indicate when a fuse blows, a practical answer is presented by the BUSS HKA fuseholder in combination with BUSS GLD fuses.

For example: When HKA holders are used on testing equipment they can give a remote signal if trouble develops in any part of the equipment . . . and the circuit in which trouble occurs is indicated by the glowing knob light.

On control circuits where the electrical fault must immediately be detected, the HKA holder can be used to give both an audible and visible signal—and a relay or other device can also be activated.

Control panels, switchboards and calculating or computing machines are but a few other examples of where it is advantageous to use HKA fuseholders to be warned of trouble on the circuit.

SPECIFICATIONS

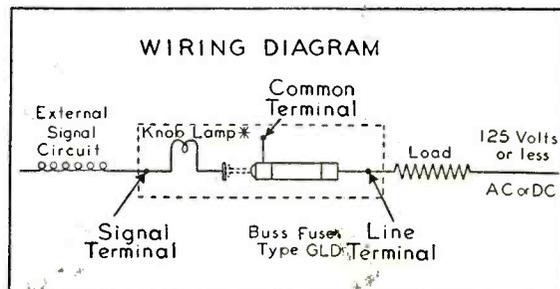
BUSS Type HKA Fuseholder. Fuseholders are panel mounted for $\frac{1}{4}$ x $1\frac{1}{4}$ inch BUSS GLD indicating fuses. Indicating lamp in transparent knob of fuseholder.

BUSS Type GLD Indicating Fuse: Indicating pin pops out when fuse is blown and activates signal or alarm.

For full information, write or phone for bulletin on HKA Fuseholders or . . . ask our Fuse Engineers to make recommendations for use of HKA Fuseholders. Send full details of proposed application.

If you prefer we will be glad to have a BUSS Sales Engineer call on you.

BUSSMANN MFG. CO. (Div. McGraw Electric Co.)
University at Jefferson St. Louis 7, Mo.



1256

Direct reading, wide range, outstanding value

SIGNAL GENERATORS



NEW! -hp- 626A/628A shf Signal Generators

10 to 21 KMC, 10 mw output

SWR 1.2, high accuracy

No calibration charts

Pulse, FM, square wave modulation

Typical -hp- signal generators



-hp- 608D vhf Signal Generator



-hp- 612A uhf Signal Generator



-hp- 624C X Band Test Set

ΔRack mounted instrument available for \$15.00 less.

New -hp- 626A/628A are the first commercial signal generators to bring the wide range, high power, convenience and accuracy of lower-frequency signal generators to the 10 to 21 KMC range. -hp- 626A covers frequencies 10 to 15.5 KMC; -hp- 628A, 15 to 21 KMC.

Operation of the instruments is typical of -hp- generators. Frequencies are directly set and read on one dial. No calibration charts are required. Output voltage is directly set and read. Output is 10 to 20 db better than previous spot-frequency generators. SWR is better than 1.2 at 0 dbm and lower. Internal pulse, FM or square wave modulation is provided, together with facilities for external pulsing or FM'ing. -hp- 626A, \$3,250.00. -hp- 628A, \$3,000.00.

OTHER -hp- SIGNAL GENERATORS

Instrument	Frequency Range	Characteristics	Price
-hp- 608C	10 to 480 MC	Output 0.1 μ v to 1 v into 50 ohm load. Pulse or CW modulation. Direct calib.	\$ 950.00
-hp- 608D	10 to 420 MC	Output 0.1 μ v to 0.5 v. Incidental FM less than 0.001% entire range.	1,050.00
-hp- 612A	450 to 1,200 MC	Output 0.1 μ v to 0.5 v into 50 ohm load. Pulse, CW or square wave modulation. Direct calibration.	1,200.00
-hp- 614A	800 to 2,100 MC	Output 0.1 μ v to 0.223 v into 50 ohm load. Pulse, CW or FM modulation. Direct calib.	1,950.00
-hp- 616A	1,800 to 4,000 MC	Output 0.1 μ v to 0.223 v into 50 ohm load. Pulse, CW or FM modulation. Direct calib.	1,950.00
-hp- 618B	3,800 to 7,600 MC	Output 0.1 μ v to 0.223 v into 50 ohm load. Pulse, CW, FM or square wave modulation. Direct calibration.	2,250.00
-hp- 620A	7,000 to 11,000 MC	Output 0.1 μ v to 0.223 v into 50 ohm load. Pulse, FM or square wave modulation.	2,250.00
-hp- 623B	5,925 to 7,725 MC	Output 70 μ v to 0.223 v into 50 ohm load. FM or square wave modulation. Separate power meter and wave meter section.	1,750.00
-hp- 624C	8,500 to 10,000 MC	Output 3.0 μ v to 0.223 v into 50 ohm load. Pulse, FM or square wave modulation. Separate power meter and wave meter section.	2,265.00Δ

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

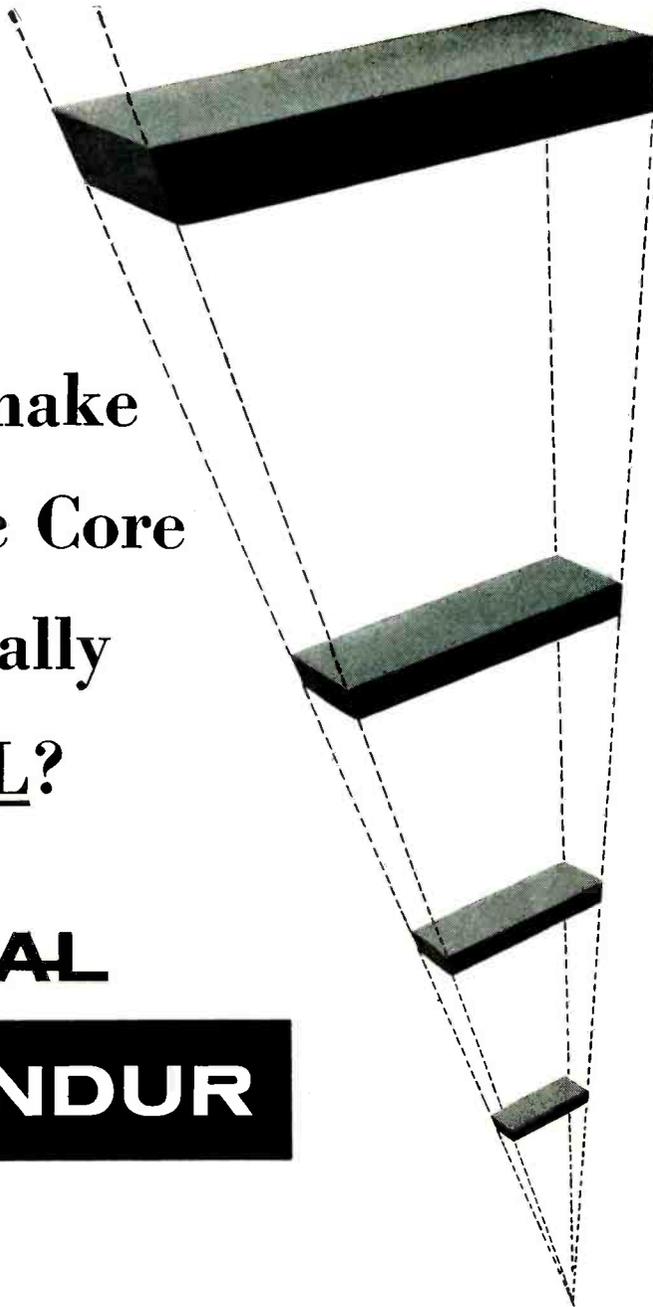
HEWLETT-PACKARD COMPANY
 3340A PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.
 Cable "HEWPACK" • DAVENPORT 5-4451
 FIELD REPRESENTATIVES IN ALL PRINCIPAL AREAS

hp COMPLETE COVERAGE, HIGHEST QUALITY

How to make a Magnetic Core that's really SMALL?

use **AL**

PERMENDUR



Write for
your copy

"MAGNETIC MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free on request.

ADDRESS DEPT. E-84

When the conditions of service make it imperative for you to hold the size and weight of magnetic cores at an absolute minimum, that's the place to use Permendur. With it you can push the flux density up to 20 kilogausses, and practically eliminate weight as a consideration.

Along with its suitability for cores wherever the premium is laid on compactness, Permendur is just the thing for sonar magnetostriction applications, too. We maintain proper annealing facilities for this

alloy. Write for technical data on it, and let our engineers help you to cash in on its possibilities.

In addition to Permendur, we offer a range of high-permeability alloys, oriented silicon steels and other electrical alloys that is unmatched in its completeness. Our services also include the most modern facilities for lamination fabrication and heat treatment.

Let us supply your requirements. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

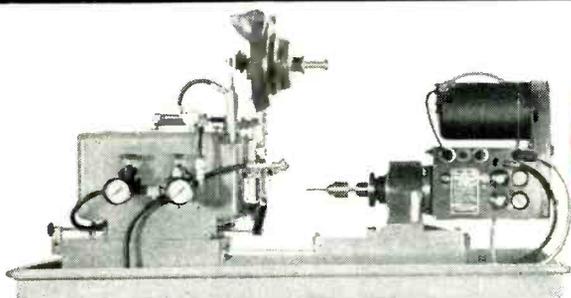
STEELMAKERS to the Electrical Industry

Allegheny Ludlum

WSW 6119

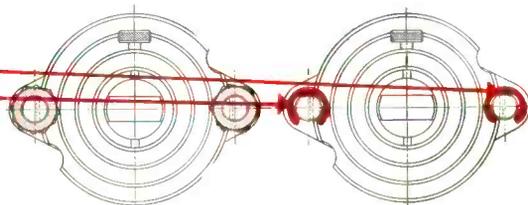


Waldes Truarc Retaining Rings Eliminate Machining and Parts—Cut Assembly Time on Drill and Tapper



Beco Model 410 Drill and Tapper

The Batchelder Engineering Co., Inc., Springfield, Vermont uses 4 different sizes of 2 different type Waldes Truarc rings in their new BECO Model 410 Automatic Drill and Tapper. Truarc rings speed assembly, reduce machining, improve design.

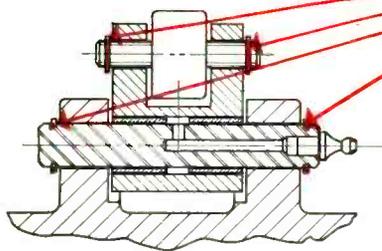


ALTERNATE DESIGN

TRUARC DESIGN

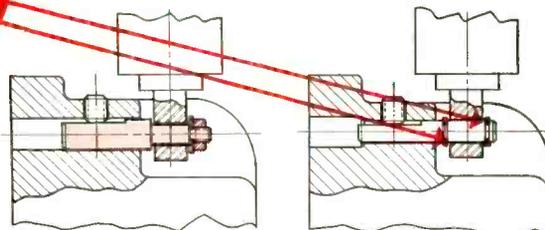
Clamp Cylinder Rod Stop Assembly

Truarc "E" Rings (Series 5133) replace stop nuts in the Clamp Cylinder assembly. They eliminate need for threading 2 rods ... the danger of cross-threading nuts ... and costly rejects. Truarc Rings cut assembly time and cost.



Bell Crank Pivot Assembly

Truarc Rings (Series 5100) in Bell Crank Pivot assembly permit grease hole not possible with cotter pin fastener. Use of nuts would have increased machining and assembly costs considerably.



ALTERNATE DESIGN

TRUARC DESIGN

Hopper Cylinder Anchor Pin Assembly

2 Truarc Rings (Series 5100) secure and position end of vertical air cylinder. Rings eliminate extra cost of machining 3-diameter pin, threading and undercutting ... plus nut and washer. Assembly is quick and sure.

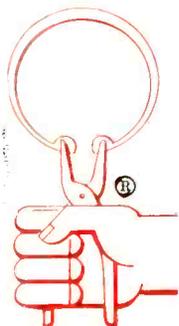
Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product ... to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types ... as many as 97

different sizes within a type ... 5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today ... let our Truarc engineers help you solve design, assembly and production problems ... without obligation.

For precision internal grooving and undercutting ... Waldes Truarc Grooving Tool!



WALDES
TRUARC®
RETAINING RINGS

WALDES KOHINOOR, INC.
47-16 AUSTEL PLACE, L. I. C. 1, N. Y.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.
(Please print)

Name

Title

Company

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City

Zone .. State ..

E128

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

TUNING FORK
RESONATORS •
THE ULTIMATE
IN PRECISION
AUDIO
FREQUENCY
CONTROL



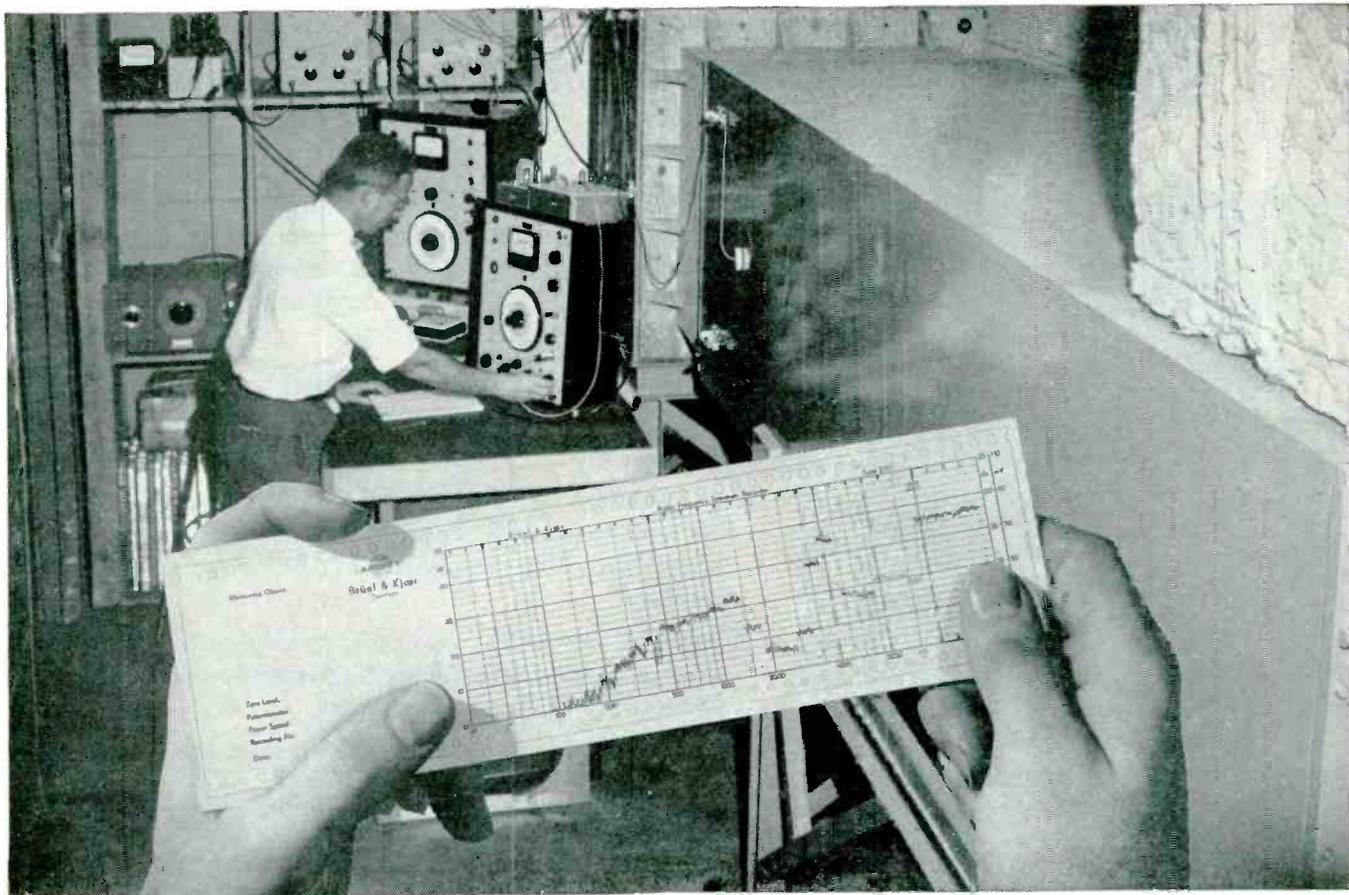
PHONE OR WRITE for complete information regarding
component type Tuning Fork Resonators, or
variously packaged Tuning Fork Frequency Standards.



PHILAMON LABORATORIES INC.

90 Hopper Street, Westbury, Long Island, N. Y. EDgewood 3-1700

BRUSH . . . complete systems for noise or vibration measurement



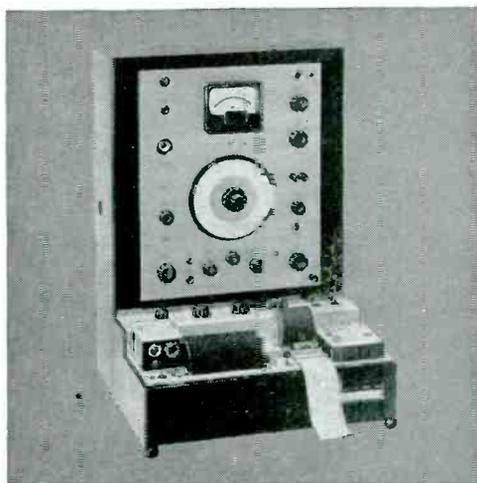
Shown above: typical noise spectrum analysis chart

Complete frequency-amplitude noise record helps Lockheed design quieter aircraft

This test at Lockheed Aircraft measures the loss in acoustic transmission through fuselage wall panels. To design for noise reduction, engineers needed *complete* data, selected the Brush-Bruel & Kjaer Spectrum Recorder for these advantages:

- Recorder automatically scans and records sounds from 35 cycles to 18,000 cycles per second automatically eliminating laborious recording.
- Measurements made in one-third octave steps, to positively identify frequencies.
- Complete recording through the audible frequency range takes only 18 seconds, to save valuable engineering time.

For noise or vibration analysis, Brush offers the outstanding line of instrumentation available. It's a *complete* line, thus units are matched, and we can offer application assistance on the complete project. For bulletin on this instrumentation write Brush Electronics Company, Dept. K-121, 3405 Perkins Avenue, Cleveland 14, Ohio.



Third-octave Spectrum Recorder, key instrument in a complete line for noise and vibration measurements.

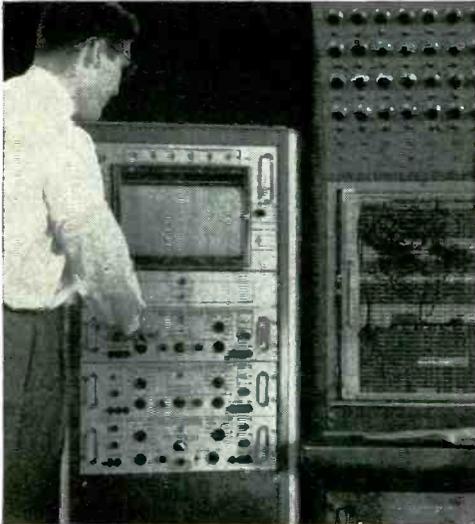
BRUSH ELECTRONICS
3405 Perkins Avenue, Cleveland 14, Ohio



COMPANY
DIVISION OF
CLEVITE
CORPORATION

PROVED BY EXPERIENCE

There are more channels of Brush industrial direct-writing



Rack mounted system



Portable instrumentation



Mobile instrument cart

IN exacting military programs and in a broad range of industrial and research applications, leading engineering groups use and prefer Brush Recording Systems because they save valuable engineering time . . . are rugged and dependable . . . have the versatility to meet changing requirements.

Only Brush offers all these advantages:

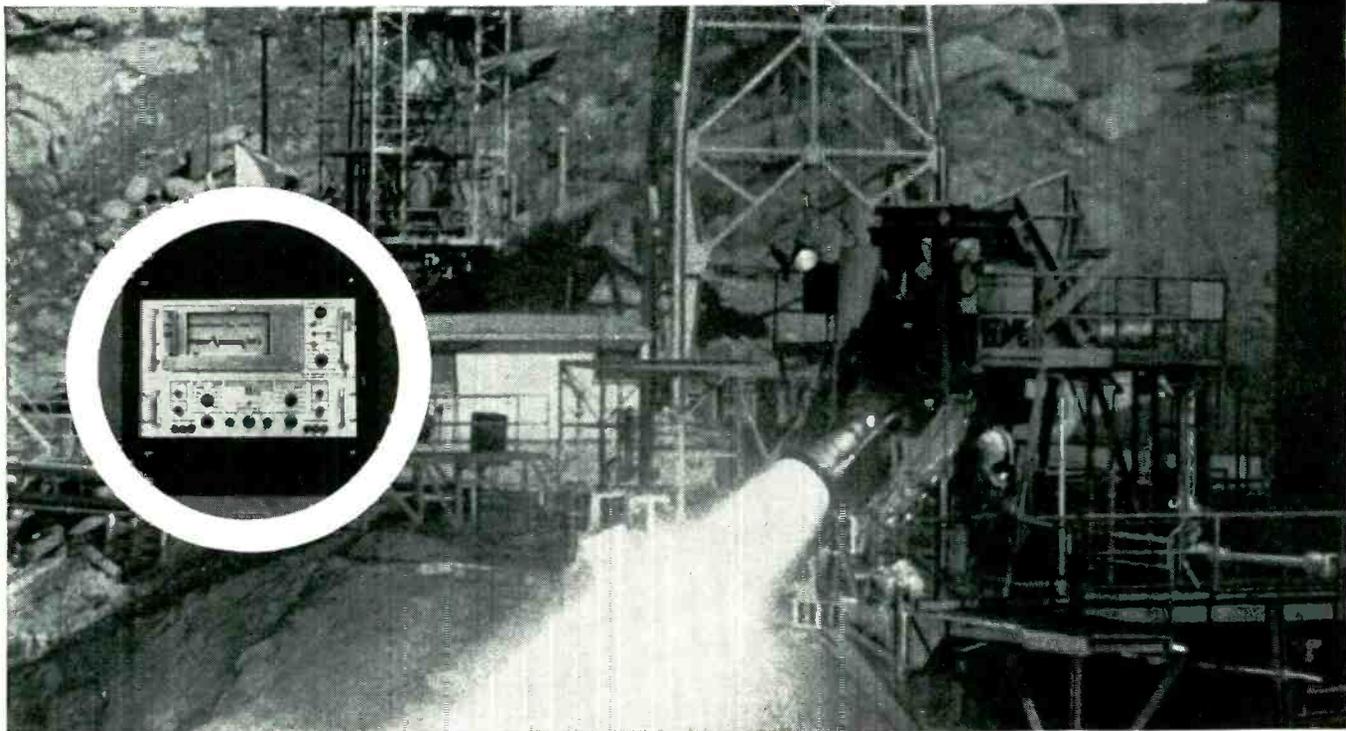
- accurate recording of phenomena from d.c. to 100 cps in immediately usable form
- widest range of chart recording speeds, from 10" per day to 10" per second. Instantaneous selection of any 16 chart speeds provides excellent readability for a wide range of signals
- choice of ink writing (for chart paper economy and easy reproducibility) or electric writing (for adverse environmental conditions)
- complete systems for rack, console mounting or portable use

For the very best engineering performance in testing and development—use instrumentation proved by experience throughout the years. Get the facts from your Brush Representative, or write us.



Checks bomber refueling. Brush instruments are rugged and durable, maintain accuracy in field use. Here they record surge pressures in gas tanks of a Strategic Air Command B-36 during refueling. For top performance, bomber must be refueled in a hurry, yet flow rate of 600 gallons per minute posed a pressure problem. Brush Recording Systems provided necessary facts.

oscillographs in use than all other makes combined.



Tests the mightiest engines ever built. Engineers at **ROCKETDYNE**, a Division of North American Aviation, Inc., use Brush Recording Systems in developing rocket engines for intercontinental guided missiles. This equipment directly

records stress, accelerations, and acoustic values when engines are under test. Considered one of **ROCKETDYNE**'s most stable recorders, this unit has the advantage of mounting readily into their relay racks.



"Mechanical stomach" for elevators. Westinghouse makes sure that its elevators give you a smooth ride. Instrumentation consisting of an accelerometer and a Brush portable oscillograph is shown here on a "trial run". Recorded test data helps develop elevator controls that produce the best acceleration pattern for passenger comfort.

For complete information write Dept. K-12.

BRUSH ELECTRONICS

3405 Perkins Avenue, Cleveland 14, Ohio

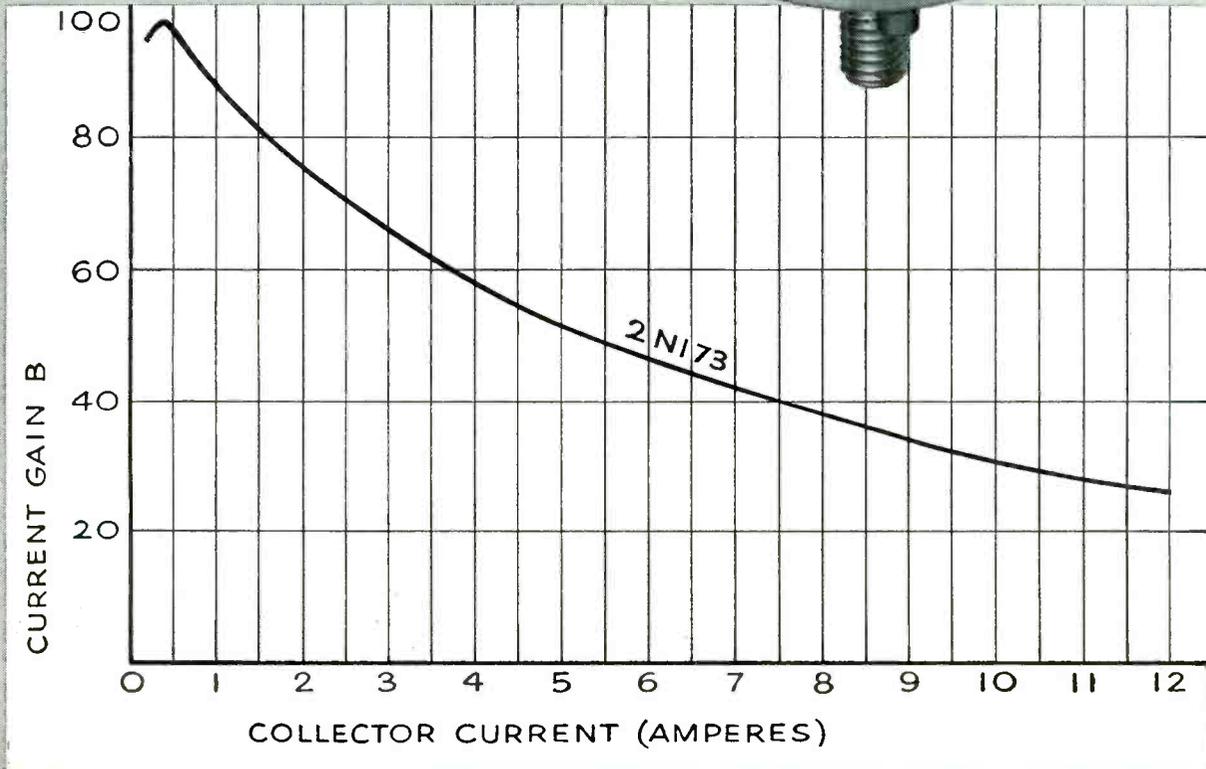


COMPANY

DIVISION OF

CLEVITE
CORPORATION

Industry's Highest Power Transistors



Delco Radio "High-Power" Transistors set a new industry standard of performance—
Produced by the thousands each day!

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

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

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

DELCO RADIO

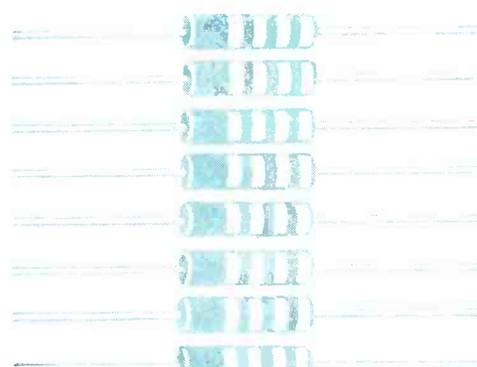
**DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA**



Meet or surpass today's critical performance requirements with

STACKPOLE fixed composition **RESISTORS**

Packaged for convenient assembly...
MANUAL or AUTOMATIC



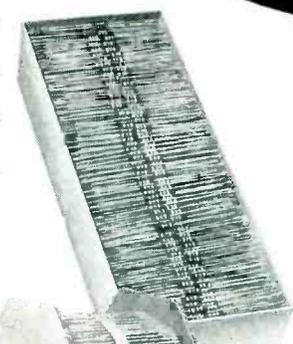
Conservatively rated at 70° C.

Low noise level.

Unsurpassed humidity protection.

Easy-to-solder, firmly anchored leads.

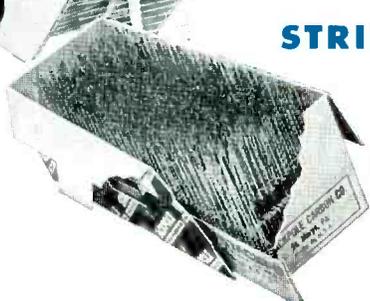
Drawings available for detailed packaging specifications.



STACK-PACK



REEL-PACK

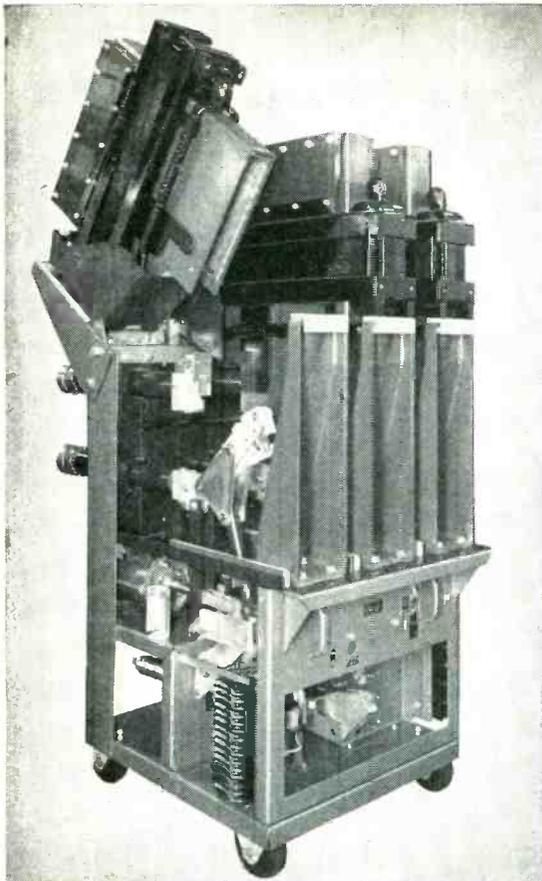


STRIP-PACK

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

Canada:
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550 Evans Avenue, Etobicoke,
Toronto 14, Ont.

Stackpole Fixed Composition Resistors are stocked by leading parts distributors



ROLLED AND MOLDED ARC CHUTE SHELLS, made by C-D-F for the I-T-E Circuit Breaker Company for 7.5 and 15 KV air magnetic circuit breaker, are good examples of paper-base Dilecto doing a hard job. Each completely closed insulating shell (NEMA grade X) has flame-retardant construction, negligible water absorption, and high dielectric strength at all points to withstand impulse test requirements.

High strength, low cost...

C-D-F paper-base Dilecto®

Excellent electrical properties, ease of machining and punching, with low costs are features of the many paper-base grades of Dilecto laminated plastics. Adaptable to forming, Dilecto is a mechanically versatile insulating material that withstands difficult operating conditions, moisture and temperature variations.

Insulating papers include kraft-alpha, cotton rag, and asbestos. Improved phenolic, or melamine silicone laminating resins are used. C-D-F builds flame resistance into a paper-base laminate—you get a worthwhile, easier-to-machine substitute for a glass-base laminate. C-D-F bonds copper uniformly to Dilecto — you get a superior metal-clad laminate for printed circuit applications.

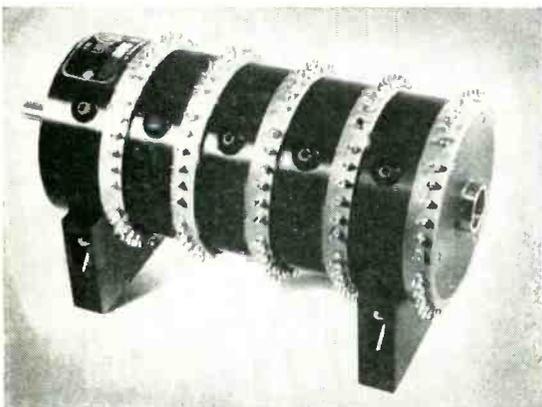
A big, reliable source of supply, C-D-F helps you improve design, simplify purchasing, speed production. Look in C-D-F's catalog in the Product Design File (Sweet's) for the address of your nearest C-D-F sales engineer. Write for samples and new Dilecto catalog:



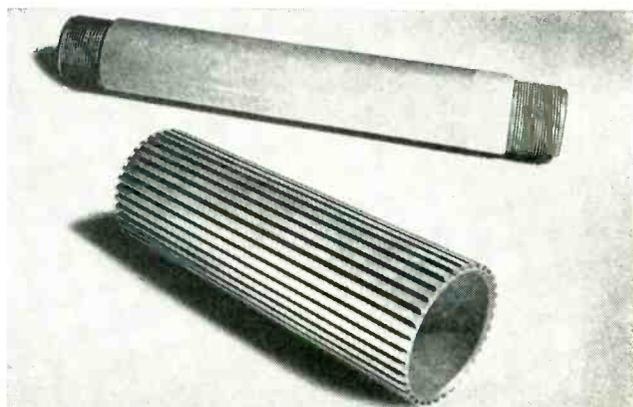
CONTINENTAL DIAMOND FIBRE

CONTINENTAL-DIAMOND FIBRE DIVISION OF THE BUDD COMPANY, INC.

NEWARK 16, DELAWARE



THIS HIGH-SPEED SAMPLING SWITCH, for missile telemetering and automation applications has a paper-base Dilecto tubing body. Materials engineers at General Devices, Inc., selected Dilecto "for its mechanical properties and low moisture absorption."



ACCURATE MACHINING, SMOOTH FINISHING are two merits of paper-base Dilecto. Note the perfection of milling cuts and threads! C-D-F has mass-production equipment, or can furnish sheets, tubes and rods with cost-cutting machining information.

ALL VIDEO TRANSMISSION TEST

STANDARDS in a suitcase



The Original Full Rack and the Portable Unit Produce the same Precise Test Signals.



Model 1003-B

Video Transmission Test Signal Generator

- ★ Completely self contained ★ Portable
- ★ Multi-frequency burst ★ Stairstep ★ Modulated stairstep
- ★ White window ★ Composite sync ★ Regulated power supply.

Now, Telechrome Video Transmission Test Equipment is available at a completely portable 12 1/4" standard-rack mounting-unit.

Everyday these Test Signals generated by Telechrome equipment, are transmitted Coast-to-Coast by NBC, CBS, ABC, the Bell System, Canadian Bell and leading independent TV stations throughout the U.S. and Canada. Hundreds of network affiliated TV stations and telephone TV centers thus check incoming video signals.

The compact, inexpensive, portable Model 1003-B is all that is required to generate signals for local and remote performance checking of your entire video, cable, or micro-wave facilities.

DELIVERY 30 DAYS

Literature on the above and more than 100 additional instruments for monochrome and color TV by TELECHROME are available on request.

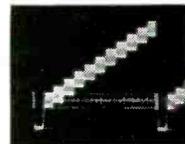
The Nation's Leading Supplier of Color TV Equipment
28 Renick Drive Amityville, N. Y.
Lincoln 1-3160



MULTI-FREQUENCY BURST AMPLITUDE vs FREQUENCY. Check wide band coaxial cables, microwave links, individual units and complete TV systems for frequency response characteristics without point to point checking or sweep generator.



WHITE WINDOW
LOW & HIGH FREQUENCY CHARACTERISTICS. Determine ringing, smears, steps, low frequency tilt, phase shift, mismatched terminations, etc. in TV signals or systems.



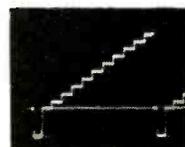
STAIRSTEP SIGNAL modulated by crystal controlled 3.579 mc for differential amplitude and differential phase measurement. Checks amplitude linearity, differential amplitude linearity and differential phase of any unit or system.

Model 1003-C includes variable duty cycle stairstep (10-90% average picture level).

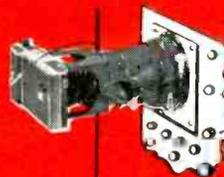
Model 608-A HI-LO CROSS FILTER for Signal analysis.



MODULATED STAIRSTEP signal thru high pass filter. Checks differential amplitude.



MODULATED STAIRSTEP signal thru low pass filter. Checks linearity.



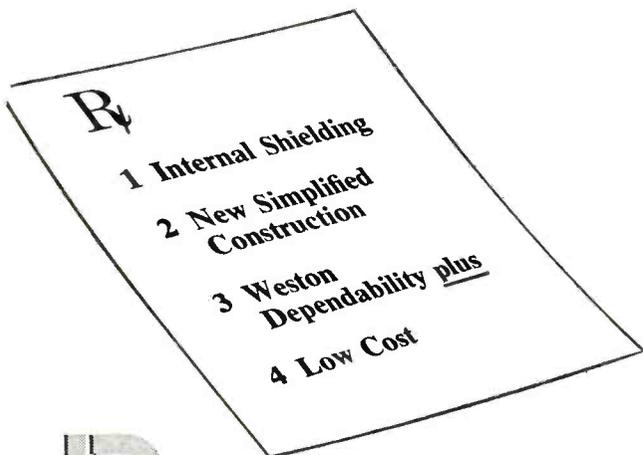
1521-A OSCILLOSCOPE CAMERA—Polaroid type for instantaneous 1 to 6" static photo-recording from any oscilloscope.



1004-A VIDEO TRANSMISSION TEST SIGNAL RECEIVER for precise differential phase and gain measurements. Companion for use with 1003-B.



Just
What
the
doctor
ordered

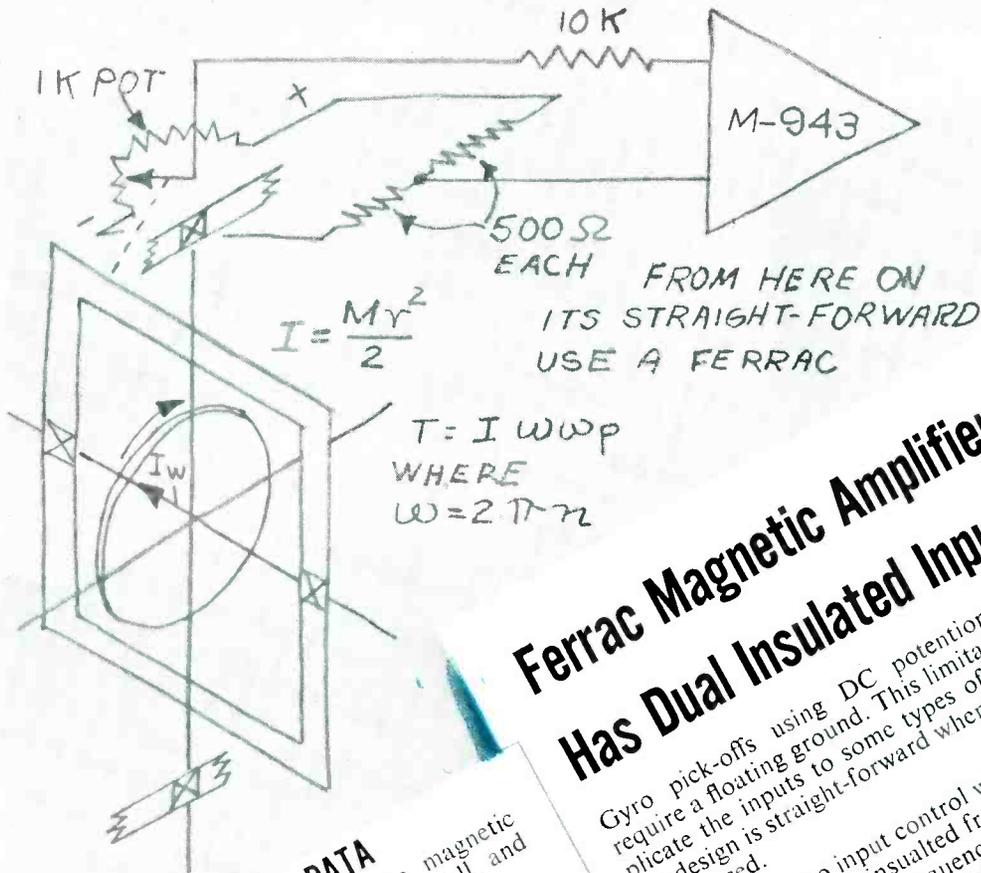


WESTON
INSTRUMENTS

WESTON CORMAG® PANEL INSTRUMENTS

Model 1301 & 1331 core-magnet panel instruments give you more, *much more*, than the unmatched performance you have always experienced from Weston meters. The mechanism construction is extremely simple, with fewer parts. It is *self-shielding* . . . which means these instruments can be mounted interchangeably on magnetic or non-magnetic panels without adjustment; and mounted in close proximity without intereffect. Best of all, these outstanding advantages bring no price premium . . . in fact, they are yours for *less* than you pay for conventional instruments. For complete information on *Cormag* panel instruments, or on other Weston instruments for panel, laboratory, production test, or servicing needs, consult your nearest Weston representative, or write, Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

MAGNETIC AMPLIFIER SIMPLIFIES GYRO PICK-OFF



Ferrac Magnetic Amplifier Has Dual Insulated Inputs

Gyro pick-offs using DC potentiometers often require a floating ground. This limitation can complicate the inputs to some types of amplifiers but the design is straight-forward when a Ferrac amplifier is used.

Each of the two input control windings of a Ferrac unit is completely insulated from ground and from each other. As a consequence, the ground connection can be at any convenient point of the input circuit. If another signal, such as a course command, is to be mixed with the gyro signal, it can be fed to the other Ferrac input, again with the ground wherever most convenient.

This flexibility of Ferrac type magnetic amplifiers makes them useful in a variety of guidance equipments. They are sufficiently stable to be used in analog computing portions of such equipments, and are so rugged as to withstand most environmental conditions.

TECHNICAL DATA

Ferrac units are instrument-type magnetic amplifiers having unusually low null and stand-off errors.

Input: Two independent control windings for reversible DC.

Output: Unfiltered DC linear over the range ± 7.5 volts into 1000-ohm load.

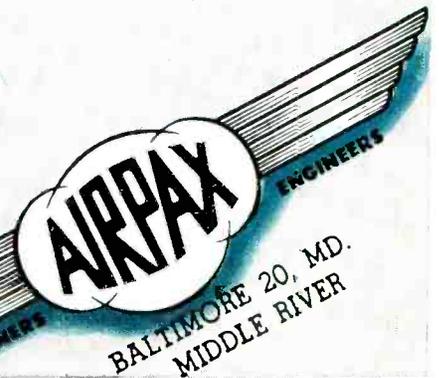
Power Requirements: Less than 3 W at 115 ± 10 RMS volts and 400 ± 40 CPS; no bias supply is needed.

Gain: Gains of typical standard Ferrac amplifiers for each of their two control windings are:

Type	Control B	Control A
M-943	2.5v/100ua	2.5v/100ua
M-1039	0.5v/100ua	10.0v/100ua
M-1057	5.0v/100ua	5.0v/100ua

These gains are expressed as output volts per 100 microamperes of input. Gains are stable within ± 1 db.

Environment: Units are rated for operation -55 C to $+85$ C, withstand vibrations of 10 G at 10 to 2000 CPS, shocks of 100 G for 11 ± 1 milliseconds along each principal axis, and are hermetically sealed.



NEW!

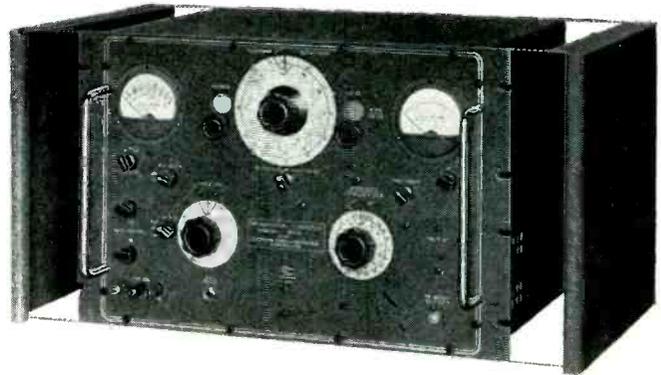
FM-AM SIGNAL GENERATOR

Designed for bench use or rack mounting

Type 202-E 54 to 216 MC



Type 202-E with cabinet end bells attached for BENCH USE



Type 202-E with cabinet end bells removed for mounting in a standard 19" RELAY RACK



Power Supply used with Type 202-E for BENCH USE



Power Supply used with Type 202-E for 19" RACK MOUNTING

RF OUTPUT VOLTAGE:

Max. open circuit voltage at front panel jack is approx. 0.4 volts. With output cable attached 0.2 volts nominal. Output impedance 50 ohms resistive at front panel jack. Minimum output 0.1 microvolts.

FREQUENCY MODULATION:

Three deviation ranges, 0-24 KC., 0-80 KC., and 0-240 KC., each continuously adjustable. FM distortion at 75 KC is less than 2% and at 240 KC less than 10%.

FIDELITY CHARACTERISTICS:

Deviation sensitivity of FM modulation system as a function of frequency is flat within ± 1 DB from 30 cps to 200 KC.

AMPLITUDE MODULATION:

Internal AM available from 0-50% with meter calibrations at 30% and 50% points. External modulation may be used over the range from 0-50%. A front panel jack connects to the screen of the final stage for pulse and square wave modulation.

SPECIAL FEATURES:

Incremental frequency range: The ΔF switch permits tuning in increments of ± 5 , ± 10 , ± 15 , ± 20 , ± 25 , ± 30 , ± 50 , ± 60 KC in the 108 to 216 MC range — half these values in the 54 to 108 MC range. A fine tuning control permits continuous tuning over a range of approximately ± 20 KC in the 108 to 216 MC range, and ± 10 KC in the 54 to 108 MC range.

FREQUENCY:

54 - 216 MC. may be extended down to 100 KC by using the Univerter Type 207-E below.



This Univerter can be used, as above, for bench or rack mounting.

PRICES:

- FM-AM Signal Generator Type 202-E with power supply \$1090.00
- Univerter Type 207-E \$390.00
- F.O.B. Boonton, New Jersey

BOONTON RADIO CORPORATION



Boonton, New Jersey

Index to

electronics

VOLUME XXIX

January to December Issues Inclusive

1956

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THIS INDEX SECTION CONSISTS OF FOUR PARTS:

1. Subject Index of Feature and Departmental Articles.... S1
2. Titles and Summaries of Feature Articles for 1956..... S10
3. Subject Index of Industry Report Articles..... S13
4. Index to Authors of Feature and Departmental Articles.... S14

A

Accelerator, linear, pulse timing for 160 June
 Accelerometer for shock damage data 178D July
 Accelerometer, r-f servo.....151 Aug
 Acoustic time regulator.....184D June
 Adder, binary gas-discharge triode 196D June
 Adhesives (Special Report: Materials for electronics)186 Oct
 Aerosol, aerosoloscope counts particles188 Mar
 Aerosoloscope counts particles in gas, Gordon, Maxwell & Alexander.....188 Mar
 AFC, mechanically tuned radar.....138 Apr
 Airborne recording, transistor modulator for166 June
 Airborne tv reconnaissance203D Nov
 Airborne weather radar uses isoecho circuit, Ruppert & Smith.....147 Feb
 Air traffic control system speeds landings190D Aug
 Aircraft approach speed.....176D Feb
 Aircraft, electronic defense for B-52 232D Oct
 Aircraft, jet exhaust temperature indicator143 Dec
 Aircraft, isoecho weather radar circuit 147 Feb
 Aircraft, radio compass uses beam deflection tube166 May
 Aircraft, recorder amplifier for.....158 Aug

Items for which the page reference is marked "D" are editorial material published monthly in *Electrons at Work and Production Techniques*.

Aircraft, three dimensional terrain clearance radar simulator.....131 July
 Aircraft, transistor amplifier for radar video142 Aug
 Aircraft, transistor modulator for recorder166 June
 Air navigation receiver used by Navy 198D Nov
 Alarm, fail safe fire.....202D June
 Alarm system, balanced capacitance 150 Apr
 Alignment, phase detector for synchro 204D July
Alignment Techniques
 Eight captive screwdrivers align video i-f strip214D Jan
 Gear-operated video i-f alignment setup228D Apr
 Intensity markers aid television alignment245D Apr
 Tuning capacitor alignment setup 258D Nov
 Alphabet, phonetic, changes.....214D Apr
 American transistor broadcast receiver 180D Jan
 Amplifier, 3,000-watt audio.....162 Nov
 Amplifier, see also type, audio, pulse, video, etc.
 Amplifier, biasing large.....141 Jan

Amplifier, chopper-stabilized operational132 Sept
 Amplifier, computer uses magnetic 138 July
 Amplifier, gain chart for transistor 224 Oct
 Amplifier, low-cost analog computer 188D June
 Amplifier, low-cost remote.....192D May
 Amplifier, low-noise design.....154 June
 Amplifier, magnetic, servo system.....140 Feb
 Amplifier, pre-, transformerless line output193D Aug
 Amplifier, push-pull transistor servo.....155 Dec
 Amplifier, quasi-complementary transistor173 Sept
 Amplifier, recorder, for flight testing 158 Aug
 Amplifier, regulating, corrects slope and level168 July
 Amplifier, self-balancing magnetic servo196 Mar
 Amplifier, shunt regulated video.....166 Nov
 Amplifier, transient analyzer for magnetic150 Jan
 Amplifier, transient-controlled magnetic176 Aug
 Amplifier, transistor202D Sept
 Amplifier, transistor hearing aid.....176D June
 Amplifier, transistor miniature.....254D Oct
 Amplifier, transistor radar video.....142 Aug
 Amplifier, transistor remote pick-up.....122 Jan
 Amplifier, transistor servo.....136 Jan
 Amplifier, transistor servo.....153 Sept
 Amplifier, transistor telephone.....173D Jan
 Analog computer, see also computer
 Analog computer, low-cost amplifier for188D June

Analog computer, operational amplifier 132 Sept
 Analog computers for the engineer, Carroll 122 June
 Analog computer, simplified 128 Jan
 Analog computer, transistor-stabilized servo 174 Oct
 Analog computer, triangular-wave multiplier 182 Aug
 Analog function generator 178 Oct
 Analog multiplier, transistor-magnetic core tube 160 Oct
 Analog-to-digital data converter, Rigby 152 Jan
 Analog-to-digital encoder disk, made by pulse technique 146 June
 Analyzer, magnetic amplifier transient 150 Jan
 Analyzer, pulse selector for spectrum 179 Aug
 Antenna, broadband for field-intensity meter 130 Feb
 Antenna, helical ground-to-air 161 Mar
 Antennas, interaction 182D Jan
 Apple tube, color receiver uses on gun tube 150 June
 Apple-tube, electron optics for 210D Mar
 Arc protection for transmitters 144 Jan
 Army meteorologists study duct effects 184D July
 Army's first semiconductor equipment 188D Apr
 Array, see also antenna
 Array, helical ground-to-air 161 Mar
Assembly Techniques
 Assembly tray 272D Dec
 Aluminum straps catch fluorescent tubes 290D Oct
 Anchoring leads in terminal strip with nylon rods 220 July
 Assembling coil strip with automatic screwdriver 252 July
 Automatic feed for radio tuner punch press 258D Sept
 Clamping fixture holds vhf tuners 242D Feb
 Connector assembly jig 260D Apr
 Cutting glass cloth 230D Feb
 Filling aircraft antennas with isocyanate foam, Hillman 256D Dec
 Installing pushbuttons on auto radio tuners 240D Aug
 Horseshoe bends in pass-along lines 264 Apr
 Imprinting fixtures 260D Nov
 Luggage clips hold units 280D Nov
 Magnetic base holds lamp and magnifier 254 July
 Potting connectors with remeltable plastic molds 232D June
 Production control chart uses golf tees in peg-board 230D Aug
 Pushbutton tuner lever assembly techniques 272D Nov
 Shock mount springs made from wire cloth 280D Mar
 Single-worker turntable for strips 236D Nov
 Socket-holding tool 252D May
 Take-apart spools for magnetic telemetering tape 230D Apr
 Three-at-a-time grommet-inserting tool 240D May
 Vacuum and vibration speed assembly of core memory planes, Guditz and Smith 214D Feb
 Waveguide twists made from thin brass laminations 228D Dec
 Wood pallet aids insertion of parts in wiring boards 214D Jan
 Atlantic cable inaugurated 196D Dec
 Atomic reactor camera 212D May
 Audio amplifier delivers 3,000 watts, Bereskin 162 Nov
 Audio amplifier, quasi-complementary transistor 173 Sept
 Audio, linear electrostatic loud speaker 208D Mar
 Audio, microammeter frequency meter 216D Apr
 Audio oscillator, superregenerative transistor 166 July
 Audio, silencer for noise peaks 156 Feb
 Audio, tape doubles response of disk recordings 125 July
 Audio, transistor phono amplifier 202D Sept
 Automatic control, beta gage controls cigarette machine 144 Nov
 Automatic control, electronics in process industries 138 May
 Automatic control for gear cutter 140 July
 Automatic control of machine tools 122 Feb
 Automatic frequency control, mechanically tuned radar 138 Apr
 Automatic inspection of magnetic-sound prints, Stafford 164 Mar
 Automatic measurement of voltage tolerances, Strassman 150 Feb
 Automatic microimage file 196D Sept
 Automatic plotter for waveguide impedance, Bachman 184 Mar
 Automatic transcontinental teleprinter 180D June
 Automatic tuning for high-power transmitter, DeLong 134 July
Automation, see automatic control
 Automobile radio, tube-transistor 178D June

B

Balanced-capacitance fence alarm system, Browning 150 Apr
 Balloon-borne transmitter trans-sonde 164 Nov
 Balls, glow, measure field intensity 206D Aug
 Bandwidth-rise time chart, Prince 188 Nov
 Beam deflection tube simplifies radio compass, Tewksbury 156 May
 Beam switching tube applications 122 Apr
 Beta gage controls cigarette machine, Harrison 144 Nov
 Bevatron-frequency measurement system, Bockeb & Struven 182 May
 Bevatron Magnet pulse-timing system, Struven 160 June
 B-H loop tracer, magnetic switch 167 Oct
 Biasing large amplifiers, Wadey 141 Jan
 Bias supply, wide range 141 Jan
 Binary adder uses gas-discharge triode, Maynard 196D June
 Binary counter, high-speed transistor 174 Mar
Biophysics, see medical electronics
 Bistable circuits using triode-pentodes, Armstrong 210D July
 Bistable circuit uses single triode, Hofheimer 230D Mar
 Blind, meter adapter for 202D May
 Blind, punched-card reader for 148 Nov
 Rotary, pulsed-light generator for plant research 200D Aug
 Braille meter adapter 202D May
 Braille punch-card reader 148 Nov
 Breakdown in gas tubes 176D Jan
 Bridge tests capacitors on production line, Boer 146 Aug
 British corona triode 238D Mar
 British scatter terminal 214D May
 Brittle material, ultrasonic machining of 132 Jan
 Broadband antenna for field-intensity meters, Singer & Caler 130 Feb
Broadcast, see also f-m, television
 Broadcast, color-signal generator 170 Sept
 Broadcast, correction for color-tv transmitter 130 Apr
 Broadcast, exciters multiplex f-m 148 Aug
 Broadcast, gas tube protects transmitter 144 Jan
 Broadcast, lenticular film for color kinescope 190D Apr
 Broadcast, low-cost remote amplifier 192D May
 Broadcast, mobile tower for remote tv pickup 206D Apr
 Broadcast, multiplex f-m 130 June
 Broadcast, pickup in twisted-pair cable 170 Feb
 Broadcast, proof of performance for tv 150 Nov
 Broadcast receiver, simplified transistor 190D Dec
 Broadcast receiver, transistor 180D Jan
 Broadcast, reducing off-air time 156 Sept
 Broadcast, scintoscope tv tube 210D Apr
 Broadcast, shunt regulated video amplifier 166 Nov
 Broadcast, switching system for television 147 Dec
 Broadcast, toroidal video transformer 150 May
 Broadcast, transistor amplifier for remote pickup 122 Jan
 Broadcast, tv modulation indicator 172 May
 Bulb-temperature, shielding effect on 204D Feb
 Business machines, character recognition for 132 Feb

C

Cabinet Techniques
 Finishing techniques for wood-metal tv cabinets 226D Apr
 Glue-drying machine for television receiver cabinet frames 224D Apr
 Metal strap holds tv chassis on plywood sheet 244D Sept
 Rubber band holds tv cabinet cover 268D Nov
 Stapling back cover hinge to television cabinet 246D Aug
 Stapling cardboard cup on back cover of tv set 276D May
 Cable, pickup in twisted-pair 170 Feb
 Cadmium oxide cover electrodes 196D July
Calculator, see computer
 Camera, atomic reactor 212D May
 Camera exposure adjusts automatically 202D July
 Camera, oil-film heat 190D Apr

Camera shutter, tester for 152 Feb
Capacitance, see also capacitor
 Capacitance alarm system 150 Apr
 Capacitor, bridge tests 146 Aug
Capacitor Production Techniques
 Building capacitors to pass pitch and roll test 306D Oct
 Checking thickness of stator plates 280D Oct
 Making metallized lacquer-film capacitors, Wehe 222D June
 New booster pump cuts capacitor drying time 262D Nov
 New vacuum metallizer for capacitor paper 299D Mar
 Tuning capacitor assembly fixture 250D Aug
 Tuning capacitor soldering techniques 222D Oct
 Capacitor, solid electrolyte tantalum 176 Oct
 Capacitor, gas-dielectric variable 158 Jan
 Capacitor, vibrating, modulator 158 June
 Cardioscope checks heart during operation 194D Sept
 Card reader, punch-, for blind 148 Nov
 Carrier telephone expands rural service, MacDowell & Nevitt 182 Oct
 Casting resins (Special Report: Materials for electronics) 188 Oct
 Cathode, field emission 176D Feb
 Cathode-ray recorder, permanent-writing 148 Apr
 Cathode-ray tube, one-gun color 150 June
 Cathode-ray tube screen, graininess 208D Sept
 Cathode-ray tube storage, designing computer 126 July
 Cathode-ray tube, wamoscope 232D Oct
 Cathode trap design chart 174 July
 Cavity field distribution, glow-balls measure 206D Aug
 Cavity, x-band magnetron tuned by coupled 182 Mar
 Centralized control for SAGE 168 Mar
 Ceramic military tubes 194D May
 Ceramics and mica (Special Report: Materials for electronics) 192 Oct
 Ceramic tube, high-temperature transmitting 230D Oct
 Ceramic tubes, metal 220D Aug
 Characteristic impedance, eccentric-line nomograph 190 Sept
 Characteristic impedance, slab line nomograph 192 Sept
 Characteristics of analog computers 122 June
 Characteristics and origins of noise—part 1, Bennett 154 Mar
 Characteristics, transistor 161 Jan
 Character recognition for business machines, Glauberman 132 Feb
 Chart, bandwidth-rise time 188 Nov
 Chart, normalized filter design 200 Mar
 Chart, selective cathode trap design 174 July
 Chart, power transformer design 184 Apr
 Chart, transistor amplifier gain 224 Oct
 Chart, triple-tuned circuit design 186 Aug
 Chart for tuned-transformer design 182 Nov
 Chemicals, electronics in, industry 138 May
 Chemistry, gas particle counter 188 Mar
 Chopper stabilized operational amplifier 182 Sept
 Cigarette, beta gage for, machine 144 Nov
 Circle-dividing machine, controlled by pulse technique 146 June
 Citizen radio evaluation 185D Jan
 Closed-circuit television, slow scan 140 Nov
 Clutter, upper atmosphere 186D Dec
 Coating, grainless for crt screen 208D Sept
 Coatings and tapes (Special Report: Materials for electronics) 194 Oct
 Coaxial line, nomograph for impedance of eccentric 190 Sept
 Code, document reader uses dots 164 Dec
 Code, phonetic alphabet changes 214D Apr
 Coded time signal generator 179 Mar
Coil Production Techniques
 Air gun inserts trimmer disks in printed i-f coils 238D Feb
 Applying dielectric to printed i-f coils 254D Mar
 Automatic grinder for ferrite yokes 234D Aug
 Color coding aids in matching auto tuner coils to cores 214D June
 Holding fixture aids varnishing of tiny coils 238D May
 Metal guard improves toroid winder 278D Oct
 Steel pails replace spools for shipping magnet wire 232D Aug
 Stick holder for multiple coil winder 276D Oct
 Winding focus coils with aluminum foil 244 July
 Winding machine for oxide-coated aluminum-foil coils 244D Sept
 Color signal generator 170 Sept
 Color television, Apple-tube electron optics 210D Mar
 Color television, correction for transmitter 130 Apr
 Color television, lenticular film for kinescope 190D Apr
 Color television, one-gun Apple tube 150 June
 Color television, signal generator for 170 Sept
 Color television, three-phase detector for 157 Oct
 Color tv monitors nuclear separation 214D May

Communication, arc protection for transmitter.....144 Jan
 Communications, automatic transmitter tuning.....134 July
 Communications, British scatter terminal.....214D May
 Communications, carrier telephone.....182 Oct
 Communications, citizens radio evaluation.....184D Jan
 Communications, characteristics and origin of noise.....154 Mar
 Communications, frequency diversity.....180D Jan
 Communications, long range jeep radio.....206D Mar
 Communications, multipath simulator.....171 July
 Communications, radio system for railroad.....158 Dec
 Communications systems, reducing noise in.....148 July
 Communications, ssb mobile.....185D Jan
 Communications, subcarrier switch for microwave.....175 Nov
 Communications, talking hat combat radio.....236D Sept
 Communications through long tunnels.....194D Nov
 Communications, transistor f-m transmitter.....220D Apr
 Communications, transistorized mobile receiver.....217 Oct
 Communications, transmitter using delta modulation.....164 Oct
 Communications, twin single-sideband converter.....214D Mar
 Communications, voice powered transmitter.....226D Mar
 Commutating devices for telemetering.....153 Apr
 Compass, beam deflection tube used in radio.....166 May
 Compensating voltage dividers for frequency, Orr.....194D Aug
 Components in radiation field.....202D Nov
 Compressor, recording time.....184D June
 Computer, analog, for the engineer.....122 June
 Computer, analog function generator.....178 Oct
 Computer, analog, low-cost amplifier for.....188D June
 Computer, analog multiplier.....160 Oct
 Computer, analog-to-digital data converter.....152 Jan
 Computer, binary adder.....196D June
 Computer, character reader for business.....132 Feb
 Computer, code disk, made by pulse technique.....146 June
 Computer control of machine tools.....122 Feb
 Computer, design of storage devices.....126 July
 Computer, digital, transistor circuits for.....160 May
 Computer, document reader for, input.....164 Dec
 Computer evaluates water table.....188D Dec
 Computer, ferrite-core memory.....158 Feb
 Computer, high-speed printer.....166 Sept
 Computer, input-output devices.....142 Sept
 Computer, magnetic-shift register.....172 Aug
 Computer, neon-tube digital storage.....162 July
 Computer, operational amplifier is chopper stabilized.....182 Sept
 Computer, SAGE air defense.....234D Oct
 Computer, simplified analog.....128 Jan
 Computer, single triode flip-flop.....230D Mar
 Computer stored program alters itself.....178D Jan
 Computer, transistor-diode stabilized servo.....174 Oct
 Computer, triangular-wave multiplier.....182 Aug
 Computer, triode-pentode bistable circuit.....210 July
 Computer, uses magnetic amplifier.....138 July
Condenser, see Capacitor
 Control, alternative tuning for transmitter.....134 July
 Control, automatic, for gear cutter.....140 July
 Control, beta gage for cigarette machine.....144 Nov
 Control, electronic, for machine tools.....122 Feb
 Control, electronics in process industries.....138 May
 Control, fuel cut-off for missile.....126 Jan
 Controller integrates spot-welding current, Fraser.....157 Aug
 Control, magnetic amplifier servo.....140 Feb
 Control, magnetic servo amplifier.....196 Mar
 Control, photo, for tunnel lighting.....186D Jan
 Control, plug-in.....204D Nov
 Control, pulse, for computer code disk machine.....146 June
 Control, transistor preamplifier for servo.....168 Feb
 Control, voltage and current.....208D Feb
 Converter, analog-to-digital.....152 Jan
 Converter for twin single-sideband, Varian.....214D Mar
 Converter, transistor singing.....216D Dec
Conveyor Belt Production Techniques
 Conveyor is added to tv cabinet shaper.....250D Mar
 Flexible-screw conveyors for subassemblies.....248D Mar
 Square-corner conveyor saves floor space.....230D Apr
 Cooling miniature equipment.....152 Oct
 Cooling, shielding effect on bulb temperature.....204D Feb
 Core, ferrite memory.....158 Feb
 Corona triode.....228D Mar
 Correction circuits for color-tv transmitters, Mullenger & McMann, Jr.....130 Apr
 Correlator, magnetic shift-register.....172 Aug

Counter, high-speed transistor.....174 Mar
 Counters control high-speed flash, Dorsey.....160 Aug
 Counter, direct reading pulse.....194D Dec
 Counter, single triode.....230D Mar
 Counter, transistor computer circuits.....160 May
 Counter using beam switching tube.....122 Apr
 Coupled cavity tunes x-band magnetron, Beltz.....182 Mar
 Cover electrodes, cadmium oxide.....196D July
 CRO, precision interlace radar display.....168 May
 Cross pulse pickup in twisted-pair cable, Stephenson.....170 Feb
 CRT power supply uses transistor oscillator, Toscano & Heffner.....162 Sept
 Crystal, fusion-heat stabilizes.....208D May
 Crystal stability, vfo with near.....230D Sept
 Current and voltage controller.....208D Feb
 Curve tracer, v-r tube.....218D Sept
 Curve, universal response.....134 Dec
 Curved passive reflector, Bedrosian.....206D Dec

Data converter, analog-to-digital.....152 Jan
 Data processing, document reader for.....164 Dec
 Data processing, input-output devices.....142 Sept
 Data storage, automatic microimage.....196D Sept
 Data storage, transistor magnetic-core.....210D Sept
 Data transmission, demodulator for wide-band f-m.....157 July
 Data transmission, pulse-code.....148 July
 Data transmission, telemetering system.....163 Apr
 Data, tube information source.....214D Apr
 Delay-line pulse generator, Barditch.....196D Jan
 Delay-line radar simulator.....143 June
 Delta modulation, transmitting system using.....164 Oct
 Demodulator, wide-band f-m.....157 July
 Design chart, equivalent R-Z chart.....170 June
 Design chart for selective cathode traps, Hillman.....174 July
 Design charts for tuned transformers, Hellstrom.....182 Nov
 Design chart, normalized filter.....200 Mar
 Design chart, power transformer.....184 Apr
 Design chart, radar second detector filter.....188 May
 Designing dielectric microwave lenses, Kelleher.....138 June
 Designing low-noise equipment, Bennett.....154 June
 Designing storage tube equipment, Buckbee & Luftman.....126 July
 Design of regulated transistor power supplies.....168 Nov
 Design of triple-tuned circuits, Geffe.....186 Aug
 Detecting thin-wall pipe flaws.....204D Dec
 Detector filter, nomograph for radar second.....188 May
 Detector, magnetron lost pulse.....164 Aug
 Detector, phase, for synchro alignment.....204D July
 Detector, regulator stabilizes infrared.....160 July
 Detector, sampling, for intercarrier sound.....138 Aug
 Detector, tack, for shoe production.....144 Feb
 Detector, three-phase, for color tv.....157 Oct
 DEW-line, centralized SAGE control.....168 Mar
 Dials, electroluminescent.....222D Apr
 Dielectric, electronics produce new high-temperature.....146 May
 Dielectric, gas, for variable capacitors.....158 Jan
 Dielectric lens, designing microwave.....138 June
 Diffusion transistors raise frequency limits, Carroll.....137 Feb
 Digital-analog computer evaluates water table.....188D Dec
Digital computer, see also computer
 Digital computer, transistor circuits for.....160 May
 Digital computer uses magnetic amplifier.....138 July
 Digital converter, analog to.....152 Jan
 Digital presentation vacuum-tube voltmeter, Nuut & Munsey.....148 Jan
 Digital storage using neon tubes, Raphael & Robinson.....162 July
 Digit reader, magnetic shift-register.....172 Aug
 Diode-transistor stabilizer for servo.....174 Oct
 Direct current signal source, Turner.....198D Feb
 Direct reading pulse counter, Williamson.....194D Dec

Directional antenna, see antenna
 Direction-finder antennas, interaction.....182D Jan
 Discriminator, time-voltage pulse.....178D Feb
 Dish antennas to scan chromosphere.....208D July
 Disk recording, tape doubles response of.....125 July
 Display equipment coordinates Nike batteries.....194D May
 Display, precision interlace radar.....168 May
 Display, storage tube for radar ppt.....172 Dec
 Display tube, grid-switched gas.....154 Aug
 Distribution, glo-balls measure field.....206D Aug
 Diversity transmission, frequency.....180D Jan
 Divider, frequency compensation of voltage.....194D Aug
 Document processor reads coded dots, Fortune.....164 Dec
 Ducts effects, army studies.....184D July
 Dynamic microphone, transistor.....216D Nov

Earth satellite, electronics for.....138 Dec
 Earth satellite uses minitrack transmitter.....196D Nov
 Eaton lens, designing.....138 June
 Eibron sees in dark.....206D Nov
 Eccentric-line impedance nomograph, Hasse.....190 Sept
 Electrically variable gas-dielectric capacitor, Gordon.....158 Jan
Electrocardiograph, see medical electronics
 Electrodes, cadmium oxide cover.....196D July
 Electrogastograph aids stomach diagnosis.....186D Dec
 Electroluminescence, for dials.....222D Apr
 Electrolyte, solid, tantalum capacitor.....176 Oct
 Electrometer, vibrating capacitor modulator.....155 June
 Electronic controller for voltage and current, Armstrong & Kochman.....208D Feb
 Electronic controls for machine tools, Findlay.....122 Feb
 Electronics shuffer B-52.....232D Oct
 Electronic shutter closes rapidly.....194D June
 Electronics in the IGY program, Findlay.....138 Dec
 Electronics in the process industries, Carroll.....138 May
 Electronic switch, silencer for audio noise.....156 Feb
 Electron optics for apple tube.....210D Mar
 Electrons produce high-temperature dielectric, Meikle & Graham.....146 May
Electron Tube, see Tube
 Electrostatic loudspeaker, linear.....208D Mar
 Electrosthethograph measures heart sounds.....194D Jan
 Energy source delivers half-sine pulses, Rosenthal.....176 Sept
 Equipment for generating noise-Part II, Bennett.....134 Apr
 Equivalent R-Z chart, Goldstine.....170 June
 Evaporograph oil-film camera.....190D Apr
 Exciters multiplex f-m carriers, Stratman.....148 Aug
 Experimental equipment checks missile ideas.....190D Nov
 Exposure adjustment, automatic camera.....202D July

Facsimile, for aircraft.....192D Nov
 Fail-safe flame alarm.....202D June
 FCC mobile monitor.....188D Jan
 FCC, proof of performance for tv broadcasters.....150 Nov
 FCC spectrum change.....200D July
 Fence, capacitance alarm for.....150 Apr
 Ferrite-core memory is fast and reliable, Alexander, Rosenberg & Stuart-Williams.....158 Feb
 Ferrite inductors tune panoramic receiver, Gabriel.....169 Aug
 Ferrites for memory toroids.....192D Dec
 Field emission cathode.....176D Feb
 Field intensity meter, antenna for.....130 Feb
 Field intensity, glo-balls measure.....206D Aug
 Field strength, see propagation
 Field studies of new propagation mechanisms.....192D Nov

Film, inspection of magnetic recording on 164 Mar
 Filter design-chart, normalized 200 Mar
 Filter, magnetostrictive 188D Dec
 Filter, nomograph for radar second detector 188 May
 Flame sensing alarm 202D June
 Flash-arc protection for transmitter 144 Jan
 Flash, counters control high-speed 160 Aug
 Flow detector, pipe 204D Dec
 Flight testing, recorder amplifier for 158 Aug
 Flip-flop, single triode 230D Mar
 Flip-flop, transistor 178 Nov
 Flip-flop, transistor computer circuits 160 May
 Flip-flop, transistor high speed 192 Dec
 Flow meter, Helmholtz coil tests 252D Oct
 Flutter, meter for wow and 152 July
 Flux-gate magnetometer tests handiness 142 Apr
 Flux-responsive recording head 172 Nov
 F-M, demodulator for wide-band 157 July
 F-M, exciters multiplex 148 Aug
 F-M, multiplex, broadcasting 130 June
 F-M receiver, mobile transistor 158 Nov
 F-M telemetering receiver 174 May
 F-M transistor transmitter 220D Apr
 Foam plastics (Special Report: Materials for electronics) 196 Oct
 Forecast of propulsion by solar power 190D Aug
 Forward-scatter, transhorizon communications techniques 154 May
 Four-place timer codes oscillograph recordings, Dorsey 154 July
 Frequency compensation of voltage divider 194D Aug
 Frequency diversity gives reliable signals 180D Jan
 Frequency measurement system for bevatron 182 May
 Frequency meter, microammeter 216D Apr
 Frequency meter, transistor 178 Nov
 Frequency meter, using half-sine pulse generator 176 Sept
 Frequency Modulation, see broadcast communication, f-m etc.
 Frequency response, tape doubles response of disk recording 125 July
 Frequency standard, South Africa transmission 190D Jan
 Frequency standards, WWV transmissions 194D Sept
 Function amplifier, low-cost 188D June
 Function generator, analog 178 Oct
 Function multiplier, triangular-wave 182 Aug
 Fuel cut-off control for guided missiles, Zomber & MacMillan 126 Jan
 Fusion heat stabilizes crystal 208D May

Ground-to-air antenna uses helical array, Zanella 161 Mar
 Guided missile, ceramic tube for 194D May
 Guided missile, experimental equipment checks 190D Nov
 Guided missile, fuel cut-off control 126 Jan
 Guided missile, ground to air helical antenna 161 Mar
 Guided missile, shipboard telemetering 134 June
 Guided missile, supersonic gun for 176D Feb
 Guided missile, transistor modulator for tape recorder 166 June
 Hardness tester, flux gate magnetometer 142 Apr
 Hawaii cable authorized 188D Jan
 Hearing aid, transistor 176D June
 Heart sounds measured by stethograph 194D Jan
 Heat pattern, oil-film camera 190D Apr
 Heat transfer, cooling miniature equipment 152 Oct
 Helical antenna, ground-to-air 161 Mar
 Helicopter blade tracker 200D Sept
 Helmholtz coil tests magnetic flow meters, Wetmore 252D Oct
 Higher pentode gain, Levy 190D July
 High fidelity, see audio
 High-frequency diffusion transistor 137 Feb
 High-frequency recording head 172 Nov
 High-output audio amplifier 162 Nov
 High-speed counter uses surface-barrier transistor, Gott 174 Mar
 High-speed flash, counters control 160 Aug
 High speed flip-flop, transistor 182 Dec
 High-speed printer for weapons testing, Fahnestock 166 Sept
 High-temperature dielectric, radiation produces new 146 May
 High temperature transmitting tetraode 230D Oct
 High-voltage power supply, transistorized 162 Sept
 Hobber, automatic control for 140 July
 Hot dials 222D Apr
 How to reduce off-air time, McKenzie 156 Sept
 Hurricane prediction 204D Apr
 Hysteresis loop tracer, magnetic switch 167 Oct

Instrument, digital vacuum-tube voltmeter 148 Jan
 Instrument, direct-reading velocity 246D Oct
 Instrument, flutter and wow meter 152 July
 Instrument, for r-f phase measurement 138 Jan
 Instrument, magnetic switch B-H loop tracer 167 Oct
 Instrument, noise measuring 162 May
 Instrument, phase generator for tropospheric research 220 Oct
 Instrument, staircase generator 192D Feb
 Instrument, to modulation indicator 172 May
 Instrument, vibration test 127 Apr
 Integrator, current, for spot welder 157 Aug
 Interaction between antennas 182D Jan
 Inter-carrier sound, sampling detector 138 Aug
 Interference filter, magnetostrictive 188D Dec
 Interlace, precision radar ppi 168 May
 Internal shielding effects on bulb temperature, Mark & MacGee, Jr. 204D Feb
 International Geophysical year, electronics for 138 Dec
 International time and frequency transmission 194D Sept
 Inverter, controlled firing time 164 Feb
 Ionosphere, see also propagation
 Ionospheric propagation, transhorizon 154 May
 Ionosphere scatter symposium 180D Jan
 Ionosphere, ultrasonic artificial 171 July
 Irradiated polyethylene high-temperature dielectric 146 May
 Isocho circuit for weather radar 147 Feb

Gage controls cigarette machine 144 Nov
 Gage, noncontacting thickness 171 Mar
 Gain chart for transistor amplifiers, Myers 224 Oct
 Gain, higher pentode 190D July
 Gamma rays preserve meat 192D Jan
 Gas detector, photoelectric 188D July
 Gas discharge tube, see tubes
 Gas particles, counter for 188 Mar
 Gas tube binary adder 196D June
 Gas tube, breakdown in 176D Jan
 Gas tube, grid switched, display 154 Aug
 Gas tubes protect high-power transmitters, Parker & Hoover 144 Jan
 Gate selects pulses for spectrum analysis, Ross & Simon 179 Aug
 Gate, transistor computer circuits 160 May
 Gear gage controls automatic hobber, Miles 140 July
 Germanium, see also transistors
 Germanium, ultrasonic machining 132 Jan
 Generator, signal, see also oscillator
 Generator, 500-kc sweep 186D Feb
 Generator, analog function 178 Oct
 Generator, color signal 170 Sept
 Generator, delay-line pulse 196D Jan
 Generator, half-sine pulse 176 Sept
 Generator, noise 134 Apr
 Generator, phase, for tropospheric research 220 Oct
 Generator, pulsed-light 200D Aug
 Generator, pulse for linear accelerator 160 June
 Generator, staircase waveform 192D Feb
 Generator, time signal 179 Mar
 Generator, transistor radar target 179 May
 Germany's first radio telescope 144D Dec
 Glass (Special Report: Materials for electronics) 200 Oct
 Glo-balls measure electric fields, Salisbury 206D Aug
 Glossary of telemetering terms 153 Apr
 Glow tube capacitor 158 Jan
 Grainless coating for crt screen 208D Sept
 Grid-switched gas tube for display presentation, Maynard, Carluccio & Polestra 154 Aug

Iconoscope, Scenioscope tv tube 210D Apr
 IGY, electronics for 138 Dec
 Image intensified x-ray 182D June
 Impedance, equivalent R-Z chart 170 June
 Impedance, measuring power-supply 206D June
 Indicator, tv modulation 172 May
 Inductors, ferrite, tune panoramic receiver 169 Aug
 Industrial applications, flux-gate hardness tester 142 Apr
 Industrial applications, noncontacting hardness tester 171 Mar
 Infrared detector, regulator stabilizes 160 July
 Infrared oil-film camera shows heat patterns 190D Apr
 Impact grinding, ultrasonic 132 Jan
 Impedance nomograph, characteristic of eccentric line 190 Sept
 Impedance plotter, automatic, for waveguide 184 Mar
 Impedance, slab line nomograph 192 Sept
 Industrial x-ray shows in daylight 182D June
 Input device, character reader 132 Feb
 Input-output devices, computer 142 Sept
 Input transducers for telemetering 153 Apr
 Inspection, automatic, for magnetic tape prints 164 Mar
 Instrument, see also measuring equipment
 Instrument, antenna for field-intensity meter 130 Feb
 Instrument, audio-frequency meter 216D Apr
 Instrument, color-signal generator 170 Sept
 Instrument, delay-line pulse generator 196D Jan

Japan, transistor circuits in 120 July
 Jeep radio increases communications span 206D Mar
 Jet exhaust temperature indicator 143 Dec
 Junction Transistor, see also transistor
 Junction transistor, high-frequency diffused 137 Feb
 Kelleher lens, designing 138 June
 Kinescope, lenticular film for 190D Apr
 Klystron, see also tube
 Klystron, nomicrophonic 238D Oct
 Klystron oscillator, one knob tunes 186 Sept
 Klystron, ssb technique using power 180 Dec

Machine-tool control, gear gage...140 July
 Machine tool, electronic controls for...122 Feb
 Machine tool, ultrasonic...132 Jan
Machining Techniques
 Aluminum hole-filler...252D Jan
 Automatic cutoff machine shears square tubing...232D Nov
 Automatic dicer for germanium slabs...250D Nov
 Capacitor-discharge welder uses off-set electrode...266D Aug
 Coining saves \$74,000 on waveguide flanges...236 July
 Corner castings eliminate tubing welds...238D Nov
 Cutting nonlinear screws for permeability tuners...250D Dec
 Making plastic reflectors for microwave antennas, Guildersleeve...244 Feb
 Milling silver inserts in plastic relay bases, Camp...300D Mar
 Piloted deburring tools clean punched socket holes in chassis, Ives...214D June
 Punch press guard...260D Nov
 Salvaging platinum from rejected contact springs...232D Nov
 Sandblasting rotors...266D May
 Shaft-spinning setup...264D May
 Ultrasonic welding...264D Nov
 Wire brush on drill cleans metal for good gounding...218 July
Magnet, manganese-bismuth...196D Aug
Magnetic amplifier, self-balancing servo...196 Mar
Magnetic amplifier, transient-controlled...176 Aug
Magnetic amplifier two-speed servo system, Suozzi...140 Feb
Magnetic amplifier, used in computer...138 July
Magnetic-core analog multiplier, transistor...160 Oct
Magnetic devices replace tubes...210D Nov
Magnetic head has megacycle range, Koreael...172 Nov
Magnetic materials (Special Report: Materials for electronics)...204 Oct
Magnetic-core memory, transistor...210D Sept
Magnetic shift-register correlator, Kelnor & Glauberman...172 Aug
Magnetic storm alarm...196D July
Magnetic-switch B-H loop tracer, Geyger...167 Oct
Magnetic-switch transient analyzer, Geyger...150 Jan
Magnetic tape, see also record, tape recording
Magnetic tape, inspection of prints...164 Mar
Magnetometer, flux gate, hardness tester...142 Apr
Magnetostriction filter cuts interference...188D Dec
Magnetron, see also tube
Magnetron, coupled cavity tunes x-band...182 Mar
Magnetron switching tube...122 Apr
Magnetron tester detects lost pulses, Koustas & Mawhinney...164 Aug
Maintenance manual, what to emphasize in...150 Sept
Manganese-bismuth magnets in production...196D Aug
Manipulator sees with 3-D tv...200D Nov
Manual, transmitting tube...218D Sept
Manual, what to emphasize in maintenance...150 Sept
Marine weather station...196D May
Marker, time, for oscillograph...154 July
Materials for electronics, Markus & Findlay...185 Oct
Materials, manganese-bismuth magnet...196D Aug
Matrix, ferrite-core memory...158 Feb
Maxwell lens, designing...138 June
Meacham-bridge oscillator, transistor...193 Mar
Measurement, electronic, in process industries...138 May
Measuring equipment, automatic impedance plotter...184 Mar
Measuring equipment, digital voltmeter...148 Jan
Measuring equipment, frequency, for bevatron...182 May
Measuring equipment, jet exhaust temperature...143 Dec
Measuring equipment, magnetic amplifier transient analyzer...150 Jan
Measuring equipment, meter adapter for blind...202D May
Measuring equipment, noise...162 May
Measuring equipment, phase at r-f and video frequencies...138 Jan
Measuring equipment, phase shifter test power meters...156 Jan
Measuring equipment, transistorized vibration...127 Apr
Measuring equipment, tv modulation...172 May
Measuring equipment, voltage tolerance...150 Feb
Measuring equipment, wide-range futter and vvm meter...152 July
Measuring instrument, direct reading velocity meter...246D Oct
Measuring instrument, magnetic-switch B-H loop tracer...167 Oct
Measuring instrument, time-voltage discriminator...178D Feb

Measuring phase at r-f and video frequencies, Yu...138 Jan
 Measuring r-f parameters of junction transistors, Coffey...152 Feb
 Measuring trucks weight...142 Jan
 Meat preserved by gamma radiation...192D Jan
Mechanically tuned radar afc...138 Apr
Medical electronics, cardioscope checks heart...194 Sept
Medical electronics, electrogastragraph...186D Dec
Medical electronics, pallometer for patient sensitivity...198D Nov
Medical electronics, stethograph for heart sounds...194D Jan
Meltback process increases transistor failure...190D Aug
Memory, computer alters own...178D Jan
Memory cores, ferrite...192D Dec
Memory, designing computer storage...126 July
Memory, ferrite-core...158 Feb
Memory, neon-tube digital...162 July
Memory, transistor magnetic-core...210D Sept
Memory unit, gas tube...220D Aug
Metal ceramic miniatures...220D Aug
Metal detector, for tack in shoes...144 Feb
Metal identification by thermocouple effect...192D May
Metal noncontacting (thickness gage for nonferrous)...171 Mar
Metals and chemicals (Special Report: Materials for electronics)...208 Oct
Meteorology, duct effects...184D July
Meteorology, robot weather station...196D May
Meteorology, three-band storm radar...230D Oct
Meteorology, transosonde weather balloon...164 Nov
Meteorology, weather radar probes storms...174D June
Meter see also test instrument, measuring equipment
Meter for flutter and wow...152 July
Meter, antenna for field intensity...130 Feb
Meter, direct-reading velocity...246D Oct
Meter adapter for blind technicians, Atkin, Bickel & Proscia...202D May
Meter, micrometer frequency...216D Apr
Meter, transistor audio frequency...178 Nov
Meter, transistor vibration...127 Apr
Microammeter measures frequency...216D Apr
Microimage file, automatic...196D Sept
Microphone, transistor dynamic...216D Nov
Microwave, automatic plotter for waveguide impedance...184 Mar
Microwave, cavity tuned x-band magnetron...182 Mar
Microwave, curved passive reflector...206D Dec
Microwave lens, designing dielectric...138 June
Microwave, nonmicrophonic klystron...238D Oct
Microwave, one knob tunes klystron oscillator...186 Sept
Microwave refractometer predicts propagation, Crain & Williams...150 Dec
Microwave, retarding field oscillator...196D Nov
Microwave search receiver, personal...164 June
Microwave, slab line impedance nomogram, slide rule computation of guide wavelength...192 Sept
Microwave spectroheliograph...208D July
Microwave, subcarrier switch for travel-wave tube applications...144 Apr
Military communications, transistorized mobile receiver...217 Oct
Military electronics, Army's first semiconductor equipment...188D Apr
Military electronics, ceramic tube, jeep...194D May
Military electronics, long-range jeep radio...206D Mar
Military electronics, high-speed printer for weapons testing...166 Sept
Military electronics, missile fuel cut-off control...126 Jan
Military electronics, missile telemetering...134 June
Military electronics, Nike display...194D May
Military electronics, Radar net uses centralized control...168 Mar
Military electronics, transistor amplifier for telephone...178D Jan
Military electronics, transistors telemeter small missile...145 July
Military electronics, voice-powered transmitter...226D Mar
Millimeter wave, retarding field oscillator generates...196D Nov
Miniature equipment, cooling...152 Oct
Miniaturized Amplifier...254D Oct
Minitrack transmitter...194D Nov
Missile, fuel cut-off control...126 Jan
Missile launching, tester simulates...200D Nov
Missile research, supersonic gun for...176D Feb
Missile telemetering, shipboard...134 June
Mobile f-m, transistor receiver...158 Nov
Mobile radio, ssb...185D Jan
Mobile tower for tv remotes, Mitchell...206D Apr
Mobile transistorized receiver...217 Oct
Modern telephone pole...202D Nov
Modulation, delta, transmitter using...164 Oct
Modulation indicator for tv...172 May

Modulation monitor, receiver calibrates...266D Oct
 Modulation, pulse code, restoring...148 July
Modulator, transistor, airborne recording...166 June
Modulator, vibrating capacitor...158 June
Monitor, mobile tv...188D Jan
Monitor, receiver calibrates tv modulation...266D Oct
Motion picture film, inspection of magnetic recording on...164 Mar
Moving target simulator for radar net...181 Apr
Multipath simulator tests communications, Deuth, Ressler, Smith & Stamps...171 July
Multiplex f-m broadcast...130 June
Multiplexer using beam switching tube...122 Apr
Multiplexing, exciters for f-m carrier...148 Aug
Multiplier, transistor-magnetic core analog...160 Oct
Multiplier, triangular wave, for computer...182 Aug
Multiprogram f-m broadcast system, Hershfield...130 June
Multivibrator 500-kc sweep circuits, Fleming...186D Feb
Narrow-band telemetering receiver...174 May
Navigation, radio compass uses beam deflection tube...166 May
Navigation receiver, Navy air...182D June
Navy Missile Launcher...162 July
Neon-tube digital storage...158 Jan
Neon tube, gas dielectric capacitor...188D July
Nerve gas, photoelectric sampler...188D July
New applications for beam switching tubes, Bethke...122 Apr
Nike Display system...194D May
Noise generator, radar simulator...170 Oct
Noise Series, characteristics and origins...154 Mar
Noise series, designing low-noise equipment...154 June
Noise series, generating equipment...134 Apr
Noise series, reducing noise in communications systems...148 July
Noise series, techniques for measuring...162 May
Noise, silencer kills audio peaks...156 Feb
Nomograph, eccentric-line impedance...190 Sept
Nomograph, radar performance...184 Dec
Nomograph, radar second detector filter...188 May
Nomograph, resistance-impedance...170 June
Nomograph, slab line...192 Sept
Noncontacting gages for nonferrous metals, Colten...171 Mar
Nonferrous metal, thickness gage for...171 Mar
Nonmicrophonic klystron, LaPlante...238D Oct
Normalized filter design, Bedrosian & McCoy, Jr....200 Mar
Nuclear research, atomic reactor tv camera...212D May
Nuclear research, bevatron frequency measuring system...182 May
Nuclear research, bevatron magnet pulse timing...160 June
Nuclear research, biasing accelerator amplifiers...141 Jan
Nuclear research, color tv monitors...214D May
Nuclear research, irradiated polyethylene dielectric...146 May
Nuclear research, meat preservation by radiation...192D Jan
Nuclear microscope for proton measurement...174D Feb
Number reader, magnetic-shift register...172 Aug

One-third watt phonograph amplifier
 McCarthy 202D Sept
 One-way waveguide correspondence
 218D May
 Operational amplifier has chopper stabil-
 ization, Robinson 182 Sept
 Origin of noise 154 Mar
 Oscillator, accelerometer uses r-f 151 Aug
 Oscillator, local, for S-band radar 179 Sept
 Oscillator, one knob tunes klystron 186 Sept
 Oscillator, retarding field 196D Nov
 Oscillator, stable variable frequency
 230D Sept
 Oscillator, superregenerative transistor
 166 July
 Oscillator, transistor Meacham bridge
 193 Mar
 Oscilloscope, timer codes 154 July
 Oscilloscope probe, video low-capacitance
 194D Apr
 Oscilloscope, signal triggered sweep
 for pulses 146 Apr
 Oscilloscope, 500-kc sweep circuit 186D Feb
 Output-input devices, computer 142 Sept
 Output indicators for telemetering 153 Apr
 Output stage, tube driven transistor
 178D June
Over-horizon propagation, see also forward scatter, propagation
 Over-horizon propagation symposium
 180D Jan
 Overseas aircraft get printed weather
 192D Nov
 Oven, crystal 208D May

P

Pads, see attenuators
 Paging receiver uses two tubes 184D Jan
 Paging system, radio 182D July
 Pallometer determines patient sensitivity
 198D Nov
 Panoramic receiver, ferrite inductors
 tune 169 Aug
 Parallel resistance and impedance
 chart 170 June
 Particle counter, for gases 183 Mar
 Party-line, for microwave 175 Nov
 Passive reflector 204D Dec
 Pattern generator, grid switched gas
 tube 154 Aug
 Pentode gain, higher 190D July
 Performance nomograph, radar 184 Dec
 Permanent-writing cathode-ray re-
 corder, Henick, Wohl, & Andrews
 148 Apr
 Personal microwave search receiver
 Herman 164 June
 Pertinent patents, Chaffin 198D Jan
 234D Mar, 226D May, 208D June,
 222D Aug, 218D Nov, 219D Dec
 Petroleum, electronics in, industry 138 May
 Phase detector for synchro alignment,
 Copper 204D July
 Phase detector, three, for color tv
 receiver 157 Oct
 Phase measurement, video and r-f 138 Jan
 Phase shifter circuits test power
 meters, Rao 214D Apr
 Phonetic alphabet changes 156 Jan
 Phonograph amplifier, quasi-comple-
 mentary transistor 173 Sept
 Phonograph amplifier, transistor 202D Sept
 Photocell, cadmium oxide cover elec-
 trodes 196D July
 Photocontrol prevents motorist blind-
 ness 186D Jan
 Photoelectric analog function gen-
 erator, Sinker 178 Oct
 Photoelectric sampler detects nerve
 gas 188D July
 Phase generator for tropospheric re-
 search, Hubbard & Thompson, Jr 220 Oct
 Photography, camera exposure adjusts
 automatically 202D July
 Photography, counters control high
 speed flash 160 Aug
 Photography, rapid closing electronic
 shutter 194D June
 Photography, universal shutter tester
 162 Feb
 Pickup in twisted-pair cable 170 Feb
 Picture tube, electron optics for
 Apple type 210D Mar
 Picture tube, one-gun color 150 June
 Pipe flaw detector 204D Dec
 Plant research, pulsed-light generator
 200D Aug
 Plastics (Special Report: Materials
 for electronics) 210 Oct
 Plotter, automatic waveguide im-
 pedance 184 Mar
 Plug-in antenna 178D Feb

Plug-in controls 204D Nov
 Polar relays, quieting 210D Nov
 Polycathode tube, applications 122 Apr
 Polyethylene, irradiated high-temper-
 ature dielectric 146 May
 Portable color-signal generator, Pop-
 kin-Gurman 170 Sept
 Portable record player 220 Dec
 Potentiometer, self-balancing vtvm
 148 Jan
 Potentiometer tachometer has high
 sensitivity, Pavalow & Davidson
 156 Sept
 Power factor meter, tester for 156 Jan
 Power supply, crt transistor oscillator
 162 Sept
 Power supply, design of transistor
 168 Nov
 Power-supply impedance, measuring
 206D June
 Power transformer design charts, Lee
 & Mullinix 184 Apr
 Power transistor used in servo ampli-
 fier 153 Sept
 Power supply, transistorized regu-
 lated 169 Dec
Pre-amplifier, see also amplifier
 Pre-amplifier, transformerless line out-
 put 198D Aug
 Pre-amplifier, transistor servo 168 Feb
Printed Circuit Techniques
 Automatic circuit-plating machine
 234D May
 Changing insertion heads on assem-
 bly machine 244D Apr
 Cutting and clinching machine for
 etched wiring boards 224D Apr
 Drilling template for etched wiring
 boards 228D Feb
 Etched wiring boards have resistiv-
 ity problem 239D Apr
 Hole sizes for etched-wiring boards
 282D May
 Hot staking of eyelets on printed
 wiring boards 274D Dec
 Jumper-inserting head for assembly
 machine 262D May
 Machine drills holes and inserts
 components 296D Mar
 Making connections to etched-wiring
 boards 268D May
 Mounting wiring boards on color
 tv chassis 242D Apr
 Press pushes sockets into etched-
 wiring board 244D Mar
 Pre-tinning techniques for etched
 wiring, Martin & Vavra 234D Jan
 Producing inkless drawings for
 etched-wiring patterns, Pennie
 228D Jan
 Quick-drying resist for etched wir-
 ing 248D Dec
 Roller-coater tins printed wiring
 boards 212D June
 Single-station machine inserts forty
 parts 264D Dec
 Socket-inserting head for automatic
 assembly machine 246D Mar
 Solenoids connect etched wiring
 board 230D Apr
 Ultrasonic cleaner for etched wiring
 boards 242D June
 Probe, low-capacitance video 194D Apr
Process control, see also automatic control
 Process control, electronic 138 May
 Production line testing of capacitor
 146 Aug
 Program, international time and fre-
 quency 194D Sept
 Projectile flight timer, high-speed
 printer for 166 Sept
 Proof of performance for tv broad-
 casters, Sexton 150 Nov
 Propagation, field studies of mech-
 anism 192D Nov
 Propagation, microwave refractom-
 eter predicts 150 Dec
 Propagation, multipath simulator 171 July
 Propagation, phase generator for
 tropospheric research 220 Oct
 Propagation of vhf and uhf tv sig-
 nals 174D Feb
 Propagation, transhorizon 154 May
 Propagation, scatter symposium 180D Jan
 Proton measurement uses new nuclear
 microscope 174D Feb
 Printer, high speed 166 Sept
 Pulse analysis, sweep circuit for 146 Apr
 Pulse circuits fabricate computer code
 disk, Jones 146 June
 Pulse circuit, low-capacitance probe
 for 194D Apr
 Pulse counter, direct reading 194D Dec
 Pulse discriminator, time-voltage 178D Feb
Pulse Generator, see also Generator
 Pulse generator, delay-line 196D Jan
 Pulse generator, for bevatron 160 June
 Pulse generator, half-sine 176 Sept
 Pulse, magnetron tester detects lost
 164 Aug
 Pulse modulation, transmitter using
 delta 144 Oct
 Pulse selector for spectrum analyzer
 179 Aug
 Pulse timing, bevatron magnet 160 June
 Pulse light generator aids plant re-
 search, Trehaner, Nosker & Ram-
 bow 200D Aug
 Pulsed-tone speed indicator 176D Feb
 Punched-card reader for the blind,
 Dado, Proscia & Raphael 148 Nov
 Push-pull transistor servo amplifier,
 Henszey 155 Dec
 PWM telemetering receiver 174 May

Q

Quasi-complementary transistor am-
 plifier, Lin 173 Sept
 Quieting polar relays 210D Nov

R

Radar a/c system uses mechanical
 tuning, Conalone & Rambo 138 Apr
 Radar, airborne weather isoecho 147 Feb
 Radar detector, personal 164 June
 Radar, klystron oscillator for 186 Sept
 Radar, nonmicrophonic klystron 238D Oct
 Radar performance nomograph,
 Wolf 182 Dec
 Radar ppi display uses precision inter-
 face, Shulman 168 May
 Radar second detector filter nomo-
 graph, Young 188 May
 Radar simulator for laboratory use,
 Bickel and Bernstein 170 Oct
 Radar simulator, three dimensional
 131 July
 Radar simulator trains master crews,
 Oberle 155 Nov
 Radar simulator, transistor 179 May
 Radar simulator, variable delay line
 143 June
 Radar, stable local oscillator 179 Sept
 Radar, storage tube projects ppi dis-
 play 172 Dec
 Radar, storage-tube simulates, net 181 Apr
 Radar, three-band storm 230D Oct
Radiation, see propagation
 Radiation field, components in 202D Nov
Radio, see also communications, broadcast
 Radio astronomy, German tele-
 scope 194D Dec
 Radio communication through long
 tunnels 194D Nov
 Radio compass uses beam deflection
 tube 166 May
 Radio, evaluation of citizens 185D Jan
 Radio, Japanese transistor portable
 120 July
 Radio paging eliminates public address
 182D July
 Radio system controls railroad in
 Venezuela, Sheffield 158 Dec
 Radio, tube-transistor automobile
 178D June
 Radar video, transistor amplifier for
 142 Aug
 Radar, wamoscope 232D Oct
 Radar warning net uses centralized
 control, Lombardo 168 Mar
 Radar, weather 174D June
 Railroad, radio system for 158 Dec
 Reader, character, for business ma-
 chines 132 Feb
 Reader, code, for documents 164 Dec
 Reader, punch-card, for blind 148 Nov
 Readout device, high-speed printer
 166 Sept
 Reducing noise in communications
 systems—Part V, Bennett 148 July
Receivers, see also f-m television
 Receiver, air navigation used by Navy
 198D Nov
 Receiver calibrates tv modulation
 monitors, Lambert, Jr 264D Oct
 Receiver, ferrite inductors tune para-
 oramic 169 Aug
 Receiver, Japanese transistor portable
 120 July
 Receiver, multiplex f-m broadcast
 130 June
 Receiver, paging 184D Jan
 Receiver, personal microwave search
 164 June
 Receiver, sampling detector for inter-
 carrier 138 Aug
 Receiver, telemetering 174 May
 Receiver, television, uses one-gun color
 tube 150 June
 Receiver, three-phase detector for
 color tv 157 Oct
 Receiver, transistor broadcast 180D Jan
 Receiver, transistor broadcast 190D Dec
 Receiver, transistor mobile f-m 158 Nov
 Receiver, transistorized mobile 217 Oct
 Recorder amplifier for flight testing,
 Pine 158 Aug
 Recorder, cathode ray permanent
 writing 148 Apr
 Recorder, tape, Japanese transistor
 portable 120 July
 Recorder, transistor modulator for
 airborne 166 June
 Recorder, video tape 194D July
 Recording, automatic inspection of
 magnetic tape prints 164 Mar
 Recording head, one megacycle 172 Nov
 Recording, tape double response of
 disk 125 July
 Recording, time compressor for tape
 184D June
 Recording, timer codes oscilloscope
 154 July
 Recording, time signal for 179 Mar
 Recording, wide-range meter for

flutter and wow 152 July
 Reference sheet, bandwidth-rise time 188 Nov
 Reference sheet, radar performance nomograph 184 Dec
 Reference sheet, tuned-transformer design chart 182 Nov
 Reference sheet, eccentric-line impedance 190 Sept
 Reference sheet, slab line nomograph 192 Sept
 Reference sheet, gain chart for transistor amplifier 224 Oct
 Reference sheet, power transformer design 184 Apr
 Reference sheet, normalized filter design 200 Mar
 Reference sheet, selective cathode trap 174 July
 Reference sheet, pickup in twisted-pair cable 170 Feb
 Reference sheet, triple-tuned circuit design 186 Aug
 Reference sheet, transistor characteristics 161 Jan
 Reference sheet, radar second detector filter nomograph 188 May
 Reference sheet, equivalent R-Z chart 170 June
Reflector, see also antenna
 Reflector, curve passive 206D Dec
 Refractometer, microwave, predicts propagation 150 Dec
 Regulated power supply, transistor 169 Dec
 Regulated transistor power supply design, Keller 168 Nov
 Regulating voltage with transistors 212D Mar
 Regulating amplifier corrects slope and level, Chaskin & Kimball 168 July
 Regulation, thyatron inverter 164 Feb
 Regulation, video amplifier using shunt 166 Nov
 Regulator stabilizes infrared detector, Weisbecker 160 July
 Regulator transistor voltage 212D Mar
 Regulator tube, stabilizing 218D Sept
 Relay, quieting polar 210D Nov
Remote control, see also Telemetering
 Remote control, missile fuel cut-off 126 Jan
 Remote pickup amplifier, transistorized 122 Jan
 Remote pickup, low-cost amplifier for 192D May
 Repeater, servo regulated 168 July
 Repeater, transistor telephone 178D Jan
 Research Publication 188D July
 Resistance-impedance chart 170 June
 Response curves, universal 184 Dec
 Restoring pulse-code modulation 148 July
Resistor Production Techniques
 Air-leak gages check potentiometer casings 256D May
 Checking linearity of shaped resistor cards 246D Apr
 Continuous furnace cures tape resistors 250D Sept
 Hydraulic press prints resistors on copper-clad phenolics 216D June
 Machines speed cutting of resistor leads for etched wiring 216D Jan
 Servo-controlled winding machines for precision potentiometers 280D Mar
 Servo-wound pots, Magnani & Czechanek 276D Mar
 Spraying molten metal on resistance cards 264D Apr
 Turn-finding welder for potentiometer taps 258D Apr
 Retarding field oscillator generates millimeter waves 196D Nov
 R-F oscillator for servo accelerometer 151 Aug
 R-F parameters, measuring junction transistor 152 Feb
 R-F phase measurement 128 Jan
 Ringing converter, transistor 216D Dec
 Rise time, chart for bandwidth 188 Nov
 Robot station telemeters weather 196D May
 Rural telephone service, carrier 182 Oct

Scale weighs moving trucks, Thurston 142 Jan
 Scatter ssb technique uses power klystron, Badger 176 Dec
 Scatter symposium 180D Jan
 Scenioscope tv tube 210D Apr
 Screen, cathode-ray tube, grainless 208D Sept
 Search receiver, microwave 164 June
 Second detector filter, nomograph for radar 188 May
 Selective cathode trap design chart 174 July
 Selector, pulse, for spectrum analyzer 179 Aug
 Self-balancing magnetic servo amplifier, Geyger 196 Mar
Semiconductor, see also diode, transistor, etc.
 Semiconductor, high-frequency transistor 137 Feb
 Semiconductor, improved transistor process 176D Feb
 Sensitive potentiometer tachometer 156 Sept
 Servo accelerometer uses r-f oscillator, Corey 151 Aug
 Servo amplifier, push-pull transistor 155 Dec
 Servo amplifier, self-balancing magnetic 196 Mar
 Servo amplifiers use power transistors, Benton 153 Sept
 Servo amplifier uses silicon power transistors, Lacy & Davis 136 Jan
 Servo control tuning for transmitter 134 July
 Servo regulated telephone amplifier 168 July
 Servo system, magnetic amplifier two speed 140 Feb
 Servo system, mechanically tuned radar, etc. 138 Apr
 Servo, transistor-diode stabilizer for 174 Oct
 Servo, transistor preamplifier for 168 Feb
 Shutter, rapid closing electronic 194D June
 Shift-register, number reader 172 Aug
 Shipboard telemetering for terrier missiles Bell & Schultz 134 June
 Shoes, tack detector for 144 Feb
 Shock-velocity measurement 178D July
 Shutter tester, camera 162 Feb
Signal generator, see also generator, oscillator
 Signal generator, color 170 Sept
 Signal generator, time 179 Mar
 Signal source, d-c test 198D Feb
 Signal-triggered sweep magnifies pulse widths, Kuehn 146 Apr
 Signaling methods for telemetering 153 Apr
 Silencer kills audio output on noise peaks, Gerlach 156 Feb
Silicon transistor, see also transistor
 Silicon transistor servo amplifier 136 Jan
 Silicon, ultrasonic machining 132 Jan
 Simple circuit measures power-supply impedance, street 208D June
 Simplified analog computer, Corey 128 Jan
 Simplified transistor broadcast receiver 190D Dec
 Simulator, crew training with radar 155 Nov
 Simulator, delay-line radar 143 June
 Simulator, multipath communications 171 July
 Simulator, radar, for laboratory use 170 Oct
 Simulator, radar net 181 Apr
 Simulator, three-dimensional radar 181 July
 Simulator, transistor radar 179 May
 Single sideband, converter for twin 214D Mar
 Single sideband, klystron scatter technique 180 Dec
 Single-sideband mobile radio 185D Jan
 Single triode flip-flop 230D Mar
 Slab line nomograph, Sion 192 Sept
 Slide-rule computation of guide wavelength, Vinding 196D Feb
 Slow scan tv described at wescon 288D Oct
 Slow-sweep tv for closed circuit use, Ennes 140 Nov
 Solar battery, propulsion by 190D Aug
Soldering Techniques
 Applying tinning compound with felt rollers 232D Feb
 Dip-soldering VHF television tuner wafers 302D Oct
 Induction soldering on conveyor line 244D Aug
 Motorized solder wheel for capacitor leads 222 July
 Solder-loaded grinder tins ceramics 243D May
 Tightening screws through soldering iron 252D Mar
 Ultrasonic unit combines stripping and soldering 238 July
Solders and Fluxes (Special Report: Materials for electronics) 216 Oct
 Solid electrolyte tantalum capacitor 176 Oct
 Solid state, see diodes transistor
Sound, see also audio
 Sound system, 3000 watt 162 Nov
 Sound, electrostatic loudspeaker 208 Mar
 Sound recording, inspection of magnetic prints 164 Mar
 Sound, sampling detector for intercarrier 138 Aug
 Source, noise 134 Apr
 South Africa time signals 190D Jan
 Special report: materials for electronics 185 Oct
 Special Report: Telemetering 153 Apr
 Spectroheliograph, microwave 208D July
 Spectrum analysis, gate selects pulse for 179 Aug

Speed, direct-reading velocity meter 246D Oct
 Speed measurement, potentiometer tachometer 156 Sept
 Spot-welder, controller integrates current 157 Aug
 Spurious response, universal curves for 184 Dec
 Square loop ferrites used in memory toroids 192D Dec
SSB, see single-sideband
 Stabilized operational amplifier, chopper 182 Sept
 Stabilizer, transistor-diode, for servo 174 Oct
 Stabilizing v-r tubes, Tomer 218D Sept
 Stabilizing infrared detector 160 July
 Stable local oscillator for S-band radar, Dauksher, WVV 179 Sept
 Standard signals, WWV 192D Apr
 Sterilization of meat by gamma rays 192D Jan
 Stethograph for heart sounds 194D Jan
 Storage devices, designing computer 126 July
 Storage, ferrite-core memory 158 Feb
 Storage, microimage data 196D Sept
 Storage, neon-tube digital 162 July
 Storage, transistor magnetic-core data 210 Sept
 Storage-tube device simulates radar net, Shenfeld & Finkle 181 Apr
 Storage tube projects radar ppi display, Gates 172 Dec
 Storage unit, gas tube 196D June
 Storms, weather radar probes 174D June
 Subcarrier switch for microwave party line, Harris 175 Nov
 Superregenerative paging receiver 184D Jan
 Superregenerative transistor oscillator, Kircher & Kaminow 166 July
Supersonic, see ultrasonic
 Supersonic gun aids missile research 176D Feb
 Suppressor, noise, for audio 156 Feb
 Surface barrier transistor used in counter 174 Mar
 Sweep circuit, 500-kc multivibrator 186D Feb
 Sweep circuit magnifies pulse width 146 Apr
 Switching tube, magnetron 122 Apr
 Synchro alignment, phase detector for 204D July

Tuning, automatic, for high-power transmitter 134 July
 Tuning, ferrite inductors, for panoramic receiver 169 Aug
 Tuning, x-band magnetron has coupled cavity 182 Mar
 Tunnel light control 186D Jan
TV, see television
 TV modulation indicator uses electronic chopper, Tink 172 May
 Twin single-sideband converter 214D Mar
 Twisted pair cable, pickup in 170 Feb
 Tachometer, high-sensitivity potentiometer 156 Sept
 Tack detector for shoe production, Bradley 144 Feb
 Taking the heat off miniature equipment, Welsh 152 Oct
 Talking hat combat radio 236D Sept
 Tantalum capacitors use solid electrolyte, McLean 176 Oct
 Tape, automatic inspection of magnetic prints 164 Mar
 Tape doubles response of disk recorders, Gilson 125 July
 Tape recorder, Japanese transistor portable 120 July
 Tape recorder, video 198D July
 Tape recorder, transistor modulator for airborne 166 June
 Tape recording, flutter and wow meter 152 July
 Tape recording, one megacycle 172 Nov
 Tape recording time compressor 184D June
 Target simulator, delay-line radar 143 June
 Technical writing, maintenance manuals 150 Sept
 Techniques for measuring noise—Part III, Bennett 162 May

- Telemetering demodulator for wide-band f-m data, Warzecha 157 July
- Telemetering—Electronic data transmission, McKenzie & Manogian, 153 Apr
- Telemetering, robot station weather 196D May
- Telemetering receiver conserves bandwidth, Redden, Jr., & Zancanata 174 May
- Telemetering, shipboard, for guided missiles 134 June
- Telemetering systems 153 Apr
- Telemetering, transistor system for small missiles 145 July
- Telemetering transmitter using delta modulation 164 Oct
- Telephone amplifier, servo regulated 168 July
- Telephone cable for Hawaii 188D Jan
- Telephone, carrier, for rural service 182 Oct
- Telephone, transistor exchange 192D Dec
- Telephone, transistors lighten amplifier for field 18D Jan
- Teletypewriter, automatic transcontinental 180D June
- Telescope, radio 194D Dec
- Television, airborne reconnaissance 208D Nov
- Television, broadcast switching system for 147 Dec
- Television, camera for reactor 212D May
- Television, color-signal generator 170 Sept
- Television, correction for color transmitter 130 Apr
- Television, manipulator sees with 3-D 200D Nov
- Television repeater, transistor high voltage supply 162 Sept
- Television, receiver calibrates modulation monitors 265D Oct
- Television receiver uses one-gun color crt 150 June
- Television, mobile tower for remote 204D Apr
- Television modulation indicator 172 May
- Television, nuclear separation monitored by color 214D May
- Television, pickup in twisted-pair cable 170 Feb
- Television, plug-in antenna 178D Feb
- Television Production Techniques**
- Assembling targets for image orthicons 278D May
- Corona resistance test for TV anode cups 280D Sept
- Dual-tube aluminumizers for tv picture tubes 22D June
- Television, proof of performance 150 Nov
- Television, propagation of vhf and uhf 174D Feb
- Television, sampling detector for inter-carrier sound 138 Aug
- Television, scintoscope tv tube 210D Apr
- Television, shunt regulated video amplifier 166 Nov
- Television, slow scan 288 Oct
- Television, slow-scan 140 Nov
- Television, three-phase detector for color 157 Oct
- Television, toroidal video transformer 216D May
- Television, underwater camera 282D Nov
- Television, wamoscope 282D Nov
- Temperature indicator, transistorized 143 Dec
- Tesla centenary honors high-frequency pioneer 180D July
- Test equipment, see also measuring equipment**
- Test equipment, camera shutters 162 Feb
- Test equipment, color-signal generator 170 Sept
- Test equipment for r-f parameters of transistors 152 Feb
- Test equipment, for wattmeters 156 Jan
- Test equipment, flutter and wow meter 152 July
- Test equipment, half-sine pulse generator 176 Sept
- Test equipment, Helmholtz coil, for flow meter 252D Oct
- Test equipment, impedance plotter for waveguide 184 Mar
- Test equipment, low-capacitance video probe 194D Apr
- Test equipment, magnetron, for lost pulses 164 Aug
- Test equipment, measurement of voltage tolerance 150 Feb
- Test equipment, meter adapter for blind 202D May
- Test equipment, multipath simulator 171 July
- Test equipment, phase generator 220 Oct
- Test equipment, radar net simulator 181 Apr
- Test equipment, radar simulator for laboratory 170 Oct
- Test equipment, radar target simulator 179 May
- Test equipment, staircase generator 192D Feb
- Tester, camera shutter 162 Feb
- Tester, hardness, flux-gate magnetometer 142 Apr
- Tester simulates missile launching 200D Nov
- Testing, also see measurement, ultrasonics**
- Testing hardness with flux-gate magnetometer, Isaacs & Grey 142 Apr
- Testing techniques**
- Easily molded adapters extend test bench use 258D Aug
- Lamps indicate errors during wiring of harness boards 218 July
- Life-testing machines for auto radio and television tuners 236D May
- Matching accelerometers with ballistic pendulum 278D Sept
- Motorized tester for waveguide components 282D Sept
- Push-along test line for printed radios 240D June
- Simple centrifuge tests missile components 248D Aug
- Tape-programmed automatic tester for subassemblies 244D Mar
- Testing slide action of pushbuttons for tuner 264D Sept
- Thickness gage for blind 304D Oct
- Test-signal source, d-c 198D Feb
- Temperature, reducing, in miniature equipment 152 Oct
- Temperature, shielding effect on bulb 204D Feb
- Terrain-clearance radar, three dimensional simulator for 131 July
- Thermocouple effect identifies unknown metals 192D May
- Thickness gage, noncontacting 171 Mar
- Three-band storm detection radar 230D Oct
- Three-dimensional radar video simulator, Pieliich 151 July
- Three new transistor circuits, Helsinki 178 Nov
- Three-phase detector for color-tv receivers, Goldberg 157 Oct
- Thyratron, see also tube**
- Thyratron inverter uses controlled firing time, Lawn 164 Feb
- Time compressor, audio 184D June
- Time generator gives direct readout, Blair 179 Mar
- Time, reducing off-air 156 Sept
- Time signals, South African 190D Jan
- Time signals, WWV modifies 192D Apr
- Time standard, WWV transmission 194D Sept
- Time-voltage pulse discriminator, Lowe 178D Feb
- Timer, current-integrating welding 157 Aug
- Timer, camera shutter 162 Feb
- Timing marker for oscillograph 154 July
- Tone keyer, transistor 178 Nov
- Toroids, ferrite memory 192D Dec
- Toroidal transformers pass video bandwith, Gray 150 May
- Tower, for remote tv pickups 206D Apr
- Tracking, helical ground-to-air 161 Mar
- Tracking radar, precision interlace display 168 May
- Trainer, radar crew 155 Nov
- Transformer, design chart for power 184 Apr
- Transformer, design chart for tuned 182 Nov
- Transformer, toroidal video 150 May
- Transformerless line output preamplifier, Turner 198D Aug
- Transhorizon circuit authorized, British scatter terminal 214D May
- Transhorizon communication techniques 154 May
- Transhorizon propagation symposium 180D Jan
- Transhorizon utilization 186D July
- Transient analyzer, magnetic amplifier 150 Jan
- Transient-controlled magnetic amplifier, Schohan 176 Aug
- Transistor amplifier for radar video, Leslie 142 Aug
- Transistor amplifier, gain chart for 294 Oct
- Transistor amplifier, miniature 254D Oct
- Transistor amplifier, quasi-complementary 173 Sept
- Transistor, broadcast receiver 180D Jan
- Transistor characteristics for circuit designers, Schwartz 161 Jan
- Transistor circuitry in Japan 120 July
- Transistor circuits for digital computers, Deutch 160 May
- Transistor, design of power supply using 168 Nov
- Transistor flip-flops have high speed, Rapp & Wong 180 Dec
- Transistor, f-m transmitter 220D Apr
- Transistor generator simulates radar target, Eckess, Deavenport & Sherman 179 May
- Transistor hearing aid 176D June
- Transistor, high-frequency diffusion 137 Feb
- Transistor, high-speed counter uses 174 Mar
- Transistor-magnetic analog multiplier, Keister 160 Oct
- Transistor, measuring v-f parameters of junction circuit 152 Feb
- Transistor, meltback process 190D Aug
- Transistor mobile receiver 217 Oct
- Transistor modulator for airborne recording, Upham, Jr., & Dranetz 166 June
- Transistor oscillator power supply for cro 162 Sept
- Transistor oscillator, superregenerative 166 July
- Transistor output stage, tube driven 178D June
- Transistor phonograph amplifier 202D Sept
- Transistor preamplifier feeds tubeless servo, Zeller 168 Feb
- Transistor preamplifier, line output 198D Aug
- Transistor processing improved 176D Feb
- Transistor, push-pull servo amplifier 155 Dec
- Transistor receiver 176D Jan
- Transistor receiver powered by sun 185D Apr
- Transistor receiver, simplified broadcast 190D Dec
- Transistor, regulated power supply 169 Dec
- Transistor ringing converter 216D Dec
- Transistor servo amplifier 136 Jan
- Transistor, servo amplifier uses 153 Sept
- Transistor, surface barrier, used in counter 174 Mar
- Transistor Techniques**
- Automatic etching of transistor pellets 225 July
- Conveyorized oven bakes resist on boards 220D Jan
- Crystal-slicing lathe reduces germanium waste 246D Sept
- Gelatin mats clean shoes in transistor lab 300D Oct
- Labeling transistors 262D Sept
- Mounting germanium pellets on transistors 252D Sept
- Precision screw drives germanium crystal grower 274D Oct
- Soldering whiskers on transistor pellets 270D Sept
- Split induction coil heats silicon crystals, Soled 140D Jan
- Testing transistors in mass production 278D Oct
- Transistor amplifier packaged in Steatite 272D Oct
- Transistor can welder 254D Aug
- Ultrasonic dicing of germanium 224 July
- Watchmakers assemble transistor-size precision relay 230D Dec
- Transistor telephone exchange 192D Dec
- Transistor telephone repeater 188D Apr
- Transistor, three new circuits 178 Nov
- Transistor vibration meter 127 Apr
- Transistor, voice-powered transmitter 226D Mar
- Transistorized voltage regulator 212D Mar
- Transistorized dynamic microphone 216D Nov
- Transistorized indicator measures jet exhaust, Cole 143 Dec
- Transistorized receiver for mobile f-m, Boothe 158 Nov
- Transistorized regulated power supply, Lillienstein 169 Dec
- Transistorized magnetic-core memory 210D Sept
- Transistorized receiver for vehicular radio, Schwartz 217 Oct
- Transistorizing Meacham-bridge oscillators, Witt 193 Mar
- Transistors and diodes stabilize servos, Gittleman 174 Oct
- Transistors for uhf 230D Oct
- Transistors lighten field telephone repeaters 178D Jan
- Transistors telemeter small missiles, Kortman 145 July
- Transistors up reliability of broadcast remotes, Wulfsberg 122 Jan
- Transmission program for WWV and WWVH 194D Sept
- Transmitter, see also broadcast**
- Transmitter, automatic tuning for high-power 134 July
- Transmitter, correction circuit for color tv 130 Apr
- Transmitter, flash arc protector 144 Jan
- Transmitter, high-temperature ceramic tube for 230D Oct
- Transmitter, minitrack for satellite 196D Nov
- Transmitter, multiplex f-m broadcast 130 June
- Transmitter, reducing off-air time 156 Sept
- Transmitter, voice power 266D Mar
- Transmitting system uses delta modulation, Watson & Hudson 164 Oct
- Transmitting tube manual 218D Sept
- Transsonde monitors inaccessible areas, Cabbage 164 Nov
- Trap design, selective cathode 174 July
- Traveling-wave tube applications 144 Apr
- Trays, for production use**
- Blower-cleaned tote trays for tube grids 219D Jan
- Fiber tote tray is experimental chassis, Amber 220D Jan
- Motorized vertical rack stores 50 tote trays 242D Dec
- Parts-bin ferris wheels permit quick changes of job setups 212D Feb
- Trends in computer input-output devices, Carroll 142 Sept
- Triangular-wave analog multiplier, Meyers & Davis 182 Aug
- Triode, corona 228D Mar
- Triode-pentode bistable circuit 210 July
- Triple-tuned circuit, design of 186 Aug
- Tropospheric propagation symposium 180D Jan
- Tropospheric research, phase generator for 220 Oct
- Trucks, weighing 142 Jan
- Tube, breakdown in gas 176D Jan
- Tube, British corona triode 228D Mar
- Tube, cathode ray, for permanent-writing recorder 148 Apr
- Tube, ceramic military 194D May
- Tube drives transistor output stage 178D June
- Tube information service 214D Apr
- Tube interchangeability 204D Apr
- Tube, metal-ceramic 220D Aug
- Tube, nonmicrophonic klystron 238D Oct

Tube, one-gun color.....150 June

Tube Production Techniques

Basing pencil triodes with epoxy resin, Lichtman & Wells.....246D Jan

Contour projector speeds beam-tube inspection.....294D Oct

Dust-lint control in tube plants; Fondy.....246D June

In-line exhaust for power magnets.....314D Oct

Oval water pan washes tube pins better.....258D Mar

Paper disks identify tube defects.....236D Dec

Rubberized fiber packing protects tube.....270D Nov

Slicing tubes for study.....230D June

Stud welder used in assembling thyratrons, Goldstein.....290D Mar

Tube printer.....242 July

Tumbling tube parts gives precision finish, Kollosch.....266D Mar

Tube, stabilizing v-t.....218D Sept

Tube, storage, projects radar display.....172 Dec

Tube, traveling-wave, applications.144 Apr

Tunable oscillator, one-knob klystron.....186 Sept

Tuned circuit, design of triple.....186 Aug

Tuned transformer, chart for.....182 Nov

Tubes, shielding effect on bulb temperature.....204D Feb

U

UHF, ground-to-air helical antenna.161 Mar

UHF transistor.....230D Oct

Ultrasonic machining of brittle materials, Hartley.....132 Jan

Ultrasonic multipath simulator.....171 July

Underwater tv camera.....216D Nov

Universal response curves, Leon & Weinberger.....184 Dec

Universal shutter tester, Wessel.....162 Feb

Upper atmosphere clutter study on West Coast.....186D Dec

USAF computer uses magnetic amplifiers.....138 July

Using traveling-wave tubes, White..144 Apr

V

Vacuum tube, see tubes

Vacuum-tube voltmeter, digital.....148 Jan

Variable capacitor, gas dielectric.....158 Jan

Variable delay line simulates radar targets, Gitlin.....143 June

Variable frequency oscillator, stable Snyder.....230D Sept

Velocity meter has direct readout, Venezuela railroad, radio for.....246D Oct

VFO with near-crystal stability, Shulman.....230D Sept

VHF transhorizon communication techniques, Ringoen & Smith.....154 May

Vibrating capacitor changes d-c to a-c, Adler.....158 June

Vibration meter uses transistors, Kinkel & Wilson.....127 Apr

Video, see also television

Video modulation indicator.....172 May

Video phase measurement.....138 Jan

Video probe, low-capacitance.....194D Apr

Video tape recorder.....198D July

Video transformer, toroidal.....150 May

Video, transistor amplifier for radar.142 Aug

Video amplifiers use shunt regulation, Jevnes.....166 Nov

Video switching for tv broadcast centers, Pores.....147 Dec

Voice powers transmitter.....266D Mar

Voltage and current controller.....208D Feb

Voltage divider, compensating for frequency.....194D Aug

Voltage-regulating tube, stabilizing.....218D Sept

Voltage regulation, thyatron a-c inverter.....164 Feb

Voltage tolerance, automatic measurement of.....150 Feb

Voltmeter, digital vacuum-tube.....148 Jan

VTVM, adapter for blind.....202D May

W

Wamoscope.....232D Oct

Water table, computer evaluates.....188D Dec

Wattmeter, phase shifter tests.....156 Jan

Waveform generator, staircase.....192D Feb

Waveguide, see also microwave

Waveguide automatic impedance plotter.....184 Mar

Waveguide, correspondence on one-way.....213D May

Wavelength, slide-rule computation of guide.....196D Feb

Wave-modulated oscilloscope for tv.....232D Oct

Weapons testing, high-speed printer.....166 Sept

Weather radar, isoecho circuit for.....147 Feb

Weather radar probes storms.....174D June

Weather, robot station telemeters.....196D May

Weighing moving trucks.....142 Jan

Welding, spot, controller integrates current.....157 Aug

What to emphasize in maintenance manuals, Sherrill.....150 Sept

White House communications car tries out ssb.....186D Dec

Wide range meter measures flutter and wow, Wirth.....152 July

Wire Production Techniques

Automatic preparation of glass-braid wire.....250D Mar

Building wire harnesses on mass-production line, Schuplin.....282D Oct

Cutting and forming leads.....250D Apr

Filed-edge test clips cut enamel insulation.....230D Aug

Fluorescent lamps aid inspection of wiring.....219D Jan

Lead-bender.....248D Nov

Lead-cutting gage.....230D June

Precision wire-stripper cuts Teflon insulation.....264D Aug

Prestripping heater.....256D Mar

Production-floor cable rack.....260D May

Self-insulating aluminum for transformer coils.....244D Jan

Short-run cable machine.....240D Apr

Tree holds wire spools.....240D Dec

Twisting insulated wire.....242D Jan

Under-bench wire bins.....234D Jan

Wire-twisting setup.....246D Dec

Wires (Special Report: Materials for electronics).....214 Oct

Wow, meter for flutter and.....152 July

Wrist receiver circuit uses three transistors.....176D Jan

Writing, what to emphasize in manuals.....150 Sept

WWV modifies broadcasts.....182D Apr

WWV-WVH transmission program.....194D Sept

X

X-ray, industrial.....182D June

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SUMMARIES of FEATURE ARTICLES

for 1956

AMPLIFIERS

- AUDIO AMPLIFIER DELIVERS 3,000 WATTS.** Bereskin—High power amplifier for direct air-to-ground communications drives multiple loudspeakers mounted on underside of aircraft.162 Nov
- BANDWIDTH-RISE TIME CHART.** Prince—Straight-line chart relates bandwidth and rise time for two to 10 amplifier stages in cascade.188 Nov
- BIASING LARGE AMPLIFIERS.** Wade—Tube acting as variable grid-leak resistor provides constant grid bias to linear accelerator amplifiers.141 Jan
- OPERATIONAL AMPLIFIER HAS CHOPPER STABILIZATION.** Robinson—High stability with 10-kc bandwidth obtained by combining conventional and chopper amplifiers.182 Sept
- PUSH-PULL TRANSISTOR SERVO AMPLIFIER.** Henszey—Transistor servo amplifier drives either push-pull transformer or saturable reactor.155 Dec
- RECORDER AMPLIFIER FOR FLIGHT TESTING.** Pine—General-purpose amplifier accepts wide range of input signals for flight-testing servo, gyro and synchro control systems.158 Aug
- REGULATING AMPLIFIER CORRECTS SLOPE AND LEVEL.** Chaskin and Kimball—Pilot tones transmitted with message signals maintain constant gain on open-wire telephone lines with changing characteristics.168 July
- TRANSIENT CONTROLLED MAGNETIC AMPLIFIER.** Schohan—Use of synchronously switched control-circuit impedance increases voltage gain of magnetic amplifier by factor of 3 or 4.176 Aug

ANTENNAS

- BROADBAND ANTENNA FOR FIELD-INTENSITY METERS.** Singer and Cacer—Unity gain antenna and balun cover range from 88 to 400 mc without adjustment.130 Feb
- GROUND-TO-AIR ANTENNA USES HELICAL ARRAY.** Zanella—Multielement phased array provides for either linear or circular polarization.161 Mar

BROADCAST

- CORRECTION CIRCUITS FOR COLOR TV TRANSMITTERS.** Mullenger and McMann—Gradient and matrix correction circuits for live and film pickup cameras improve color telecasts.130 Apr
- CROSS PULSE PICKUP IN TWISTED-PAIR CABLE.** Stephenson—Chart shows when twisted-pair cable can be used instead of coax.170 Feb
- PROOF OF PERFORMANCE FOR TV BROADCASTERS.** Sexton—Steps required to check tv transmitters for station license or renewal are outlined.150 Nov
- TRANSISTORS UP RELIABILITY OF BROADCAST REMOTES.** Wulfsberg—Lightweight amplifier similar to conventional four-channel equipment weighs less and is independent of power line.122 Jan
- HOW TO REDUCE OFF-AIR TIME.** McKenzie—Practical hints to radio operating engineers using techniques developed at broadcast stations.156 Sept
- SWITCHING SYSTEMS FOR TV BROADCAST CENTERS.** Pores—Electromechanical and electronic systems for switching color and black-and-white video are discussed.147 Dec
- TV MODULATION INDICATOR USES ELECTRONIC CHOPPER.** Tink—Video output is interrupted electronically to provide 100-percent modulation reference on A-scope monitor.172 May

CIRCUIT DESIGN

- BEAM DEFLECTION TUBE SIMPLIFIES RADIO COMPASS.** Tewksbury—Number of tubes and components reduced by using 6AR8 beam tube.166 May
- DESIGN CHART FOR SELECTIVE CATHODE TRAPS.** Hillman—Equations and chart speed determination of values of R, L and C for given attenuation at two frequencies.174 July
- DESIGNING LOW-NOISE EQUIPMENT.** Bennett—Techniques the engineer can employ to reduce effects of random noise.154 June
- DESIGN OF TRIPLE-TUNED CIRCUITS.** Geffe—Procedures and curves allow design of triple-tuned circuits with flat response.186 Aug
- EQUIVALENT R-Z CHART.** Goldstine—Charts determine parallel resistance and reactance from Q-meter readings with minimum of time and effort.170 June
- FERRITE INDUCTORS TUNE PANORAMIC RECEIVER.** Gabriel—Double superheterodyne uses electrically tracked inductors in tuned circuits.169 Aug

- NEW APPLICATIONS FOR BEAM SWITCHING TUBES.** Beklike—Circuits show practical uses as counters, distributors, gates and multiplexers.122 Apr
- NORMALIZED FILTER DESIGN.** Bedrosian and McCoy—Design chart for composite low-pass filters permits predetermining rejection in db.200 Mar
- RADAR SECOND DETECTOR FILTER NOMOGRAPH.** Young—Gives optimum circuit constants for second detector and video circuits of radar receiver.188 May
- REDUCING NOISE IN COMMUNICATIONS SYSTEMS.** Bennett—Pulse-code modulation provides reliable communication through noise.148 July
- TAKING THE HEAT OFF MINIATURE EQUIPMENT.** Welsh—Eight rules for cooling electronic gear and some of the practical details.152 Oct
- THYRATRON INVERTER USES CONTROLLED FIRING TIME.** Lawn—Use of third thyatron to extinguish conducting inverter tube gives improved performance.164 Feb
- UNIVERSAL RESPONSE CURVES.** Leon & Weinberger—Graph shows spurious responses that may occur in super-heterodyne receivers for any selected intermediate frequency.184 Dec

COMMUNICATIONS

- AUTOMATIC TUNING FOR HIGH-POWER TRANSMITTER.** DeLong—Frequency-selecting dial operates servo system which tunes transmitter and adjusts loading of final stage.134 July
- CARRIER TELEPHONE EXPANDS RURAL SERVICE.** MacDowell and Nevitt—Carrier system allows six ten-telephone channels to be stacked on one pair of wires.182 Oct
- CHARACTERISTICS AND ORIGINS OF NOISE.** Bennett—First in a series of survey articles dealing with modern concepts of electrical noise and suppression techniques.154 Mar
- GAS TUBES PROTECT HIGH-POWER TRANSMITTERS.** Parker and Hoover—Microsecond-response fault-detection and protection circuits minimize flash-arc damage to power tubes.144 Jan
- MULTIPATH SIMULATOR TESTS COMMUNICATIONS.** Deuth, Ressler, Smith and Stamps—Ultrasonic artificial ionosphere uses crystal transducers operating in air to simulate fading effects.171 July
- SCATTER SSB TECHNIQUE USES POWER KLYSTRON.** Badger—Klystron provides low distortion, good linearity and high efficiency for ssb scatter propagation.176 Dec
- SILENCER KILLS AUDIO OUTPUT ON NOISE PEAKS.** Gerlach—Article contrasts filters, limiters and silencers as noise suppressors.156 Feb
- TRANSISTORIZED RECEIVER FOR VEHICULAR RADIO.** Schwartz—Hybrid communications receiver saves battery power and retains performance.217 Oct
- TRANSMITTING SYSTEM USES DELTA MODULATION.** Watson and Hudson—Integrated staircase formed by pulses at constant repetition is compared with modulation to produce pulse-train for voice communication.164 Oct
- VHF TRANSHORIZON COMMUNICATION TECHNIQUES.** Ringoen and Smith—Long-distance radio circuits, particularly in arctic regions, can be maintained using special equipment and scatter propagation.154 May

COMPONENTS

- DESIGN CHARTS FOR TUNED TRANSFORMERS.** Hellstrom—Charts permit rapid correlation between coupling-circuit performance and parameters of double-tuned transformers.182 Nov
- DIFFUSION TRANSISTORS RAISE FREQUENCY LIMITS.** Carroll—Thin-based transistors provide operation up to 120 mc without sacrificing power-handling ability.137 Feb
- ELECTRICALLY VARIABLE GAS-DIELECTRIC CAPACITOR.** Gordon—Capacitor uses neon diode as gas dielectric to give varying capacitance between plates.158 Jan
- ELECTRONS PRODUCE HIGH-TEMPERATURE DIELECTRIC.** Melike and Graham—Modified polyethylene bombarded by high-velocity electrons retains properties at 300 C.146 May
- GRID-SWITCHED GAS TUBE FOR DISPLAY PRESENTATION.** Maynard, Carluccio and Poelstra—Application of potential between any cathode strip and anode core of lattice-like tube causes glow at intersection.154 Aug
- MATERIALS FOR ELECTRONICS.** Special Report by John Markus and David A. Findlay.185 Oct
- POWER TRANSFORMER DESIGN CHARTS.** Lee and Mullinix—Charts based on a specific core type and typical operating conditions cut transformer design time.184 Apr
- TANTALUM CAPACITORS USE SOLID ELECTROLYTE.** McLean—Semiconductor replaces wet electrolyte in subminiature electrolytic capacitors.176 Oct
- TRANSISTOR CHARACTERISTICS FOR CIRCUIT DESIGNERS.** Schwartz—Charts give physical, electrical and circuit-design data for 241 units.161 Jan

COMPUTERS

- ANALOG COMPUTERS FOR THE ENGINEER**, Carroll—Description of 20 analog computer models, covering general purpose types and representative special-purpose machines.....122 June
- DESIGNING STORAGE-TUBE EQUIPMENT**, Buckbee and Luftman—Describes circuits needed to put storage tubes to work.....126 July
- DIGITAL STORAGE USING NEON TUBES**, Raphael and Robinson—Economic fast-access storage for digital information.....162 July
- FERRITE-CORE MEMORY IS FAST AND RELIABLE**, Alexander, Rosenberg and Stuart Williams—Matrix wiring and pulse switching circuits enhance reliability of 168,960 core memory.....158 Feb
- PHOTOELECTRIC ANALOG FUNCTION GENERATOR**, Sinkler—Stores analog data as density variations on photographic film.....178 Oct
- PULSE CIRCUITS FABRICATE COMPUTER CODE DISK**, Jones—Photoelectric and wave-shaping circuits produce disk encoder.....146 June
- SIMPLIFIED ANALOG COMPUTER**, Corey—Solves every-day differential equations.....128 Jan
- TRANSISTOR CIRCUITS FOR DIGITAL COMPUTERS**, Deutch—Several digital computer electronic circuits are given in transistorized form.....160 May
- TRANSISTOR-MAGNETIC ANALOG MULTIPLIER**, Kelster—Square-wave multiplier achieves 3 percent linearity, requires only 250 mw.....160 Oct
- TRIANGULAR-WAVE ANALOG MULTIPLIER**, Meyers and Davis—Four-quadrant multiplier uses triangular-wave oscillator signal added to input to obtain product.....182 Aug
- USAF COMPUTER USES MAGNETIC AMPLIFIERS**—Pulse-type magnetic amplifiers operate at 600 kc.....138 July

COMPUTER INPUT/OUTPUT DEVICES

- ANALOG-TO-DIGITAL DATA CONVERTER**, Rigby—Gating variable-frequency pulse oscillator into fixed-interval counter converts analog voltage into digital quantity over four-decade range.....152 Jan
- CHARACTER RECOGNITION FOR BUSINESS MACHINES**, Glauberman—Printed numerals analyzed by photoelectric scanner providing electrical output usable in computers.....132 Feb
- DOCUMENT PROCESSOR READS CODED DOTS**, Fortune—Printed-dot code on standard business forms is sensed and translated at speed of 500 forms per minute.....164 Dec
- HIGH-SPEED PRINTER FOR WEAPONS TESTING**, Fahnestock—Photoelectric detector and counter times projectile flights.....166 Sept
- MAGNETIC SHIFT-REGISTER CORRELATOR**, Kelner and Glauberman—Printed digits are recognized by correlating input waveform with reference standard.....172 Aug
- PUNCHED-CARD READER FOR THE BLIND**, Dado, Prossia & Raphael—Device provides braille and aural indication to permit blind to read punched cards almost as rapidly as visual inspection.....148 Nov
- TRENDS IN COMPUTER INPUT/OUTPUT DEVICES**, Carroll—Character readers, fast printers and new printing techniques may break a computer bottleneck.....142 Sept

CONTROL SYSTEMS

- BEVATRON MAGNET PULSE-TIMING SYSTEM**, Struven—Controls repetition rate and duration of 8,333-amp magnet pulse.....160 June
- CONTROLLER INTEGRATES SPOT-WELDING CURRENT**, Fraser—Welding time is automatically changed to compensate for changes in weld resistance and line voltage.....157 Aug
- COUNTERS CONTROL HIGH-SPEED FLASH**, Dorsey—Control unit limits number of flashes of electronic flash equipment used in weapons research.....160 Aug
- ELECTRONIC CONTROLS FOR MACHINE TOOLS**, Findlay—Survey of currently in use electronic controls for machining operations in automatic production systems.....122 Feb
- ELECTRONICS IN THE PROCESS INDUSTRIES**, Carroll—Trend towards automatic plant operation requires more measurement and control equipment.....138 May
- GEAR GAGE CONTROLS AUTOMATIC HOBBER**, Miles—Automatically measures pitch diameter and root fillet of automobile transmission gears, sorts them and resets cutter as required.....140 July
- RADIO SYSTEM CONTROLS RAILROAD IN VENEZUELA**, Sheffield—Radio replaces wire lines in centralized-traffic-control system controlling 30-mile single-track railroad.....158 Dec

F-M

- EXCITERS MULTIPLEX F-M CARRIERS**, Stratman—Exciters combines 32.5-kc subcarrier with main carrier to provide f-m multiplexing.....148 Aug
- MULTIPROGRAM F-M BROADCAST SYSTEM**, Hershfield—Increased revenue when paid programs are sent out on subcarrier of regular broadcast transmission.....130 June
- TRANSISTORIZED RECEIVER FOR MOBILE F-M**, Boothe—Unit designed for printed-circuit mass production uses 19 transistors.....158 Nov

GUIDED MISSILES

- FUEL CUT-OFF CONTROL FOR GUIDED MISSILES**, Zomber and MacMillan—Fuel-cut off control for guided missiles has high-Q over 2-to-1 frequency range.....126 Jan
- SHIPBOARD TELEMETERING FOR TERRIER MISSILES**, Bell and Schultz—Automatic system tape-records signals from up to six missiles in all during test firings from U.S.S. Mississippi.....134 June
- TRANSISTORS TELEMETER SMALL MISSILES**, Kortman—Photoelec counts spins, other circuits measure pressure, acceleration.....145 July

INDUSTRIAL

- AUTOMATIC MEASUREMENT OF VOLTAGE TOLERANCES**, Strassman—Test circuit is activated by electronic gate only when measured d-c voltage in unit to be tested is within specified tolerances.....150 Feb
- BALANCED-CAPACITANCE FENCE ALARM SYSTEM**, Browning—Detects movement of person up to 7 feet from antenna wires paralleling barbed or woven wire fence.....150 Apr
- BETA GAGE CONTROLS CIGARETTE MACHINE**, Harrison—Beta gage and dielectric bridge control firmness and density of automatically made cigarettes.....144 Nov
- BRIDGE TESTS CAPACITORS ON PRODUCTION LINE**, Boer—Bridge system measures capacitance and dissipation factors and displays results on crt for rapid testing.....146 Aug
- NONCONTACTING GAGES FOR NONFERROUS METALS**, Colten—Thickness-measuring circuits gage copper and aluminum from 0.003 to 0.5 in. thick by electromagnetic absorption.....171 Mar
- SCALE WEIGHS MOVING TRUCKS**, Thurston—Highway trucks are weighed at speeds up to 48 mph while traveling in special lane. Overweight vehicles are flagged automatically.....142 Jan
- TACK DETECTOR FOR SHOE PRODUCTION**, Bradley—Loading of oscillator probe by contact with metal triggers alarm in production checker.....142 Feb
- TESTING HARDNESS WITH FLUX GATE MAGNETOMETER**, Isaacs and Grey—Gage measures magnetic retentivity of steel after magnetization, giving readings proportional to hardness.....142 Apr
- ULTRASONIC MACHINING OF BRITTLE MATERIALS**, Hartley—Semiconductors, ceramic and other machineable materials are sliced or cut with greater precision by impact grinding.....132 Jan
- UNIVERSAL SHUTTER TESTER**, Wessel—Direct-reading device measures camera shutter speed deviation in accordance with ASA rating method.....162 Feb
- WHAT TO EMPHASIZE IN MAINTENANCE MANUALS**, Sherrill—Results of survey of several-hundred maintenance manual users shows relative emphasis that should be given to various types of information.....150 Sept

MEASUREMENT

- AEROSOLSPECTROSCOPE COUNTS PARTICLES IN GAS**, Gordon, Maxwell and Alexander—Counts and sizes aerosol particles for chemist.....188 Mar
- AUTOMATIC PLOTTER FOR WAVEGUIDE IMPEDANCE**, Rachman—Shows input impedance locus of X-band waveguide component on cathode-ray screen throughout range of 3,500 to 3,600 mc.....184 Mar
- BEVATRON FREQUENCY MEASUREMENT SYSTEM**, Brobeck and Struven—Digital techniques employed to measure varying bevatron magnetic field.....185 May
- DIGITAL PRESENTATION VACUUM-TUBE VOLTMETER**, Nunt and Munsey—Counter is coupled to shaft of servo-driven potentiometer.....148 Jan
- ELECTRONICS IN THE IGY PROGRAM**, Findlay—International Geophysical Year projects make wide use of electronic instrumentation.....138 Dec
- ENERGY SOURCE DELIVERS HALF-SINE PULSES**, Rosenthal—Thyratron and series-tuned circuit function as energy-burst source.....176 Sept
- EQUIPMENT FOR GENERATING NOISE**, Bennett—Noise sources play important role in testing electronic equipment.....134 Apr
- GATE SELECTS PULSES FOR SPECTRUM ANALYSIS**, Ross and Simon—Selector passes single pulse from train to spectrum analyzer for investigation.....179 Aug
- MAGNETIC-SWITCH B-H LOOP TRACER**, Geyger—Silicon diode modulator is operated by magnetic switch for 20-ke operation.....167 Oct
- MAGNETIC-SWITCH TRANSIENT ANALYZER**, Geyger—Frequency tripler and magnetic switch improve performance of analyzer for high-speed magnetic amplifiers.....150 Jan
- MAGNETRON TESTER DETECTS LOST PULSES**, Koustas and Mavhinner—Missing radar-magnetron-output pulses detected by test set having one calibration adjustment.....164 Aug
- MEASURING PHASE AT R-F AND VIDEO FREQUENCIES**, Yu—Comparison-type instrument indicates phase angle between two sine waves in frequency range 10 kc to 20 mc with high accuracy.....138 Jan
- MEASURING R-F PARAMETERS OF JUNCTION TRANSISTORS**, Coffey—Equipment and techniques used for measuring small-signal h-parameters of junction transistors in the range of 1 to 24 mc.....152 Feb
- PHASE GENERATOR FOR TROPOSPHERIC RESEARCH**, Hubbard and Thompson—Laboratory standard instrument provides two phase-displaced signals for checking and calibrating phase meters and other instruments.....220 Oct
- PHASE SHIFTER CIRCUITS TEST POWER METERS**, Venkata Rao—Phase-shifting device simplifies testing and calibration of wattmeters.....156 Jan
- SIGNAL-TRIGGERED SWEEP MAGNIFIES PULSE WIDTHS**, Kuehn—Permits expanding widths of pulses displayed on oscilloscope screen independently of pulse input frequency.....146 Apr
- TECHNIQUES FOR MEASURING NOISE**, Bennett—Compares nine measurement scales and describes various procedures.....162 May
- TIME GENERATOR GIVES DIRECT READOUT**, Blair—Visual or audible indication of time signals to nearest 0.1 min on 24-hour notation provides absolute reference.....179 Mar
- TRANSISTORIZED INDICATOR MEASURES JET EXHAUST**, Cole—Temperature indicating system requires about 1/5th weight and space allowance of vacuum-tube units.....143 Dec
- VIBRATION METER USES TRANSISTORS**, Kinkel and Wilson—Portable battery-operated instrument is immune to microphonics.....127 Apr
- DESIGNING DIELECTRIC MICROWAVE LENSES**, Kelleher—Data for Maxwell, Luneberg, Eaton, Kelleher and modified types of dielectric lenses.....138 June
- ECCENTRIC-LINE IMPEDANCE NOMOGRAPH**, Haase—Chart permits finding characteristic impedance of eccentric coaxial line in terms of conductor dimensions and eccentricity.....190 Sept
- MICROWAVE REFRACTOMETER PREDICTS PROPAGATION**, Crain & Williams—Pair of resonant cavities, one sealed and one open to the atmosphere, show refractive index upon which wave transmission depends.....150 Dec

ONE KNOB TUNES KLYSTRON OSCILLATOR. Altman and Craft—Dual-mode reference cavity provides automatic control of X-band klystron for one-knob tuning.....186 Sept

PERSONAL MICROWAVE SEARCH RECEIVER. Herman—Crystal detector and slab-line resonator feed hearing-aid amplifier.....164 June

SLAB LINE NOMOGRAPH. Sion—Gives design values for matching section between coaxial line and strip transmission line.....192 Sept

SUBCARRIER SWITCH FOR MICROWAVE PARTY LINE. Harris—Voice modulation removes cut-off bias on local subcarrier transmitters.....175 Nov

USING TRAVELING-WAVE TUBES. White—Characteristics of traveling-wave tubes for applications in microwave and radar systems.....144 Apr

POWER SUPPLIES

CRT POWER SUPPLY USES TRANSISTOR OSCILLATOR. Toscano and Heffner—Provides 10 kv at 900 microamperes with 30-v input.....162 Sept

REGULATED TRANSISTOR POWER SUPPLY DESIGN. Kellerm—Equations for shunt and series type regulators provide method of obtaining low-voltage supplies with any desired degree of regulation.....168 Nov

REGULATOR STABILIZES INFRARED DETECTOR. Weisbecker—Bolometer power supply uses both d-c and a-c compensation.....160 July

TRANSISTORIZED REGULATED POWER SUPPLY. Lillienstein—Supplies for 60 and 400 cps provides 100-mv regulation using power transistors as control elements.....169 Dec

VIBRATING CAPACITOR CHANGES D-C TO A-C. Adler—Provides better linearity and waveshape than mechanical chopper.....158 June

RADAR

AIRBORNE WEATHER RADAR USES ISOECHO CIRCUIT. Ruppert and Smith—Commercial lightweight pilotage aid weighs less than 150 pounds and employs a unique circuit to locate storm centers.....117 Feb

COUPLED CAVITY TUNES X-BAND MAGNETRON. Beltz—Pulsed magnetron for airborne radar tunes from 9,000 to 9,600 mc; delivers 140 kw.....182 Mar

RADAR AFC SYSTEM USES MECHANICAL TUNING. Confalone and Rambo—Radar local oscillator tuned mechanically by motor-driven afc system.....138 Apr

RADAR PERFORMANCE NOMOGRAPH. Wolff—Chart permits rapid determination of pulsed radar performance.....182 Dec

RADAR PRI DISPLAY USES PRECISION INTERLACE. Shulman—Marker symbols from computers are displayed on ppi by interlacing.....168 May

STABLE LOCAL OSCILLATOR FOR S-BAND RADAR. Dauksher—Tunable crystal oscillator has high short-term stability for mtl local-oscillator service.....179 Sept

STORAGE TUBE PROJECTS RADA PPI DISPLAY. Gates—Remote ppi indicator uses high-brightness projection tube with controllable long-time storage to provide 50-inch display for air-traffic control systems.....172 Dec

TRANSISTOR AMPLIFIER FOR RADAR VIDEO. Leslie—Simple R-C degeneration avoids use of series and shunt peaking networks.....142 Aug

WARNING RADAR NET USES CENTRALIZED CONTROL. Lombardo—Coordinated control by computer speeds identification and interception of planes entering radar warning areas.....168 Mar

RADAR SIMULATORS

RADAR-SIMULATOR FOR LABORATORY USE. Bichel and Bernstein—Equipment duplicates statistical and systematic characteristics of video signal from search radar receiving echoes from flying target.....170 Oct

RADAR SIMULATOR TRAINS MISSILE-MASTER CREWS. Oberle—Simulator checks out computers used to coordinate missile battery fire.....155 Nov

STORAGE-TUBE DEVICE SIMULATES RADAR NET. Shenfeld and Finkle—Shows how moving targets appear when viewed from two or more stations.....181 Apr

THREE-DIMENSIONAL RADAR VIDEO SIMULATOR. Pielich—Terrain-clearance radar data is presented as three-dimensional oscilloscope display.....131 July

TRANSISTOR GENERATOR SIMULATES RADAR TARGET. Eckess, Davenport and Sherman—Transistorized generator provides video for testing radars.....179 May

VARIABLE DELAY LINE SIMULATES RADAR TARGETS. Gitlin—Adjustable speed motor moves corner reflector through water-filled tank to vary ultrasonic path between two quartz crystals.....143 June

RECORDING

FOUR-PLACE TIMER CODES OSCILLOGRAPH RECORDINGS. Dorsey—Generator creates pattern that indicates time on oscillograph record in increments of 0.001 from 0 to 9.999 seconds before repeating itself.....154 July

MAGNETIC HEAD HAS MEGACYCLE RANGE. Kornei—Ferrite-core head uses metallic pole shoes.....172 Nov

PERMANENT-WRITING CATHODE-RAY RECORDER. Heynick, Wohl and Andrews—Inertialless electron-beam recorder tube utilizes beam current to write directly on high-sensitivity electrographic paper.....148 Apr

TAPE DOUBLES RESPONSE OF DISK RECORDERS. Gilson—Signals recorded on tape at 15 in. per sec are played back to cutting head at half speed.....125 July

WIDE RANGE METER MEASURES FLUTTER AND WOW. Wirth—Test instrument measures variation in speed of tape transport mechanisms over 0.01 to 5.0 percent range.....152 July

SENSING DEVICES

POTENTIOMETER TACHOMETER HAS HIGH SENSITIVITY. Davidson and Favalow—Rotational speeds as low as 1/200 rpm are measured by electro-mechanical device that is at least 100 times as sensitive as existing tachometers.....158 Sept

SERVO ACCELEROMETER USES R-F OSCILLATOR. Corey—Superregenerative oscillator and galvanometer movement measure acceleration.....151 Aug

TRANSISTOR MODULATOR FOR AIRBORNE RECORDING. Upham and Oranetz—Six-transistor tape recorder weighing under 3 lb employs phase modulation for accelerometer signals up to 180 g.....166 June

SERVO SYSTEMS

MAGNETIC AMPLIFIER TWO-SPEED SERVO SYSTEM. Suozzi—Electron-tube amplifier in tow speed servo system replaced by half-wave magnetic amplifier with full-wave slave output.....140 Feb

SELF-BALANCING MAGNETIC SERVO AMPLIFIER. Geyger—Feedback improves performance of single-stage 400-cps unit.....196 Mar

SERVO AMPLIFIERS USE POWER TRANSISTORS. Benton—Pulsating collector supply voltage increases transistor servo amplifier efficiency.....153 Sept

SERVO AMPLIFIER USES SILICON POWER TRANSISTORS. Lacy and Davis—Outputs of more than 5 watts obtained from servo amplifiers employing silicon transistors.....136 Jan

TRANSISTOR PREAMPLIFIER FEEDS TUBELESS SERVO. Zeller—Four-transistor circuit permits use of low-level input devices with 60-cps transistor-magnetic amplifier servo.....168 Feb

TRANSISTORS AND DIODES STABILIZE A-C SERVOS. Gittleman—Varying diode resistance with input signal controls servo amplifier gain.....174 Oct

TELEMETERING

SPECIAL REPORT: TELEMETERING. McKenzie and Manoogian—Survey of systems development, input transducers, signaling methods, commutating devices and output indicators with bibliography.....153 Apr

TELEMETERING DEMODULATOR FOR WIDE-BAND F-M DATA. Warzecha—Translating wide-band f-m subcarrier to lower frequency permits recording of modulating signal at lower tape speed.....157 July

TELEMETERING RECEIVER CONSERVES BANDWIDTH. Redden and Zancanata—Doubie superhet for 220-mc telemetry band has crystal-controlled first oscillator.....174 May

TRANSOSONDE MONITORS INACCESSIBLE AREAS. Cabbage—Ballonborne transmitters provide weather information for over-ocean research.....164 Nov

TELEVISION

PORTABLE COLOR SIGNAL GENERATOR. Popkin-Clurman—Checks color circuits of monitors, adders, encoders and receivers.....170 Sept

SAMPLING DETECTOR FOR INTERCARRIER TV SOUND. Schlesinger—Two-tube f-m sound detector locks on signals of 6mv or more and produces audio output of 25 v with 40 to 50-db of a-m rejection.....138 Aug

SLOW-SWEEP TV FOR CLOSED-CIRCUIT USE. Ennes—New tv system uses reduced scan rates to produce good resolution picture signal that can be transmitted over telephone lines.....140 Nov

TELEVISION RECEIVER USES ONE-GUN COLOR CRT. Philco "Apple" tube uses beam indexing and sequential scanning of vertical phosphor stripes to produce color picture.....150 June

THREE-PHASE DETECTOR FOR COLOR-TV RECEIVERS. Goldberg—Triple-diode balanced phase detector provides noise-immune operation of afc, acc and color-killer circuits.....157 Oct

TOROIDAL TRANSFORMERS PASS VIDEO BANDWIDTHS. Gray—Design data for tv video transformers with 6-mc bandwidth that will drive 50-ohm coaxial cable.....150 May

VIDEO AMPLIFIERS USE SHUNT REGULATION. Jaynes—Characteristic equations and practical tv applications of shunt-regulated video amplifiers.....166 Nov

TRANSISTOR CIRCUITS

GAIN CHART FOR TRANSISTOR AMPLIFIERS. Myers—Design chart simplifies calculations for grounded-emitter and grounded-collector amplifiers.....224 Oct

HIGH-SPEED COUNTER USES SURFACE-BARRIER TRANSISTOR. Gott—Pulse-code modulation system employs 6-mc reversible binary counter.....174 Mar

QUASI-COMPLEMENTARY TRANSISTOR AMPLIFIER. Lin—Transistorized amplifier provides six-watt output using quasi-complementary output circuit.....173 Sept

SUPERREGENERATIVE TRANSISTOR OSCILLATOR. Kireher and Kaninow—Basic self-quenching oscillator circuit provides 500-cps a-f at a 7-cps rate.....166 July

THREE NEW TRANSISTOR CIRCUITS. Heikimian—Describes stabilized flip-flop tone kever and audio-frequency.....178 Nov

TRANSISTOR CIRCUITRY IN JAPAN. Designs of four broadcast receivers, portable tape recorder and a hearing aid.....120 July

TRANSISTOR FLIP-FLOPS HAVE HIGH SPEED. Rapp & Wong—Design considerations of direct-coupled, and emitter-follower-coupled circuits are given.....180 Dec

TRANSISTORIZING MEACHAM-BRIDGE OSCILLATORS. Witt—Point-contact and junction transistor circuits are extremely stable.....193 Mar

INDUSTRY REPORT INDEX

Aircraft

Aircraft electronics in squeeze... 20 Mar
 Air Force gets new radar system... 14 July
 Airliners avoid bad weather... 20 Oct
 Aviation wants more electronics... 7 June
 Bomber's electronics now costs \$6 million... 14 Oct
 CAA budgets for electronics... 8 July
 CAA to buy more long-range radar equipment... 17 Oct
 H-bomb carrier gets stinger... 20 Sept
 New atomic clock improves air navigation... 22 Nov
 SAGE device to aid air safety... 22 Aug
 Tubeless autopilot flies light planes... 16 June

Broadcast

Broadcast employees get top pay... 20 Oct
 Broadcasters get set for 1956 politics... 8 July
 F-M stations take on new business... 12 Feb
 Voice of America ups service... 14 Dec

Business and Finance

1956 Western electronic show expects 30,000... 9 Aug
 Airplane firms spread interests... 16 Jan
 Business failures up in electronics... 14 July
 Computer firm mergers continue... 12 May
 Electronics expands in North Carolina... 30 June
 Electronics: San Francisco picture... 16 May
 Environment creates big business... 20 July
 Finance firms take to electronics... 20 Feb
 Industry's future grows brighter... 8 Feb
 Industry subsidizes science teachers... 22 Aug
 IRE show plans top attendance... 8 Mar
 Island attract more electronics firms... 12 Dec
 Manufacturers add over ten million sq ft... 20 Mar
 Mergers keep pace in electronics... 10 Jan
 President Eisenhower hails deForest... 10 May
 Small-boat electronics gets industry nod... 22 Feb
 Small business looms large in electronics... 22 Dec
 Tube testers invade supermarkets... 16 July
 West coast wants parts makers... 10 Nov

Foreign

Britain moves ahead in hi-fi exports... 20 Aug
 Canadian electronics nears half billion... 24 Oct
 Engineers tour Russian electronic plants... 22 Mar
 Industry invests in Australia... 26 Jan
 Output expands in west Germany... 24 May
 Russians look at U. S. electronics... 25 Jan
 Transistor activity expands abroad... 22 May
 Transistor business multiplies rapidly... 18 Dec

Sales

College radio comes of age... 22 June
 Companies size up net profits after taxes... 8 May
 Crystal diode sales near 35-million units... 18 Nov
 Dielectric heating on up-swing... 16 Apr
 Electronics strikes gold in bowling... 20 May
 High-fidelity makers see expanding sales... 20 Nov
 How U.S. and Britain compare in exports... 26 Dec
 Industry boosts plant expansion plans... 7 June
 Industry heads toward \$22 billion... 10 Dec
 Industry high in defense business... 10 Oct
 Insulation sales increase... 14 May
 Isotopes boost electronic instrument sales... 26 Oct
 Long-range missiles swell industry coffers... 7 Sept
 Magnetic recording sales rise... 14 Feb
 Manufacturer grids for expansion... 24 Aug
 Manufacturers push tv sales to hotels... 24 Sept
 Measuring instrument sales gain... 16 Aug
 More auto radios use transistors... 16 Oct
 Noise measuring gear has brisk sales... 24 July
 Parts houses gain business... 14 Jan
 Picture tube sales hold unit volume... 24 Dec
 Record business keeps changing... 18 Aug
 RETMA pegs sales volume at \$9 billion... 8 Nov
 Tantalum capacitor sales increase... 22 Mar
 Test equipment volume triples... 20 July
 Transmitter antenna sales up... 24 Feb
 Transistor sales quadruple in year... 12 Sept
 Tube business hits \$800 million... 24 Oct
 Will sun spots boost mobile sales?... 20 Feb

Communications

Commercial scatter circuit authorized... 12 Feb

Communications gear adopts transistors... 10 Mar
 New activity seen in citizens radio... 26 Mar
 Picture-phone tv gets a boost... 28 Sept
 Scatter circuits to link three continents... 7 Jan
 Two-way radio gets set for expansion... 12 Sept
 Two-way radio grids for highway expansion... 10 Aug

Computers

Army buys \$4-million computer... 20 Jan
 Businessmen appraise computers... 14 Apr
 Computer firms see new markets... 14 Mar
 Computer stores 5 million digits... 12 Oct
 Computer teams make more jobs... 14 June
 Computers diagnose for doctors... 16 Nov
 Computers readied for election results... 7 Nov
 Desk-top analog computer appears... 8 Jan
 Memory capacity tops half billion... 24 Nov
 Nationwide hookups feed computers... 16 Aug
 New business computer appears... 22 Apr
 Original documents feed computers... 24 June
 Printer ties computer speed... 16 Sept

Government

Conelrad extends radio blackout regulations... 24 Feb
 Government appraises 1956 business... 9 Aug
 Government examines test equipment field... 18 Sept
 Government outlines electronics spending... 7 Feb
 Senate group gets uhf-tv date... 22 May
 U. S. proposes tax reduction plan... 8 Sept

Federal Communications Commission

FCC actions... 10 July, 12 Aug, 22 Sept, 26 Oct
 FCC proposes tv shift to uhf... 20 Aug
 New FCC commissioner takes office... 12 Aug
 Quiet motors, shield receivers, FCC warns... 8 Feb
 Split-channel action means more mobiles... 10 Nov

Industry and Business Applications

Auto firms eye radar brake unit... 7 Jan
 Banks extend services by facsimile link... 24 Apr
 Casey Jones goes electronic... 12 Jan
 Controls for car fuel injector... 7 Nov
 Electronics advances in industrial control... 10 Aug
 Electronics aids ignition mechanics... 24 Apr
 Electronics aids weather bureau... 14 July
 Electronics invades chemical labs... 14 Jan
 Electronics invades graphic arts... 20 Aug
 Electronics speeds news coverage... 7 Sept
 How industrial tv stands today... 20 May
 Movie makers use more electronics... 30 Oct
 Railroad radio takes on new growth... 12 Jun
 Tape controls materials banding... 24 Jun
 TellerVision takes curbside deposits... 16 Oct
 Tubes clear highway traffic jams... 12 Jul
 Welding uses more electronics... 24 Aug

Materials

Magnet Material Burns... 7 Jul
 New materials perk up magnets... 24 Sept
 Rising copper prices finally halt... 24 May
 Selenium shortage may be eased... 24 Feb
 Synthetic quartz now on open market... 10 Apr
 Transistor-silicon sources to increase... 22 Apr

Military

Army adds new techniques... 20 Jun
 Army backs automatic production... 8 Jun
 Canadian radar expanding... 10 May
 Continental defense pushes ahead... 14 Sept
 Defense business holds level... 12 Jun
 Electronics boosts army efficiency... 12 Sept
 Marines land radar... 26 Feb
 Military Backlogs Hold up... 7 Jul
 Military television gets off the ground... 14 Apr
 Mil-reps become big business in electronics... 9 Dec
 Radar chain boosts missile work... 12 Apr
 SAGE readies Sunday punch... 7 Feb
 Scopeless radar used by army... 26 Dec
 U. S. orders more heat-seeking missiles... 9 Dec
 U. S. starts nuclear warning system... 12 Nov

Personnel

Automatic production creates new jobs... 16 Feb
 Companies push college recruiting... 10 Jun

Electronics wage payments rise... 8 Mar
 Engineer pay takes big jump... 12 Dec
 How engineers evaluate jobs... 18 Aug
 Industry eyes retirement plans... 22 Sept
 Industry tops Europe for engineers... 22 Dec
 Salaries rise with experience... 10 Apr
 Solid state lures physicists... 28 Oct
 Tech schools combat technician shortage... 16 Nov
 U. S. counts engineering in industry fields... 16 Jan

Production

Auto radio designs are changing... 14 Mar
 Crystal diode registrations rise... 16 Apr
 Designs for the future move toward market... 14 Nov
 Electronics output hits new high... 8 Jan
 Electron microscopes keep gaining... 20 Jul
 Fire fails to upset defense output... 24 May
 Hi-fi gets transistors, p-c units... 16 May
 Magnetic tape market expands... 14 Aug
 Manufacturers push modular electronics... 12 Mar
 Navy examines industry capacity... 8 Jun
 New models ready for '56... 20 Feb
 Recent equipment emphasizes batteries... 22 Feb
 RETMA sees increased volume rise... 7 Jul
 Transistor shipments in sharp rise... 7 Apr
 Transistors replace tubes in more radio sets... 12 Aug
 Wire makers size up future... 22 Jul

Research and Development

Announce New Transistors and new applications... 8 May
 Bonded diodes... 19 Jun
 Commercial labs make R&D pay off... 22 Dec
 Designers deal tubes out... 7 Apr
 Electronics speeds heart research... 16 Dec
 Electronics attacks heart ills... 24 Aug
 Electronics patents increase... 10 Sept
 Future missile components withstand 500 C... 9 Oct
 Germanium rectifiers save space... 16 Feb
 Hearing aids move up to head... 24 Mar
 Hot tube developed for military use... 10 Sept
 Hot tube made for automatic circuits... 12 Jul
 Industry gets private nuclear reactor... 22 Jul
 Industry increases spending for research... 20 Nov
 Nonprofit research shows growth... 16 Jun
 Particle accelerators gain sales... 24 Jan
 Photocell sets iris automatically... 12 Jun
 Radio astronomy makes strides... 22 Jun
 Research and development gains... 12 Feb
 R-F lamp brightens filming future... 24 Mar
 Satellite electronics shape up... 22 Aug
 Silicon transistors... 18 Jun
 Transistorized radio detects interference... 16 Apr
 Transistors progress, applications multiply... 10 Feb
 Transistor superhet fits pocket... 22 Oct
 Tubes print at 900 lines a minute... 10 Jun
 U. S. to double research reports... 12 Oct

Television

Bright future seen for kinescope recorders... 16 Jul
 Community antenna systems keep growing... 14 Sept
 Closed-circuit tv picks up volume... 24 Nov
 Educational tv takes on new life... 18 Aug
 Low-power tv gains ground... 8 Apr
 New heat proposed to spur uhf-tv... 12 Mar
 Paris determine tv set design... 20 Dec
 Slow-cant speeds business data... 10 Jan
 Tape maker enters video recording... 10 Oct
 Television networks swing to microwave... 14 Feb
 Television set penetration deepens... 26 Apr
 TV amplifies light 40,000 times... 16 Mar
 TV eyes teeth... 28 Jun
 TV flexes its muscles and takes first place... 22 Jan
 TV screen sizes start to shrink... 24 Apr
 TV set concentration survey... 14 Jun
 TV tape recording progresses... 7 May
 UHF continues in limelight... 16 Sept
 X-ray business holds growth... 26 Sept

Color

British demonstrate color television... 14 May
 Color television receiver boom expected... 7 Mar
 Color tv gathers momentum... 10 Aug
 Color tv sales head toward \$75 million... 18 Oct
 Speeds single-gun color sets... 8 Nov
 TV industry pushes color... 24 Jul
 TV stations equip for color... 22 Feb
 Video tape recorders aim for color... 16 Dec

AUTHOR INDEX

Items in the author index for which page references are preceded by (letter) are comments from readers, published monthly in the Backtalk department

A

Adler, J. A., Vibrating Capacitor changes d-c to a-c.....158 Jun
 Alexander, M. A., Rosenberg & Stuart-Williams, Ferrite-core memory is fast and reliable.....158 Feb
 Alexander, N. E., Gordon & Maxwell, Aerosoloscope counts particles in gas.....138 Mar
 Altman, J. J. Craft, One knob tunes klystron oscillator.....186 Sept
 Amber, G. H., Fiber tote tray is experimental chassis.....220D Jan
 Andrews, D. H., Heynick & Wohl, Permanent-writing cathode-ray recorder.....148 Apr
 Armstrong, H. L., Bistable circuits using triode-pentodes.....210D Jul
 Armstrong, H. L. & Kockman, Electronic controller for voltage and current.....208D Feb
 Atkin, J., Bickel & Proscia, Meter adapter for blind technicians.....202D May
 Axtell, R. H., More shoddy gear (letter).....372D Jul

B

Bachman, H. L., Automatic plotter for waveguide impedance.....184 Mar
 Badger, G.M.W., Scatter ssb technique uses power klystron.....176 Dec
 Barditch, I., Delay-line pulse generator.....196D Jan
 Barditch, I., Tubes plus diodes (letter).....444D Apr
 Bataimis, D. J., Automatization (letter).....356D Jan
 Bedrosian, E., Curved passive reflector.....206D Dec
 Bedrosian, S. D. & McCoy, Normalized filter design.....200 Mar
 Bell, W. S. & Schultz, Shipboard telemetering for terrier missiles.....134 Jun
 Beltz, W. P., Coupled cavity tunes X-band magnetron.....182 Mar
 Bennett, W. R., Characteristics and origins of noise.....154 Mar
 Bennett, W. R., Designing low-noise equipments.....154 Jun
 Bennett, W. R., Equipment for generating noise.....134 Apr
 Bennett, W. R., Reducing noise communications systems.....148 Jul
 Bennett, W. R., Techniques for measuring noise.....162 May
 Benton, B. M., Servo amplifiers use power transistors.....153 Sept
 Bereskin, A. B., Audio amplifier delivers 3,000 watts.....162 Nov
 Bernstein, R. L. & Bickel, Radar simulator for laboratory use.....170 Oct
 Bethke, J., New applications for beam switching tubes.....122 Apr
 Bickel, H., Atkin, & Proscia, V., Meter adapter for blind technicians.....202D May
 Bickel, H. J. & Bernstein, Radar simulator for laboratory use.....170 Oct
 Blair, W. L., Time generator gives direct readout.....179 Mar
 Boer, J., Bridge test capacitors on production line.....146 Aug

Boothe, A. M., Transistorized receiver for mobile f-m.....158 Nov
 Bradley, R. W., Tack detector for shoe production.....144 Feb
 Brobeck, W. M. & Struven, Bevatron-frequency measurement system.....182 May
 Browning, G. H., Balanced-capacitance fence alarm system.....150 Apr
 Buckbee, J. A. & Luftman, Designing storage tube equipment.....126 Jul

C

Caler, H. R. & Singer, Broadband antenna for field-intensity meters.....130 Feb
 Camp, R. L., Milling silver inserts in plastic relay bases.....300D Mar
 Carluccio, J., Poelstra, & Maynard, Grid-switched gas tube for display presentation.....154 Aug
 Carroll, J. M., Analog computers for the engineer.....122 Jun
 Carroll, J. M., Diffusion transistors raise frequency limits.....137 Feb
 Carroll, J. M., Electronics in the process industries.....138 May
 Carroll, J. M., Trends in computer input-output devices.....142 Sept
 Cechanek, R. & Magnani, Servo-wound pots.....276D Mar
 Chafin, N. L., Pertinent patents 198D Jan, 234D Mar, 226D May, 208D Jun, 22D Aug, 218D Nov
 Chaskin, W. S. & Kimball, Regulating amplifier corrects slope and level.....168 Jul
 Clurman-Popkin, J. R., Portable color signal generator.....170 Sept
 Coffey, W. N., Measuring r-f parameters of junction transistors.....152 Feb
 Cole, G. H., Transistorized indicator measures jet exhaust.....143 Dec
 Colten, R. B., Noncontacting gages for nonferrous metals.....171 Mar
 Colten, R. B., Useful gage (letter).....470D Oct
 Confalone, J. L. & Rambo, Radar arc system uses mechanical tuning.....138 Apr
 Coombs, W. C., Speed meter accuracy (letter).....396D Jun
 Copper, G. S., Phase detector for synchro alignment.....204D Jul
 Corey, V. B., Servo accelerometer uses r-f oscillator.....151 Aug
 Corey, V. B., Simplified analog computer.....128 Jan
 Craft, K. & Altman, One knob tunes klystron oscillator.....186 Sept
 Craign, C. M. & Williams, Microwave refractometer predicts propagation.....150 Dec
 Cubbage, H. D., Transosonde monitors inaccessible areas.....164 Nov

D

Davidson, G. M. & Pavalow, Potentiometer tachometer has high sensitivity.....156 Sept

Dado, F., Proscia & Raphael, Punched-card reader for the blind.....148 Nov
 Davis, H. B. & Meyers, Triangular-wave analog multiplier.....182 Aug
 Davis, P. D., Jr. & Davis, Servo amplifier uses silicon power transistors.....136 Jan
 Dauksher, W. J., Stable local oscillator for S-band radar.....179 Sept
 Deavenport, J., Eckess & Sherman, Transistor generator simulates radar target.....179 May
 Deutch, D. E., Transistor circuits for digital computers.....160 May
 DeLong, V. R., Automatic tuning for high-power transmitter.....134 Jul
 Deuth, A. F., Ressler, Smith & Stamps, Multipath simulator tests communications.....170 Jul
 Dixon, L. W., Intensity markers aid television alignment.....254D Apr
 Dorsey, S. E., Counters control high-speed flash.....160 Aug
 Dorsey, S. E., Four-place timer codes oscillograph recordings.....154 Jul
 Dranetz, A. I. & Upham, Transistor modulator for airborne recording.....166 Jun

E

Eckess, W., Deavenport & Sherman, Transistor generator simulates radar target.....179 May
 Ennes, H. E., Slow-sweep tv for closed circuit use.....140 Nov

F

Fahnestock, J. D., High-speed printer for weapons testing.....166 Sept
 Findlay, D. A., Electronic controls for machine tools.....122 Feb
 Findlay, D. A., Electronics in the IGY program.....138 Dec
 Findlay, D. A. & Markus, J., Materials for electronics.....186 Oct
 Finkle, M. & Shenfeld, Storage-tube device simulates radar net.....181 Apr
 Fleming, L., Multivibrator 500-kc sweep circuits.....186D Feb
 Fleming, L., Ground tank tap (letter).....406D Aug
 Fleming, L., Patents challenge (letter).....500D Mar
 Forbes, G. F., Gravity radiation concept (letter).....468D Oct
 Forbes Simpson, A. I., Reliability semantics (letter).....386D Feb
 Fortune, S. L., Document processor reads coded dots.....164 Dec
 Fraser, H. J., Controller integrates spot-welding current.....157 Aug

G

Gabriel, F. C. Ferrite inductors tune panoramic receiver169 Aug
 Gates, H. W. Storage tube projects radar ppi display172 Dec
 Geffe, P. R., Design of triple-tuned circuits186 Aug
 Gerlach, A. A., Silencer kills audio output on noise peaks156 Feb
 Geyger, W., Magnetic-switch B-H loop tracer167 Oct
 Geyger, W. A., Magnetic-switch transient analyzer150 Jan
 Geyger, W. A., Self-balancing magnetic servo amplifier196 Mar
 Giddersleeve, R. E., Making plastic reflectors for microwave antennas244 Feb
 Gilson, W. E., Tape doubles response of disk recorders125 July
 Gitlin, S. A., Variable delay line simulates radar targets143 June
 Gitlin, S. A., Credit (letter)438D Sept
 Gittleman, R., Transistors and diodes stabilize a-c servos174 Oct
 Glauberman, M. H., Character recognition for business machines132 Feb
 Glauberman, M. H. & Kelner, Magnetic shift-register correlator172 Aug
 Goldberg, A. A., Three-phase detector for color-tv receivers157 Oct
 Goldberg, A. A., Another rental plan (letter)374D July
 Goldstein, N. R., Stud welder used in assembling thyratrons290D Mar
 Goldstine, H. E., Equivalent R-Z chart170 June
 Gordon, E. S., Maxwell & Alexander, Aerosoloscope counts particles in gas188 Mar
 Gordon, J. F., Electrically variable gas-dielectric capacitor158 Jan
 Gott, E., High-speed counter uses surface-barrier transistor174 Mar
 Goubau, G., Novel transmission line (letter)502D Mar
 Graham, B. & Meikle, Electronics produce high-temperature dielectric146 May
 Gray, G. W., Toroidal transformers pass video bandwidths150 May
 Grey, G. & Isaacs, Testing hardness with flux gate magnetometer142 Apr
 Guditz, E. A. & Smith, Vacuum and vibration speed assembly of core memory planes214D Feb

H

Harley, H. V., Magnetic demodulation (letter)406D May
 Harris, B., Subcarrier switch for microwave party line175 Nov
 Harrison, Jr., E., Beta gage controls cigarette machine144 Nov
 Hartley, M. S., Ultrasonic machining of brittle materials132 Jan
 Hasse, J. A., Eccentric-line impedance nomograph190 Sept
 Heffner, J. B. & Toscano, CRT power supply uses transistor oscillator162 Sept
 Hekimian, N., Three new transistor circuits178 Nov
 Helstrom, M. J., Design charts for tuned transformers182 Nov
 Henszey, R. T., Push-pull transistor servo amplifier155 Dec
 Heppe, R., Tubes plus diodes (letter)444D Apr
 Herman, E. B., Personal microwave search receiver164 June
 Hershfield, W. N., Multiprogram f-m broadcast system130 June
 Heynick, L. N., Wohl & Andrews, Permanent-writing cathode-ray recorder148 Apr
 Hillman, K., Design chart for selective cathode traps174 July
 Hillman, L., Filling aircraft antennas with isocyanate foam236D Dec
 Hofheimer, E. W., Bistable circuit uses single triode230D Mar
 Hoover, M. V. & Parker, Gas tubes protect high-power transmitters144 Jan
 Hornsbostel, E., Profitable problem for design engineers (letter)462D Oct
 Hubbard, R. W. & Thompson, Jr., Phase generator for tropospheric research220 Oct
 Hudson, O. K. & Watson, Transmitting system uses delta modulation164 Oct

I

Isaacs, J. P. & Grey, Testing hardness with flux gage magnetometer142 Apr
 Isbell, W. D., Take-apart spools for magnetic telemetering tape232D Apr
 Ives, R. L., Piloted deburring tools clean punched socket holes in chassis214D June

J

Jennings, J. E., Power broadcasting (letter)462D Oct
 Jaynes, W. E., Video amplifiers use shunt regulation156 Nov
 Jones, E. M., Pulse circuits fabricate computer code disk146 June
 Jupe, J. H., Linear electrostatic loudspeaker208D Mar

K

Kaminow, I. P. & Kircher, Superregenerative transistor oscillator166 July
 Keister, G. L., Transistor-magnetic analog multiplier160 Oct
 Kelleher, K. S., Designing dielectric microwave lenses138 June
 Keller, Jr., J. M., Regulated transistor power supply design168 Nov
 Kelner, R. C. & Glauberman, Magnetic shift-register correlator172 Aug
 Kimball, H. R. & Chaskin, Regulating amplifier corrects slope and level168 July
 Kinkel, J. F. & Wilson, Vibration meter uses transistors127 Apr
 Kircher, R. J. & Kaminow, Superregenerative transistor oscillator166 July
 Kilvans, L. S., D-C path (letter)504D Mar
 Kochman, A. & Armstrong, Electronic controller for voltages and current208D Feb
 Koeppen, H., Television pioneer (letter)358D Jan
 Kollosch, A. W., Tumbling tube parts gives precision finish266D Mar
 Kornei, O., Magnetic head has megacycle range172 Nov
 Kortman, C. M., Transistors telemeter small missiles145 July
 Kortman, C. M., Transistorized telemetering (letter)438D Sept
 Kouster, P. & Mawhinney, Magnetron tester detects lost pulses164 Aug
 Kuehn, R. L., Signal-triggered sweep magnifies pulse widths146 Apr
 Kramer, S. I., Staircase generator192D Feb

L

Lacy, J. W. & Davis, Servo amplifier uses silicon power transistors136 Jan
 Lambert, Jr., R. D., Receiver calibrates tv modulation monitors266D Oct
 LaPlante, R. A., Nonmicrophonic klystron238D Oct
 Lawn, F., Thyatron inverter uses controlled firing time164 Feb
 Lee, R. & Mullinix, Power transformer design charts184 Apr
 Leitner, G., Old voice power (letter)406D Aug
 Leon, H. I. & Weinberger, Universal response curves184 Dec
 Leslie, R., Transistor amplifier for radar video142 Aug
 Levy, L., Higher pentode gain190D July
 Lichtman, D. & Wells, Basing pencil triodes with epoxy resin246D Jan
 Lillienstein, M., Transistorized regulated power supply169 Dec
 Lin, H. C., Quasi-complementary transistor amplifier173 Sept

Littell, C. C., Jr., Gravity and inertial mass (letter)500D Mar
 Lombardo, J. L., Radar warning net uses centralized control168 Mar
 Lowe, C. E., Time-voltage pulse discriminator178D Feb
 Luftman, A. S. & Buckbee, Designing storage tube equipment126 July

M

MacDowell, J. E. & Nevitt, Carrier telephone expands rural service132 Oct
 MacGee, R. C., Jr. & Mark, Internal shielding effects on bulb temperatures204D Feb
 MacMillan, D. & Zomber, Fuel cut-off control for guided missiles126 Jan
 Maduell, Jr., C. R., Allocation problem (letter)436D Sept
 Magnani, P. & Cechanek, Servo-wound pots276D Mar
 Manogian, H. A. & McKenzie, Telemetering electronic data transmission153 Apr
 Mara, W. A., Punched tape, not magnetic (letter)374D July
 Mark, M. & MacGee, Jr., Internal shielding effects on bulb temperatures204D Feb
 Markus, J. & Findlay, Materials for electronics186 Oct
 Martin, L. J. & Vavra, Pre-tinning techniques for etched wiring234D Jan
 Martin, I. J. & Vavra, Etched wiring boards have resistivity problem239D Apr
 Mawhinney, D. D. & Kouster, Magnetron tester detects lost pulses164 Aug
 Maxwell, D. C., Jr., Alexander & Gordon, Aerosoloscope counts particles in gas188 Mar
 Maxwell, K., Low-cost remote broadcast amplifier192D May
 Maynard, F. B., Binary adder uses gas-discharge triode196D June
 Maynard, F. B., Carluccio & Poelstra, Grid-switched gas tube for display presentation154 Aug
 McCarthy, W. A., One-third watt phonograph amplifier202D Sept
 Meikle, J. B. & Graham, Electronics produce high-temperature dielectric146 May
 Meyers, R. S. & Davis, Triangular-wave analog multiplier182 Aug
 McCoy, R., Jr. & Bedrosian, Normalized filter design200 Mar
 McKenzie, A. A. & Manogian, Telemetering electronic data transmission153 Apr
 McKenzie, A. A., How to reduce off-air time156 Sept
 McLean, D. A., Tantalum capacitors use solid electrolyte176 Oct
 McMann, R. H. Jr. & Mullenger, Correction circuits for color tv transmitters130 Apr
 Miles, R. C., Gear gage controls automatic hobber140 July
 Mitchell, J., Mobile tower for tv remote control206D Apr
 Mollitor, F. W., Gravity and inertia (letter)402D June
 Mullenger, K. E. & McMann, Jr., Correction circuits for color tv transmitters130 Apr
 Mullinix, N. E. & Lee, Power transformer design charts184 Apr
 Munsey, C. & Nutt, Digital presentation vacuum-tube voltmeter148 Jan
 Myers, G. H., Gain chart for transistor amplifiers224 Oct

N

Nevitt, J. B. & MacDowell, Carrier telephone expands rural service132 Oct
 Nosker, C. R., Rambow & Treharne, Pulsed light generator aids plant research206D Aug
 Nutt, A. & Munsey, Digital presentation vacuum-tube voltmeter148 Jan

O

Oberle, G. W., Radar simulator trains master crews155 Nov

P

Parker, W. N. & Hoover, Gas tubes protect high-power transmitters...144 Jan
 Paulson, R., MTJ reliability (letter) 436D Sept
 Pavalow, M. & Davidson, Potentiometer tachometer has high sensitivity156 Sept
 Pennie, D. F., Producing inkless drawings for etched-wiring patterns...228D Jan
 Pielich, P., Three-dimensional radar video simulator131 July
 Pine, C. C., Recorder amplifier for flight testing158 Aug
 Poelstra, W. G., Maynard & Carluccio, Grid-switched gas tube for display presentation154 Aug
 Pondy, P. R., Dust-lint control in tube plants246D June
 Pores, E. B., Video Switching for tv broadcast centers147 Dec
 Prince, M. D., Bandwidth-rise time chart158 Nov
 Proscia, V., Atkin & Bickel, Meter adapter for blind technicians...202D May
 Proscia, V., Rappanael & Dado, Punched-card reader for the blind148 Nov
 Pugh, Jr., J. E., Proposed junction symbol (letter)463D Sept

R

Rambo, W. R. & Confalone, Radar a/c system uses mechanical tuning138 Apr
 Rainbow, P. R., Nosker & Trehanne, Pulsed light generator aids plant research200D Aug
 Rao, P. V., Phase shifter circuits test power meters156 Jan
 Raphael, M. Dado & Proscia, Punched-card reader for the blind148 Nov
 Raphael, M. S. & Robinson, Digital storage using neon tubes162 July
 Rapp, A. K. & Wong, Transistor flip-flops have high speed180 Dec
 Redden, Jr., M. S. & Zancanata, Telemetering receiver conserves bandwidth174 May
 Ressler, H. C., Smith, Stamps & Deuth, Multipath simulator tests communications170 July
 Rigby, S., Analog-to-digital data converter152 Jan
 Ringoen, R. M. & Smith, VHF trans-horizon communication technique...154 May
 Rivera, J. J., Gravity and other factors (letter)465D Oct
 Rivera, J. J., Transistor symbol (letter)400D June
 Roberts, H. L., Low capacitance probe for video testing194D Apr
 Robinson, A. S. & Raphael, Digital storage using neon tubes162 July
 Robinson, B. H., Useful Gage (letter)470D Oct
 Robinson, D. A., Operational amplifier has chopper stabilization182 Sept
 Rosenberg, M., Stuart-Williams & Alexander, Ferrite-core memory is fast and reliable158 Feb
 Rosenthal, L. A., Energy source delivers half-sine pulses176 Sept
 Ross, A. & Simon, Gate selects pulses for spectrum analysis179 Aug
 Ruppert, E. W. & Smith, Airborne weather radar uses isoecho circuit...147 Feb

S

Salisbury, D., Glo-balls measure electric fields206D Aug
 Schlesinger, K., Sampling detector for intercarrier tv sound138 Aug
 Schohan, G., Transient controlled magnetic amplifier176 Aug
 Schreiber, W. F., Cathode-compensated amplifiers (letter)384D Feb

Schultz, C. W. & Bell, Shipboard telemetering for terrier missiles...134 Jun
 Schwartz, S., Transistor characteristics for circuit designers161 Jan
 Schwartz, S., Transistorized receiver for vehicular radio217 Oct
 Sexton, J. R., Proof of performance for tv broadcasters150 Nov
 Shapiro, J., Man's dissipation (letter) 406D Aug
 Sheffield, R., Radio system controls railroad in Venezuela158 Dec
 Shenfeld, S. & Finkle, Storage-tube device simulates radar net171 Apr
 Sherman, K., Eckess & Deavenport, Transistor generator simulates radar target179 May
 Sherrill, P. N., What to emphasize in maintenance manuals150 Sept
 Shulman, A., Radar ppi display uses precision interlace168 May
 Shulman, J. M., VFO with near-crystal stability230D Sept
 Sienkiewicz, J. M., Transistor symbol (letter)355D Feb
 Simon, L. & Ross, Gate selects pulses for spectrum analysis179 Aug
 Singer, E. N. & Galer, Broadband antenna for field-intensity meters...130 Feb
 Sinker, R. A., Photoelectric analog function generator178 Oct
 Sion E., Slab line nomograph192 Sept
 Smith, J. M. & Ruppert, Airborne weather radar uses isoecho circuit...147 Feb
 Smith, J. W. & Ringoen, VHF trans-horizon communication techniques...154 May
 Smith, L. B. & Guditz, Vacuum and vibration speed assembly of core memory planes214D Feb
 Smith, W. J., Stamps, Deuth & Ressler, Multipath simulator tests communications170 Jul
 Snyder, H. W., Velocity meter has direct readout246D Oct
 Soled, J., Slit induction coil heats silicon crystals240D Jan
 Stafford, J. W., Automatic inspection of magnetic-sound prints164 Mar
 Stamps, G. M., Deuth, Ressler & Smith, Multipath simulator tests communications170 Jul
 Stratman, H. G., Exciters multiplex f-m carriers148 Aug
 Stephenson, J. G., Cross pulse pickup in twisted-pair cable170 Feb
 Strassman, A. J., Automatic measurement of voltage tolerances150 Feb
 Street, C. C., Simple circuit measures power supply impedance206 Jun
 Struven, W. C. & Brobeck, Bevatron-frequency measurement system182 May
 Struven, W. C., Bevatron magnet pulse-timing system160 Jun
 Stuart-Williams, R., Alexander & Rosenberg, Ferrite-core memory is fast and reliable158 Feb
 Suzzo, J. J., Magnetic amplifier two-speed servo system140 Feb

T

Tewksbury, C. H., Gravity hypothesis (letter)372D Jul
 Tewksbury, J. M., Beam deflection tube simplifies radio compass166 May
 Thomas, A. G., Electronic printing (letter)376D Jul
 Thompson, Jr., M. C. & Hubbard, Phase generator for tropospheric research220 Oct
 Thurston, Arthur L., Scale weighs moving trucks142 Jan
 Tink, Edward M., TV modulation indicator uses electronic chopper172 May
 Tomer, R. B., Stabilizing v-tubes...218D Sept
 Toscano, P. M. & Heffner, CRT power supply uses transistor oscillator...162 Sept
 Trehanne, R. W., Nosker & Rainbow, Pulsed light generator aids plant research200D Aug
 Turner, R. P., Direct current signal source198D Feb
 Turner, R. P., Transformerless line output preamplifier198D Aug
 Tustin, W., Equipment rental (letter) 500D Mar

U

Upham, J. L. & Dranetz, Transistor quer-film capacitors222D Jun

V

Varian, S. B., Converter for twin single-sideband214D Mar
 Vavra, M. J. & Martin, Pre-tinning techniques for etched wiring...234D Jan
 Vavra, M. J. & Martin, Etched wiring boards have resistivity problem...239D Apr
 Vinding, J. P., Slide-rule computation of guide wavelength196D Feb

W

Wadey, W. G., Biasing large amplifiers141 Jan
 Warzecha, T. D., Telemetering demodulator for wideband f-m data157 Jul
 Waters, W. E., Jr., Low-cost amplifier for analog computers188D Jun
 Watson, R. B. & Hudson, Transmitting system uses delta modulation164 Oct
 Wehe, H. G., Making metallized lacquer-film capacitors222D Jun
 Weinberger, H. & Leon, Universal response curves184 Dec
 Weisbecker, H. B., Regulator stabilizes infrared detector160 Jul
 Wells, B. G. & Lichtman, Basing pencil triodes with epoxy resin...246D Jan
 Welsh, J. P., Taking the heat of miniature equipment152 Oct
 Wessel, A. B., Universal shutter tester162 Feb
 Wetmore, G. E., Helmholtz soil tests magnetic flow meters252D Oct
 White, R. E., Using traveling-wave tubes144 Apr
 Williams, C. E. & Crain, Microwave refractometer predicts propagation...150 Dec
 Williamson, C. N., Direct reading pulse counter194D Dec
 Wilson, M. C. & Kinkel, Vibration meter uses transistors127 Apr
 Wirth, H. J., Wide range meter measures flutter and wow152 Jul
 Witt, S. N., Jr., Transistorizing Meacham-bridge oscillators193 Mar
 Wohl, R. J. & Heynick & Andrews, Permanent-writing cathode-ray recorder148 Apr
 Wolff, E. A., Radar performance nomograph182 Dec
 Wong, S. Y. & Rapp, Transistor flip-flops have high speed180 Dec
 Wouk, V., Human resistance (letter) 374D Jul
 Wulfsberg, P. G., Transistors up reliability of broadcast remotes...122 Jan

Y

Young, C. W., Radar second detector filter nomograph188 May
 Yu, Y. P., Measuring phase at r-f and video frequencies138 Jan

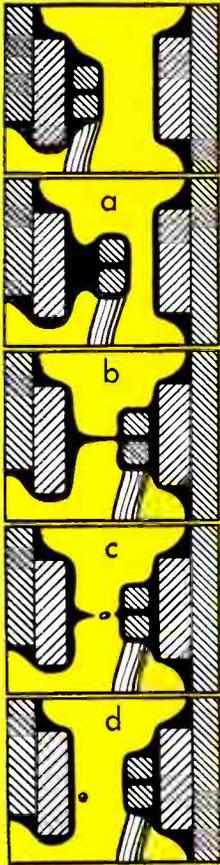
Z

Zancanata, H. W. and Redden, Jr., M. S., Telemetering receiver conserves bandwidth174 May
 Zanella, V. J., Ground-to-air antenna uses helical array161 Mar
 Zeller, H. R., Jr., Transistor preamplifier feeds tubeless servo168 Feb
 Zohar, S., Staggered crystal filters (letter)406D May
 Zomber, G. L. & MacMillan, Fuel cutoff control for guided missiles...126 Jan

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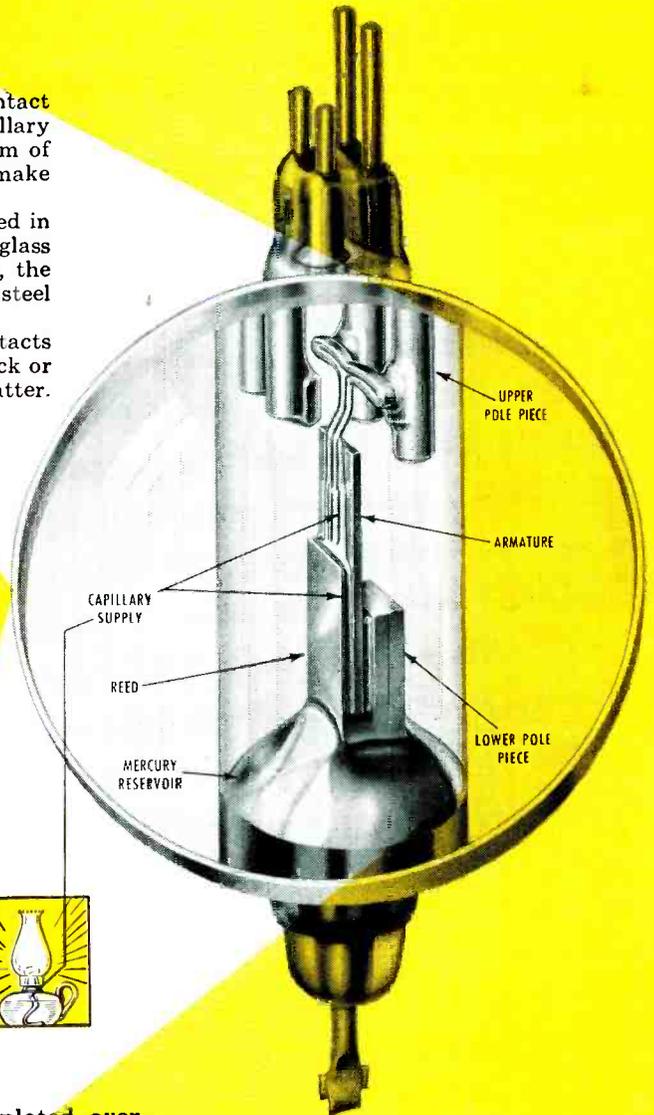


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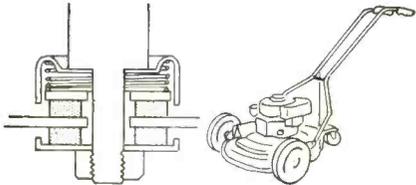
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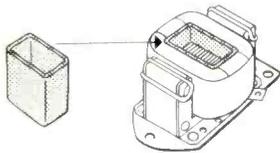
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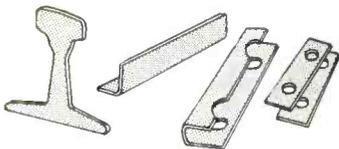
Tips for designers



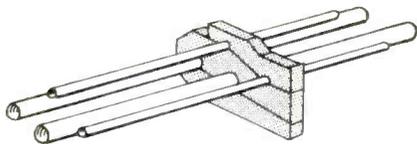
Rotary lawn mower utilizes abrasion resistance of Taylor phenol laminate washer in slip-clutch attachment of drive shaft to cutting blade.



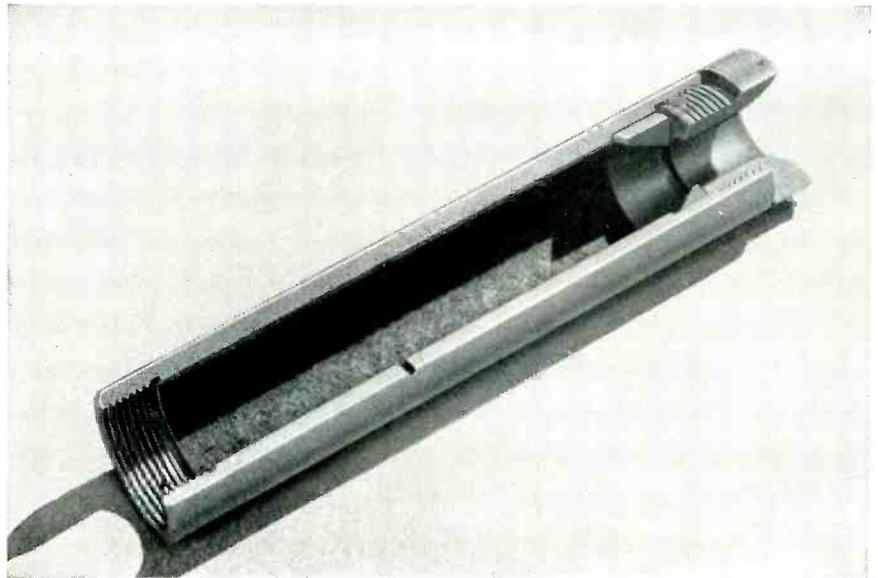
Coil forms for this solenoid have to operate at high temperatures . . . an ideal application for Taylor glass melamine laminates.



Railroad track-joint insulation, a specially developed grade of Taylor vulcanized fibre, withstands heavy impact and mechanical stress of high-speed trains.



Fuel-line clamp for a fighter plane's "pipeline" system is machined from Taylor fabric base laminate which has high mechanical strength and resists extreme temperature and humidity.



Fuse holder used in power lines for underground trolley service is machined to extremely close tolerances from Taylor Grade XX tubing.

Make strong insulated parts ... from TAYLOR laminated tubes and rods

These rugged, readily machined materials make outstanding electrical or mechanical components—at substantial savings in fabrication, assembly, and material costs. Taylor Laminated tubes and rods are the logical choice wherever specifications call for mechanical strength, heat resistance, and electrical insulation.

Taylor tubes and rods are made in many paper, fabric, and glass-base grades, with special formulations of phenol, silicone, melamine, or epoxy resins. Within the complete line the designer and the production man can find a variety of combinations of electrical and physical properties for a broad range of product applications.

Taylor tubes and rods are standard products. Tubes are available with inside diameters as small as three thirty-seconds of an inch . . . rods with diameters from one-sixteenth of an inch.

A Taylor sales engineer will be glad to help you select the grade and size of laminated tubes or rods to match the exact requirements of your application. And, you can eliminate many purchasing, stocking and manufacturing problems by having the Taylor Fabrication Division produce finished parts to your specifications. Call your nearest Taylor sales engineer for a discussion of your specific needs.

NEW TAYLOR

COPPER-CLAD LAMINATES

Taylor GEC (glass-epoxy) Copper-Clad and Taylor XXXP-242 cold punching (paper-phenol) Copper-Clad. Taylor uses high purity rolled copper on base materials with outstanding electrical properties.

BROADBAND MICROWAVE COMPONENTS

Broadband-Pass Filters

Five Models Covering 650 to 13,000 mc
... sharp skirt selectivity. Low pass band insertion using 50 ohm co-axial connections.



Microwave Test Antennas

Six Models Covering 1,000 to 26,000 mc
... rugged, portable. For field measurements, leakage measurements and other laboratory uses. Excellent front to back ratio.



Microwave Attenuator

Model SJJ Covering 4,000 to 12,400 mc
... continuously variable, stub-tuned wave guide beyond cut off attenuator. For use in making microwave measurements with spectrum analyzers, signal sources, receivers, and power meters.



Sub-Miniature S-Band Cavities

Plate and Grid Pulse Models Covering 2,750 to 3,000 mc
... only 3" long and 1" diameter. Useful where miniaturization and high power are essential. Frequency can be varied by simple tool adjustment. Meets stringent military requirements for shock and vibration.



In addition to this wide range of Broadband Microwave Components, Polarad manufactures an extensive line of microwave equipment created to accomplish a variety of difficult testing tasks with a minimum of operational procedure.

For information regarding Polarad General Electronics, Microwave and Color TV Equipment consult your Polarad Field Representatives.



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

YOUR "SPECIAL" TIMER may be one of our 721 STANDARD UNITS!

FUNCTION	no 1		
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TIME			0' 10' 20' 30' 40' 50'

We have 20 years of experience in developing new timers to meet our customers' widely varying requirements. Our Engineering Department not only originates new designs, but also develops modifications for that purpose. That's why most requests for special timers can be filled without delay—by one of the 721 combinations we've developed so far from our 17 basic types of timers. But if we don't have what you want on hand, we'll welcome the chance to design and make it for you! And quickly too!

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*Timers that Control
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HIG-3 MODEL 2 GYRO

The smallest integrating Gyro available to meet the exacting requirements of guidance systems. This viscous damped, single degree of freedom Gyroscope has a drift rate of .005 milliradians/second.



PRESSURE SENSING DEVICES

Used for the measurement of absolute, differential and gage pressures. Accuracies within $\pm 2\%$ or better throughout entire operating range.



HIG-4 MODEL 2 GYRO

Greater accuracy, including low drift rate, is a feature of this HIG-4 Gyro, now being used for missile guidance and fire control systems. The design and development phases of this Gyro have long been completed and it is now a production item.



FREE, RATE, DIRECTIONAL AND VERTICAL GYROS

For telemetering, missile guidance, inertial guidance and navigation. Whatever your gyroscope requirements, Greenleaf has the accurate, economical answer.



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The Greenleaf line includes linear, angular and three-axis accelerometers. Accuracy is within $\pm 2\%$ or better throughout the entire operating range. Military environmental conditions were considered in the design of these units in order to comply with the reliability concept.

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Complete specifications and technical Bulletins will be sent immediately upon request. Write, wire or 'phone today.

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Greenleaf offers unusual opportunities for mechanical and electrical engineers.

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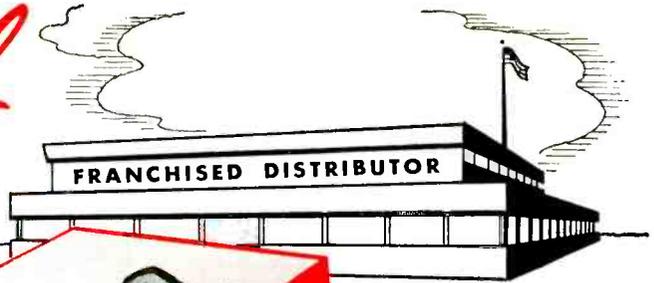
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Producers of the HIG-3 and HIG-4 Gyros, Rate and Free Gyros, Differential Pressure Mach Meters, Air Speed Indicators, Computers, Switches, and many other precision-built components.

GRE-55RR

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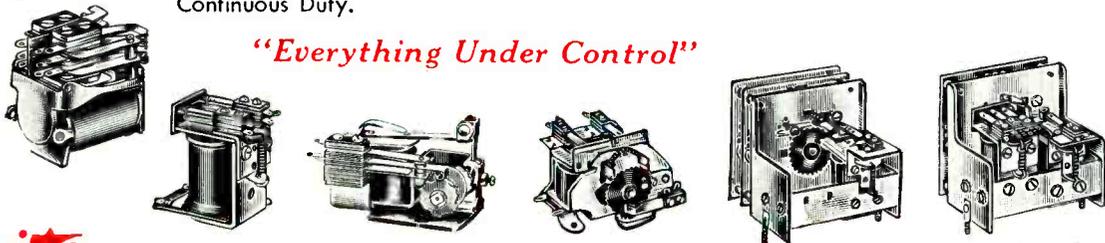
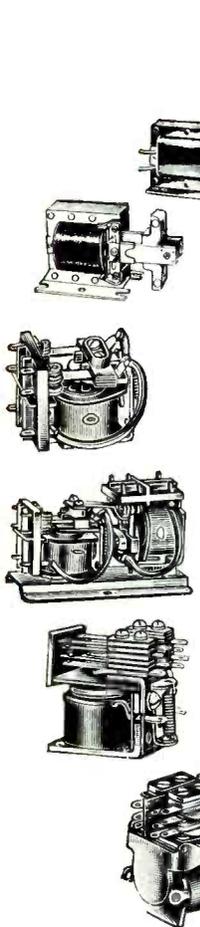


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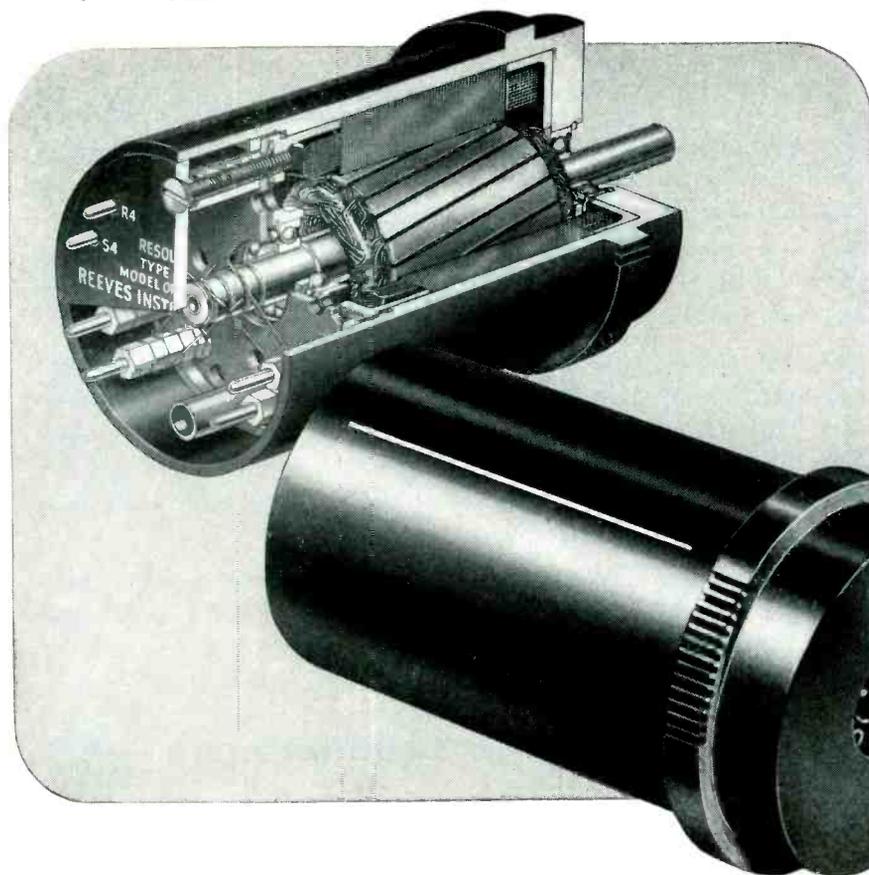
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the HIGHEST PRECISION resolvers available

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Reeves' many years of experience as a pioneer in the field has made it possible to manufacture these compact precision resolvers in quantity production to a functional accuracy of 0.05% without culling—or to an accuracy of 0.03% on special order. Harmonic distortion and null voltages are held below one-tenth of one per cent.

Reeves resolvers are primarily designed for 60 and 400 cps. operation, with or without booster amplifier compensation. Special units are available for use at over 100 kc bandwidth. The Reeves R600 series is the standard of comparison among precision resolvers. Miniature resolvers of highest precision are also available.

Write for the Reeves Resolver Handbook.



REEVES INSTRUMENT CORPORATION

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THE HOW AND WHY

OF THE WORLD'S PUREST SILICON

The purification of silicon by Bell Laboratories metallurgists has been richly rewarding. Their original research in this field revealed the chemical factors that control semiconductors; it was a major advance leading to Bell Laboratories' invention and development of transistors and the Bell Solar Battery. Now they have devised a simple but highly effective way to remove boron—one of the most difficult impurities to extract from silicon.

During refining, a stream of hydrogen and water vapor is kept flowing past the silicon. As the water vapor passes over the liquid silicon, it seizes boron atoms, forming boron oxide. The oxide is then pulled away to condense on the wall of the refining tube which is cooled by a water stream. Result of refining: boron and other harmful impurities are reduced to less than one part in 10,000,000,000.

The new silicon is being used to develop still better transistors and rectifiers for telephony. It is another example of how Bell Laboratories metallurgists help open the way to improved telephony.

BELL TELEPHONE LABORATORIES



World center of communications research and development



Metallurgist Henry C. Theuerer, M.A. in Chemistry, Columbia, watches a molten zone in a silicon rod under purification. Mr. Theuerer's most recent achievement was development of water-vapor treatment for removal of boron.

Transitron

SILICON VOLTAGE REGULATORS

UP TO 50 ma



Type	Voltage Range (volts)	Maximum Average Current ma		Maximum Dynamic Resistance (ohms)
		at 25°C	at 125°C	
SV-5	4.3 - 5.4	50	10	55
SV-6	5.2 - 6.4	40	8	20
SV-7	6.2 - 8.0	30	6	10
SV-9	7.5 - 10.0	25	5	20
SV-11	9.0 - 12.0	20	4	70
SV-13	11.0 - 14.5	17	3.4	100
SV-15	13.5 - 18.0	14	2.8	120
SV-18	17.0 - 21.0	12	2.4	200

UP TO 150 ma



SV-804	4.3 - 5.4	150	30	55
SV-805	5.2 - 6.4	120	24	20
SV-806	6.2 - 8.0	90	18	10
SV-808	7.5 - 10.0	75	15	20
SV-810	9.0 - 12.0	60	12	70
SV-812	11.0 - 14.5	50	10	100
SV-815	13.5 - 18.0	40	8	120
SV-818	17.0 - 21.0	35	7	200

UP TO 2 AMPS



Type	Voltage Range (volts)	Maximum Average Current		Maximum Dynamic Resistance (ohms)
		(amps)	(ma)	
SV-904	4.3 - 5.4	2.0	400	2
SV-905	5.2 - 6.4	1.6	320	2
SV-906	6.2 - 8.0	1.2	240	2
SV-908	7.5 - 10.0	1.0	200	2
SV-910	9.0 - 12.0	.8	160	2
SV-912	11.0 - 14.5	.7	140	4
SV-915	13.5 - 18.0	.6	120	6
SV-918	17.0 - 21.0	.5	100	8

Transitron's silicon voltage regulators (sometimes called Zener diodes) are constant voltage elements for control and similar circuitry. They provide excellent regulation and stability over a wide operating range.

Through improved thermal design, each of the three regulator series will give high load currents in the smallest possible size. The subminiature glass types, for example, provide twice the current in less than half the size of conventional regulators. High power types can be used to simplify circuits and eliminate amplification stages.

Inquiries are invited on higher voltage regulators, and precision, temperature compensated voltage reference elements.

SEND FOR
BULLETIN TE 1352

Transitron

electronic corporation • wakefield, massachusetts



Germanium Diodes



Transistors



Silicon Diodes



Silicon Rectifiers

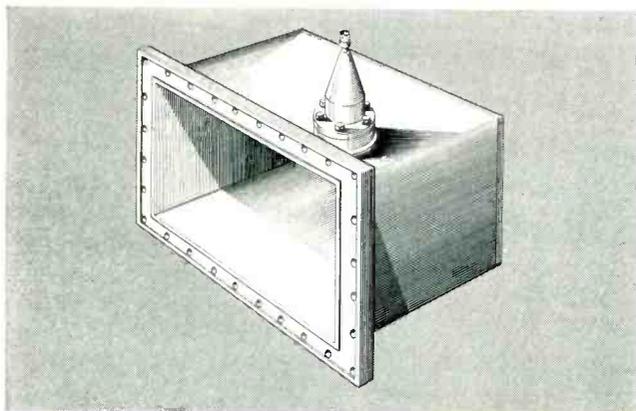


LARGE

WAVEGUIDE COMPONENTS

WR 770 to WR 2100 and larger if required

To complement the waveguide presently being supplied for major military and commercial applications we now offer a complete line of components and test equipment. All items are currently in production and are available on short term delivery.



● Waveguide to Coaxial Transitions

High-strength, lightweight aluminum construction. Supplied as standard with 3 1/8 in. coaxial connector-adapters to other sizes available. All transitions designed for high power handling capacity.

● Terminations

Aluminum construction. Engineered to absorb virtually all incident power. Load is adjustable with locking device to secure it in any position.

● Attenuators

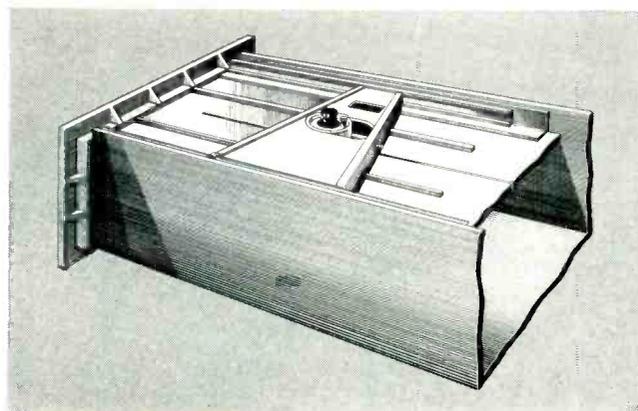
Vane type designed to provide 20 db of attenuation with a minimum of mismatch. Calibration curves available.

● Directional Couplers

Bolted and doweled aluminum construction. Power split to customer requirements.

● Special Components

Including Waveguide Switches, Duplexers, Diplexers, Series and Shunt Tees, Rotary Joints, and Special Shapes.



● Slotted Lines

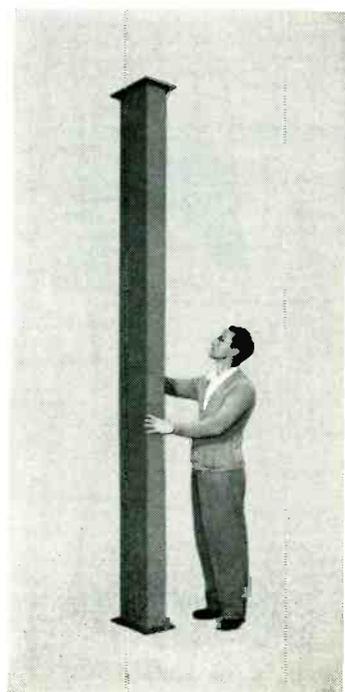
Fully engineered, aluminum bolted, and doweled construction. Probes tunable over entire frequency band.



For more information on above components and waveguide, write I-T-E Circuit Breaker Company, Dept. 55, Special Products Division, 601 East Erie Avenue, Philadelphia 34, Pa.

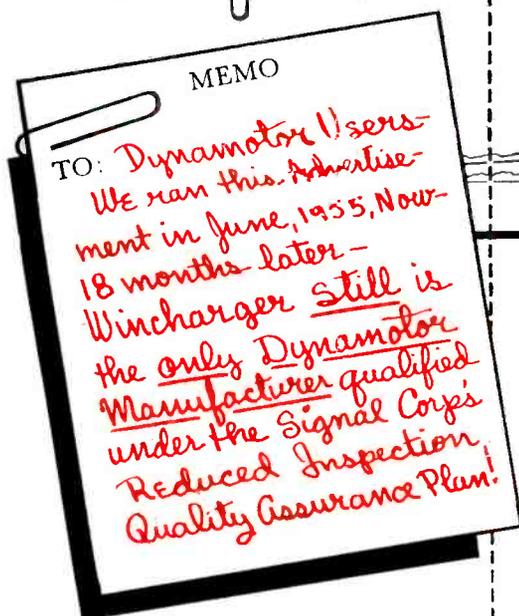
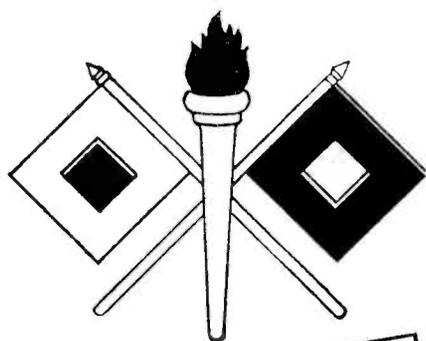
I-T-E CIRCUIT BREAKER COMPANY

Special Products Division



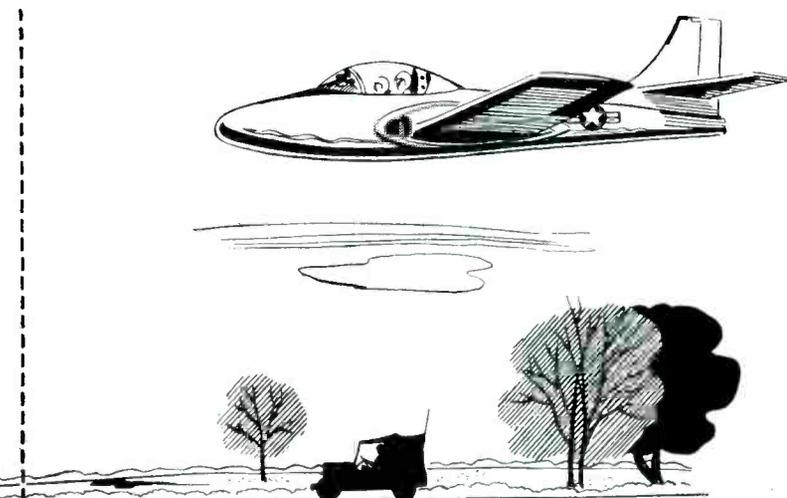
Winco dynamotors qualify

for Signal Corps Reduced Inspection Plan



WINCO®

Power for the nation's
mobile communications



The Wincharger Corporation's long history of producing dynamotors *equal to or better than the Acceptability Quality Level established by the government* has resulted in the Signal Corps' selection of Winco dynamotors for its Reduced Inspection Quality Assurance Plan.

As of this writing, *Wincharger is the only manufacturer of dynamotors qualified under RIQAP.* Only those suppliers who have consistently furnished material of the highest quality level and who maintain quality control and inspection methods and procedures acceptable to the Signal Corps are considered for this honor.

This new Signal Corps plan places more responsibility for maintenance of quality on the manufacturer by reducing the amount of government inspection. It is an honor inspection program.

What does Wincharger qualification for RIQAP mean to you — further evidence that you can depend on Winco Products.

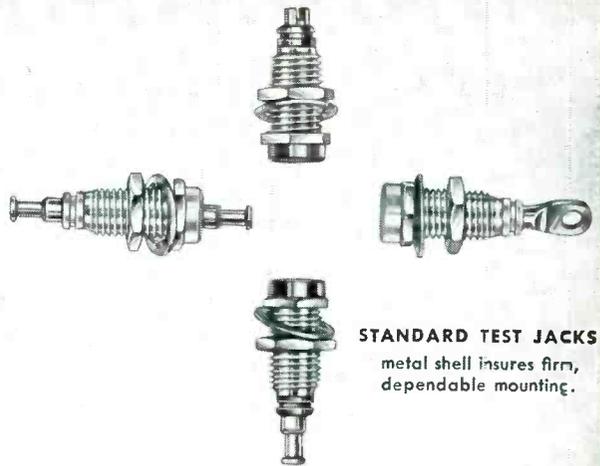
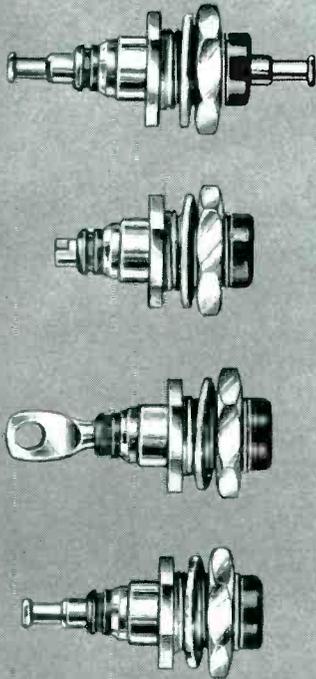
WINCHARGER CORPORATION

Sioux City 2, Iowa

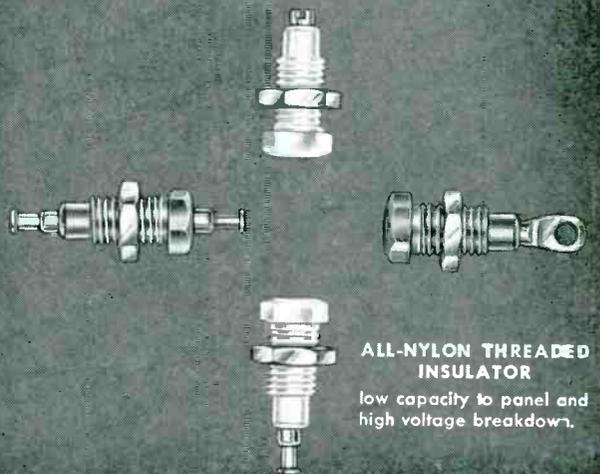
Subsidiary of Zenith Radio Corporation

new

BACK-MOUNTING TEST JACKS
permit bench soldering to wiring harness before mounting.



STANDARD TEST JACKS
metal shell insures firm, dependable mounting.



ALL-NYLON THREADED INSULATOR
low capacity to panel and high voltage breakdown.

Test Jacks by Ucinite

The introduction of Ucinite's back-mounting jacks makes available for the first time a *complete* line of *high quality* test jacks suitable for use in equipment where long life and dependability are essential.

Ucinite Test Jacks, designed for standard .080 phone tips, are available in a variety of colors ideally suited to coded application. Silver-plated, heat treated beryllium copper contact is made in one piece with large terminal ends for easy solder-

ing. The feed through type is provided with a one-piece brass terminal stud, tin-plated.

The specialized abilities and experience of Ucinite's own staff of design engineers are available for work on new and unusual problems. Volume production facilities ensure fulfillment of the largest requirements.

For full information, call your nearest Ucinite or United-Carr representative or write directly to us.



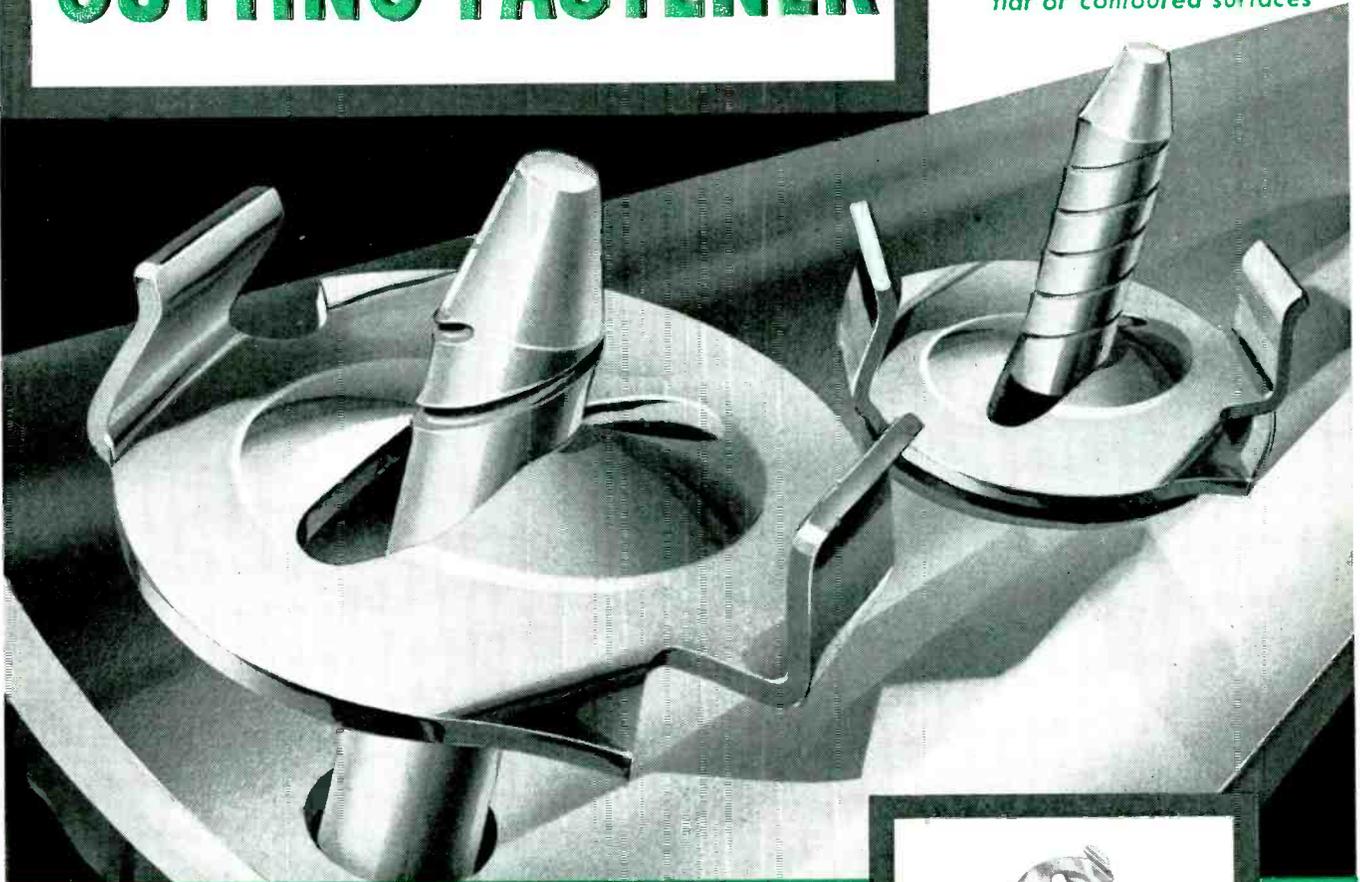
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UCINITE CO.
Newtonville 60, Mass.
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NEW **THREAD** **CUTTING FASTENER**

- LOW COST
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- SELF-LOCKING
- VIBRATION-PROOF
- SPRING TAKE-UP

*Pulls up tight
without backup on
flat or contoured surfaces*

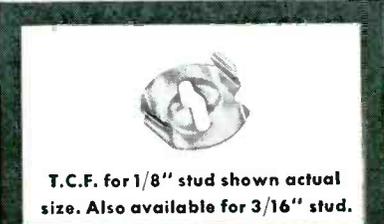


Specially designed to hold die-cast or cold-forged name plates, emblems and trim against sheet metal surfaces, DOT's new T. C. F. cuts clean, deep threads on unthreaded studs, even those that are chrome plated. Immediately available to fit 1/8" and 3/16" studs.

When used with its pre-assembled plastic sealer, the new T. C. F. makes a watertight seal. The sealer precedes the fastener onto the stud so that it is not damaged by the thread-cutting process.

Available in quantity with or without sealer from Monadnock Mills subsidiary and Carr Fastener Division.

United-Carr's design staff is ready to apply the same engineering creativity that produced the T. C. F. and thousands of other special-purpose fastening devices to the solution of your special fastening problems. Field representatives are located in most principal cities.



T.C.F. for 1/8" stud shown actual size. Also available for 3/16" stud.



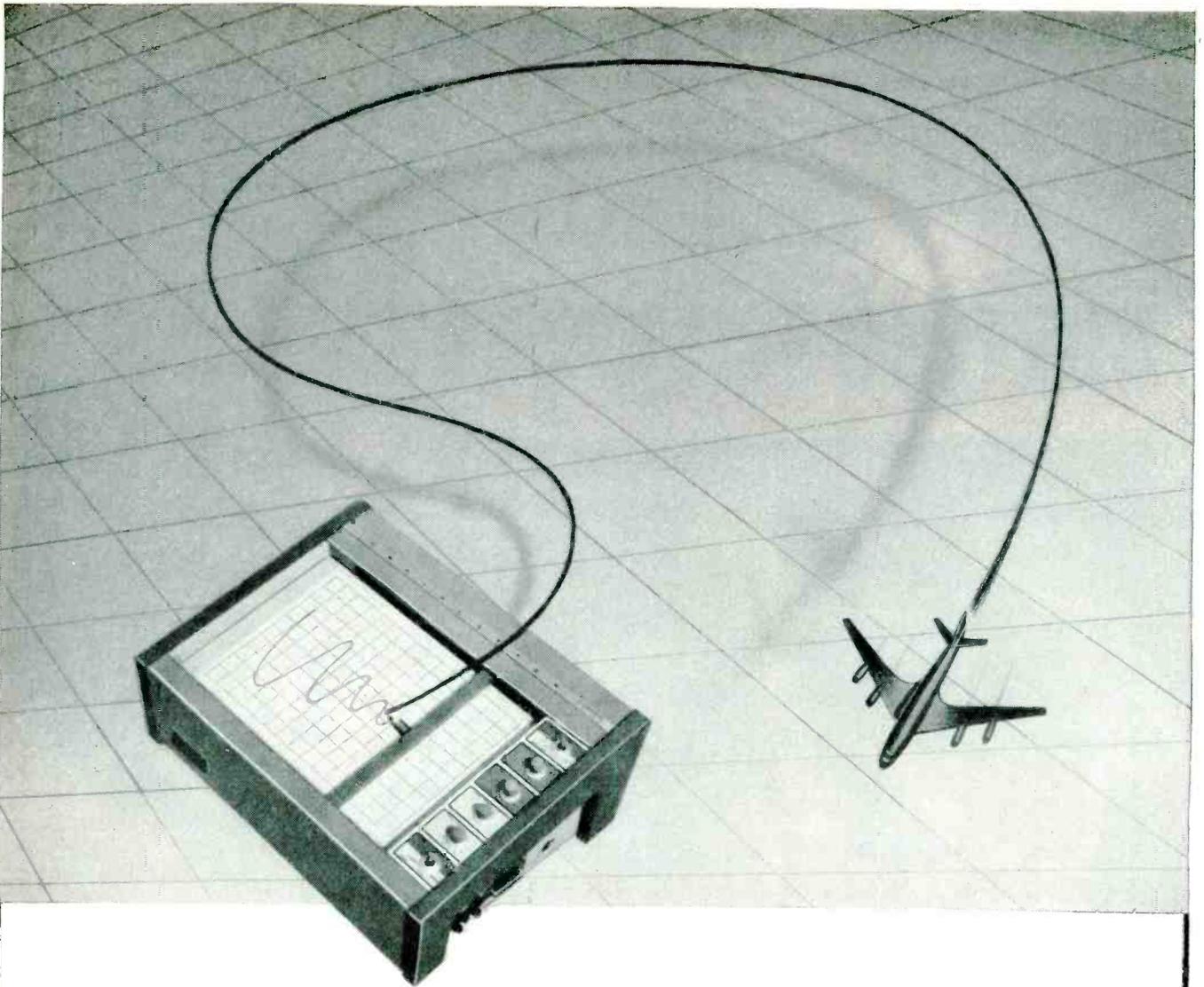
T.C.F. for 1/8" stud with plastic sealer.

MONADNOCK MILLS
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San Leandro, California



CARR FASTENER CO.
DIVISION
Cambridge, Massachusetts

UNITED - CARR FASTENER CORPORATION



*Announcing a new member
in a proud family*

Once again, setting the PACE, Electronic Associates announces the newest addition to the royal family of recording equipment — the new Variplotter Model 1100D.

Another example of the PACE of Progress set by Electronic Associates, the new Model 1100D Variplotter offers 9 specific, built-in operational advantages, as well as 5 new integral convenience factors, to assure the ultimate in X-Y; table-top recording.

Complete specifications on these 9 operational advantages and 5 convenience factors will be forwarded to you on request.

For details on this and other Variplotter models, as well as information on Analog Computing Equipment, time rental at our Princeton Computation Center, or a visit with our skilled Sales Engineering staff, write Dept. EL-12, Electronic Associates, Inc., Long Branch, N. J.

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the answer...or, we
can manufacture a
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to your unique
specifications!

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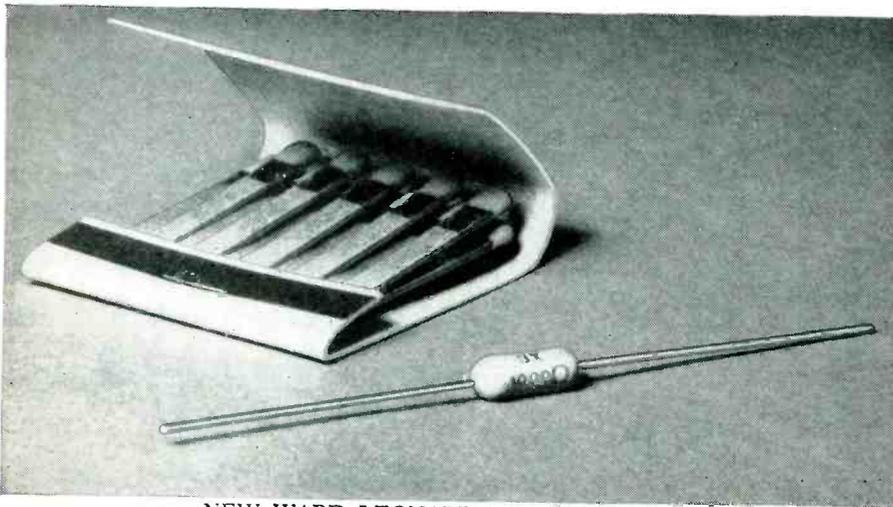
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★ Control Components Digest ★

News and notes on resistors, rheostats, relays, motor controls, dimmers and other control components

NEW! MINIATURE RESISTOR for MINIATURE EQUIPMENT

New Ward Leonard 3-watt wirewound fills need for high-stability, space-saving power resistor



NEW WARD LEONARD TYPE 3X Resistor

A 3-watt wirewound with the compactness of an ordinary 1/2-watt composition resistor—that's what Ward Leonard's new Type 3X Axiom resistor gives you!

This new resistor now makes it practical to specify a wirewound resistor for your transistorized, printed-circuit, or other miniaturized designs. You get the wirewound resistor's drift-free stability, low voltage coefficient, and high overload capacity in a tiny package.

Type 3X Axioms, like larger Ward Leonard Axiom resistors, are wound with special alloy resistance wire on tough miniature ceramic cores. Temperature coefficient of resistance is exceptionally low.

Resistance wire and axial leads are spot-welded to end caps, insuring a strong, permanent, low-resistance bond.

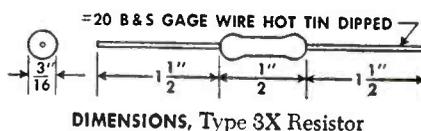
The entire resistor assembly is encased in Vitrohm enamel forming a hard, crazeless, heat-conducting hermetic seal. Leads are tin-dipped for fast soldering. No mounting hardware is required. Conservative 3-watt rating is based on 300°C rise, 40°C ambient.

Order these resistors by type number (3X) and resistance value (see table at right).

STOCK VALUES, TYPE 3X

Value* (Ohms)	Current (ma)	Value* (Ohms)	Current (ma)
1	1732	400	87
1.5	1413	450	82
2	1226	500	78
3	1000	600	71
4	866	700	66
5	776	750	63
7.5	632	800	61
10	548	900	58
12	500	1000	55
15	447	1100	52
20	387	1200	50
25	346	1250	49
30	316	1500	45
35	293	1750	42
40	274	2000	39
50	245	2250	36
75	200	2500	35
100	173	3000	32
125	155	3500	29
150	141	4000	27
200	123	4500	26
225	116	5000	25
250	110	6000	22
300	100	6500	21
350	93	.....	..

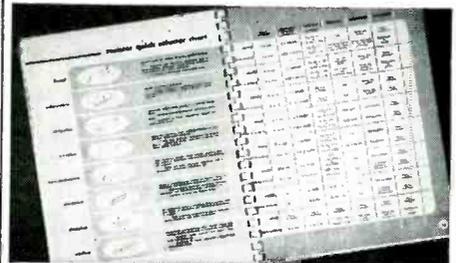
*Resistance tolerance ± 5 percent



You can still get 5- and 10-watt Ward Leonard miniatures

Ward Leonard 5- and 10-watt Axioms have proved themselves in business machines, guided missiles, computers, communications equipment, and many other electronic and electrical devices. They have the same wirewound construction as the new miniature 3X resistor—differing only in size and wattage rating.

You'll find complete specification data on these larger miniature resistors in Ward Leonard's information-packed Catalog 15. (Complete data on the 3-watt unit will be found in Catalog 15, Supplement B.)



WARD LEONARD CATALOG 15. Sixty-five pages of data help you select the right resistor for any job.

And big ones, too!

Ward Leonard Vitrohm resistors are available in stock sizes up to 200 watts. Similar resistors up to 550 watts are made on special order. You'll find these power resistors in a wide variety of mounting styles and types, tapped, untapped and regular or non-inductive wound, described in our big Catalog 15. Write for your copy today. 6.9

WARD LEONARD ELECTRIC COMPANY
31 SOUTH ST., MOUNT VERNON, N. Y.



Result-Engineered Controls Since 1892
RESISTORS • RHEOSTATS • RELAYS • CONTROLS • DIMMERS

where frequency stability is a "must"...

THIS

VARIAN

KLYSTRON



HAS

NO

EQUAL

FOR X-BAND RADAR RECEIVERS

IT'S THE LOW COST RUGGED VA-203B . . . most advanced reflex klystron ever developed for 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 250 G) . . . Varian offers the VA-201 klystron. This tube is equipped with integral molded silastic leads, is similar to the VA-203B 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-203B weighs less than 4 ounces. Both tubes mate directly to standard waveguide flanges.

GUARANTEED SPECIFICATIONS

8500 to 9600 mc	VA-203B	VA-201
Resonator Voltage	300 V	300 V
Heater Voltage	6.3 V	6.3 V
Heater Current	0.45 Amp	1.2 Amp
Power Output	20mW, Min	40mW, Min
Electronic Tuning Range	30 Mc, Min	20 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 VA-203B and its companion VA-201 . . . finest klystrons made for modern radar. Write to our Applications Engineering Department today.

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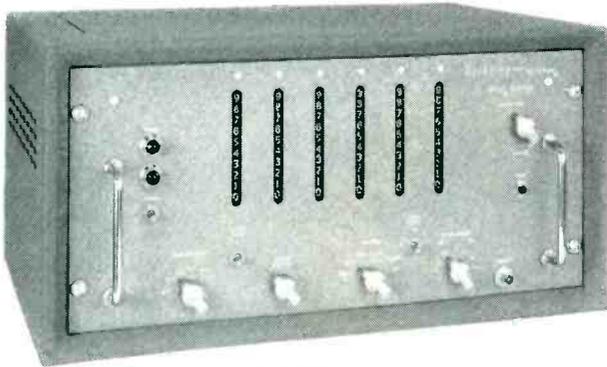
from the leader in the field!

NEW

Berkeley

MODELS
7150 and 7160

EPUT* METERS



MODEL 7160—Frequency range, 0 cps to 1 mc

DESCRIPTION

BERKELEY EPUT* METERS automatically count and display the number of events that occur during a precise time interval. Events may be any mechanical, electrical, optical or other physical occurrence that can be represented by changing voltages. Capable of counting random or regularly occurring events at rates to 1,000,000 per second (Model 7160), the EPUT* meter is a highly flexible instrument.

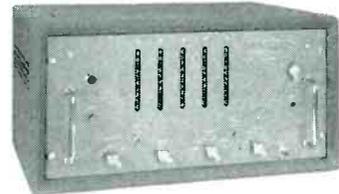
It is useful as an electronic tachometer, secondary frequency standard, frequency or period measurement device, or as a multipurpose laboratory instrument. Operation is simple and results are presented in direct-reading decimal form.

FEATURES

- 1 0.1 v rms sensitivity
- 2 Step attenuators; trigger-adjusted noise discriminators
- 3 More stable frequency dividers
- 4 Electronic (not relay) reset
- 5 External frequency standard input connection
- 6 AC or DC coupling of all input circuits; 10 megohm input impedance
- 7 Multivoltage accessory socket to power photocells, etc.
- 8 Binary-coded output with direct connection to digital printers, data converters, inline readouts, etc.
- 9 Crystal-controlled time marker output
- 10 Unitized modular design
- 11 Larger, brighter readout numbers
- 12 Modern-styled all-aluminum cabinets

BRIEF SPECIFICATIONS

	Model 7150	Model 7160
Range:	0 cps to 100 kc	0 cps to 1 mc
Accuracy:	± 1 part in 10^3 , ± 1 count	± 3 parts in 10^3 , ± 1 count
Time Bases:	10 μ sec to 1 sec, decade steps	1 μ sec to 1 sec, decade steps
Input Requirements:	0.1 v rms, dc or ac-coupled, 10 megohms impedance	
Power Requirements:	117 v, $\pm 10\%$, 50-60 cps, 175 watts (approx.)	
Display Time:	(Automatic reset), adjustable, 0.05 to 5 sec. Manual reset also provided	
Dimensions, Weight:	10 $\frac{1}{4}$ " H x 20 $\frac{3}{4}$ " W x 16 $\frac{1}{2}$ " D, 60 lbs. (Cabinet mount); (Also available in rack mount)	
Price:	\$775.00 f.o.b. factory	\$995.00 f.o.b. factory



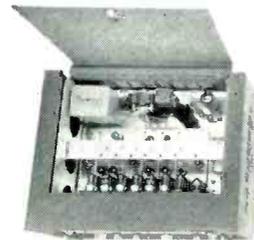
MODEL 7150—Frequency range, 0 cps to 100 kc



MODEL 5916—In-Line Remote Readout connects directly to EPUT* meter. Illuminated in-line figures reduce error and fatigue; ideal for remote observation of data.



MODEL 1452—Digital Printer, prints data on standard adding machine tape. EPUT* meters will also drive data converters to operate IBM card punches or teletypewriters.



Accessibility is an important feature of BERKELEY 7000-Series instruments. Modular chassis design permits rapid checking or replacement of components and sub-assemblies.

Technical bulletins and application data files are yours for the asking; please address Department G-12

TRADEMARK REG.

Berkeley

division

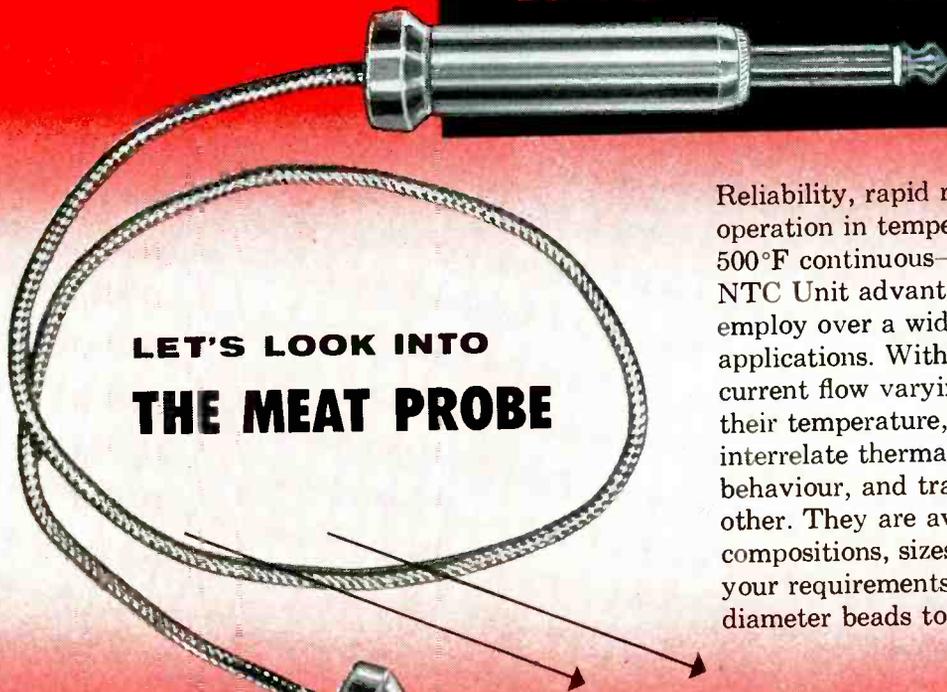
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96

WHERE YOUR PROJECT
CALLS FOR
**TEMPERATURE
MEASUREMENT
and CONTROL....**

Design with
DEPENDABLE
KEYSTONE
NTC THERMISTOR UNITS



**LET'S LOOK INTO
THE MEAT PROBE**

Reliability, rapid response, stable operation in temperatures as high as 500°F continuous—these Keystone NTC Unit advantages are yours to employ over a wide range of project applications. With resistance to current flow varying inversely to their temperature, Keystone thermistors interrelate thermal and electrical behaviour, and translate one into the other. They are available in many compositions, sizes and shapes to meet your requirements (from tiny .050 diameter beads to 5 watt discs).



**HOW DO YOU
LIKE YOUR ROAST?**

Manufactured by King-Seeley Corporation, this remarkable Meat Probe lets housewife see exact degree of "doneness" of the meat as cooking progresses—without opening oven door! Probe is inserted in roast, monitors internal rising temperature continuously, indicates Rare, Medium, Well Done conditions accurately on external gauge, thanks to Keystone NTC sensing element.



KEYSTONE NTC Thermistor in nose of stainless steel probe decreases in electrical resistance as temperature rises, permitting greater circuit current flow, thus actuating external temperature gauge. Circuit consists of regulated voltage supply with thermistor and gauge connected in series.

K *eystone* **CARBON COMPANY**

ST. MARYS, PA.

Telephone 41-591



Should you be using... ..ALITE?

If you require a material with properties such as these:

- **LOW DIELECTRIC LOSS FACTOR** • **HIGH TEMPERATURE STABILITY**
- **EXTREME HARDNESS** • **EXCELLENT CORROSION RESISTANCE**

— it would be well to investigate the possibilities of Alite.

The Alites are a series of sintered metallic oxides developed by The U. S. Stoneware Co. Because Alite possesses the unique combination of electrical and physical properties above, it is finding increasing use in critical applications involving stringent electronic and/or mechanical requirements.

Alite retains its mechanical characteristics at working temperatures well above 2000° F. It maintains low loss characteristics throughout the entire spectrum, into the microwave range. In addition to giving durable service as high-strength insulating components, Alite is used for rotating seals, pump plungers,

slide valves, crucibles, sleeve bearings, bushings, extrusion dies, etc.

We can form Alite to practically any shape by extruding, pressing, molding or casting. It can be finished to precision tolerances by diamond wheel grinding and lapping. Alite is abrasion-resistant, vacuum-tight, can be metalized and brazed to metal components.

If "heat-barrier" problems or mechanical limitations forestall improved performance of your product or application, *consider designing for Alite.* We'll furnish complete data promptly. Write today for Bulletin A-7.

382-E

ALITE DIVISION

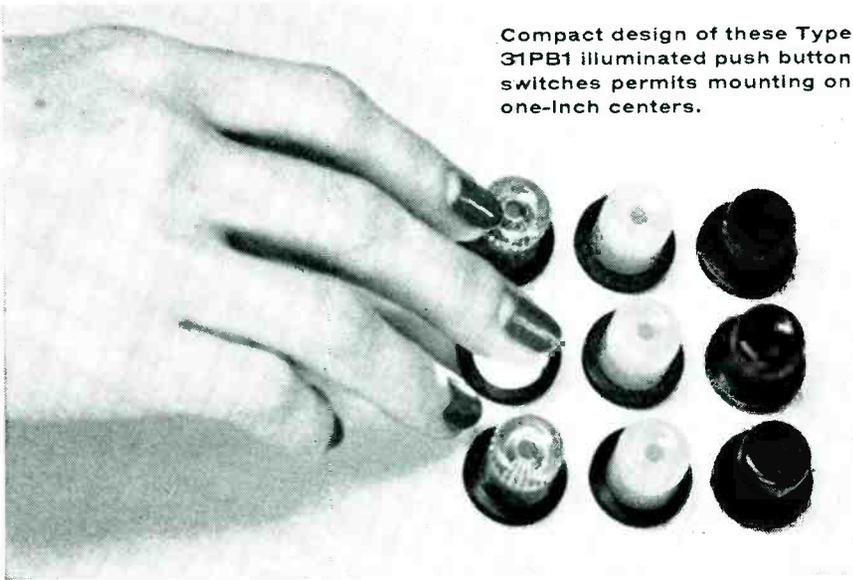


U. S. STONEWARE
AKRON 9, OHIO

MICRO precision switches



... THEIR USE IS A PRINCIPLE OF GOOD DESIGN



Compact design of these Type 31PB1 illuminated push button switches permits mounting on one-inch centers.

SPACE-SAVING FEATURES of these Illuminated Push Button Switches CAN CUT PANEL COSTS IN HALF

Designers of equipment for electronic, aircraft, marine, railway and other low voltage a-c or d-c applications find the MICRO SWITCH line of illuminated push button switches to be ideal components—to meet a wide variety of applications.

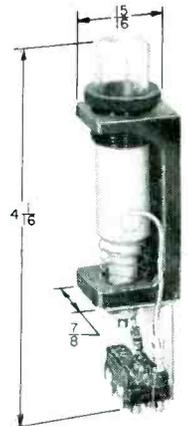
All MICRO SWITCH illuminated push button switches incorporate the features of precision switching with self-contained indicating light or lights in one compact assembly.

Basic switching units of these switches are rated: 125 or 250 volts a-c, 5 amperes; 30 volts d-c inductive, 3 amperes at sea level, 2.5 amperes at 50,000 feet; 30 volts d-c resistive, 4 amperes at sea level, 4 amperes at 50,000 feet; maximum inrush 15 amperes.

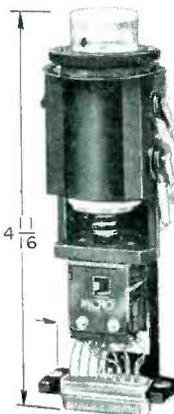
For complete information on these illuminated push button switches, and the complete line of MICRO SWITCH Precision switches, we invite you to contact your nearest MICRO SWITCH branch office. Engineering Service is available to assist in the solution of your switch application problems.

MICRO SWITCH TYPE 31PB1

switches are low-force, high-pretravel switches with an indicating light as integral part of the push button. Incandescent bulbs are used with 6 to 28 volt d-c circuits—neon bulbs with resistor on 115 volt circuits.



(Send for Data Sheet 99)



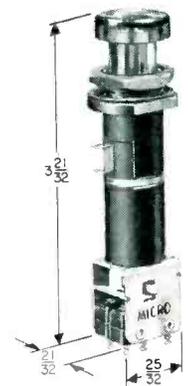
MICRO SWITCH TYPE 62PB1

switch lights in three different colors and plugs in like a radio tube. Three separate lamps, energized by separate circuits, are alternately visible through the plastic button.

(Send for Data Sheet 110)

MICRO SWITCH TYPE 52PB

switches are unusually precise, accurate and dependable for operation of computers and other similar devices. Power for the light is obtained from a circuit other than that to which the switching units are wired.



(Send for Catalog 75)

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS





BENDIX SUPERMARKET FOR PRECISION SYNCHROS

If you're in the market for precision synchros, it will pay you to make sure it's the *Bendix* "market" you're in. There you'll get—

FAST DELIVERY: Because of our heavy volume—as the country's largest producer of synchros—we can offer immediate delivery of practically all synchro types.

MINIMUM COST: Again, because of our heavy volume, we can fill even small-quantity synchro orders at production prices.

ALL TYPES—PREMIUM PRECISION: We make just about any type of synchro you could want—all built to the exacting precision standards that long ago made Bendix the "buy-word" for synchros.

So, when you're shopping for precision synchros to use as transmitters, receivers, control transformers, differentials, or resolvers . . . including corrosion-resistant and high-temperature models . . . be sure to find out what we have to offer.

District Offices: Burbank, Calif.; Dayton, Ohio; Seattle, Wash.
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SIZE 8
CORROSION-
RESISTANT





✓ SYNCHROS
Outstanding electrical characteristics.

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Smallest on market. Linearity
1/2 of 1% to 3000 rpm.



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High torque-to-inertia ratio.

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For high-speed switching

CBS HIGH-FREQUENCY TRANSISTORS

2N182
2N183
2N184

These transistors are especially designed for high-speed switching . . . control . . . analog and digital computer applications. They are:

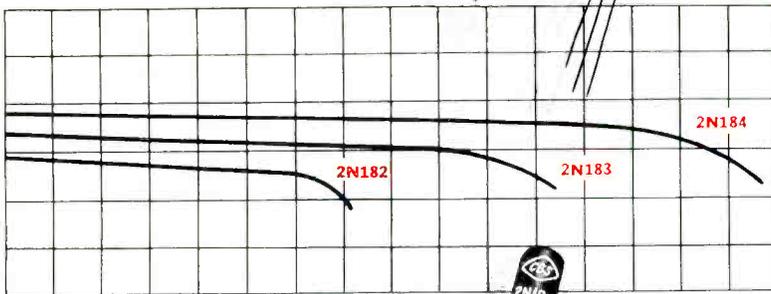
1. *NPN Symmetrical* . . . for better frequency response and reversible collector and emitter, permitting unusual applications.
2. *Alloy-Junction* . . . for greater uniformity, higher voltage and current, flatter gain, and more dependable performance.

Note the many desirable features. Write for Bulletin E-268 giving complete data and helpful application notes.



CHECK THESE FEATURES

1. High frequency response:
2N182 2.5 to 5 mc.
2N183 5 to 10 mc.
2N184 10 to 20 mc.
2. High operating voltage . . . up to 30 volts.
3. High switching speed . . . below 0.2 μ sec.
4. High current amp. factor . . . up to 100.
5. High dissipation rating . . . up to 100 mw.
6. Low leakage current 3 μ amps av.
7. Low base resistance 150 ohms av.
8. Low collector capacitance 10 μ mf.



*Reliable products
through Advanced-Engineering.*



semiconductors

CBS-HYTRON

Semiconductor Operations, Lowell, Mass.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

Sylvania is
your source!

Ge

high purity GERMANIUM

for
transistors

for
diodes

Need germanium of critical purity? Sylvania is your source for zone-purified and single crystal germanium of 40-ohm cm resistivity—for your most exacting electronic applications.

Every step in germanium production, from concentrated ore to monocrystalline material, is performed in Sylvania's own plant, under the most rigid quality control checks known to metallurgical science. Starting with spectrographically pure germanium dioxide powder, ingots are produced in a reducing atmosphere. After cleaning and etching, each ingot is repeatedly zone purified. When impurities are reduced to the necessary minimum, undoped crystals are grown by the vertical (Czochralski) method.

Sylvania germanium is available in several forms and degrees of purity, to suit your requirements: as reduced and melted ingots; zone-purified ingots; undoped single crystals. At 25° C, all forms are of the n-type. Also available is high purity germanium dioxide.

You are invited to write us about your specific germanium needs. Standard forms are available promptly. Others, to fulfill special conditions, can be supplied to your order. Write for technical data.

SYLVANIA ELECTRIC PRODUCTS INC.
Tungsten and Chemical Division
Towanda, Penn.

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS

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LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY



GIVE YOUR PRODUCT
A luxury look...
WITHOUT INCREASING COSTS

WITH CHASE® S-19 PROCESS BRASS STRIP

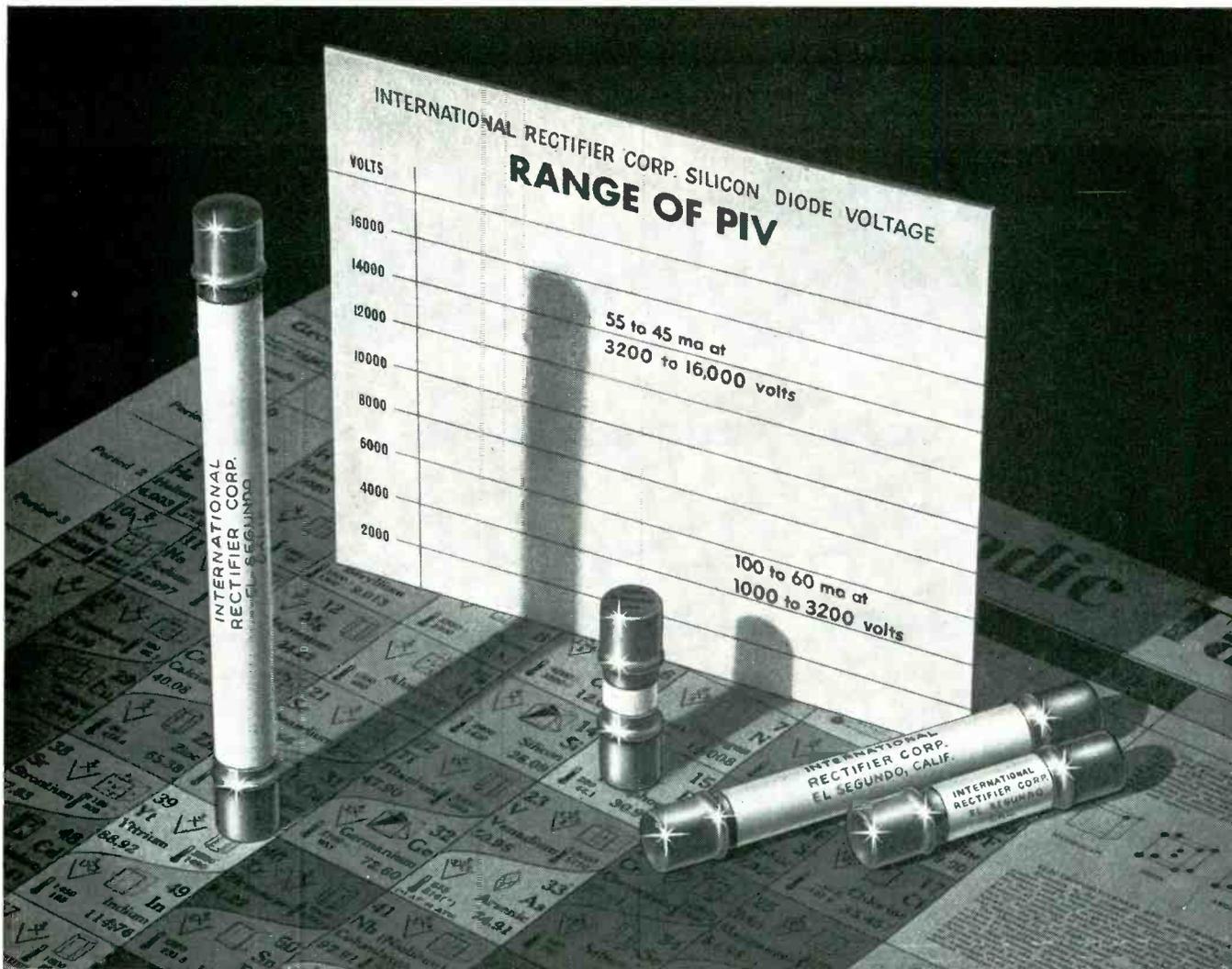
CHASE S-19 BRASS is *unique* through and through! Special manufacturing techniques give it an exceedingly fine, uniform grain structure, and it has unusually high ductility. It is adaptable for forming or even relatively deep-drawing articles which are surprisingly scratch and dent resistant. They will buff or polish more easily, too.

It takes precise Chase quality control at the mill to produce the superb finish, stiffness and formability of Chase S-19 brass—*yet it costs you no more than commercial soft brass!* Call in a Chase representative for all the facts, today!

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Pictured are the 4 sizes available, ranging in length from $1\frac{13}{16}$ " to $6\frac{1}{16}$ ". Diameter $\frac{3}{16}$ ".

International Silicon Diodes feature ratings to 16,000 volts PIV...require up to 95% less space!



Here is the answer to tough miniaturization problems where high temperature and high efficiency are prime design factors. International's high-voltage silicon diode series, now in full production, offers ratings ranging from 600 volts at 100ma half-wave dc output, to 16,000 volts PIV at 45ma, over a temperature range of -55°C to $+150^{\circ}\text{C}$. Constructed from selected silicon junction diodes connected in series, hermetically sealed within a metalized ceramic housing, these rectifiers feature ferrule terminals for clip-in applications into standard 30-ampere fuse clips.

This new series is ideal for those "com-

pact-packaging" jobs. For example, the 16,000 volt unit, with a diameter of $\frac{3}{16}$ ", measures only $\frac{6}{16}$ " in length. This represents a size ratio of 20 to 1 over rectifiers of other types. This marked size and weight savings over conventional units of comparable rating cuts engineering time normally spent "designing around" bulky units... can sharply reduce the dimensions and weight of your equipment.

Write, wire or telephone our Application Advisory Department. This group of experienced rectifier engineering specialists will be happy to supply specific information on how these rectifiers can fit into your project.

International Rectifier

C O R P O R A T I O N

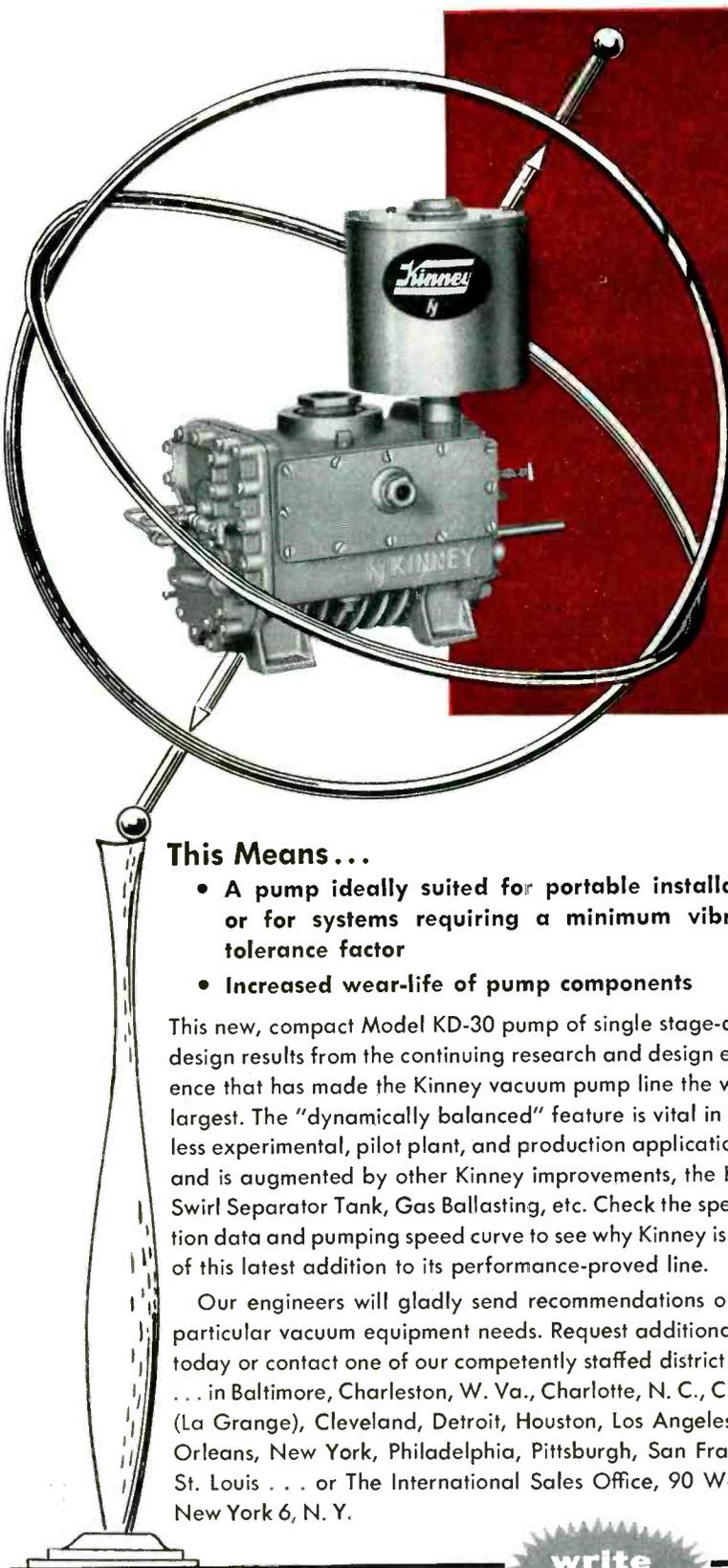
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NEW YORK: 132 E. 70TH ST., TRAFALGAR 9-3330 • CHICAGO: 205 W. WACKER DR., FRANKLIN 2-3889

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THE WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS



DYNAMICALLY BALANCED!

NEW *Kinney*[®]

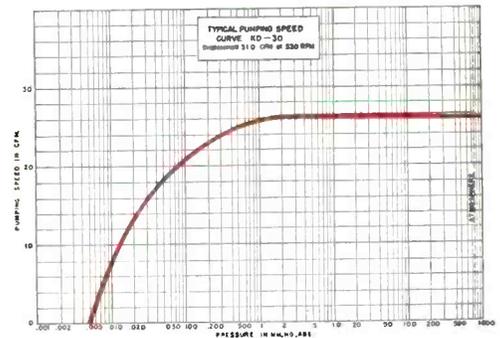
**MODEL KD-30 HIGH VACUUM
PUMP IS FUNCTIONALLY
VIBRATION-FREE!**

This Means...

- A pump ideally suited for portable installations or for systems requiring a minimum vibration tolerance factor
- Increased wear-life of pump components

This new, compact Model KD-30 pump of single stage-duplex design results from the continuing research and design experience that has made the Kinney vacuum pump line the world's largest. The "dynamically balanced" feature is vital in countless experimental, pilot plant, and production applications . . . and is augmented by other Kinney improvements, the Kinney Swirl Separator Tank, Gas Ballasting, etc. Check the specification data and pumping speed curve to see why Kinney is proud of this latest addition to its performance-proved line.

Our engineers will gladly send recommendations on your particular vacuum equipment needs. Request additional data today or contact one of our competently staffed district offices . . . in Baltimore, Charleston, W. Va., Charlotte, N. C., Chicago (La Grange), Cleveland, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis . . . or The International Sales Office, 90 West St., New York 6, N. Y.



SPECIFICATION DATA

Model KD-30 Single Stage-Duplex Design High Vacuum Pump

Ultimate Pressure (McLeod Gauge)	10 Microns
Free Air Displacement	30.4 CFM
Free Air Displacement	14.4 Liters/sec.
RPM	525
Motor H.P.	1 1/2
Motor RPM	1800
Oil Capacity	2 1/2 qts.
Cooling	Air
Shaft Diameter	3/4"
Inlet Connection	1 1/2" screwed
Outlet Connection	1 1/4" screwed
Valve Type	Poppet
Separator Tank	Kinney Swirl
Net Weight, Complete Unit	370 lb.

Overall Dimensions, Complete Unit with Motor
Length — 28 3/4"; Width — 20 1/8"; Height — 19 7/8"

**write
today**

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3565 WASHINGTON STREET • BOSTON 30 • MASS.
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.



Name Title

Company

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- Please send complete data describing the new Model KD-30 high vacuum pump.

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There's a rising tide of interest in the *business* side of the electronic industry.

For instance, the engineer who used to be concerned chiefly with designing a circuit or a product ... now wants to know where and how it can be *sold*.

His need, increasingly, is for marketing, topical or business information.

This trend could be foreseen ... *was* foreseen by the editors of **electronics**. For they keep in close and constant touch with its subscribers. Thousands of editorial questionnaires, hundreds of personal interviews all over the country, readership studies by McGraw-Hill's research staff ... these gave the editors advance knowledge of this growing industry's growing needs in terms of information.

One of the clearest indications was the increasing readership of **electronics'** "Industry Report" and "Plants and People" sections. Letters, comments and requests for information showed that these features of **electronics** should be *expanded* ... the amount of business information *increased*.

The answer? Two extra editions of **electronics**.

Otherwise, **electronics** remains unchanged.

On the 1st of each month, starting in January, 1957, **electronics** will appear as it always has. This will be the Technical Edition. On the 10th of each month will appear a Business Edition. On the 20th of each month, another Business Edition will appear. The same 46,000 subscribers will receive all three editions.

As for the advertiser, he will have 37 issues to choose from. (This includes the annual BUYERS' GUIDE issue.) He can run all his ads in the original first-of-the-month, Technical Edition, if he wishes. Or in either of the two Business Editions. Or in *both* Business Editions. Or in *all three editions*. He can run a staggered schedule, using any editions.

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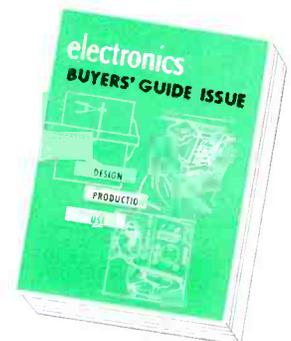
Published on the

1st

of each month

+ PLUS

The **electronics BUYERS' GUIDE**, which is the industry's source book for purchasing electronic products and services. Published each year mid-June, it contains the most accurate, up-to-date listings of what to buy and where.



reduce costs

with

SOUTHCO

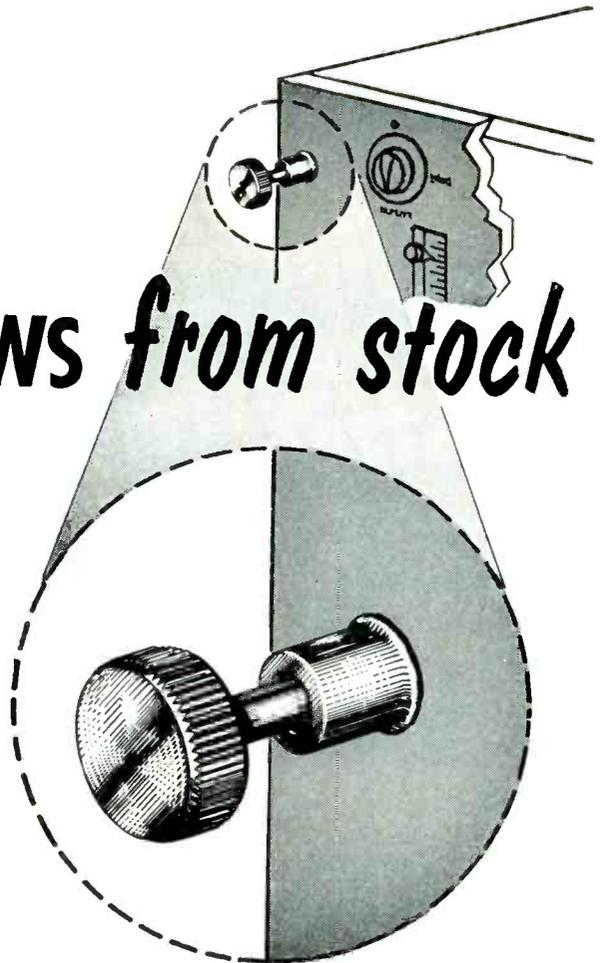
CAPTIVE PANEL SCREWS *from stock*

Here's a low-cost retractable screw fastener to save you assembly time and to eliminate the frequent need for costly special design fasteners. Unmatched for fast, economical use by assemblers of electronic units and other paneled cabinets.

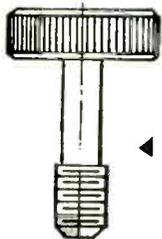
"Floating" screw insures easy alignment no matter how many screws are engaged in a single panel. No special skills or tools needed; installation fast and simple.

3 head sizes and 3 standard thread sizes available. On special order, slotted heads, stainless steel screws, and extra long screws.

Write for complete information. Southco Division, South Chester Corporation, 233 Industrial Highway, Lester, Pa.



3 SIMPLE COMPONENTS



← SCREW



← STAND-OFF



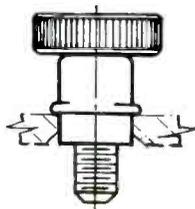
← RETAINING RING

EASILY INSTALLED

Stand-off is flanged into panel. Screw is inserted into over-size hole in stand-off and locked in place by retaining ring, which is passed over threads to seat behind last thread.

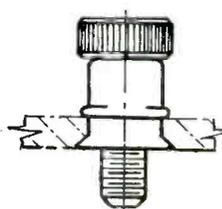
A SIZE FOR EVERY NEED

LARGE HEAD ($\frac{3}{4}$ " diameter)



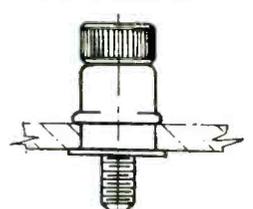
$\frac{1}{4}$ "-20 thread

MEDIUM HEAD ($\frac{1}{2}$ " diameter)



$\frac{1}{4}$ "-20 and
12-24 thread

SMALL HEAD ($\frac{1}{8}$ " diameter)



10-24 thread

Screw and stand-off are brass, nickel plated. Retaining ring is durable vinyl plastic.

Choice of stand-offs for each screw size to accommodate panel thicknesses from $\frac{1}{16}$ " to $\frac{1}{4}$ ".

SOUTHCO

FASTENERS

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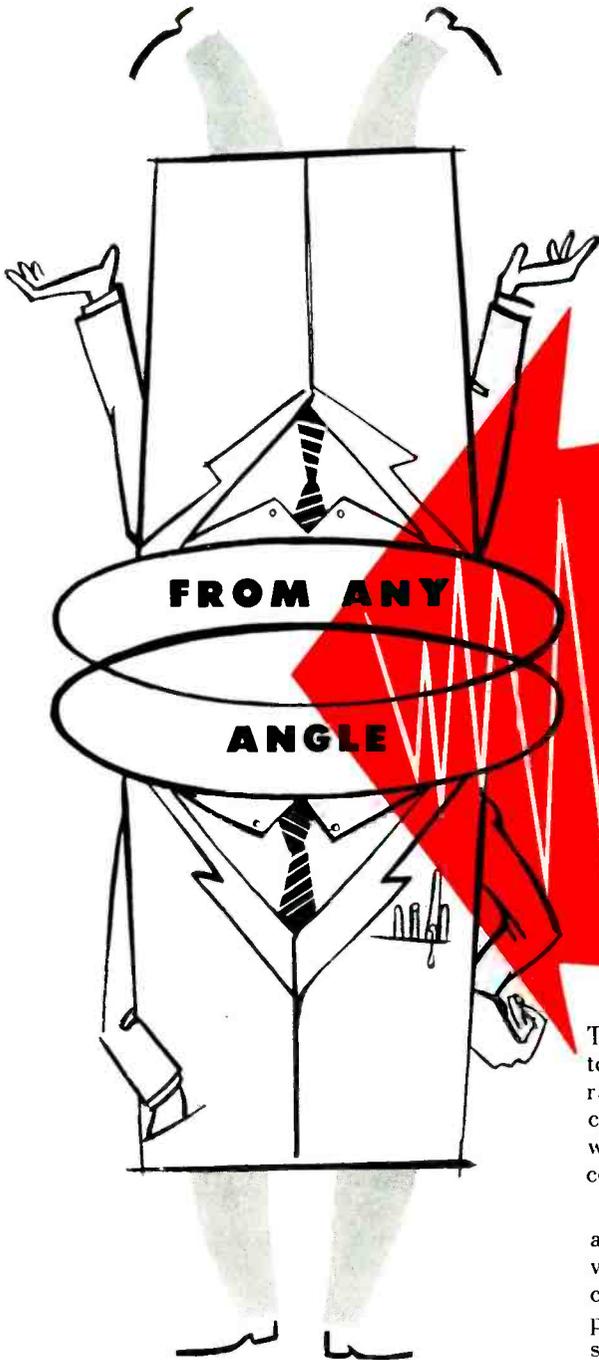
LION

SOUTH CHESTER CORPORATION • LESTER, PENNSYLVANIA

TRANSISTOR

SERIES **126** CURVE TRACER

(LICENSED FROM PHILCO CORP.)



FROM ANY

ANGLE



The AEL Model 126 series of Curve Tracers has been designed to fill the pressing need for instruments capable of not only accurate, versatile measurements of all types of transistors, but of continued usefulness and application in a rapidly changing field wherein the characteristics of the transistors to be considered are constantly being expanded.

The "126" units are flexible in that they supply wide voltage and current ranges, oscilloscopic switching and make available various outputs to any terminal of the transistor under test. The constant-current steps are **electronically** generated in order to provide electrically and acoustically quiet operation. The current steps and variable-amplitude sweep voltages are applied to the transistor under test and produce a family of curves for oscillographic study.

Maximum stepped bias current is 120 Ma. Sweep current is conservatively rated at 3.0 amperes; 5.0 amperes can easily be obtained at slightly reduced voltages. Internal calibration and blanking are standard.

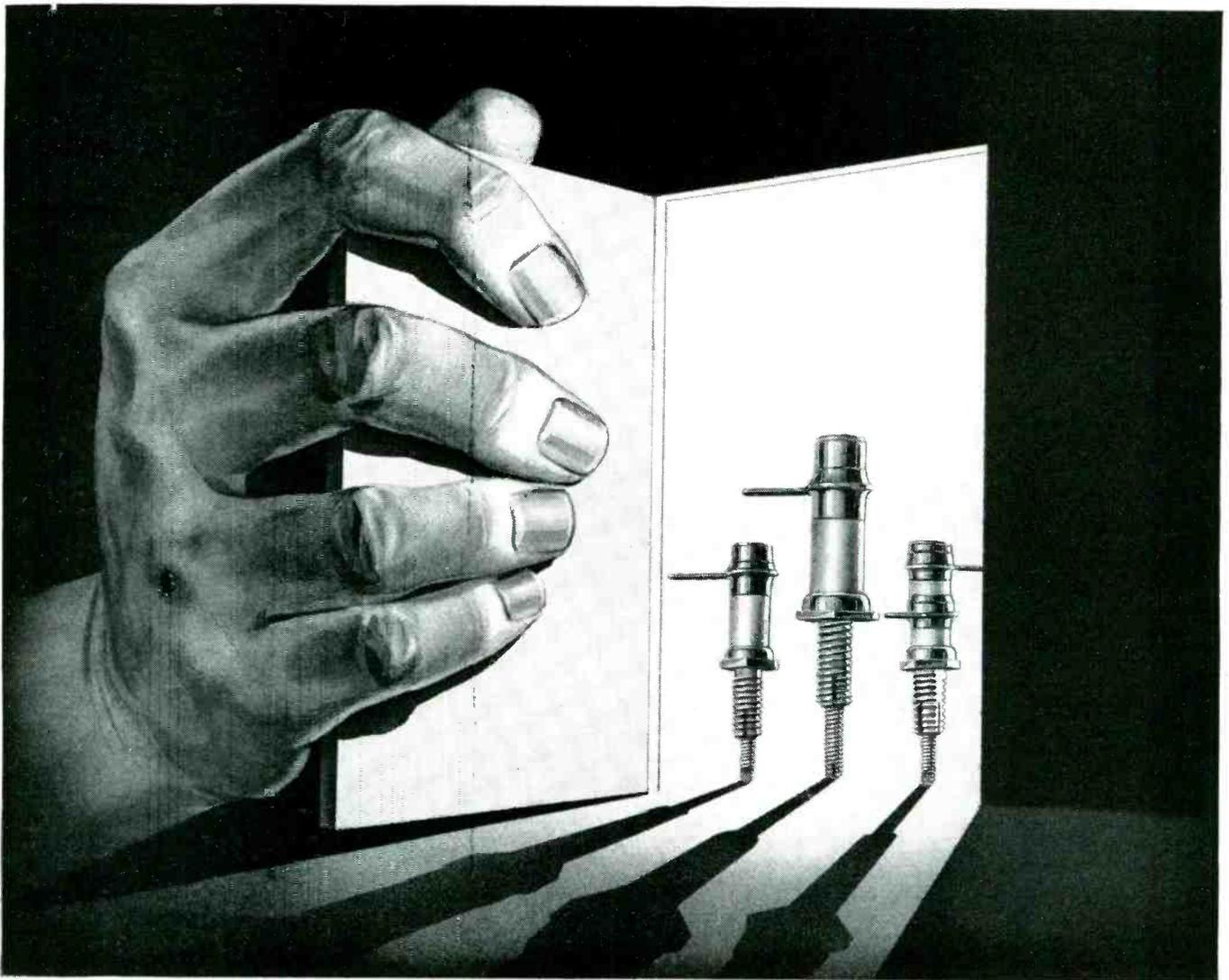
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CTC Capacitor Data: Metallized ceramic forms CST-50, in range 1.5 to 12.5 MMFD's; CST-6, in range 0.5 to 4.5 MMFD's; CS6-6, in range 1 to 8 MMFD's; CS6-50, in range 3 to 25 MMFD's; CST-50-D, a differential capacitor, with the top half in range 1.5 to 10 MMFD's and lower half in range 5 to 10 MMFD's.

These Midgets do big jobs well

These capacitors outperform capacitors several times their size. Their tunable elements virtually eliminate losses due to air dielectric, resulting in wide minimum to maximum capacity ranges. The tuning sleeves are at ground potential, and can be locked firmly to eliminate undesirable capacity change.

Every manufacturing detail has to conform to the highest quality control standards. Because of these standards, CTC can guarantee the performance of this family, and of every electronic component CTC makes.

Other precision-made CTC components that benefit from CTC high quality standards include terminals, terminal boards, swagers, hardware, insulated terminals and coil forms. For all specifications and prices, write Cambridge Thermionic Corporation,

437 Concord Ave., Cambridge 38, Mass. On the West Coast contact E. V. Roberts and Associates, Inc., 5068 West Washington Blvd., Los Angeles 16, and 61 Renato Court, Redwood City, California.

New Series X2122 Stand-Off Capacitors with ceramic dielectric are exceptionally rugged. These are general RF by-pass capacitors for use in high quality electronic equipment. The encapsulating resin provides rigidity and durability under extreme conditions of shock, vibration, and humidity. Over-all height mounted is under $\frac{3}{8}$ ". Available in a range of values.



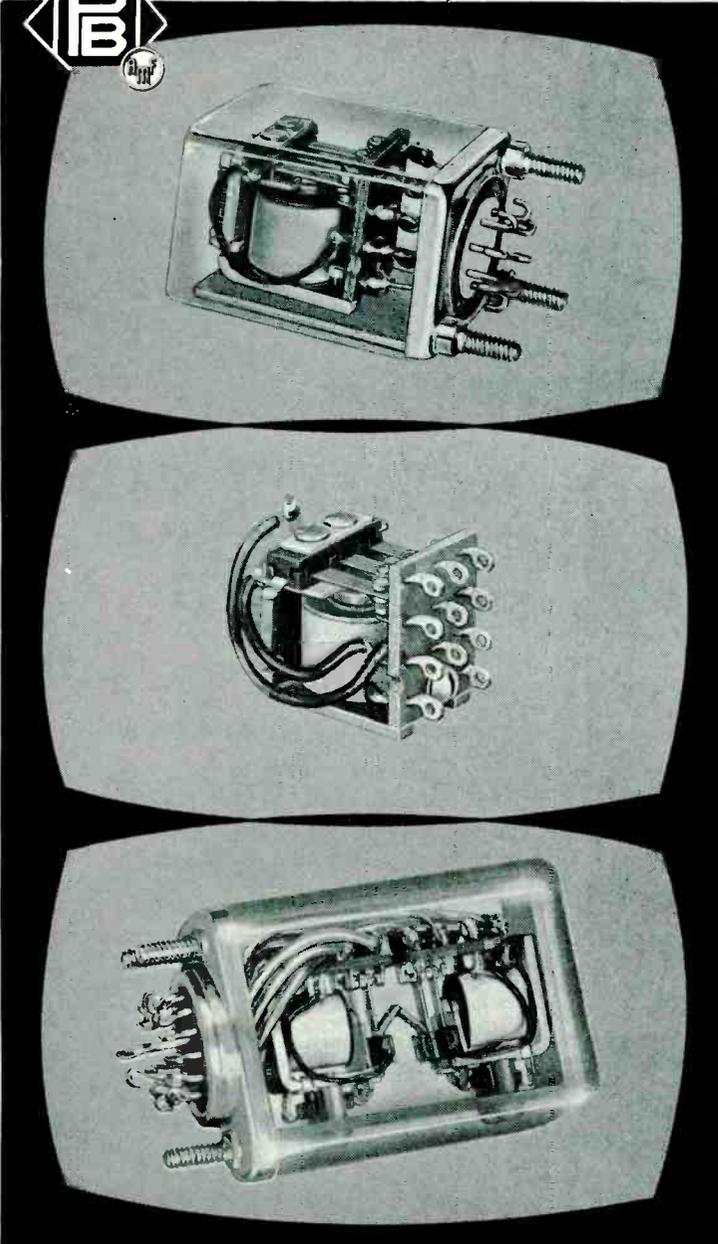
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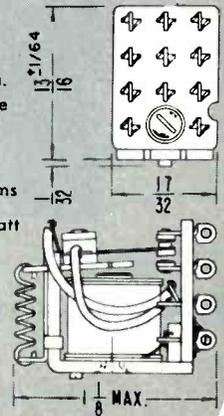
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A three-pole, hermetically sealed version of the KM provides a multiplicity of action yet requires a minimum of space. Mounted with three #6-32 studs; eight solder terminals. This relay is especially useful in low voltage, DC applications where size and weight are critical factors.

ENGINEERING DATA KM SERIES

- CONTACTS:** Max. 3PDT. 3/32" Dia. Silver 2 amps, 115V 60 cy. resistive
- VOLTAGE RANGE:** Up to 48V DC nominal
- COIL RESISTANCE:** Up to 6700 ohms
- COIL POWER REQUIREMENT:** 1 watt
- TEMP RANGE:** -45° C to +55° C
- PULL-IN:** 75% of nominal voltage
- TERMINALS:** Solder lugs



Designated as the KE, this latching relay combines two KMs for minimum size and weight. It operates on momentary impulse to either coil with a mechanical latch and electric release. Available up to 6 PDT. This relay was designed for intermittent duty only. Three-stud mounted with solder terminals. Hermetically sealed model is shown at left. Also available in open version.

Good Relay News! KM SERIES ANSWERS DESIGN NEEDS

Designers plagued with problems of miniaturization welcome the KM series as good relay news.

These subminiature relays—open, hermetically sealed and latching—are wonderfully versatile, light in weight, and amazingly compact. The open KM occupies less than a cubic inch of space!

Application possibilities range over such diverse fields as remote control systems, automated toys, small business machines and alarm systems. New applications suggest themselves daily to engineers working with designs where component size and weight must be kept to barest minimums. Your inquiries about our KM series relays are invited!

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4×10^6	1.0	400, 7,000
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*Special for high impedance sources.

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115 v., 60 cycles (fused power line)

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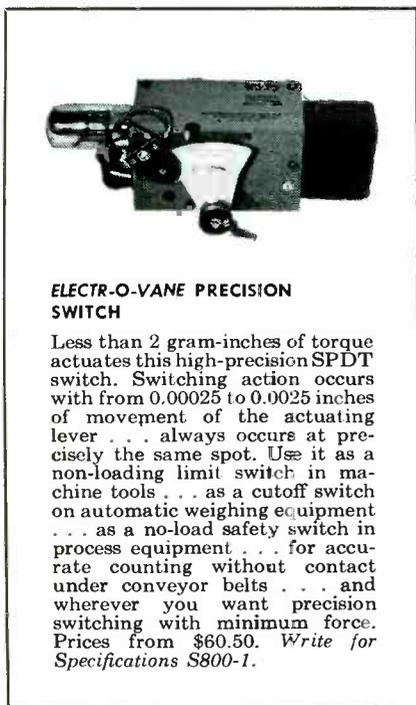
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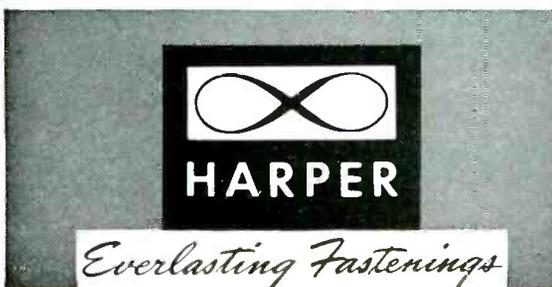


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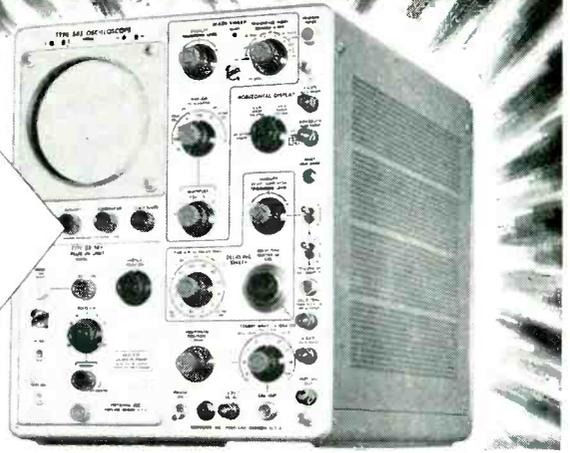
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Why are there **TWO SWEEP GENERATORS** in these oscilloscopes ?



The extra sweep generator makes an oscilloscope much more useful. With the Tektronix delaying sweep you can . . .

1 START THE OSCILLOSCOPE SWEEP WITH THE FIRST TRIGGER RECEIVED AFTER A CONTROLLABLE TIME-DELAY PERIOD.

This is an important reason for the extra sweep generator and its associated pickoff circuit in Tektronix Type 535 and Type 545 Oscilloscopes. Triggering the delayed sweep by the observed signal guarantees a jitter-free display . . . ideal for examination of time-modulated pulses and signals with inherent jitter.

2 START THE OSCILLOSCOPE SWEEP AT THE END OF A CONTROLLABLE TIME-DELAY PERIOD . . . convenient for observation of occurrences after an accurately determined time interval.

3 MAKE MORE ACCURATE TIME-INTERVAL MEASUREMENTS.

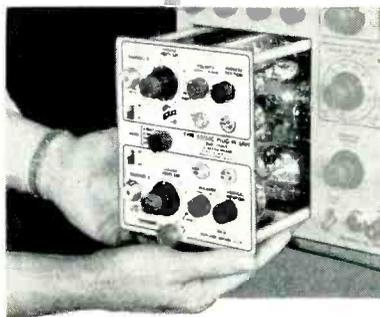
A calibrated ten-turn time-delay control divides each of the twelve delay ranges into a thousand units. Range accuracy is within 1%, incremental accuracy on any range is within 0.2% of full scale.

4 TRANSFER PART OF A DISPLAY TO A FASTER SWEEP.

By initially displaying a signal on the extra, delaying sweep, and then transferring it to the main oscilloscope sweep, a continuously adjustable horizontal expansion can be obtained. Degree of magnification is determined by the time/cm ratio between the two sweeps. The average jitter of 1 part in 25,000 permits practical use of very large magnifications. Further, the exact portion of the display on the delaying sweep that will appear on the faster main sweep is positively identified by trace brightening. Unblinking pulses for both sweeps are applied to the crt grid, causing the main sweep to show up as a brightened portion of the display on the delaying sweep.

5 ARM THE OSCILLOSCOPE SWEEP FOR TRIGGERED ONE-SHOT OPERATION.

A front-panel pushbutton or an electrical signal from a remote location can be used instead of the internal delayed trigger to arm the sweep. After the button is pressed, or the pulse received, the next trigger causes the main sweep to fire once and revert to the locked-out condition. Photographic recordings of a single transient made in this manner cannot be blurred by spurious signals following its occurrence. Because the single sweep can be triggered any time after the button is pressed or the pulse received, the time of occurrence need not be accurately predictable.



GREATER VERSATILITY PREFERRED

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TYPE 535 and TYPE 545 CHARACTERISTICS

Delay Specifications

A calibrated twelve-step range control and a ten-turn precision control provide for continuously-variable coverage of the full sweep-delay range—1 μ sec to 0.1 sec. Range accuracy is within 1%, incremental accuracy within 0.2% of full scale. Time jitter is less than 1 part in 20,000 in conventional sweep-delay operation. Display is completely jitter-free in triggered operation. The delaying sweep can be used as a rate generator, producing trigger rates from 10 cycles to 40 kc, continuously adjustable. The delayed trigger is available at a front-panel connector for external applications.

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Type 535 (without plug-in units) **\$1300**
Type 545 (without plug-in units) **\$1450**

Prices f.o.b. Portland, Oregon

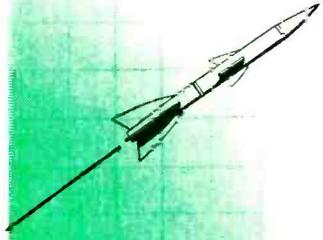
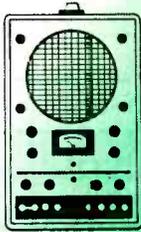
Your Tektronix Field Engineer or Representative will be happy to furnish complete specifications and arrange a demonstration at your convenience.

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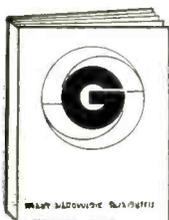
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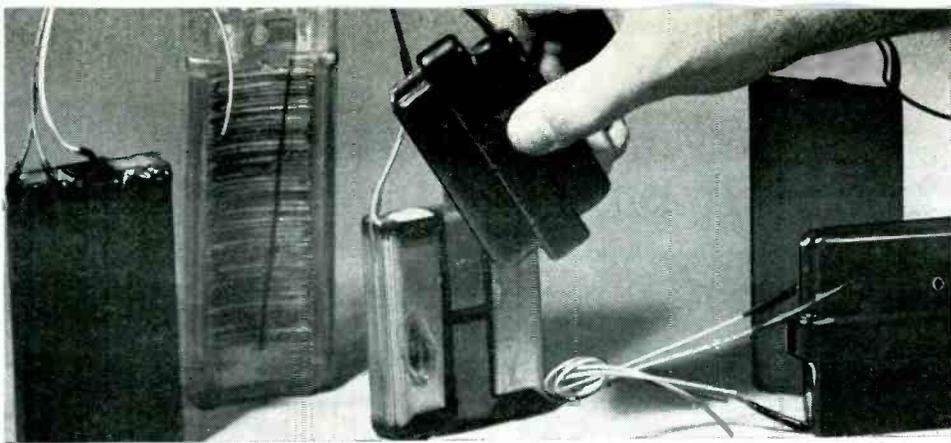


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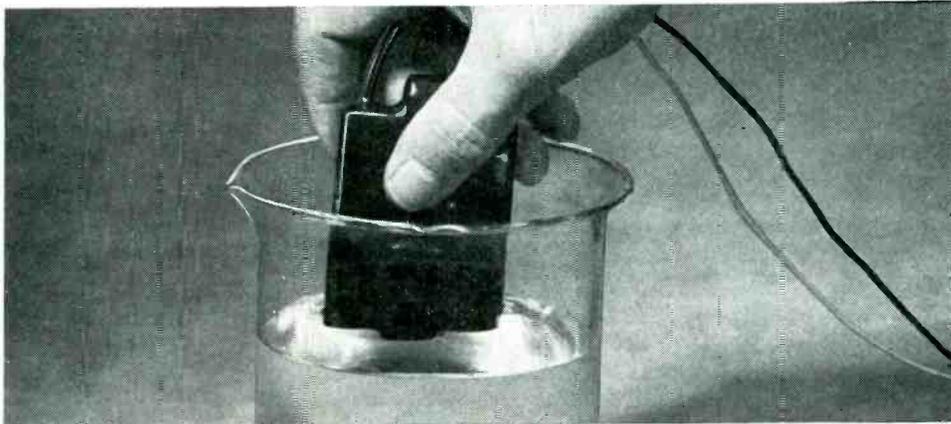
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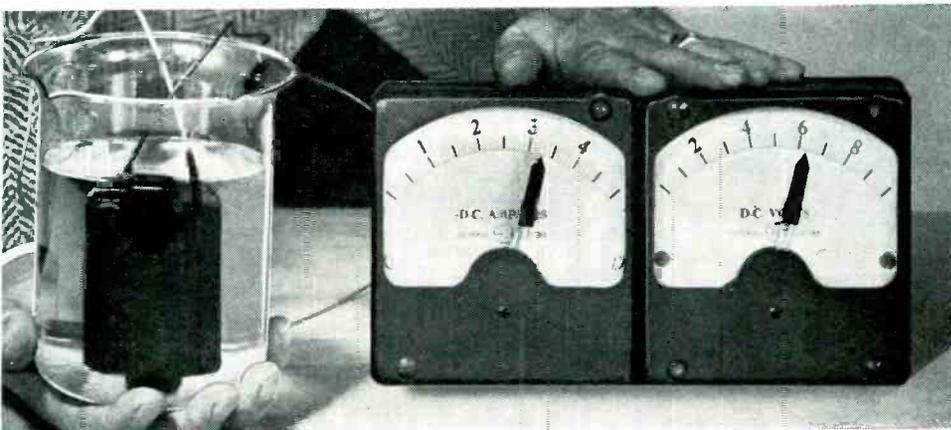
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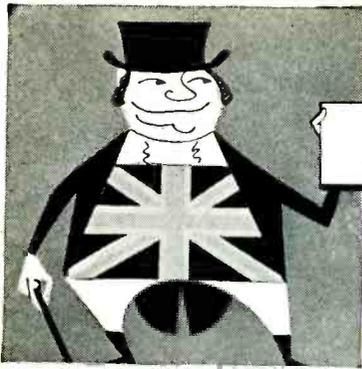
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ELECTRONICS IN BRITAIN

The British Electronics Industry is making giant strides with new developments in a variety of fields. Mullard tubes are an important contribution to this progress.

The expert choice for



medium
power,
high
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equipment

EL84

Principal Ratings

Heater	6.3V, 0.76A
Max. plate voltage	300V
Max. plate dissipation	....	....	12W
Max. screen voltage	....	....	300V
Max. screen dissipation (max. signal)	....	....	4W
Max. cathode current	65mA

Base

Small button noval 9-pin

Supplies available from:— In the U.S.A.

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Rogers Majestic Electronics Limited, Dept. 1.0.,
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Canada.

British high fidelity experts know that for medium powered equipment there is no finer tube than the EL84. A pair of these tubes provide a power output of 10W at a distortion level of less than 1% while their transconductance value of 11,300 μ mhos results in exceptional sensitivity. The EL84 may also be used for higher powers. For example, two tubes in push-pull will provide outputs of up to 17W at an overall distortion of 4%.

A single EL84 has a maximum plate dissipation of 12W. It provides an output of 5-6W for an input signal of less than 5V r.m.s. at plate and screen voltages of 250V.

Supplies of the EL84 for replacement in British equipments are available from the companies listed.



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used throughout the world

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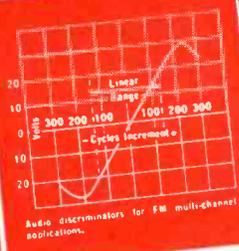


MEV 43

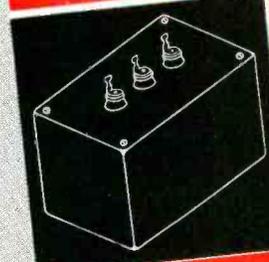
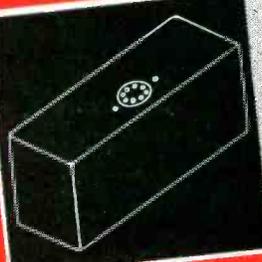
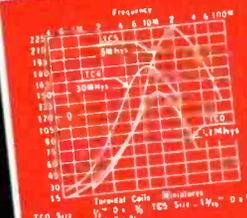
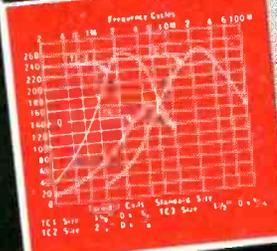
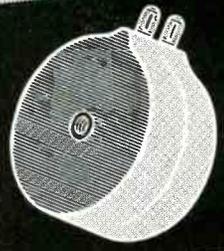
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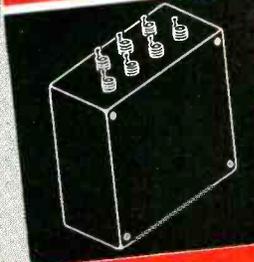
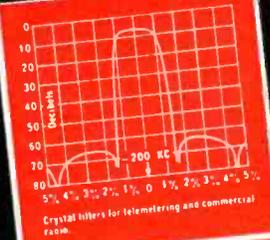
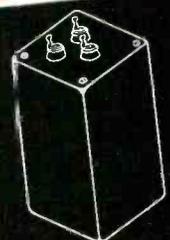
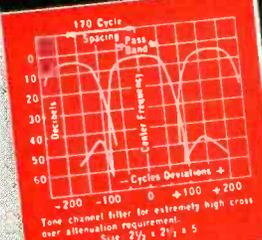
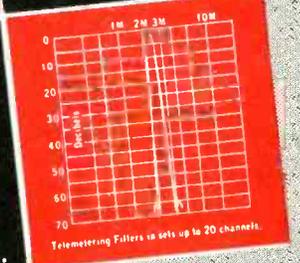
* Can you see why the "checkmate" below is an impossible position?



Audio discriminator for FM multi-channel applications.



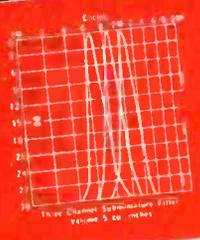
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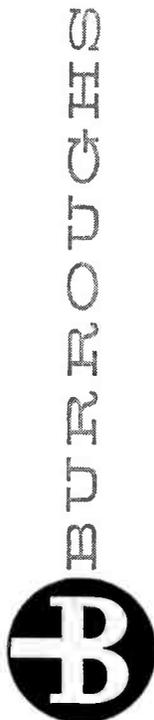
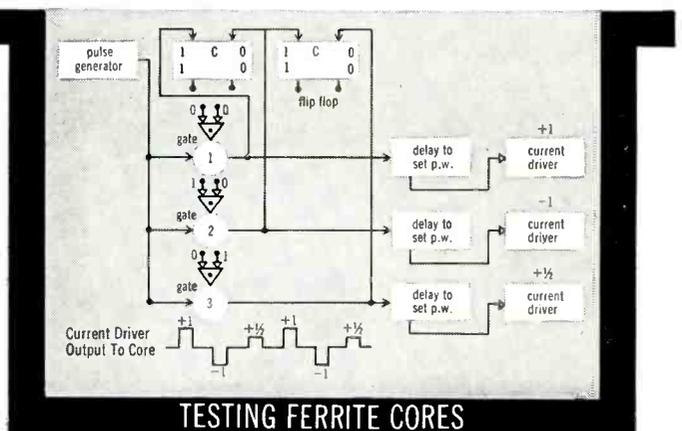
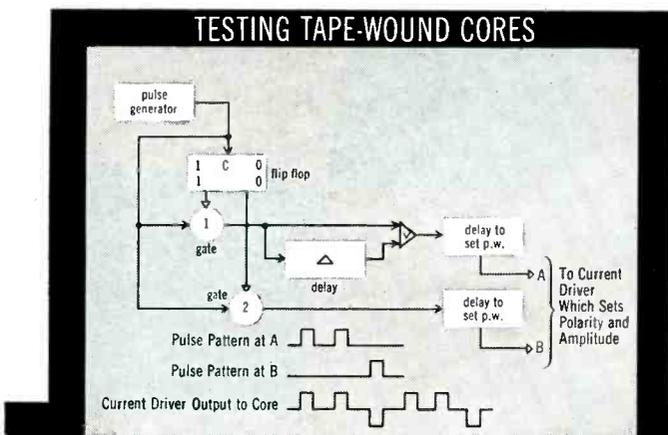


modern methods for testing cores

The future of magnetic cores in information handling systems is already well assured. Their high reliability, fast action, small size, and low power consumption stimulate the imagination of more and more engineers working in data processing, weapons systems, and control. And every day finds these new components included in more new designs.

One problem still facing those who want to exploit these exciting properties is the lack of precise uniformity in cores made on a production basis. For as Burroughs has found through 5 years of working with the pioneers in core applications, uncertainties still exist. And before cores become standardized, many changes will probably be made. Those who want to take advantage of the great potential in this new component now must use reliable test procedures which precisely check the tolerances of each core, and are versatile enough to check for the new core specifications of tomorrow.

Burroughs Pulse Control Systems answer this need for leading manufacturers and users of cores by simulating the actual conditions under which each core produced will eventually operate. When conditions require a change in core operating characteristics, the testing system is changed at will, in a matter of minutes, to meet the new requirements.



Shown here are typical examples of how these core manufacturers, including Burroughs own core production department, use Burroughs Pulse Control Systems to check tape wound and ferrite cores. An interesting booklet describing core testing in greater detail is yours for the asking. But if you want to test another component by digital techniques, just send us your problem. We'll be glad to work it out, at no cost, and show you how Burroughs Pulse Control Systems can save you hours of engineering time and production headaches.



MEMO

FROM: The Engineering Staff at N J E
 TO: Electronic Design Engineers

SUBJECT: THE CONCEPT OF TOTAL REGULATION

JUST ONE YEAR AGO, the first of these historic "memos" appeared. It was entitled, "Why Semi-Regulated Power Supplies?", and it touched off a very satisfactory storm of interest and activity. Since then, for example, we have sold over half a million dollars worth of these tubeless, brute-force supplies.

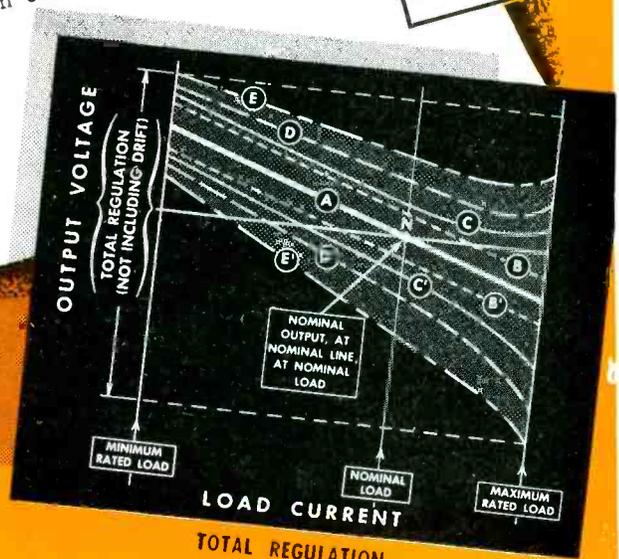
Perhaps the most eloquent tribute to the appeal of our semi-regulated concept has been the rush of "me-too" activity on the part of our competition, much of it conservative and experienced, but some...well...a bit green and eager, to put it kindly. That kind of thing is bad for all of us, and we write this memo to clear the air.

The most serious error made in specifying and designing some of the inadequate semi-regulated equipment that we see around springs from a tendency to ignore one or more of the factors which make up what we call the "total regulation" of a power supply. Perhaps the most neglected factors are line-transient and load-transient effects.

Consider pin down all of the regulation components should pin down all of the regulation components shown. We would welcome correspondence from our customers (and competitors) on this method of describing power supply performance.

Incidentally, extra copies of this graph, somewhat enlarged and easier to read, are available on request.

N J E leads
the power
supply field.



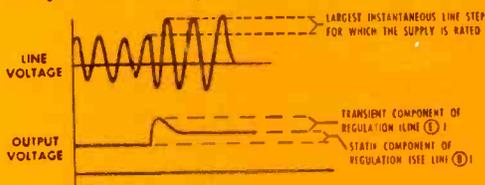
TOTAL REGULATION—Point N is rated output voltage at nominal (average, or expected average) load. N is often, but not necessarily, taken at 50% load.

Slope of Line A describes static (slow) load regulation at fixed (nominal) line input.

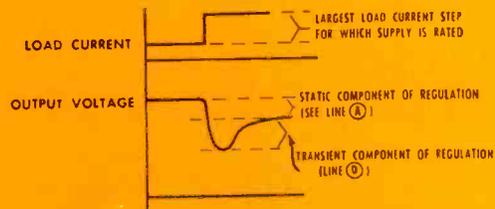
Lines B and B' indicate, by their spacing from Line A, the static (slow) line regulation at all loads within rating.

Line C superimposes on Line B the peak ripple excursion in one direction, at each load current. Similarly, Line C' represents the opposite polarity of peak ripple.

Lines E and E' add the transient line regulation components (only) which result from the largest instantaneous line voltage changes for which the supply is rated. See graph below:



Lines D and D' add the transient load regulation components (only) which result from the largest instantaneous load change for which the supply is rated. See graph below:



NOTES:

1. Lines on this chart are not necessarily straight, parallel, or equidistant.
2. Drift, manifested by a gradual vertical shift in the entire pattern as a result of temperature changes, aging of components, or reference instability, is not included.
3. Line frequency and/or waveform changes, if present, will add additional regulation components.
4. Shaded area is locus of all possible output voltage-current conditions which can occur... unless transient load or line steps can overlap additively with previous load or line steps, before recovery curve is substantially complete.

N J E CORPORATION • 345 Carnegie Avenue, Kenilworth, New Jersey

What Does VACUUM Do For a Relay?



RE4
SPDT



RD1
N/O



RD2
N/C



RE2
SPDT



RE3
SPDT



JGF-RE2
SPDT



RM4
4PDT



RM2
2PDT

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

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

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

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

Two new transfer relays have recently been developed by Jennings. The type JGF-RE2 relay is a 10 kv, 10 ampere RE2 vacuum relay enclosed in a rugged gas-filled container so that it can be mounted in exposed locations. The Type RE4 relay is for higher operating voltages up to 25 kv.

It has a 5 watt actuating coil and like all Jennings transfer relays it has a simple flange mount so that the high voltage terminals can be sealed into a pressurized or oil filled container with the low voltage terminals and the coil accessible from the outside.

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

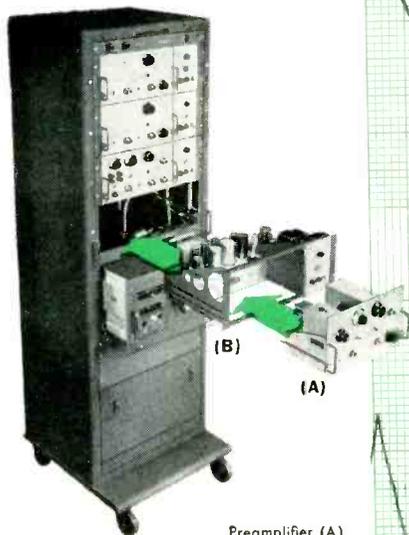


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ALL SANBORN 150 SERIES OSCILLOGRAPHIC RECORDERS PROVIDE THESE

SPECIFIC ADVANTAGES

THE three foremost operating advantages of a Sanborn "150" are evident in the record, and are given at the right. Equally popular with industrial users is the *wide versatility* of these systems. Each one comprises a basic assembly to which the user adds his choice of an interchangeable, plug-in type preamplifier for each channel. Presently available different preamplifiers now number *eleven*.



Preamplifier (A) shown in position to plug into a Driver Amplifier with Power Supply (B) which are normally already in place in the Basic Cabinet Assembly

RECTANGULAR COORDINATE RECORDING

is a Sanborn feature that is especially valuable in multi-channel recording. The user of a 2-, 4-, 6- or 8-channel "150" system can record interrelated events simultaneously on one strip of record paper, and then correlate them against time quickly and accurately, even during the recording.

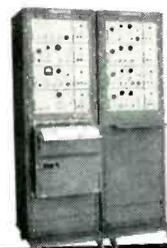
CLEAR, SHARP, INKLESS TRACINGS

The nichrome ribbon tip "150" heated stylus removes the white opaque surface of Sanborn recording paper (Permapaper) permitting the black undercoating to show. Tracings are permanent, will not fade or smudge.

IMPROVED OVER-ALL LINEARITY

resulting from current feedback design of Driver Amplifiers and new shorted coil frame, high torque (200,000 dyne cm.) galvanometers. Maximum error over middle 4 cm. of chart: 0.25 mm . . . over entire 5 cm. chart width: 0.5 mm.

Sanborn "150" Series available in 1-, 2-, 4-, 6- and 8- Channel Systems.

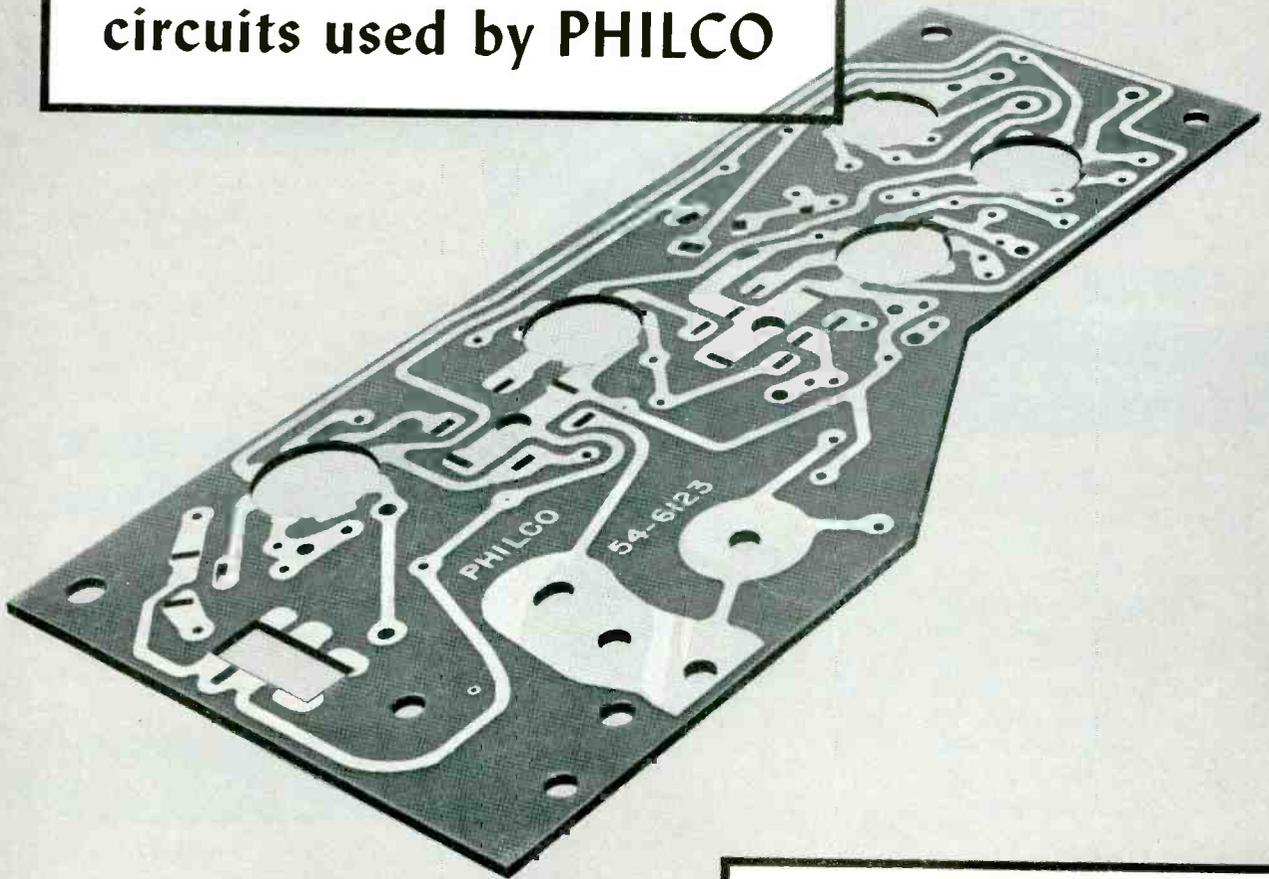


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A new "150" Catalog provides complete descriptive data, specifications and prices on all 150 Systems, Accessories and Cabinets. A copy will be sent on request.

INSUROK[®] T-725 printed circuits used by PHILCO

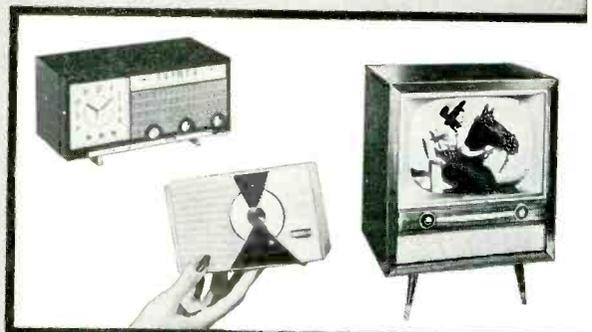


Philco design and production engineers are using Richardson Copper-Clad INSUROK T-725 laminate for printed TV and radio circuits.

Examples are Underwriters approved assemblies for Philco's 21" console TV, Philco's five tube table radio and Philco's transistorized portable radio. All use INSUROK T-725 printed circuits.

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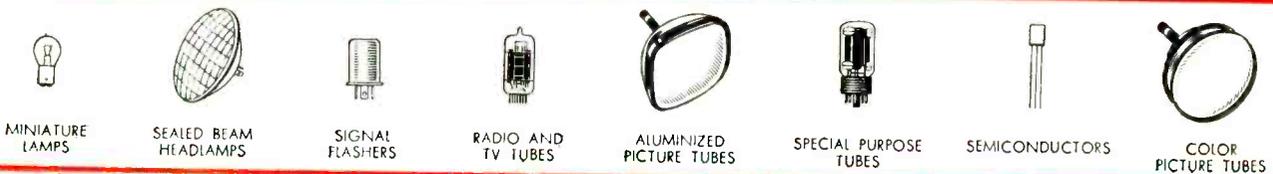
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It is the Tung-Sol policy to offer engineering assistance impartially and to treat all information received in strictest confidence. Tung-Sol does not manufacture radios or television sets.

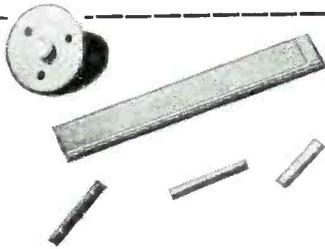


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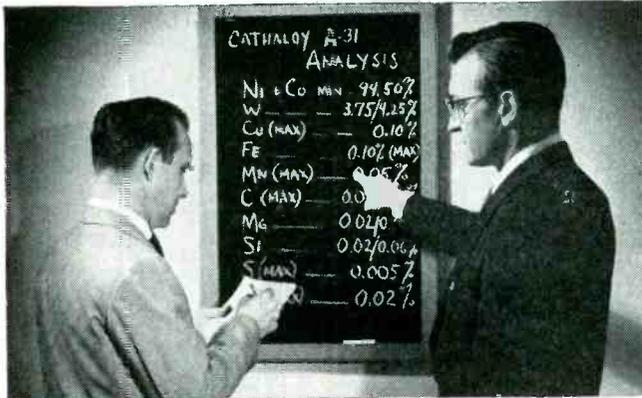


How Superior guards cathode quality to insure uniformly excellent performance

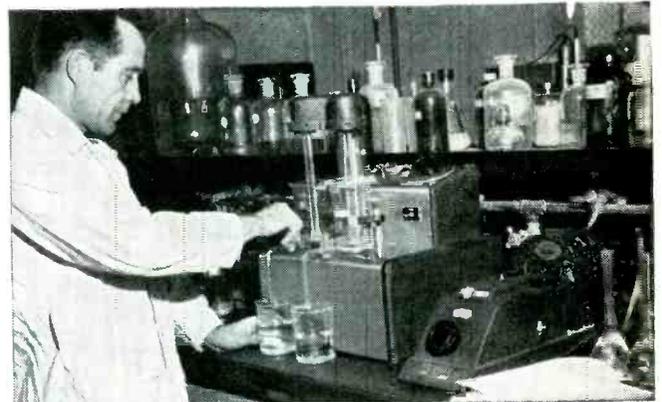


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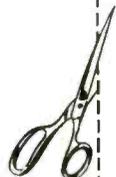
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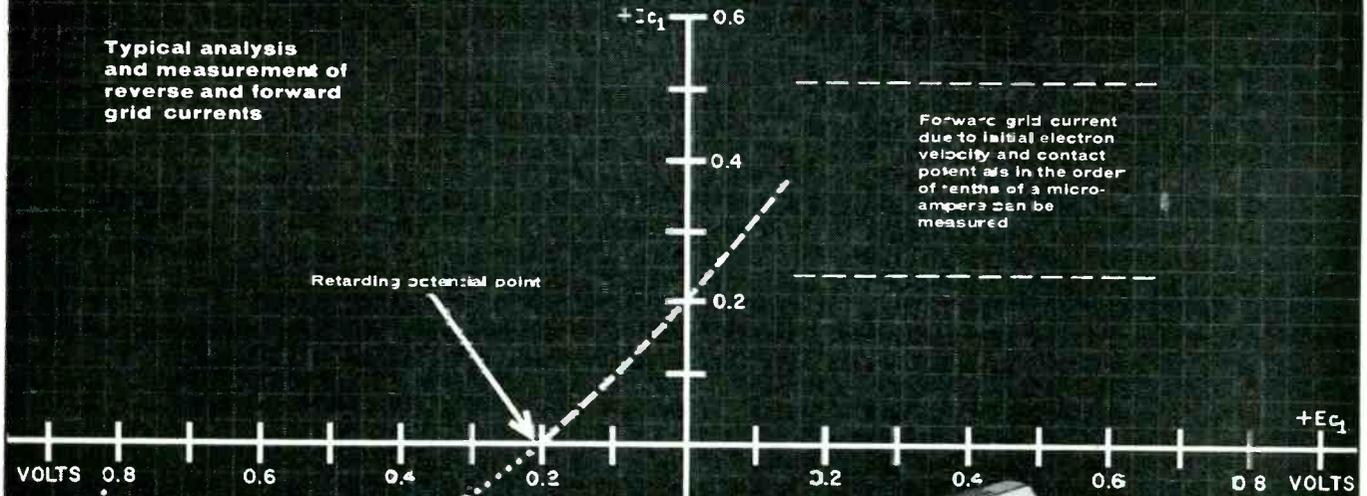
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Typical analysis and measurement of reverse and forward grid currents



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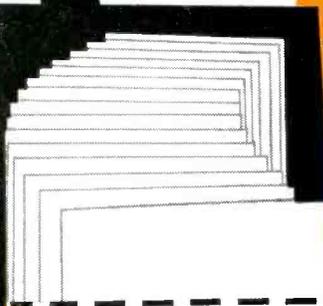
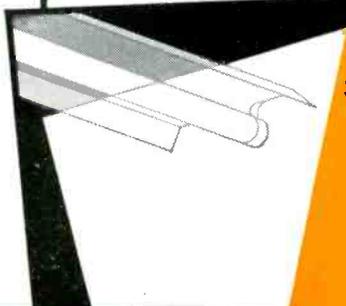
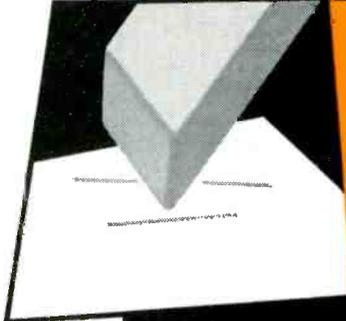
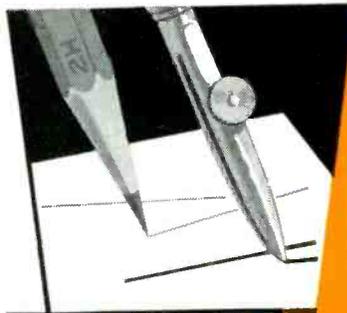


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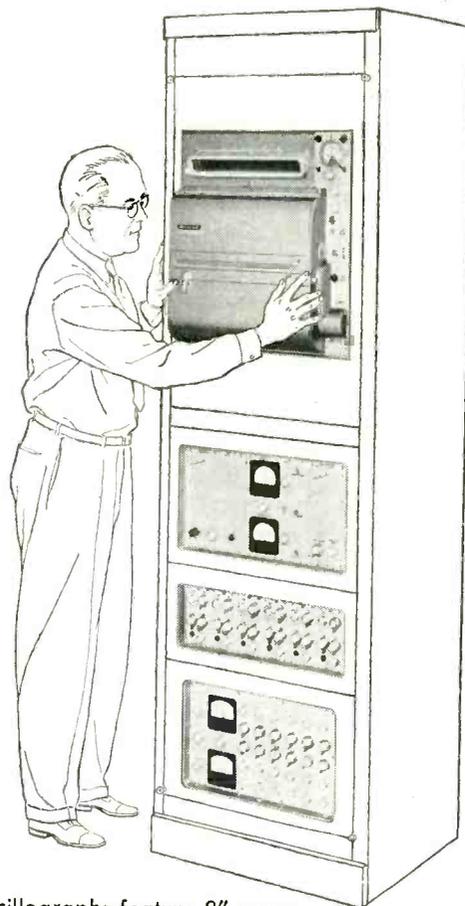
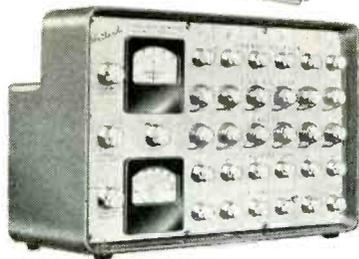
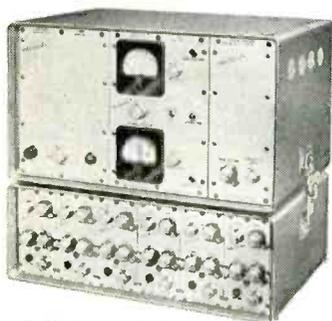
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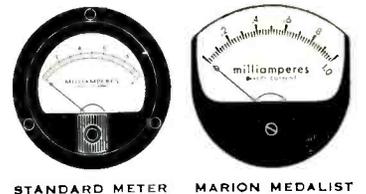
attention to that critical area, the indicator — where electronics meets the eye of the user. Now, Marion Medalist* meters in your equipment will provide added eye appeal and sales appeal by successfully combining accuracy and reliability with color harmony and distinctive styling.

MARION MEDALIST METERS bring color harmony and functional beauty to panel design. Crystal clear, high temperature Plexiglas** fronts are available in many standard colors with harmonizing or contrasting dials. Custom case and dial colors can also be supplied.

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*T.M. Reg. U. S. Pat. Off. U. S. & Foreign Patents
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Marion Medalists have another important advantage — increased readability. In the *same panel space*, a Medalist provides up to 50% more scale length — longer pointer — larger numerals — and greater natural dial illumination, than a standard round or square meter of the same size.



These are the reasons that Marion Medalist Meters are setting new standards of appearance and readability, where electronics meets the eye.

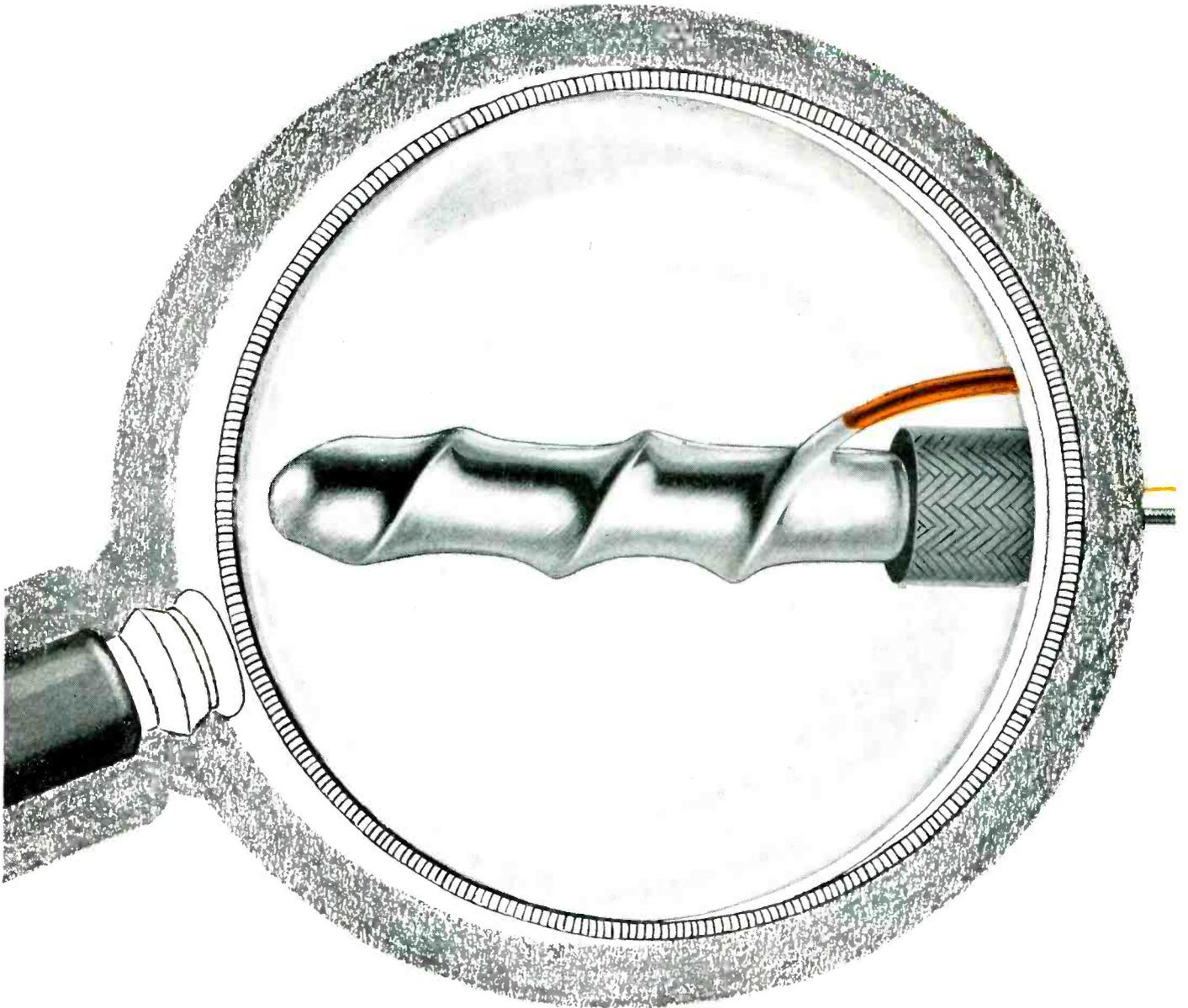
marion meters

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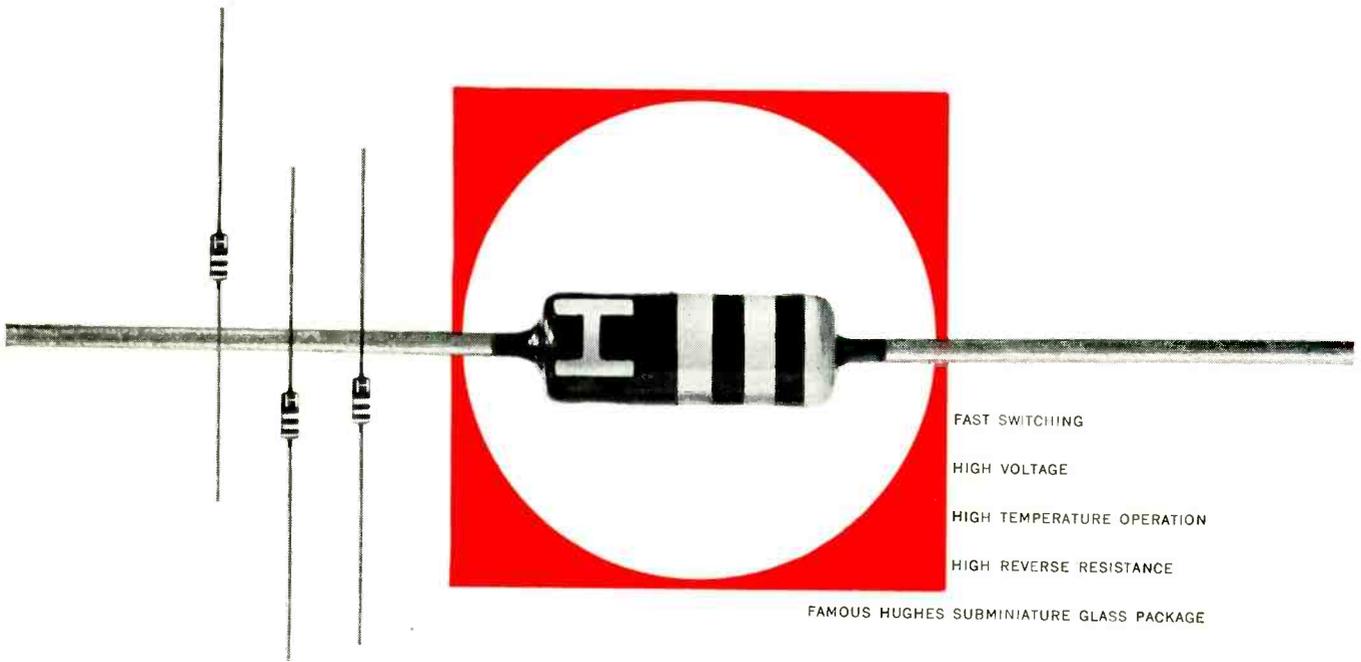
* Isocyanates, when combined with other resins, form Polyurethanes that can be balanced in properties to give the maximum in performance as a magnet wire insulation. Several years of research have been spent on Phelps Dodge Sodereze to accomplish this result. A patent application covering Phelps Dodge isocyanate-type magnet wire has been filed.

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Features of the FR-1100 include interchangeable plug-in amplifiers, interchangeable heads and four tape speeds. It can equal (and surpass) five standard two-track recorders in Ampex's familiar 300 Series (303, 306, 307, 309 and 311 – also a 303/306 combination). Photograph shows a two-track FR-1100 equipped with a meter panel and Servo Speed Control.

Both tracks are available for data, even when the Servo Speed Control signal is recorded on one of them.

In addition to its versatility, the FR-1100 has basic improvements in performance over the previous models it supplants. Specifications and a complete description should be in your information files.

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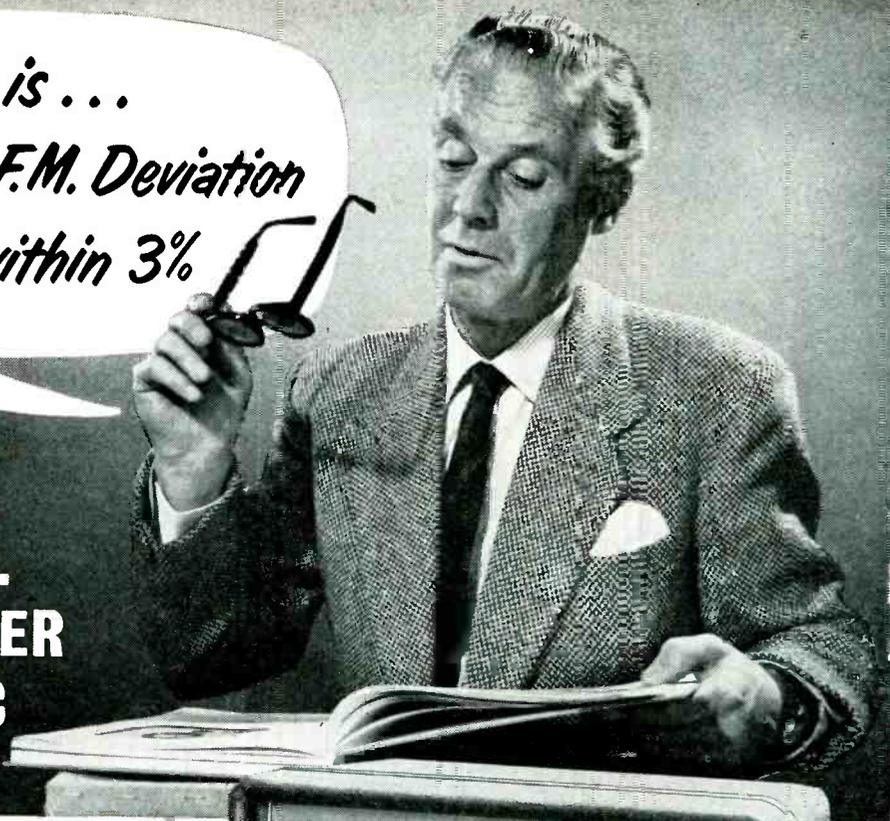
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measured to within 3%*

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TYPE TF 791C**



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CARRIER FREQUENCY RANGE : 4 to 540 Mc. DEVIATION MEASUREMENT RANGE : 0 to \pm 125 kc.
 ACCURACY OF DEVIATION MEASUREMENT : For modulation frequencies between 50 cps and 25 kc, \pm 3% of full-scale.
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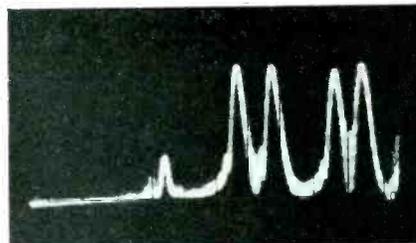
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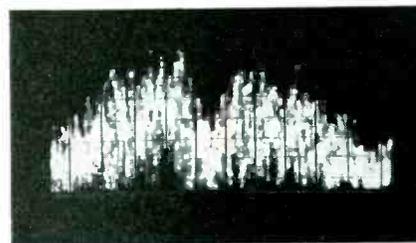


How you can "squeeze" 64 simultaneous messages into a single frequency

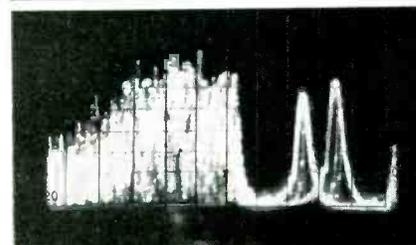
Breaking communication bottlenecks is a specialty of the Hoffman CV-157 Dual Sideband Converter. In one quarter the space of previous sideband converters it achieves maximum use of today's limited frequency bands, relieves traffic overloads. The CV-157, designed and developed by Hoffman, receives independently modulated AM signals with a highly suppressed carrier and splits them into two sidebands. Result: up to 75% greater effective range without increasing transmitter power—2 to 32 times more traffic capacity without increasing frequency bandwidths. As many as 64 dualtone teletype channels, or various combinations of teletype, facsimile and AM voice can be handled by the CV-157. Write today for additional data on this and other advanced communications techniques now under evaluation at Hoffman.



Scope pattern taken from Hoffman CV-157 showing two dualtone teletype channels on upper sideband, carrier partially suppressed. Each sideband can carry 32 teletype channels at one time.



One AM voice channel (made by continuous vowel sound) on each sideband, carrier completely suppressed. CV-157 carries two 3KC voice channels on each sideband.



AM voice on lower sideband, dualtone teletype channel on upper. With suitable multiplexing equipment, the CV-157 handles 64 simultaneous dualtone teletype channels.

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-the heat's off!



This Electronic Reliability Engineer just discovered the IERC way to insure his chances of meeting equipment reliability specifications and military acceptance schedules.

Tubes failures (too often and too soon) caused by heat and vibration, *the major causes of electron tube failures*, were his problem.

With IERC Heat-dissipating Tube Shields, the "heat was off" both the suffering tubes and our man with the problem! Tube operating temperatures were lowered as much as 150°C and tubes are lasting 5 times longer. Schedules were met—time and money saved—highest tube reliability achieved!

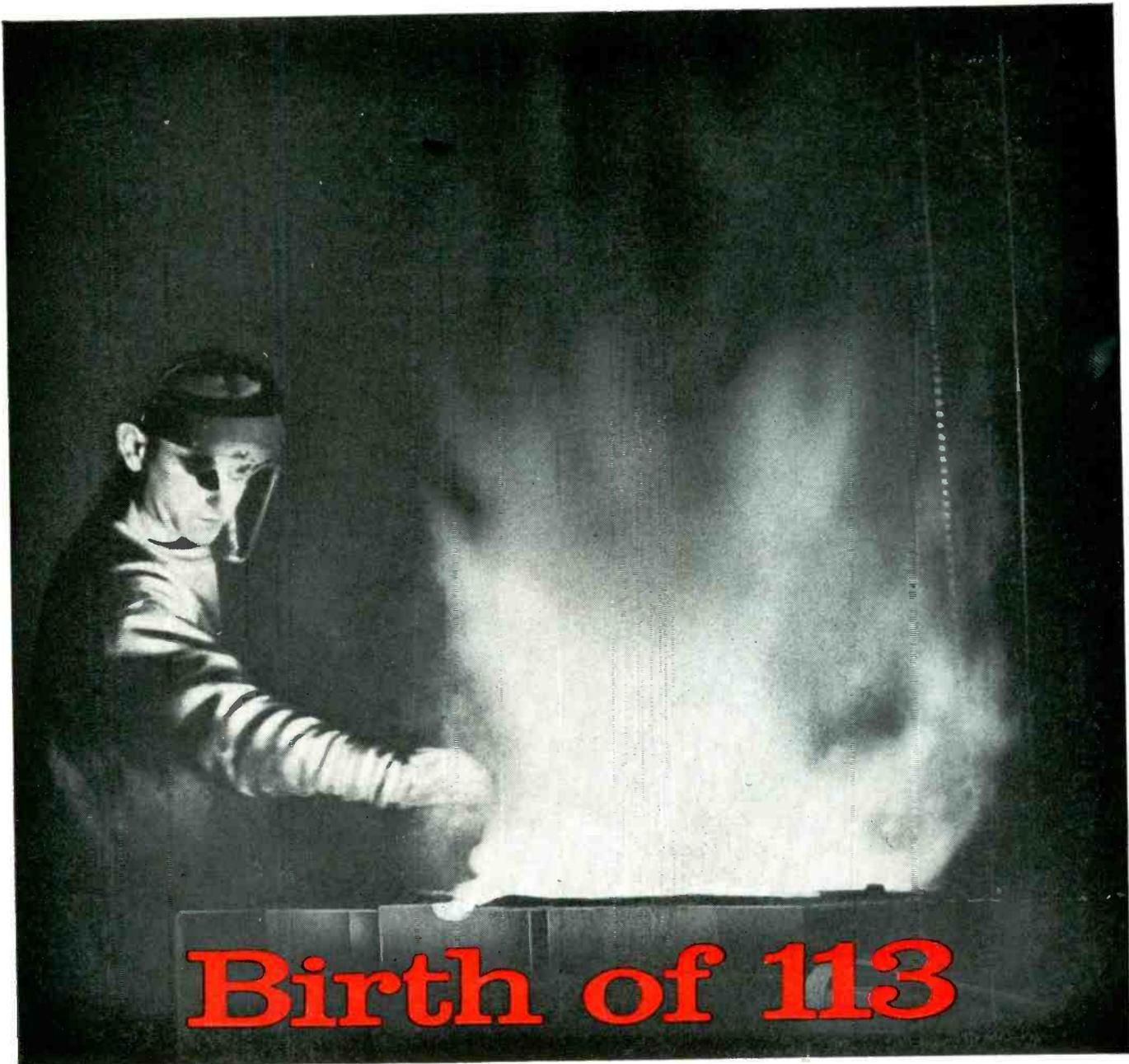
Suspect and investigate the heat and vibration menace when tube failures plague you. Eliminate it with IERC Heat-dissipating Tube Shields — available in sizes for Miniature, Subminiature, Octal and Power types of electron tubes.

PATENTED OR PATE. PEND. IERC T-12 SHIELD AND BASE WITH 6080 TUBE ILLUSTRATED.
CROSS-LICENSED WITH NORTH AMERICAN AVIATION, INC.

IERC literature and latest Octal and Power tube shield Technical Bulletin available now—FREE!

International
electronic research corporation
145 West Magnolia Boulevard, Burbank, Calif.





Birth of 113

At this stage, #113 is just a number. If all proceeds as planned, it will shortly acquire a name—the name of Driver-Harris's newest special-purpose alloy . . . made, as always, to meet the needs of a specific manufacturer.

When someone asks us for an alloy we do not have, we try to make it. Usually we succeed. To date we have succeeded 112 times. Many of our long line of electrical, electronic, and heat-resistant alloys—Nichrome*, Nichrome* V, Advance*, Karma*, Manganin, Nilvar*, and

the rest—are today famous names in industry the world over. And each of these was originally custom-made . . . produced exactly to the specifications of someone who needed it.

Are you in need of an alloy with special properties, not yet available? Put your specifications in our hands. You will gain the benefit of the 57 years of experience which has developed the largest variety of alloys ever made by any one company.

*T.M. Reg. U. S. Pat. Off.

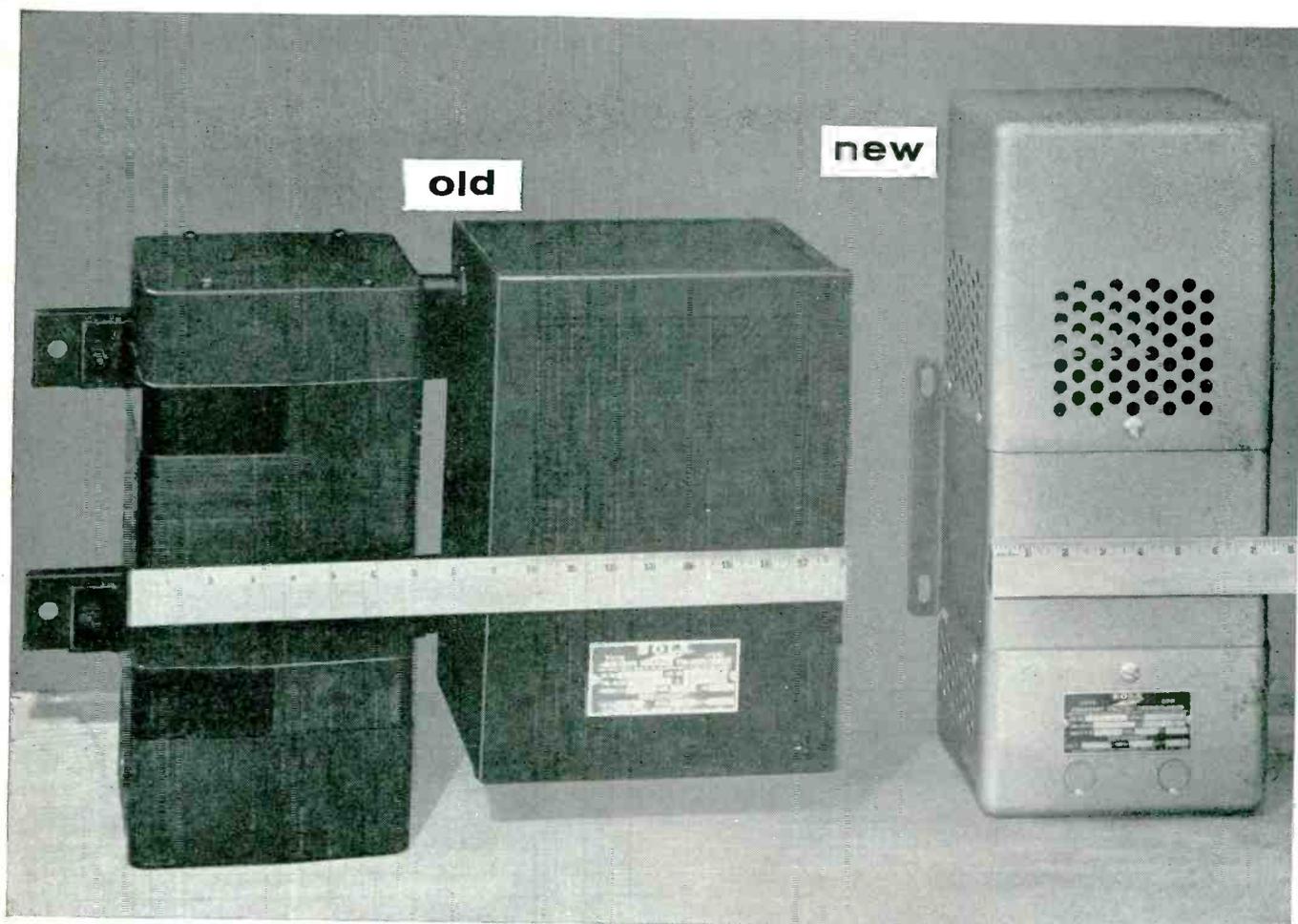


Driver-Harris
COMPANY

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Louisville, Los Angeles, San Francisco • In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD



SMALLER SIZE, LIGHTER WEIGHT of the new Sola Type CVH regulating transformer design is shown by the comparison of 1000va units shown above. The new unit shown at the right utilizes a single,

rectangular housing that replaces the core-and-coil-assembly and separate neutralizer component. Also available in the new design are 250 and 500va capacities. Finish is gray hammerloid.

New Sola Harmonic-Neutralized Constant Voltage Transformers greatly reduced in size and weight

Now the valuable performance features of the Sola Harmonic-Neutralized Constant Voltage Transformer (Type CVH) are offered in a new unit design that provides up to 60% reduced size and 54% lighter weight. In addition to significant size and weight reductions, the new Sola Type CVH regulator design provides the lowest external field of any stock static-magnetic stabilizer available.

Essentially, electrical characteristics of the new Type CVH regulator are unchanged. Stabilization is $\pm 1\%$ regardless of primary voltage swings over a newly-expanded range of 95-130 volts. Sinusoidal output is delivered with less than 3% harmonic distortion at rated

load. The nominal output rating has been raised to 118 volts to correspond with similar input reratings of electronic and other equipment.

Sola harmonic-neutralized regulators may be used for the most exacting applications with equipment having elements which are sensitive to power frequencies harmonically related to the fundamental. They are especially suitable for input to a rectifier when close regulation of the dc output is required.

New design Sola Type CVH regulators are available in three capacities — 250, 500, and 1000va. For specific advice on your particular application, consult your Sola representative listed below.

SOLA *Constant Voltage*
TRANSFORMERS



Request Explanatory Circular

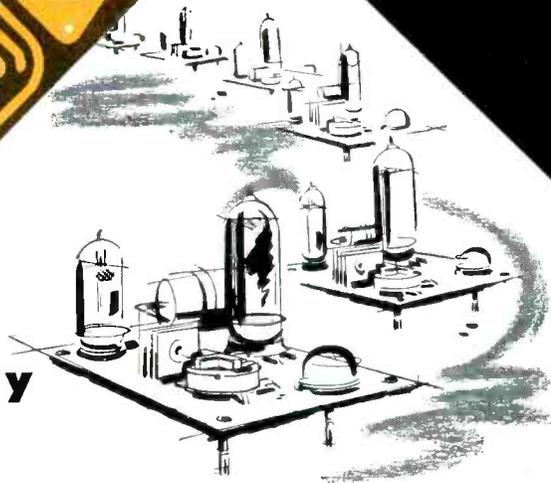
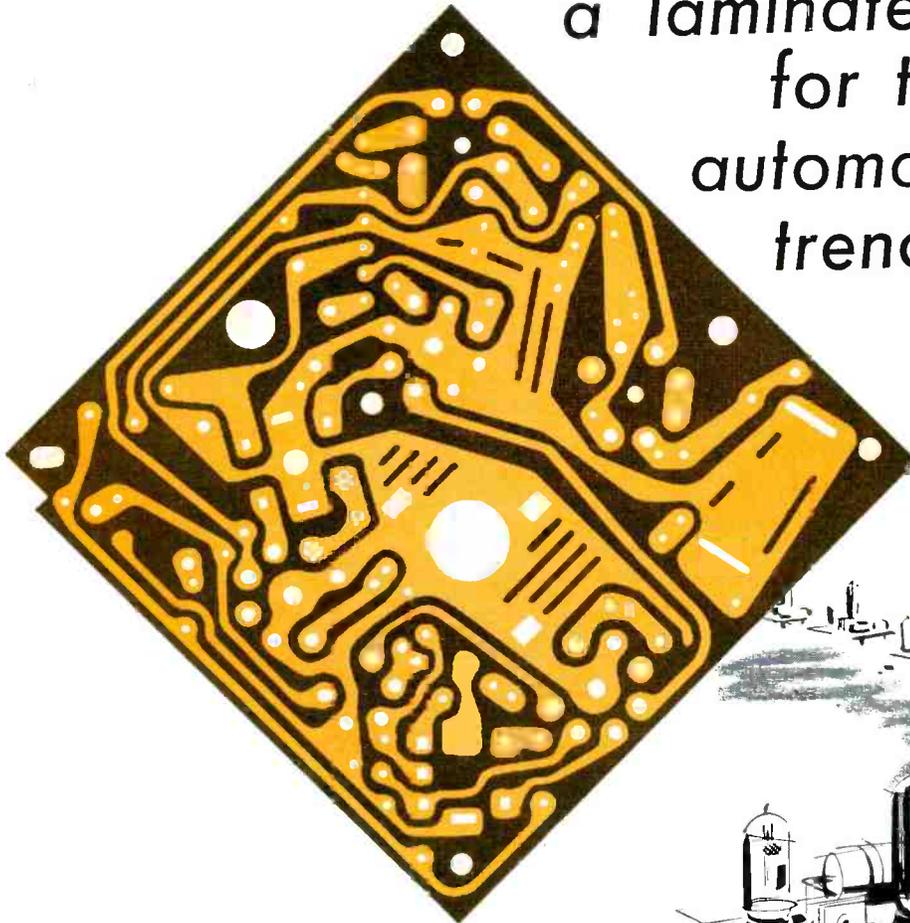
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4633 W. 16th Street
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9-9431 • SOLA ELECTRIC (CANADA) LTD., TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554 • Representatives in Other Principal Cities



Textolite® COLD PUNCH 11570

a laminate
for today's
automation
trends...



new precision registry for printed circuits

G-E TEXTOLITE Cold Punch 11570, a phenolic paper-base laminate, adds new concepts to mechanized printed circuitry. This high insulation resistance XXXP laminate can be punched at normal room temperatures—eliminating dimensional changes in the material, as is the case of grades that are heated prior to punching.

The cold fabricating quality of G-E TEXTOLITE 11570 makes possible precision registration of printed circuits, and affords manufacturers the opportunity to use automatic assembly equipment in mounting components.

Other outstanding features of G-E TEXTOLITE 11570 include high flexural strength, very low power factor, high heat resistance, and optimum uniformity. The translucency of TEXTOLITE 11570 permits a visual check for accuracy of circuit registration.

This new G-E TEXTOLITE Cold Punch 11570, with superior electrical and mechanical properties, now offers new opportunities to electrical and electronic manufacturers.

*when the properties have to be right
specify G-E Textolite*

Send the attached coupon for the factual booklet "A Laminate For Automation." It gives all the important facts about G-E TEXTOLITE COLD PUNCH 11570.

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- G-E Textolite® Laminated Sheets, Rods & Tubes
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General Electric Company
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Section EL-126 Coshocton, Ohio

- Please send me your new booklet, "A Laminate for Automation."
- Please have your representative call.

Name

Firm

Street

City Zone State

FREQUENCY STANDARDS



PRECISION FORK UNIT TYPE 50

Size 1" dia. x 3 3/4" H.* Wght., 4 oz.

Frequencies: 240 to 1000 cycles

Accuracies:—

Type 50 ($\pm 0.02\%$ at -65° to 85°C)

Type R50 ($\pm 0.002\%$ at 15° to 35°C)

Double triode and 5 pigtail parts required

Input, Tube heater voltage and B voltage

Output, approx. 5V into 200,000 ohms

*3 1/8" high
400 - 1000 cy.

FREQUENCY STANDARD TYPE 50L

Size 3 3/4" x 4 1/2" x 5 1/2" High
Weight, 2 lbs.

Frequencies: 50, 60, 75 or 100 cycles

Accuracies:—

Type 50L ($\pm 0.02\%$ at -65° to 85°C)

Type R50L ($\pm 0.002\%$ at 15° to 35°C)

Output, 3V into 200,000 ohms

Input, 150 to 300V, B (6V at .6 amps.)



PRECISION FORK UNIT TYPE 2003

Size 1 1/2" dia. x 4 1/2" H.* Wght. 8 oz.

Frequencies: 200 to 4000 cycles

Accuracies:—

Type 2003 ($\pm 0.02\%$ at -65° to 85°C)

Type R2003 ($\pm 0.002\%$ at 15° to 35°C)

Type W2003 ($\pm 0.005\%$ at -65° to 85°C)

Double triode and 5 pigtail parts required

Input and output same as Type 50, above

*3 3/8" high
optional
400 to 500 cy.

FREQUENCY STANDARD TYPE 2005

Size, 8" x 8" x 7 1/4" High
Weight, 14 lbs.

Frequencies: 50 to 400 cycles
(Specify)

Accuracy: $\pm 0.001\%$ from 20° to 30°C

Output, 10 Watts at 115 Volts

Input, 115V. (50 to 400 cycles)



FREQUENCY STANDARD TYPE 2007T

TRANSISTORIZED

Size 1 1/2" dia. x 4 1/2" H.* Wght. 7 ozs.

Frequencies: 240 to 1000 cycles

Accuracies:—Same as 2003, above

Type 2007S—Silicon type

Input, 28V.

Output, Multitap, 75 to 100,000 ohms

*3 1/2" in 2007S, 400 to 800 cycles.

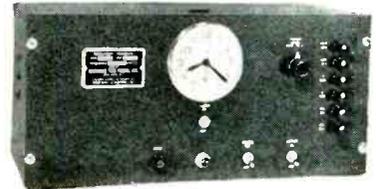
FREQUENCY STANDARD TYPE 2121A

Size
8 3/4" x 19" panel
Weight, 25 lbs.

Output: 115V
60 cycles, 10 Watt

Accuracy:
 $\pm 0.001\%$ from 20° to 30°C

Input, 115V (50 to 400 cycles)



FREQUENCY STANDARD TYPE 2001-2

Size 3 3/4" x 4 1/2" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles

Accuracy: $\pm 0.001\%$ at 20° to 30°C

Output: 5V. at 250,000 ohms

Input: Heater voltage, 6.3 - 12 - 28

B voltage, 100 to 300 V., at 5 to 10 ma.



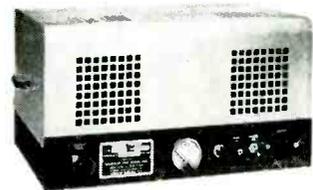
FREQUENCY STANDARD TYPE 2111C

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8 3/4" H.
Weight, 25 lbs.

Frequencies: 50 to 1000 cycles

Accuracy: ($\pm 0.002\%$ at 15° to 35°C)

Output: 115V, 75W. Input: 115V, 50 to 75 cycles.



ACCESSORY UNITS for TYPE 2001-2

L—For low frequencies
multi-vibrator type, 40-200 cy.

D—For low frequencies
counter type, 40-200 cy.

H—For high freqs, up to 20 KC.

M—Power Amplifier, 2W output.

P—Power supply.



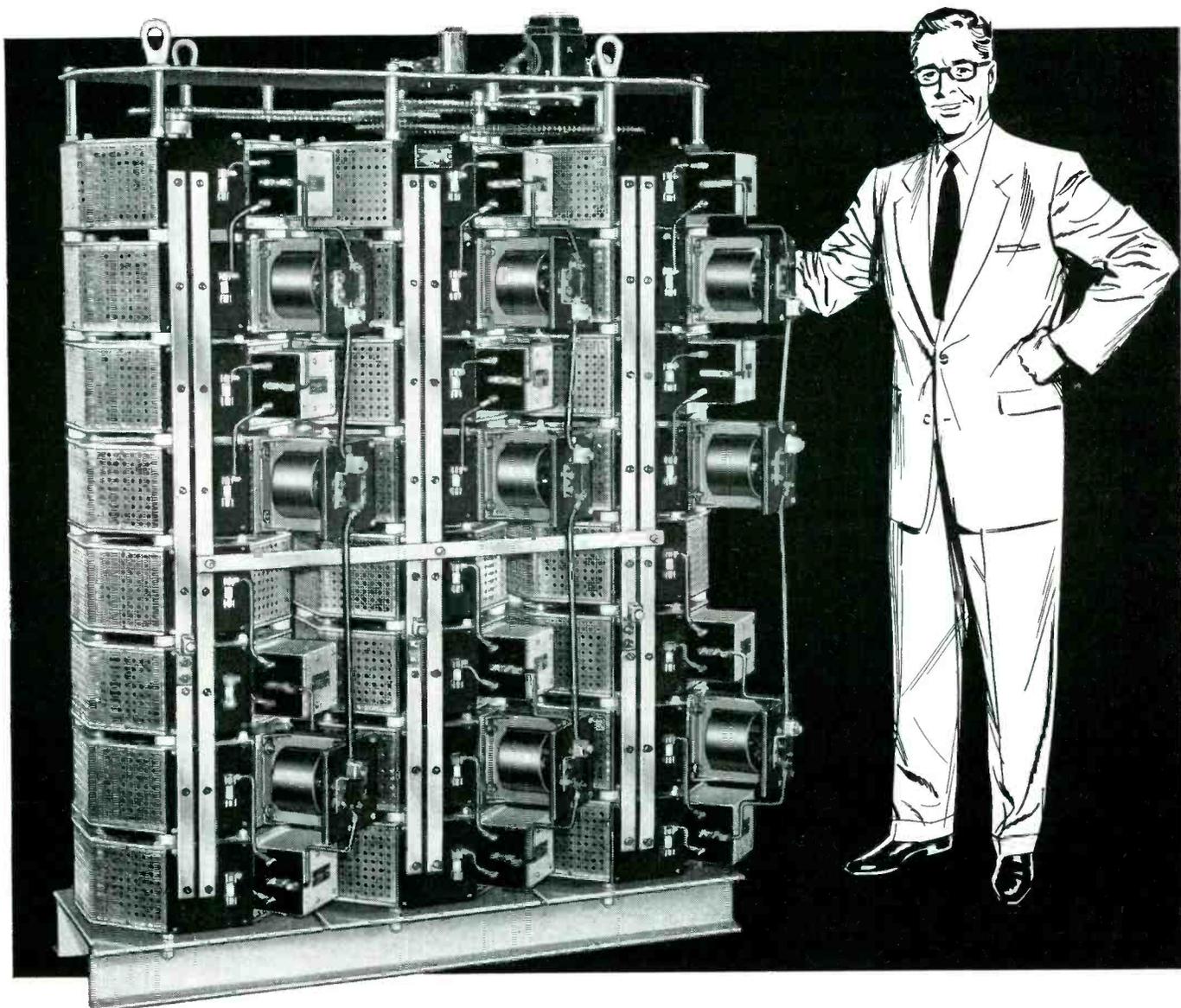
This organization makes frequency standards within a range of 30 to 30,000 cycles. They are used extensively by aviation, industry, government departments, armed forces—where maximum accuracy and durability are required.

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

American Time Products, Inc.

580 FIFTH AVENUE, NEW YORK 36, N. Y.

POWERSTAT[®] Variable Transformers



...for heavy duty applications

As the leader in its field, The Superior Electric Company offers the widest selection of variable a-c voltage control apparatus. Standard POWERSTATS are available in ratings from 150 to 160,000 volt-amperes. For heavy duty requirements, POWERSTATS in gangs of 6, 8, 9, 12, 15, 18 or more provide the same fast accurate adjustments to fractions of a volt as the smallest rated unit.

Generally, heavy duty POWERSTATS are motor-driven for effortless control from remote "raise-lower" switches or positioner stations. Standard heavy duty POWERSTATS are supplied for single or three phase; 120, 240 or 480 volt service with current ratings up to 400 amperes.

For more information on POWERSTATS for heavy duty applications, use the coupon below.

Be sure to see Superior Electric's
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Offices: Los Angeles, California • San
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THE SUPERIOR ELECTRIC COMPANY
212 MIDDLE STREET, BRISTOL, CONNECTICUT

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PRECISION REELS

Bobbin dimensions or big as a bike wheel, your special requirements for precision reels can be met by Standard Record with equal facility. Wide experience in producing reels for military, commercial, and industrial users,

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in research, manufacturing, and entertainment applications, provides a wide range of pre-engineered hubs and flanges that may be adaptable to your need. This same wide experience will speed a custom design for applications requiring an entirely new approach. Write today for full information on our design, engineering and production facilities.

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SR-1



**accuracy,
0.1 mv to 300 v!**

-hp- 400H High-Accuracy Vacuum Tube Voltmeter

New! 1% accuracy 50 cps to 500 KC
Frequency range 10 cps to 4 MC
10 megohm input resistance
12 ranges, 0.1 mv to 300 v
Direct readings in volts or db
Functions as stable amplifier

OTHER -hp- QUALITY VOLTMETERS



-hp- 400AB, for general ac measurements. Covers 10 cps to 600 KC, 0.3 mv to 300 v. Accuracy $\pm 2\%$, 20 cps to 100 KC. 10 megohm input impedance plus 25 μf shunt insures circuits under test against disturbance. Readings direct in volts or dbm. \$200.00



-hp- 400D, highest quality, wide range, maximum usefulness. Covers 10 cps to 4 MC, 0.1 mv to 300 v. New amplifier circuit provides 56 db of feedback. (mid-range) for ultimate stability. 10 megohm input impedance prevents disturbing circuits. Sealed or long-life electrolytic condensers; rugged, trouble-free. \$225.00



-hp- 410B, industry's standard for vhf-uhf voltage measurements. Wide range 20 cps to 700 MC, response flat within 1 db full range. Diode probe places 1.5 μf capacity across circuit under test; this plus 10 megohm input impedance prevents disturbance. Instrument combines highest quality ac voltmeter with dc voltmeter (122 megohm input impedance) and ohmmeter covering 0.2 ohms to 500 megohms. \$245.00

New -hp- 400H Vacuum Tube Voltmeter combines broadest usefulness with wide voltage and frequency coverage, and the greatest accuracy ever offered in a multi-purpose voltmeter.

On line voltages of 103 to 127 v, accuracy is $\pm 1\%$ full scale, 50 cps to 500 KC; $\pm 2\%$, 20 cps to 1 MC, $\pm 5\%$, 10 cps to 4 MC. Readings are direct in db or volts on 5" mirror scale meter; 12 ranges cover 0.1 mv to 300 v. High 10 megohm input resistance minimizes loading to circuits under test. Stabilized amplifier-rectifier with feedback loop gives high long-term stability; line voltage changes as great as $\pm 10\%$ cause negligible variation. Overvoltage protection is 600 v on all ranges. Highest quality, rugged construction throughout. \$325.00.

**CALL YOUR -hp- REPRESENTATIVE
FOR COMPLETE DETAILS**

HEWLETT-PACKARD COMPANY

3691A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.

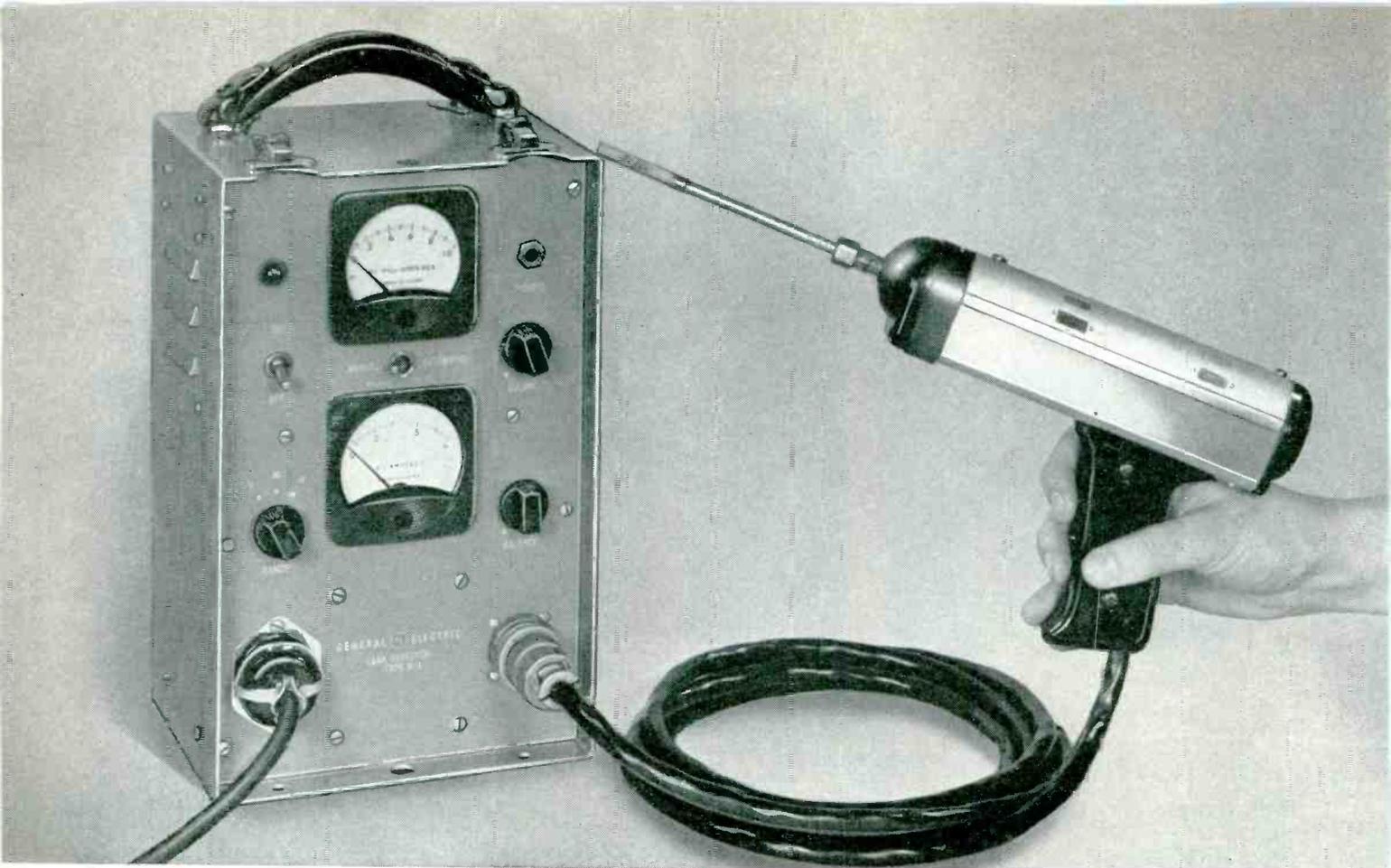
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Field Engineers in all Principal Areas

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



Quality, value, complete coverage in voltmeters



1 **HIGHLY SENSITIVE**, the G-E Halogen leak detector, Type H-1 will find a leak of 1/100 ounce of "Freon"* a year. Use it to check for leaks in pressure systems such as refrigeration equipment as well as in closed systems into which a tracer gas and pressure can be placed such as tanks, tubing, fuel

cells, boilers, pipes, pneumatically operated equipment, etc. Whenever leaks can be expensive in terms of money, danger or reputation, use the General Electric Type H-1 leak detector to find them. No other method or instrument approaches its sensitivity, fast response, versatility and convenience.

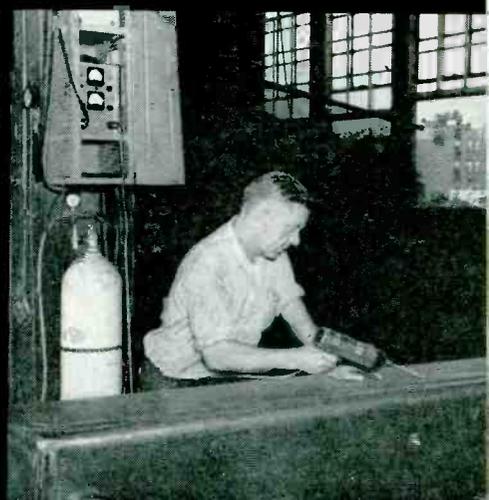
G-E LEAK DETECTORS SERVE INDUSTRY AS

FOR PRESSURE SYSTEMS

Type H-1
Halogen tracer gas
Indicates leak, does
not measure leak
Price \$604.80**

FOR VACUUM SYSTEMS

Type M-1
Helium tracer gas
Indicates and meas-
ures leak
Price \$4100.00**



IN ASSEMBLY-LINE TESTING of Lincoln automobile air-conditioners, the General Electric Halogen Leak Detector, Type H-1, is used to quickly "sniff" all vital connections under the chassis and hood.

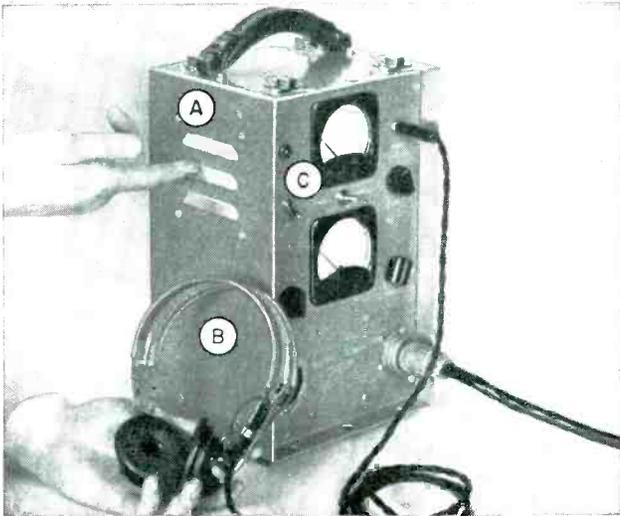
TO CUT REJECTS, the Angle Products Company, Cleveland, Ohio, checks their hydraulic oil and fuel tanks with the G-E leak detector. It has reduced the company's inspection time by 35%.

*Registered trade-mark, Kinetic Chemicals Div. of E. I. du Pont de Nemours & Co.

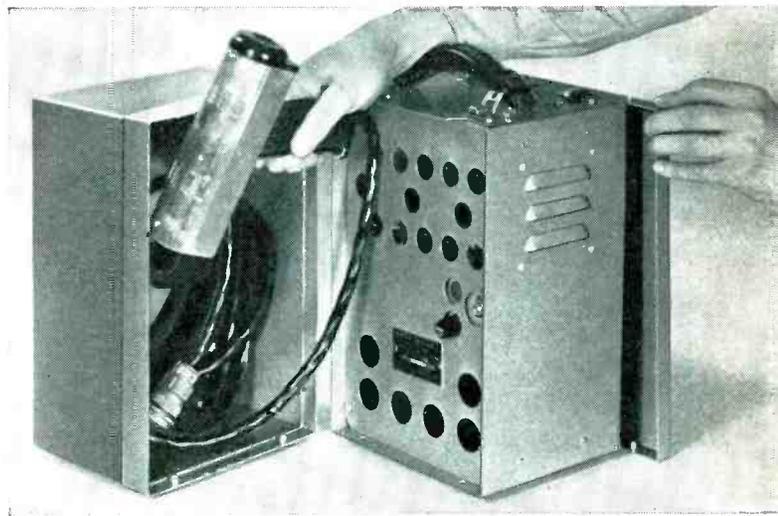
**Manufacturer's suggested retail price.

How Dependable G-E Leak Detectors Simplify Locating Hard-to-find Leaks

FIND LEAKS QUICKLY IN EITHER PRESSURE OR VACUUM SYSTEMS

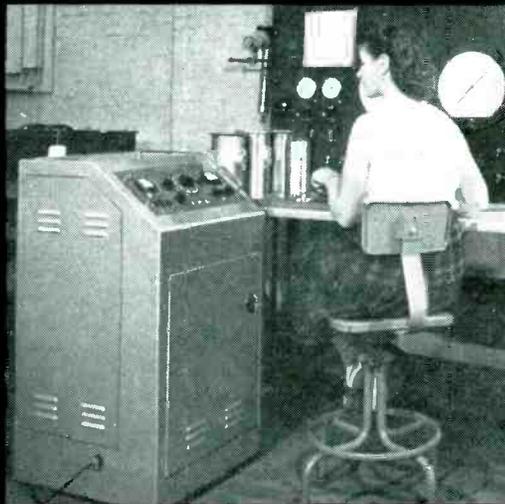


2 LEAK INDICATIONS given by a variable-pitch loudspeaker (A), earphones (B), and instrument dial (C) assure a true leak signal. Unit pin-points leaks too small to be found by older methods. Earphones may be purchased from your radio-supply dealer.



3 READILY PORTABLE, weighing only 24½ pounds, the unit may be carried to where it is needed. It is well suited for assembly-line use as well as for service testing in the field wherever alternating current is available. Leads and probe may be stored easily in rear of control cabinet.

IMPORTANT TESTING AND INSPECTION TOOLS



SECTION J605-60
GENERAL ELECTRIC COMPANY
SCHENECTADY 5, N. Y.

Please send me the following bulletins:

- Halogen Leak Detector, Type H-1 (GEC-233)
- Mass Spectrometer Leak Detector, Type M-1 (GEC-336)
- Measuring Equipment Catalog (GEC-1016)

NAME

COMPANY

STREET

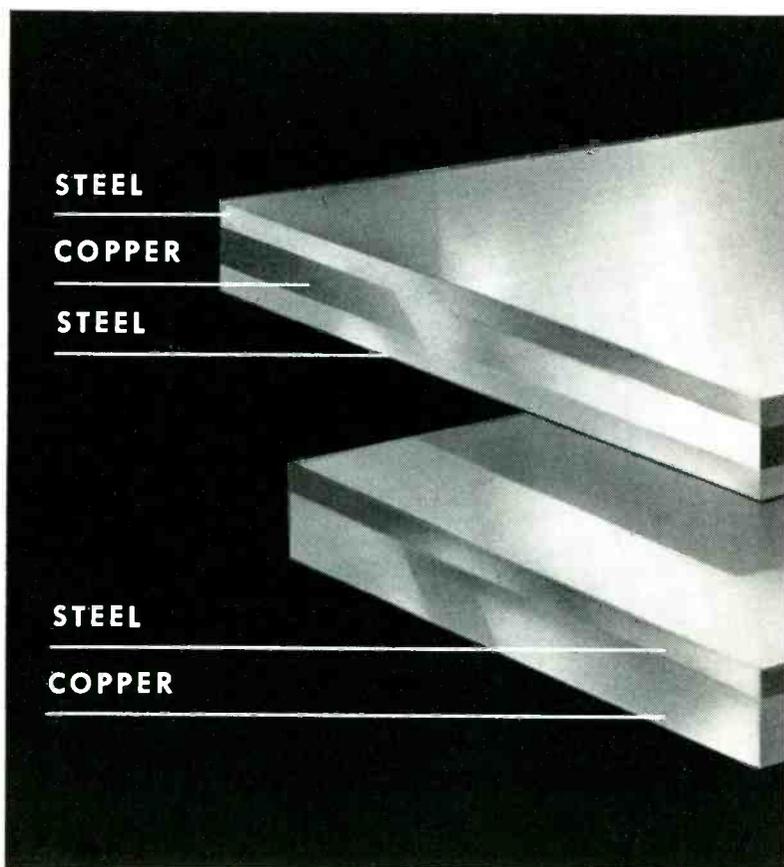
CITY..... ZONE..... STATE.....

FOR VACUUM SYSTEMS or pressure systems the Type M-1 Mass Spectrometer leak detector will locate leaks as small as 5×10^{-10} standard cubic centimeters of air per second.

Shown above (left) checking an evacuated refrigeration cooling unit, the detector detects leaks so small that in 1000 years only 1 cubic inch of air would pass through the opening.

GENERAL  ELECTRIC

Two Metals are often Better than one!



...and GENERAL PLATE Stainless Clad Copper is a case in point

Here's what General Plate Stainless Clad Copper offers:

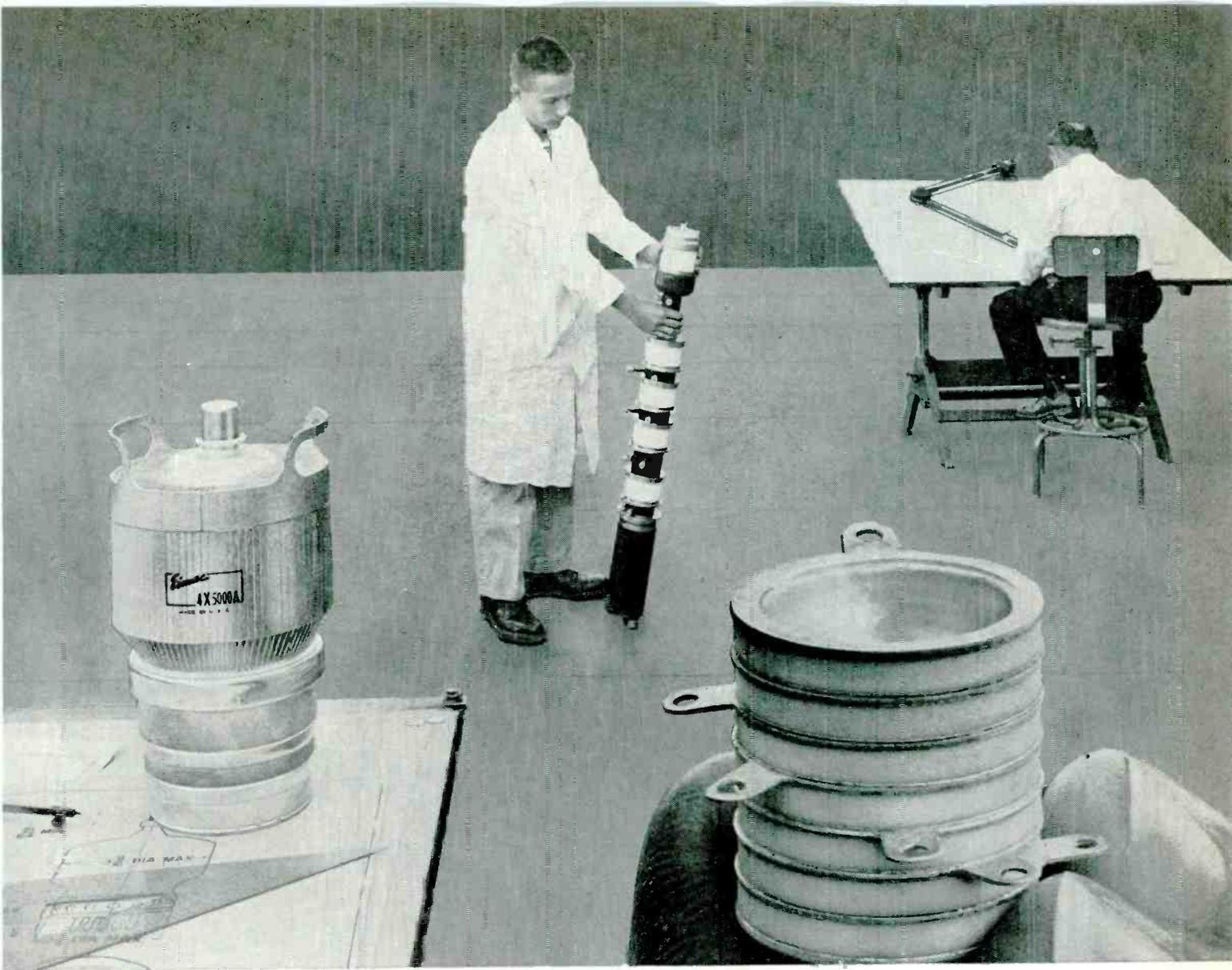
- High thermal and electrical conductivity for excellent heat transfer
- Corrosion resistance equal to stainless steel
- Superior performance at elevated temperatures

You can profit
by using General Plate Clad Metals

General Plate's Stainless Clad Copper strip adds the superior thermal conductivity of copper to the high temperature corrosion resistance of stainless steel. Molecularly bonded without brazing alloys or other intermediate agents, these two metals combine in clad form to offer improved characteristics for a wide range of applications involving electrical conductivity or heat exchange.

If you are interested in metals with new and better characteristics — look to General Plate Clad Metals. Write today without obligation for new catalog, PR-700A, describing many clad metal combinations — both precious and base metal; TRUFLEX® Thermostat Metals; composite electrical contact buttons and rivets.

METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
1312 FOREST STREET, ATTLEBORO, MASS.



Eimac ceramic tubes open up new horizons

The future of many electronic applications depends on the ability of the electron tube to overcome extreme shock and temperature barriers. Anticipating this need, Eitel-McCullough has extended its leadership in transmitting tubes to the development and production of ceramic tubes in the negative grid, klystron, rectifier, and receiving tube field.

Aside from superior immunity to shock damage, ceramic permits new design concepts and optimum production techniques to be employed. The result is smaller, more reliable tubes.

In its new ceramic line, Eimac is enabling the electron tube to overcome old barriers

and establish new goals of performance and dependability.

What is your goal beyond present day horizons? With scientific certainty, you may look where you are going. But only dependable tools will enable you to go where you are looking. Make sure you have such tools. Check carefully the incomparable capabilities of performance-proved Eimac ceramic tubes.

For further information on Eimac's full line of electronic tubes, contact our Application Engineering Department and ask for the new Quick Reference Catalog.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes



CERAMIC AMPLIFIER KLYSTRONS

3K2500SG	3K20,000LA	3K50,000LA
3K3000LQ	3K20,000LF	3K50,000LF
3KM3000LA	3K20,000LK	3K50,000LK
		3K50,000LQ
		4K50,000LQ

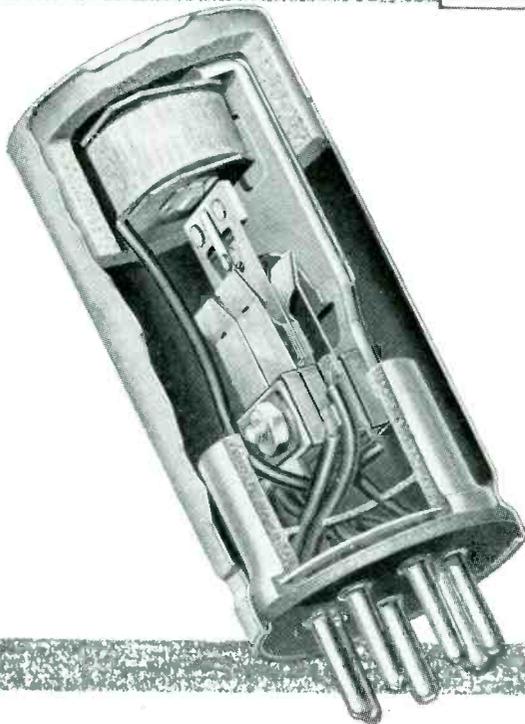
CERAMIC NEGATIVE GRID TUBES AND RECTIFIER

Triode	Tetrode	Rectifier
2C39B	4CX250K	2CL40A
	4CX300A	
	4X5000A	

CERAMIC RECEIVING TUBES

5C2A
33C3A2

P. R. MALLORY & CO. Inc.
MALLORY



New 1700 series Mallory split-reed vibrator uses special alloy leaves which serve both as contacts and as springs . . . eliminating usual button contacts. Life is greatly increased, constancy of output improved, and driving power reduced.*

**Patent Applied For*

New Heavy Duty Mallory Vibrator

gives far longer life, constant output

For the peak in dependability and performance, plan to use this newest Mallory vibrator in your communications equipment. A completely new idea in vibrator design eliminates conventional contact buttons. The spring leaves themselves . . . made of special contact alloy . . . act as contacting members. This design provides greatly increased contact area, with these important advantages:

Consistently Longer Life. Tests made on heavy duty cycles prove up to 100% greater service can be expected . . . with a high degree of consistency.

Steadier Output. The decreased rate of erosion means less change in contact spacing, less variation in voltage.

Flare-Proof Starting. The new low-mass design permits wider contact spacing to prevent start-up flare . . . without need for greater driving power.

Exceptional Uniformity of characteristics is made possible by the simplified design.

Minimum Size for heavy duty ratings.

The new design is available in the split-reed type shown here, for 6/12 volt service, and in the Duplex heavy duty model without the split reed construction. For full technical data, and for a consultation on your specific power supply requirements, write or call Mallory.

COMPLETE POWER SUPPLIES

It may be that you can save time and reduce over-all costs by employing a complete Mallory Vibrapack® power supply. Vibrapacks can be engineered around the new heavy-duty 1700 series vibrator to give long, reliable service. Design includes precise balancing of critical components. Normal ratings are conservative. Compact-sized Vibrapacks fit readily into crowded layouts. For further information, advise Mallory of your specific requirements.

Serving Industry with These Products:

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

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

Expect more . . . get more from

P. R. MALLORY & CO. Inc.
MALLORY

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

CROSS
TALK

THREE EDITIONS start next month

FIVE YEARS AGO we introduced the "Industry Report" pages in *ELECTRONICS*. They were placed up front in the magazine, well separated from technical material.

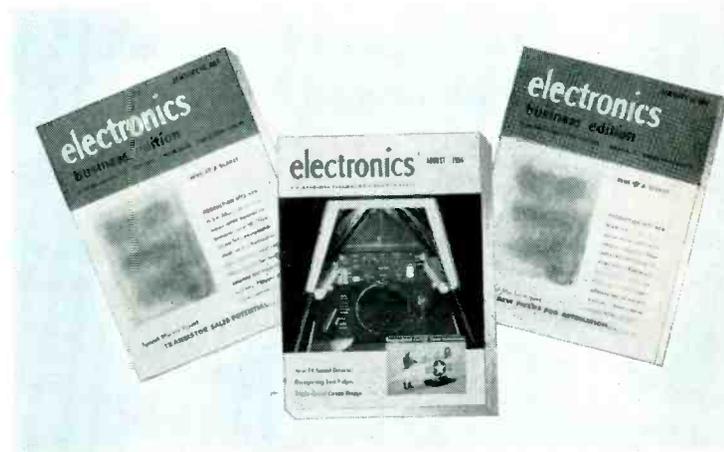
We learned a lot from this long experience. Technical men are definitely interested in the commercial aspects of electronics, just as front-office people are interested in product development. The principal difference in reading requirements if, indeed, there is any sharp line of demarcation in this highly scientific field, is in the degree of interest each man takes in the other man's specialty.

We learned also, and our conviction has been growing as the industry grows, that while the engineer's ability to absorb more periodically published technical information may be nearing saturation this is not necessarily true in the area of commercial or "business" information. Both technical men and their less-technically-bent associates appear to need more help here.

How to give them this help? Here is our plan:

BEGINNING IN JANUARY every subscriber on *ELECTRONICS'* circulation list will receive three editions each month. Our issue dated January 1, 1957 will be the one you are accustomed to receiving, and will be the same as it has been in recent years; nothing will be changed. Then, dated January 10 and again, dated January 20, you will receive a second and a third edition. These two editions will be Business Editions.

The two Business Editions will concentrate upon the commercial problems of the electronics industry, as distinguished from its technical problems. They will devote major space to such subjects as the industry's immediate and long-range business outlook, its financial position, stocks, mergers and acquisitions, the influence of government, production and sales statistics, military requirements and communications growth potential. They will cover electronic materials supply



and demand, foreign business and new equipment applications. And they will contain brief digests of important technical developments for busy executives.

THE EDITORIAL STAFF has been more than doubled to provide this extension of service. We have added engineering manpower. We have staked out full-time editors on the Pacific Coast, in the Midwest and in New England. And we have added many men who will specialize in reporting to you on such subjects as the credit situation as it applies to our specific field, manpower supply and demand, significant product developments and news of plants and people.

We think, and we hope our readers discover, that increased frequency of publication can be useful when applied to the type of service represented by our Business Editions. And that is the new job we have tackled . . . to provide an expanded service that will help men and managements to be still more successful, not just technically but technically and commercially too.

W W Mac Arnold

EDITOR

ELECTRONICS in the IGY PROGRAM

SUMMARY — Projects planned for the International Geophysical Year will use electronic instrumentation to sense, record and telemeter data. Earth satellite program will use transistorized oscillators for tracking and telemetering of data to ground from subminiature measuring equipment

By **DAVID A. FINDLAY**

Assistant Editor, ELECTRONICS

STUDIES of the earth and its atmosphere during the International Geophysical Year 1957-58 will make wide use of electronics to measure and record data. The projects include the earth satellite program, rocket research, ionospheric and oceanographic measurement.

The earth satellite program, as planned, will consist of placing a number of satellites in orbits around the earth. Each will carry different types of equipment to

make physical measurements. The first satellite will be a sphere 20-in. in diameter and weighing 21 lb.

Common to all satellites will be the 15-mw tracking transmitter and 100-mw telemetering system designed by the Naval Ordnance Laboratory. The 108-mc crystal-controlled tracking unit is shown in Fig. 1A. The transistor is a Philco SBDT-12, having an alpha cutoff at 150 mc, or a Western Electric GA 53233. With seven RN-12 Mallory

batteries, the unit will weigh 13 oz.

During the telemetering period, power is applied to the 100-mw transmitter by an interrogating pulse from the ground. The system, shown in Fig. 1B, uses the tracking transmitter as local oscillator for the telemetering-unit receiver. The telemetering transmitter is amplitude modulated by the telemetering coder output.

When the interrogation pulse is received the relay is closed, turning on the 100-mw oscillator, telemetering coder and measuring equipment for the experiments being carried. A relay-operated switch feeds the telemetering output to the transmitting antenna.

After a 30-second transmission period, the relay opens and switches the antenna back to the tracking oscillator output. The telemetering unit will be powered by fourteen RN-42 silver-cell batteries providing power for 16 days of periodic operation. Total weight of the unit is 5½ lb.

Ground stations for tracking and telemetering will be of two types.



Satellite tracking antenna is mounted on jack-type posts to permit leveling

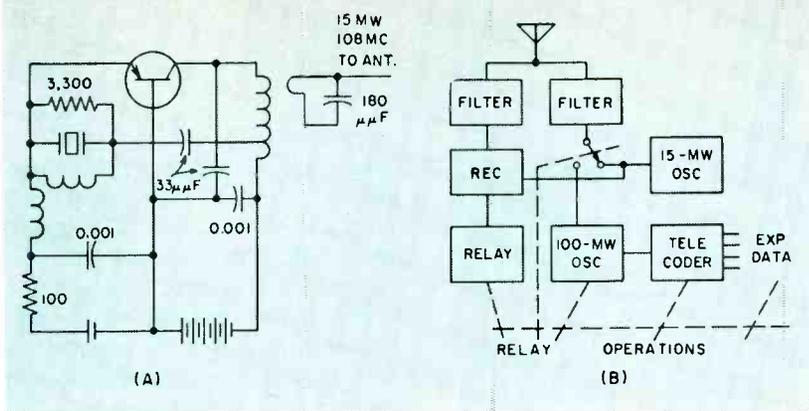


FIG. 1—Satellite tracking oscillator (A) is also used as local oscillator for telemetry turn-on control receiver (B)



Transistor oscillator for satellite tracking is shown with silver-cell battery pack. Single high-frequency transistor is at rear center of plate

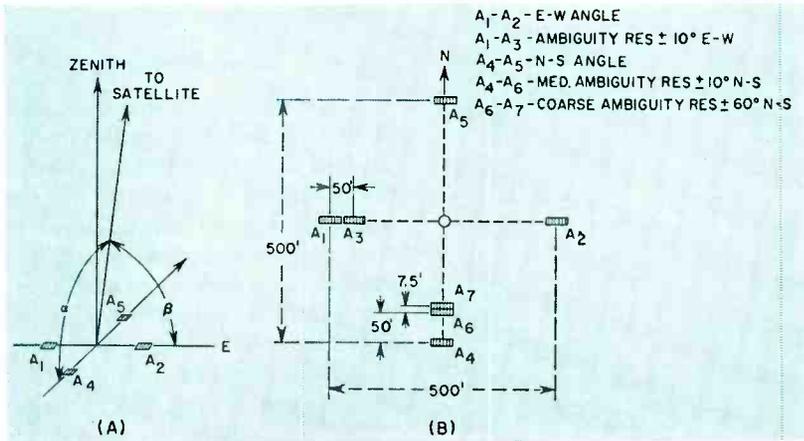


FIG. 2—Four-antenna configuration for ground station (A) determines angle to satellite by phase comparison. Multiple antenna system (B) is used at major tracking stations along satellite path

A prime Minitrack station will provide exact location of the satellite by radio interference techniques using multiple antenna systems. Less complex tracking stations will provide ambiguous location data and use prime station correlation to resolve ambiguities.

The ground station techniques and arrangement are shown in Fig. 2. Measurement of phase difference in signals arriving at two antennas provides angular position. Using antenna arrays arranged in a north-south and east-west configuration provides sufficient information to fix the satellite position in space. Because of phase repetition every 360 degrees, a secondary set of antennas is required to resolve ambiguity.

The ground station electronic equipment is shown in block form in Fig. 3. Eight antennas are used, each feeding a low-noise 108-mc preamplifier and mixer to provide two i-f signals separated in frequency by 500 cps. The two signals are fed to an adder stage and then to the second mixer to provide a

470-kc output signal to the second i-f stage.

The i-f signal is demodulated in a square-law detector to obtain a 500-cps signal. This is then compared with a 500-cps reference to provide an output identical in phase difference with that received at the two antennas. The phase difference is then recorded in analog and digital recorders with time reference markers tied to WWV time signals.

Secondary Stations

The simplified secondary station uses four antennas with each pair feeding a hybrid junction. A conventional a-m receiver is used to amplify the junction output providing a series of nulls as the path length to the moving satellite changes.

The tracking antennas will be calibrated by photo-optical methods using an airborne satellite transmitter. A light on the plane pulsed on and off from the ground station will be photographed from the center of the antenna array as the

plane passes over. Relating the receiver signal to the light flashes will provide spatial calibration of the antenna group.

A 12-element antenna and an 8-element slot array are now under test for the tracking system. The radiation pattern is fan-shaped, 90 by 12 degrees, in the north-south direction. The antennas will provide a gain of about 40 db.

The complete Minitrack system was described by John T. Mengel in a paper presented at the 1956 ISA conference in N. Y. Scientific measuring equipment to be carried in the satellite was described by Herbert Friedman.

The measuring equipment must meet the requirements of importance and the 21-pound weight limit for the sphere and payload. Initial experiments will be carried out with the sphere although future satellites may be made in other shapes. Experimental data will be transmitted to the ground by the 220-mc telemetering transmitter.

So far, over twenty experiments have been proposed. All of them re-

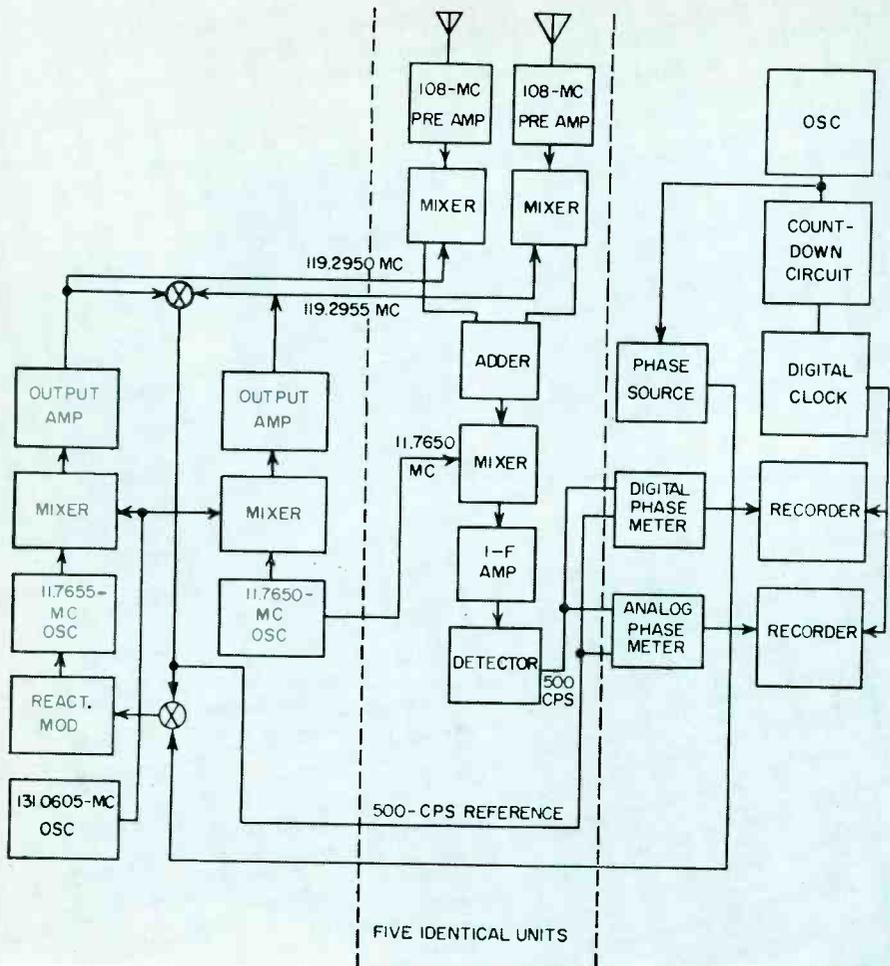


FIG. 3—Main tracking station equipment on the ground requires separate r-f-through-detector sections for each pair of antennas

quire long-term measurement that cannot be obtained from rocket flights.

Internal and external temperature measurements will be made with thermistors. One mounted on the instrument pack will measure internal temperature of the satellite over a range from 0 to 80 C. Two other units on the satellite skin will measure temperature due to aerodynamic heating and temperature change as the satellite moves

around its orbit. The aerodynamic heating is not expected to go above 150 C and orbit temperature variations are expected to be from -40 C to 75 C.

Three methods can be used to obtain information about meteor particles hitting the satellite. Rockets have carried crystal microphone-tuned amplifier systems to record the sound of particles. This method gives number and size-velocity data.

The satellite version will use a transistor amplifier and counter to record hits of particles ranging from 1 micron up to visual dimensions. The unit weighs 41 oz. and will operate for 30 days.

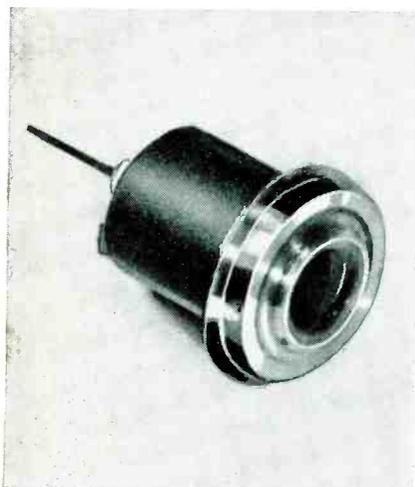
Resistance material on the satellite skin can also be used to indicate the frequency of particle hits by erosion. Change of resistance caused by meteors can indicate the frequency of hits. A similar technique using radioactive material and Gieger tube can also be used to measure surface erosion.

Solar Research

Ion chambers of the type shown in one of the photographs will be used to measure intensity of solar radiations at wavelengths cut from the earth by the atmosphere. Filters will select the wavelength to be studied. Mounted on the outside of the satellite, the window of the chamber will traverse the surface of the sun once for each rotation of the satellite around the earth.

The peak output of the electrometer, fed by the ion chamber, is stored as a charge on a capacitor. Interrogation at telemetering time by a pulse from ground closes a switch connecting the charged capacitor across the input to the telemetering system. The capacitor is then discharged in preparation for the next transit across the sun.

The system for cosmic ray counting, shown in Fig. 4A, was developed at the University of Iowa. The output of a Geiger counter is scaled down and fed to a mixer where a timing pulse is superimposed. The



Ionization chamber mounted on rocket skin to measure solar radiation

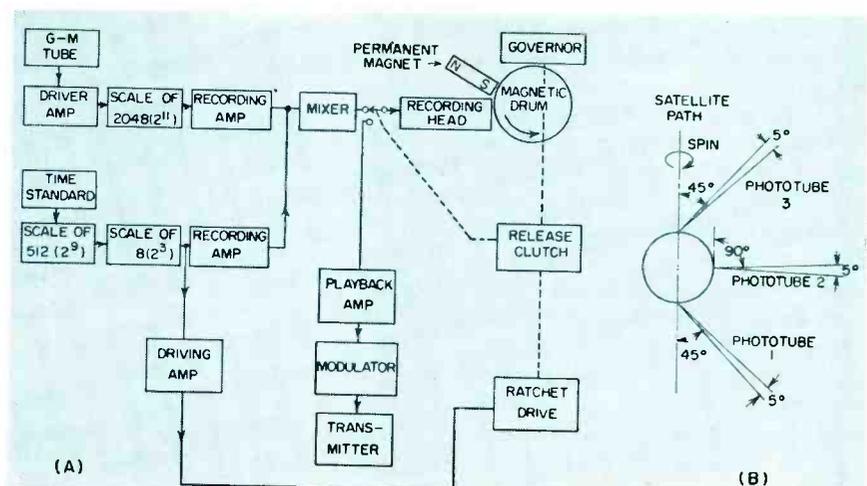


FIG. 4—Equipments to be carried in the earth satellite include recording cosmic-ray counter (A) and system for determining cloud cover of earth (B)

timing pulse also provides the drive signal for the magnetic recording drum motor.

The telemetering interrogation-pulse switches the recording head to the playback amplifier and the recorded data is transmitted as the drum returns to its starting position. This system weighs 1.7 lb and uses a 15-oz silver cell battery for 2 weeks of operation. A permanent magnet erases the data after transmission.

Three photocells on the outer surface of the sphere can provide information on the cloud cover of the earth. As shown in Fig. 4B the photocells will scan the earth from horizon to horizon as the satellite moves around the earth. Since cloud reflection is about 55 percent as compared to 10 to 35 percent for the earth, the cloud pattern can be determined from satellite position information and the phototube outputs. This technique is expected to be of use in early detection of hurricane formations.

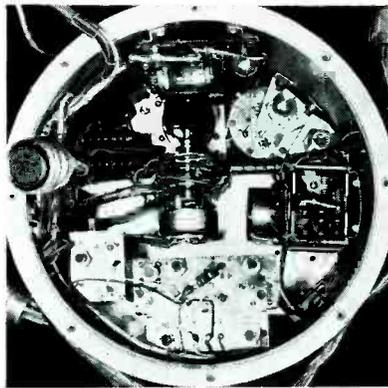
Rocket Research

The IGY rocket program, described by P. H. Wyckoff, will consist of firings from Fort Churchill, Canada, of Aerobee and other types of rockets.

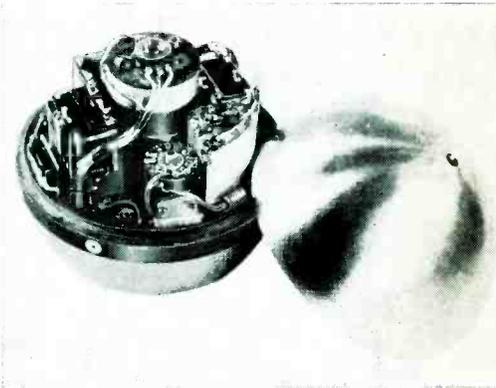
Accurate velocity information will be obtained by the DOVAP doppler velocity and position system. With this technique a 39-mc c-w signal is transmitted from ground to the rocket. The signal received at the rocket will be at a lower frequency than that transmitted due to doppler effect.

This signal is fed through a doubler circuit and transmitted back to ground. The returned signal which has been modified twice by the doppler effect is then beat against the original signal to give velocity.

The rocket telemetering system is shown in Fig. 5A. The output of a 5-kc oscillator provides 200- μ sec pulses to step a selector gate for instrument channels, trigger a multivibrator and feed a frequency divider. The sixteenth pulse from the oscillator activates a triple-pulse generator through the divider and blanks the output from the multivibrator. The triple pulse indicates zero time reference for the



Rocket warhead showing placement of units. Beacon is circular can at upper right. Function selector switch at center is for prefiring check



Falling-sphere air density measuring equipment. Electromagnet is at center. Teflon-separated sections of sphere serve as dipole for transistor oscillator

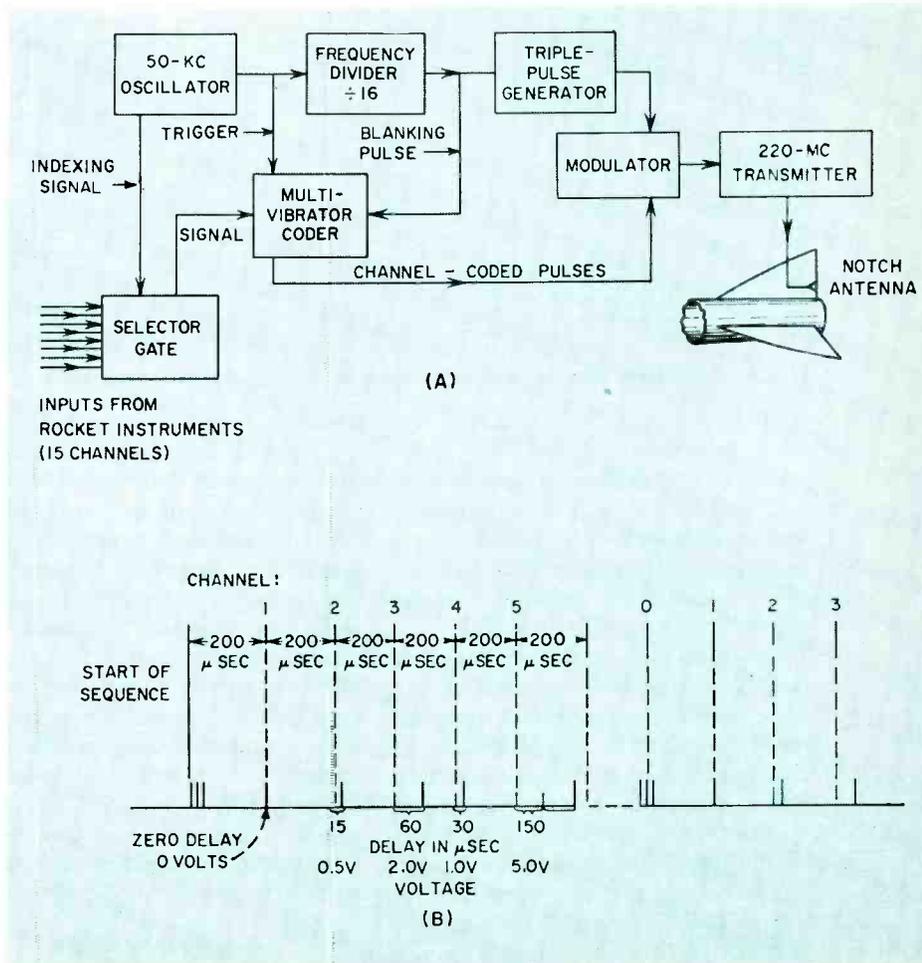
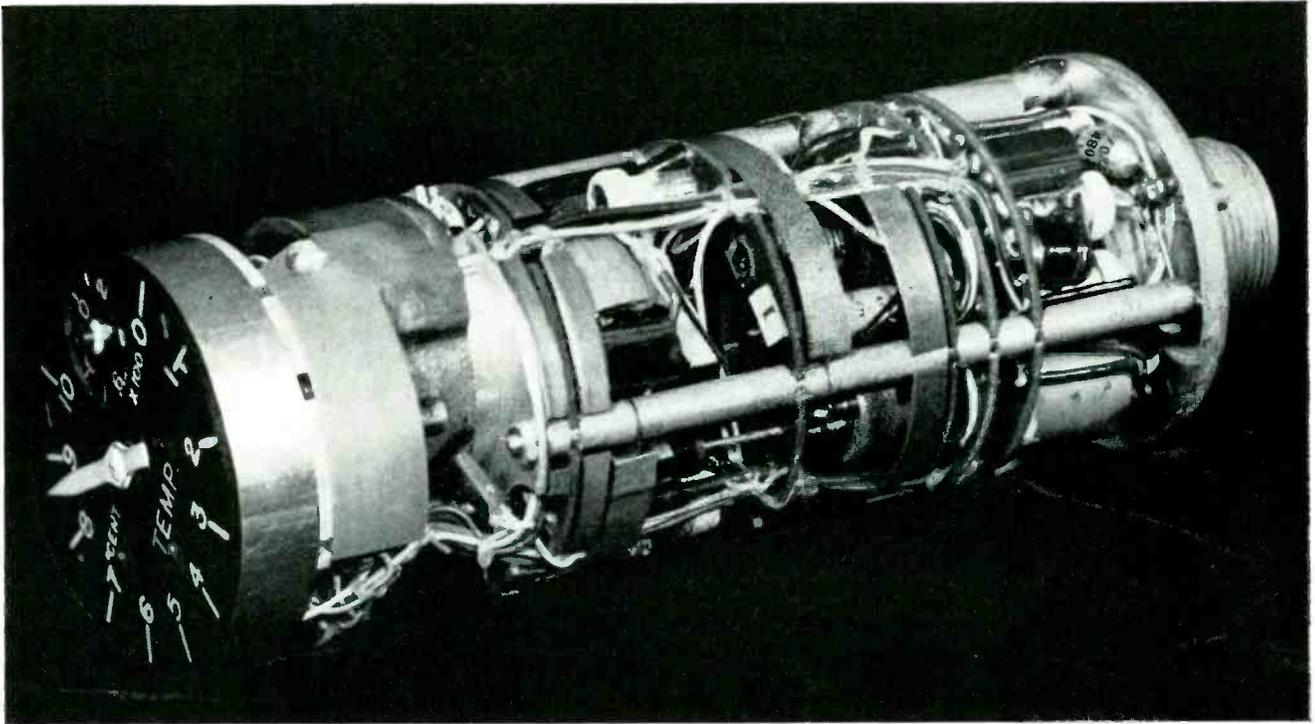


FIG. 5—Rocket telemetering system (A) uses instrumentation output to delay triggering of multivibrator in proportion to voltage level as shown at (B)

telemetering transmission as shown in Fig. 5B. The next pulse from the oscillator steps the select gate to the first channel of instrument information. The signal from the instrument places a bias on the grid of a multivibrator, changing the delay time in proportion to signal level. The pulses modulate a 220-

mc transmitter feeding a notch antenna mounted in the tail assembly of the rocket.

Two methods are used for measurement of the charge density of the ionosphere. In both techniques, two transmitters are required to measure delay time caused by the ionosphere at low and high fre-



Transistorized temperature indicator occupies space of 17 cu in. behind instrument panel as compared to 75 cu in. for vacuum tube unit. Power consumption is about 7 watts and weight is less than a pound

Transistorized Indicator Measures Jet Exhaust

SUMMARY — Thermocouple bridge at jet engine exhaust feeds temperature indicating system, including chopper, reference source and a-c amplifier, mounted directly behind 2-inch indicator dial on pilot's instrument panel. Weight and space requirements are about one-fifth that of vacuum-tube or magnetic-amplifier equipment

ACCURATE MEASUREMENT of jet engine exhaust gas temperature permits protection against excessive engine temperatures without sacrificing performance because of conservative operation.

Thermocouples are capable of withstanding high temperatures and corrosive atmospheres and permit temperature averaging around the exhaust area. However, their use in precision systems produces problems in amplifying low level d-c voltage.

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The most feasible approach has been to compare the thermocouple signal to a d-c reference voltage and to convert the difference signal to a-c for amplification.

When this technique has been used in conjunction with a null-rebalance servo loop, accuracies in the order of ± 0.5 percent for tem-

perature ranges of 1,000 C. have been achieved.

A typical electron-tube or magnetic-amplifier system, miniaturized and ruggedized for airborne use, consists of a 2-in. diameter, 4-in. long panel indicator and a remotely located amplifier about 4 by 4 by 4 inches in size. The volume of this two-unit system is about 75 cubic inches and total weight is on the order of 5 pounds.

The equipment described here uses semiconductor devices for ref-

reference voltage supply, thermocouple bridge, modulator and amplifier. The entire circuit is mounted in a 2-in. diameter case, 5½-in. long.

The repeatability and stability of the reference voltage directly affects system accuracy. For an accuracy of ± 0.5 percent, the reference voltage requires a ± 0.1 -percent stability.

Use of subminiature voltage-reference tubes was considered, but study and tests of the Zener voltage characteristic of silicon diodes showed that the required stability could be obtained using these components.

The relatively low ranges of Zener voltages available with diodes also assured that little power would be wasted in dividing the reference voltage to thermocouple levels.

Diode Circuit

A silicon-diode circuit and compensation network were designed requiring only a single diode. A simplified schematic is shown in Fig. 1.

Only moderate filtering of the rectified supply is necessary because the regulation properties of the diode effectively remove some of the ripple. In Fig. 1, resistors R_1 , R_2 and R_3 are used for line-voltage compensation, temperature sensitive resistor R_c for temperature compensation and R_p for calibration purposes.

The circuit actually represents an unbalanced bridge, part of the output of which is used to energize the temperature bridge. The diode is operated with the anode nega-

tive and no current is passed until the voltage exceeds the Zener voltage of about 8 volts. At this point, breakdown occurs and the current increases very rapidly with voltage. The operating point of the diode is set at about 1 ma by current limiting resistor R_1 .

In the other leg of the bridge, R_2 is chosen so that the voltage-current slope matches that of the diode. The difference between the two voltages then remains practically constant even though the supply voltage varies as much as ± 15 percent. The diode, however, is temperature sensitive which would cause thermocouple-bridge voltage to increase directly with temperature. As the increase is practically linear it is relatively easy to compensate with a copper resistor, R_c , in series with the output to the thermocouple bridge. Adjustable resistor R_p adjusts bridge current to compensate for variations in Zener voltage of the diodes and also resistor tolerances.

The entire circuit can be contained within approximately one cubic inch and offers indefinite life. A unit which has been operated continuously for a period in excess of 10,000 hours has undergone less than 0.03-percent change in output. The reduction in power requirements compared to a reference-tube circuit is about 15 to 1.

Thermocouple Bridge

The thermocouple bridge, shown in Fig. 2, supplies voltage to the rebalance potentiometer for nulling incoming thermocouple signals, and

also furnishes thermocouple cold-junction compensation.

This bridge utilizes large resistors with low temperature coefficients to load the reference voltage and set up constant currents in two bridge legs. One current path is through a temperature-sensitive resistor so that the product of the constant current and the temperature-sensitive resistor provides a millivoltage equal and opposite to that of the chromel-alumel cold junction.

The two voltages cancel each other throughout the ambient temperature range of -85 to $+78$ C within ± 2 C. error. The compensating elements are mounted together to minimize temperature differentials.

The second bridge leg contains resistors which establish the rebalance voltages at the ends of the rebalance potentiometer. In this case the measured temperature range is 0 to 1,000 C and the potentiometer voltage correspondingly extends from 0 to about 45 millivolts. The resistance of the rebalance potentiometer is such that it does not appreciably load the bridge and at the same time will not insert enough series resistance in the null circuit to cause loss in sensitivity. Potentiometer R_p is used to establish the desired level of bridge current. Total volume is less than one cubic inch excluding the rebalance potentiometer which is contained in the motor section.

Transistor Modulator

The transistor-type modulator, in Fig. 2, converts d-c error signals received from the thermocouple bridge to essentially square-wave a-c before amplification. It will handle signal magnitudes of 40 microvolts without mechanical contacts.

Two transistors act as single-pole switches which close and open on alternate half-cycles of line frequency. As each closes, it provides a low-impedance path for the signal current to flow through one-half of the primary of the output transformer. Opening and closing of the transistor switches is accomplished by the a-c voltages e_1 and e_2 which alternately bias the transistor collector and emitter positively and

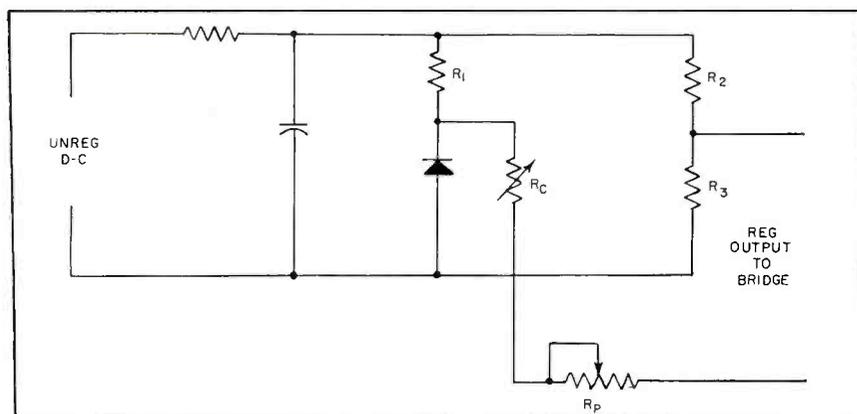


FIG. 1—Reference-voltage circuit using silicon diode has less than 0.03-percent change in output in more than 10,000 operating hours

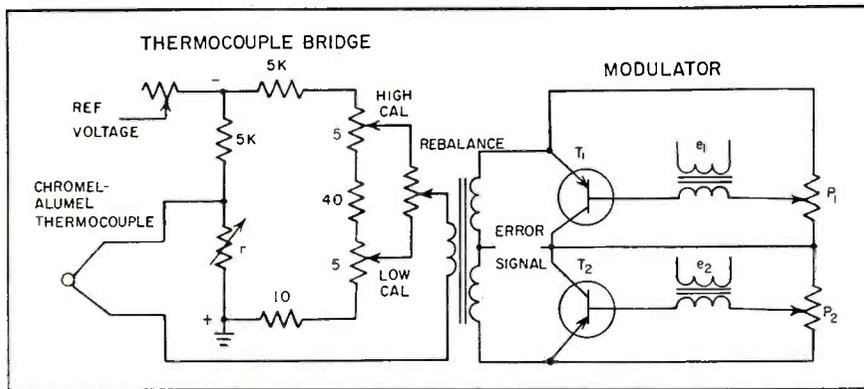


FIG. 2—Thermocouple bridge and modulator unit provide error voltage to transistor servo-amplifier

negatively with respect to the base, thus creating corresponding low and high impedance paths. Potentiometers P_1 and P_2 are high enough in resistance to minimize their shunting effect during the off cycle of each switch.

The circuit actually forms two bridges with e_1 and e_2 as excitation voltages, transistor junctions as two legs, potentiometer halves as the other two legs and each bridge output impressed across one-half of the output transformer primary. So that none of the excitation voltage appears in the output, it is essential that each potentiometer leg ratio be the same as the transistor junction resistance ratio.

Because the ratio of emitter and collector junction resistances in the forward and reverse directions changes as temperature varies, it is necessary to stabilize the bridge balance over a wide temperature range. This was done by a combination of design fixes, some of them based on empirical data. As a result, the circuit has been developed to where less than 120 microvolts are introduced to the modulator output by the excitation voltage through a temperature range of -85 to $+72$ C. Once adjusted, the circuit has shown no need for readjustment.

Transistor Amplifier

The transistor amplifier was designed specifically for low-level amplification and temperature stabilization. The circuit uses transistors with easily obtainable parameters.

Three low-power transistor stages in cascade are used for signal amplification and an H-4 power-type

transistor is used for the servomotor drive. The three low-power stages are used common emitter and operate class A for small signals. Saturation does not occur until almost 50 millivolts input signal (about a 1,000 C. temperature signal) is reached.

Transformer coupling is used for the inputs to the first and second stages. The transformer input to the first stage provides impedance matching and also isolates the thermocouple circuit from ground. Because of the latter, accidental grounds in the engine thermocouples do not offset system calibration. The second stage is direct coupled to the third stage which is transformer coupled to the output stage.

Power for the first three stages are obtained from a common rectified supply. The output stage has its own power supply to avoid coupling to earlier stages, and also because its larger current requirement would cause undue power loss in the filter section required by the first three stages. Filtering for the output stage is not strong as the 800-cycle ripple is noneffective.

The output stage acts as a discriminator to drive the servo motor in the correct direction to balance out error signals. The H-4 power transistor is operated with grounded collector. This connection simplifies the mounting and improves heat dissipation from the transistor since the collector is grounded to the transistor case.

Indicator Section

The H-4 transistor drives a miniaturized, two-phase servo motor

designed for transistor amplifier operation by a low-impedance phase. The line-phase to amplifier-phase power ratio is approximately 8-to-1 to improve torque over balanced power operation.

A 400-to-1 gear train drives the rebalance potentiometer, rate feedback potentiometer and main and vernier pointers.

The entire indicator section including motor, gear train, potentiometers and space for the addition of a switch for actuating external circuits is contained within a $1\frac{1}{2}$ -in. long section of the 2-in. diameter case.

Construction

Components are assembled on five circular, stacked cards. Components are preassembled on the five cards which are then mechanically fastened and wired together in the final amplifier assembly. In laying out the circuit and mounting components, it was essential to locate certain components not only in exact locations but also with a specific orientation to reduce pickup.

Because of the use of miniaturized components throughout, the entire assembly is rugged. The case is hermetically sealed after calibration adjustments are made as the low aging properties of the components involved do not require readjustment. The assembly is shown in photograph prior to canning and sealing.

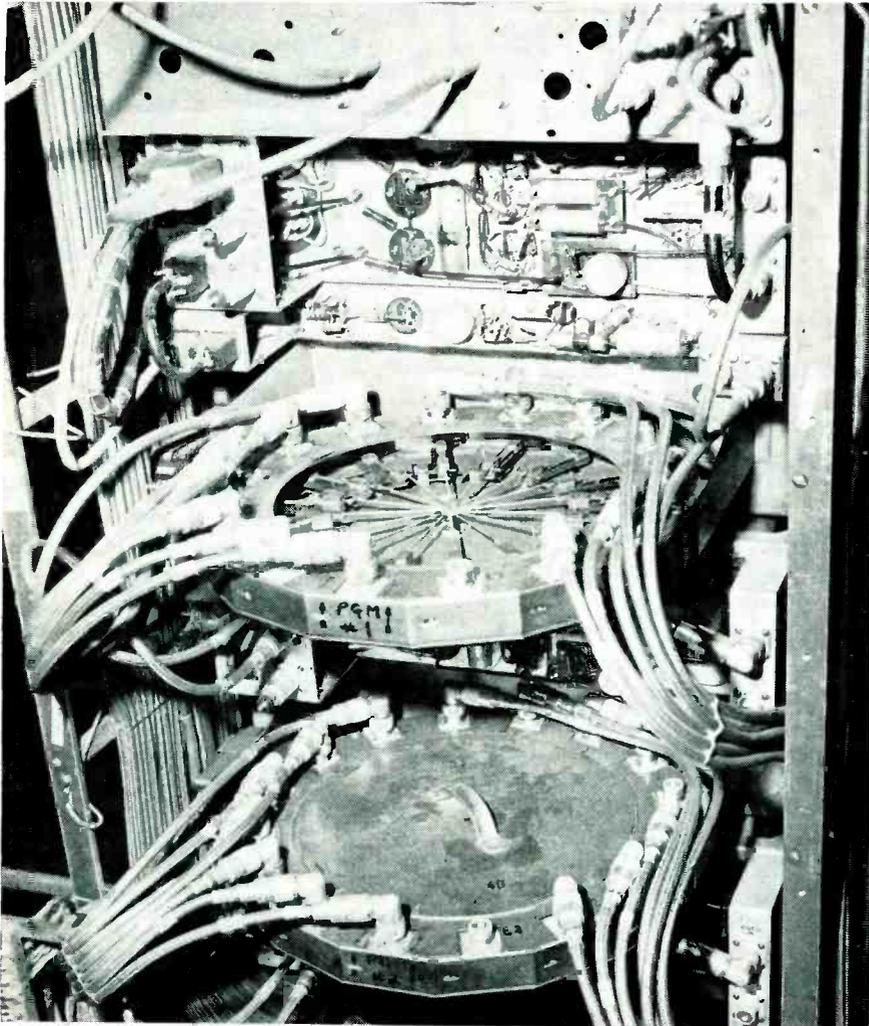
The accuracy of the system has proven to be as good as that of larger vacuum-tube units. Under room temperature conditions, the error is less than ± 5 C. across the 1,000 C. range. Under environmental extremes, less than ± 12 C. error occurs.

The travel time of the pointer across the 1,000 C. range is less than 3 sec and response to a step input occurs with negligible overshoot. Power consumption of the system is 7 watts.

One result of transistorization is the almost complete lack of sensitivity of the high-gain circuit to pickup from external sources.

Acknowledgement is due William Freeborn and Nathan M. Lawless, senior development engineers, for their contributions in design of the instrument.

VIDEO SWITCHING For



Centripetally-oriented video relay panel minimizes bus capacity and crosstalk while permitting input-output transfer within 0.001 m μ s at 3.58 mc

By E. B. PORES

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TELEVISION BROADCASTING involves a considerable amount of time and money for the development of switching systems for cameras, special effects, studio and master control.

Switching systems can be divided into two major categories of electromechanical and electronic switching that can be further classified by the methods of cable termination and input-output bus isolation.

At present, the application to video of an old audio technique, resistive pad splitting, appears to be the most economical and easiest to maintain system.

Unisolated Switching

Figure 1A shows the direct switcher, a simple crossbar switcher with a switch or relay at each junction. Mechanical interlocking switches would be economical, their reliability is marginal. Even with

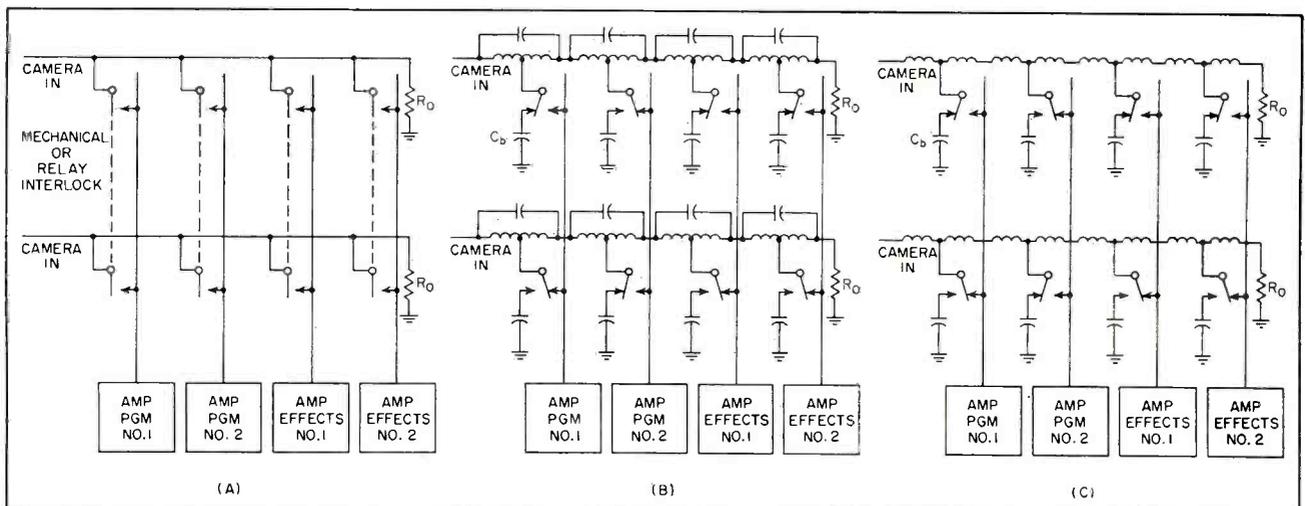


FIG. 1—Direct switcher (A) is unisolated while bridged T (B) and M-derived (C) switchers are isolated

TV BROADCAST CENTERS

SUMMARY — Color and black-and-white tv broadcasting requires extensive video switching. Systems described are broken down into electronic and electromechanical with further subdivisions discussing unisolated, isolated, electron-tube isolated, resistance splitting, electronic and beam-switching methods. Cost figures for most methods are also given

the use of relays, this type of system can be built quite compactly and inexpensively.¹

In 1937, it was found that long relay busses introduce reactance to the camera input cable termination, thereby limiting flexibility.² The term camera refers to tv sources such as live or film cameras, studio, remote or special signals. Work has been done on systems of the order of 180 $\mu\mu\text{f}$ of capacity across 75 ohms. The transient response of this becomes impaired so that square waves of 0.05 μsec . rise time yield overshoots of the order of 10 percent.

Network Operation

In network operation cascading such systems can cause serious picture degradation (7.5 percent decrease in frequency response at 3.58 mc for 180 $\mu\mu\text{f}$) as well as poor transient response for each switcher.

Interaction between busses creates an additional deleterious effect as each bus can be represented by additional capacity. The 60 $\mu\mu\text{f}$ per bus in the RCA TS-20 causes three degrees of phase shift for each bus switched.

The most pleasant type of camera switching from the viewers standpoint, is the overlapped switch method where a camera remains on the air for a number of milliseconds after the next camera is switched up and then dropped out.

Overlapping may be contrasted with gap switching where an actual hiatus occurs between camera switches. Owing to the psychological advantage of the overlap, the unisolated switch has been all but abandoned except in black and

white field pickups, since attempting to overlap cameras on one bus causes 100-percent crosstalk in any of the other busses having a similar camera on the air.

Isolated Termination

Two partial solutions were arrived at to improve the disadvantages of the unisolated input switcher bus capacity effects on the input terminations.

The approaches to the problem were similar in theory as seen in Fig. 1B and 1C. To calculate the parameters, bus capacity C_b was measured. From C_b and Z_0 , the coaxial cable impedance, the bridge T in Fig. 1B and M derived low-pass filter section in Fig. 1C, were designed to eliminate the bus capacity and present a constant input impedance.^{3,4,5} The passive sections minimize interbus reaction.

The major disadvantages of this solution are the transient changes in frequency response and phase shift during the switching interval. In addition, crosstalk will occur if overlap switching is used on a simple grid basis without additional bus isolation and relays.

The estimated cost is about \$15 per junction, but the system does not lend itself to simple modularization and large network expansion.

Electron-Tube Isolation

Passive isolation can compensate for some of the problems of the direct switcher, but in a large system, transient isolation effects would become troublesome.

The next step taken was to use tube isolation at each switching junction as shown in Fig. 2A and these systems have proved to be

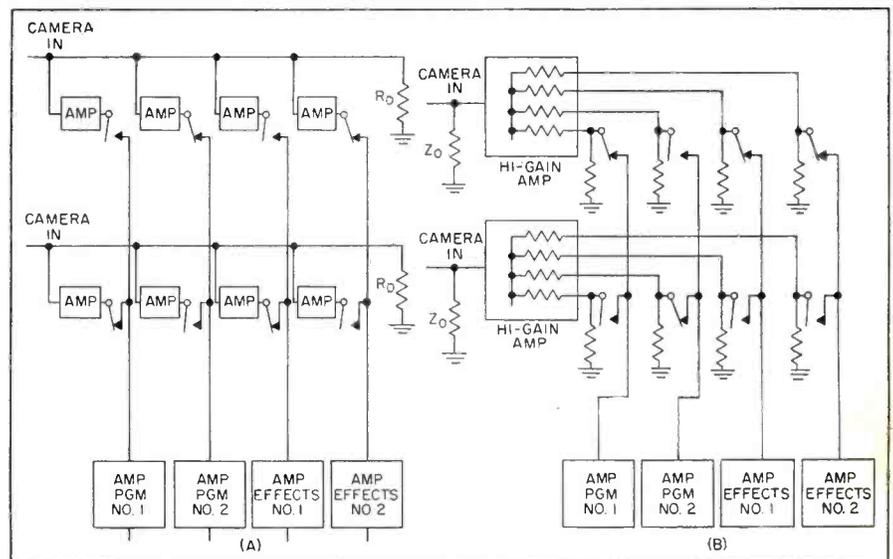


FIG. 2—Electron-tube method (A) provides —50-db isolation at 3.58 mc. High-gain amplifier drives resistance splitting pads (B) to provide 36 db of transient crosstalk isolation

adequate from an isolation standpoint, providing -50 db at 3.58 mc. However, this system costs approximately \$75 per junction and has limited reliability.

The most serious objection to further use of this system is the number of adjustments required in setting levels and frequency response. The number of controls is equal to twice the product of the number of inputs times the number of outputs.

High-Level Amplifier

It was proposed that a high level amplifier be designed to have a number of resistive isolated outputs feed individual busses as shown in Fig. 2B.* A six-output amplifier was developed having 24 db of isolation between outputs and supplemented by 12 db of external pads yielding 36 db of transient crosstalk isolation during the overlap.

Operational tests have concluded that this is ample transient crosstalk isolation. The static crosstalk is in excess of 60 db at 3.58 mc.

Another innovation developed was a centripetally-oriented video-relay panel minimizing bus capacity and crosstalk and permitting all inputs to arrive at the output timed within 0.001 millimicroseconds at 3.58 mc.

The amplifier has proved to be quite stable although it does require periodic adjustment and tube replacement.

This amplifier followed by splitting pads to feed individual centripetal relay panels has proved to be flexible. Many combinations of systems have been packaged in a modular fashion for live and film camera switching providing from nine inputs to 16 inputs and from one to 10 output busses.

This system is presently in use at NBC Color-tv studios but is still not a panacea. It costs about \$85 per junction and requires almost twice the rack space of earlier systems because of the input amplifiers and associated power supplies.

Resistive Splitting Pads

Use of resistive pads to isolate relays is an outgrowth of audio techniques. Owing to severe re-

quirements it has only recently been developed for overlap switching of television cameras. The system shown in Fig. 3 is presently being used commercially in NBC's Chicago plant.

This system possesses all of the technical advantages of the previously mentioned system, with one exception. The transient signal-to-noise figure is approximately 30 db below signal level (0.7-v p-p)

under way to improve this figure even though the transient is not visible on a monitor when switching from a 10 to 90-percent duty cycle signal.

Pad isolation will cost approximately \$20 per junction, approximately one-fourth the cost of the high-level amplifier method. It requires only one-fourth the rack space per input and no air conditioning.

Reliability

Reliability and maintenance problems are minimized with resistive pads since they contain no tubes to fail and no controls to adjust within the crossbar grid. Use of this system at NBC-TV master control in New York would reduce the number of knobs from 336 to only eight line amplifier controls.

The preamplifier shown in Fig. 4 is comprised of three stages to achieve an overall amplification of 20 db. with good frequency and phase characteristics and negligible differential gain and differential phase distortion.

An equivalent input noise of 15 microvolts is made possible by V_1 , a 2C51 dual-triode operated as a cascode amplifier at a gain of about five. Another 2C51, V_2 , is used in a cathode-coupled circuit to provide a gain of about two, with provision for gain adjustment in its cathode circuit. Final stage, V_3 , uses a 6BK7A in a shunt-regulated or bootstrap amplifier circuit to provide the necessary drive into the

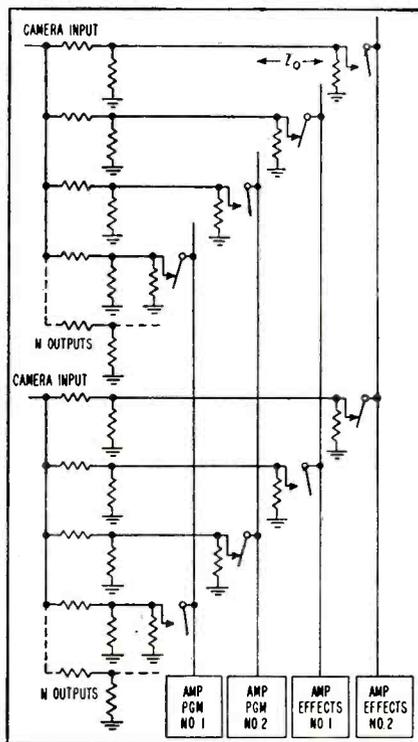


FIG. 3—Resistive video splitting pads provide a transient s/n ratio of about 30 db below signal level during overlap

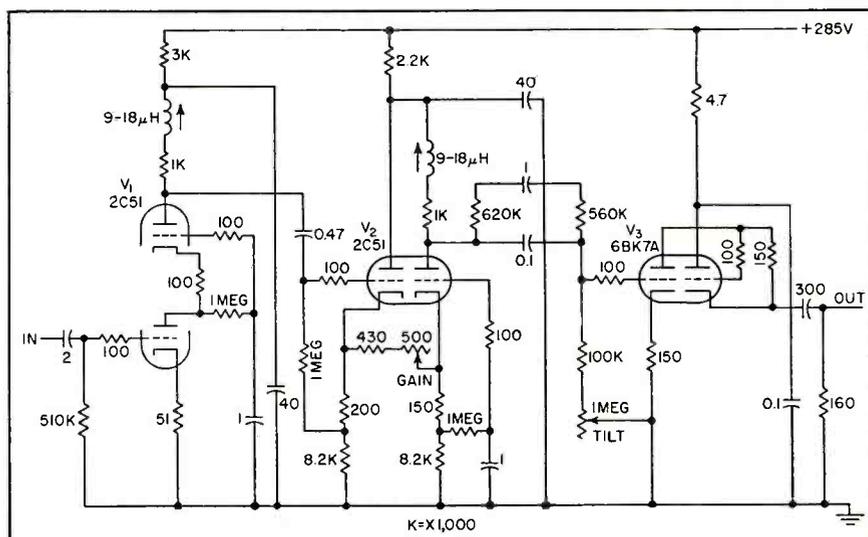


FIG. 4—Video preamplifier used in switching systems

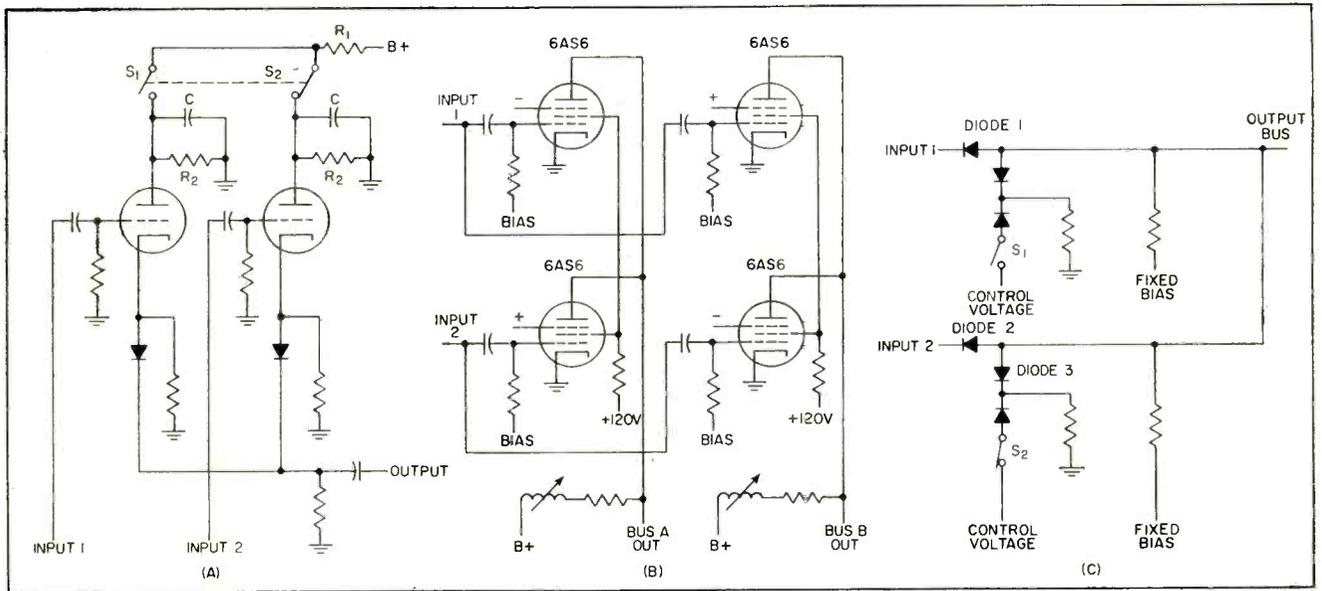


FIG. 5—Electronic switching systems remove plate voltage (A), vary suppressor grid bias (B) and use diodes in place of tubes (C)

160-ohm load without compression.⁷ A tilt control is provided to adjust the overall low-frequency phase response for zero 60-cycle squarewave tilt.

Electronic Switching

The following methods of all-electronic switching employ a tube at each switch junction. On an average, these schemes cost a minimum of \$50 per junction and have the attendant maintenance problem expected with a vacuum tube at each junction.

Tubes at switch points can be cut off by the removal of B plus from the plates as shown in Fig. 5A. These units must be followed by clampers owing to bounce caused by the R-C time constant of the plate circuit.⁷

Suppressor grid bias has been used to cut off tubes.⁸ An example of this principle in switching sys-

tems is shown in Fig. 5B. The reliability of the switch is dependent upon a minimum of one tube per junction with a cost of \$50 per switch point. The expansion of such a system once installed can become complex.

High-quality diodes have been substituted for vacuum tubes at each junction as seen in Fig. 5C. It was found that the forward resistance of present day diodes is too variable to use the diode in place of a relay. In addition, crosstalk was too great due to insufficient cutoff. Future research in the field of diodes and transistors could yield an optimum solution to the problem of a small, inexpensive switcher.

A method and apparatus for switching tv sources during the vertical blanking interval is being developed at NBC and is shown in Fig. 6. This plan would eliminate

video relays but would still employ a vacuum tube at each switching junction, hence cost upwards from \$50 per junction in addition to the blanking circuitry.

Electronic Beam Switching

There are in existence electronic beam tubes similar to those employed in reading out computer information.

In essence, the devices can be described as multiinput grid tubes with only desired grids gate open. The input would then be switched during the vertical blanking interval.

Only one tube per output would be required for twelve inputs. In addition gating circuitry would have to be provided.

Tubes of this nature are available from the Ericsson Company and could be applied to television switching.

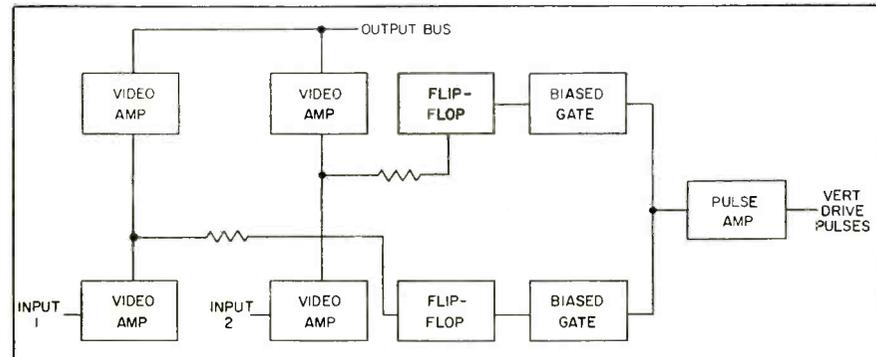
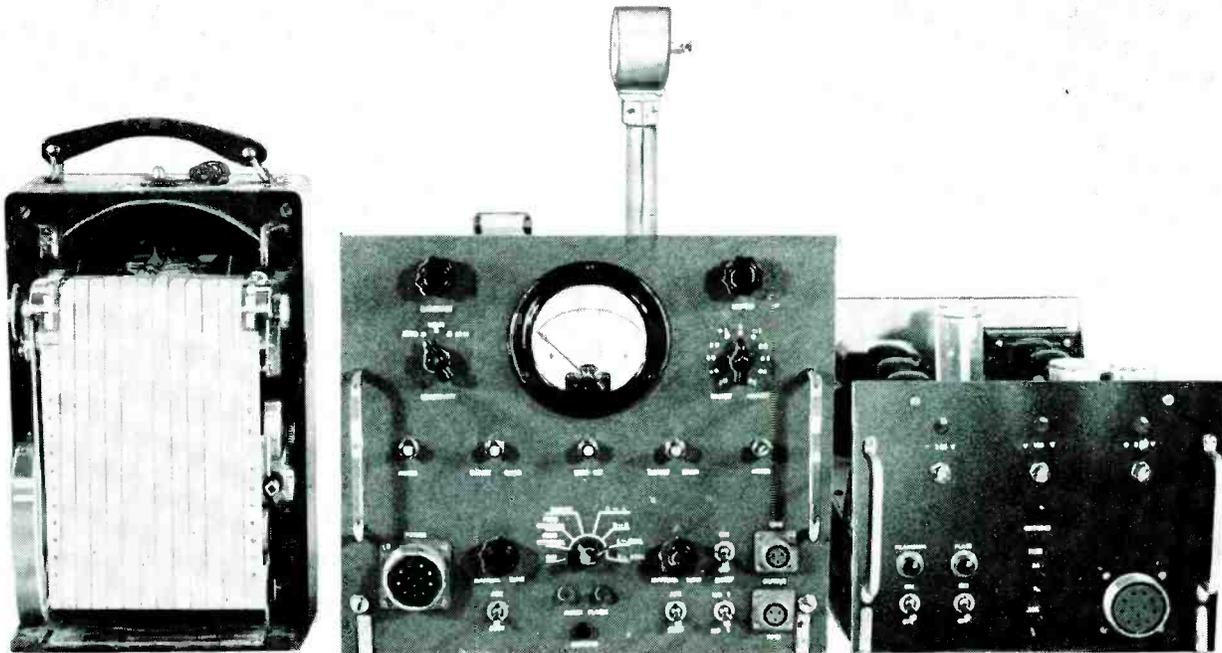


FIG. 6—Beam-switching method still in developmental stage

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Predicts Propagation



Recording meter, refractometer (external cavity above) and airborne power supply make up the measuring equipment

For gases, the refractive index is not much greater than unity. The actual value depends merely on the type of molecules, their concentration and also temperature, for polar molecules. Neglecting the effect of particles such as dust and water droplets, the atmospheric refractive index results from the additive effects of the constituents of dry air and water vapor.

It has a value in the range from unity to less than about 1.000400 or from 0 to 400 *N* units. The variation of water vapor concentration in the atmosphere causes most of the refractive index characteristics that are of principal interest.

Improved Method

Prior to the first direct airborne microwave refractometer measurements made in 1951 at Lakehurst Naval Air Station and at the Wright Air Development Center¹ the refractive index of the atmosphere had been determined by such indirect methods as measuring pressure, dry-bulb temperature and relative humidity using such devices as radiosondes and airborne psychographs.²

These methods require considerable data reduction and calculation. In addition, the devices are for many purposes not capable of adequate resolution owing to the excessive time constants of the sampling elements, particularly the various types of elements used for measuring water vapor concentration.

When used in conjunction with a rapid-response temperature element the refractometer provides a sensitive and essentially instantaneous means for determining variations in water vapor content of the atmosphere. It has found application in several basic meteorological investigations and has recently been used in the study of cumulus and other types of clouds.³

Stabilized Oscillators

The airborne refractometers that have been used extensively by various activities for measurements of atmospheric refractive index are all in basic principle the same and employ the resonant-cavity stabilized oscillator and beat-frequency system shown in Fig. 1. A microwave refractometer using a sweep frequency and cav-

ity comparator principle has been developed⁴ at the Bureau of Standards; however its airborne use has been limited, thus far, to one reported flight.

The frequencies of the stabilized oscillators that operate near 10,000 mc are controlled to a high degree of precision by the resonant frequencies of associated cavity resonators. The basic principle of such resonators is the i-f system originally described by Pound⁵ and incorporating modifications⁶ suggested by Tuller and others.

One oscillator, the reference, is controlled by an evacuated and sealed cavity resonator and except for small changes in the dimensions of the cavity resulting from temperature and pressure variations, the frequency is constant. The other oscillator is controlled by the measuring cavity resonator, which has holes appropriately placed to permit a flow of atmospheric air through it without appreciably lowering its *Q*.

Tests by the author and others⁷ have shown that short time stabilities of the order of better than 10⁸ are easily achieved in the Pound

oscillator and that the long term stability is to all practical purposes determined by the resonant frequency of the cavity resonator itself. The original claims by Pound have been found to be conservative for a properly built system.

The Pound oscillator is not a zero-error feedback system; that is, the klystron does not oscillate at precisely the resonant frequency of the associated cavity resonator even in an ideal system. This has been erroneously thought by some to be an important liability; however, it is actually of little consequence in refractometer applications. The only important requirement is that the system design and construction be such that the change in klystron frequency be closely tied to the change in resonant frequency of the cavity resonator.

In tests on numerous oscillators such as described below it has been found that for frequency changes in the order of 10 mc or less the change in oscillator frequency is within ± 0.2 percent of the change in cavity resonator frequency and it is questionable whether the small apparent variation between cavity and oscillator frequency was actual or resulted from the system used for measurement, which was similar to that described by Essen.

In any event, the use of stabilized oscillators and the beat-frequency principle makes possible a precision of measurement of atmospheric refractive index that is greater than can normally be achieved in practice because of such limitations as the error caused by sampling the air and the effect of temperature changes on the dimensions and hence resonant frequency of the cavity resonators.

Oscillator Stability

For oscillators operating near 10,000 mc, a change of one part per million, or one *N*-unit, in refractive index of the air in the cavity resonator produces an oscillator frequency change of 10,000 cycles. For cavity resonators built of brass one degree centigrade change in temperature produces a frequency change of nearly 200 kc or the equivalent of nearly 20 *N*-units. Such cavities are impractical for

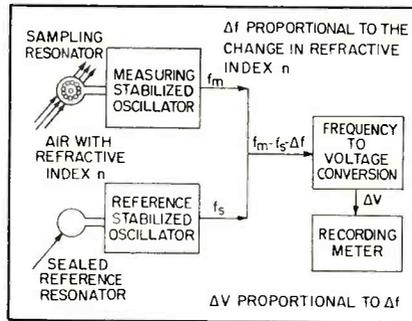


FIG. 1—Basic arrangement of airborne microwave refractometer

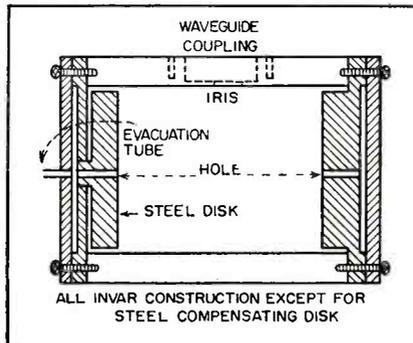


FIG. 2—Temperature-compensated, pressure-isolated resonator

measuring atmospheric refractive index.

By fabricating cavities from treated invar and using a compensating end plate of invar and steel it has been practicable to fabricate cavities that change less than 2 kc or 0.2 *N*-unit per degree centigrade over the wide range of temperatures encountered in the atmos-

phere. The cavities are easily temperature calibrated using the refractometer itself as the measuring device. By measuring the ambient temperature it is possible to correct satisfactorily for the temperature-caused error.

In practice, the variation in the atmospheric index with height, time, distance and location is so great that applying this small temperature correction is academic. The principal interest in propagation problems of current study is to evaluate the effect of the gross refractive index structure.

Atmospheric Effect

In addition to the temperature effect, the frequency of the sealed reference resonator is shifted slightly by changes in atmospheric pressure. Sealed resonators having frequencies in the order of 10,000 mc with invar walls a quarter inch thick undergo a frequency change of about 70 kc or the equivalent of 7 *N*-units as the pressure is reduced to that existing at an altitude of 20,000 feet.

This potential error is large enough to warrant employing pressure isolation in addition to the temperature compensation. Most of the frequency change in a TE_{011} resonator owing to pressure changes results from motion of the end plates. An actual reference cavity resonator is fabricated as

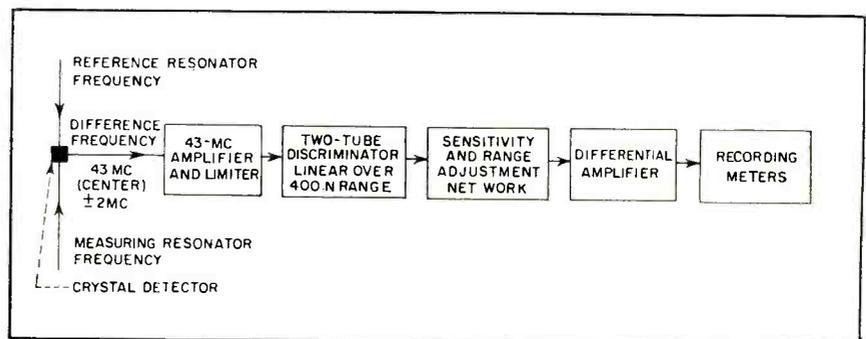


FIG. 3—Typical metering circuit arrangement for microwave refractometer

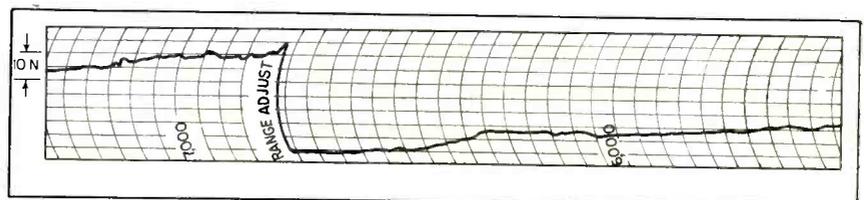


FIG. 4—Section of refractive index sounding made at Fairbanks, Alaska

shown in Fig. 2. With the arrangement shown, the cavity resonator undergoes a frequency change of about 10 kc over the same 20,000 foot pressure altitude range.

The change in beat frequency between the two oscillators is related on a long-term basis to changes in the refractive index of the air in the sampling, or measuring, cavity resonator to an accuracy that is determined essentially by the temperature characteristics of the resonators themselves.

With cavity resonators having temperature coefficients near $0.2 N$ unit per degree centigrade, an error in the order of several N units can accumulate in a sounding to tens of thousands of feet above the earth's surface. By knowing the cavity-temperature calibration, however, and making only coarse temperature measurements this error can be kept to no more than an N unit per 10,000 feet of altitude. Since in the first 20,000 feet above the surface the index of refraction decreases some $200 N$ units on the average, this temperature error can be kept near 1 percent.

Frequency Conversion

For the highly precise measurement of the microwave refractive index of a gas in the laboratory, it is merely necessary to measure the change in beat frequency between the two stabilized oscillators of Fig. 1 as the gas to be measured is introduced into a previously evacuated cavity resonator.

For making continuous measurements and recordings of atmospheric refractive index, it is necessary to make use of additional metering circuits. In general the arrangements used have depended on whether the refractometer application was primarily for measuring refractive index profiles, that is, index of refraction as a function of altitude, for measuring the microvariations of refractive index from the average values, or whether both profiles and fluctuations data were equally desired.

For profile refractometers it is necessary to provide a useful measuring range of about $400 N$ units. A metering circuit must be provided with linear output vs fre-

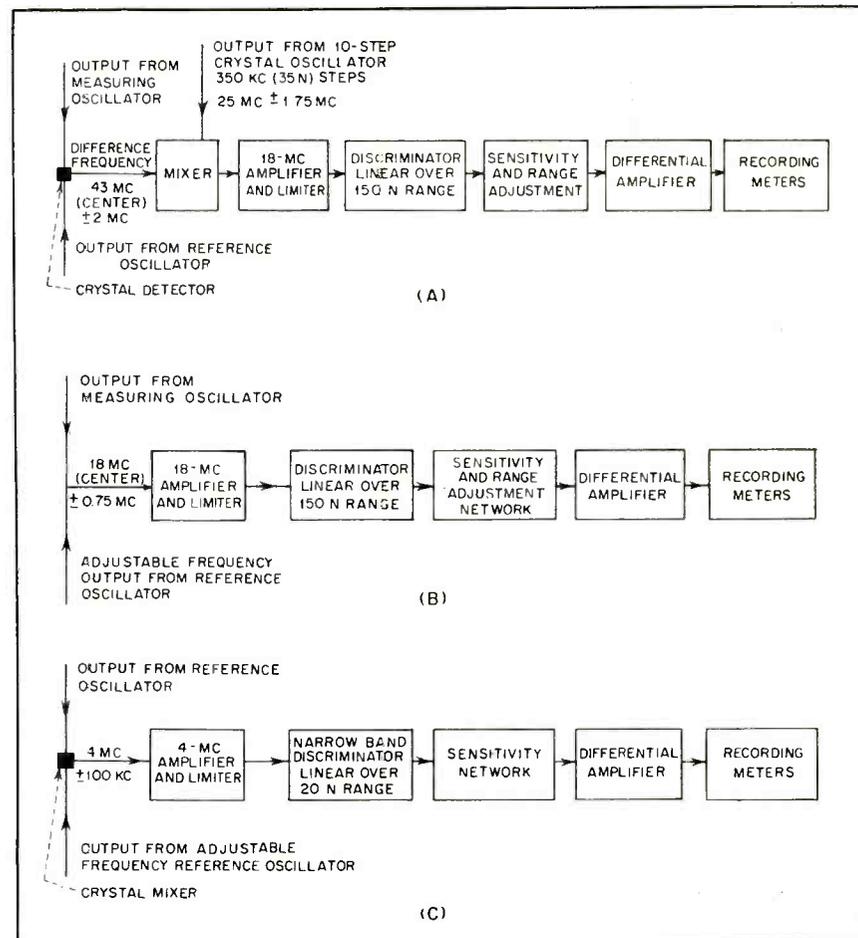


FIG. 5—Metering circuit employing crystal mixer (A) with sealed-tunable reference resonator (B) and optimum metering arrangement for sensitive scale measurements (C)

quency characteristics over a 4-mc range for stabilized oscillators operating near 10,000 mc. An amplifier, limiter, discriminator and differential amplifier arrangement similar to that shown in Fig. 3 has been used in several versions of refractometers.

With the arrangement shown the change in beat frequency between the stabilized oscillators caused by a change in the refractive index of the atmospheric air in the measuring cavity resonator is converted into a proportional deflection of the recording meter. For most applications it has been desirable to record on a scale of 50 or $100 N$ units to obtain more detail in the coarse variations. A calibrated range adjustment in the differential amplifier circuit permits use of a $50 N$ or other suitable scale over a $400 N$ unit range with continuous record.

Figure 4 shows a typical profile obtained with a refractometer em-

ploying the arrangement shown in Fig. 3. The chief disadvantage of this metering circuit is the considerable care required in the alignment during construction to assure good linearity. Calibration is subject to change with the differential aging of the discriminator tubes.

Crystal Calibrator

This change in calibration may be negligible for several hundred hours of operation. It can be checked by applying a signal generator to the input of the metering amplifier or by using the tunable reference cavity discussed below and noting the change in meter output as a function of frequency. Other arrangements that have additional advantages are now being used for some applications where a $400 N$ unit continuous scale is not necessary.

Figure 5A shows an arrangement that permits the use of a

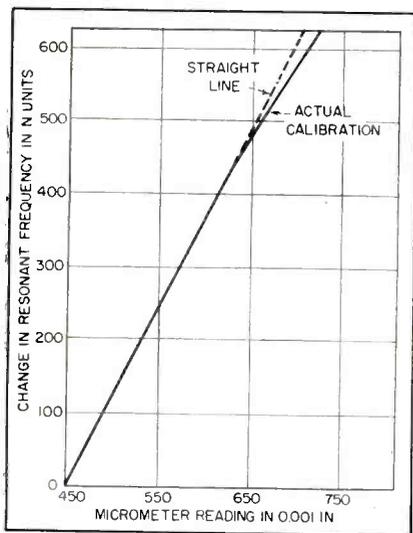


FIG. 6—Typical calibration curve of sealed-tunable cavity resonator

lower-frequency metering amplifier and has an inherent self-calibration. The crystals used are built to have stepped frequency differences of 35 N units. Recording can be done on a nominal 50 N unit scale over a 350 N unit range. The scale calibration in N units can be determined within the accuracy of the recording meter. As the refractive index of the measuring cavity changes so as to cause the recording meter to move off scale the operator turns to the next crystal position and causes an equivalent 35 N unit motion of the recording pen.

In some applications it is desired to have scales in the order of 20 N units full scale and still have a recording range sufficient for the full range of atmospheric refractive index that may be encountered, that is, some 400 N units. The arrangement shown in Fig. 5B is the most practical for such applications. By using a narrower range and lower-frequency metering amplifier there is improved long-term stability and enhanced attainment of a linear discriminator output versus frequency.

Coarse frequency changes are made by adjusting the tuning screw of the sealed, temperature and pressure-compensated reference cavity resonator. The change is caused by varying the penetration of a small rod into the resonator. Figure 6 is a typical calibration curve of the tunable sealed reference resonator that was obtained by using

the refractometer itself and a frequency meter (such as the BC 221-A or the Gertch Model FM-3).

Measuring Technique

For measurements the tuning of the sealed reference is adjusted until its difference frequency is in the desired portion of the metering amplifier pass band. The recording meter is then positioned on scale with the range adjust switch. With the cavity calibration curve the recording calibration can be checked to a precision dependent chiefly upon the coarseness or sensitivity of the cavity resonator tuning rod.

For measuring the microfluctuations of atmospheric refractive index about a mean value the metering arrangement of Fig. 5C is probably the most desirable and has been used in one type of refractometer. With this arrangement scales as low as 0.14 N unit per inch of recorder deflection have been used in high altitude measurements. Airborne recordings using a high-speed photographic recorder indicated an overall instrument and recording rms noise level of 0.007 N units using a recording bandwidth from 0 to 30 cycles per second. These data were obtained by flying the refractometer with the measuring cavity closed to the passage of air.

The procedure for obtaining data with the arrangement of Fig. 5C is to adjust the frequency of the reference resonator such that for the ambient value of refractive index of the air in the sampling resonator, the difference frequency between the resonators is in the center of the pass band of the metering amplifier as indicated by the inking recorder, then to switch the high speed photographic recorder across the output of the metering circuit and to record for several seconds.

Combined Device

A refractometer combining the overall characteristics of both the so-called profile and sensitive scale refractometers has been developed that is basically the one shown in Fig. 1 using a metering arrangement similar to that shown in Fig. 3. The differential amplifier is modified to provide several outputs

with different sensitivities simultaneously.

With this unit, profiles may be recorded on an X - Y plotter such as a Mosely or Librascope using any desirable scale up to 400 N units, refractive index vs time may be shown on inked recorders using scales of 50 or 100 N with a frequency response from d-c to 10 cps and small scale, rapid variations are recorded by either a photographic recorder or magnetic tape recorder using scales of 5 to 50 N units and frequency responses in the range 0.05 to 100 cps.

Microwave refractometers employing the principles discussed above have been widely used for airborne measurements. Some thirty instruments are now in existence and data have been gathered throughout the United States and Alaska, in the vicinity of Hawaii and in Europe.

In summary, the direct application of stabilized oscillators and the beat frequency principle to the design of microwave refractometers makes possible an instrument whose stability, ease of calibration, overall accuracy and versatility are far more than adequate for current wave propagation applications and which provides data⁸ unobtainable by other means.

The equipment described was developed under contracts AF 18-(600)-113, AF 19(604)-494, AF 33(616)-2423, Nonr 375(08) and Nonr 1770(01) with the University of Texas Electrical Engineering Research Laboratory.

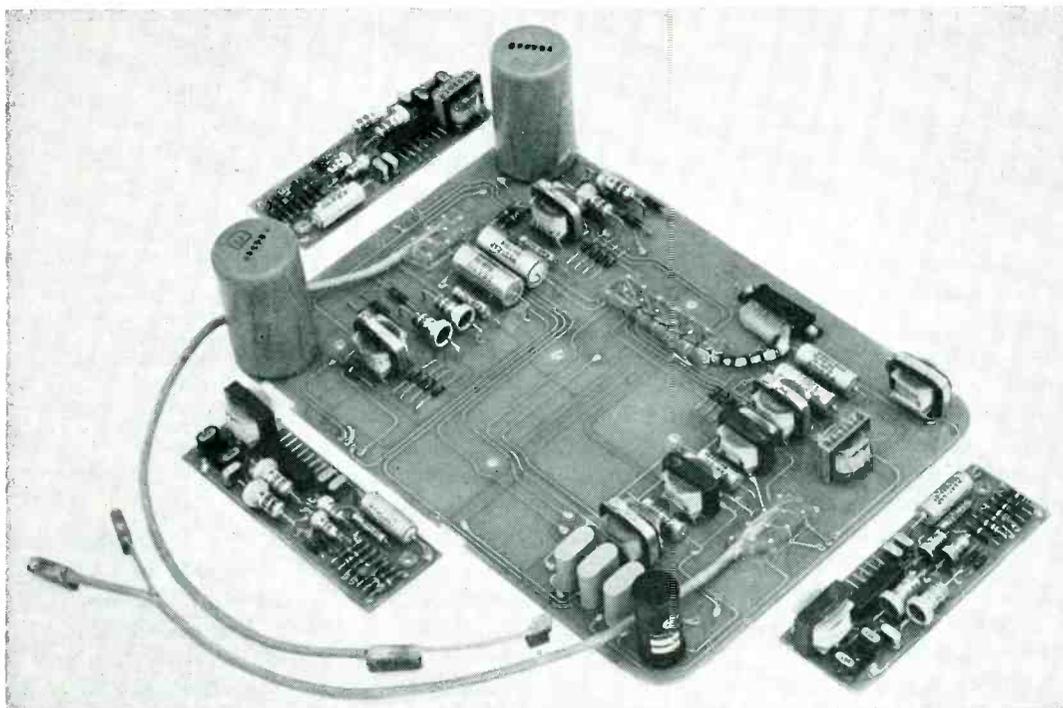
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Push-Pull Transistor SERVO AMPLIFIER

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Main assembly board contains two complete 7.5-watt servo amplifier channels and a 0.75-watt channel plus related switching circuits. Subassembly boards contain complete amplifier except for output transformers

SUMMARY — Negative feedback keeps gain variations under 1 db from -55°C to 100°C in servo amplifier using silicon transistors in push-pull circuit that delivers 0.75 watt into transformer or 7.5 watts to saturable reactor. Signal source impedance is low compared with input impedance. Unfiltered, rectified a-c is adequate for collector supply

SILICON TRANSISTORS are used in a preamplifier which may be coupled to a push-pull transformer for 0.75 watt output or to a saturable transformer for 7.5 watts output.

Negative feedback is the major factor contributing to the performance of the amplifier about to be described. Other features aiding the overall performance are low signal-source impedance compared

with input impedance, direct coupling of transistors and the use of unfiltered full-wave rectified a-c for the collector supply.

Interchangeability was stressed from the outset, resulting in considerably simplified assembly and testing of the amplifiers and sub-assemblies.

The schematic of Fig. 1 shows the amplifier up to the points A, B, C and D. Here, it may be

connected either to a push-pull transformer or to a discriminator saturable transformer if higher gain and output are required. The connections are shown in Figs. 2A and 2B respectively.

The amplifier is designed to operate from a low-impedance E-I type pickoff. The pickoff tuning is integral with the pickoff. The loads for both amplifiers are two-phase torque motors operated with locked

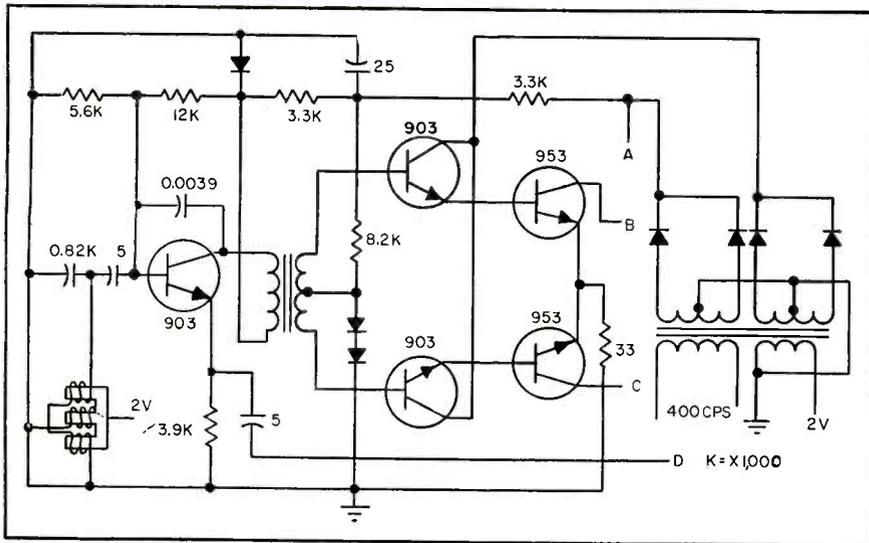


FIG. 1—Amplifier, supplied by unfiltered, rectifier a-c, drives either push-pull transformer or saturable reactor shown in Fig. 2

rotors. Since there is little motion of the motor rotors the load impedance is constant. All of the data were obtained with the actual operating sources and loads.

The input stage is a single-ended class A stage with emitter-bias stabilization. This stage is transformer-coupled to a balance driver stage. The driver stage is direct-coupled to the balanced output stage which is biased for class B operation. Proper bias is maintained at the output over the temperature range by the two diodes in the driver base circuit.

Feedback

The major advantage of the negative feedback incorporated in the circuits is temperature stability. Figure 3A shows the gain variation from -55°C to 100°C . The curves were prepared from averages of six tests for each amplifier type. Transistors with h_{re} ranging from 7 to 35 at 400 cps for the common-emitter circuit were used. The maximum variation for any individual test was 1 db.

Another advantage of the negative feedback is that parts interchangeability without adjustment is possible. Transistors with h_{re} ranging from 7 to 50 have been tested in the circuits. In most cases, the operation is completely satisfactory. However, when transistors which have a high h_{re} are used simultaneously, there is a

tendency toward oscillation at a low signal level.

The transistors in the balanced stages were matched to within 20 percent for h_{re} at 25°C . An additional advantage of the feedback is the increased frequency response. The effect of feedback on the response to a sinusoidal input is shown in Fig. 3B and 3C.

The overall negative feedback in both circuits is approximately 15 db at maximum output. At small signal levels, the feedback increases because of the increase in open-loop gain. Necessary stabilization of the amplifiers is obtained by proper attenuation of high and low frequencies.

The high-frequency response is limited by the $0.0039\text{-}\mu\text{f}$ capacitor from collector to base of the first

Table I—Characteristics of Amplifiers.

Class B Transformer Output	Saturable Transformer Output
Load Z 790 $\angle 48^{\circ}$ untuned 1,200 $\angle 0^{\circ}$ tuned	1,150 $\angle 49^{\circ}$ untuned 1,770 $\angle 0^{\circ}$ tuned
Signal Source Z 500 ohms	500 ohms
Input Z 500 ohms without feedback 3000 ohms with feedback	500 ohms without feedback 3000 ohms with feedback
Power Out 0.75 watt max (30 v out)	7.5 watts max (115 v out)
Power Gain 60 db without feedback 45 db with feedback	70 db without feedback 55 db with feedback
Negative Feedback 15 db at max output	15 db at max output
Power In for max Out 0.75 microwatt without feedback 25.0 microwatts with feedback	0.75 microwatt without feedback 25.0 microwatts with feedback
Gain-Power Out Constant	Constant

stage. This capacitor also tends to lower the input and output impedance of the first stage.

The low-frequency response is limited by the $5\text{-}\mu\text{f}$ capacitor in the feedback circuit to the emitter of the first stage. This capacitor is small enough to produce degeneration in the first stage below 400 cps. Also, the low-frequency feedback is attenuated by this capacitor.

The variation of capacitance

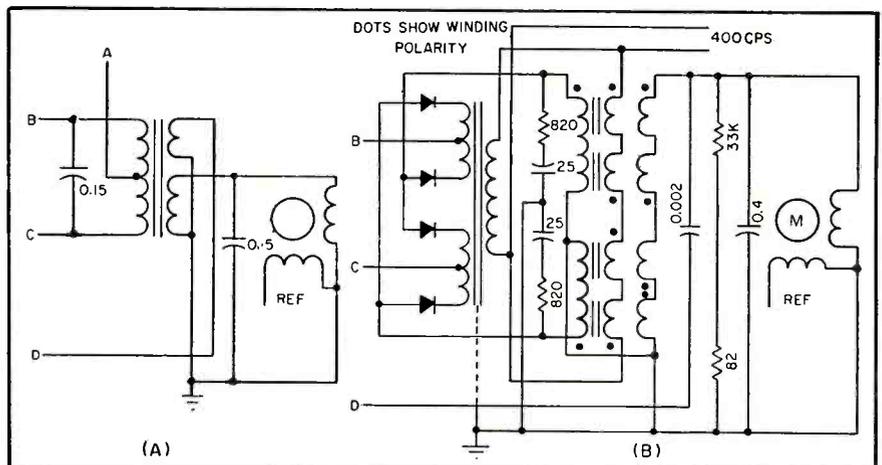


FIG. 2—Diagram shows method of connecting servo amplifier to transformer (A) and to saturable reactor (B) shown in Fig. 1

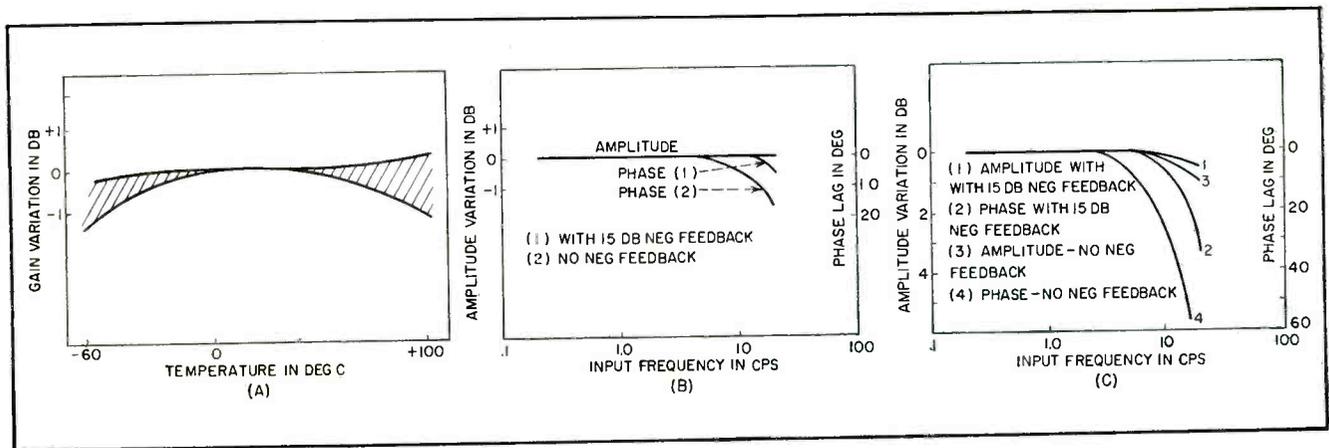


FIG. 3—Curves show spread of gain-temperature characteristic over twelve tests (A), response characteristic of 0.75-watt system (B) and 7.5-watt system (C) with and without negative feedback

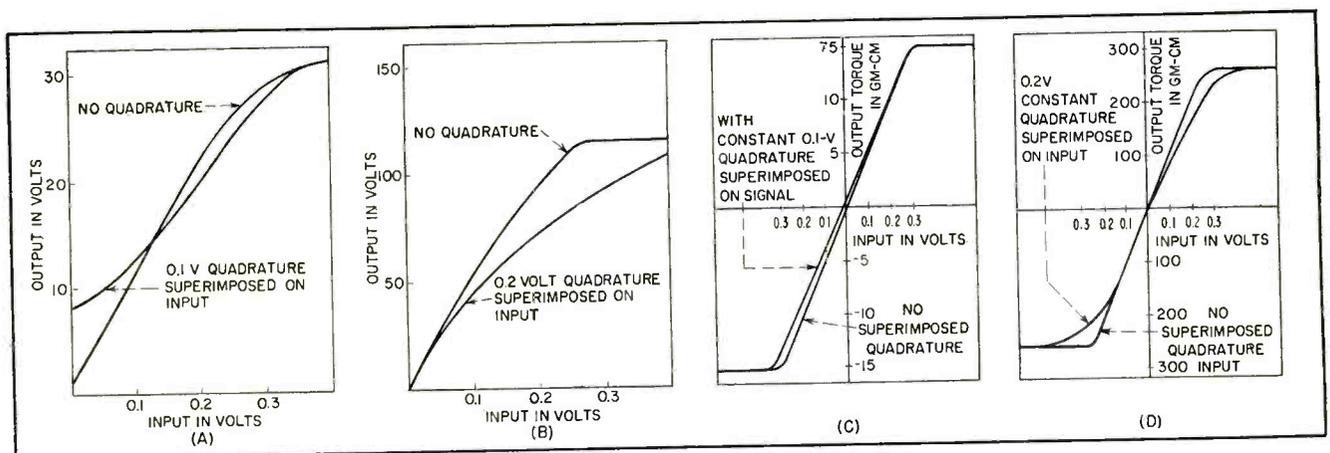


FIG. 4—Curves show output-input voltage characteristic of 0.75-watt system (A) and 7.5-watt system (B). Also shown are output torque-input voltage characteristics for the 0.75-watt (C) and 7.5-watt (D) systems

with temperature is such as to aid the overall stabilization. The open-loop frequency response (point D grounded) is approximately 300 to 1,200 cps. To make this measurement it was necessary to use a filtered collector supply

Saturable Transformer

Some additional stabilization was necessary in the saturable transformer output. The 820-ohm resistor in series with the 25- μ f capacitor across the control winding prevents self oscillation of the output circuit. The 0.0033- μ f capacitor in the feedback circuit gives additional stabilization in the region of zero signal.

The output of the saturable transformer is nonsinoidal except at full output. The feedback is taken from a divider across the output at the saturable transformer and mixed with the sinusoidal input in the first stage. The first stage has sufficient dynamic range

to handle the resulting complex waveform.

Power Supply

The collector supply is somewhat unconventional. The unfiltered full-wave rectified a-c supply reduces transistor dissipation considerably. Also, some quadrature rejection is attained.

The application of this type of supply is possible because of the balanced stages. Due to the nature of the collector supply, the push-pull output is not a true class B stage but is more of a switching-type circuit. No phasing problem has been encountered with this supply.

The first stage has a filtered supply consisting of an R-C network plus a Zener diode which has a dynamic impedance below 50 ohms from d-c up to the highest frequency required by the system.

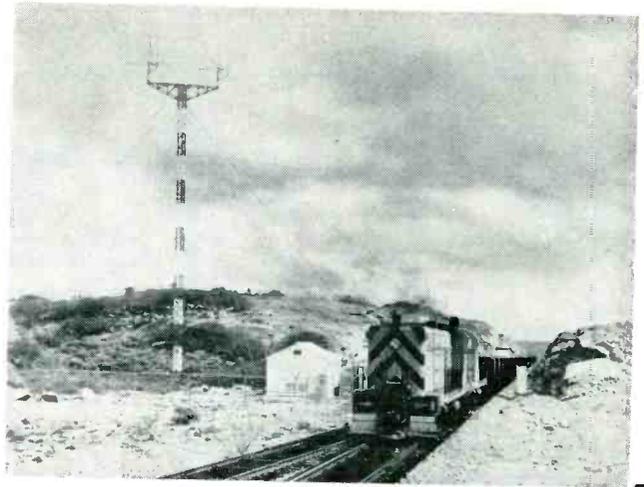
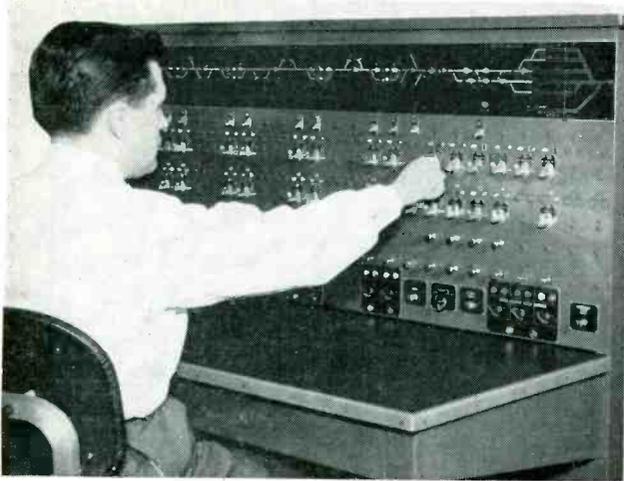
The effect of input quadrature voltages on the output voltage is shown in Fig. 4A and 4B. The

amount of quadrature superimposed was the maximum which would not saturate the first stage when combined with full input signal. The voltages presented on the curve were measured with an ordinary rectifier voltmeter and represent the total of in-phase, quadrature and harmonics.

Performance

The system performance is much better than indicated by the output voltage curves alone. Since the two-phase motor load acts as an additional discriminator against quadrature, the effect of quadrature superimposed on the input is further reduced. The composite system performance is presented in Fig. 4C and 4D. Good linearity is maintained from input to output.

The average characteristics of the two amplifier types are presented in Table I. These values represent test data from several amplifiers at room temperature.



Dispatcher at console in Puerto Ordaz (left) controls switch positions at remote sidings by radio. Both track switches and signal lights are radio activated and each siding has a radio telephone for maintenance personnel

RADIO SYSTEM Controls

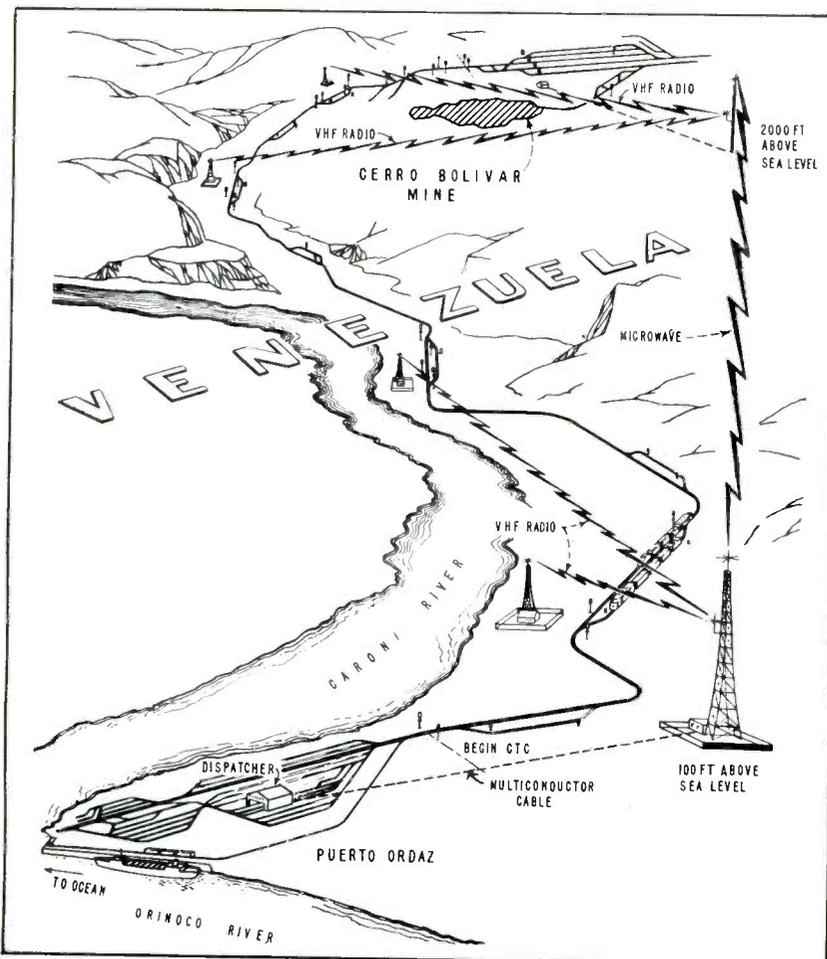


FIG. 1—Overall view of centralized-traffic-control system used between Puerto Ordaz and Cerro Bolivar

DEVELOPED to provide railroad traffic control by radio instead of wire lines, the radio centralized-traffic-control (ctc) system was recently put into operation on the ore-carrying railroad of the Orinoco Mining Company in Venezuela. This system enables a centrally located dispatcher to supervise and direct by radio, a railroad extending 80 miles into the interior.

Radio was applied to this modern railroad's centralized traffic control system upon Paul Godley's estimate which exceeded \$500,000 in savings plus other advantages over wire lines.

Provided with fail-safe features to ensure safe railroad operation, the radio-activated ctc system was developed by RCA in conjunction with the Union Switch & Signal Division of Westinghouse Air-brake Co.

Basic Principles

Figure 1 shows an overall view of this system. An f-m radio system enables the train dispatcher in Puerto Ordaz to supervise the controlled switches and train signals along the wayside. The particular wayside switching stations selected by a control code send an

SUMMARY — Centralized-traffic-control system uses radio instead of wire lines to enable a dispatcher at port end of 80-mile single-track railroad to control movements of ore cars at passing sidings. Technique is applicable to remote supervisory systems and telemetering for the process industries. Equipment includes a multiplexed f-m carrier system, a mobile railroad radio system as well as telephone and teleprinter channels

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indication code back to the dispatcher's office as soon as the wayside function has changed. The change shows on the console lights when the codes sent and the wayside functions received are in agreement.

Disagreement between transmitter and returned codes terminates the operation with no registered change and the request may then be repeated at the dispatcher's option. It is a completely fail-safe system.

The radio stations at the mine and at the four waysides transmit an indication code to the dispatcher whenever a change occurs in the position of track switches or in the status of signals. An indication code is transmitted also when a train moves past a check point within the control area of a particular station or when radio or ctc equipment transfer to standby. Thus, changes at supervised field locations produce corresponding changes in the light arrangement on the dispatcher's track model.

Only one radio station at a time can transmit ctc codes. This is accomplished by a lockout feature, whereby the ctc code transmitted by any switch station will disable

all others. In certain cases radio capture effect establishes siding radio station priority.

The ctc system also stores the indication codes of any stations wishing to indicate either simultaneously or while another station is transmitting. The stored codes will be subsequently released on a ctc priority basis or through capture effect when the circuits are clear. Storage produces negligible delays since only four seconds are needed to send either control or indication code.

The ctc codes transmitted from the dispatcher's console are an uninterrupted 2,500-cps synchronizing tone and simultaneously, a 2,900-cps tone keyed for coding at approximately 4 pulses per second.

The passing track radio stations are normally silent. However, to transmit a code, a passing track radio station is automatically turned on and keys the 2,500-cps synchronizing tone received from the dispatcher location, thus returning the tone to the dispatcher in the form of an indication code.

Other Services

The system is basically multichannel and also provides numerous communication services vital to mining operations, including a mobile railroad radio system, five telephone channels, two teleprinter channels, a remote radio transmitter control and four tone dialing or signaling channels.

Figure 2 illustrates the radio ctc system arrangement. Operations are controlled from Puerto Ordaz, where the central ctc machine is directly connected with a broad-band multichannel radio trunk between Puerto Ordaz and Cerro Bolivar. This circuit operates on the 72 to 76-mc band.

At Puerto Ordaz and Cerro Bolivar this trunk connects to vhf radio systems extending the ctc system to the distant stations located at passing tracks B, D, F,

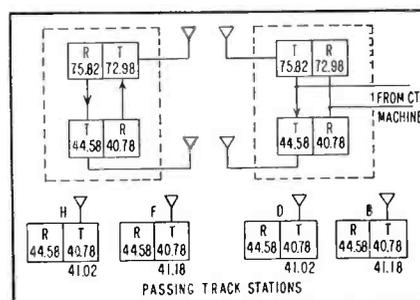


FIG. 2—Basic radio ctc system

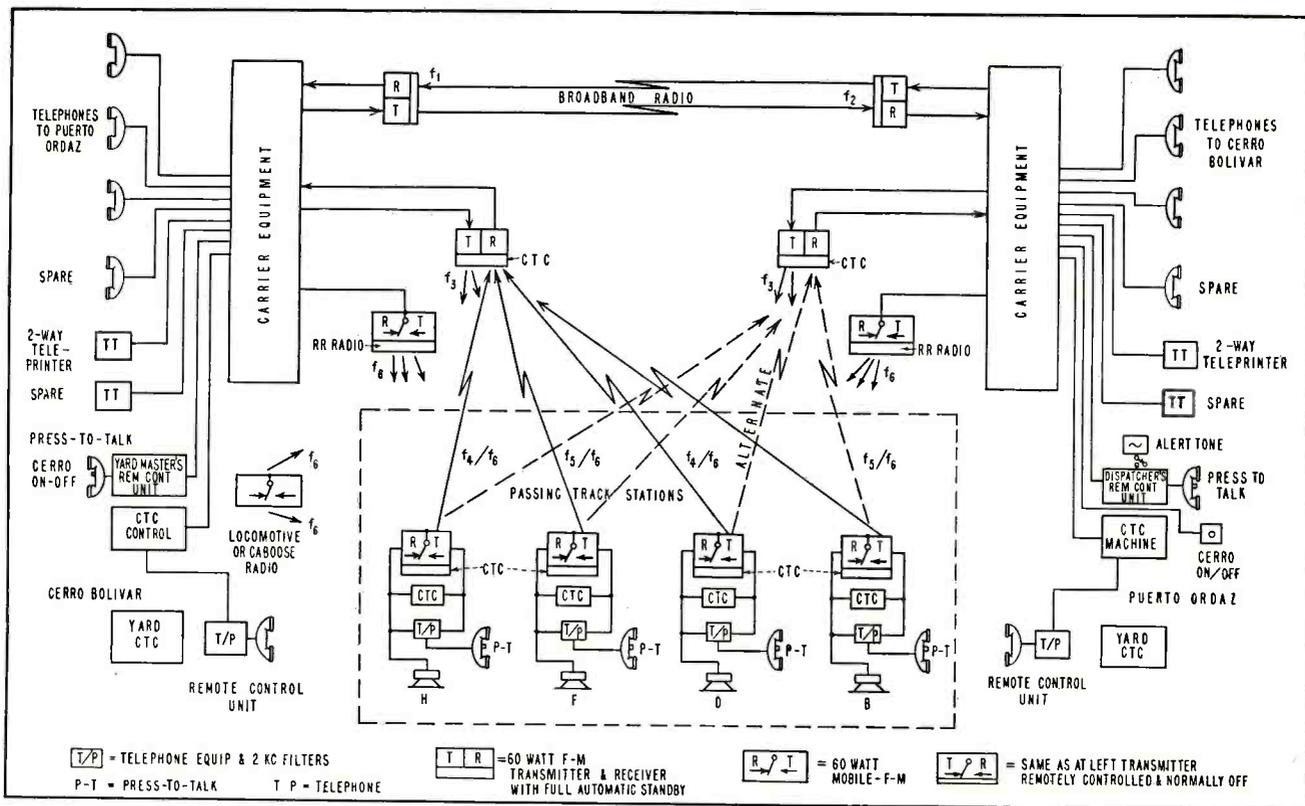


FIG. 3—Railroad radio and multiplex communications system uses microwaves for broadband radio and f-m transceivers for ctc

and H. Accordingly, ctc codes are on a two-way basis between the central control machine and any station included in the radio network.

The vhf radio stations use f-m transmitters and receivers operating in the 30 to 50-mc frequency range. Normal ctc operation to and from the sidings is handled via the Cerro Bolivar vhf station. The Puerto Ordaz vhf station performs a standby function.

Broad-Band Trunk

In addition to accommodating radio-ctc, the broad-band radio trunk constitutes a link providing the facilities shown in Fig. 3.

The dispatcher's voice-frequency telephone channel between the port and the yardmaster at the mine is a full duplex circuit using voice calling exclusively for railroad operations. When the push button on the dispatcher's hand set is pressed, the railroad mobile terminal transmitters are actuated and the dispatcher (or yardmaster) may talk to railroad personnel on radio equipped trains and vehicles on a push-to-talk basis.

The dispatcher simultaneously

controls the mobile terminal transmitters at port and mine. The yardmaster however, controls only the mine terminal.

Four telephone channels, carrier derived, operate between the automatic exchanges in Puerto Ordaz and the mine. The telephone channels are provided complete with carrier dialing. Toll calls are dialed by an operator during business hours, but are on a full dial basis at other times.

A teleprinter channel exchanges printed telegrams between Orinoco

headquarters in port and operational headquarters at the mine. A second printer circuit is a spare.

Mobile Radio System

Communication between the dispatcher (or yardmaster) and all locomotives and cabooses, train-to-train and end-to-end as well as train-to-sidings and sidings-to-sidings is done by mobile radio. For sidings, voice transmission is on the mobile frequency to prevent interference with ctc transmitters from other sidings.

Table I—Time Delays

Location	Release of Monitor	Changeover	Delay Time in Sec
Puerto Ordaz	Broad-band f-m trans	Broad-band f-m trans and rec	30 sec
	Broad-band f-m receivers	Broad-band f-m trans and rec	110 sec
	VHF f-m transmitter	VHF f-m trans and rec	30 sec
	VHF f-m receiver	VHF f-m trans and rec	30 sec
	2.9 kc & 2.5 kc transmitter	2.9 and 2.5 kc trans and 2.5 kc rec	30 sec
Typical siding	2.5 kc receiver	2.9 and 2.5 kc trans and 2.5 kc rec	30 sec
	VHF f-m transmitter	VHF f-m trans and rec	30 sec
	2.9 kc U receiver	VHF f-m trans and rec	110 sec
		2.9 kc rec	
Cerro Bolivar	Broad-band f-m transmitter	Broad-band f-m trans and rec	30 sec
	VHF f-m transmitter	VHF trans and rec	30 sec
	VHF f-m receiver	VHF trans and rec	30 sec
	2.9 kc receiver	Broad-band f-m trans and rec and 2.9 kc rec	110 sec

Normally voice reception of the mobile system at the sidings is by the ctc vhf mine terminal. For emergency operation there is also a direct circuit to the port.

Failure Protection

The radio stations are equipped with automatic devices for switching radio equipment and power supply to standby units. Thus the failure of either radio, tone equipment or main power effects a changeover to standby equipment. Time delay sequences minimize unnecessary switch-overs at points other than where failure may have occurred.

In addition, any transmitter, receiver, or power circuits may be manually switched to standby equipment so either equipment may be used for continuous or standby service. Failures are detected by monitoring circuits. Typical arrangements are shown in Fig. 4 and Fig. 5.

Status lights at radio stations and the dispatcher's desk indicate normal or standby operation. A failure also alerts the dispatcher at Puerto Ordaz with a resettable alarm bell. Status and failure indications are sent to the dispatcher using ctc coding facilities at each location.

The use of the dispatcher's facility remotely to transfer radio equipment to standby units is restricted to radio and signals maintenance personnel.

Multiplex Equipment

The channels required for ctc, telephones and teleprinters are transmitted without mutual interference over a single wide-band radio channel using Lenkurt carrier equipment. Each railroad radio and ctc radio is connected to a separate branch of the carrier equipment, using filters and terminal equipment for isolation. Since the carrier facilities at both terminals are identical, the port terminal will be discussed and the minor differences at the mine will be described.

Telephone and teleprinter signals are brought to the multiplex equipment by telephone cable.

The coded ctc tones are passed between carrier equipment and the

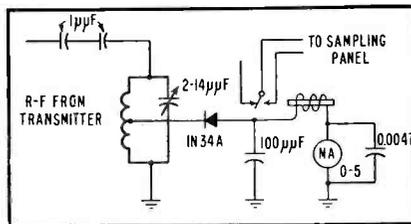


FIG. 4—Transmitter r-f monitor. Transmitter carrier keeps relay energized

racks in the radio house. The equipment serves to convert the coded d-c pulses from the dispatcher's control machine into coded tones that are then sent by radio.

Similarly, coded tones received by radio are converted by the equipment into d-c pulses that are put on the telephone lines connected to the control machine.

By the control circuits of Fig. 6, the mine yardmaster can turn on the train transmitter whenever desired using the on-off switch on his telephone handset. However, at Puerto Ordaz the dispatcher's on-off switch turns on the train transmitters at both the port and the mine simultaneously.

Low-pass filters limit the physical channel on the broad-band circuit to 2,000 cycles to permit the

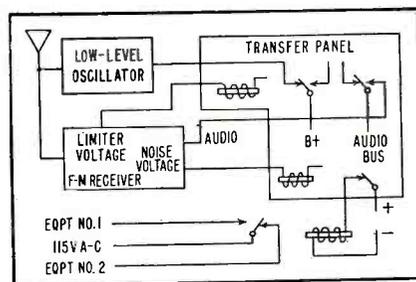


FIG. 5—Block shows interconnection between ctc receivers and transfer panel

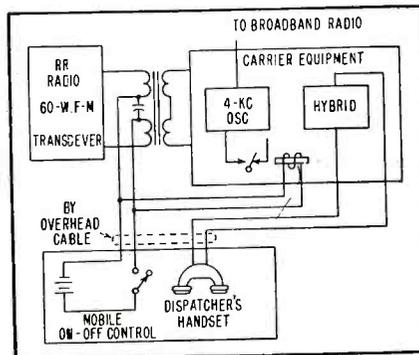


FIG. 6—Control circuits enable dispatcher to turn on train transmitters at both port and mine simultaneously

etc tones to be handled in the same channel without interference between the two services.

The ctc tones are channeled by high-pass filters between the Tone Control terminals, the two branches leading to the ctc radio equipment and the broad-band equipment.

Two teleprinter channels were provided with one assigned to spare service. Operation is half-duplex and only the send-loop terminals were tied to the external-loop terminals.

Four carrier telephone channels were provided with one, a spare, used as a service channel. It is operated with 20 cps ring-down, but can be converted for dialing, if required.

Broad-Band Circuits

The broad-band radio system uses 60-watt f-m transmitters and special broad-band receivers operating in the 70 to 75-mc range to carry the multichannel trunk between port and mine.

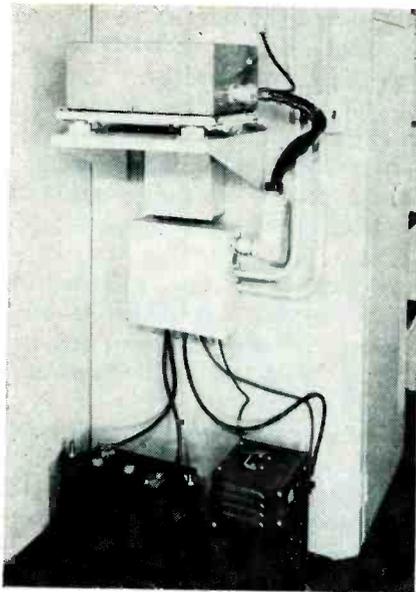
Groups of two f-m transmitters and two receivers were mounted on individual racks. Power can be applied to either transmitter and its associated receiver so the switching circuits may select one set of equipment as preferred.

By manual switches on the racks, it is possible to make either No. 1 or 2 the preferred equipment. Accordingly, the standby equipment is deenergized whenever the normal equipment is in use.

The audio circuits of receivers and transmitters, however, are not switched. They are connected in parallel through a matching network as shown on Fig. 7.

A transfer to the standby equipment occurs when either a transmitter or its corresponding receiver fails. For this purpose, an r-f monitor checks transmitter operation. Failure to develop an r-f carrier disables the relay of the transmitter monitor. This opens the corresponding circuits to transfer a-c power to the standby equipment.

Receiver failure causes a transfer to the standby transmitter-receiver combination in the same manner whenever the carrier operated relay of a receiver drops out, as it would on failure to receive a



Typical installation of 60-watt f-m transmitter equipment in caboose

carrier. The two broad-band receivers at the port are connected to a codan panel that terminates the audio line in a case of temporary circuit interruption that could introduce noise into the branches of the multiplex circuits.

In practice, operation of the two receivers at the mine is checked by equipment that monitors the 2.9-kc tone. The f-m receiver and its associated f-m transmitter will transfer to standby, if this tone should be interrupted for a period exceeding the normal coding interval. In all cases the transfer of a-c power is not instantaneous. The time delays shown on Table I were deliberately introduced to prevent unnecessary transfers.

Transmitting and receiving antennas are switched to the particular equipment in operation by coaxial relays activated by the automatic switching circuits.

CTC Radio Terminals

At the mine terminal there are two 60-watt mobile station transmitters and four communications type f-m receivers. At the port, since no standby is required, for occasional emergency operation one transmitter and two receivers only are installed. Emergency switching is provided as for the broad-band equipment.

The 60-watt mobile terminal f-m transmitters have the same failure protection also.

Receiver monitoring circuits include a novel feature. Ordinarily, no carrier is received since the siding radio stations are silent except for the short periods while transmitting an indication code. Therefore, a simulated carrier was provided using a special stable r-f oscillator whose output is adjusted for the lowest usable output (between 1 and 2 microvolts) which will actuate a carrier operated relay.

The ctc circuits require special treatment to prevent the initiation of false transmissions of ctc codes owing to noise. Sustained noise pulses are normally produced during an f-m receiver squelch interval and since the receivers operate near threshold during idle periods they can produce occasional noise bursts while receiving the low level oscillator.

Both effects were eliminated by a simple relay panel devised by C. H. Brereton. This device operates from rectified limiter grid voltage, which serves to disable a relay for breaking the audio line to the ctc machine during idle periods.

Siding Radio Stations

At each siding one rack contains all the radio equipment. The standby equipment is de-energized whenever the normal equipment is in use and either No. 1 or 2 equipment can be used in the preferred status by throwing a switch on the racks.

The fault-detecting circuits differ from those in the broad-band and ctc equipment because the preferred transmitters at the sidings go on the air only for brief periods whenever an indication has to be transmitted, but the receiver is on continuously. Accordingly, the transmitter r-f monitor circuit

actuates the transfer circuits only during the intervals when a code transmission is initiated by the ctc equipment.

Preferred-transmitter plate power is applied only during the coding interval. If the transmitter should fail to develop r-f during that interval, transmitter and receiver equipment transfer immediately to standby units and the preferred equipment shuts down. The standby unit requires approximately ten seconds delay for plate power application. Codes for ctc are stored during changeover and resume after the changeover is complete.

The f-m receivers are monitored indirectly by a monitor of the 2.9-kc tone. Failure to receive this tone for a period of 110 seconds causes transfer of transmitter and receiver to the standby equipment.

Each of the existing railroad mobile radio system terminals is equipped with an auxiliary transmitter-receiver and provisions, independent of ctc, for automatically transferring to standby equipment.

At each terminal station there are two racks of railroad radio equipment, each containing a 60-watt f-m transmitter, f-m receiver and a carrier operated relay panel. In addition, one of the two racks at each terminal is equipped with a transmitter monitor, and a specially developed sampling panel which contains control circuits for transferring from preferred to standby equipment and for initiating supervisory signals.

Sampling Panel

The sampling panel shown in Fig. 8, automatically transfers a radio transmitter and receiver to standby equipment on failure of either the normally operating transmitter or receiver.

Failure of the relay contacts, in the r-f monitor, to close when the transmitter is turned on de-energizes a transfer relay in the sampling panel and a-c power is transferred to standby transmitter-receiver.

Receiver operation is checked by a carrier operated relay whose contacts close when a carrier is received. As an additional feature the receiver is checked every f-

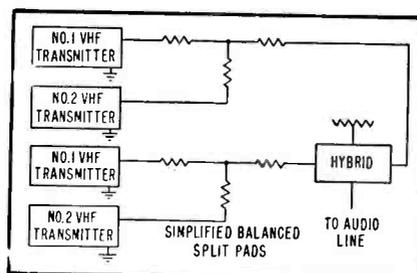


FIG. 7—Typical networks for combining radio transmitters and receivers

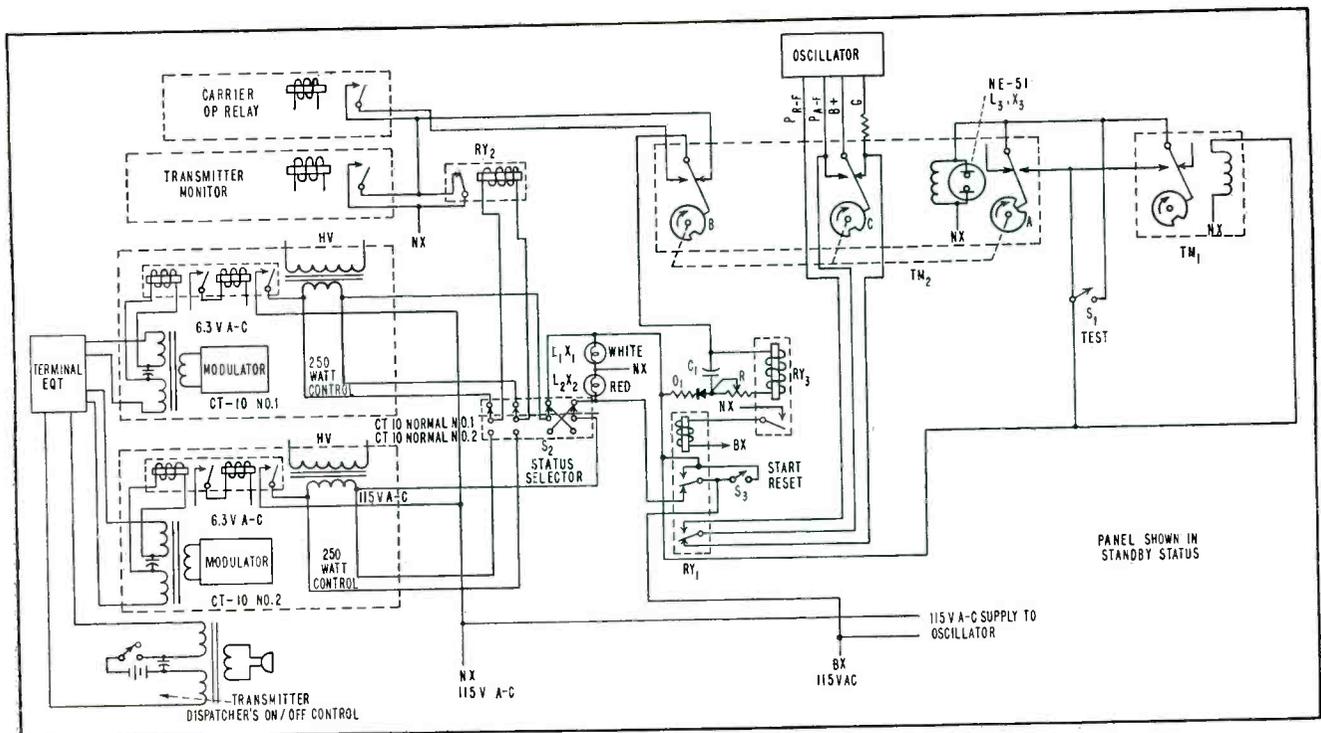


FIG. 8—Sampling panel circuits transfer a-c power from normal to standby equipment

teen minutes even though no carrier is received. Failure of the relay to close de-energizes transfer relay RY_1 , in the sampling panel and a-c power is then transferred to the standby transmitter-receiver.

Circuit Details

The circuit of Fig. 8 shows the sampling panel in the standby status. If status switch S_2 is thrown in the position labeled CT-10 Normal No. 1, equipment No. 1 is deenergized and standby equipment No. 2 is energized.

The sampling panel is started by depressing the momentary-close switch button S_3 . This applies 115 v a-c to the main supply bus and white status light, the transfer control relay RY_3 and the timer TM_1 .

Accordingly, timer TM_1 starts rotating and relay RY_3 pulls in, provided the relay supply circuit is closed through the series combination of rectifier D_1 , timer contact TM_{2B} , and relay contacts of transmitter status relay RY_2 . As a result, transfer relay RY_1 pulls in. One set of contacts closes the 115-v a-c supply circuit. The other set of contacts parallel the r-f and contacts $Pa-f$ and $Pr-f$.

The transmitter monitoring cir-

cuit of Fig. 8 shows that a transfer to standby equipment occurs if the contacts of RY_2 and of the r-f monitor are open. Normally this relay pulls in and its contact opens when the normal transmitter is turned on. Simultaneously, the monitor relay contacts close if r-f carrier has been developed by the transmitter.

The short interval between the opening of one and closing of the other of the two paralleled relays is bridged by the combination of R and C_1 . This delays slightly the opening of transfer control relay RY_3 , and prevents an erroneous transfer to standby at the beginning and end of the monitoring period.

Receiver Sampling

During normal operation timer TM_1 is energized and revolves continuously, its contacts energizing timer TM_2 for a short interval once every 15 minutes. Once timer TM_2 begins to revolve, it remains energized for one minute by the contacts on cam A . During this one minute interval the sampling period of 4 seconds has to take place.

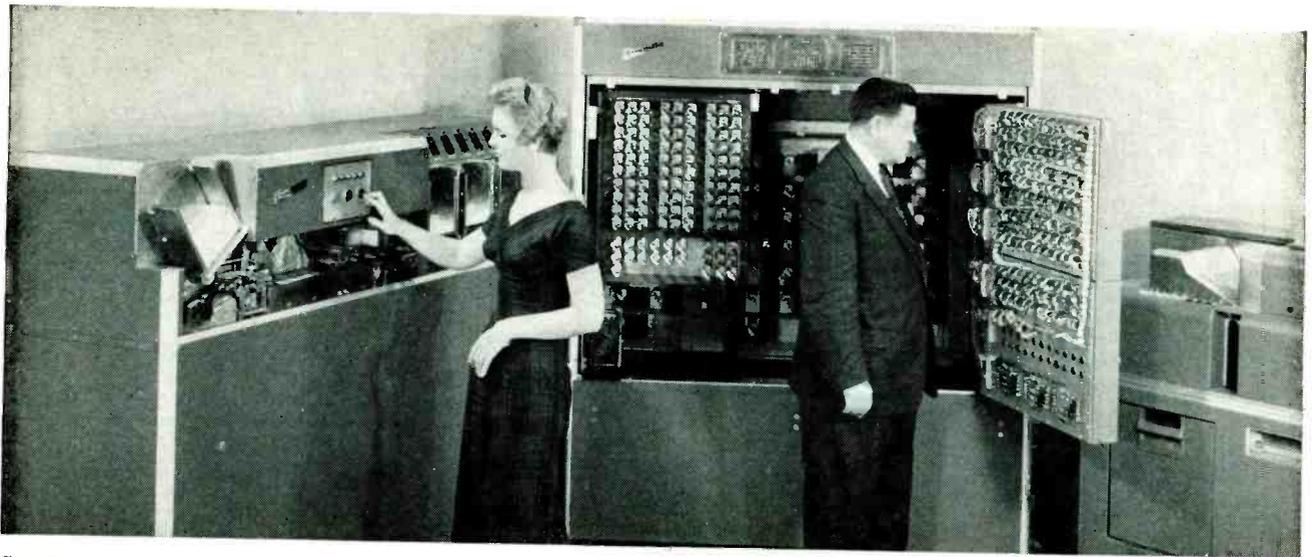
Receiver sampling begins when the contacts of cam C close the circuit applying B plus to the a-f and

r-f oscillator circuits. An audible tone is put on the dispatcher's telephone line for the duration of the sampling period indicating it is in progress. Simultaneously, an r-f signal is applied to the receiver by relay RY_1 .

This r-f signal causes the carrier-operated relay to close for 4 seconds. Its contacts are inserted in the supply line of transfer control relay RY_3 , when the contacts of cam B open the relay coil supply line. This will happen after the r-f oscillator has been on for approximately 1 sec, so the r-f signal will be monitored during the last three seconds. Transfer relay RY_1 releases and a continuous tone is applied to the telephone line. The audio oscillator is continuously energized by contacts of RY_1 .

Operation can be checked by pressing the test switch to initiate one sampling cycle.

The radio-ctc was suggested by Paul S. Godley and the author acknowledges his cooperation along with that of the Orinoco Mining Co., Union Switch and Signal and their engineers A. D. Etchison and W. P. Quintin Jr. The engineering project in N. Y. was directed by D. H. Pain, with engineering by the author, R. M. Ball Jr. and C. H. Brereton.



Complete data-processing system includes sorting and sensing unit (left) memory and translating unit (center) and readout unit (right)

Document Processor

SUMMARY — Coded information, in the form of dots printed on source documents, is converted into pulse-signal output for operation of computers, card-punchers and other data-handling equipment. Printed code on business forms is sensed and translated at speed of 500 forms per minute

By **RAYMOND L. FORTUNE**

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NEEDED for a means to transmit information from original source documents into machine language for computers has resulted in the development of a machine system known as Stanomatic, from the words Symbol Translator Automatically eNergizing Office Machinery.

Stanomatic operates from coded information preprinted with special ink, ribbon or carbon paper capable of upsetting a sensitive balanced electronic circuit. This coded information, in the form of dots printed on source documents, is arranged in 30 columns of five dot locations per column consisting of 150 bits of information.

A single digit in this code occupies one column and its value is

determined by the location of two dots printed in a given column. The coded dots release parallel pulses through a predetermined sequence of operations and a suitable signal is fed into data handling machines.

Output can be in any numbering system, binary or similar codes used in electronic computers, five, six, seven and eight-channel punched-tape code or any machine code by the use of suitable conversion units.

Coding

The 150 bits of printed dots may be used in any combination to provide decimal digits in separate control groups. Each dot represents

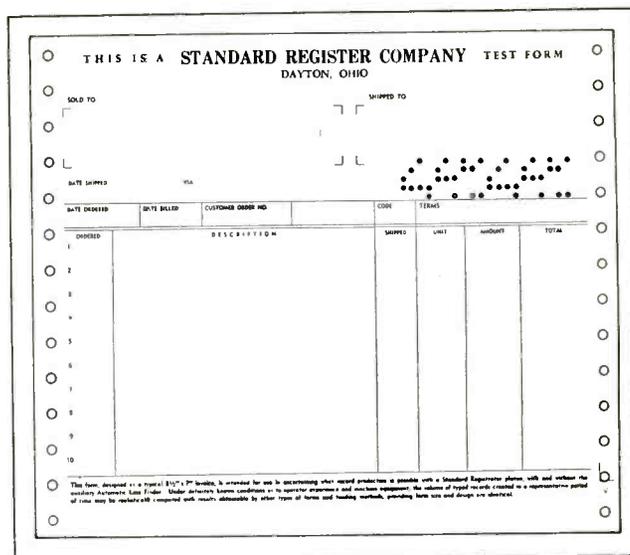
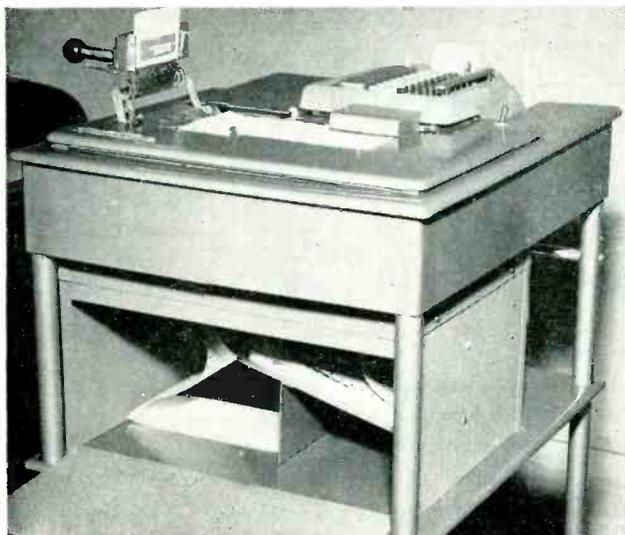
essentially a binary digit or bit; the numbers zero through nine are shown in Fig. 1 with their associated codes.

Each printed dot is approximately 0.086 in. in diameter. Dots in two of five spot locations in a vertical column are used to represent each decimal digit. The first dot in any column is assigned the value one; the second, two; the third, four; the fourth, seven and the last provides a self-checking feature.

Each digit is composed of two dots so the translation from their numerical designation is made in self-checking circuits.

A block diagram of the system is shown in Fig. 2.

At any time after the coding is



Coding register for standard perforated-edge business forms (left) imprints dot code on upper right of form (right)

READS CODED DOTS

completed on the forms, they may be inserted into the sensor. The forms may be fed through the feeder in a continuous strip or as individually cut forms. Either way, the principle of sensing or reading the coded information is the same.

As coded areas pass over a sensing head the presence of a code dot in any given area triggers a balanced circuit. The pulses thus created actuate the buffer storage unit.

The buffer storage is composed of relays in the plate circuit of the sensing unit thyratrons. Each relay is independently controlled by its own thyatron.

The thyratrons have common plate and bias supplies. Individual control is obtained by a capacitor coupling to the sensing unit with which the thyatron is associated.

Check Pulses

Relay contacts are interconnected to provide a check on the completeness of the information sensed. This interconnection provides the necessary two out of five check pulses which then: indicate information is correct; set up storage in the ferrite memory by the write thyratrons; initiate tape punch,

magnetic tape, etc; and select proper pocket for stacking sensed document.

If the necessary path for the two out of five check is not completed, showing some bit of information has not been sensed, the following sequence of events occurs: (1) all sensed information is erased from the buffer storage; (2) the rejected circuit is operated causing the document to be placed in the reject hopper; (3) all circuitry is restored to its initial condition ready for the sensing of the next document.

Ferrite Storage

The ferrite storage and translating section is composed of mem-

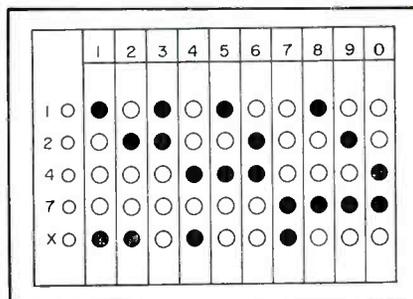


FIG. 1—Each dot in numeral code represents binary digit

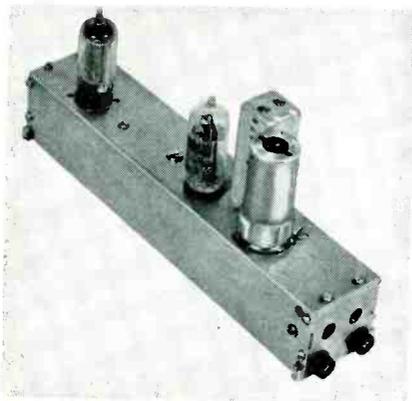
ory packages, each capable of storing a given number of selected digits of information and the means for decoding and translating this information to an output device.

For output to card-punching equipment, translating is accomplished by an arrangement of ten ferrite cores and associated wiring for each digit used. Information is stored in the cores in parallel but is read out serially.

Parallel input to the cores is obtained by pulsing the half-write lines associated with each of the sensing units that is pulsed when a document is sensed. Through the particular circuitry involved, each half-write line is associated with certain cores and when complete information is sensed the coincidence of the two half-write pulses occurring in a given core will cause information to be stored in that core only.

None of the other cores are affected. The core that is forced to change its magnetic state and thus store information is the core that occupies the position given to that particular digit that has been sensed, for example, a one, two or three.

The half-write pulses are con-



Sensing unit package of Fig. 4

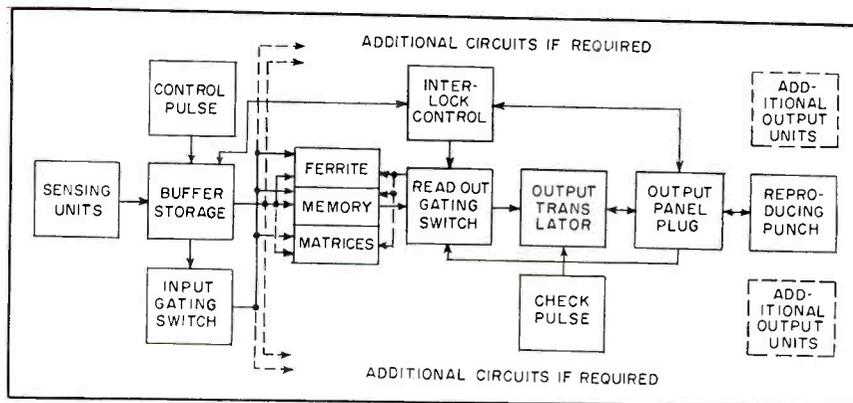


FIG. 2—Block representation of dot-code sensing and translating system

trolled by thyatron circuits designed to supply the necessary current for a specified period of time.

Read Lines

Associated with each core position in each of the memory planes is a read line. This read line is pulsed in step with the output device so the information can be read out and used at the proper time. For example, with the IBM 519 punch the read lines are pulsed in synchronization with the 519.

When the zero position in the punch card is in punching position, all zero read lines in the memory planes in a given memory position are pulsed and if any information has been stored in these cores a change of state of the core causes a pulse to appear on the sense windings. This pulse triggers a thyatron and the thyatron pulls-in a selected punch magnet in the 519 causing a zero punch to appear in the punch card. The same action occurs in turn as each of the other numbers on the card moves into punching position.

Thus, by the wiring arrangement of the ten cores used for each digit, it is possible to store binary information and to read this information out directly as digital information.

Digit Memory Plane

The digit memory plane consists of an assembly of 10 magnetic cores that possess the essential characteristic of having nearly a rectangular hysteresis. These cores are threaded with windings as shown in Fig. 3 and a photograph.

The plane has a dual use, storage and decoding.

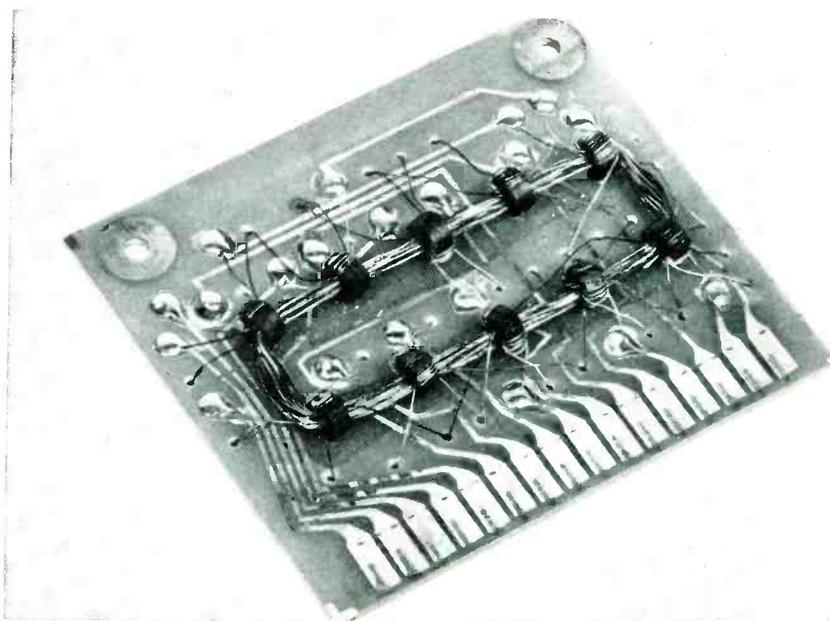
Referring to Fig. 3, note that five lines, designated 1 input, $\frac{1}{2}$ write; 2 input, $\frac{1}{2}$ write; etc., each thread a group of four cores. Any two of these windings will be common at a single core. For example, if lines of the 1 input and the X input are traced it will be found that they each pass through core positions designated as No. 1. Input lines 2 and X are common at core 2, 1 and 2 at core 3, 4 and X at core 4, 1 and 4 at core 5, 2 and 4 at core 6, 7 and X at core 7, 1 and 7 at core 8, 2 and 7 at core 9, 4 and 7 at core 0.

In operation, two of input lines 1, 2, 4, 7 and X are energized in the half-write current. This half-write current creates a magnetic flux in each core through which

the lines thread. This flux by itself is not sufficient to set the core. At the core position where the lines are common, however, the flux will be doubled; this flux magnitude is sufficient to set or magnetize the core. The core remains in this state until further action is taken.

Core Read Out

To read the information in a stored or set core, each core is threaded with an individual winding. These windings are designated as reads and bear the numerical designations 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0. A current is applied to these windings sequentially to produce a flux of equal magnitude or greater than that produced to store the core. This flux is opposite in



Digital memory plane unit, shown schematically in Fig. 3, has 10 magnetic cores



Dial encoder is manually operated

direction to the storage flux.

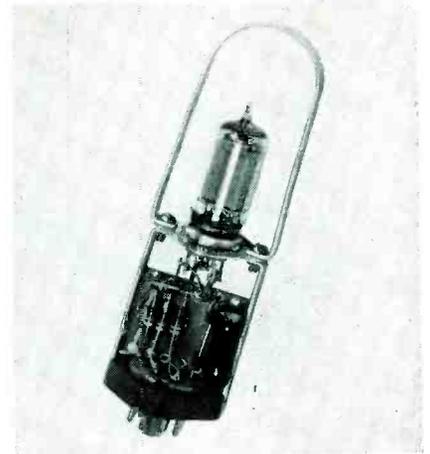
During storage and readout there is a change of flux and a momentary voltage is developed in the sense winding. By proper observance of winding directions, polarity of applied current and/or combinations of both, a momentary negative-going voltage will be developed in the sense winding at the time a core is stored and a momentary positive-going voltage, will be developed at the time a core is read.

The momentary positive-going voltage is used to trigger a 2D21 thyratron tube. In practice those points shown common in the Fig. 3 are individually terminated. This allows maximum flexibility in the interconnection of one digit memory plane to another forming a complete system.

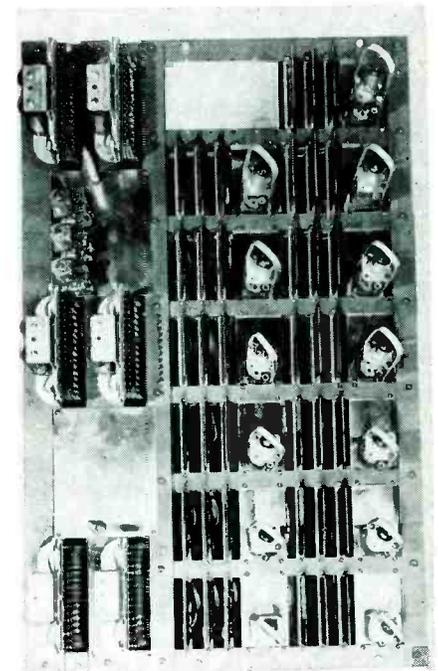
The necessary functions of circuit selections and switching of input and output information paths are performed by relays. These circuits are conventional and perform the following functions: selection of the proper ferrite memory section in which the sensed information is to be stored; selection of the necessary output paths to send information into the output device; selection of the read thyratrons which are to be pulsed by the output device controls at the proper time for transmission of the stored information to the output device.

In addition, the relays provide the necessary interlock control functions to keep all elements of the sensor, translator and output device coordinated. They see that all electrical functions of the machine are at starting position before the sensor will run, control the operation of the sensor and translator, control feeding and stacking, check the output device to make sure it is ready to receive the translated information and that it continues to function correctly while running, make sure that all documents fed into the sensor are stacked in the correct pocket, stop the machine in case a jam, misfeed or end of run should occur and permit operation of individual sections of the sensor translator for checking purposes.

Functionally the sensing circuit provides a pulse at the grid of V_3 in Fig. 4, sufficient to cause ioniza-



Typical thyratron-unit package



Thyratron and memory plane installation

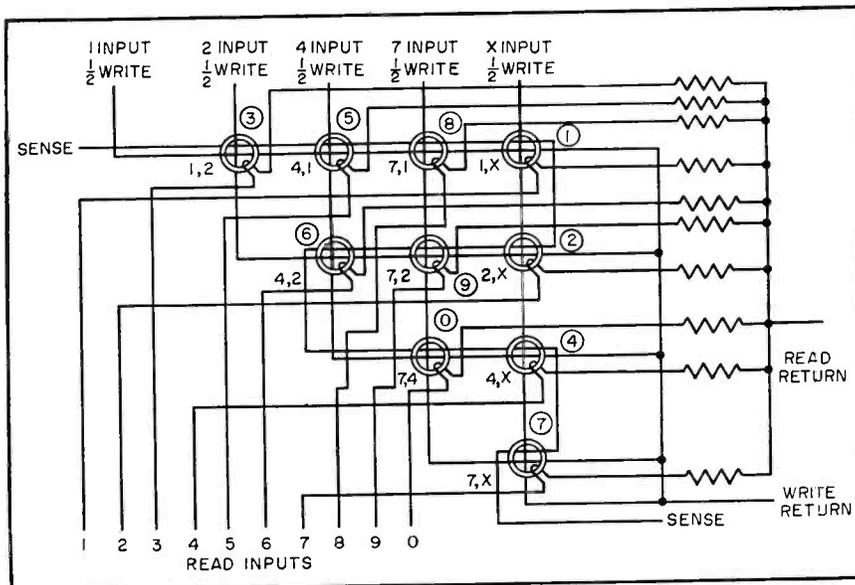
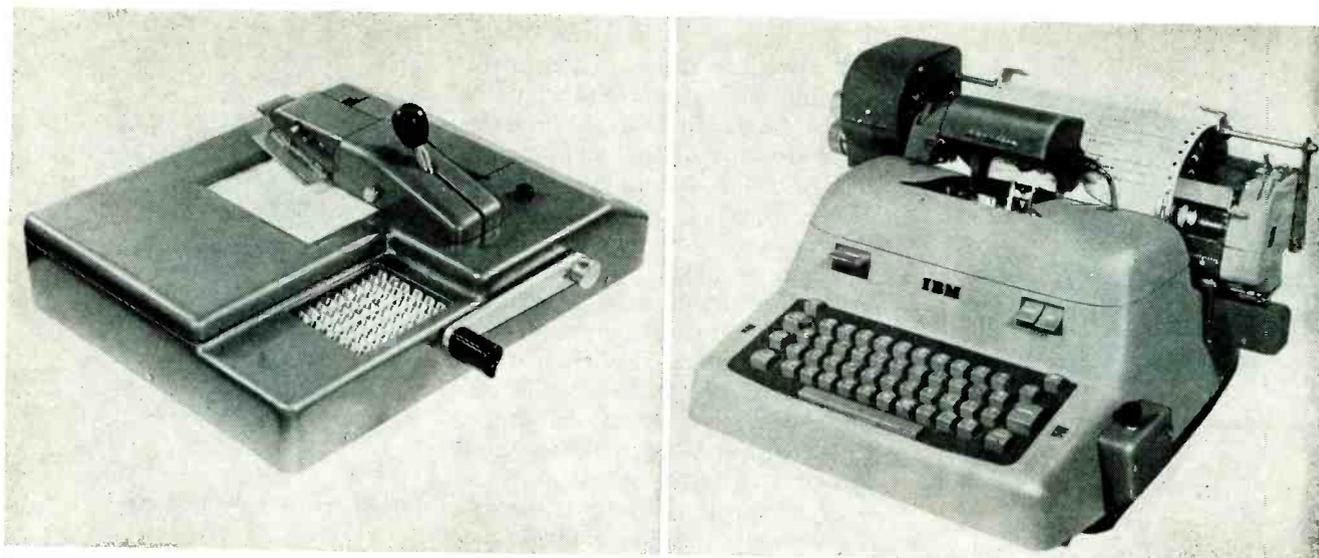


FIG. 3—Digit memory plane uses 10 RCA XF-1778 ferrite core assemblies. Half write pulse is 85 ma, read pulse is 1,000 ma and sense pulse is 80 v

tion when an abrupt increase of the capacitance between probe and infinite ground plate C , occurs. The change of capacity seen by the probe is proportional to the difference between the projected area of the probe and the area of C . Fringing at this point is neglected since the distance d is small and constant.

An alternating voltage of constant magnitude and frequency is introduced some place along line A. Tube V_1 is an r-f amplifier which is coupled to V_2 through an i-f transformer. The rectified i-f voltage developed by the diode section of V_2 is coupled to the grid of V_3 through a coupling capacitor. The



Two types of encoders; typewriter at right imprints code simultaneously with printing of digit

voltage change across the plate load resistor of V_2 is capacity coupled to the grid of V_3 , which in turn ionizes V_3 .

Capacitor C_2 and L_2 are adjusted to resonance and C_1 is adjusted so current I_2 is at a minimum in the direction indicated. At resonance, C_2 allows minimum impedance to I_2 , therefore developing maximum voltage across C_2 , which appears at the grid of V_1 .

Capacitor C_2 further compensates for the shock capacity across the lower section of L_2 . This shock capacity is represented by the cable inner conductor and r-f shield. Capacitor C_1 reduces the grid voltage by inducing a voltage in opposition to L_2 , controlling the direction of I_2 .

A small plate inserted in contact with the probe forms C_s . This capacity allows a current flow I_s in a direction similar to I_2 causing a voltage increase to appear across

L_2 due to its transformer action. The impedance of C_s is large compared to the impedance at the tap on L_2 . Consequently, I_s is approximately proportional to C_s , for C_s is not excessively large.

Serial numbers and other permanent figures are code imprinted with Stanomatic ink at the time forms are printed.

Document Origination

If the originating document is to be handwritten, an autographic register is available for handling marginally punched continuous forms and for imprinting in code such information needed to complete the business transaction. This information may consist of the account number of the customer, the branch from which the order originated, the cash amount of the order and the specific items required by this customer.

Constant data, such as branch-office, area or register numbers, is imprinted from a code slug. Personal account numbers can be obtained from code embossed on credit cards carried by the customer.

Basic Coding Units

Two basic units are available for imprinting codes reflecting machine-written information, depending on the type of form used. On a typewriter or bookkeeping machine feeding marginally punched continuous form, a code imprinting head is mounted directly above the type position of the machine so the code appears in line and with the same spacing as the machine. The imprinting of the code occurs simultaneously with the printing of the digit.

When individual forms are processed over a machine the coding mechanism is not mounted on the machine but consists of a separate unit which rests on the typewriter.

While it is necessary that the code spots be located in relationship to two edges of the source documents so the sensor can interpret the data correctly, the code can appear at any predetermined position on the form. Code data in excess of 30 digits is encoded on the form in successive groups of 30 digits by advancing the form into the coding machine a suitable distance to give an effect of line-at-a-time printing. A similar arrangement is provided for the reader and sensor.

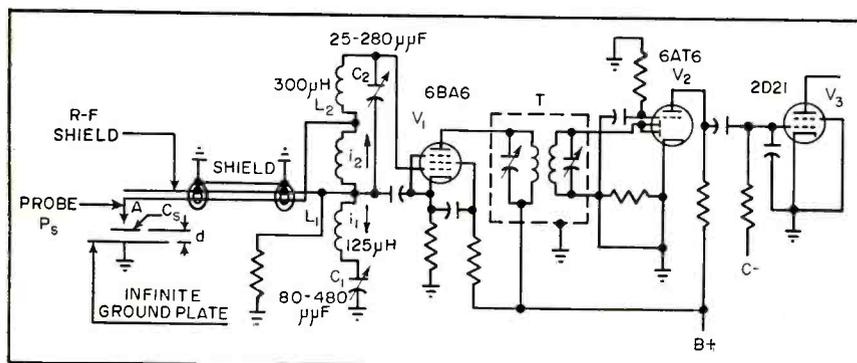
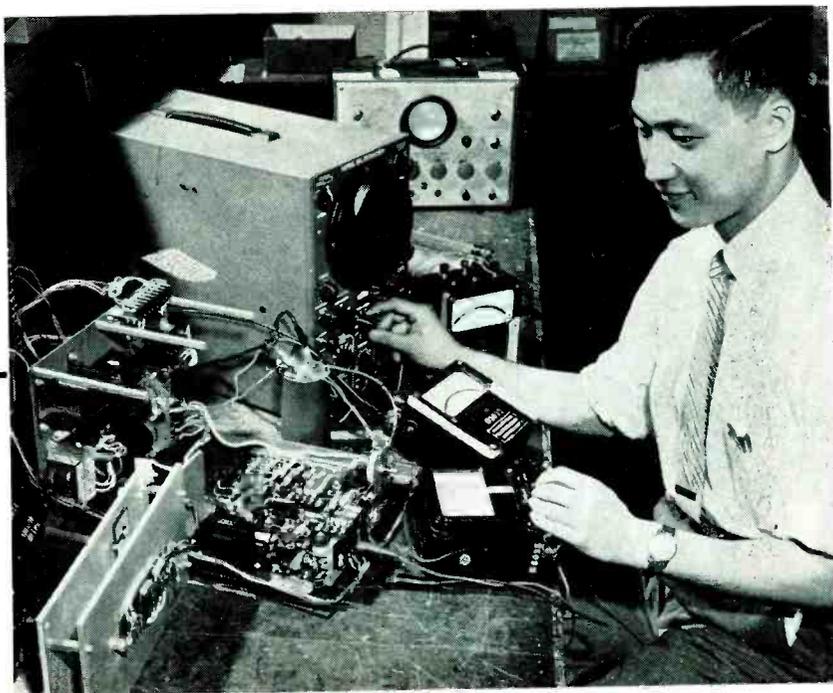


FIG. 4—Dot-sensing unit is sensitive to spot capacitance C_s of dot printed on document; C_s has value of $1 \mu\mu\text{f}$ and is function of document thickness d and dielectric constant

Transistor power supply under test for ripple and regulation. Power transistors are mounted on heat-sink panel at lower left



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Transistorized Regulated Power Supply

SUMMARY — Design of transistor and diode power supplies for 60 cps provides 100-mv regulation from zero to full load with 2.5 mv ripple. Output is 70 volts at 1.5 amperes. Similar circuit for 400-cps input uses d-c amplifier in feedback loop to control 4 paralleled power-transistor regulating elements providing 150 v at 5 amperes

ADVANTAGES of a transistor power supply are lower weight and volume, the possibility of using printed wiring throughout, long life and no warm-up time.

Typical applications of such a power supply as that described here might be found in computer work, in military airborne applications or in the laboratory.

Operation

The unit, shown in block form in Fig. 1, receives a-c power from the line. This is transformed to the proper voltage and then rectified. A bridge, with a voltage-sensitive element in one leg and linear re-

sistors in the other legs, is placed across the output of the power-supply unit. The bridge is designed to balance at the desired d-c output voltage. The bridge output is amplified and converted to an a-c signal proportional to the difference in actual d-c output and the desired d-c output.

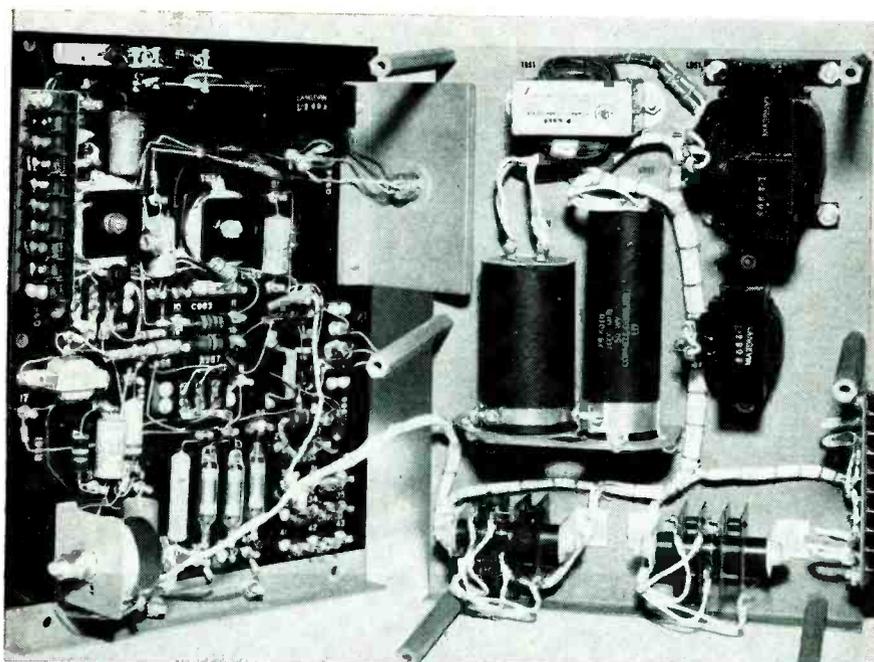
This a-c signal, used as a carrier, is amplified and detected, rectified and filtered. Further amplification may be obtained in a d-c amplifier. This carrier then is applied to the power transistor. Thus, any error between the desired d-c output voltage and the actual d-c output voltage is amplified and controls the

voltage across the power transistors.

In the schematic diagram, Fig. 2, the a-c voltage is rectified by conventional selenium, germanium or silicon power rectifier and filtered by L_1 and C_1 .

The voltage sensing bridge consisting of 3 fixed resistors, (R_2 , R_3 , R_4) one set of zener diodes and an adjustable resistor R_1 are connected across the power supply load. A *pn*p transistor Q_2 is placed across the bridge.

Applying a base voltage, slightly lower than emitter voltage, will cause this transistor to produce a virtual short circuit from collector



Regulation-control section of power supply shows terminal-board wiring with control transistors mounted on screw terminals and power transistor on heat sink at top center

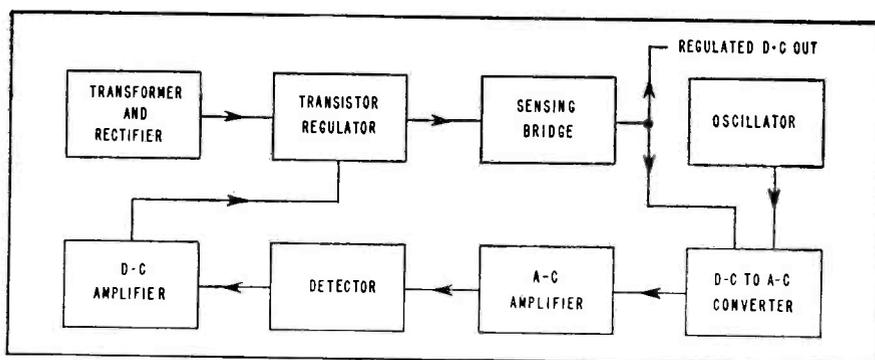


FIG. 1—Power supply regulating system in block form. The d-c amplifier between detector and regulating element is required only when oscillator frequency is above 30 kc.

to emitter. Increasing base voltage to near or above emitter voltage will cause a virtual open circuit from collector to emitter. The voltage swing required to change states is about 0.2 volts.

Collector voltage of transistor Q_2 is essentially a chopped d-c supplied by an auxiliary power supply feeding a transistor oscillator. Thus, the collector voltage of Q_2 changes from nearly zero to twice the rectifier output voltage at oscillator frequency.

The oscillator is a modified Hartley circuit operating at approximately 15 kc. The active element of this oscillator is Q_1 . The oscillator tank coil is a miniaturized transistor coupling transformer to which capacitor C_3 has been added for tuning.

Positive terminals of the auxiliary power supply are grounded to the emitter of Q_2 which, in turn, is floating in the middle of the bridge.

If Q_2 is fully conducting, all the r-f and d-c voltage is dropped in resistor R_6 since negligible voltage exists between collector and emitter. The r-f current then goes directly through Q_2 to the positive side of the auxiliary power supply.

In the nonconducting state, the chopped d-c is present on the collector of Q_2 and the a-c component is transferred to the base of Q_1 through transformer T_1 . This a-c voltage is dependent on the conduc-

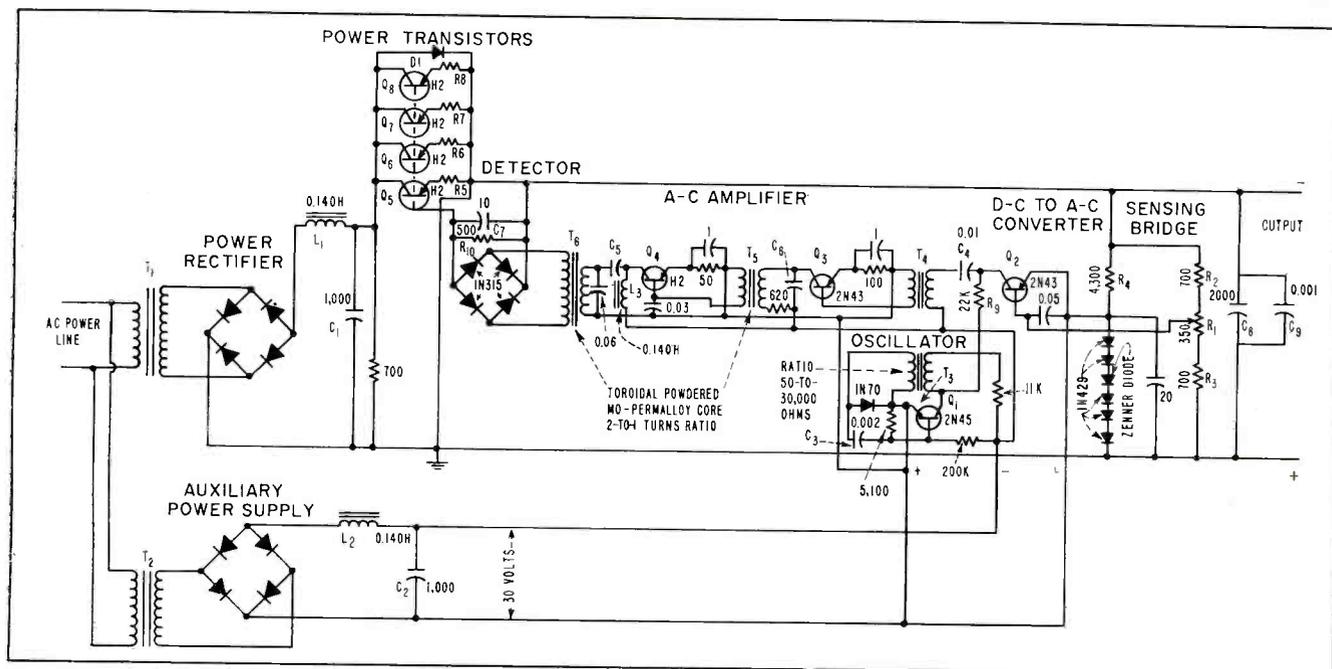


FIG. 2—Power supply uses transistors and diodes to provide 100-mv regulation at 70 volts

Storage Tube Projects

By HARRY W. GATES

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SUMMARY — Remote ppi indicator uses high-brightness projection tube with controllable long-time storage to provide 50-inch display for air-traffic-control systems. Provision for radar, Rafax and mapping signal inputs enhances usefulness of equipment. Buildup of ground clutter or large slow-moving rain-cloud formations is automatically kept down



Radar projector indicator as used with plotting board for air traffic control

To project live radar or beacon information directly onto a plotting board, two basic conditions must be fulfilled, high brightness and controllable long-time storage.

The radar projector indicator described in this article fulfills these requirements by utilizing a high-brightness storage tube called an Iatron. The equipment, consisting of a range-azimuth projection indicator and a control console, is a remote ppi indicator providing a 50-inch display for search radars.

To make the display equipment more useful separate inputs for radar, Rafax and mapping are included. It is possible to select five radar ranges from 20 to 200 nautical miles and range markers from 5 to 50 nautical miles. Sweep ranges are available for use with Rafax at 120 pps, 60 pps and 30 pps. The indicator will accept radar triggers from 200 pps to 1,200 pps.

Antenna rotation information may be from three rpm to 30 rpm and a two-speed synchro system insures accurate rotational information. A cycled, instant-erase automatically keeps down buildup of ground clutter or large, slow-moving rain-cloud formations.

Storage Tube

The basic elements of the Iatron storage tube are a writing beam of low intensity and high defini-

The erase generator is a blocking oscillator, V_{2B} , with the output taken from the cathode circuit as shown in Fig. 2. Erase rate control R_1 controls the blocking oscillator frequency. Pushbutton switch S_1 , when depressed, shorts out R_1 and R_2 , causing the blocking oscillator to operate at a high frequency, which instantly erases the insulator screen.

Automatic instant erase is provided at fixed intervals by a stable multivibrator, V_1 . The grid circuit of V_{1A} has a long time constant which may be varied by S_2 , causing the period to be varied, in steps, from 2 to 100 seconds.

The grid of V_{1B} has a relatively short time constant. When the plate of V_{1B} goes positive, the grid of cathode follower V_{2B} goes positive, causing the grid of the blocking oscillator to go positive. This prevents the blocking-oscillator grid from being driven negative, due to the cathode follower, which causes it to operate at a high frequency for the relatively short period that the plate of V_{1B} is positive. Rheostat R_3 controls the stiffness of the cathode follower and hence the instant erase frequency. When the cathode follower is less stiff (higher impedance), the grid of the blocking oscillator can be driven slightly negative, decreasing the frequency.

Application

When the indicator is used in conjunction with the Rafax video bandwidth compression system for



Control console for projector indicator

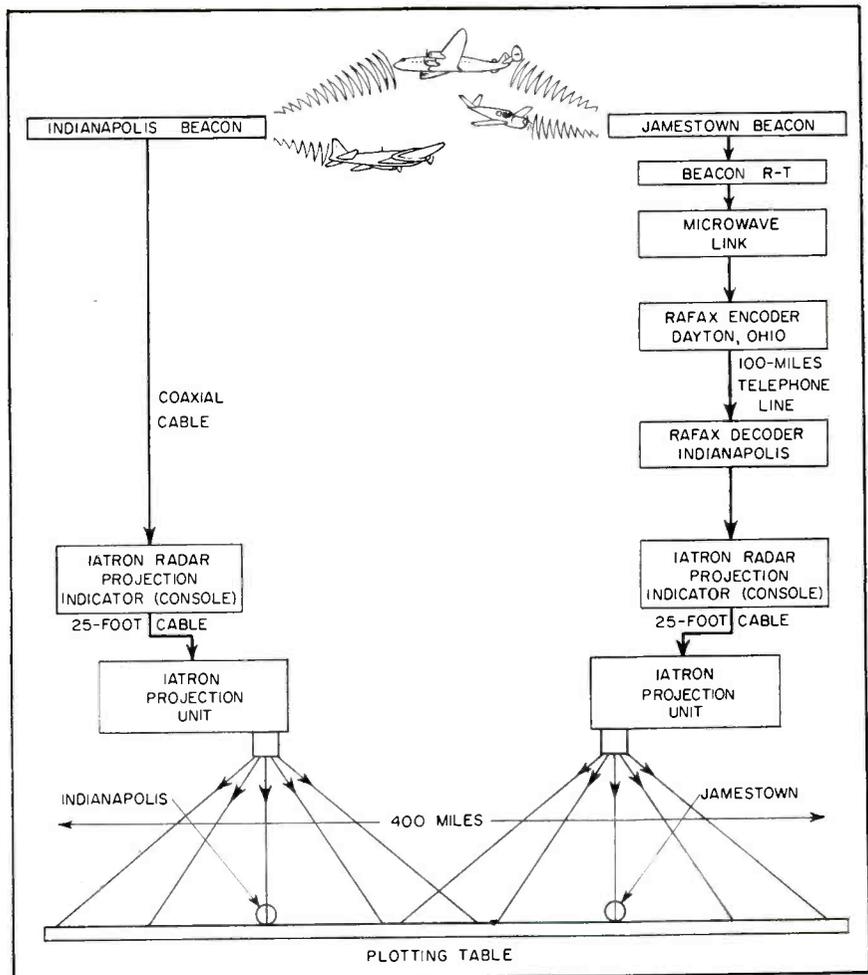


FIG. 3—CAA traffic control system utilizing radar projector indicator

remoting radar or beacon information, a novel and interesting display is produced. Such a system illustrated in Fig. 3, was demonstrated by the Technical Development Center of the CAA in Indianapolis.

Aircraft equipped with beacon equipment were interrogated by the beacon station in Jamestown, Ohio. The beacon video, trigger and rotational information were transmitted by microwave link to Dayton, Ohio. At Dayton the beacon information was reduced in bandwidth by the Rafax encoder. This reduced bandwidth information was then sent over the 100 miles of telephone line to Indianapolis where it was displayed by the Iatron radar projection indicator onto a plotting board centered at Jamestown.

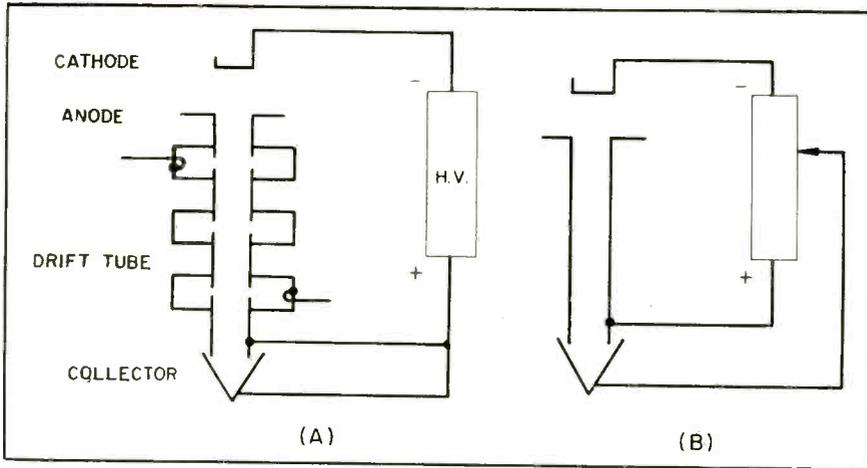
Another indicator was projecting beacon information from the Indianapolis beacon onto the same plotting board centered at Indian-

apolis. The composite display was then used for traffic control evaluation for the surrounding 400-mile radius.

The storage time of the Iatron was set for slightly greater than one antenna revolution so pertinent information was displayed at all times. Aircraft were identified and shrimp boats placed on the plotting board to be moved along as the flights progressed.

The projection unit of the indicator is normally mounted at the ceiling of the control room and the information displayed on a horizontal plotting board. However, the projection unit can be mounted in any position for vertical projection onto a screen or underneath projection through a translucent surface.

Simple refractive optics eliminate the problems of adjustment encountered in the more complex Schmidt-type optics. A single knob is the only adjustment.



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FIG. 1—Normal klystron connection to beam power supply (A) and connection for collector depression (B) to decrease power input to klystron

SCATTER SSB Technique

SUMMARY — Ultra-high frequency tropospheric point-to-point communication using single-sideband techniques requires high-power klystrons capable of providing low distortion, good linearity and high efficiency. Latest klystron development providing these characteristics is described

IN COMPARING ssb to f-m in long-distance uhf communication systems, assuming 100-channel frequency-division multiplex, the following fundamental aspects should be considered: bandwidth, the characteristics of tropospheric transmission and f-m threshold.

In addition, such equipment as-

pects as frequency stability, phase distortion, amplitude linearity and power amplifier efficiency must be considered.

Signal To Noise

Frequency modulation can achieve a better s/n ratio than ssb if the deviation ratio is made suffi-

ciently large. However, the bandwidth of f-m systems is limited by two characteristics of tropospheric propagation, wide variations in transmission loss and severe dispersion and multipath effects.

As the deviation ratio is made larger, the f-m threshold increases, destroying weak signal performance. In addition, distortion, caused by phase shift over the pass band, increases. For these reasons typical forward scatter f-m systems employ a deviation ratio of two.

Bandwidth

The bandwidth requirement for ssb is that of the modulation. This immediately places a six to one advantage for ssb over f-m.

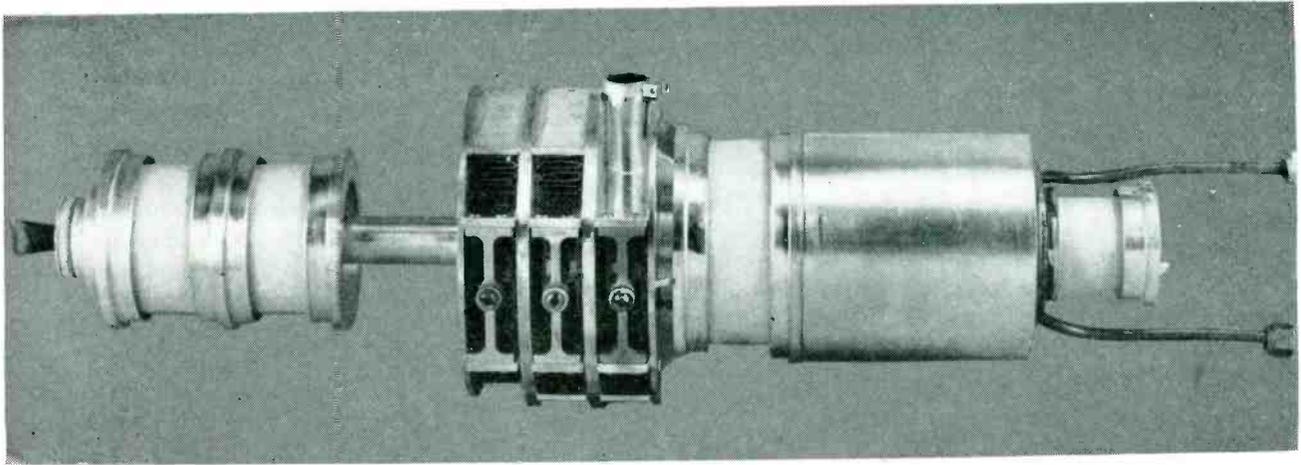
Since the variation in transmission loss is great, the forward-scatter system must be designed for good weak-signal performance.

SINGLE-SIDEBAND TRANSMISSION, in use for many years in wire carrier-current systems, was not widely applied to radio communications until the midtwenties. The first transatlantic single-sideband voice transmission was made on Jan. 5, 1923, between New York and London. Later, certain advantages of single sideband for long distance point-to-point radiotelephone and radiotelegraph communications helped it to come into relatively heavy use.

During World War II, for example, ssb was used extensively in the military's long-distance communications services.

When single-sideband techniques were commercially justified in transatlantic point-to-point telephone service, technical and economic factors rather than spectrum conservation determined its choice. It was found to give superior weak-signal performance in long-haul point-to-point circuits and more channels became available per high power transmitter.

Since World War II, spectrum economy has become an ever-increasing problem and crowded conditions are slowly leading to the day when all communications services below 30 mc will be single-sideband



Klystron designed for high-efficiency ssb operation has segmented collector to obtain maximum energy from spent electron beam

Uses Power Klystron

The weak-signal performance of ssb is superior because no sudden threshold effects, as in f-m occur. In this regard, ssb offers further advantages if amplitude compression and diversity techniques are applied.

Should the carrier frequency in a ssb receiver be incorrectly reinserted by more than a few cycles with respect to the sideband components, severe distortion results. Consequently, a frequency stability requirement of two or three

orders of magnitude better than that required for f-m is necessary.

Phase Distortion

The phase distortion requirements for ssb are much less than for f-m because the bandwidth requirement is less. However, ssb requires a high degree of amplitude linearity in all heterodyne and amplifier stages. This has been particularly difficult to achieve in the final power amplifier stage. Linearity of one percent is neces-

sary to keep distortion to an acceptable level in multichannel systems.

In comparing the two systems against noise, when the received signal is above the threshold, f-m has a 5 or 6-db advantage over ssb if the ssb peak power is equal to the f-m c-w power². On the other hand, when ssb average power equals the f-m average power, ssb then has a 2-db advantage over f-m. If the received signal drops below the threshold, ssb is superior in any case.

FORWARD SCATTER or tropospheric propagation for long-range transmission has become a reality recently.

While a theory which fully describes long-range uhf propagation has not yet been formulated, sufficient experimental data have been recorded and published to permit design of forward scatter systems and accurately predict their reliability.

In tropospheric propagation, wide signal variations exist in phase and amplitude with time, space and frequency. Average transmission loss is high, typically 80 db above free-space loss. Nevertheless, it is much less than that predicted by earth-diffraction theory alone.

Present beyond-the-horizon systems use high-gain antennas, high-performance receivers and high-power klystron amplifiers to overcome these transmission characteristics. Cost of such equipment is offset by the elimination of many low-power repeater stations.

Frequency modulation and single-sideband suppressed-carrier amplitude modulation seem most suitable for uhf tropospheric transmission considering bandwidth and performance.

Frequency modulation has been used in these systems, since it is comparatively simple and widely used in other uhf applications. High-power klystron amplifiers are now being operated in these systems at high efficiency.

Noise

Each channel of a multichannel f-m system has components throughout the pass band of the system. Therefore, the receiver must accept noise over the whole pass band. Single sideband, on the other hand, requires the receiver to accept noise over only that narrow pass band assigned to a particular channel.

No single argument can be offered to prove irrefutably the superiority of one system over another. Yet when all factors have been weighed and allowances made for future equipment development,

it would appear that ssb offers distinct advantages.

Klystron Linear Amplifier

Theory indicates that the gain linearity of a klystron amplifier is a Bessel function of the first order and the first kind. In practice, klystrons have produced better linearity than predicted by theory.² The klystron, unlike conventional tubes, inherently has exceptionally good small signal line-

arity. However some nonlinearity will show up near saturation. Distortion exists at saturation, but the fraction of time the klystron is driven to saturation can be small in ssb service.

A power klystron can be operated as a straight linear amplifier in ssb service, but the long-term average conversion efficiency is low because the beam power input is constant and must be high enough to produce the peak power

output. The long-term average ratio of peak-to-average power in clipped speech or multichannel telephone is 7 db, or about 5 to 1.

Efficiency

A klystron power amplifier capable of 50-percent saturation efficiency would, under these conditions, operate at a long-term average efficiency of less than 10 percent. At the high power levels necessary for forward scatter, efficiency is a very important consideration.

It has been suggested that a power klystron can be designed to operate efficiently as ssb linear amplifiers by allowing the klystron to operate continuously at full beam current and voltage and recovering the unconverted energy at the collector or by varying the beam current with the modulation envelope, which keeps the average power input to a minimum.

In the first case, efficiency is improved by collecting the beam at a voltage less than the beam voltage.

Connections

A klystron is normally connected to the beam power supply as shown in Fig. 1A. Electrons from the cathode are accelerated to the anode attaining a velocity corresponding to the beam voltage.

Under static conditions, the beam remains at constant velocity through the drift tube and the beam energy is then dissipated in the collector. The collector dissipation and power input are equal, neglecting the small current lost to the drift section.

If the klystron is connected as shown in Fig. 1B, the collector is depressed to a potential less than the beam voltage. The beam is decelerated by the field at the collector gap and is collected at low energy. The power input has been decreased by the depression voltage.

The limit to which the collector can be depressed is determined by the allowable increase in drift tube current. This current comes primarily from two sources: secondary electrons which arise from beam electrons impinging on the

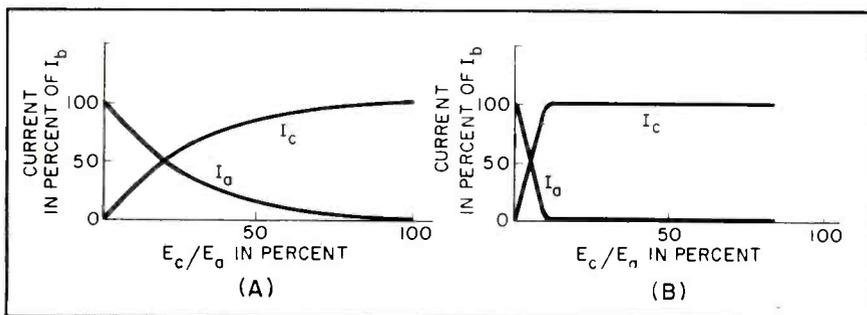
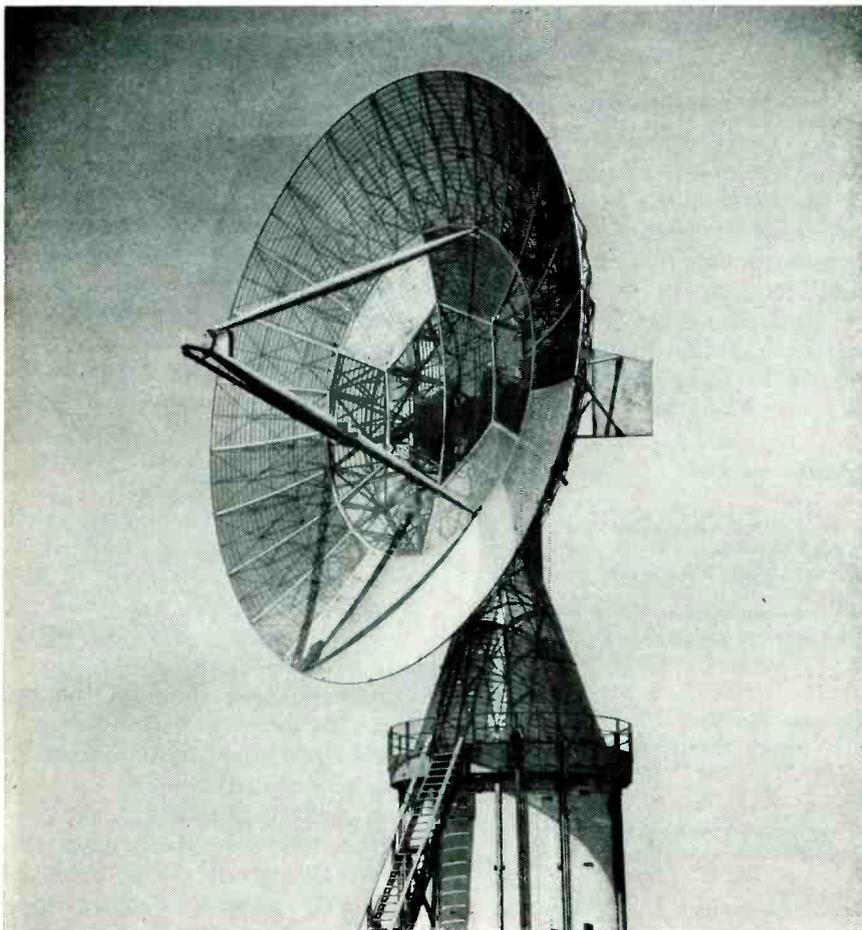


FIG. 2—Curves show improvement in characteristics of typical collectors (A) compared to special collectors (B) of the segmented type



Typical scatter terminal equipment employing high-power klystron for ssb operation

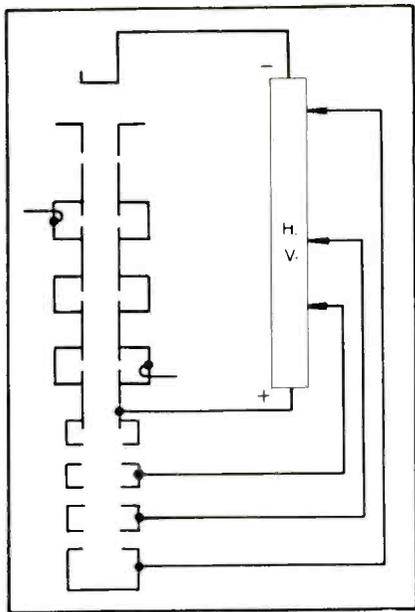


FIG. 3—Segmented collector klystron

collector and electrons which, as a result of the klystron velocity modulation process, have insufficient velocity to cross the retarding field at the collector gap.

Collector Design

Collectors of traditional design have the poor secondary emission characteristics shown in Fig. 2A. The collector voltage cannot be reduced far below the anode voltage before the drift section current increases sharply.

Tube structures having desirable collector characteristics are shown in Fig. 2B. The X625B, shown in the photograph is an example of a klystron designed for high-efficiency single-sideband operation.

Further improvement in efficiency can be realized through segmenting the collector.³ That is, separating the collector electrically into several segments along the axis so that different voltages can be applied to each segment as seen in Fig. 3, thereby recovering maximum energy from the spent beam.

Beam Current Modulation

Efficiency can be improved by supplying the klystron with only enough beam current to sustain the power output at any instant.

Referring to Fig. 4, the ssb driving signal is detected before it is

clipped and fed to the first cavity of the klystron. The klystron output signal is also detected. These envelope signals are compared in a difference amplifier.^{4,6} The resulting difference signal is amplified and applied to the modulating anode.

The modulating anode voltage thus maintains linearity between the klystron power output and driving power. The zero-signal beam current is determined by the clipping level.

Should the equipment problems be solved, this balanced feedback system would produce high efficiency because the power input is varied with modulation. Essentially, the beam is density modulated by the amplitude components of the ssb signal and velocity modulated at the first gap by the phase and frequency components of the ssb signal.

Klystron High-Level Mixer

Some encouraging experiments have been performed using the klystron as a high-level mixer to produce single-sideband power at uhf. This system also modulates the beam current to attain high average efficiency.

The experiments were performed with X594, which is a 3K50,000LF with a grid for beam control. The beam was density modulated by applying a 30-mc ssb signal to the grid.

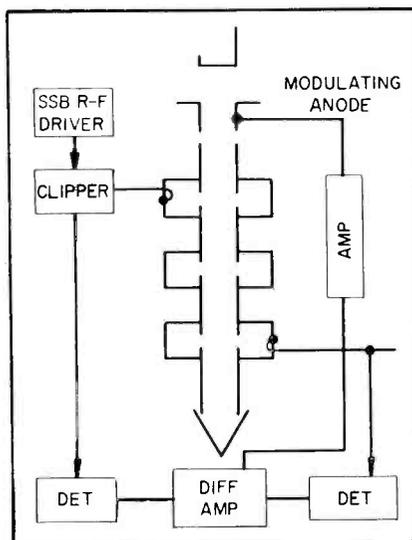


FIG. 4—Balanced feedback applied to klystron produces high-efficiency ssb power at ultrahigh frequencies

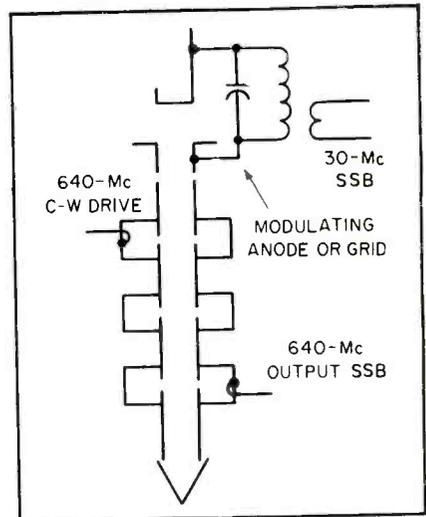


FIG. 5—Klystron connected as a high-level mixer for high efficiency ssb power at ultrahigh frequency

The signal was applied to a tuned circuit consisting of a small inductance and the inherent capacity (30 μmf) of the grid to surrounding electrodes as seen in Fig. 5. Less than 40-watts peak ssb driving power at 30 mc was required.

The first cavity resonator of the X594 was driven with five watts of 640-mc c-w carrier. Mixing action in the klystron allowed the second and third cavity resonators to be tuned to 610 mc or 670 mc, producing ssb power at 24-percent average efficiency. The efficiency was measured under two-tone modulation.

Over two-kilowatts peak ssb power was measured at a beam voltage of 15 kv and a peak envelope beam current of 550 ma. The unwanted carrier and products were rejected by the narrow band-pass of the second cavity resonator. With no feedback, the total harmonic distortion produced by the klystron was less than four percent.

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TRANSISTOR Flip-Flops

SUMMARY — Flip-flops for digital computers may be designed in three ways: direct coupled, emitter coupled or resistance coupled. Delay and transition times are discussed for these circuits under loaded and unloaded conditions. Nonsaturating circuits and the effects of loading with zero to four transistor bases are also given

By **A. K. RAPP** and **S. Y. WONG**

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TRANSISTORS HAVE made possible electronic computers requiring only a small fraction of the space and power required by the vacuum tube equivalent.

This article compares maximum speeds measured for changes of state for three types of circuits using surface-barrier transistors.

Basic Pulse Amplifiers

Shown in Fig. 1, the three basic types of pulse amplifier circuits are the direct-coupled, the resistance-coupled and the emitter-follower-coupled cascades.

Figure 1A illustrates the simplest method of coupling cascaded common-emitter stages by connecting the output of one stage directly to the base of the following stage.¹

The circuit modification in Fig. 1B overcomes one of the principal limitations in the switching speed of transistors, the storage of minority carriers in the base region of a saturated transistor. This storage produces a time delay at the collector on application of a cutoff signal.

One convenient means of reducing turnoff time delay is to limit

the base current by inserting resistance in the base leads. Capacitors are shunted across the base resistors to help speed up the circuit.

Figure 1C illustrates the use of an emitter follower as an active coupling network. The emitter follower does not suffer from hole storage and its low source impedance permits high charging currents to be supplied to the stray and internal capacitances, usually the limiting factors in fast pulse operation.

Figure 2 shows flip-flops using

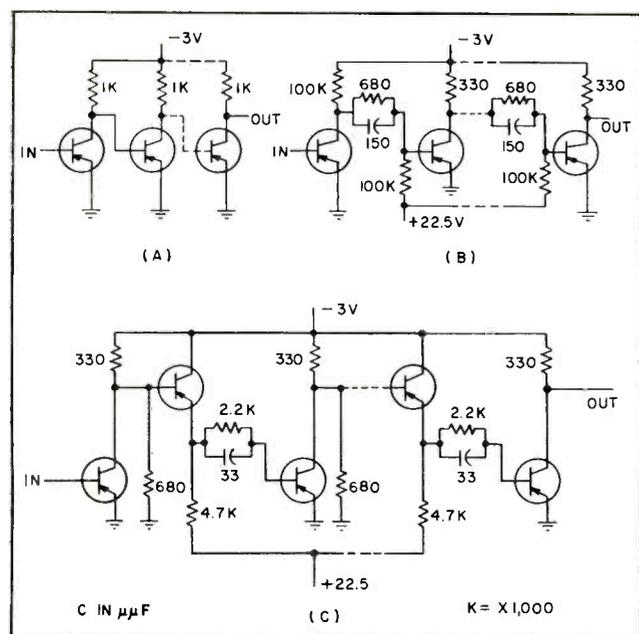


FIG. 1—Direct-coupled (A), resistance-coupled (B) and emitter-follower-coupled (C) pulse amplifiers coupled in cascade

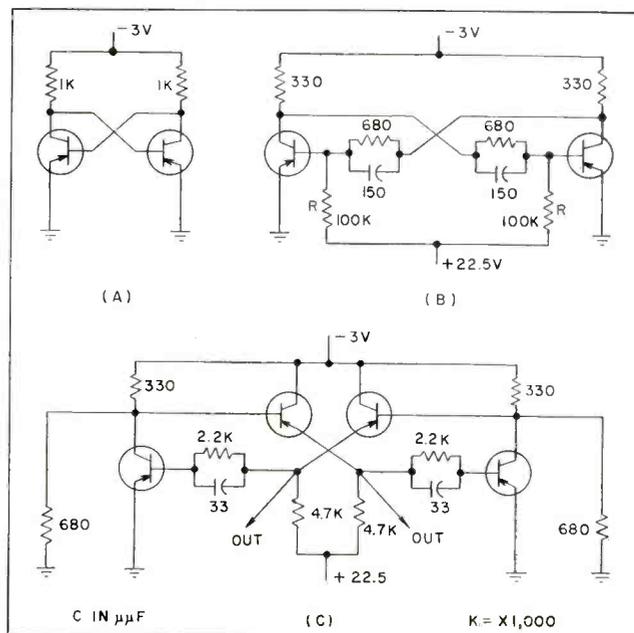


FIG. 2—Flip-flops derived from circuit configurations of Fig. 1. Circuit (A) contains a minimum number of components

Have High Speed

the three types of coupling given in Fig. 1. The circuit of Fig. 2A is a simple flip-flop circuit containing a minimum of components.

The flip-flop of Fig. 2B is analogous to the Eccles-Jordan circuit. It may be operated without the bias network consisting of +22.5 v and resistors, R, since the network has no effect on speed but increases reliability.

The emitter-follower stages of Fig. 2C produce buffering action and consequently provide convenient output terminals.

Switching Times

The direct-coupled flip-flop of Fig. 2A is redrawn in Fig. 3 to illustrate the switching times employed as criteria of high-speed performance. The delay time, δ is the time interval between the point where the collector potential of the gating transistor changes by 10 percent of its total voltage excursion and the point where the collector potential of the off-going transistor falls 10 percent of its total voltage excursion.

The total transition time X is the delay plus the fall time of the collector voltage of the off-going transistor. Fall time is the time required for the collector voltage of the off-going transistor to move from 10 percent to 90 percent of its voltage excursion.

Time Measurement

Delay and transition times were measured with the flip-flops loaded symmetrically with from zero to four pairs of transistor bases. Owing to its higher ratio of collector to base current, the resistance-coupled circuit has considerable less delay than the direct-coupled circuit. Transition time is more indicative of operational speed since it represents the total time required for the flip-flop to acquire a new state. Using transition time as the criterion, the resistance-coupled circuit requires about 18 percent less time than

the direct-coupled, while the added complexity of emitter-follower coupling results in a 70 percent reduction in transition time.

Speed

The speed of the direct-coupled circuit increases to double its no-load value when it is loaded with four pairs of bases, while the resistance-coupled circuit is slowed down by the addition of load. The buffer action of emitter followers allows the emitter-follower-coupled flip-flop to remain relatively unaffected by load.

The nonsaturating, resistance-coupled flip-flop² shown in Fig. 4 makes use of small resistors connected from each base to ground to form a voltage divider which limits the voltage swing of the base. The insertion of resistance into the circuit common to both emitters provides d-c feedback which forces the emitter to follow about 0.3 v more positive than the base of the conducting transistor. Since this base-to-emitter potential is independent of the emitter resistance, the choice of resistance controls the emitter current. Once the base voltage and emitter current are fixed, the collector current is also determined. A small collector resistance then holds the collector voltage of the conducting transistor sufficiently negative with

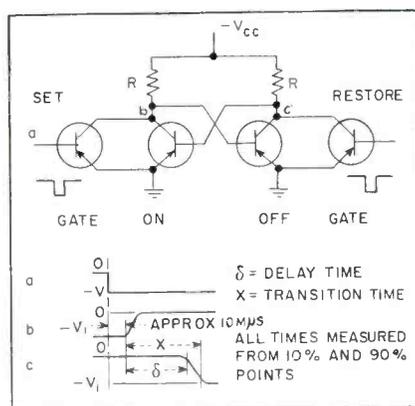


FIG. 3—Direct-coupled flip-flop illustrates switching time criteria for high-speed performance with symmetrical loads

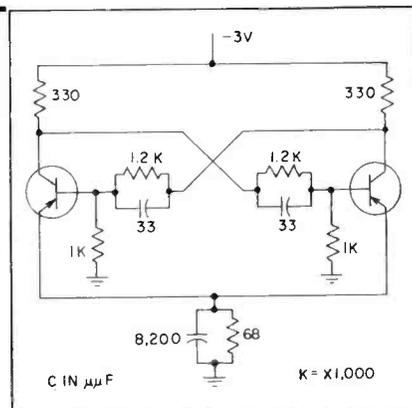


FIG. 4—Nonsaturating resistance-coupled flip-flop has d-c feedback

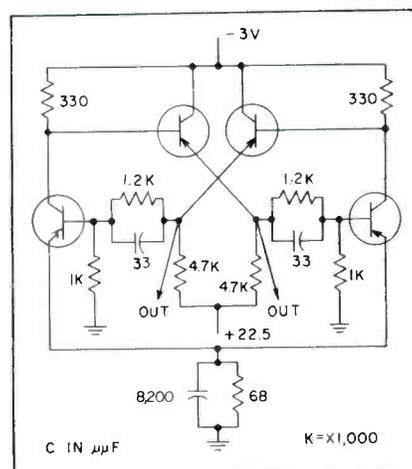


FIG. 5—Nonsaturating emitter-follower-coupled flip-flop uses emitter biasing

respect to the base to prevent saturation.

The nonsaturating, emitter-follower-coupled flip-flop shown in Fig. 5 also applies the emitter-biasing method of preventing saturation to the emitter-follower-coupled flip-flop.

The avoidance of saturation produces a reduction of more than 60 percent in the transition time of the resistance-coupled circuit. Prevention of saturation in the emitter-follower circuit results in an increase in speed to the extremely fast transition time of 22 millimicroseconds.

REFERENCES

- (1) R. H. Beter, W. E. Bradley, R. H. Brown and M. Rubinoff, Directly Coupled Transistor Circuits, *ELECTRONICS*, p 132, June 1955.
- (2) R. E. McMahon, Designing Transistor Flip-Flop, *ELECTRONIC DESIGN*, p 24, Oct. 1955.

Radar Performance Nomograph

SUMMARY — Pulsed radar performance is found in terms of percent of rated range available for a given radar target area when transmitted pulse width, average pulse power, minimum detectable signal and prf are known

RADAR PERFORMANCE can generally be determined by measuring the transmitted pulse width and pulse repetition frequency (duty cycle), the averaged transmitted power and the minimum detectable signal. With these measurements, this nomograph provides a rapid method of determining the performance of a pulsed radar in terms of the percent of rated range available for a target of given radar area.

(1) Connect the pulse repetition frequency on scale 1 with the pulse width on scale 3. The intersection of this line with scale 2 will be the duty cycle.

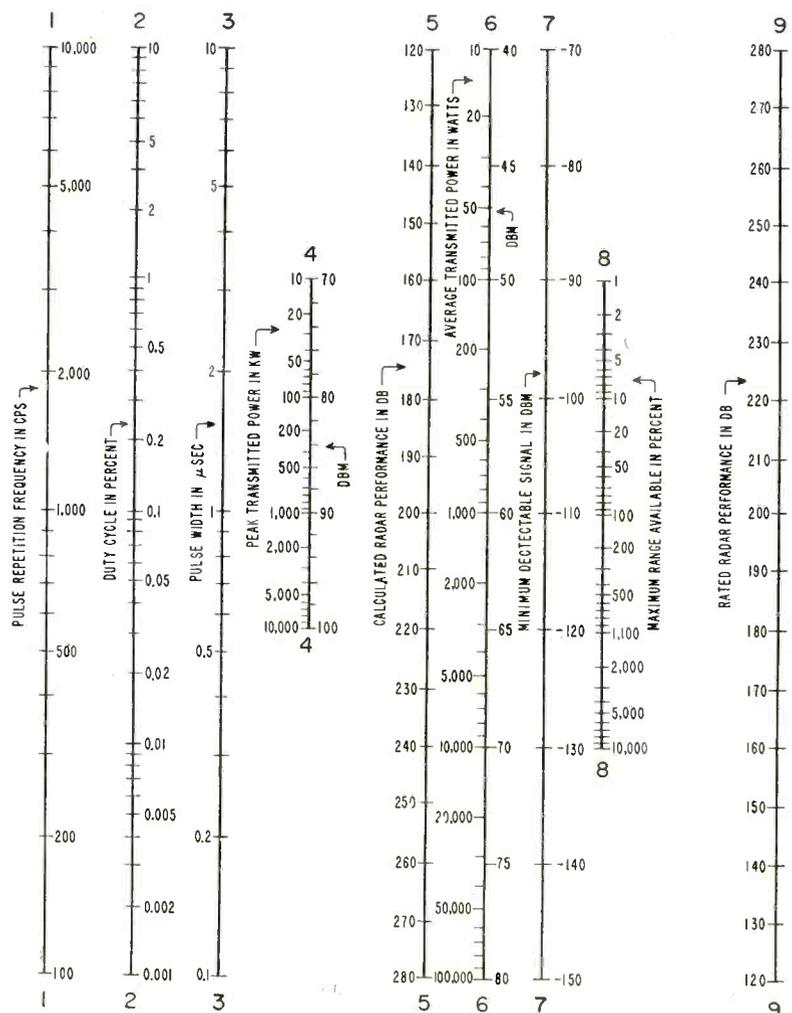
(2) Connect the average transmitted power on scale 6 with the duty cycle on scale 2. The intersection of this line with scale 4 will be the peak transmitted power.

(3) Connect the minimum detectable signal on scale 7 with the peak transmitted power on scale 4. The intersection of this line with scale 5 will give the radar performance figure.

(4) Connect the rated performance of the radar on scale 9 with the calculated radar performance found on scale 5. The intersection of this line with scale 8 will be the percent of maximum range available for a given target. For instance, if scale 8 is intersected at the 200-percent point, a target which would normally not be detected until it was 40 miles away can be detected at 80 miles.

By **EDWARD A. WOLFF**

*Maryland Electronic Mfg. Corp.
College Park, Maryland*



Universal Response Curves

By HERMAN I. LEON and HOWARD WEINBERGER

The Ramo-Wooldridge Corp.
Los Angeles, Calif.

SUMMARY — Graph showing spurious responses that may occur in wide-band uhf and vhf superheterodyne receivers aids in selection of intermediate frequencies and specifications for preselector selectivity

SELECTIVITY of superheterodyne receivers makes possible a high degree of protection from adjacent-channel interference. Unless the receiver is properly designed, however, it is possible for a signal not in the immediate vicinity of the dial setting to produce a spurious response.

It is possible, by proper choice of the intermediate frequency, to place these spurious response frequencies far from the dial setting. In this way, the preselector selectivity required for a given spurious response attenuation is minimized.

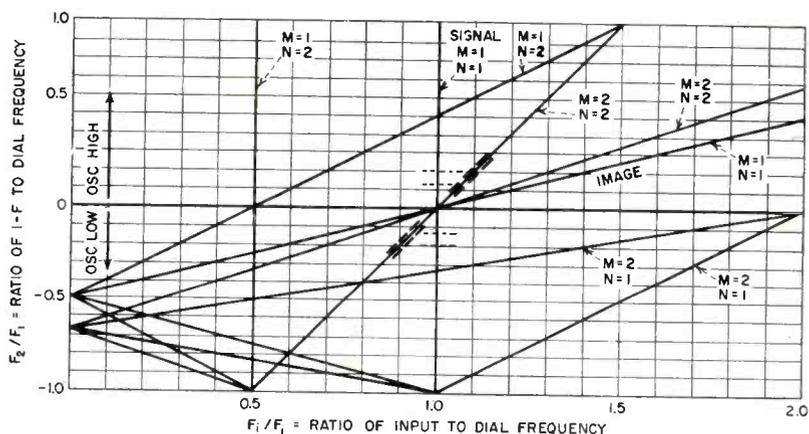
Equations

A spurious response is produced whenever integral multiples of the input and local oscillator frequencies differ by the intermediate frequency. The curves presented here show the strongest responses. Additional curves may be constructed for the higher-order responses from

$$\frac{F_2}{F_1} = \pm \frac{N}{M \pm 1} \frac{F_i}{F_1} - \frac{M}{M \pm 1} \quad (1)$$

where F_1 = dial frequency, F_2 = center of i-f passband, F_i = any input frequency, M = order of local-oscillator harmonic and N = order of signal harmonic.

This is the equation of a series of lines. For the local oscillator frequency above the dial frequency, only positive values of F_2/F_1 apply. For the local oscillator frequency below the dial frequency, only negative values of F_2/F_1 apply.



In the case of a receiver with a wide i-f bandwidth or one with a sweeping local oscillator, each line becomes a band whose boundaries are obtained by drawing two lines parallel to and equidistant from the original line. The displacement in the vertical direction from the original line is

$$\pm \frac{1}{2} \left[\frac{M}{M \pm 1} \frac{B_o}{F_1} + \frac{1}{M \pm 1} \frac{B_2}{F_1} \right] \quad (2)$$

where B_2 = i-f bandwidth and B_o = sweep band of local oscillator, if any.

Example

As an example, for a vhf receiver tunable from 100 to 150 mc and having a 20-mc i-f, the ratio F_2/F_1 ranges from 0.20 to 0.13 over the dial. Referring to the chart, it is seen that, for the local oscillator on the high side, the $M = 2, N = 2$ harmonic response will appear for input frequencies 6.5 to 10 percent above the dial frequency (about 10 mc

above the dial frequency). If a 2-mc i-f bandwidth is assumed, the bandwidth term, calculated from Eq. 2 and represented by the dashed lines, reduces this margin by about 1 mc. For a crystal mixer the $M = 2, N = 2$ response is normally attenuated about 35 db. If the dynamic range of the receiver is greater than this, r-f preselection is necessary.

Other harmonic responses at midband are $M = 1, N = 2$ at 50 percent and at 33 percent below the dial frequency, $M = 2, N = 2$ at 25 percent above, the image $M = 1, N = 1$ at 35 percent above.

For the local-oscillator frequency below the dial frequency, the closer harmonic responses appear for the image $M = 1, N = 1$ at 35 percent below the dial frequency, $M = 2, N = 2$ at 25 percent and at 5 to 9 percent below, $M = 2, N = 1$ at 50 percent and at 92 percent above dial frequency.

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We'll be glad to consult on your specific circuit requirements, and to send full technical data. Just write or call Mallory today.

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

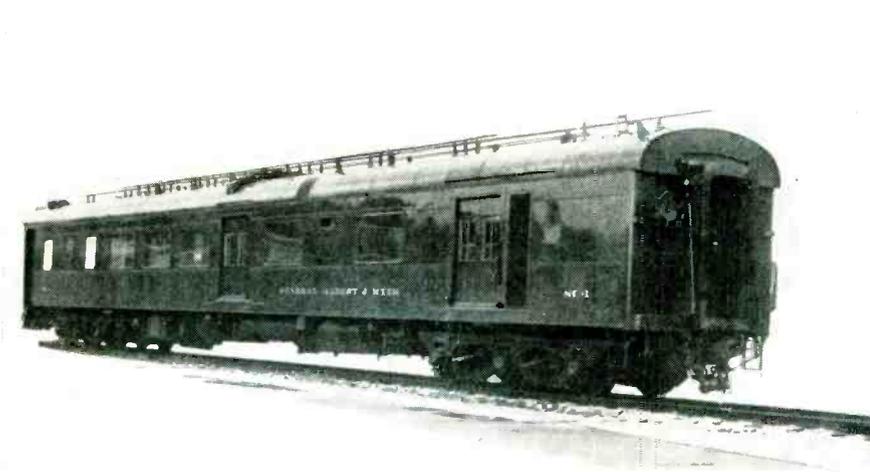
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White House Communications Car Tries Out SSB



White House communications car the *General Albert J. Myer* was recently used by amateur radio station W3WTE to try out single sideband radiotelephone equipment of a type that may later be used for point-to-point service under the call WTE. Permanent antenna shown atop the car (left) is a capacitance-feed grid net-

work that excites a field flowing in line of force to ground. The return circuit rises vertically on the car, making the car a non-directional vertical radiator. The master console (right) is control point for all types of communications equipment including radio teleprinter, mobile radiotelephone, public address and recording

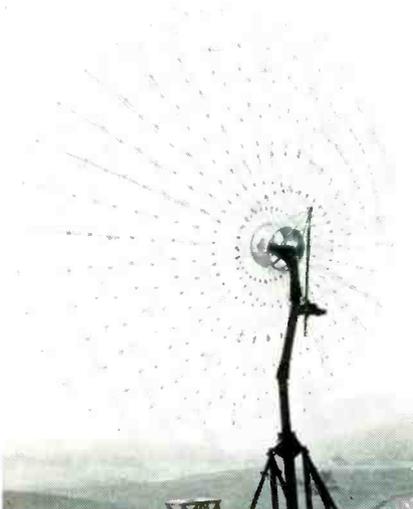
Upper Atmosphere Clutter Study On West Coast

FURTHER progress in the propagation studies being carried on by Stanford Research Institute (ELECTRONICS, p 192, Nov. 1956) is marked by completion of the field

equipment for investigating upper atmosphere clutter.

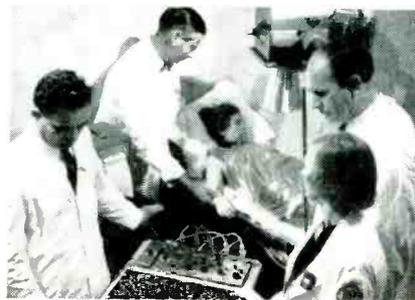
The antenna shown in the photograph is a 61-foot parabola of unusual design having a gain of 23 db

and beam width of 12 degrees at 100 mc. At 200 mc it has 30-db gain and 6-deg beam width. There is 36-db gain at 400 mc and 3 degrees between the half-power



Stanford antenna of novel construction nears completion at test site

Electrogastrograph Aids Stomach Diagnosis



Research team using the six-electrode gastrograph at Columbia-Presbyterian Medical Center in New York City. Patient swallows a small balloon to which the six electrodes are affixed. They contact the interior wall of the stomach. Another electrode is strapped to the patient's right forearm. Electrical change in the stomach is measured as a difference in potential between the inside stomach wall and the skin. Electronic engineer George B. Katz (right) built special preamplifiers to feed signals into a standard electroencephalograph unit that records impulses



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MODEL	Volts	Current	Regulation		Ripple	Recovery Time*	Stability For 8 Hours	Output Impedance		Dimensions			Price
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2600	0-60	0-2 Amp.	5 Mv.	5 Mv.	1 Mv.	50 μ sec.	10 Mv.	0.002 Ω	0.0005 Ω	19"	10 1/2"	17"	\$690
2650	0-60	0-5 Amp.	5 Mv.	5 Mv.	1 Mv.	50 μ sec.	10 Mv.	0.001 Ω	0.0002 Ω	22 1/2"	28"	19"	\$1190

Good stability
Fast recovery time
Low output impedance
Excellent regulation
Low ripple

POWER REQUIREMENTS: 105-125 volts, 60 cycles.
FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to prevent unregulated voltage from appearing at the output terminations.

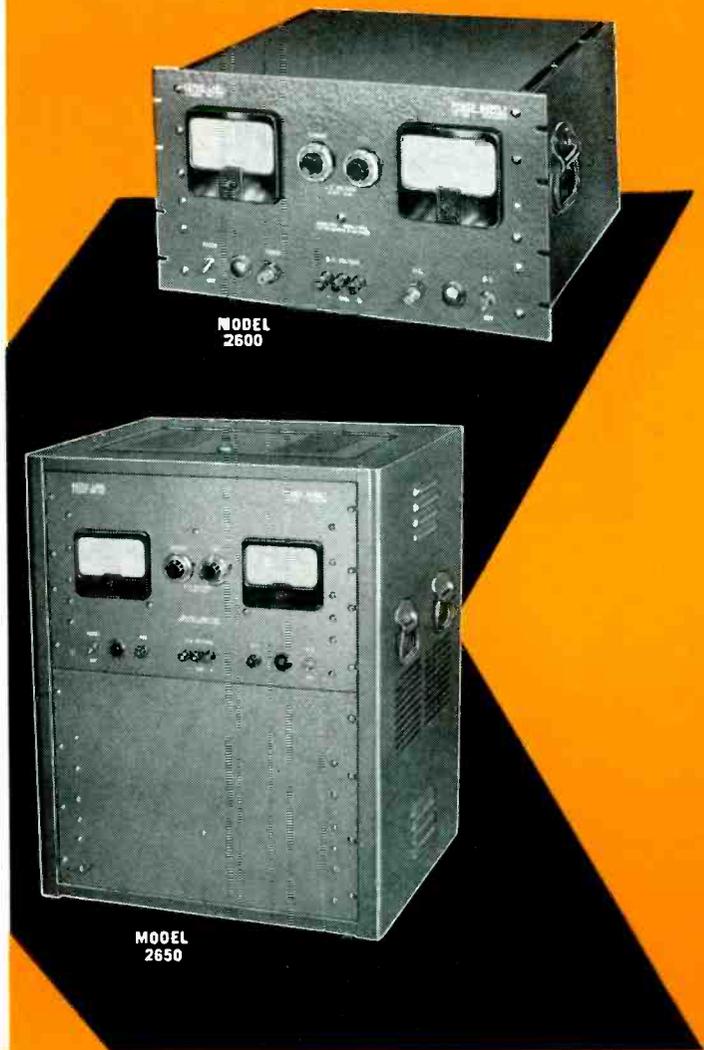
OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post is available for connecting to the chassis. All terminals are also brought out at the rear of the unit. Two terminals are mounted at the rear of the chassis to provide for picking up the error signal directly at the load. This connection compensates for the voltage drop in the wires (and ammeter) connecting the power supply to the load.

METERS: Ammeter: 0-2 amperes, 4" rectangular for Model 2600
0-5 amperes, 4" rectangular for Model 2650

Voltmeter: 0-60 volts. 4" rectangular

CONTROLS: Power on-off switch, DC on-off switch, remote error signal on-off switch, coarse and fine voltage controls. The coarse voltage control is a ten turn potentiometer which varies the voltage from 0-60 volts. The fine voltage control is a ten turn potentiometer which varies the voltage 1 volt. The voltage divider network allows a 61 volt variation in output voltage.

*Recovery time is less than 50 microseconds. The excursion in the output voltage during the recovery period is less than 50 millivolts for line fluctuations from 105-125 volts or load variations from 0-to maximum current.



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points of the lobe pattern.

A modified 50-kw transmitter is used at 100 mc. Pulse widths available can be varied from 50 μ sec to 1 sec. Pulse-rate frequency is variable between 1,500 and 0.1 cps. Multiple pulsing is possible with groups of four pulses available.

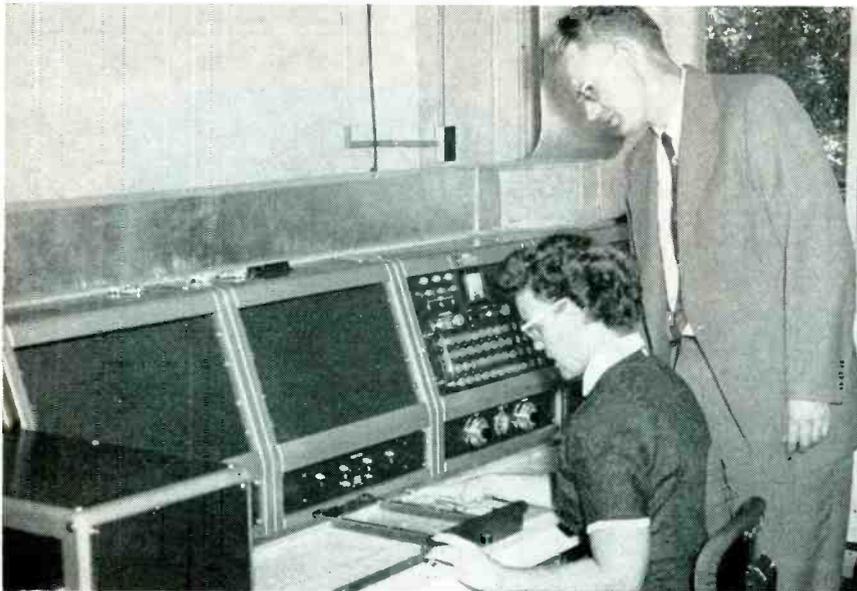
The receiver for 100 mc has a 3-db noise figure and variable bandwidth from 200 cps to 16 kc. Phase coherent detection is available to measure sign and magnitude of Doppler shifts.

The 200 to 400-mc transmitter uses an Eimac X590E klystron with 20-kw average power and 70-

kw peak power at 30-percent duty cycle. Pulse width and prf are the same as for the 100-mc equipment.

The receiver has a 3.5-db noise figure at 200 mc and a 4-db noise figure at 400 mc. There is 200-cps to 16-kc variable bandwidth as well as ability to measure Doppler shifts.

Digital-Analog Computer Evaluates Water Table



Geological Survey tries out new SURWAC computer on river gage height charts

FIRST engineering model of a surface water automatic computer (SURWAC) is undergoing evaluation tests by the U. S. Geological Survey. The machine has been designed to relieve scientific personnel from the chore of computation and likewise to speed the recovery of data that may have short-range significance.

Containing 440 electron tubes, the computer also employs a mechanical scanning disk and chart-drive mechanism. Discrete values represented by pulses are handled by the digital section and physical quantities are handled as analogs.

► **Operation**—The computer scans the chart from one of 7,000 river-gage stations to determine gage height in intervals of 1/100 day. These data it adds in digital form and strikes a daily mean gage height.

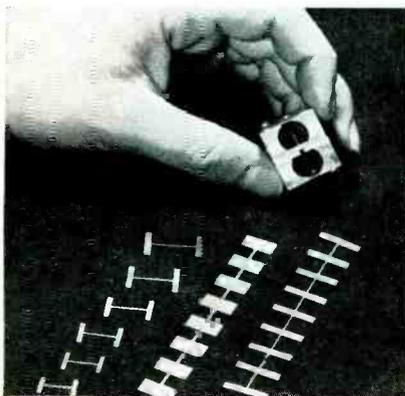
Rate of flow at the time of each reading is computed in a function generator and converted to digital form. Average daily flow is then determined. These two sets of daily figures on punched tape are used to make additional analyses that are valuable in flood control, power potential and other studies.

Compatible Single Sideband

ADVANTAGES of single-sideband radiotelephone transmissions include halving bandwidth otherwise required for conventional a-m, signal-noise improvement and elimination of selective fading.

Halving receiver bandwidth de-

Magnetostriction Filter Cuts Interference



New filter operating on magnetostriction

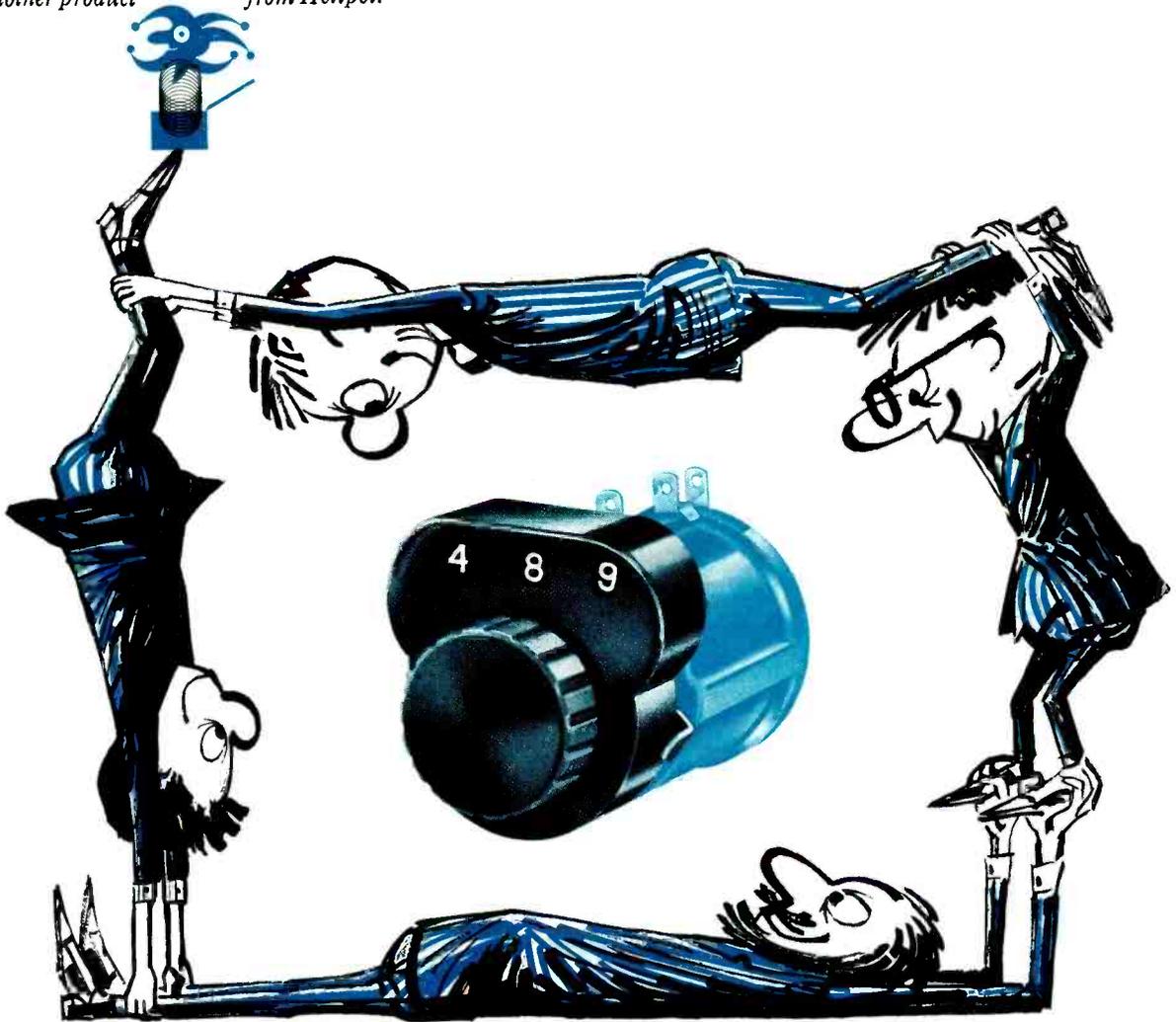
DESIGNED for low-frequency operation, a new magnetostriction filter has been developed by Federal

Telecommunication Laboratories, IT&T affiliate. It comprises a strip of Ni-Span C alloy in form of a row of six or seven rectangles a half by a quarter inch on a side connected by $\frac{1}{8}$ inch strips a half inch long.

The filter is stamped from a single piece. Such economical construction contrasts with earlier techniques that required fastening a series of disks together and mounting on a brass base.

Selectivity of the filter is determined by the size of the rectangles, which are made resonant at a quarter wavelength of the desired frequency.

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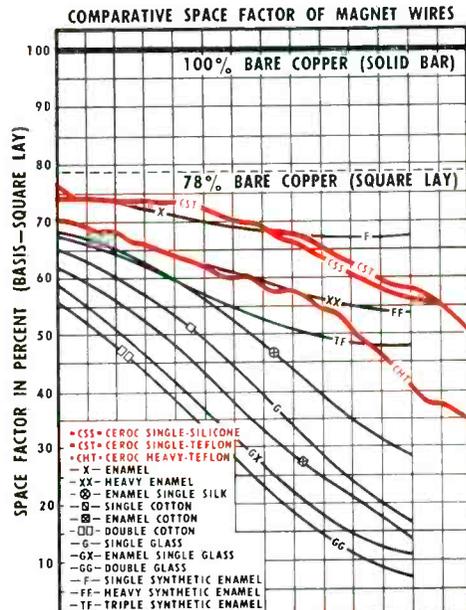
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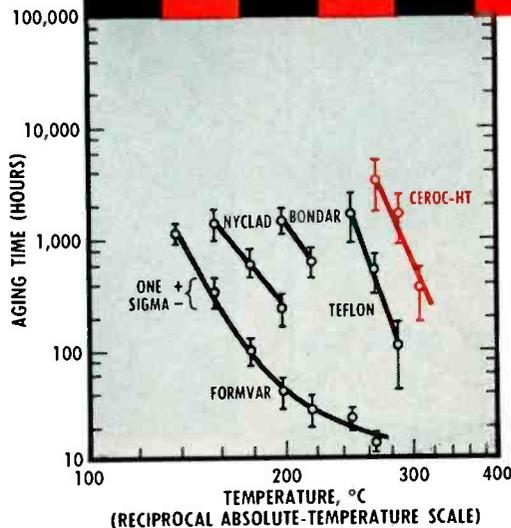
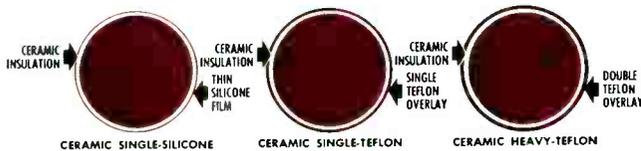
There are three standard Cerroc Wires: Ceramic Single-Teflon and Ceramic Heavy-Teflon for operation at 250°C feature unique characteristics of flexibility, dielectric strength and resistance to moisture. They have been used successfully to 300°C in short time military applications. Ceramic Single-Silicone, for 200°C application, pairs the ceramic with a silicone reinforcement to facilitate winding.

All three Cerroc Wires have far superior cross-over characteristics to all-plastic insulated wire—all provide an extraordinarily high space factor that facilitates miniaturization with high-reliability standards.



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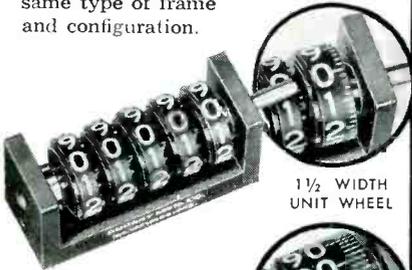
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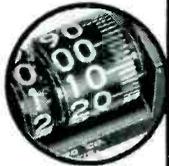
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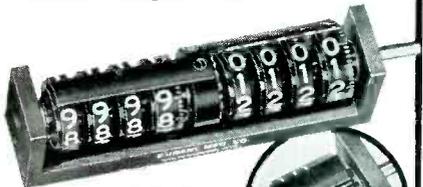
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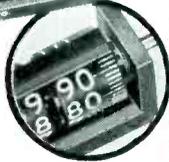
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envelope wave is free of harmonic distortion. Therefore, at the receiver, a diode detector will produce essentially zero distortion at 100-percent modulation. A conventional a-m receiver can be utilized.

The undesired sideband is about 30 db below the desired. Oscilloscope patterns seem to show a pure a-m wave, using linear sweep, but actually the wave is single-sidebanded.

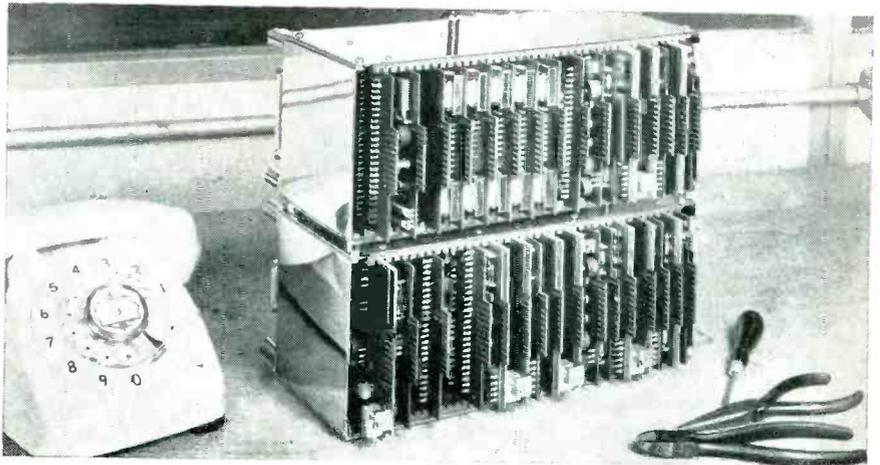
In terms of average power, it would take a full kilowatt single-

sideband full carrier signal to equal a 187-watt average power compatible single-sideband wave.

A full account of this system is to be published in the Transactions of the Professional Group on Aeronautical and Navigation Electronics (Institute of Radio Engineers).

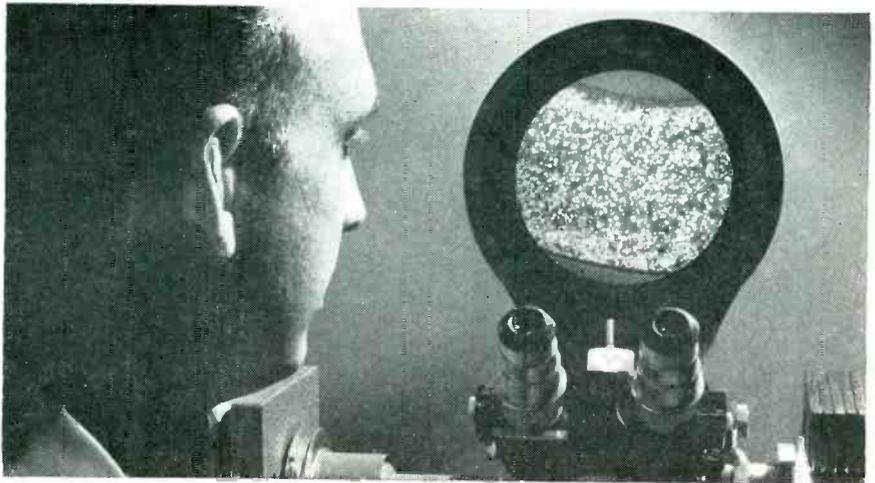
Voice of America has recently announced successful use in Europe of compatible single-sideband modulation equipment furnished by Kahn Research Laboratories of Freeport, New York.

Transistor Telephone Exchange



Display model of 10-line telephone exchange exhibited by Automatic Electric employs transistors instead of electron tubes and printed circuits instead of conventional wiring. Tone signaling replaces bells. Still experimental, the electronic switching system is expected to operate a thousand times faster than electromechanical relay equipment and take much less space

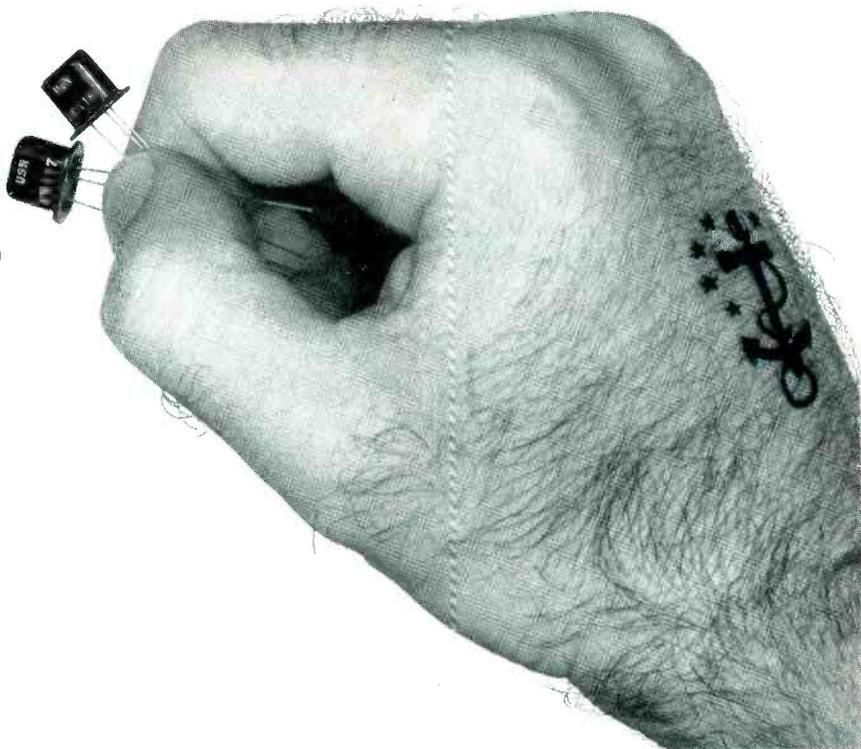
Square Loop Ferrites Used In Memory Toroids



Grain structure of a ferrite is magnified 300 times and projected on a viewing screen by GE scientist R. W. Johnston. Rings of the material having a diameter of 1/125 inch are now in use for electronic computer memories

(Continued on page 194)

FIRST silicon transistors meeting NAVY SPECS



For *reliability* under *extreme* conditions . . . design with TI's military silicon transistors . . . built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS) and MIL-T-19502 (SHIPS), these welded case, grown junction devices furnish the tremendous savings in weight, space and power you expect from transistorization . . . *plus* close parameter control

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degradation rate tests for TI's USN-2N117 and USN-2N118 silicon transistors

test	condition	duration	end point at 25°C
lead fatigue	three 90-degree arcs	—	no broken leads $I_{CO} = 2\mu A$ maximum at 5V $h_{OB} = 2\mu mhos$ maximum $h_{FB} = -0.88$ minimum for 2N117 $h_{FB} = -0.94$ minimum for 2N118
vibration	100 to 1000 cps at 10 G	3 cycles, each x, y, and z plane	
vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	
temperature cycle	-55°C to +150°C	10 cycles	
moisture resistance	MIL-STD-202	240 hours	
life, intermittent operation	$P_c = 150$ mW, $V_c = 30$ V	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	no mechanical defects interfering with operation
salt spray	MIL-STD-202	50 hours	

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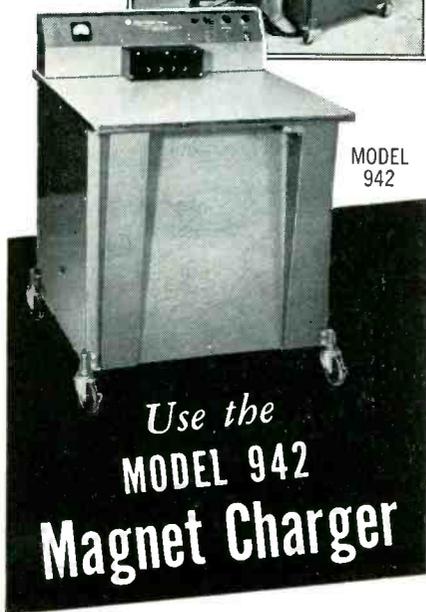
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Operates from regular 115 volt, 60-cycle line with only intermittent 10-ampere drain (the few seconds when condensers are charging). Mounted on casters for convenient mobility. Price of basic unit with pulse transformer is less than \$2,000.



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Germany's First Radio Telescope



The parabolic mirror pointing upward is installed on Mt. Stockert near Muenstereifel, Germany. Mounted on a cement tower 17 meters high, the huge dish has a diameter of 25 meters. Maximum deviation from the mathematical parabola is 5 millimeters. The mirror is comprised of light metal sheet with about 70 percent of its surface punched out, thus reducing weight, effects of thermal radiation and cutting wind resistance by a fifth. The directive antenna and its associated electronic equipment, built by Telefunken, will be used to map hydrogen gas zones through reception of 1,420 mc signals

Direct Reading Pulse Counter

BY C. N. WILLIAMSON

Project Engineer
Airpax Products Co.
Baltimore, Md.

SHOWN in Fig. 1 is a circuit that provides instantaneous indication of pulse repetition rate from 0 to 5 kc. Interchanging tubes or varying the B supply from 200 to 250 volts has little effect on the frequency indication. An overall accuracy of ± 2 percent of full scale is readily obtained; with a more accurate indicating instrument, the circuit can be calibrated and expected to retain an accuracy of better than 0.25 percent of full scale.

► **Mode of Operations**—The pulse rate counter consists essentially of three stages. The first stage, which uses a dual triode 5963, is a binary counter. The second stage, a 12AT7, is a driver stage and the third stage is an Airpax ferromagnetic frequency detector¹, called a Magmeter detector. This latter stage provides the essential stability of the pulse rate counter.

The waveforms of Fig. 2 describe

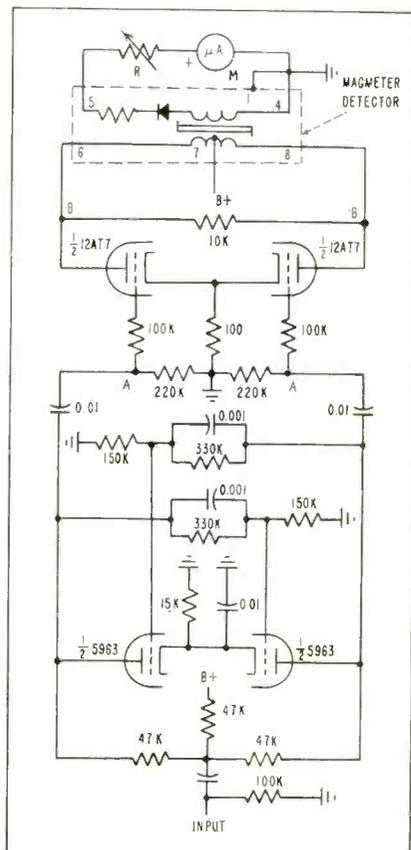
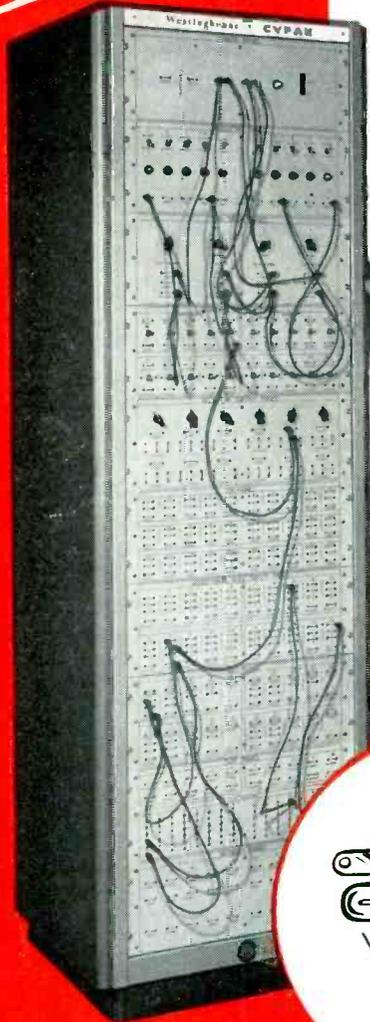


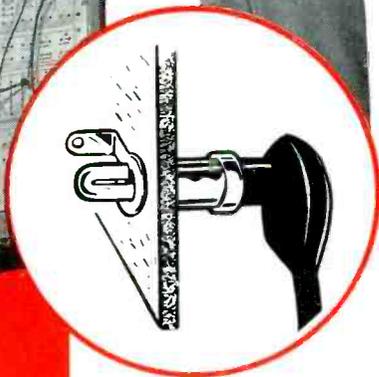
FIG. 1—Pulse repetition rates from 0 to 5 kc are shown on the meter

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Accuracy!*



*Trade Mark

Magnified view shows how the *Interlock Type "A" Plug*, used in the Cypak Problem Simulator, locks into built-in panel eyelets. Double-ended Jumper Cords are available in standard lengths from 6" to 36" or longer if specified.



HUBBELL *Interlock* PLUGS

provide a dependable, low contact resistance Jumper System for

CYPAK*

THE REVOLUTIONARY, NEW

Westinghouse

System Control

The unique Cypak System introduces *static control*—with life at least 15 times that of conventional relays—from units that fit in the palm of your hand, and which have no moving parts to wear or erode. Using a logic function approach, decision elements are jumpered together by automatic locking *Interlock Plugs and Jumper Cords*, which afford a constant low contact resistance. *Interlock Plugs* were also specified by Westinghouse, because eyelets were simple to install in quantity within a small area.

Just as Cypak offers a longer life and a higher degree of reliability than conventional relays, so Hubbell *Interlock Plugs* offer more dependable connections, through a *locked contact*, than other connectors on the market.

For Further Information, Write Dept. C



HARVEY HUBBELL, INC.

Interlock Electronic Connector Dept., Bridgeport 2, Conn.



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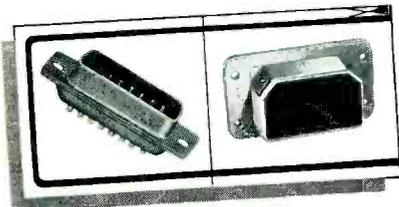
New Material on

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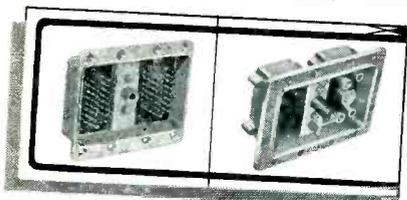
Rack-Panel-Chassis

CONNECTORS

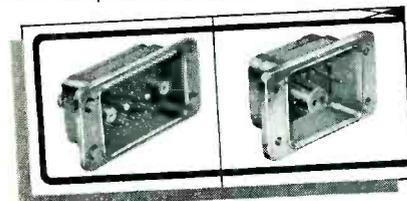
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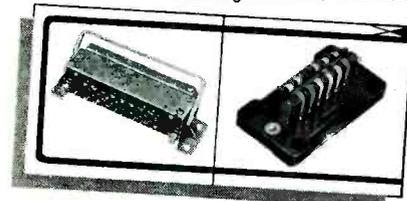
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Write for New DP9 Bulletin—a new kind of engineering bulletin. Please refer to Dept. 120



CANNON PLUGS

CANNON ELECTRIC CO., 3209 Humboldt St., Los Angeles 31, Cal.
Want more information? Use post card on last page.

the operation of the circuit. An input pulse (A) triggers the binary counter to generate a balanced square wave (B). Consider first the waves shown by the solid lines. The square wave is further amplified by the driver stage and applied to the magnetic detector.

The detector comprises a transformer, rectifier and resistor. The transformer core has a square hysteresis loop characterized by abrupt saturation and high retentivity. The input signal from the driver stage is more than sufficient to saturate the core. Until the core saturates, the transformer presents a high inductive impedance to the driver (about 200,000 ohms between terminals 6 and 8). The driver is thus able to develop substantial voltage across the transformer.

When the core saturates, the input impedance of the detector drops to the copper resistance of the transformer primary. The output voltage (C) from the driver abruptly falls nearly to zero and remains there until the square wave reverses polarity.

► **Frequency Detector**—Saturation of the transformer core provides a

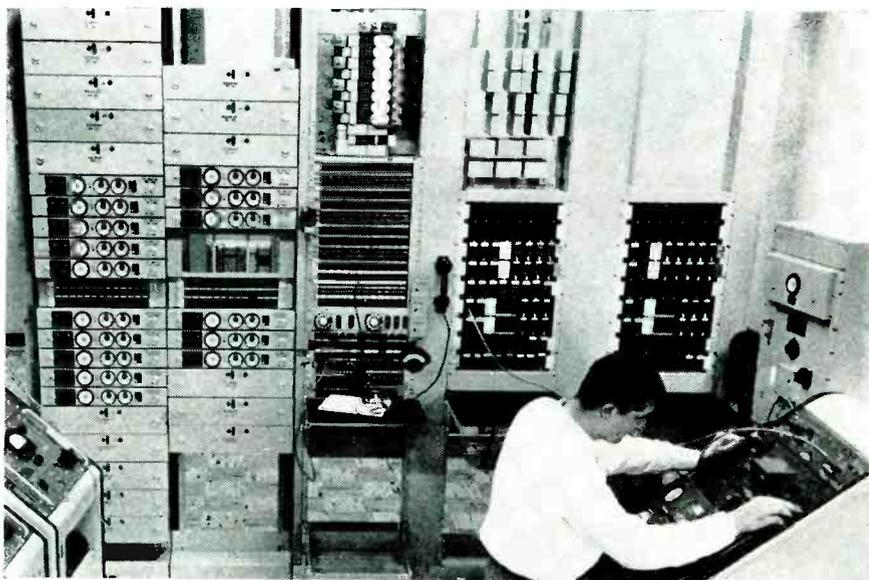
flux metering action that enables the overall circuit to retain its accuracy despite wide fluctuations in supply voltages and environmental conditions. This is accomplished as follows. In driving the core heavily into saturation on one half cycle, the driver stage establishes a magnetic reference within the core. On the next half cycle, the driver swings the core into saturation in the opposite polarity.

As the flux traverses from saturation in one polarity to saturation in the opposite polarity, a voltage pulse is induced in the transformer secondary winding. Because the core was initially saturated in one polarity and is driven into saturation in the opposite polarity, the total flux change is constant and dependent only on the invariant magnetic properties of the transformer core.

These properties determine the overall performance of the circuit, hence it maintains its calibration for long periods despite unfavorable environments. As a consequence, the ferromagnetic detector is used as the basis for simple frequency meters and tachometers².

The output pulse is, therefore, of constant volt-second area, regard-

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Western terminal equipment at Clarenville, Newfoundland of submarine cable that links North America with British Isles. Increased use of radiotelescope circuits and occasional radio blackouts made use of cable necessary. Fifty-one vacuum-tube repeaters built into the cable amplify signals every 40 miles. The facility is operated by Eastern Telephone and Telegraph Co., a Canadian subsidiary of A. T. & T.

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change of no-load to full-load and for supply-voltage
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(no-load to full-load or full-load to no-load)
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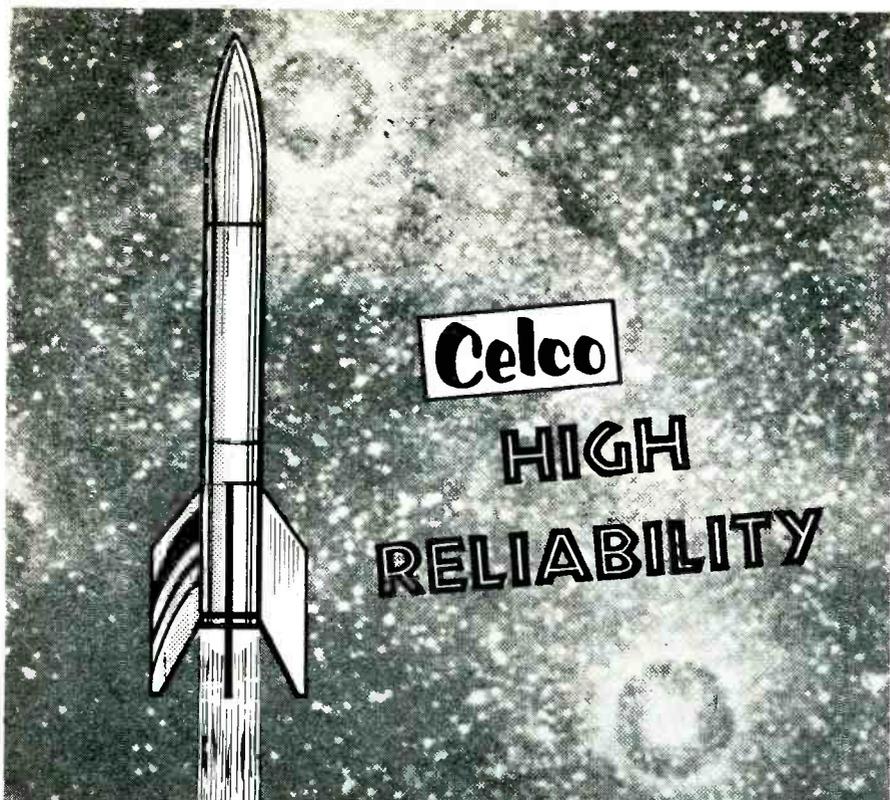
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less of waveshape, frequency and other operating and environmental conditions—the only requirement is that each half cycle of input power be sufficient fully to saturate the core. The driver stage provides the required 1 watt of power to operate the magnetic detector.

These metered secondary pulses are rectified by the diode in the detector to produce a unidirectional pulse output. There is one pulse for each cycle of input square wave with a half-wave rectifier as shown in Fig. 1, or two pulses per cycle with a full-wave rectifier. The internal precision resistor gives the detector output somewhat the characteristic of a constant-current generator as seen by the meter load on its output. Thus, the meter current (D) consists of a series of pulses of constant ampere-second area.

If the signal input increases, the core saturates earlier in the cycle and traverses the active portion of the core characteristic faster. As a consequence, the output current

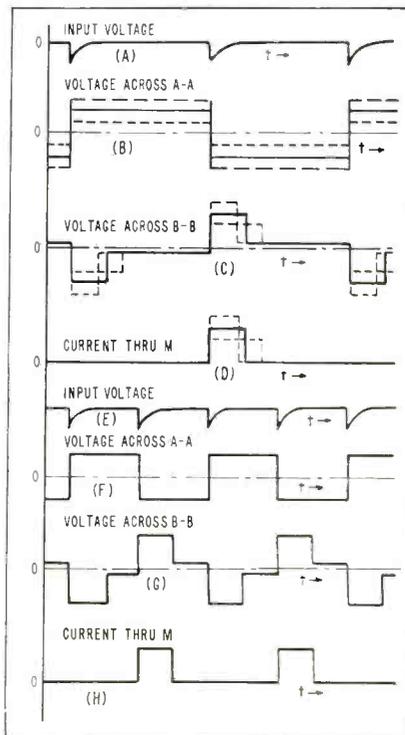
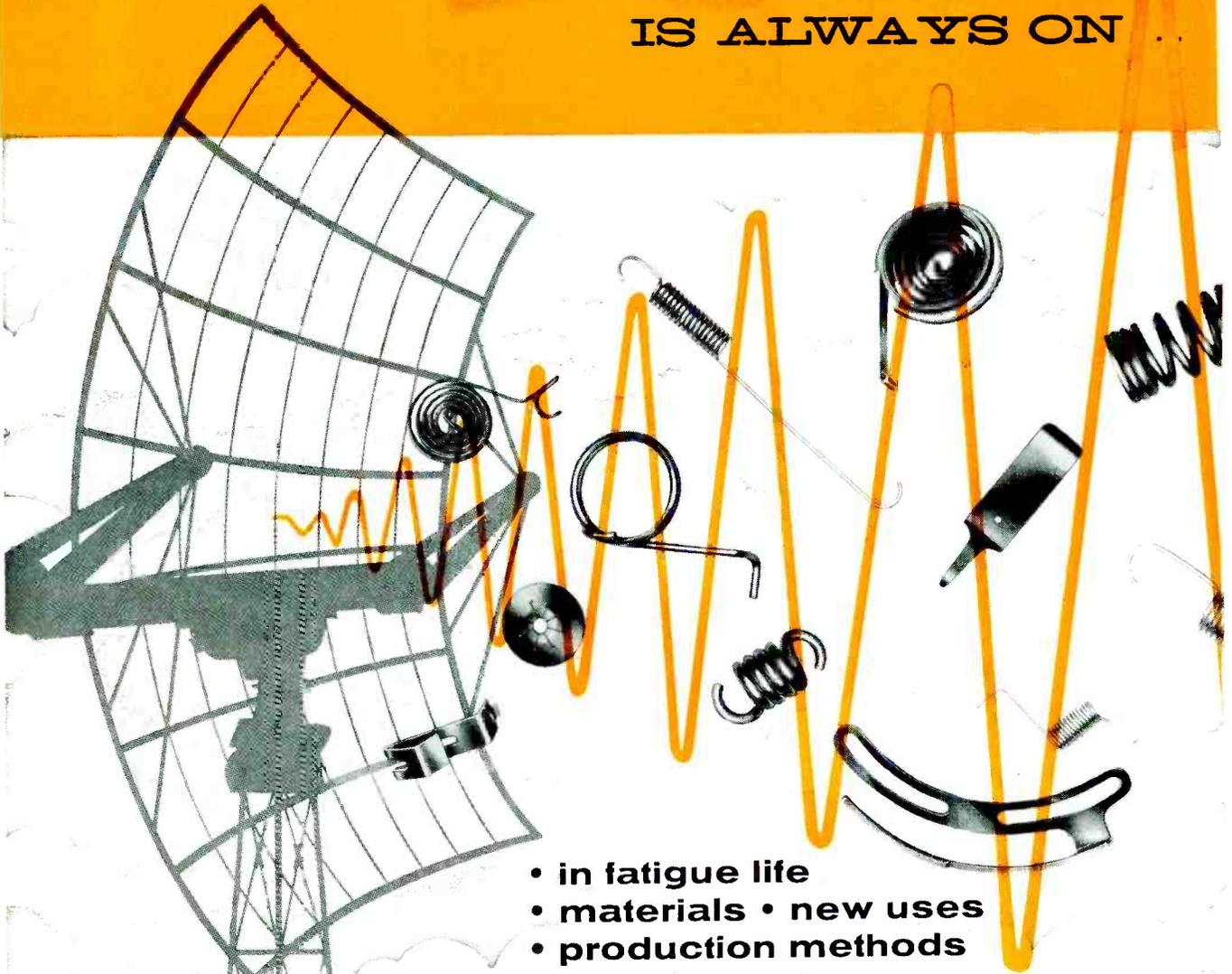


FIG. 2—Waveforms appearing at various points of Fig. 1

pulse is shorter but of greater amplitude and of the same ampere-second area as shown by the dashed waves of Fig. 2. If the input decreases, the output pulse is longer

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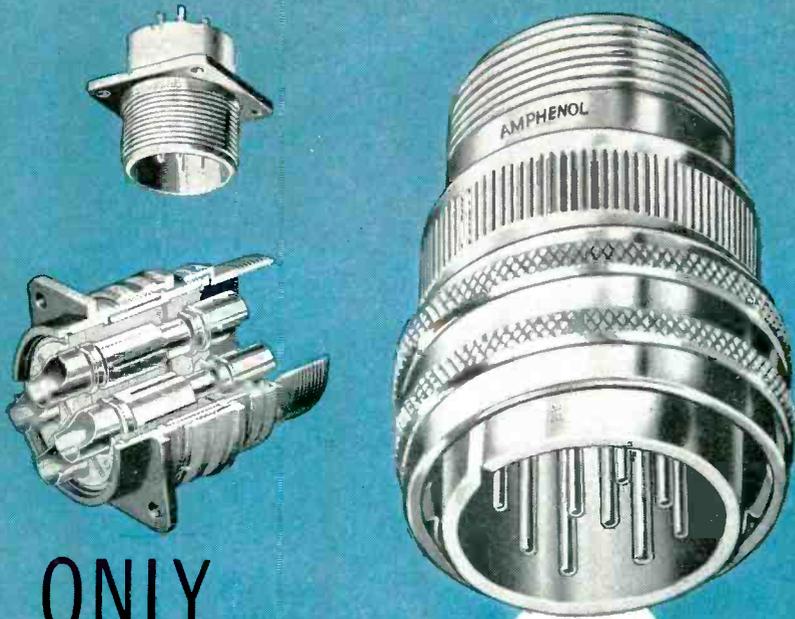
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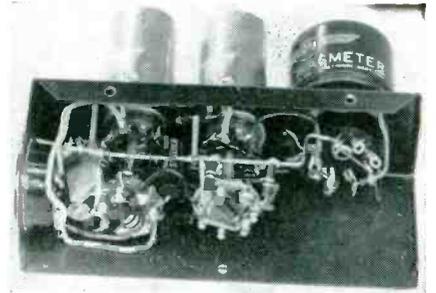
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but of lesser amplitude as shown by the dotted waves of Fig. 2.

If the input pulses arrive faster (E), the same action takes place throughout the circuit but at the faster rate (F) and (G). The output current pulses are still of the same current-second areas as at the other pulse rate. Thus the energy delivered to the indicating instrument is highly linear with frequency.



Underchassis view of the simple frequency meter

The indicating instrument *M* serves as an averaging device to provide a steady indication from the constant ampere-second pulses. It is, therefore, a d'Arsonval movement.

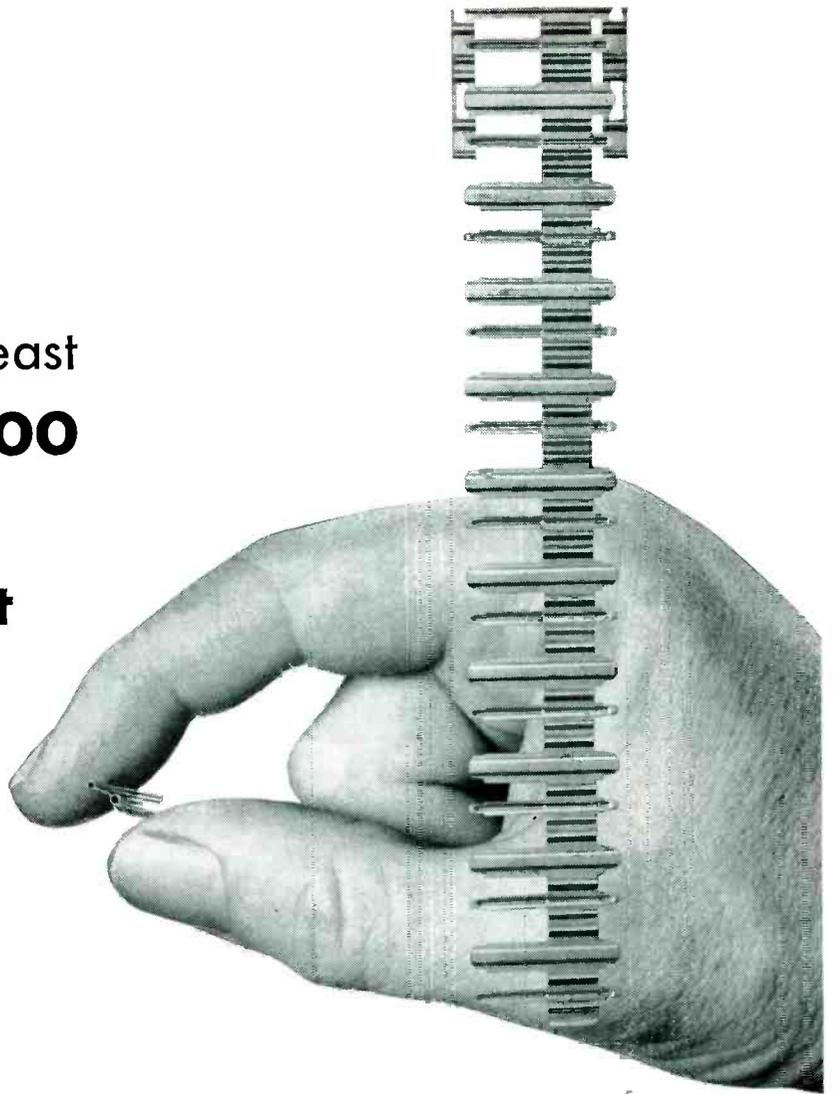
► **Circuit Requirements**—The characteristics of the magnetic frequency detector determine the requirements for the rest of the circuit. The foregoing description shows that a unidirectional pulse could not operate the magnetic detector properly. Furthermore, even if the original pulse were balanced about ground, if it were short it would need to be of such amplitude as to produce negative pulses in the transformer secondary that would exceed the rated inverse peak voltage of the diode rectifier.

Also any substantial component of direct current in the input to the detector tends to bias its core thus requiring a larger a-c component to produce flux traverse and saturation. The signal power delivered to the detector by the driver is sufficient to overcome usually encountered unbalances in plot current between halves of the 12AT7.

The binary flip-flop is thus required to perform two functions, to stretch the pulse, and to develop a

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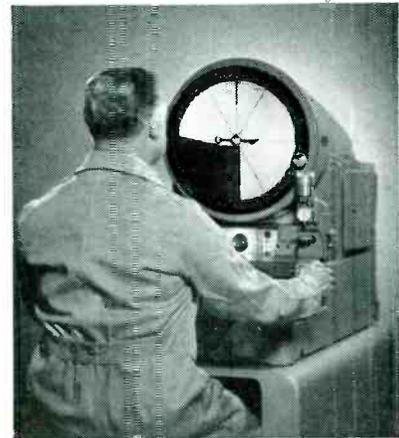
The Metal Stampings Plant, Sylvania Electric Products, Inc., keeps rejects under 2%—even on complex, close-tolerance parts produced at rates to 9,000 per hour. Optical gaging helps set this level.



The diode plate shown above is an example of the complex, mass-produced, parts turned out to close tolerances by The Metal Stampings Plant, Sylvania Electric Products, Inc., at York, Pennsylvania. Tolerances run to $\pm .001$ "; as many as 10 dimensions must be held, including inner and outer diameters. Yet even on parts more difficult than this—parts with tolerances of $.0005$ " and forming rates of 9,000 per hour—Sylvania gets an acceptance rate of over 98%.

Inspection on Kodak Contour Projectors helps Sylvania do the job to the satisfaction of its customers, both internal and external. Operators check the first parts produced by every machine to assure correct setup. Then, throughout the run, production samples are checked at regular intervals—making certain each machine is holding to tolerance. The speed with which these parts can be checked using optical gaging methods has helped slash rejection rates more than 50% since Kodak Contour Projectors were installed.

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The MR 532-15 is short circuit-proof. When short circuited, line current is automatically limited, protecting power supply from internal damage. Normal operation is resumed automatically—no re-setting of switches, no fuses, no downtime. **Extremely wide voltage range** is accomplished by means of static magnetic circuitry.

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Model MR 532-15/SPECIFICATIONS

Type: Dual magnetic regulated
Input: Voltage Range 80-150V
Frequency Range 57-63 cps
Output: Voltage Range 5-32V DC
Extended Range 3-36V DC
Current Range 0-15A DC
Short Circuit Current 30A DC
Voltage Adjustment: Continuous with vernier.
Ripple: less than 50 millivolts
entire voltage range
Response time: less than 25 milliseconds for
line transients
max. 150 milliseconds for
load transients

Size: 17.5" w x 12.5" h x 15.5" d (also
avail. for 19" st'd rack mt.)

Weight: 150 #

REGULATION

Static:	Dynamic:
$\pm 1/4\%$ for 80-150V line change	less than 1% for 10% line transient
$\pm 1/2\%$ for 0-15A load, 5-32V range	less than 1.5V for 10% load transient
$\pm 1\%$ for extended voltage range	

Table I—Typical Detector
Ratings

Frequency range in cps	Full scale output in μA	Total load resistance in ohms
0-500	500	850
0-100	100	3,125
0-1,000	1,000	325
0-2,000	200	2,100

ation will be exactly one-half the pulse repetition rate. Higher pulse rates can be measured by further scaling down the repetition rate.

Full-scale output currents show the sensitivity of indicating instrument used with each detector. Total



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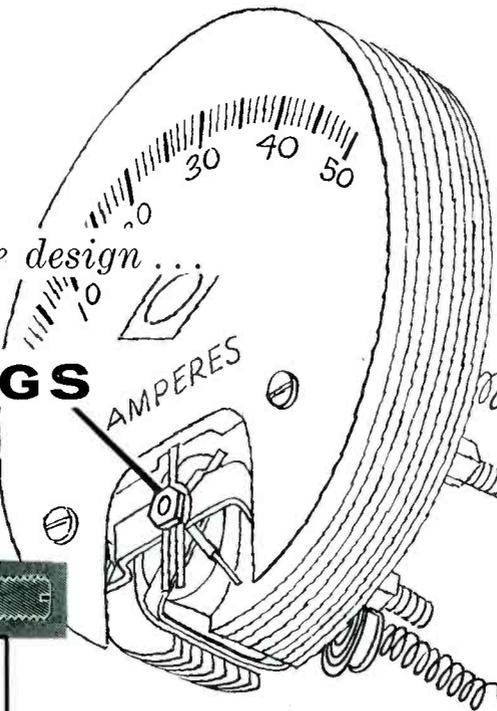
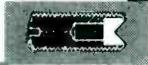
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load resistance includes the internal resistance of the indicating instrument M plus the calibrating rheostat R . The rheostat compensates for production variations between detectors and for variations in sensitivity and resistance of indicating instruments.

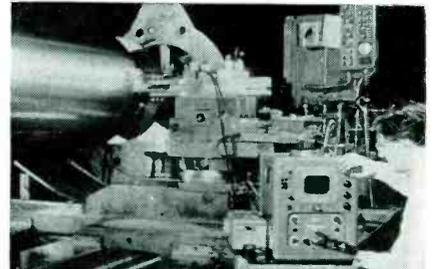
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- (1) Microammeter Measures Frequency, *ELECTRONICS*, p 216, Apr. 1956.
- (2) Henry W. Patton, An Accurate Magnetic Tachometer, *Proc NEC XI*, p 183.

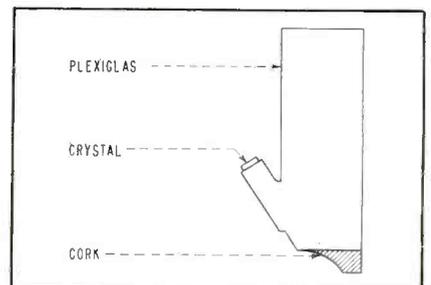
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When testing thin-wall pipe in



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Delayed shear-wave transducer used to check thin-wall pipe

which defects are necessarily close to the outer surface, the main bang normally obscures nearby echoes. To suppress this initial pulse a delayed shear wave transducer has been designed.

As shown in the figure, the Plexiglas line shown at the left between

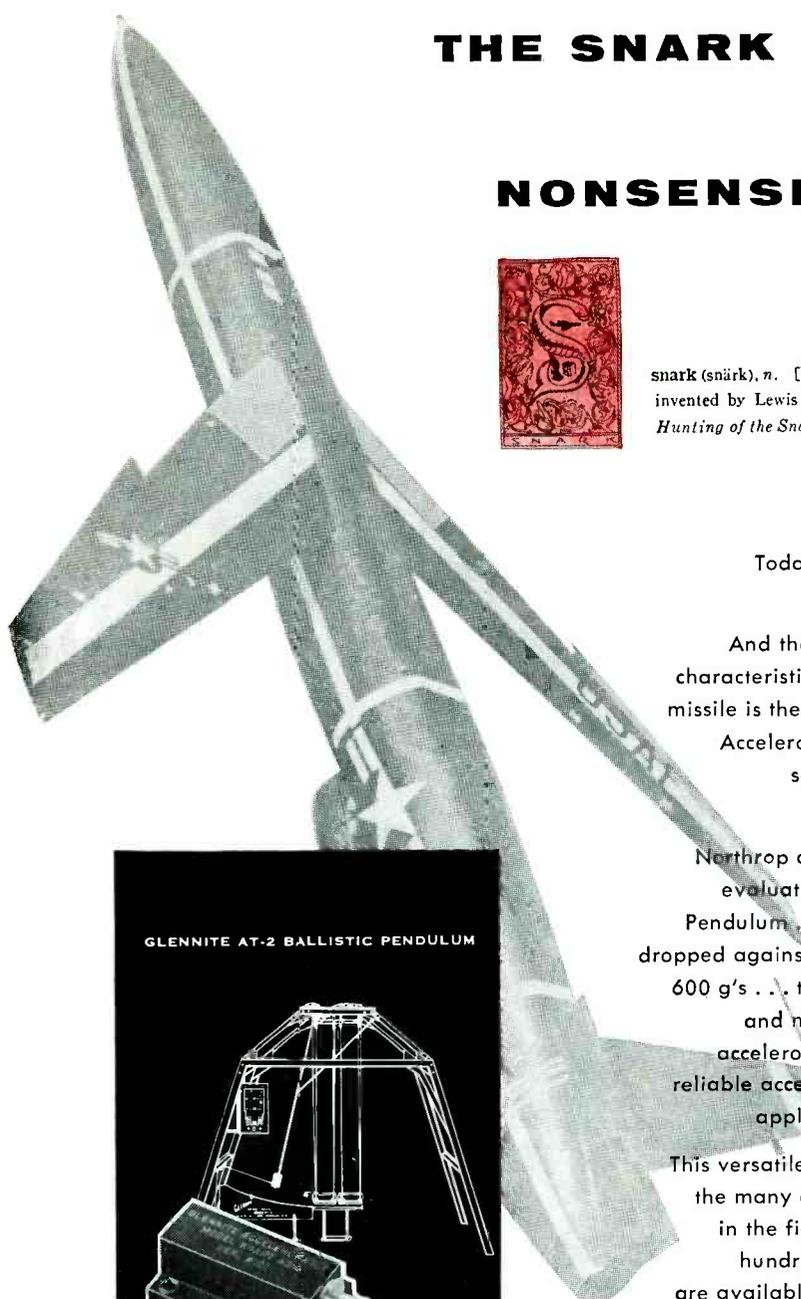
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snark (snärk), *n.* [A blend of *snake* and *shark*.] A nonsense creature invented by Lewis Carroll (Charles L. Dodgson), in his poem, *The Hunting of the Snark* (1876).



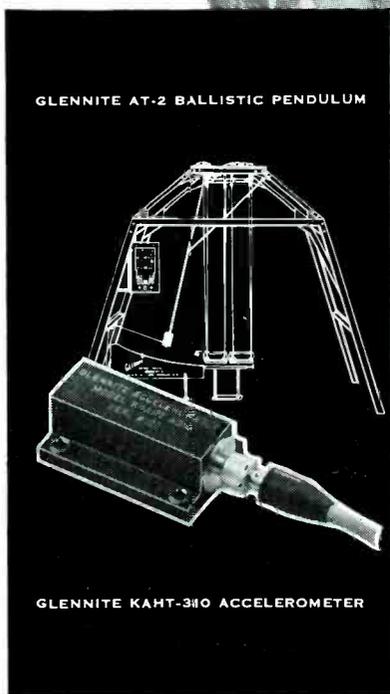
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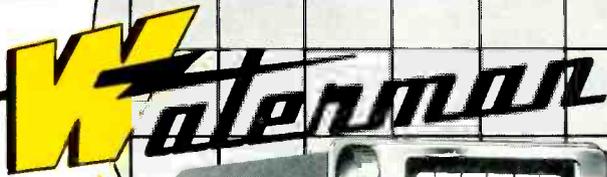


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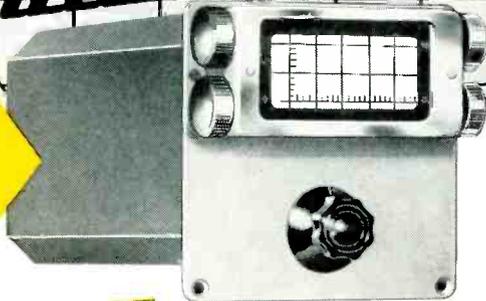
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crystal and work allows time for ringing in the amplifier to damp out while the absorption path at the right absorbs echoes of the initial pulse that occur at the interface and prevents them from returning to the transducer.

Defects within 1/32 inch of the surface can be detected by this device. The cork tip indicated wipes off oil to leave a uniformly thin film for coupling.

This information has been abstracted from a paper presented by R. G. Goldman of GE at the recent Industrial Electronic Symposium held at Cleveland.

Curved Passive Reflector

By EDWARD BEDROSIAN

*Motorola Inc.
Riverside, Calif.*

DEVELOPMENT of microwave systems for radar use during world war II gave impetus to the establishment of point-to-point communications systems using microwave beams rather than wire lines as carriers.

Line of sight propagation usually requires that a path be divided into links which vary in length from 20 to 50 miles. Problems considered are terrain, power facilities and station accessibility.

Tower heights at terminals are selected to provide proper ground clearance. Since the operating frequency is known nominally, the selection of the proper antenna system completes the design.

Early systems used antenna pairs atop the towers which were made as tall as possible to increase range. The engineer was faced with the choice of strengthening the tower to mount transmitting and receiving equipment at the top (increasing cost considerably) or placing the equipment at the base of the tower and accepting transmission-line loss. The problem is neatly circumvented in modern systems by placing both the equipment and the directional antenna at the base of the tower, and illuminating a passive reflector at the top.

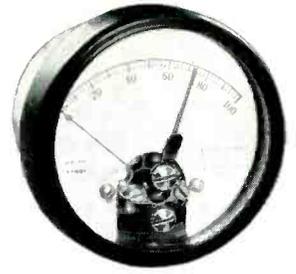
The primary radiator is a horn-

METER-RELAYS: Construction and Operation

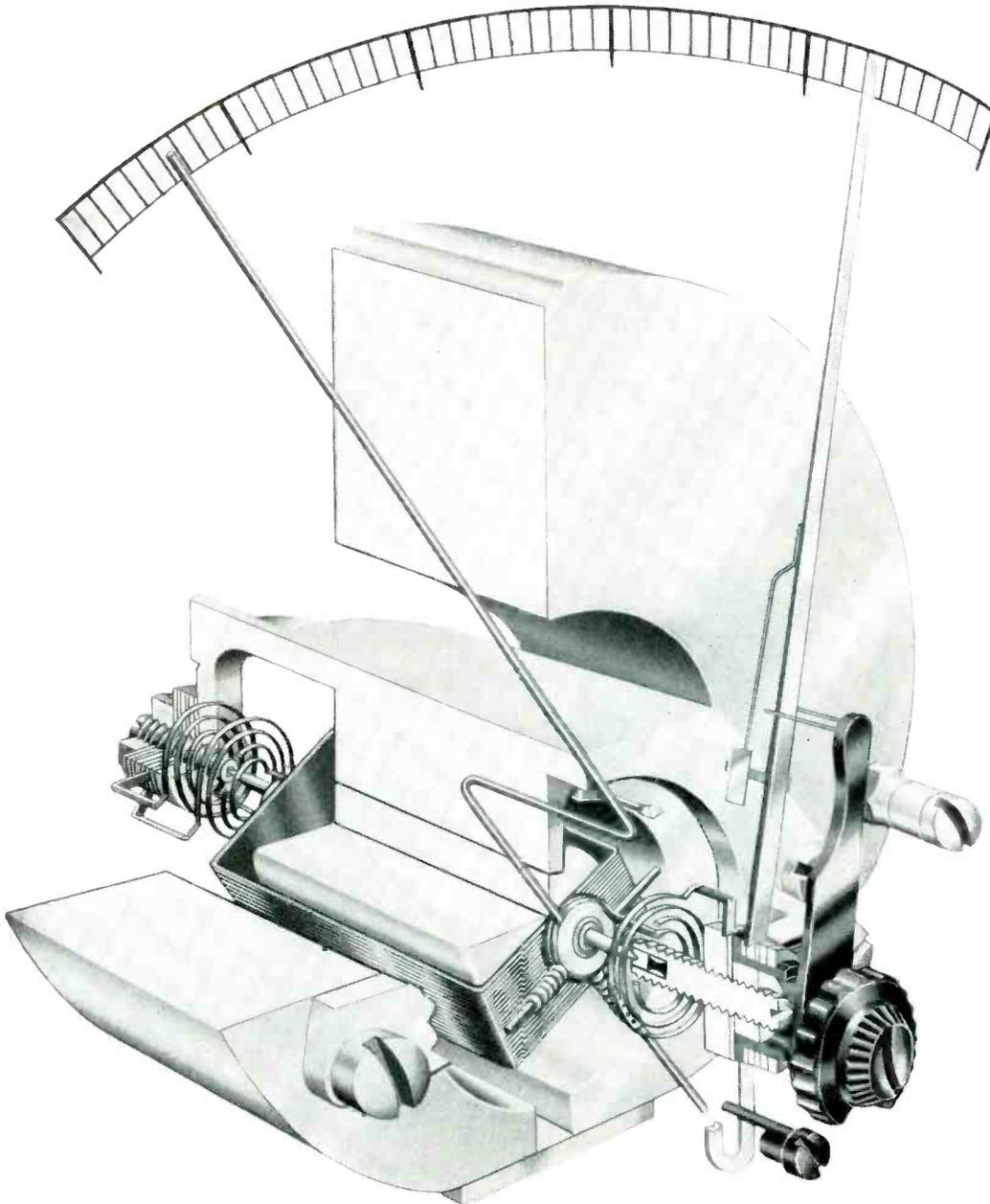
Adjustable pointer with plate contact, foreground, is mounted in bracket. Moving pointer, with contact, is part of conventional D'Arsonval-type meter movement. The moving coil and pointer assembly is pivoted in cushioned jewels, and rotates in the flux of a permanent magnet. The coil is connected to hairsprings.

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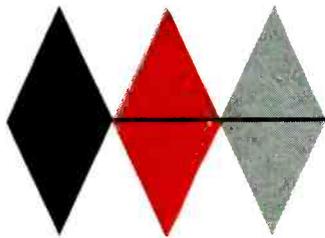


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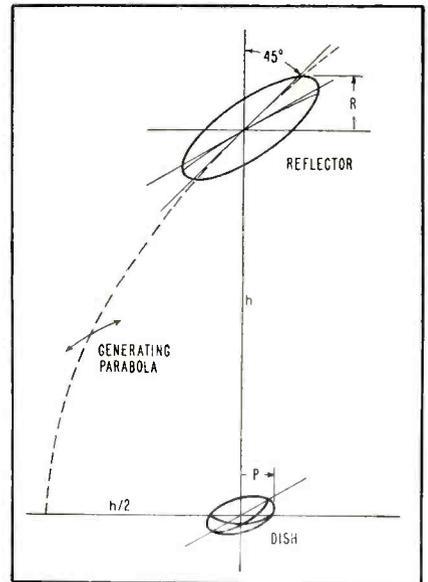
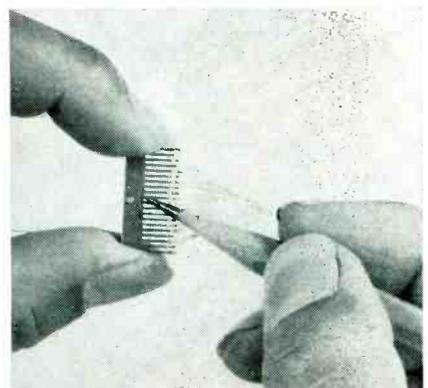


FIG. 1—Basic configuration of curved passive reflector antenna system

fed parabolic dish mounted on the equipment housing and oriented to provide vertical polarization upon reflection. The reflector is usually a flat perforated sheet mounted at a 45-deg angle and may vary in shape from a rectangular to an elliptical contour.

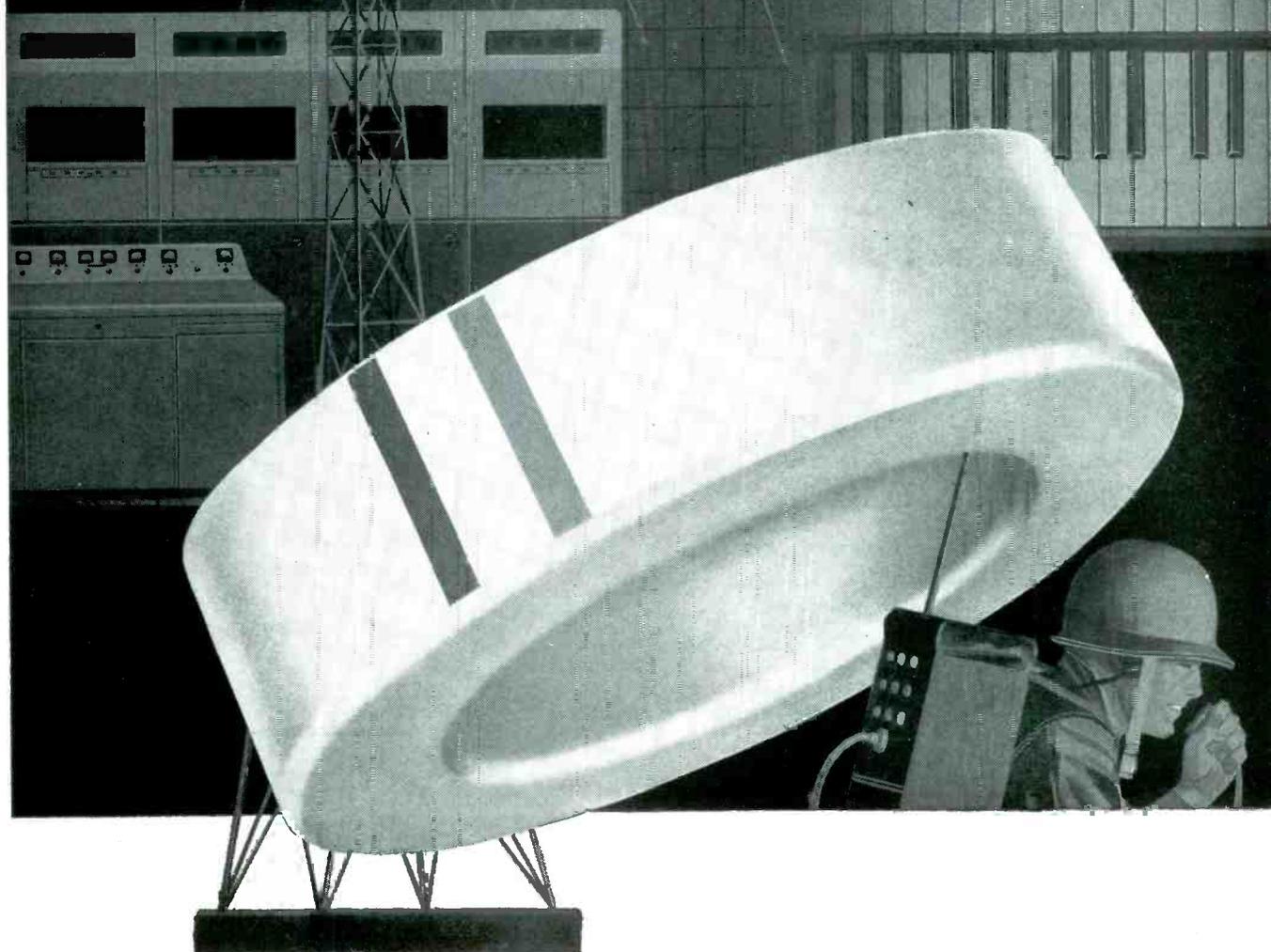
Theoretical and experimental investigations of the flat reflector have shown that a reflector-dish

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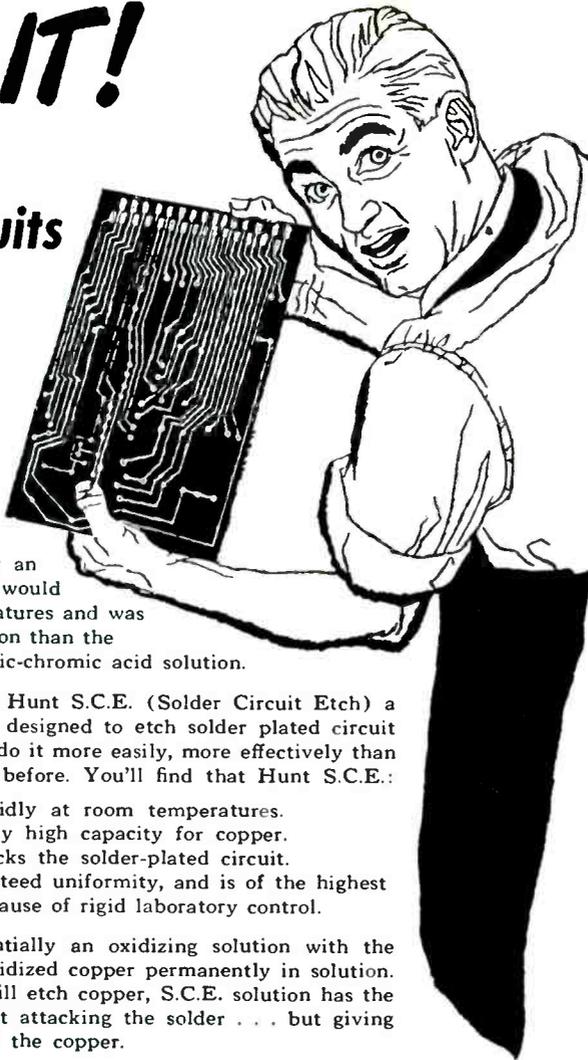
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combination can exhibit a greater far-field signal strength than that from the dish alone.²⁻⁴ The theoretical limit for this increase is 6 db although practical systems seldom achieve more than 2 or 3 db. The increase results from the Fresnel-type of interference associated with apertures in optics.

The curved reflector corrects the phase errors which occur on the surface of the flat reflector producing a focussing effect which further augments the reflected field. The far-field signal may be strengthened to any desired amount by increasing the reflector size. The basic configuration is shown in Fig. 1.

A comprehensive treatment of the methods for computing the diffracted field is given by Silver.⁵ Curved-reflector performance was analyzed using the aperture-field method assuming a transmitting system is used.⁶

The reflector gain is

$$G = \left| \frac{4a^2}{(2-k)} \int_0^1 f(y) y dy \right|^2$$

A plot of the curved-reflector gain characteristics is shown in Fig. 2 for the 10-db parabolic taper which closely matches typical dish illuminations. The curves may be considered plots of gain against tower height for various reflector-dish radii ratios. Each curve maximum corresponds to an optimum tower height. At lower tower

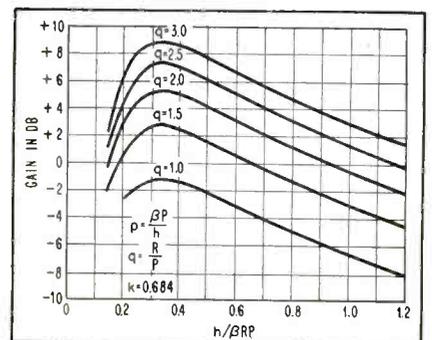


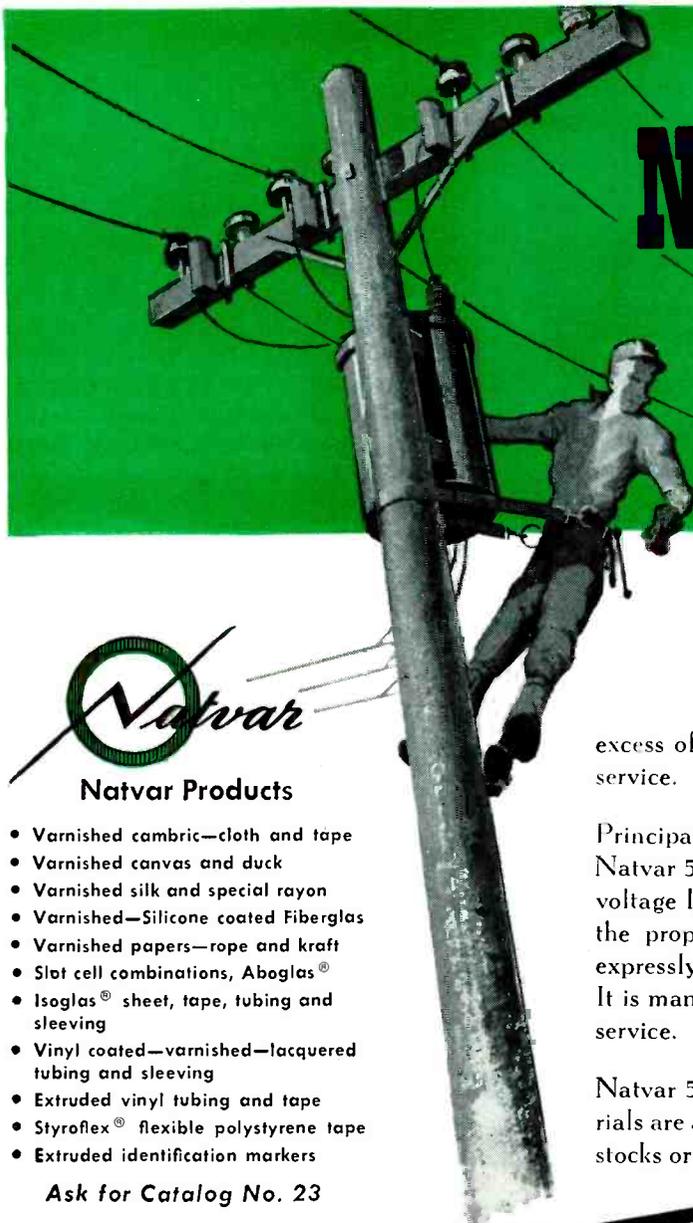
FIG. 2—Gain characteristics of the curved reflector

heights gain falls off because illumination distribution becomes poor. At greater tower heights the power intercepted by the reflector decreases.

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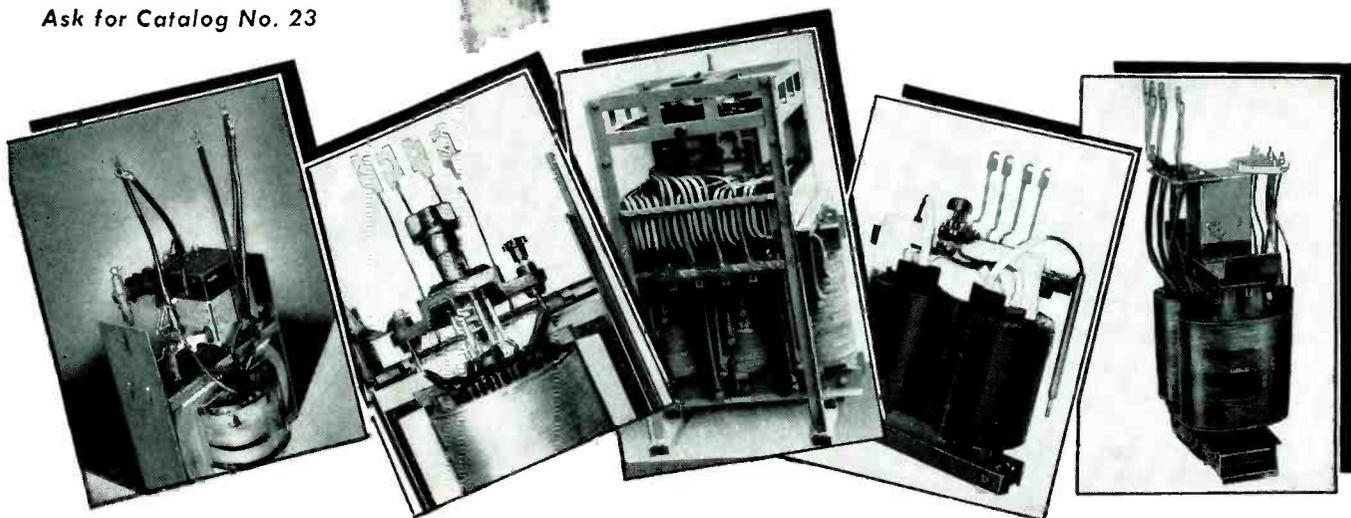
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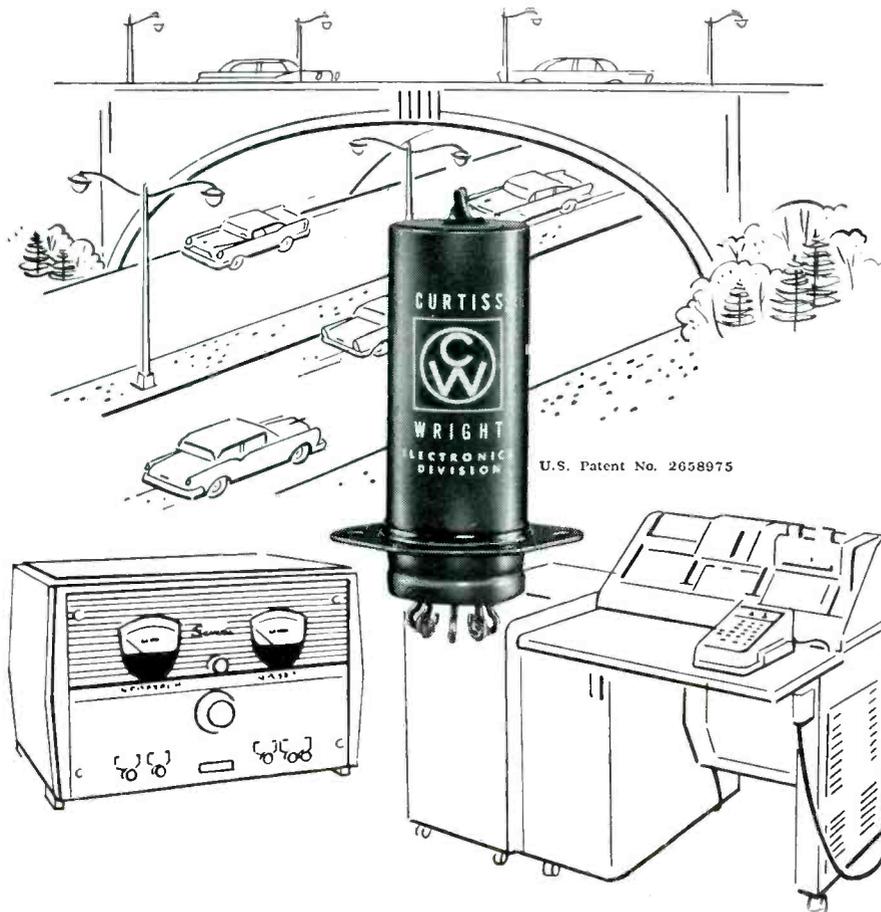
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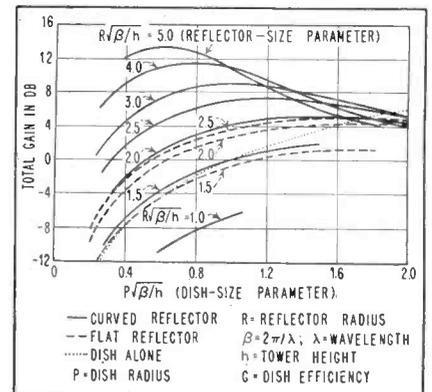


FIG. 3—Total gain characteristics of passive reflector systems

Figure 3 reveals that the total system gain using medium-sized reflectors, whether curved or flat, is relatively insensitive to dish size over wide limits. The reduction in dish gain caused by reducing the dish size is compensated up to a point by an increase in reflector gain owing to improved reflector illumination. Since the cost of a dish rises rapidly with size, it is important to considered this point with care.

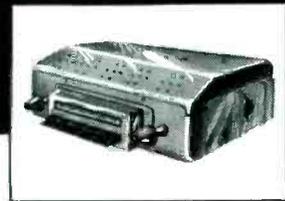
When the reflector-size parameter $R\sqrt{\beta/h}$ is about 2 or 2.5, the curved reflector offers a gain increase of 1.5 to 4.0 db per tower (3 to 8 db for the link) compared to the flat reflector. Similarly, the use of a curved reflector permits a 25 to 50-percent reduction in dish size for the same total gain.

For larger reflector sizes, the

must select the proper dish and reflector after the operating frequency and the tower height have been determined. In this case the data of Fig. 2 are difficult to apply because the gain of the dish is not considered.

The total gain characteristics shown in Fig. 3 are a replot of Fig. 2 wherein the total gain of the reflector-dish combination over an isotropic radiator appears as the dependent variable. Since β and h , as defined on Fig. 3, can be considered as constants, the curve is a plot of total gain per tower against dish size for various reflector sizes. The characteristics of the flat reflector are shown by the dashed lines. The single dotted line is the gain of the dish alone.

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Power Gain	28 ^a	23 ^a	30 ^a	23 ^a	27 ^b	20 ^b	db
Frequency Cutoff	6	4	7	4	6	4	kc/s

^a $V_{ce} = -14V$; $I_c = 500$ ma; $R_L = 30 \Omega$ (choke coupled); $R_E = 10 \Omega$

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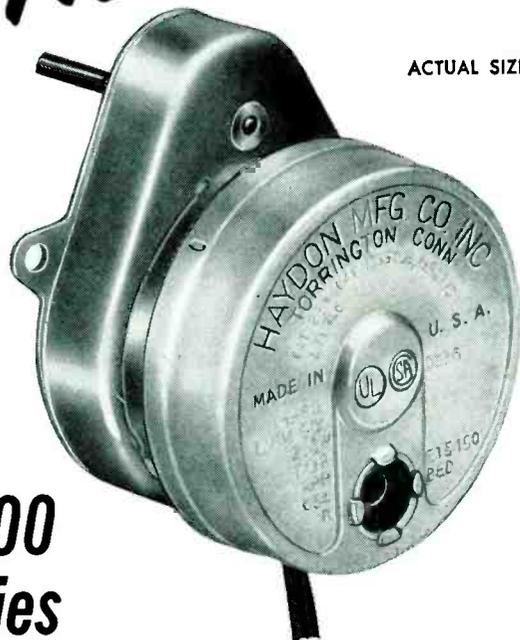
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gain of the flat reflector decreases while that for the curved reflector increases. Increasing the curved-reflector size also causes the optimum gain region to become more pronounced and to correspond to the use of smaller dishes.

The curved reflector is formed by attaching suitable screening material to a rigid framework indented at several points to form the proper curvature for a given tower height. A jackscrew arrangement permits the curvature to be adjusted after the reflector is erected. The effect of curving has been observed in the field by erecting adjustable reflectors while flat and noting that adding curvature invariably increases the receiver limiter current by the predicted amount.

As an example of a practical system design, consider a 150-foot tower operating at 6,700 mc. Then $\beta = 42.8 \text{ ft}^{-1}$ and $h = 140 \text{ ft}$ (assuming the dish-reflector spacing is 10 ft less than the tower height) giving $\sqrt{\beta/h} = 0.553$. A typical dish efficiency $G = 0.65$ then gives 10

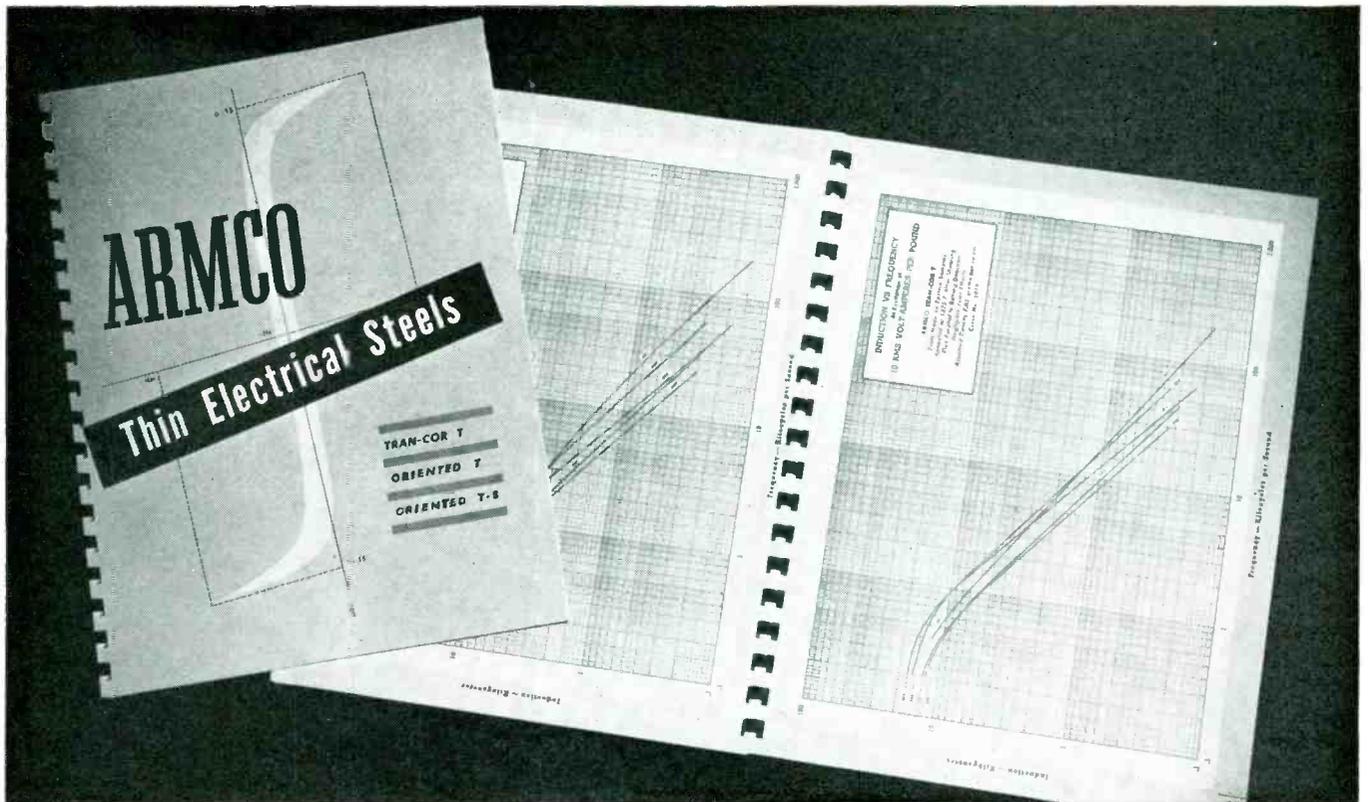
Table I—Total Gain for 150-ft Tower at 6,700 mc. $G=0.56$

Dish Diameter (Ft)	Dish Gain Alone	Reflector Diameter (ft)			
		4	6	8	10
2	30.9	26.2	33.0	37.8	41.3
		26.0	32.0	34.8	....
4	36.8	31.9	37.8	41.7	44.0
		31.5	36.8	39.5	....
6	40.4	....	39.0	41.5	42.4
		....	38.1	40.5	....

Upper—Curved Refl Lower—Flat Refl

$\log G\beta h = 35.98$. Assuming further that standard dishes of 2, 4, and 6 ft diameter and reflectors with equivalent diameters of 4, 6, 8, and 10 ft are available. The total gains per tower to be expected from the various combinations are shown in Table I. Data for the flat reflector are included for comparison.

It is seen that the 4-ft reflector would be a poor choice whether curved or flat. The 6-ft reflector and 2-ft dish are an economical choice where gain is not a dominant factor while the use of a 6-ft. dish is not justified under any circumstance. (Its value appears at the



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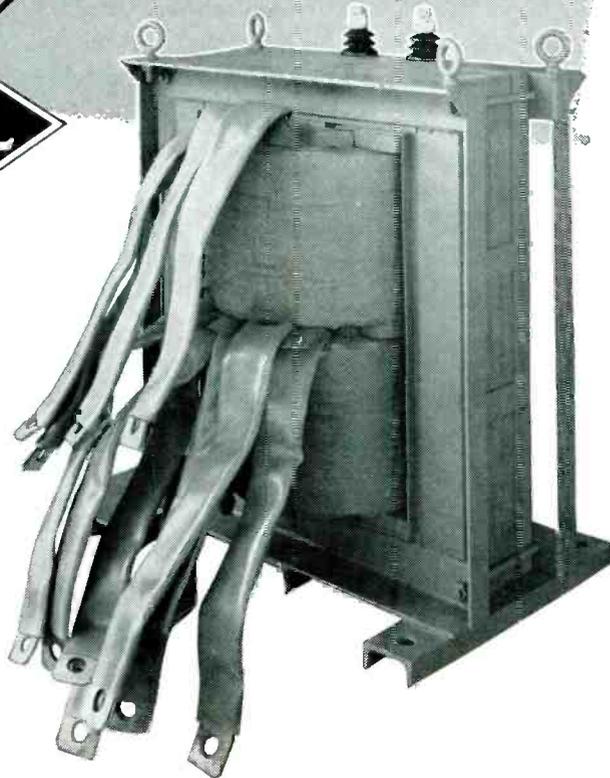


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greater tower heights.)

The total gain using flat reflectors is less for 10-ft reflectors than for 8-ft reflectors so the best flat-reflector combination is the 4-ft dish with the 8-ft reflector. The 4-ft dish and 10-ft curved reflector would be an excellent choice for a high-gain system.

REFERENCES

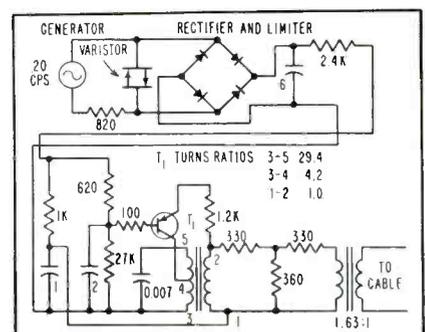
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- (2) J. Drexler, An Experimental Study of a Microwave Periscope, *Proc IRE*, 42, p. 1022, June 1954.
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- (6) E. Bedrosian, The Curved Passive Reflector, *IRE Trans Ant & Prop.* AP-3, p. 168, Oct. 1955.

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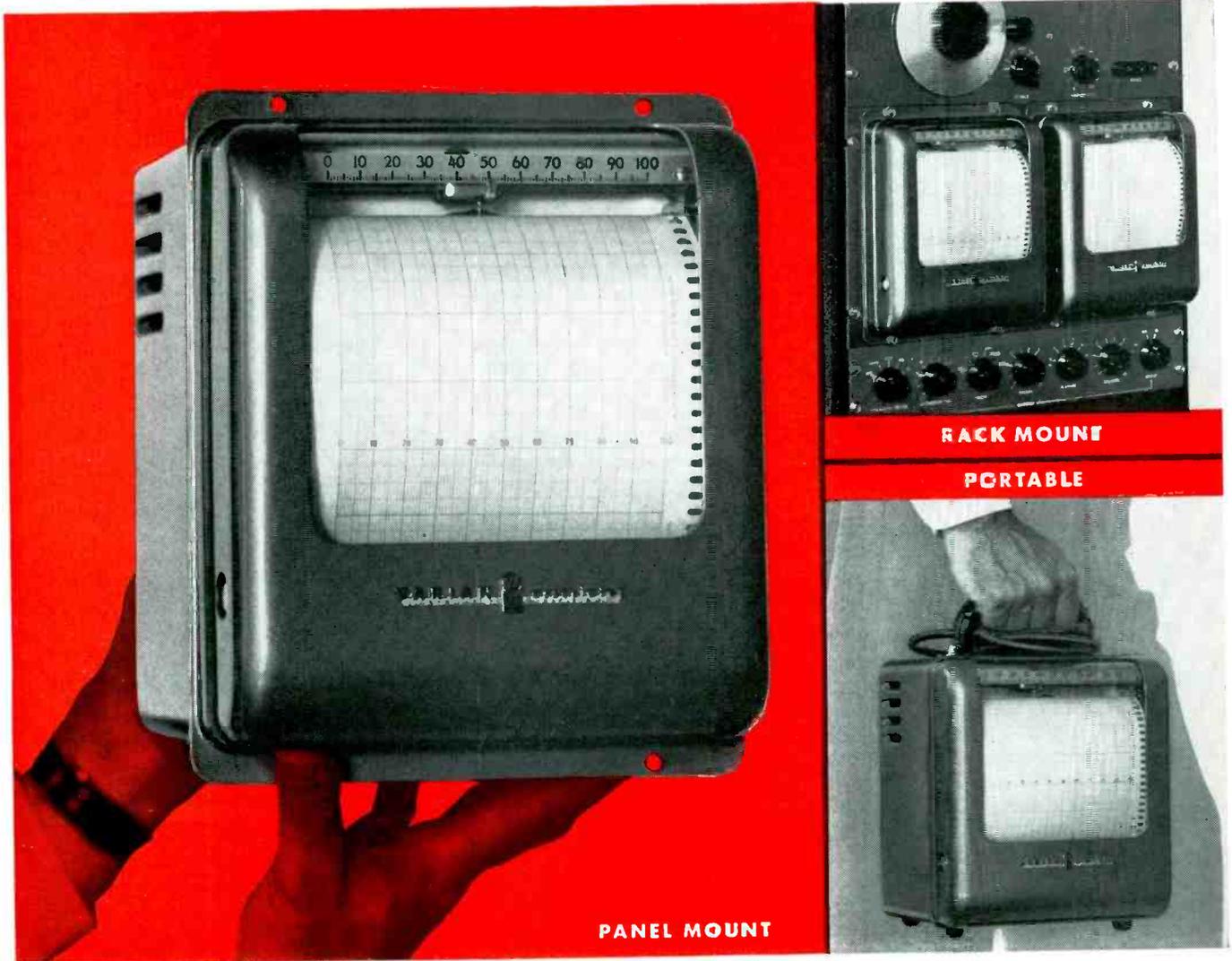
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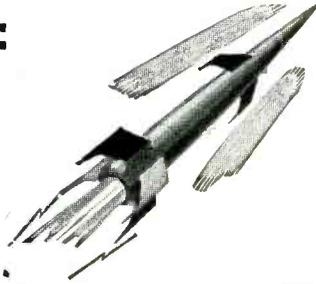
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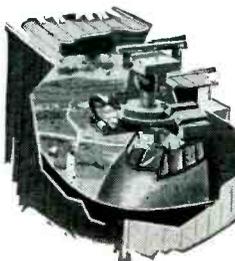
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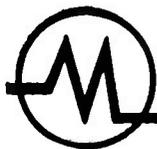


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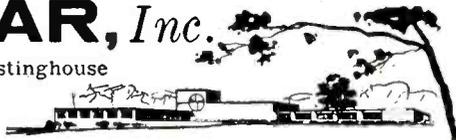
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tary systems employ ringdown calling methods that operate at 1,600 cps, the hand-cranked generator at 20 cps cannot be used here.

► **Oscillator**—Test set telephones are now being equipped with a point-contact transistor circuit that oscillates at 1,600 cps when d-c potential resulting from rectification of the 20-cps signal is applied. At the receiving location, visual and audible signals call the attendant.

It is necessary to rotate the hand crank only a couple of turns to produce the signal. Power from the generator is sufficient to operate the transistor oscillator circuit, so no batteries are required. There is no warmup time and the circuit shown is so compact that it adds little weight or bulk to the test set.

Information on this transistor application has been provided through the courtesy of Bell Telephone Laboratories.

PERTINENT PATENTS

FREQUENTLY, inventions lie dormant for a number of years, as in the case of the antenna system described, before achieving popular use. Other inventions gain high interest at once, as may be true with the flat television display likewise mentioned this month.

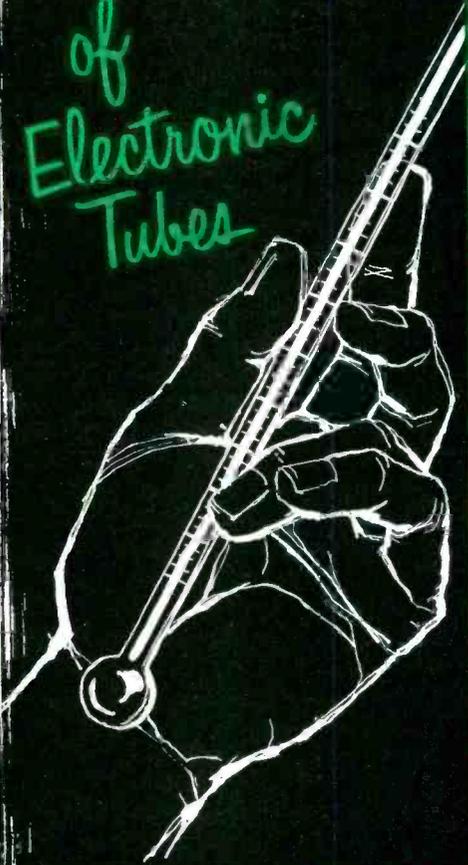
Mural Television

Patent 2,760,119 has been awarded Pierre M. G. Toulon for a shallow television tube. Such a tube can contain a viewing screen supported in an ionized gas with proper gating means for passage of ions to the phosphorescent material. Its general appearance is suggested in Fig. 1.

A phosphorescent screen is contained in a cavity filled with gas, like helium, maintained in a state of ionized agitation. This screen comprises a transparent front plate, control electrodes and a grid structure, such as honeycombs. The rear surface of the plate can be divided into some standard number of hori-

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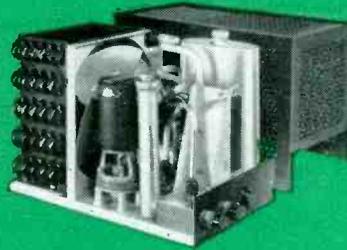
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Eastern Cooling Units provide coolant liquid for maintaining within safe operating temperature limits liquid cooled electronic tubes or similar devices. The units are completely self-contained and usually comprise such components as heat exchangers, fans or blowers, liquid pumps, reservoirs, flow switch, thermostat, etc. Cooling units can be modified as required for varying conditions encountered in land or sea as well as aircraft service. Almost all units are designed to meet such specifications as MIL-E-5400 and MIL-E-5272.

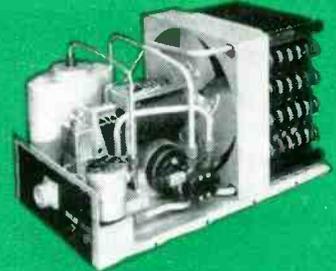
The units shown below are intended only to illustrate the varying requirements which can be satisfied. By utilizing fairly standard components and designs based on broad experience in this field, Eastern is able to provide at minimum cost equipment exactly suiting a specific requirement.

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Write for Aviation Products Bulletin 330.



MODEL MB-175, TYPE 200 DISSIPATION: 2,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 25 pounds. **SIZE:** 10" x 15-15/16" x 10 3/4" high.



MODEL E/HT-205, TYPE 200A DISSIPATION: 1,600 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 25 pounds. **SIZE:** 10" x 21" x 10" high.



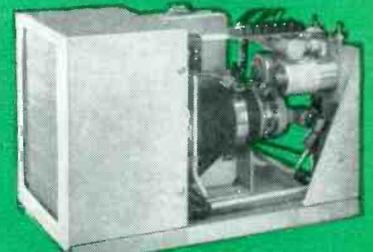
MODEL MB-177, TYPE 202 DISSIPATION: 1,700 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 110 volt, 400 cycle, 3 phase. **WEIGHT:** 27 pounds. **SIZE:** 10" x 19 15/32" x 7 3/8" high, per JAN-C-1720A, size 81-D1.



MODEL E/HT-210, TYPE 200 DISSIPATION: 1,500 watts. **ALTITUDE RANGE:** sea level to 10,000 feet. **POWER REQUIRED:** 208 volts, 400 cycle, 3 phase. **WEIGHT:** 35 pounds. **SIZE:** 11 1/4" x 19 1/2" x 12 1/2" high.



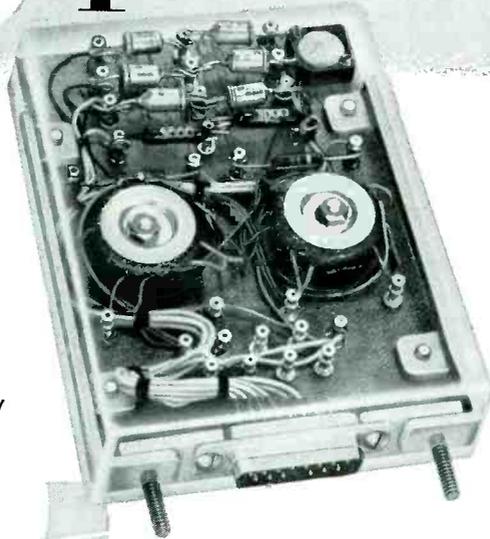
MODEL E/HT-200, TYPE 201 DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 50,000 feet. **POWER REQUIRED:** 28 volts D.C. **WEIGHT:** 14 1/2 pounds. **SIZE:** 10" x 10" x 6" high.



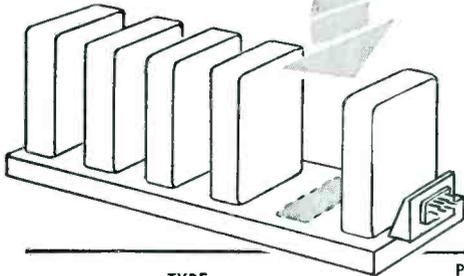
MODEL NO. 5-A DISSIPATION: 1,000 watts. **ALTITUDE RANGE:** sea level to 5,000 feet. **POWER REQUIRED:** 100 to 110 volts D.C. **WEIGHT:** 10 pounds. **SIZE:** 7 3/8" x 13 1/2" x 9-1/16" high.

Lightweight! SERVO Magnetic Amplifiers

The servo amplifiers illustrated are typical standard types. Other models, including higher power types, are available for systems engineering. The complete MA line offers the designer a choice of compact, low cost types, amplifiers featuring fast response at high gain and all-magnetic models providing highest performance.



In addition to standard types, custom designs can be produced for special applications, or complete servo and automatic control systems can be engineered to your requirements.



TYPE	SUPPLY	POWER OUTPUT	SENSI- TIVITY	RESPONSE TIME—SEC.
LIGHTWEIGHT SUB-MINIATURE MAGNETIC AMPLIFIER	115 volts 400 cps.	½, 3, 5, 10 watts	.02 volts	.003
MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS	115 volts 400 cps.	3, 5, 6, 10, 18 watts	1 volt AC	.03
MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 cps.	5, 10, 15, 20 watts	0.1 volt AC	.008 to .1
TRANSI-MAG*: TRANSISTOR + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 or 60 cps.	2, 5, 10, 15, 20 watts	.08 volt AC into 10,000 ohms	.01

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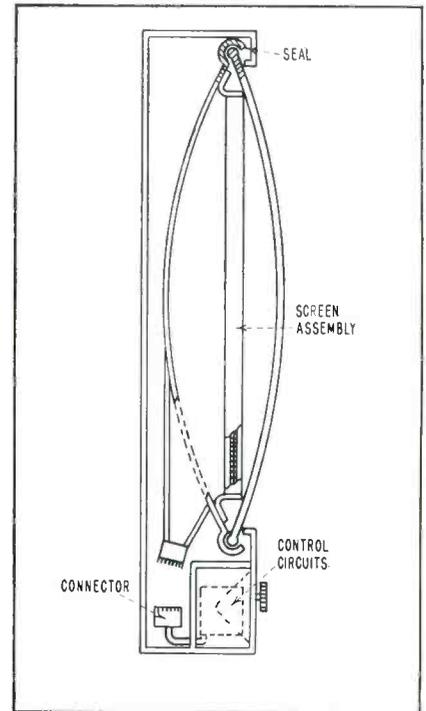


FIG. 1—An arrangement of receiver and flat tv screen

zontal lines, like 525. Each horizontal line, divided into 500 dots, has an electrode.

Each vertical line has an electrode. Each point of the screen corresponding to a distinct video signal is controlled by the crossing of a

Portable Record Player

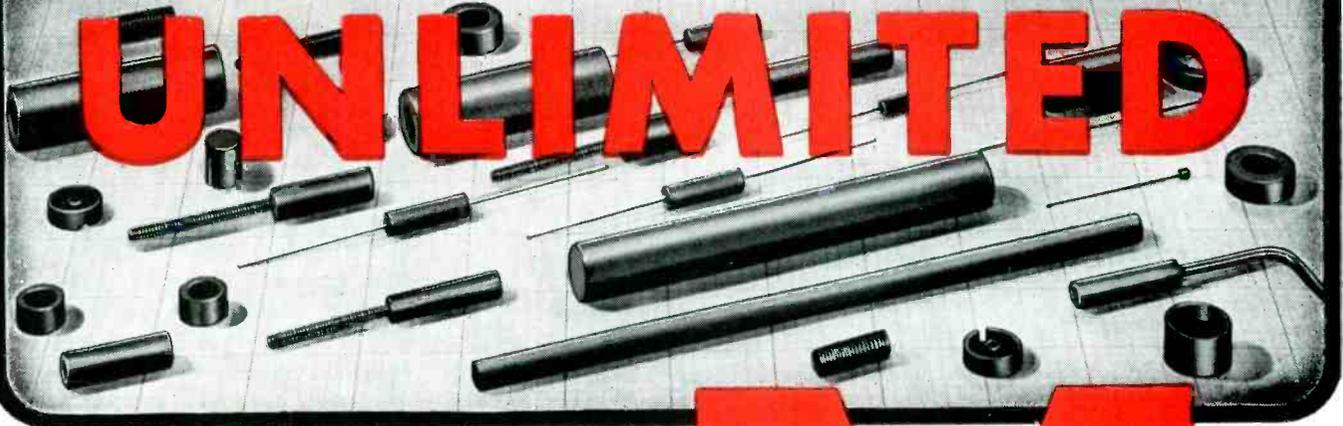


Japanese ingenuity is displayed in the transistor record player shown above. The pickup presses against the underside of the record, which is effectively locked onto the turntable. According to Sony engineers, the motor requires 50 and the amplifier only 15 milliamperes.

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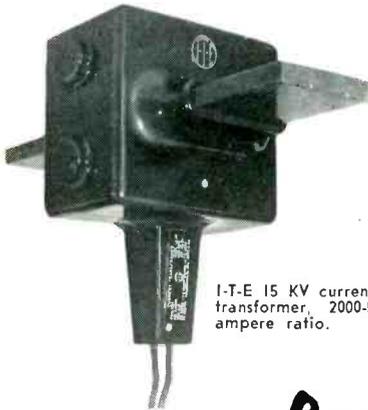
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2419 South Grand Ave.
Los Angeles, Cal.

John S. Plewes Co.
52 Humbercrest Blvd.
Toronto 9, Ontario

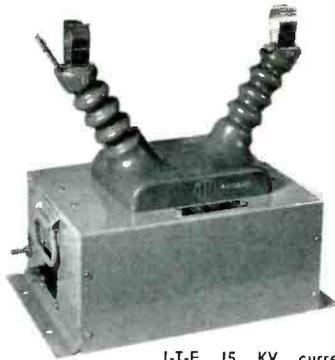
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 - Low coefficient of linear thermal expansion
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 - Self-extinguishing properties
 - Good chemical resistance
 - New economies

Using HYSOL 6800, transformer design engineers have found they can achieve reduction in size and streamlined appearance heretofore impossible.

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vertical and a horizontal electrode. Each dot or target of fluorescent material can be caused to glow as desired.

A lens with a lenticular surface eliminates the black-space effect of the discontinuous fluorescent deposit and color can be reproduced by the proper selection of phosphors and electrodes.

All-Band Antenna

When it is desired to operate a transmitter with two or more selectable output frequencies into the same antenna, means must be found

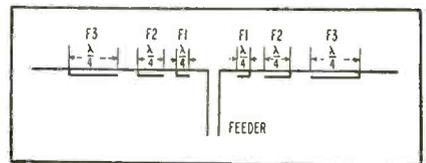


FIG. 2—One form of multiband antenna

to cause antenna resonance at the chosen frequencies.

An antenna system with these properties is the subject of patent 2,535,298 awarded W. J. Lattin. Basically the invention comprises a doublet antenna that resonates at the highest desired frequency. Quarter-wave sections, measured at this frequency, are attached to the ends of the doublet that is the center section. The next frequency, which will be lower, determines the length of additional sections. These, together with the quarter-wave sections and the center sections, resonate at the second frequency.

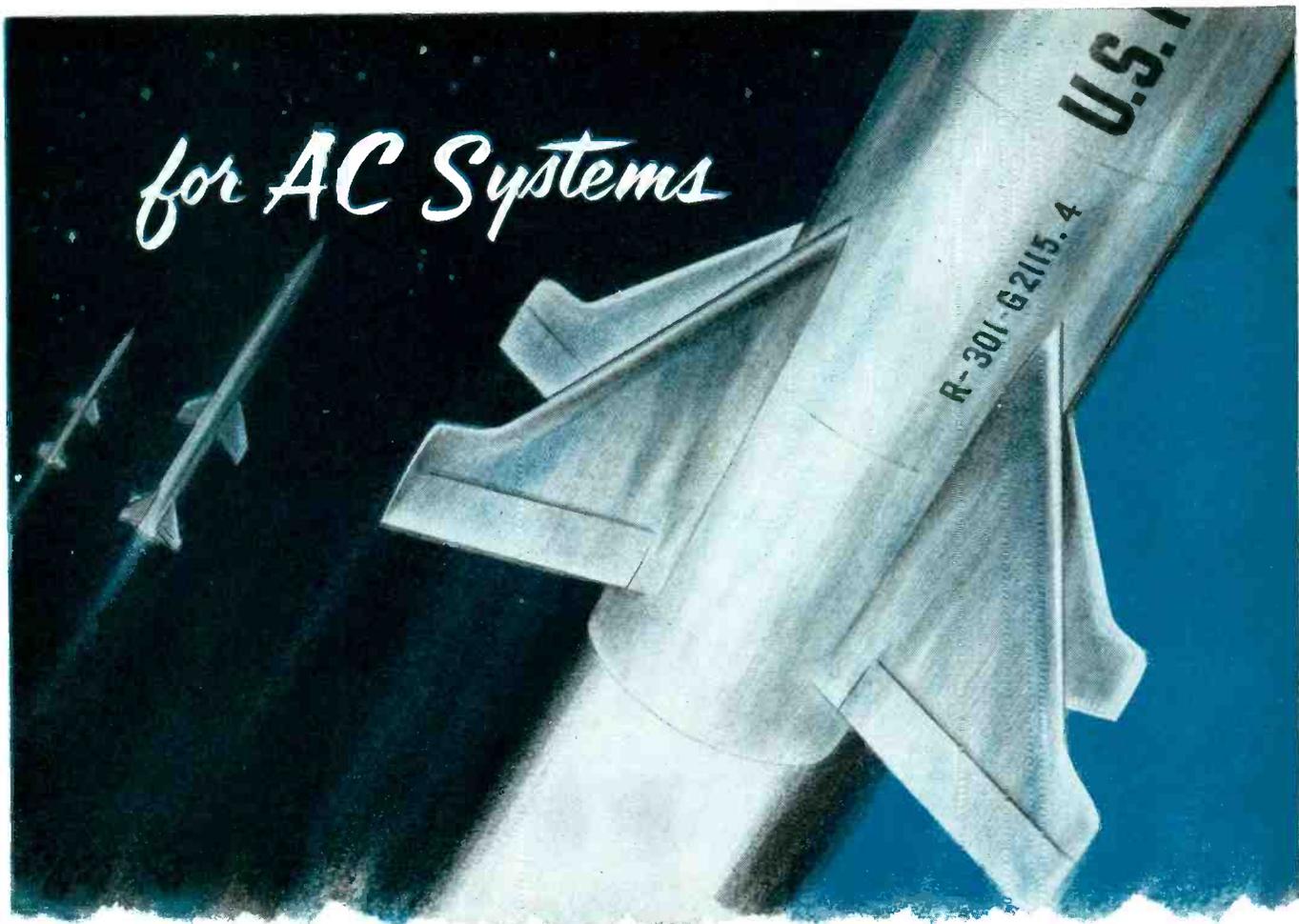
Other frequencies are accommodated in a similar manner. The antenna may take the form shown in Fig. 2. The doublet sections are shown connected to transmission line sections that may be formed from coaxial, parallel or twisted conductors.

The system is similar to the all-wave receiving antenna system proposed by Amy in patent 282,292.

Break Detector

Apparatus for tracing underground cables and for detecting flaws is the subject of patent 2,731,598 awarded Earl Herbert and assigned, in part, to Whitney W. Potter.

A faulty cable is detected at both



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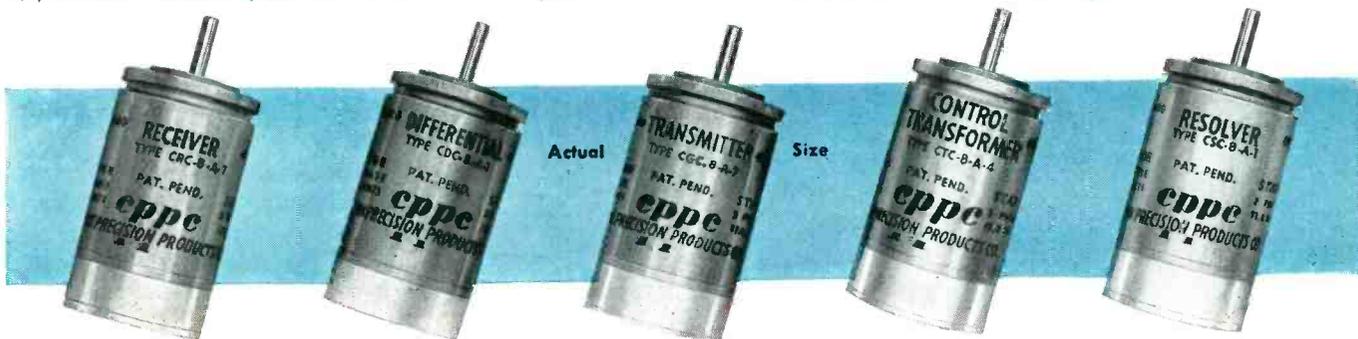
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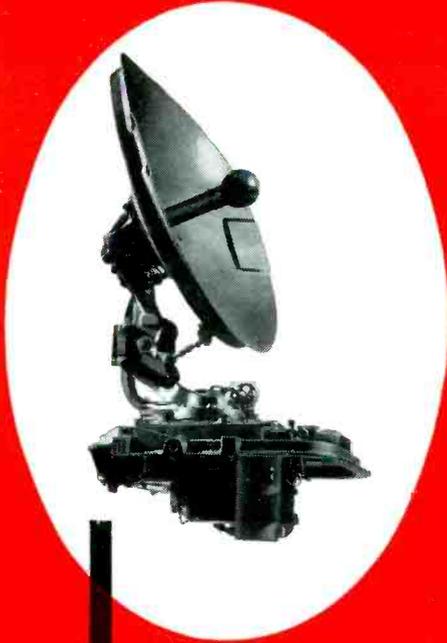
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Clifton Heights, Pa.

STANDARD UNITS		ROTOR					STATOR					IMPEDANCE			PHASE							
SYNCHRO FUNCTION	CPPC TYPE	Input V400cy	Input Amps	Input Watts	Ohms (DC)	Output Rotor (MV/deg.)	Sensitivity (MV/deg.)	Output Volts	Sensitivity (MV/deg.)	Input Volts	Input Amps	Input Watts	Ohms (DC)	Zro	Zso	Zrss	R-S	S-R	Nulls (MV)	Possible Error	Spd.	Length in inches
Torque Transmitter	CGC-8-A-7	26.0	100	.5	37	—	—	11.8	200	—	—	—	12	54+j260	12+j45	76.4+j19.6	8°	—	30	7'	14'	1.240
Control Transformer	CTC-8-A-1	26.0	.050	.25	143	24	410	11.8	200	11.8	.090	.23	25	220+j740	28+j110	246+j60	8.5°	30	7'	14'	1.240	
Control Transformer	CTC-8-A-4	—	—	—	381	24	410	—	—	11.8	.037	.09	60	508+j1680	67+j270	640+j190	—	9.2°	30	7'	14'	1.240
Control Differential	CDC-8-A-1	—	—	—	36	11.8	200	—	—	11.8	.085	.21	25	38+j122	27+j120	48.6+j13.8	—	9°	30	7'	14'	1.240
Electrical Resolver	CSC-8-A-1	26.0	.039	.43	230	23.2	400	10.6	180	11.8	.084	.27	27	280+j600	38+j136	70+j136	20°	11°	30	7'	14'	1.240
Torque Receiver	CRC-8-A-1	26.0	.100	.50	37	—	—	11.8	200	—	—	—	12	54+j260	12+j45	85.1+j20.4	8°	—	30	30'	30'	1.240



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ends and into each end is fed a signal of different frequency, such as 175 and 262 kc. The detector proper consists of a receiving circuit for each frequency and a pair

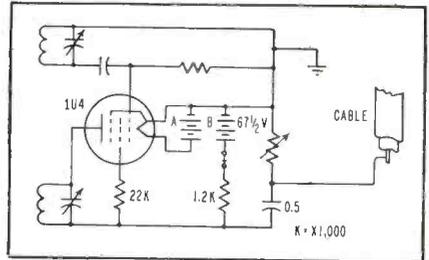


FIG. 3—Circuit oscillator for cable fault detector

of detecting coils. It is claimed that the position of a flaw can be located within a very few inches or even fractions of an inch.

Figure 3 is an oscillator generator suggested by the inventor for producing one or the other of the signals required.

Copying Device

Of recurring interest are methods for obtaining facsimiles of written or printed material without going through normal photographic processes. An electronic printing device invented by A. G. Thomas is the subject of patent 2,549,546.

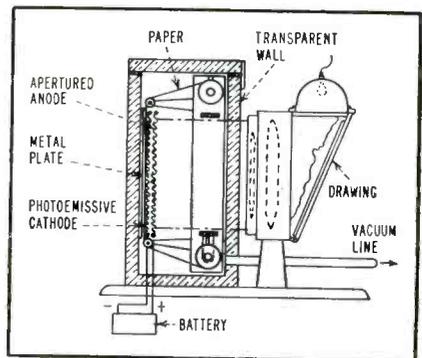
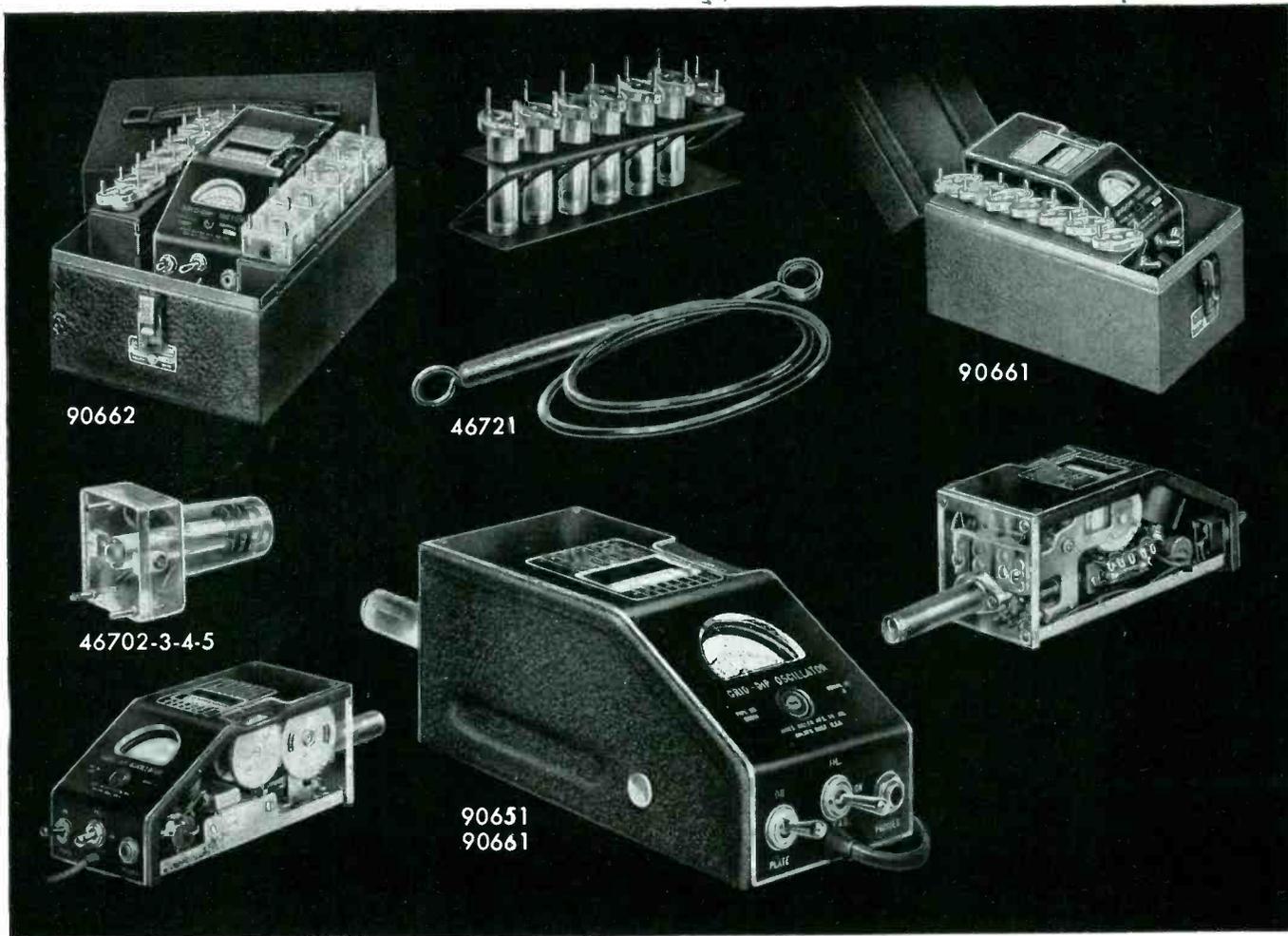


FIG. 4—Electronic printing device using photoemissive cathode

As shown in Fig. 4, it comprises an evacuated chamber with one transparent wall through which the image of a drawing is cast. Apertures in an anode allow the varying degrees of light to fall upon a photoemissive cathode.

The density of electrons, liberated by light and accelerated by the positively charged anode, depends



Designed for Application

Grid Dip Meters

Millen Grid Dip Meters are available to meet all various laboratory and servicing requirements.

The 90662 Industrial Grid Dip Meter completely calibrated for laboratory use with a range from 225 kc. to 300 mc. incorporates features desired for both industrial and laboratory application, including three wire grounding type power cord and suitable carrying case.

The 90661 Industrial Grid Dip Meter is similar to the 90662 except for a reduced range of 1.7 to 300 mc. It likewise incorporates the three wire grounding type cord and metal carrying case.

The 90651 Standard Grid Dip Meter is a somewhat less expensive version of the grid dip meter. The calibration while adequate for general usage is not as complete as in the case of the industrial model. It is supplied without grounding lead and without carrying case. The range is 1.7 to 300 mc. Extra inductors available extends range to 220 kc.

The Millen Grid Dip Meter is a calibrated stable RF oscillator unit with a meter to read grid current. The frequency determining coil is plugged into the unit so that it may be used as a probe.

These instruments are complete with a built-in transformer type A.C. power supply and internal terminal board to provide connections for battery operation where it is desirable to use the unit on antenna measurements and other usages where A.C. power is not available. Compactness

has been achieved without loss of performance or convenience of usage. The incorporation of the power supply, oscillator and probe into a single unit provides a convenient device for checking all types of circuits. The indicating instrument is a standard 2 inch General Electric instrument with an easy to read scale. The calibrated dial is a large 205° drum dial which provides seven direct reading scales, plus an additional universal scale, all with the same length and readability. Each range has its individual plug-in probe completely enclosed in a contour fitting polystyrene case for assurance of permanence of calibration as well as to prevent any possibility of mechanical damage or of unintentional contact with the components of the circuit being tested.

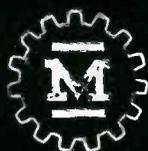
The Grid Dip Meters may be used as:

1. A grid Dip Oscillator
2. An Oscillating Detector
3. A Signal Generator
4. An Indicating Absorption Wavemeter

The most common usage of the Grid Dip Meter is as an oscillating frequency meter to determine the resonant frequencies of de-energized tuned circuits.

Size of Grid Dip Meter only (less probe): 7 in. x 3 $\frac{3}{8}$ in. x 3 $\frac{3}{8}$ in.

JAMES MILLEN



MFG. CO., INC.

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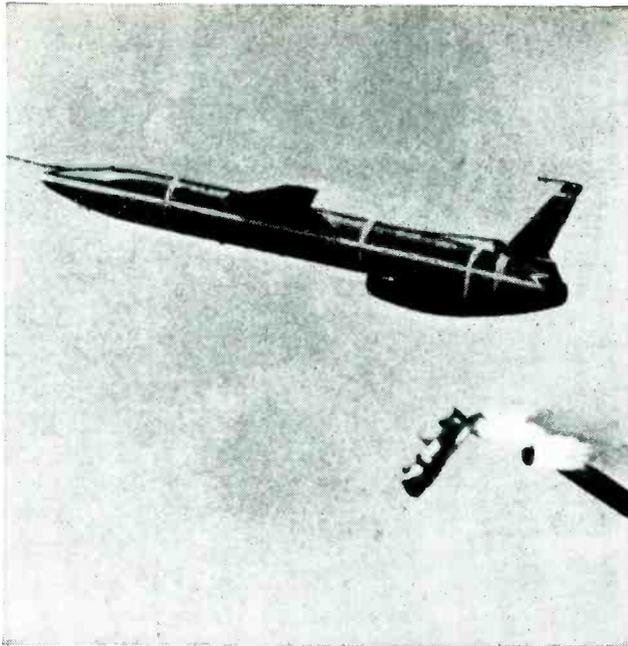


Photo courtesy of Northrop Aircraft, Inc.

High-speed control for high-speed missiles

Nowadays, target, aircraft, and missile speeds are too fast for human reactions. Automatic equipment makes ready, radar eyes take aim and a computer pulls the trigger.

Replacing men with machines on the firing line gives us a better chance for an interceptor kill or successful missile shot. And, today, we can't afford to miss. That's why reliability of every component is so important in modern fire control gear. And reliability is the main reason engineers—like those designing Northrop Aircraft's Snark missile (above)—so often pick Bristol's® Syncroverter® High-Speed relays (or the very similar Syncroverter chopper).

These high-speed relays have a normal life of billions of operations in dry circuit applications. They're available in SPDT and DPDT models with the typical characteristics listed below and in many variations.

And, of course, many critical applications other than fire control—such as air-to-ground telemetering, analog and digital computers, aircraft or missile navigation equipment, carrier current switching—can benefit from the outstanding reliability of Bristol's Syncroverter line. Write for complete technical data today. The Bristol Company 152 Bristol Road, Waterbury 20, Conn.

6.61

TYPICAL CHARACTERISTICS

Temperature range: -55°C to 100°C
 Operating shock: 30G; 11 milliseconds duration
 Vibration: 10-55 cps (see below, Mounting); 10 G
 Contact ratings: up to 35v, 45 microamperes
 Stray contact capacitance: less than 15 mmfd
 Pull-in time (including bounce):
 as low as 200 microseconds
 Drop-out time: 300 microseconds
 Life: Billions of operations
 Mounting: Octal tube socket; others available, including types for vibration to 2000 cps.

BRISTOL FINE PRECISION INSTRUMENTS
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upon the original drawing. Electron bombardment falling upon suitably treated paper produces a copy.

The device can be so constructed that the paper can be unreeled without breaking vacuum and advanced automatically each time the light causes an exposure.

Video Recording

Assigned to Magnecord by inventor J. H. Greenwood is patent 2,698,875 describing plural track magnetic recording and reproducing apparatus. Essentially, the inventor proposes to separate elements of a complex, broad-band signal, by means of a commutating device, into a sequence of individual current pulses that may be recorded by individual heads.

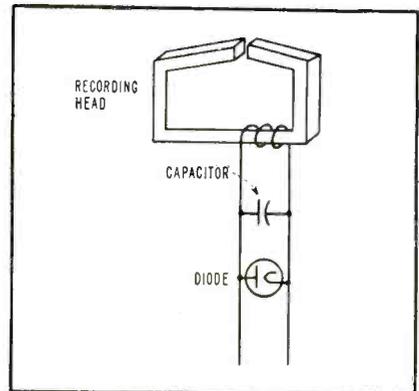


FIG. 5—One arrangement of recording head for fast, broad-band signals

It is claimed that the system provides a two-dimensional magnetic method capable of recording signals of vastly greater frequency range than is possible with existing one-dimensional systems. This results from the transverse movement of the magnetic flux across the magnetizable sheet being much faster than the highest speed of the traveling sheet.

Various means of accomplishing desired recording are described, including the use of capacitor and diode across the recording head coil as shown in Fig. 5.—A. A. MCK.

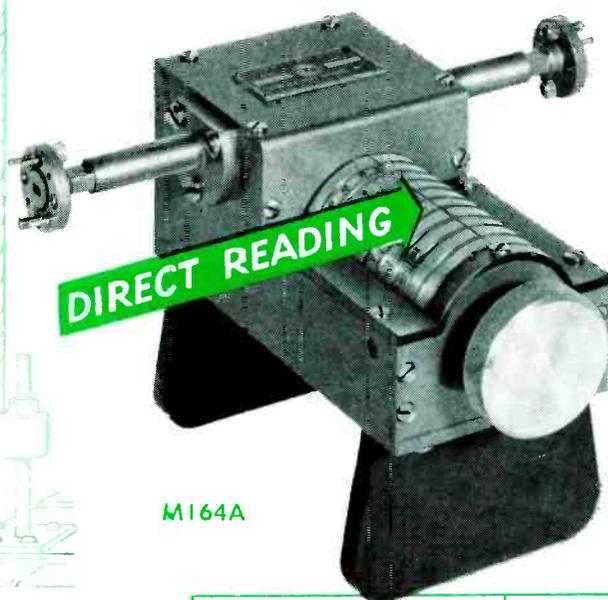
Erratum

Figure 3 on p 242 of the October issue was incorrectly titled. It should have been captioned "fixed-frequency klystron".

Greatest Single Span

In building the Brooklyn Bridge, John Roebling fulfilled a creative engineering dream which stamped him as a master craftsman in his field. Completed by his son in 1883, it was at that time the longest single span ever erected and its record length of 1,595-1/2 feet was unsurpassed for twenty years.

FXR Precision MM Variable Attenuator gives Greatest Range



M164A

Here is an important step forward in the development of Microwave components, for measuring gain, coupling, and attenuation. Never before have direct attenuation readings been attainable with such speed and accuracy at millimeter wave lengths. Direct reading over a full waveguide bandwidth, this exceptionally convenient unit is calibrated to 50 DB of attenuation and features bilateral matching. The Precision Variable Attenuator is the latest in a growing line of Microwave Test Equipment, reflecting the outstanding craftsmanship for which FXR has become known throughout the microwave electronics industry.

Direct Reading Precision Variable Attenuator	Frequency Range (KMC/sec)	Waveguide Size	Calibrated Attenuation Range*	Maximum VSWR	Flange Type	Insertion Length
Type No. M164A	50-75	RG-98/U (0.148 x 0.074)	0-50db	1.15	UG-385/U	4-1/2"

*Maximum Calibration Error 0.1 db or 2% of reading, whichever is greater. Transmission loss is less than 1.0 db (not included in calibration).

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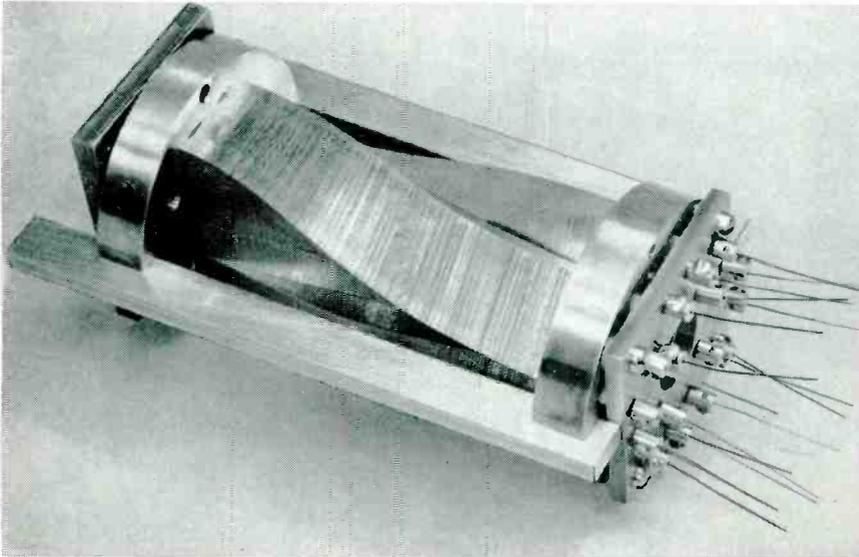
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NOW AVAILABLE . . . the new FXR catalogue for 1956-57 showing a complete line of Precision Microwave Test Equipment.

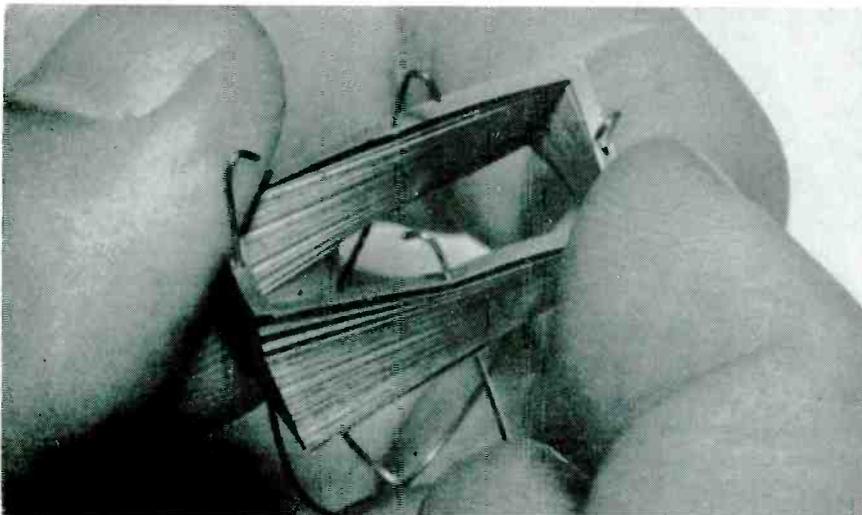
Waveguide Twists Made from Thin Brass Laminations



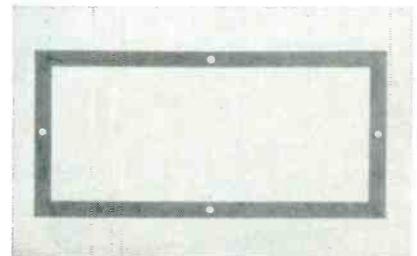
End plates hold laminations of four-waveguide twisted section in vise-like grip to insure precise alignment during soldering or brazing operation that fuses laminations together



Four-waveguide twisted section, shown in inset at upper right, is mounted within tube supporting antenna of instantaneous direction finder that receives radar signals from all directions simultaneously over wide frequency range to determine direction of enemy pulsed radar



Stack of laminations is strung on four wires to insure alignment. Twisting in manner shown here gives desired uniformly gradual curve while keeping end laminations parallel to each other



Example of $\frac{1}{2} \times 1$ inch lamination punched from 0.005-inch brass for use in precision X-band waveguide twists

PRECISION WAVEGUIDE twists constructed of short sections of waveguide can easily be made to assume complicated shapes. Electrical properties such as vswr, attenuation and power-handling capacity are essentially the same as those of straight sections of waveguide. The construction technique was developed by R. R. McPherson of Stanford Research Institute for waveguide components needed by

E. M. T. Jones and R. C. Honey in an instantaneous direction finder for radar and other microwave signals.

► **Stampings**—The short lengths of waveguide used in these twists are stampings formed by a precision punch and die, and consequently can be inexpensively mass produced. One convenient method for aligning the stampings is to

string them together on wires by small holes in the corners. When the stampings are strung on the wires, the complete stack can be twisted and one end translated with respect to the other in any desired manner, keeping the two ends parallel to each other. The stack can then be compressed to assure good electrical contact between stampings. Good electrical contact can also be insured by

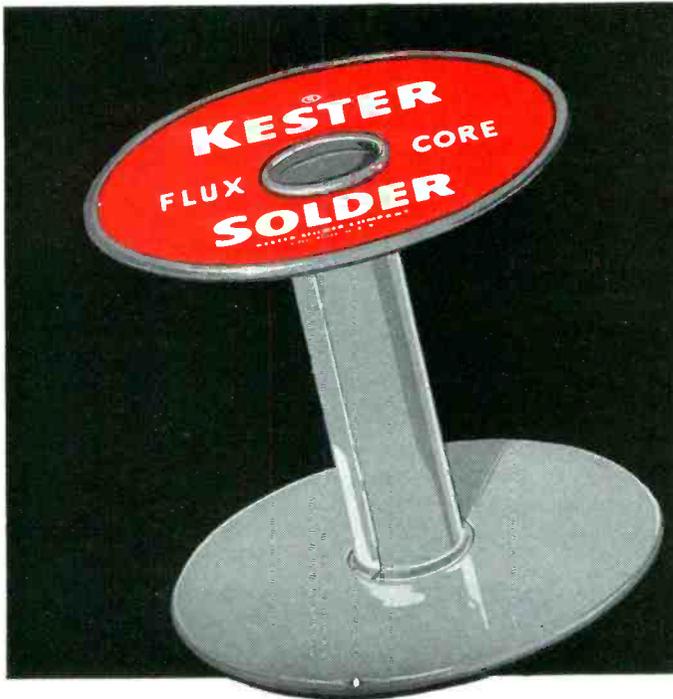


going...

going...



gone!

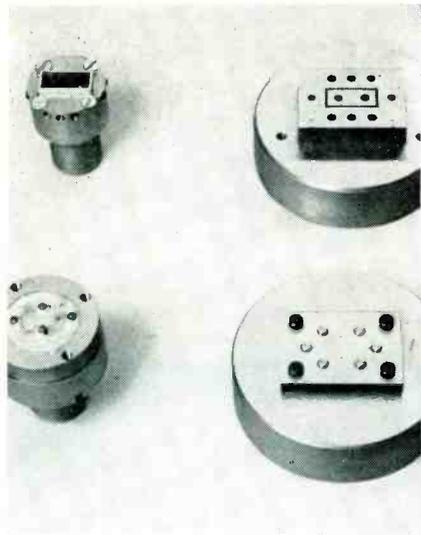


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soldering the stack, forming a solid unit which does not require continuous compression.

► **Example**—A complex multiple waveguide twist section was easily constructed of 0.005-inch thick brass stampings in the manner described above. In this case the assembly was soldered together in an electric oven. For the application in which this twist section was used, it was necessary that all the

Dies used for blanking out laminations (upper pair) and for punching the four alignment holes (lower pair)

waveguides have the same electrical lengths to a high degree of precision.

Initial measurements showed that over the 1.5 to 1 waveguide frequency range the electrical lengths of the four guides differed by as much as 8 degrees due to their slightly different physical lengths. Therefore the widths of the appropriate individual guides were increased, by honing with an abrasive piston, until all guides had electrical lengths within one degree of each other over this frequency range. The vswr of each guide was less than 1.02 over the full waveguide frequency range.

Watchmakers Assemble Transistor-Size Precision Relay

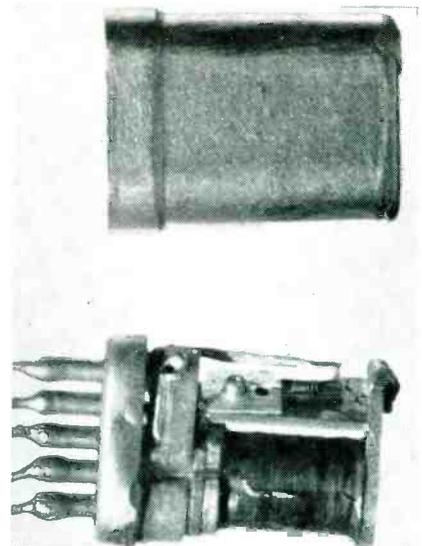
PRECISION subminiature relays now in mass production in the Electronics Division of Elgin National Watch Co. are hermetically sealed into transistor-size housings. Production teams with six years or more experience in watch work use jeweler's eye loupes or other magnifying lenses in almost every phase of assembly work on the new Neomite relay, which is $\frac{1}{2}$ inch long and weighs only 1/16th ounce.

► **New Adhesives Used**—Assembly of the relay starts with a pre-cast Mycalex glass-bonded mica or ceramic header. To this is bonded two main header wires, each having a tiny silver bushing. After assembling ten such headers on a 10-position assembly ring, a special epoxy resin bonding cement

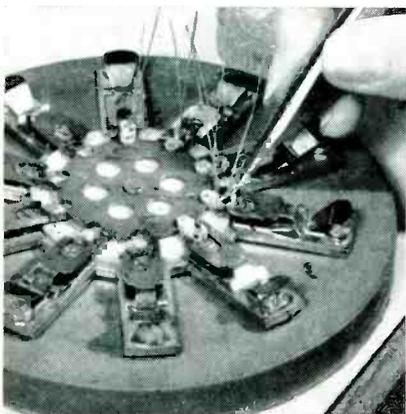
is applied to the headers and cured in an infrared oven. Tiny guide pins hold the assemblies in the fixture.

► **Tapping**—After curing, each header in turn is transferred to a precision holding fixture. Here one of the bushings is tapped with a watch-tapping machine to receive the microscopic contact screw, only 0.030 inch in diameter and 0.056 inch in length. If extended, the threads would measure 180 to the inch. The special tapping machine, having provisions for bringing the work smoothly up to the stationary tapping chuck, is essential to give the precision required.

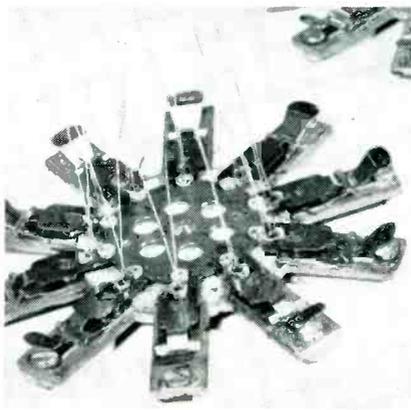
In the next step the ceramic header with three additional wire leads is bonded to a metal base,



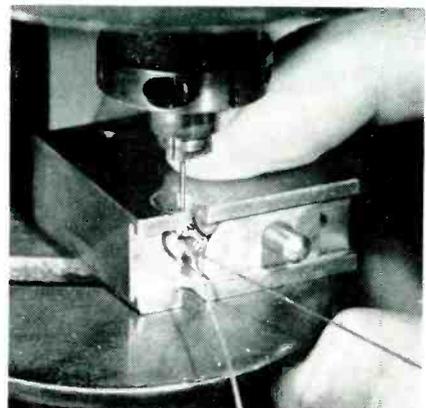
Appearance of relay when ready for hermetic sealing in transistor-size housing at top. Relay body is $\frac{1}{2}$ inch long and coil is only $\frac{1}{4}$ inch long



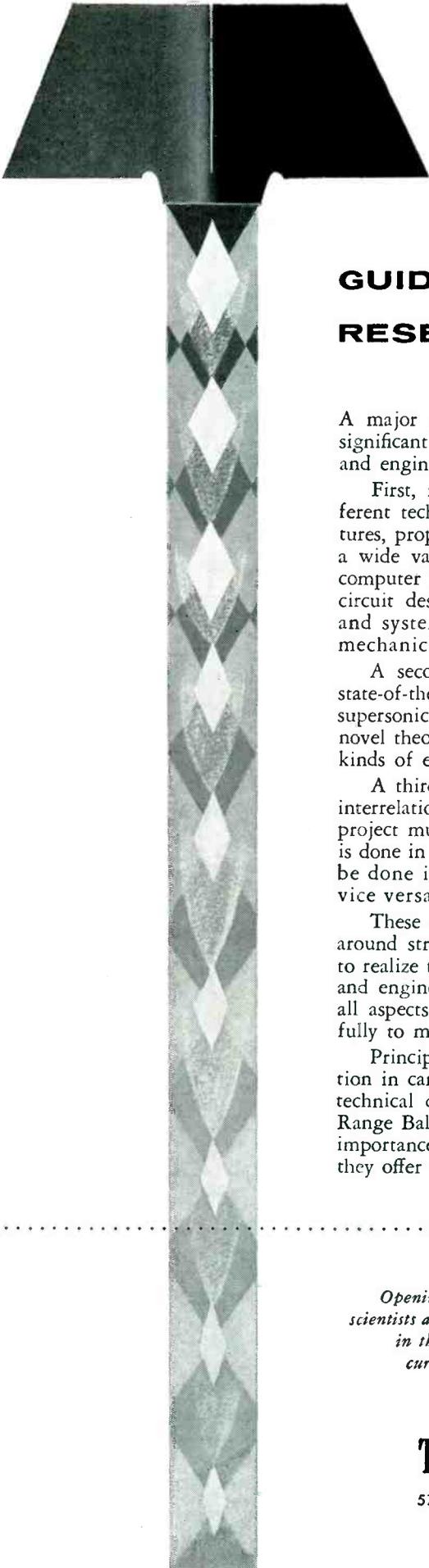
Placing wires in ceramic headers on 10-position fixture



Loaded fixtures go into infrared oven for curing of epoxy bonding material



Fixture holds header on watch-tapping machine for threading tiny silver bushing



GUIDED MISSILE

RESEARCH and DEVELOPMENT

A major guided missile research and development program has several significant characteristics that are of particular interest to the scientist and engineer.

First, it requires concurrent development work in a number of different technical areas such as guidance and control, aerodynamics, structures, propulsion and warhead. Each of these large areas in turn contains a wide variety of specialized technical activities. As an example, digital computer projects in the guidance and control area involve logical design, circuit design, programming, data conversion and handling, component and system reliability, input-output design, and environmental and mechanical design.

A second characteristic is frequently the requirement for important state-of-the-art advances in several of the technical areas. For instance, the supersonic airframe needed for a new missile may necessitate not only novel theoretical calculations, but also the design and performance of new kinds of experiments.

A third characteristic of missile development work is that such close interrelationships exist among the various technical areas that the entire project must be treated as a single, indivisible entity. For example, what is done in the guidance portion of the system can affect directly what must be done in the propulsion and airframe portions of the system, and vice versa.

These characteristics make it clear why such work must be organized around strong teams of scientists and engineers. Further, for such teams to realize their full potential, they must be headed by competent scientists and engineers to provide the proper technical management. And finally, all aspects of the organization and its procedures must be tailored carefully to maximize the effectiveness of the technical people.

Principles such as these have guided The Ramo-Wooldridge Corporation in carrying out its responsibility for overall systems engineering and technical direction for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. These major programs are characterized by their importance to the national welfare and by the high degree of challenge they offer to the qualified engineer and scientist.

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Welding relay coil lead to header wire with dental welder. Dial controls weld time

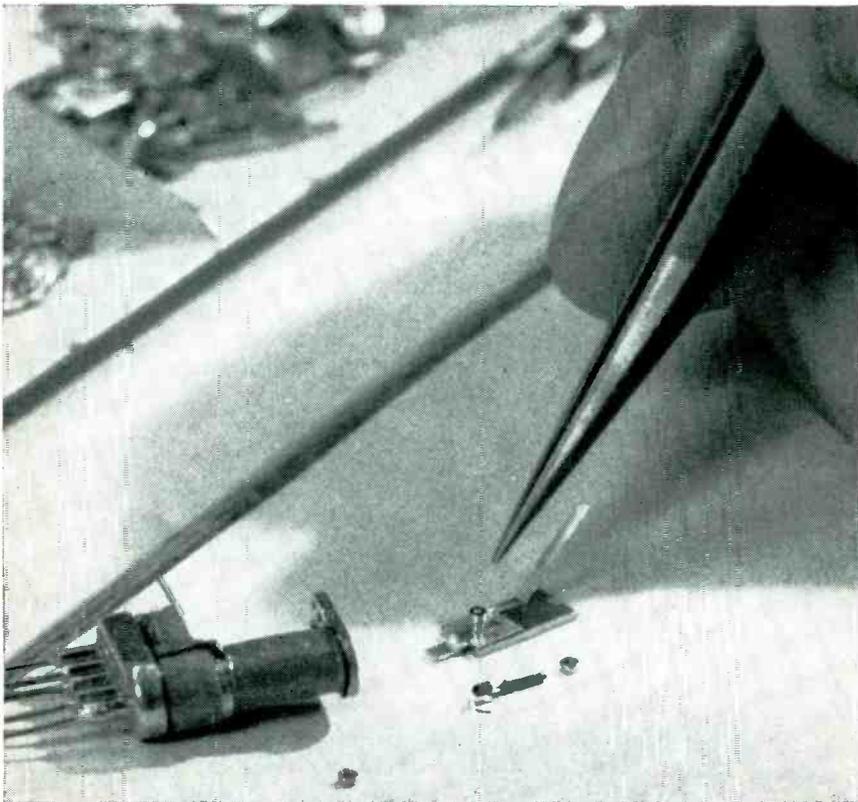
along with the H-shaped coil and frame assembly.

► **Welding**—Coil leads are fused to the contact screw and header wire with a special Dial-A-Weld pulsation welder of the type used in making dental braces. The operator sets the weld heat control for the desired heat level (welding current), then dials for the num-

ber of pulsations (usually one) needed to complete the weld. The dial thus controls weld time.

Final assembly involves inserting the tiny armature in the contact chamber of the ceramic header, then hinging the upper end of the armature to the top frame of the relay coil.

► **Training**—To facilitate person-



Tweezers point to banking pin (watch industry term) which runs through relay armature to prevent it from jumping out of position. Coil has already been mounted on relay header and armature goes on next

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- 4.1.2.2. Valve shall control downstream pressure under the following conditions:
- Max. ambient temp. 1040°R
 - Max. operating temp. 1420°R
 - Max. operating press. @ 1160°R = 275 P.S.I.A.
 - Regulated pressure req. 76 ± 2 P.S.I.G.
 - Min. operating pressure 8 P.S.I.G.
- 4.1.2.3. All valves shall be tested under the conditions shown in 4.1.2.2. with flows as shown in fig. 4.
- 4.1.2.4. Leakage at max. press. and temp. shall not exceed .10 lbs. per min.

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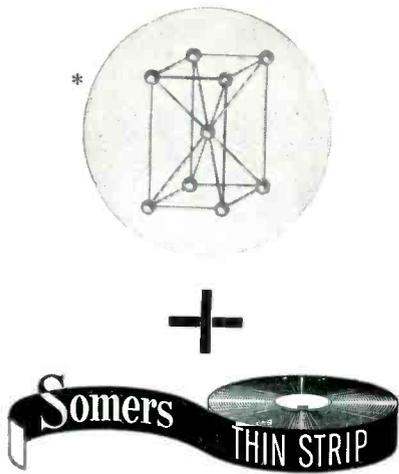
when required. AiResearch units have been on every U.S. built turbine powered aircraft since the first, and are now becoming the accepted standard on many foreign aircraft as well. We are prepared to provide solutions for the most difficult problems in this field.

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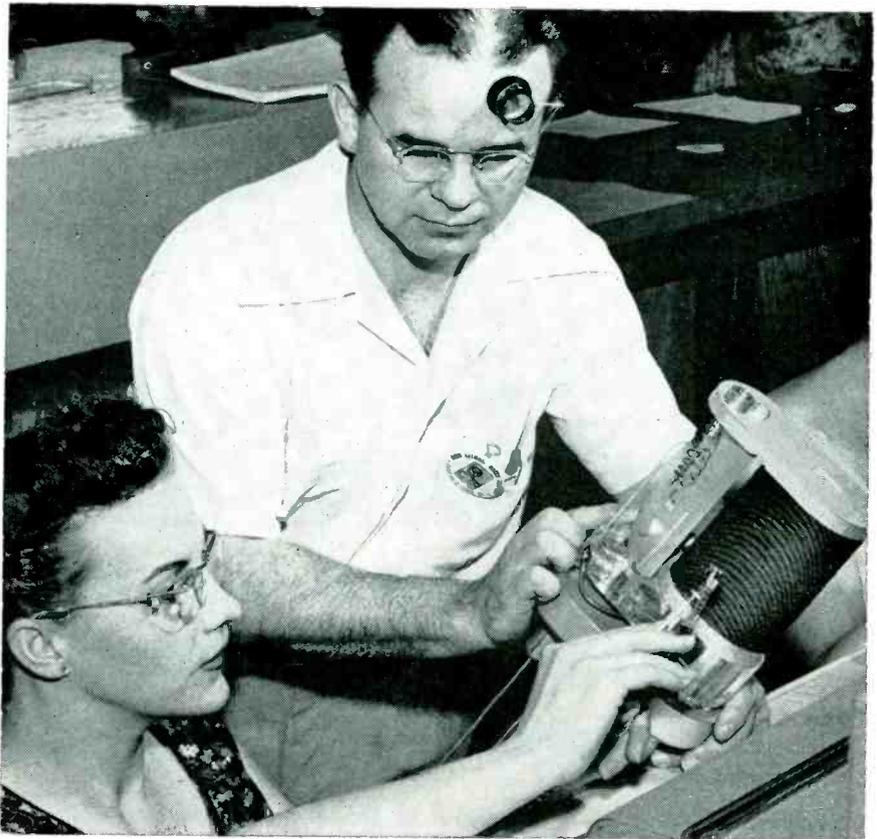
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nel training, an accurate model was built 20 times the size of the relay. A solenoid inside the large dummy coil produces armature movement when desired. Key adjustment areas can be clearly seen here by assemblers during training sessions.

► **Relay Specifications**—The relay coil, about the size of the head of a paper match, is wound with 6,600 turns of 1-mil wire (about half the diameter of a human hair) for one of the available operating voltages. Available coil resistances are

brushes for applying the special bonding agents and watch screwdrivers.

In inserting the tiny contact screws, the operator uses a special watch screwdriver which grips and holds the 0.0300-inch-diameter screw. This is necessary because the silver bushing is deeply recessed in the header and the screw itself is too small for holding with fingers while inserting. The tiny silver screws require extreme precision placement to prevent thread-stripping in the soft silver bushing. Screw tolerances are closer



Scale model of relay, 20 times actual size, aids in training operators to make delicate adjustments of contact screws, so small that over 8,000 are needed to fill a thimble

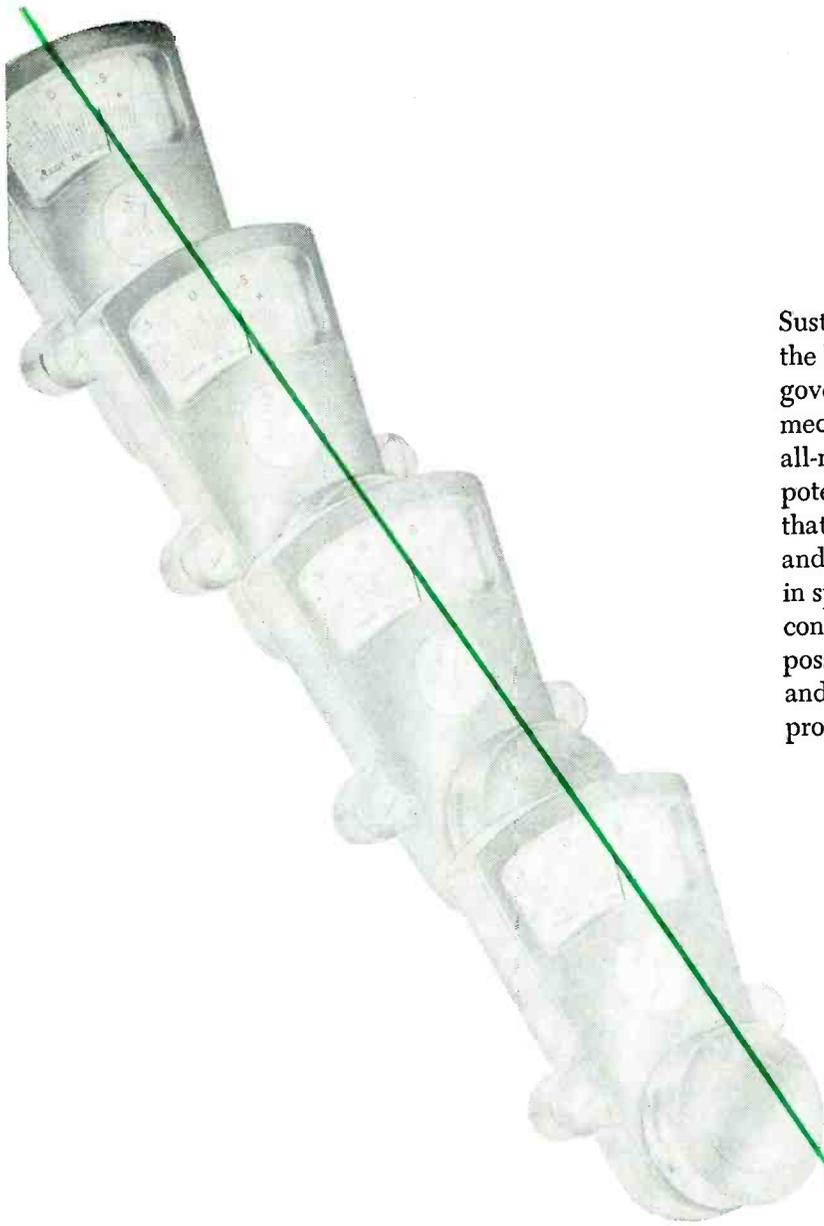
50, 100, 200, 500, 1,000 and 2,000 ohms, within a 10-percent tolerance, for d-c operating voltages of 4, 8, 12, 16 and 24 v respectively. The core bar is 0.086 x 0.025 inch in cross-section and 0.140 inch long. Contacts are arranged for single-pole double-throw operation.

► **Assembly Tools**—In addition to the jeweler's loupe, other watch tools used in assembling the relay include watch tweezers to handle delicate parts, watch feelers (wire probes for positioning), watch

than watch screw standards. Once set, the contact screws are bonded into place with a special thread-penetrating adhesive so electrical properties will not change.

Watch cleaning methods are used between production stages. These involve demagnetizing the relay so that foreign metal parts are washed away in the cleaning solution or drawn off by a special vacuum cleaner.

► **Final Tests**—After all electrical adjustments and tests have been



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

The sustained accuracy made possible by all-metal-case construction is now available in a 10-turn potentiometer. This unit has only $\frac{1}{2}$ the diameter and $\frac{1}{3}$ the weight of usual standards. It is the Fairchild Standard Type 920. Its $24\frac{1}{2}$ " coil length assures linearities of $\pm 0.25\%$ in a resistance range of 1,000 to 200,000 ohms, with $\pm 0.1\%$ available for special applications. Your choice of servo, threaded bushing or three-hole pilot bushing mountings.

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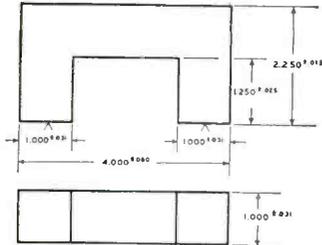
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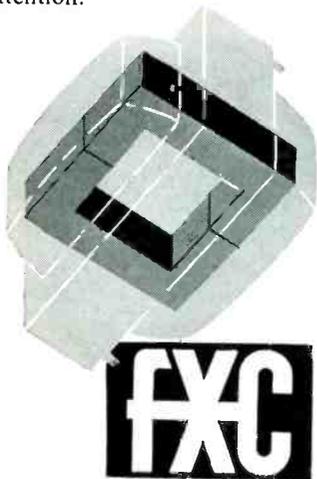
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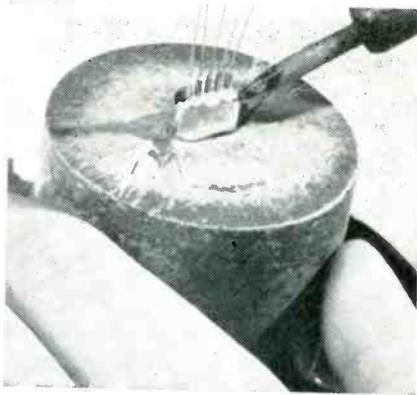


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Soldering relay housing to header for hermetic seal

made, the metal cover of the relay is soldered to the header to give a hermetic seal. This is done conventionally with a pencil-type soldering iron while the relay is in the recess of a heat-absorbing metal holding fixture. Care must be taken to avoid reheating the pre-soldered header wires and the bonding materials.

The operator tests the relay for a faulty seal with a standard surgical hypodermic needle. This has an elongated silver tube which is soldered into the relay evacuation opening. Air is pumped through the hypo into the relay while it is submerged in alcohol, to create bubbles if the seal is faulty. Alcohol, instead of water, is used since it will not aerate in long standing and will not damage the relay if it gets inside. In normal operation special metal containers with safety drop lids are used for the alcohol to minimize fire hazards.

► **Applications**—The finished relay is the size of a transistor and operates over transistor circuit power conditions. It has applica-

tion in airborne and land-based computers, control equipment for missile and other aircraft and portable communications gear.

Recently built into new aircraft control prototypes, the relay permitted weight reductions of several pounds. Since 1 lb of equipment necessitates about 10 extra pounds of airframe, the new relay will help to increase a plane's payload.

In tests at the Autonetics Division of North American Aviation, Inc., Downey, Calif., the relay was operated 4.5 million times without failure. As a result of this life test, it is being built into a new control device under study.



Applying air pressure with hypodermic syringe while relay is submerged in alcohol, to check for leaks. Flexible silver "needle" of hypo is soldered to relay evacuation opening

Paper Disks Identify Tube Defects

WHEN DEFECTIVE TUBES show up during alignment and testing of color television receivers in RCA's Bloomington, Ind. plant, the operator places a punched paper disk over the tube pins and marks on it the nature of the defect. This permits salvage of some of the tubes for less critical circuits and

expedites analysis of the causes of trouble in the other tubes.

► **Octals**—For octal tubes a heavy paper disk having a punched center hole is used. This fits snugly over the tube pins. The various types of defects encountered are printed on the disks, so



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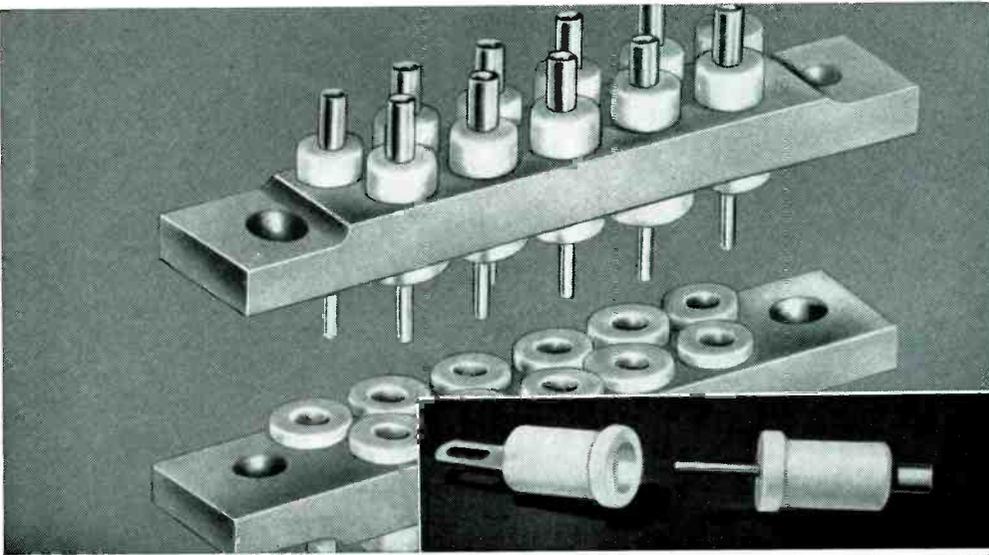
ELECTRONIC DESIGN

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NEWS

No. 12, 1956

Electronic connectors of Du Pont TEFLON® unaffected by temperature changes, humidity and mechanical shock



"Connectors of Teflon" with their respective mating parts. Male and female connector pins can be compression-mounted directly into drilled or

punched chassis holes. Available in various RMA colors. (Manufactured by Fluorocarbon Products, Inc., Division of United States Gasket Co., Camden 1, N.J.)

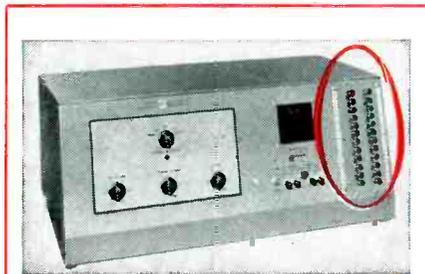
Laminations of TEFLON® for printed circuit bases

Typical uses for laminations of glass cloth and Du Pont "Teflon" tetrafluoroethylene resin include: conductor and ground insulation, hookup wire, power cable, printed circuit bases and structural parts. The laminations combine the dielectric properties, chemical inertness and heat resistance of "Teflon" with the tensile strength, resistance to cut-through, and resistance to creep of woven glass fiber.

An informative free bulletin describing the preparation and uses of laminations and impregnations of glass cloth employing "Teflon" tetrafluoroethylene resin is now available. Specify Bulletin X-64.

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Magnifying lens of LUCITE® for Stromberg-Carlson communication-system control panel. Names or numbers under the lens are magnified with maximum optical clarity—easily visible from a distance. "Lucite" resists cracking, crazing and chipping and is unaffected by age. (Lens extruded by Anchor Plastics Co., Long Island City, New York.)

New connectors with bodies of "Teflon" are designed for low-loss, high-frequency service in interconnection of radio, radar and other electronic equipment—where connectors are subjected to a wide range of temperatures, pressure, humidity and mechanical shock and vibration.

Continuous current rating is 3 amp. for .040 pins and 5 amp. for .063 pins. Voltage rating is 3,300 V. RMS (short time test at sea level).

Du Pont "Teflon" tetrafluoroethylene resin was selected for this particular insulation job because of its unique properties. In this application, it is serviceable at temperatures from -110°F and operates in pressure altitudes from sea level to 60,000 ft. It has zero water absorption by ASTM test D570-42.

"Teflon" is nonflammable and will not carbonize under arcing; it has good dielectric strength. Resiliency of "Teflon" enables the insulation to expand to original diameter after it is pressed into the hole—and locks the connector securely and permanently in place.

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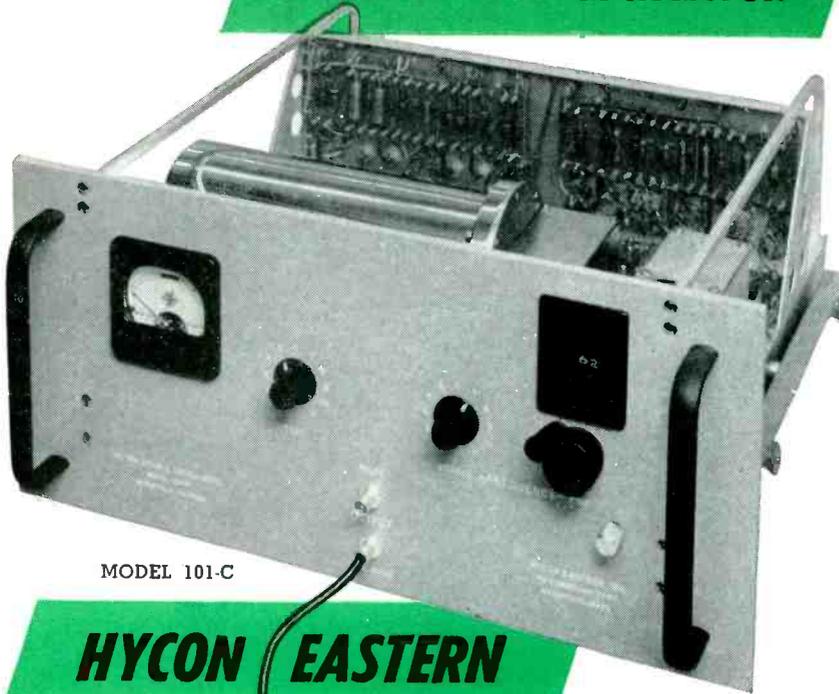
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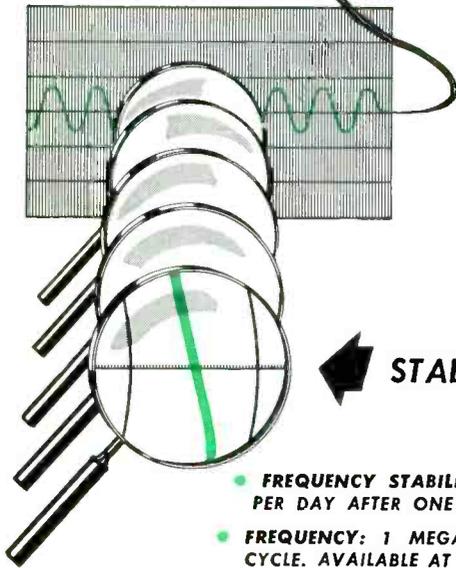
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MODEL 101-C

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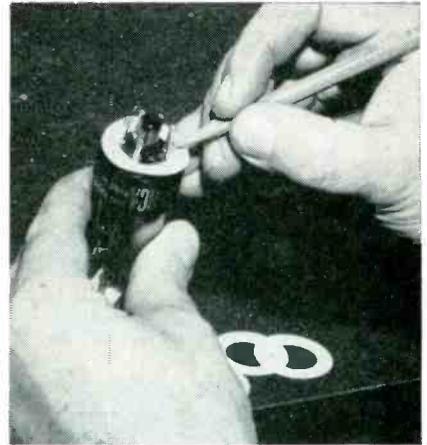
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- **FREQUENCY:** 1 MEGACYCLE, VARIABLE OVER A RANGE OF 1 CYCLE. AVAILABLE AT OTHER FREQUENCIES ON SPECIAL ORDER.
- **CRYSTAL OVEN:** STABILIZED TO BETTER THAN 0.01°C BY TEMPERATURE-SENSITIVE RESISTANCE BRIDGE. OVEN CONTAINS NO MOVING PARTS.
- **DISSIPATION IN OSCILLATOR CRYSTAL:** STABILIZED AT A POWER LEVEL LESS THAN ONE MICROWATT.
- **2 OUTPUTS:** SINE WAVE—4 VOLTS RMS; PULSE—1 VOLT.
- **OUTPUT IMPEDANCE:** APPROXIMATELY 250 OHMS.

Write for Ultra Stable Oscillator Bulletin

HYCON EASTERN, INC.

75 Cambridge Parkway Dept. A-12 Cambridge 42, Mass.
Affiliated with HYCON MFG. COMPANY, Pasadena, California



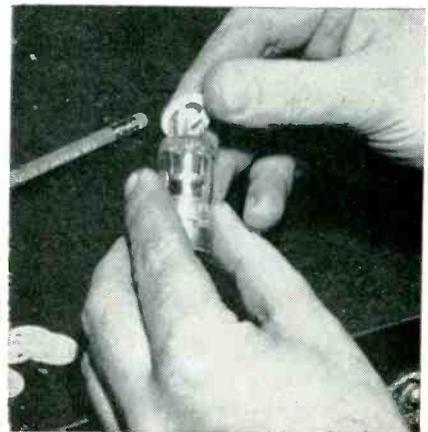
Checking tube fault designation printed on cardboard washer placed over pins of defective octal tube

the operator merely needs to check the type of trouble observed. These notations are: CUTS OUT; INTERM. NOISE; WEAK; HUM; DISTORT; OSCILLATES; MICROPHONIC; STOPS OSC.; DEAD; SHORT; OPEN; ELEC. NOISE; LOW GAIN.

► **Miniature**—For miniature tubes a smaller disk without printing is

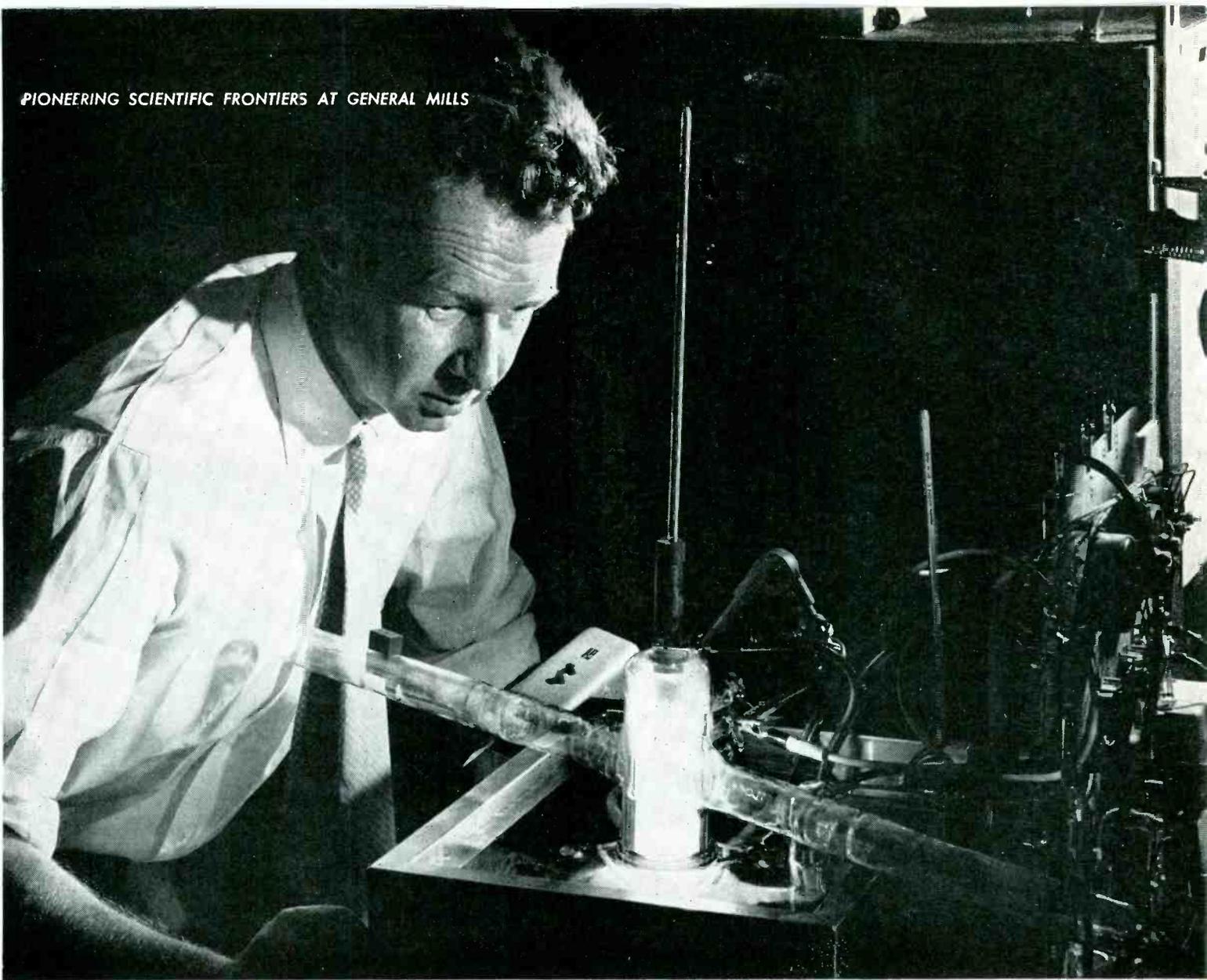


Examples of disks used for identifying tube faults. Smaller disk, for miniature tubes, is made at same time as large disk by punching the three holes in the otherwise wasted center area of the larger disk



Placing three-hole disks over pins of defective miniature tube after writing code letter for fault on center of disk





This scientific pioneer is Dr. G. K. Wehner, designer of the space chamber which he uses here to determine the "sputtering" or disintegration rate of molybdenum under bombardment from atoms moving at 25,000 m.p.h., 200 miles above the earth.

What happens to metals at 25,000 m.p.h. 200 miles up?

General Mills scientists are finding some of the answers to this question, which bears directly on space ships and man-made satellites.

Their findings indicate that materials to be sent into space must possess properties not found in today's ores and alloys. Since few new metals remain to be discovered, they conclude that present ones must be given new properties to cope with the heat barrier and to keep vehicles from disintegrating under particle bombardment.

The study of metals in space flight represents but a single phase of General Mills' over-all program of advanced

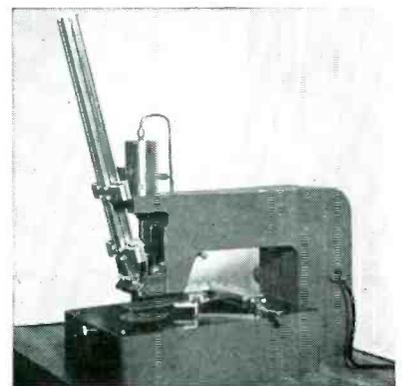
exploration in theoretical and developmental physics.

Findings in this "research for tomorrow" are being translated regularly into practical applications for industrial and military use today. If you have product or production problems, you can profit from these applications, and from our high-level production facilities.



Send for Production Facts

This interesting booklet tells the story of how you profit by giving us your difficult production problems. Write Mechanical Division, Dept. EL 12, General Mills, 1620 Central Ave. N. E., Minneapolis, Minn.



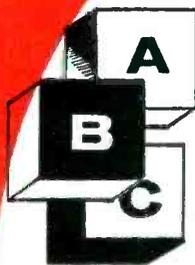
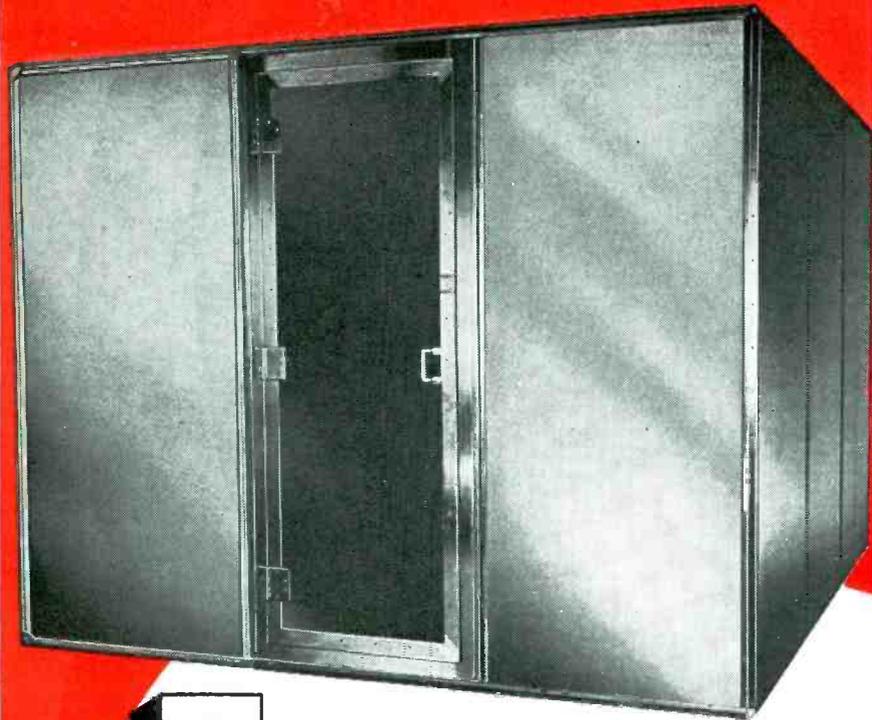
AUTOFAB: built for the present

From General Mills' creative research and precision manufacturing come machines for industry to use today — machines such as *Autofab*, for near-automatic assembly of electronic components on printed circuit boards.

MECHANICAL DIVISION OF General Mills

CREATIVE RESEARCH AND DEVELOPMENT + PRECISION ENGINEERING AND PRODUCTION

NEW SHIELDING'S UNIVERSAL ENCLOSURE



EASY TO INSTALL

A Shielding Universal Enclosure can now be erected by using **only** a screwdriver! . . . saves time and labor costs . . . your choice of modular panels of single or double shielding.

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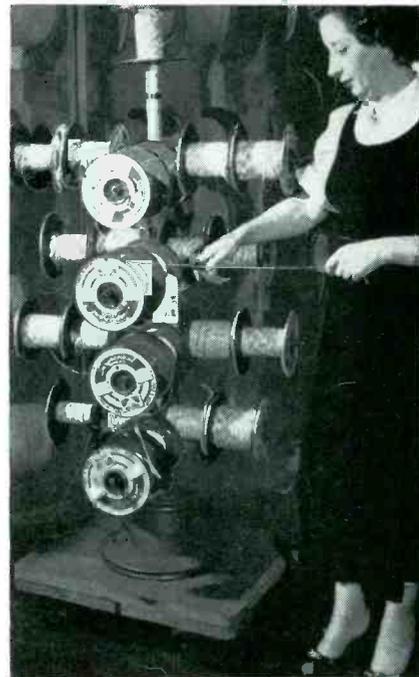
SHIELDING INC.

Dept. E-2 • Box 217 • RIVERSIDE, NEW JERSEY

In Chicago, R. W. Stemm In Canada, MJS Sales Ltd.

used. This has three punched slots for the pins. Here the operator writes in the center of the disk a code letter designating the type of fault, then pushes the disk over the tube pins. Code examples are: S—short; O—open; A—arcing; B—broken glass; D—dead; G—microphonic; P—plate cap loose; W—weak.

Tree Holds Wire Spools



Removing length of wire from spool on tree. Dolly permits moving entire tree readily to input end of Artos machine when desired

PIPES AND pipe fittings mounted on a dolly hold a total of 34 different spools of hookup wire in position near an Artos wire stripper, so any desired wire can easily be pulled out and fed into the stripper. Alternatively, assembly line workers can walk over to the tree and quickly cut out lengths of wire in the desired color and size.

As constructed at Ford Instrument Co., Long Island City, N. Y., the wire tree uses a conventional heavy-duty dolly for its base. To this is bolted a large empty wire spool, as a bearing for the vertical pipe. Smaller rods or pipes go through drilled holes in the vertical pipe at right angles to form the supports for the spools. Each

Mr. A. Brunetti
Autonetics
Engineering Personnel
P.O. Box AN
Bellflower, Calif

June 1, 1954

Dear Mr. Brunetti

I would like details on career opportunities in the Autonetics Division of North American. I am chiefly interested in two aspects: work that is really worthwhile and creative; and a corresponding opportunity to advance on my merits. Though my present job is satisfactory, I feel that a greater

This letter moved a man ahead 5 years

Two years ago a man took 10 minutes to write this letter. Today he enjoys the responsibility and professional standing in the AUTONETICS Division of North American that might have taken 7 to 10 years to achieve in other fields.

THE FIELD AT AUTONETICS—A FIELD OF OPPORTUNITY

Now under way at AUTONETICS are nearly 100 projects, comprising some of the most advanced and progressive work being done today in the fields of Electronics, Electro-Mechanics, Control Engineering and Data Processing.

You will work on automatic control systems of many kinds, for manned and unmanned vehicles. Every state of the art is represented, from preliminary conception right through flight testing. Facilities are the finest obtainable. Your colleagues will be men of ability and imagination, of the highest professional standing.

The long-range potential in this field is truly limitless. The techniques being developed at AUTONETICS today will have the widest application in the industrial methods of tomorrow.

You owe it to yourself to consider how far you can advance by entering this exceptionally promising field right now. Here are the opportunities:

COMPUTER SPECIALISTS • COMPUTER APPLICATION ENGINEERS • ELECTRO-MECHANICAL DESIGNERS • ENVIRONMENTAL TEST ENGINEERS • ELECTRONIC COMPONENT EVALUATORS • INSTRUMENTATION ENGINEERS • FIRE CONTROL SYSTEMS ENGINEERS • FLIGHT CONTROL SYSTEMS ENGINEERS • ELECTRONIC RESEARCH SPECIALISTS • AUTOMATIC CONTROLS ENGINEERS • ELECTRONIC ENGINEERING WRITERS • INERTIAL INSTRUMENT DEVELOPMENT ENGINEERS • PRELIMINARY ANALYSIS AND DESIGN ENGINEERS • RELIABILITY SPECIALIST

Write your letter today. Decide now to get the facts, so you can make the most of your potential. Just put your address and brief qualifications on paper—handwritten will be fine. Reply will be prompt, factual, confidential.

Write: Mr. A. Brunetti, Autonetics Engineering Personnel,
Dept. 991-12E, P. O. Box AN, Bellflower, California

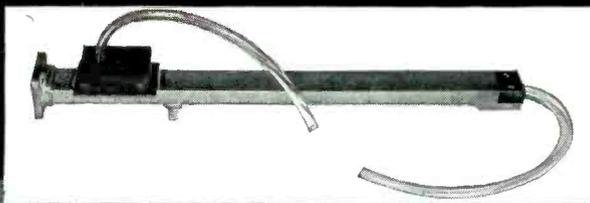
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A DIVISION OF NORTH AMERICAN AVIATION, INC.



A U T O M A T I C C O N T R O L S M A N H A S N E V E R B U I L T B E F O R E

Accurate, rapid microwave power measurements



projecting small pipe holds two spools, the outermost being kept in position by a cotter pin, nail or simply a piece of bent wire inserted in a drilled hole. An additional small pipe inserted into the top of the tree holds two or more additional spools.

Spools of wire are arranged according to color in the order of the standard color code, with single colors at the top of the tree and bicolored wire at the bottom. Knowing this, the operator can quickly locate the desired wire without having to hunt over the entire tree.

Motorized Vertical Rack Stores 50 Tote Trays

METAL TOTE TRAYS filled with heavy and bulky components are stored in a minimum of floor space right in the assembly area through use of an 18-foot-high motorized endless-

New Calorimeter, X-Band Water Load!

Now Sierra offers a new and highly convenient means of obtaining accurate measurements of power from a few watts to kilowatts—at any frequency 7 KMC to 10 KMC.

Model 190A Calorimeter, together with Model XB187A Water Load, measures rf power with approximately 2% accuracy. The Meter consists of a differential thermopile, millivoltmeter, long flow-path valve, water calibrator heater, and appropriate calibrating switches, meter damping resistors, etc. It operates by measuring the temperature of water before and after power has been dissipated in the water load, and presenting the differential on the millivoltmeter.

Model XB187A Water Load, designed for use with 190A Calorimeter, has frequency range of 7 KMC to 10 KMC, VSWR less than 1.2 over full range.

SPECIFICATIONS

Model 190A Calorimeter

Full Scale Ranges: 300, 600, 1,500, 3,000 w.

Max. Pressure: 50 psi.

Meter Sensitivity: 1.5 millivolts

Thermopile Sens.: 1 mv per °C.

Weight: Approx. 21 lbs.

Dimensions: 8 1/4" x 9" x 17".

Model XB187A X-Band Water Load

Frequency Range: 7 KMC to 10 KMC.

VSWR: Less than 1.2 full range.

Power: 1 Kw cw, 30 Kw peak.

Coupling: UG-52/U choke flange.

Probe: Fixed. BNC UG-290/U.

Size, Weight: 18 1/2" long. App. 2 1/4 lbs.

Specifications subject to change without notice.



New! Model 189A Differential Thermopile

Converts differential temperatures in flowing liquids to electrical energy. Has 30 pairs of copper-advance junctions enclosed in watertight case. Electrical connections through sealed banana jacks. Water connections to 1/4" tubing through Uniflare fittings. Internal resistance approx. 5 ohms; output voltage approx. 1 mv per °C; max. pressure 75 psi; wt. 15 oz. Write for bulletin!

Sierra Electronic Corporation

San Carlos 2, California, U. S. A.

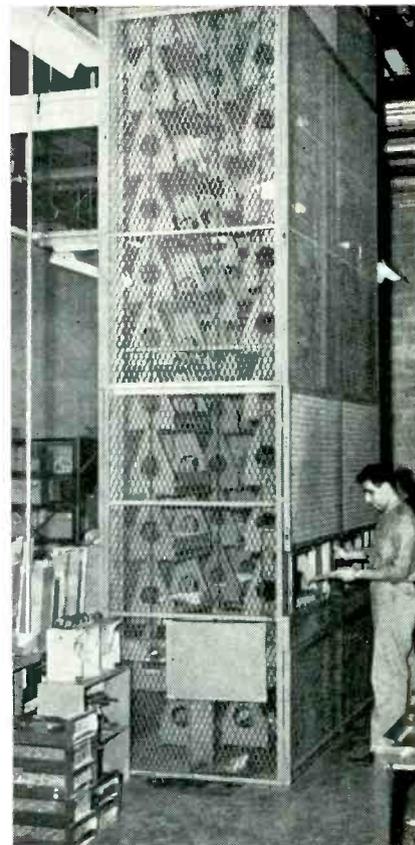
Canada: Atlas Radio Corporation, Ltd.

Toronto, Ontario

Manufacturers of Carrier Frequency Voltmeters, Directional Couplers, Wave Analyzers, Line Fault Analyzers, Wideband RF Transformers, Custom Radio Transmitters, VHF-UHF Detectors, Variable Impedance Wattmeters, Reflection Coefficient Meters, Calorimeters, Water Loads, Thermopiles, Ion Gauge and Ion Gauge Amplifiers, Phase Changers.



Sales representatives in major cities



Storage unit rises 18 feet above plant floor, yet gives access to any one of 50 trays in a few seconds. Stock clerk is pushing motor control button. Trays were formerly stored under workbenches or in piles on floor as at left



Dore Schary, Head of M-G-M Studios, tells how:

“I send Liz Taylor home every night!”

“‘Raintree County’ is colossal in every respect — including its problems! Shooting schedules have to be kept. Release dates have to be met. Over \$5,000,000 is at stake!

“Yet, each night we have to send Elizabeth Taylor’s ‘rushes’ — and all the others, too — from location in Kentucky back to Hollywood for processing. Then, re-take if necessary — or go ahead.

“We never slipped off schedule — thanks to Air Express!

“With Air Express picking up the cans of film, flying them out immediately, meeting them by radio-controlled truck for faster delivery — this major problem was solved without a single delay!

“And yet, most of our shipments cost less than any other air service. 15 lbs., for instance, Lexington, Kentucky, to Los Angeles, California, is \$10.91. It’s the lowest-priced complete air service by \$1.09!”



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KODAK COLOR PRINTER

USES



LOGARITHMIC POT FOR PRECISE

EXPOSURE
TIMING



An important requirement in the design of the precision Kodak Color Printer, Model 1599C, is its highly accurate electronic exposure timing device. Rigid specifications set by Eastman Kodak Co. engineers for a precision 6:1 ratio logarithmic potentiometer were met by TIC — specialists in the design of non-linear function potentiometers.

TIC manufactures standard 50 db and 20 db logarithmic potentiometers of high resolution and high conformity. The unique double-contoured resistance-element card makes possible the high accuracy of all TIC non-linear potentiometers. This card design (contoured symmetrically on both edges) also permits greater flexibility in the design of non-linear functions—flexibility required for special designs like the pot used in the Kodak Color Printer.

Low temperature coefficient of resistance . . . high resolution . . . complete environmental protection . . . and precision mechanical construction add to the high conformity and reliability of TIC non-linear potentiometers. As leaders in the field, TIC design experience can help you in selecting a non-linear pot, standard or special, for your application.

Complete specifications on TIC non-linear potentiometers available upon request.

TECHNOLOGY INSTRUMENT CORP.

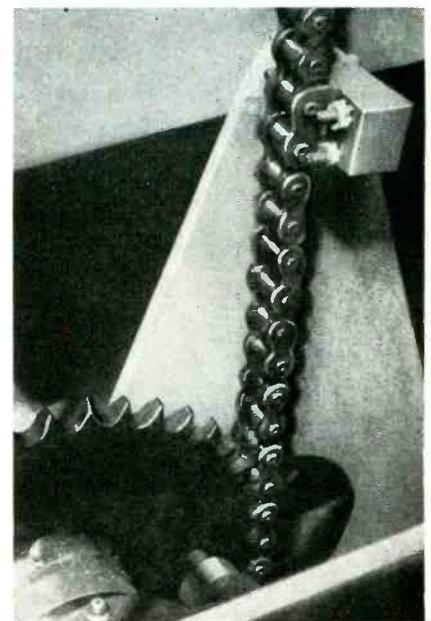
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West Coast Mail Address, Box 3941, No. Hollywood, Calif., POplar 5-8620



Transferring tote tray from storage machine to cart, for moving to work position. Tray design includes conical steel pegs for safe stacking and raised handles to protect parts when trays are stacked

chain vertical storage machine in GE's Light Military Electronic Equipment Department in Utica, N. Y. Pushbuttons at the loading and unloading windows control a reversing motor to get quick access to a desired tray of parts.

Suspension hangers for the trays are bolted to angle brackets riveted



Method of anchoring tray bracket on chain. Below is idler sprocket wheel for preventing side sway

RMC DISCAPS



Modern research, manufacturing, and testing methods have made RMC DISCAPS the standard of performance throughout the entire electronics industry. Leading manufacturers of electrical and electronic products have established this standard by continuing to specify DISCAPS where specifications call for ceramic capacitors.

In a temperature compensating capacitor, RMC Type C DISCAPS have proved ideal for VHF and UHF applications because of smaller size and lower self-inductance. Available in a wide range of temperature coefficients and capacities, all type C DISCAPS are rated at 1000 working volts to provide a higher safety factor than other standard ceramic or mica capacitors.

Write today on your company letterhead for information on standard or special ceramic capacitors.

world-wide standard of quality

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RMC

RADIO MATERIALS CORPORATION

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ENGINEERS & PHYSICISTS

Electronics

APL—An Organization Of And For Technical Men And Scientists

The Applied Physics Laboratory (APL) of the Johns Hopkins University is an organization of and for technical men and scientists. Several factors allow for more effective utilization of "mind power" at APL. They lead to tangible and intangible satisfactions for staff members that could not be gained elsewhere.

Among them are:

1. Individual staff members are given a measure of responsibility and initiative much greater than in many comparable establishments. Decision-making, on all levels, is placed in the hands of scientists and technical men.
2. Staff members do not restrict their efforts to limited technical problems. Instead they are asked to assess and solve problems of a systems nature, including analyses of complete tactical problems.
3. APL handles technical direction of the work of many associate and sub contractors, including 21 universities and leading industrial organizations. As a result, APL staff members enjoy a rewarding exchange of ideas and techniques with other leaders in R & D.
4. The combined facilities of APL, its associate and sub contractors, and Government test stations provide opportunities for members of its technical staff to develop and exploit their varied capabilities in a unique environment where teamwork and individual initiative are fused.
5. This esprit and freedom to look into new concepts has resulted in a number of "quantum jumps" in defense capability, including the proximity fuze, the first supersonic ramjet engine, and the Navy's Bumblebee family of missiles which includes TERRIER, TALOS and TARTAR. APL is presently attempting breakthroughs on several important fronts.

APL'S expansion program recently witnessed the completion of new laboratories covering 350,000 sq. ft. in Howard County, Maryland, equidistant from Washington, D. C. and Baltimore. Men of originality are invited to inquire about staff opportunities. Salaries compare favorably with those of other R & D organizations.

OPENINGS EXIST IN:

ANALYSIS: Dynamic analysis of closed-loop control systems; analysis and synthesis of guidance systems; counter-counter-measures systems; electrical noise and interference.

DESIGN: Control and guidance circuitry; telemetering and data-processing equipment; microwave components, antennas, and radomes; transistor and magamp applications; external missile systems.

TEST: Prototype engineering and field test evaluation.

For Additional information write: Professional Staff Appointments

The Johns Hopkins University Applied Physics Laboratory

8609 GEORGIA AVENUE,

SILVER SPRING, MD.

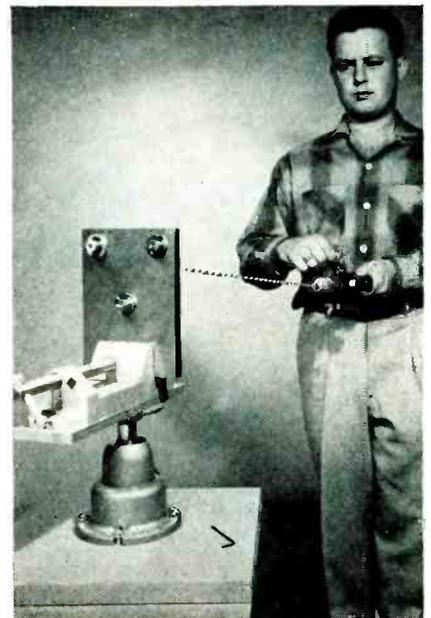
directly onto the heavy-duty roller link chain. The brackets are pivoted to swing freely as they go around the sprocket wheels at the top and bottom.

► **Construction Details**—The machine has two sets of chains, each holding 25 carriers, to give a total capacity of 50 trays. The drive motor is mounted at the top between the sections, to drive both simultaneously. The weight of the storage load on the chains keeps them from slipping off the teeth of the drive sprockets, such as occurred when the motor was initially mounted at the bottom.

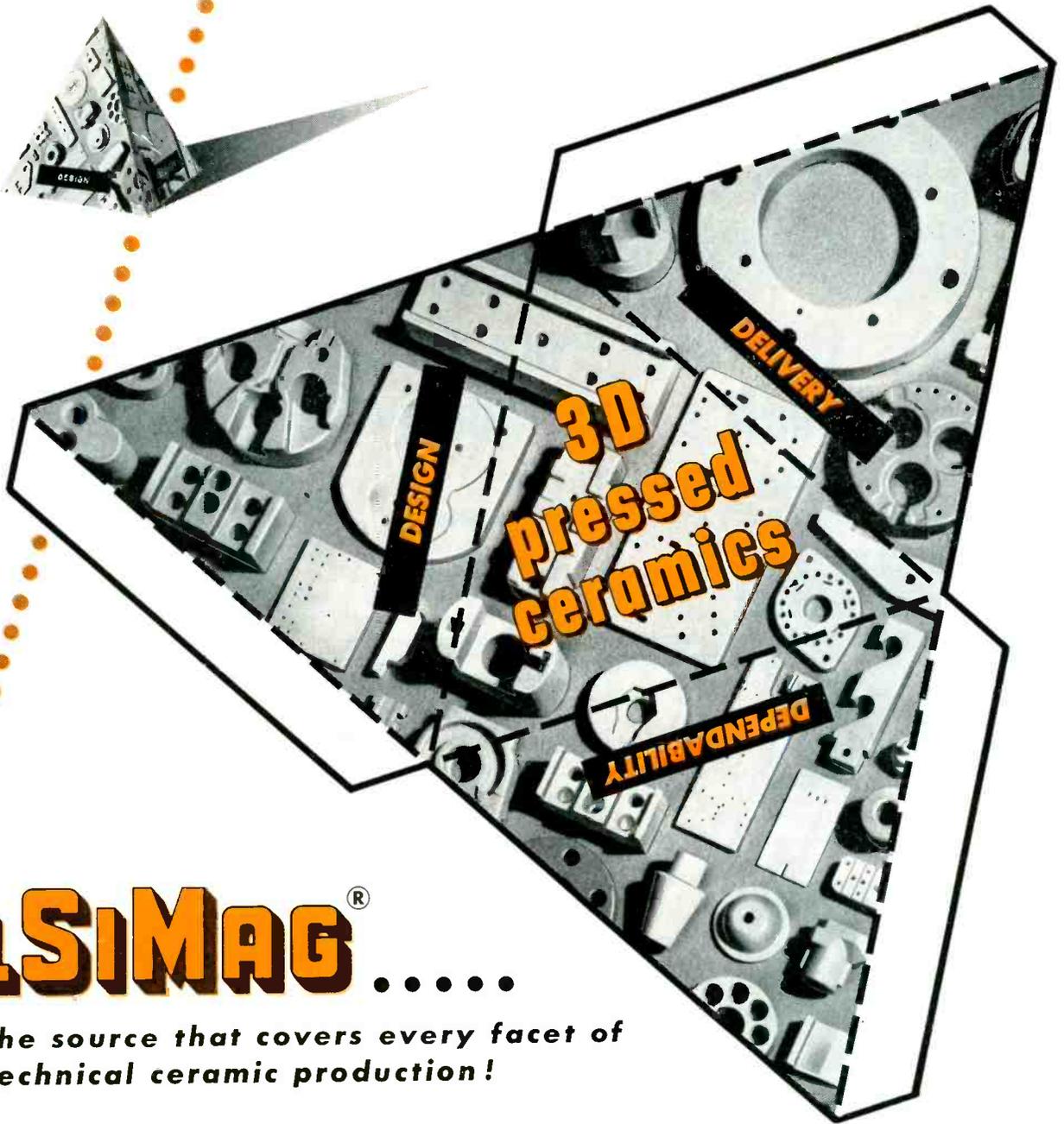
Wire-Twisting Setup

TWISTED WIRE that won't untwist is produced faster and more uniformly with the aid of a special wire-holding fixture developed by William Hargrave of the Special Products Department of Consolidated Engineering Corp., Pasadena, Calif. Formerly the ends of the wire were held in a vise and a drill was used to turn the separate strands. The drill method often broke the wire and the strands were never turned enough to keep the wire from untwisting as soon as tension was relaxed.

The new setup turns out an



Ball-bearing fixture permits anchored ends of wires to turn independently of each other while wires are being twisted together



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DELIVERY—As promised. Facilities for any volume. Line-ups of modern, high-speed automatic presses—rotaries, single stroke types, domestic, imported. Specialized equipment for every operation. Dies produced in our own shop. Enormous kiln capacity. Staffed by experts dedicated to getting jobs done!

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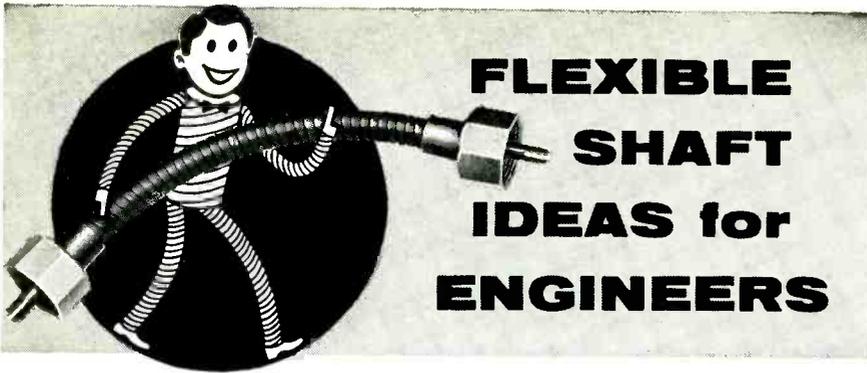
Your problems might be solved by ALSiMag Pressed Ceramics. Why not try them and see? Send blueprint or sketch with details of operating procedure for complete information.

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FLEXIBLE SHAFT IDEAS for ENGINEERS

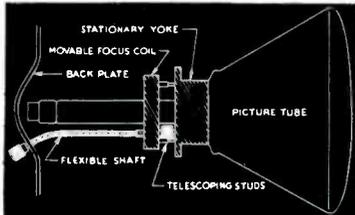
4 Ways to profit from a flexible shaft's adaptability

Ideas that may help you design better drives and controls for electronic equipment

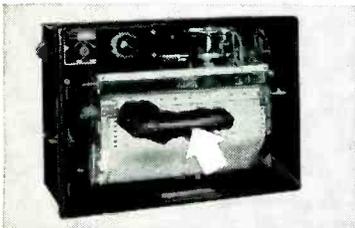
S.S.White flexible shafts easily solve these design problems



Control of inaccessible parts is easily accomplished by running a single remote control flexible shaft between the controlled element and its control knob.



Mounting controls in convenient operating positions is easier when a flexible shaft is used as the coupling. The shaft allows the control to be mounted wherever desired.



Alignment problems are never a factor when you use flexible shafts to couple two parts. Its flexible construction automatically compensates for misalignment.

1. Eliminating Alignment Problems

Where misalignment exists, or where accurate alignment of drive and control elements is likely to be costly and time-consuming, an S.S.White flexible shaft is a "must." The flexible shaft automatically compensates for misalignment, thereby simplifying assembly and eliminating possible operating troubles.

2. Providing Adjustable Drives

Where there is relative movement between driving and driven parts, or where the driven part must be moved or adjusted in operation, an S.S.White power drive flexible shaft is an economical, dependable way to transmit power between the two. The shaft readily adapts itself to any operating position and is capable of giving long trouble-free service.

3. Gaining Extra Design Freedom

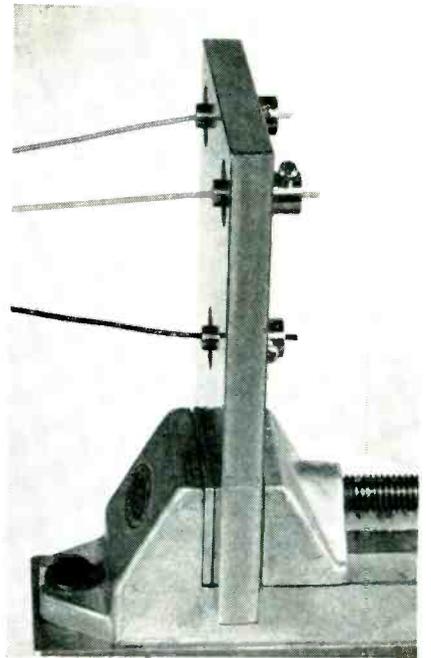
Consider the use of S.S.White flexible shafts if you want to gain greater freedom in positioning drive and control elements in their most desirable locations. It will simplify the job of meeting specific operating and service requirements.

4. Satisfying Space Limitations

Flexible shafts are more adaptable, less complicated, less expensive and considerably more compact than systems of bevel gears, straight shafts, belts, pulleys, etc. Their use allows you to develop more efficient, more compact equipment.

FLEXIBLE SHAFT INFORMATION

Bulletin 5601, a helpful informative guide on flexible shaft construction, selection and application, will be sent on request. Write for your copy.



Details of fixture. Set screws hold wires in ball-bearing collars

average twist job in 30 seconds, as compared to 10 minutes before. From two to four wires up to 25 feet long, in sizes from No. 10 to No. 22, can be twisted together easily now without injury to insulation and without kinks. Even longer wires can be twisted in the smaller sizes.

► **How It Works**—The setup consists of a steel plate held in a vise or other holding device, into which have been bored three holes just large enough to take (press-fit) three modified ball bearings. The inside of each bearing has a collar with screw attached to hold the single strand of wire. Each of the three bearings is free to turn within its mounting in the steel plate.

Quick-Drying Resist for Etched Wiring

BAKING OR DRYING of resist is eliminated in the production of etched wiring through use of a new silk-screen press developed by Dry Screen Process, Inc., 801 Brighton Road, Pittsburgh. Circuit boards can be printed and etched, the resist removed and board punched ready for assembly within 14 minutes. Etching is clear and sharp, free from noticeable undercutting

S.S. White

FIRST NAME

IN FLEXIBLE SHAFTS

FG-6A

S. S. WHITE INDUSTRIAL DIVISION, DEPT. E, 10 EAST 40th ST., NEW YORK 16, N.Y.

Western Office: 1839 West Pico Blvd., Los Angeles 6, Calif.

THE ONE UNIVERSAL METER

MICROVOLTS TO KILOVOLT



The KAY LAB Model 203 is a combination DC microvolt-ammeter and amplifier. It provides an exceptionally wide range of measurements. Fifteen voltage ranges cover from 100 microvolts full scale to 1000 volts full scale, with 100 megohms input impedance. Ten current ranges cover from 100 micro-microamperes full scale to 100 milliamperes full scale. As little as 10 microvolts or 10 micro-microamperes may be measured with accuracy. The uncluttered zero-center meter face instantly indicates polarity on a mirrored scale. When used as a DC amplifier, the instrument features exceptionally low drift with high gain, very high input impedance and low output impedance. Gains up to 80 db with less than 10 microvolts drift may be obtained. The Model 203 utilizes KAY LAB's unique chopper stabilized circuit to provide high sensitivity with previously unobtainable drift-free stability and high input impedance.

APPLICATIONS: Electronic, medical, geophysical, chemical, metallurgical research and development... transistor production and circuit design... thermocouple calibration... null detector... recorder driver amplifier... and as a general purpose laboratory instrument wherever dc voltages and currents are measured or amplified.

SPECIFICATIONS

Voltage Range (full scale).....100 μ v to 1000v
 Current Range (full scale).....100 μ μa to 100 ma
 Input Impedance.....10 megohms below 10 mv,
 30 megohms at 30mv,
 100 megohms above 30mv
 Impedance Accuracy.....±1.5%

Accuracy on All Ranges.....±3% of full scale
 Maximum Gain as Amplifier.....80 db ±1.5%
 Output Rating.....1v across 1000 Ω
 Output Impedance.....less than 5 Ω
 Drift (after 15 min. warmup).....10 μ v equivalent input
 Price.....\$550.00

Rack Mounting available as Model 203R



STABILITY



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WITH CHOPPER AMPLIFIERS

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UNION

SPACE SAVER "Selenium Slim" Rectifiers

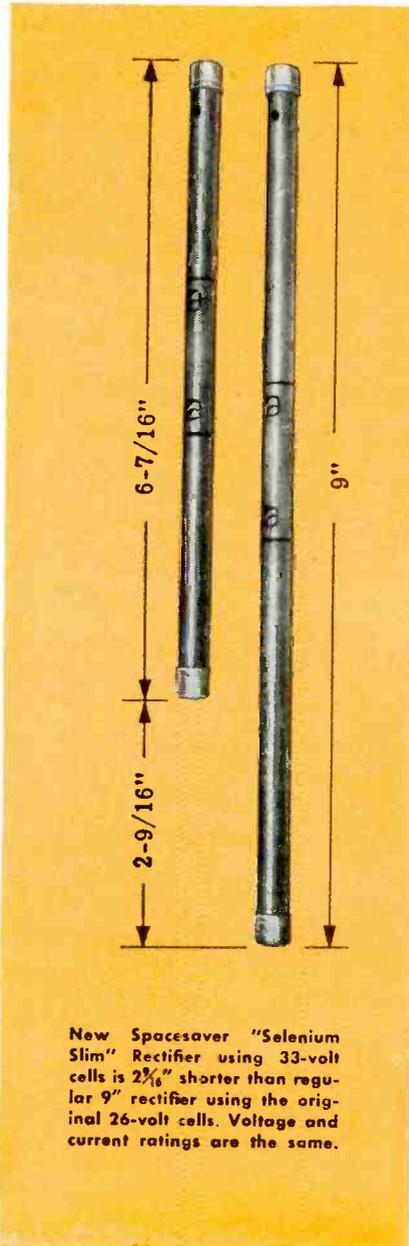
A COMPLETE line of UNION "Selenium Slim" Rectifiers is now made with a new cell which has a reverse voltage rating of 33 volts rms and is approximately 20% thinner than the previous cell.

These Spacesaver rectifiers offer more compact, efficient rectifier units and permit rigid space and performance requirements to be met. What's more, UNION's radically different manufacturing method for these miniature cells results in lower prices.

UNION Selenium Tubular Rectifiers, especially developed for high-voltage, low-current applications, are available in physical cell sizes from $\frac{1}{8}$ to $\frac{1}{2}$ inch in diameter and are rated 1.25, 2.5, 5, 10 and 20 milliamperes, D. C. per cell, in a half-wave circuit supplying a capacitive load. They are made for fuse-clip type mounting or with axial end leads. Available in both phenolic or hermetically sealed glass tubes.

A new, 33-volt, UNION selenium power rectifier cell is also available. Cells range in physical size from 1" x 1" to 5" x 6" and are designed for stud, bolt or bracket mounting. Ratings range from .180 to 10.0 amperes per cell on a single-phase, full-wave bridge basis in accordance with the latest NEMA approved specifications.

Write for complete information.



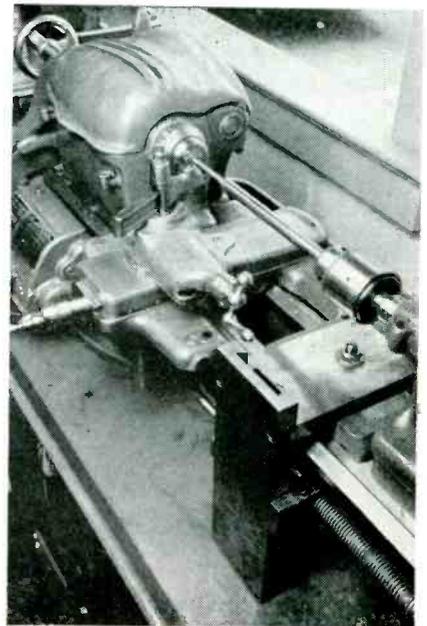
New Spacesaver "Selenium Slim" Rectifier using 33-volt cells is $2\frac{7}{16}$ " shorter than regular 9" rectifier using the original 26-volt cells. Voltage and current ratings are the same.

or pitting, and no hand tooling is required.

Basic principle is the use of thermoplastic acid resist which is held in its hot liquid state before and in the screen. The acid resist dries immediately on contact with the cooler copper-clad surface, coming off the press perfectly dry. Since no baking or drying is required, the circuits go directly to the etching step. After easy solvent removal of the resist, they are ready for drilling and assembly.

Cutting Nonlinear Screws For Permeability Tuners

A SIMPLE LATHE ATTACHMENT for cutting screw threads with a nonlinear pitch consists of a vertically moving cam plate that bears against the tool holder carriage and moves the carriage horizontally. The attachment is primarily for cutting threads on drive screws of permeability-tuned r-f inductors. It was designed by G. Shapiro and R. O. Stone of the electronics engineering laboratory at the National Bureau of Standards in connection with a program of radio receiver subminiaturization spon-



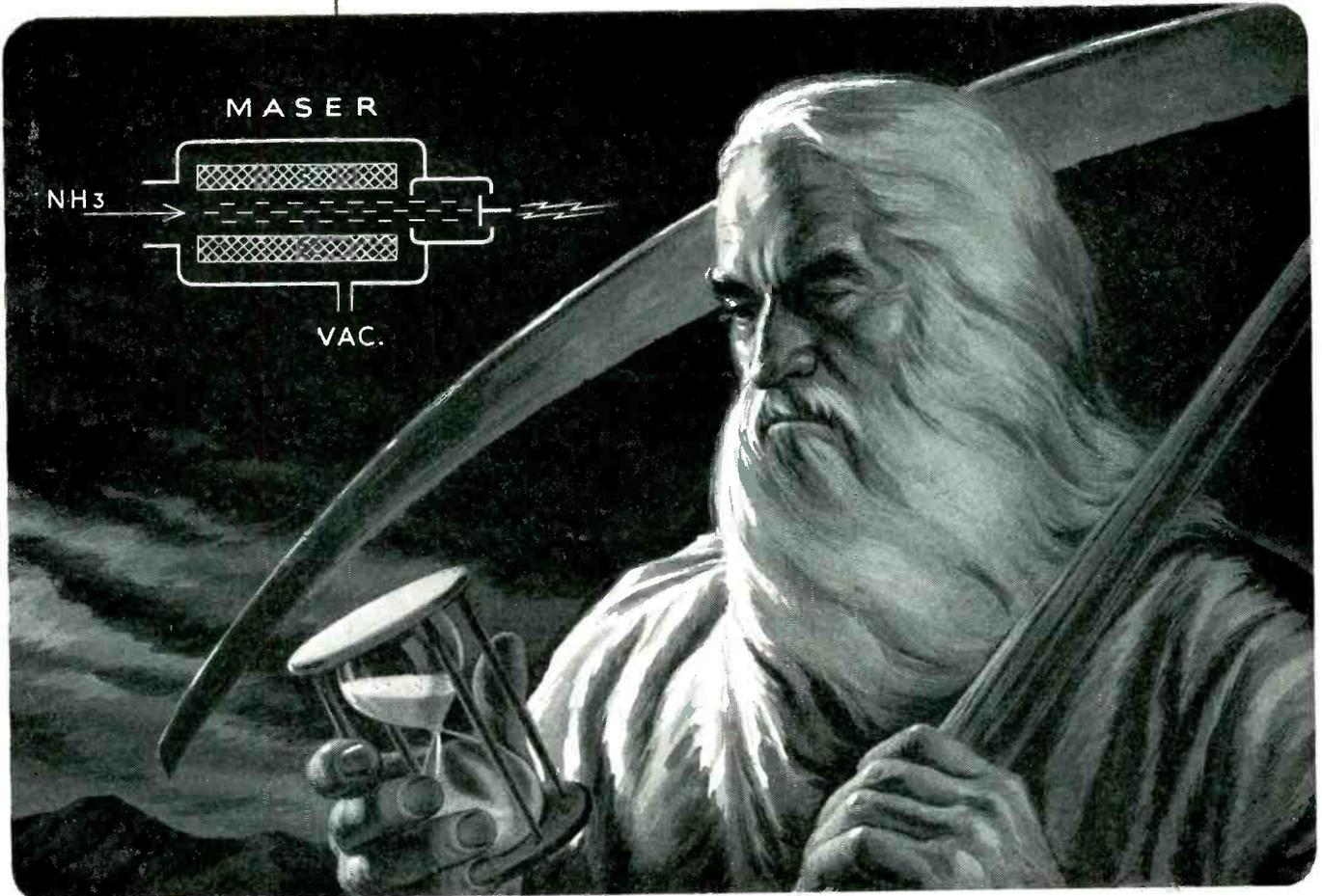
Lathe attachment for cutting nonlinear-pitch screws, shown in place at right of carriage on lathe. Vertically-moving cam plate inside attachment drives tool holder carriage at nonlinear rate

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The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

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Electronic research at the Jet Propulsion Laboratory covers many areas of interest to engineers working on problems of missile guidance and control. One of these is frequency and time standards—a prime requisite in Missile System Engineering.

The familiar crystal oscillator and similar timing sources have been exploited to the limits of their applicability. Looking to the future, our Electronics Research group is keeping abreast of developments in atomic and molecular resonance devices.

One such device under advanced development at the Laboratory is known as MASER (Micro Wave Amplification by Stimulated Emission of Radiation) invented by Prof. C. H. Townes of Columbia University. In MASER a beam of ammonia molecules is

separated into energetic and non-energetic parts by an electrostatic field. The energetic molecules then enter a microwave cavity and sustain an oscillation by giving up their energy to the microwave field. The frequency of oscillation is determined principally by those properties of the molecules which are independent of environment.

MASER is one of the most stable sources of oscillations and is therefore a prime source reference for frequency and timing information. This device will have many applications in future missile design and is one of many challenging research projects in electronics in which the Laboratory is engaged.

If you are interested in an exceptional research opportunity and are qualified to do truly creative work in this field, write us today.

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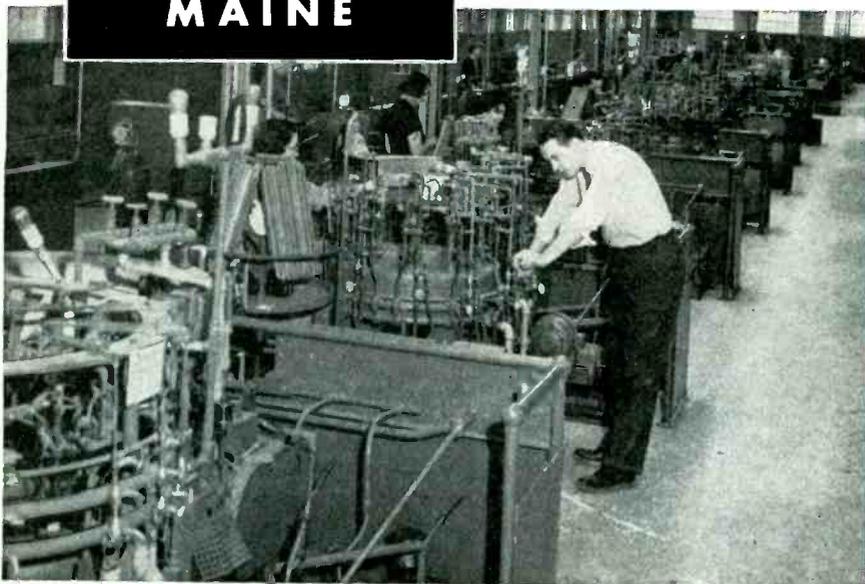
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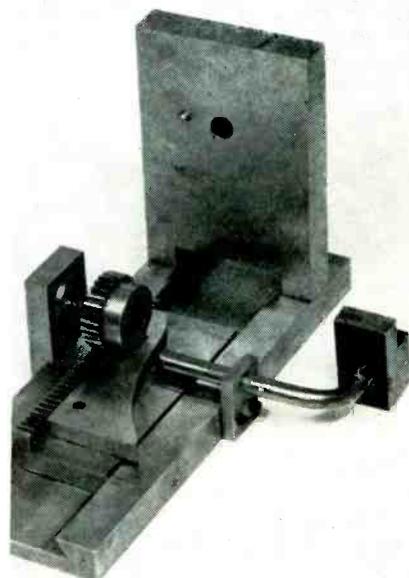
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sored by the Navy Bureau of Aeronautics.

► **Construction Details**—The sliding cam plate is driven up and down by engaging a rack to a pinion gear keyed to the lead screw of the lathe. The cam contour cut on the side of the cam plate moves upward at a constant rate, bears against the tool-holder carriage and displaces the carriage sideways. The nonlinear motion of the carriage is controlled by the contour of the cam.

The cam contour is easily established from the curve of fre-



Inside view of attachment. Pinion gear is keyed to lead screw when in place on lathe and drives racks fastened to cam plate. Curve of cam plates displaces round bar. Blocks transmit resulting nonlinear motion to tool holder carriage

quency vs slug penetration into the inductor, the vertical length of the cam and the horizontal cam dimension.

► **Plotting Cam Curves**—To find the frequency-displacement curve, the inductor and its tuning slug are placed in a jig containing a conventional linear screw drive for the slug. The inductor is resonated with the appropriate capacitance in a Q-meter. Readings are taken of the resonant frequency at incremental values of slug penetration into the in-

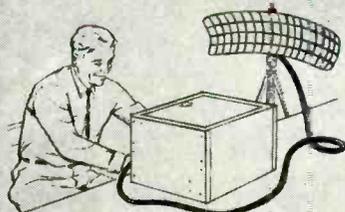
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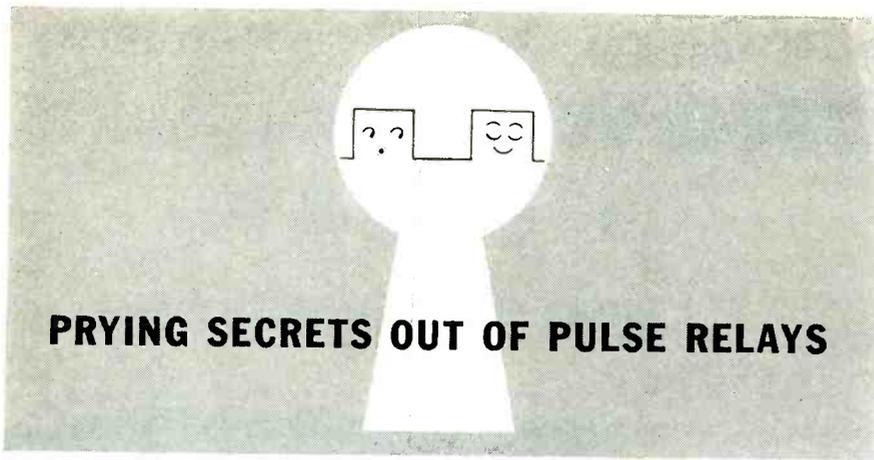
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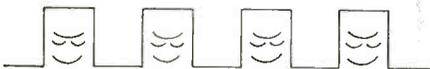


PRYING SECRETS OUT OF PULSE RELAYS

High speed polar relays for telegraph use and other data handling applications have their work all cut out for them, in the form of little pulses who confidently expect to go in and come out of the relay looking like better little pulses



—or come out taller than they went in.

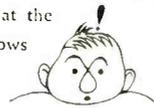


Sometimes as many as 500 of them show up at the relay in the space of one second, all wanting efficient accommodation. This of course requires that (1) the relay be pretty good in the first place, and (2) as time goes on and even the best relay begins doing strange things to the pulses,



that it be possible to do something about it. We seem to have gotten the first part* pretty well in hand, and now have something to say about rummaging around inside a pulse relay to find out why an unpleasant case of distortion has already developed, or to forestall it by "preventive maintenance." To get technical, the logical course is to investigate some or all of the following: operating values (by manual and automatic means), bias, percent-break, and insulation of the relay, and then proceed with the necessary adjustments or repairs.

Since by now the unmistakable impression has been given that we know what the relay user should do, it follows that we should also say how. Without expecting to surprise anyone, then, we hereby announce the development and availability (soon) of the Model 4501 Telegraph Relay Test Set. On a standard relay rack panel 5-1/4" high, it looks like this



and will

Measure the five characteristics previously mentioned, making use of any or all of the operating coils of Sigma Series 72 and 7, WE 255A and 215, and similar relays.

Permit connection of an external drive directly on relay coils, and an external scope for observation of contact performance during bias and percent-break tests.

It may be mounted in either a standard relay rack or in its own case.

The Test Set is by no means the only one on the market, nor do you have to have one simply because you own some of our 72's (development of the Test Set resulted from customer request). It will, however, make the most of the 72's built-in adjustability, and probably prove useful for other relays for which there is no suitable test equipment. With the 4501, besides a case and octal socket adapter, you also get a comprehensive instruction manual, which describes in detail the theory and operation of the Test Set. Other socket adapters are available.



* FAMOUS SIGMA SERIES 72

SIGMA INSTRUMENTS, INC.

62 Pearl St., So. Braintree, Boston 85, Mass.

ductor. The resulting curve, properly scaled, provides the shape of the variable contour.

The maximum vertical dimension of the cam is limited by the vertical travel of the cam attachment. The useful portion of the contour is selected at about 90 percent of the total travel. Two arbitrarily shaped cam sections, one on each end of the useful portion of the curve, are added to provide time to allow the lathe operator to back out his cutting tool and to



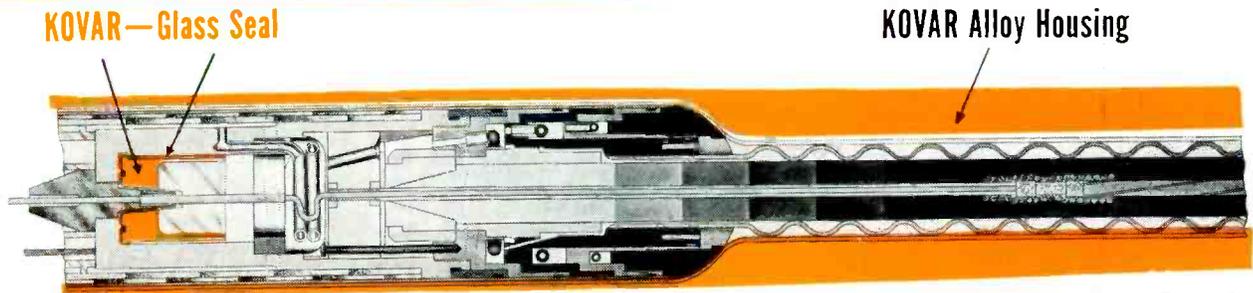
Sample screw cut with lathe attachment. Screw pitch is determined by cam

reverse the lathe. As the threads cut by these end sections are never engaged in the tuner, their outlines are not important.

The number of revolutions the nonlinear screw must make to displace the slug over its entire tuning range is chosen by the designer. The gear ratio between the headstock spindle and the lead screw is set to a value that will displace the sliding cam plate about 90 percent of its maximum possible vertical travel for the desired number of revolutions of the screw blank. This vertical distance is then divided into as many equal increments of length as there are increments of frequency for which slug displacements have been plotted. The horizontal component of the contour is determined from the length of the screw to be cut. The horizontal and vertical coordinates, appropriately scaled to the dimension of the cam, are then plotted on the cam blank. As soon as the contour is machined, the cam plate is fastened to the attachment, where it is ready to guide the carriage in the thread cutting operation.

► **Modification**—If a straight, piv-

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Submarine Cable Repeater Courtesy of Western Electric Co.

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In the development of this project, one of the engineering problems was to design, build and test a series of amplifiers to meet severe conditions never previously encountered. Not only would these repeater units be subjected to several tons pressure, but they must have a minimum life of 20 years.

The project is now a reality and the undersea repeaters developed by Bell Laboratories and manufactured by Western Electric have a vital role as part of the

world's first transatlantic telephone cable. In the precision manufacture of the repeater units, high quality components and materials were selected—including Kovar Alloy for the interior glass-to-metal seals.

Kovar Alloy has won the confidence of the electronic industry for the past twenty years—and we invite you to call upon us with your metal-to-glass sealing problems.

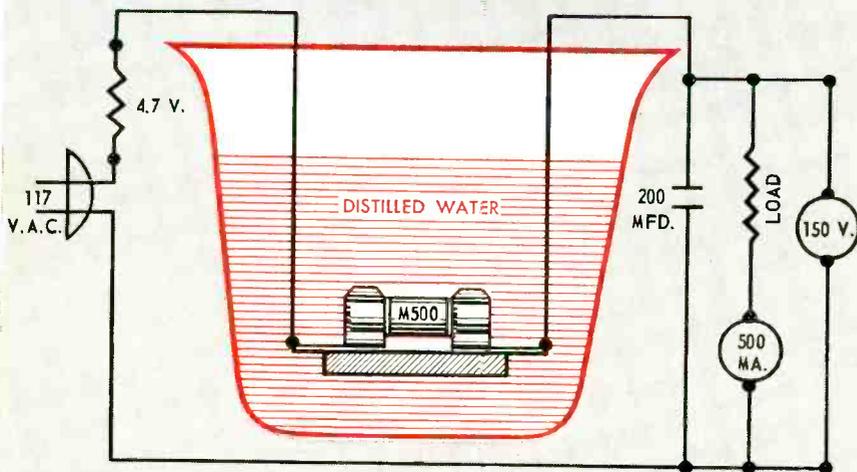
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oted bar is used in place of the cam in this attachment, it becomes another useful laboratory tool. By adjusting the slope of the bar and clamping it in place at the appropriate angle, it becomes a cam surface that permits the cutting of any nonstandard linear screw thread for which gear ratios in the lathe are not available.

Filling Aircraft Antennas With Isocyanate Foam

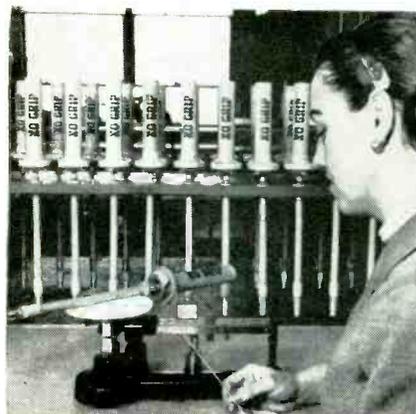
By LEON HILLMAN

Chief Engineer
Production Research Corp.
Thornwood, N. Y.

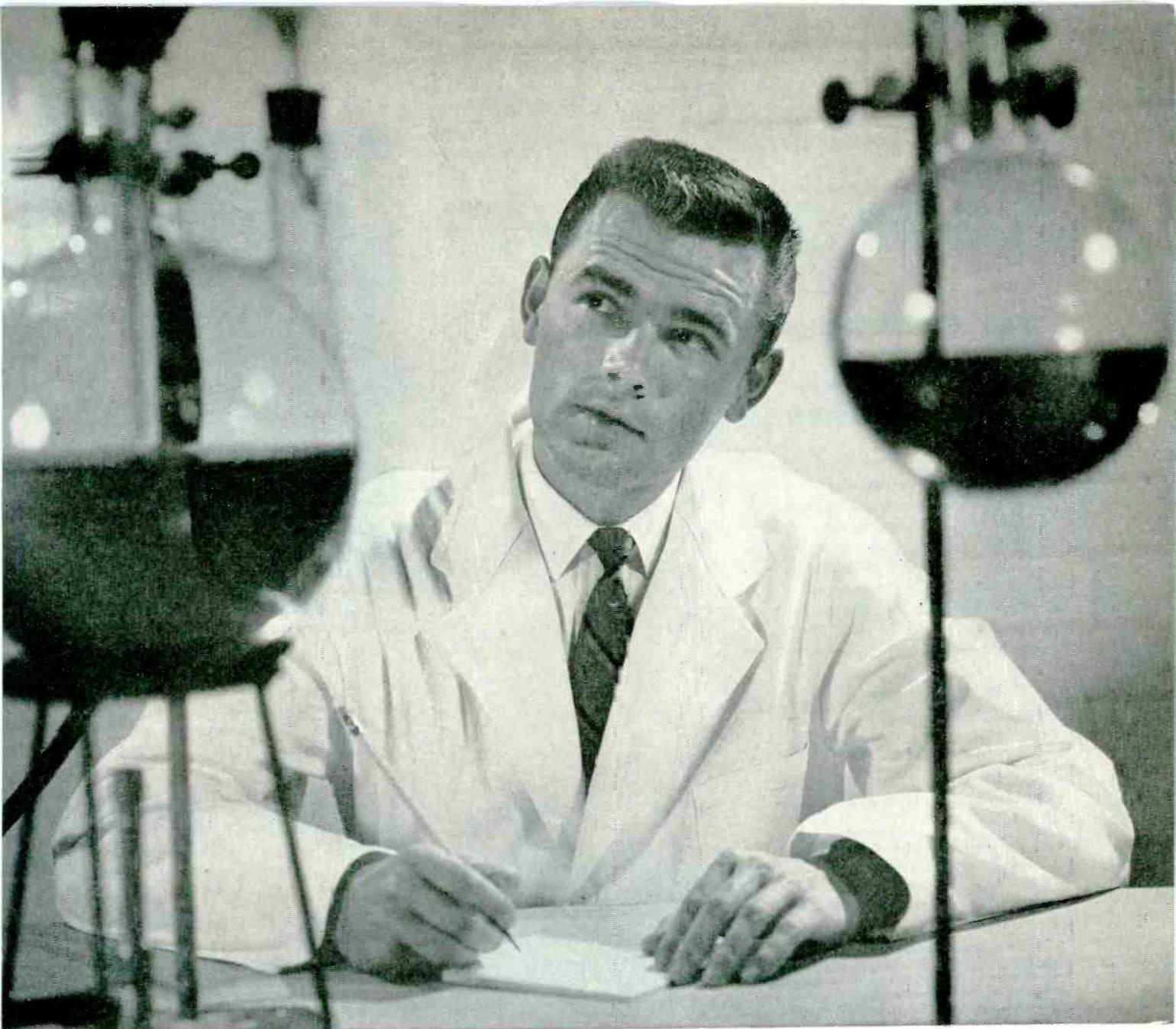
FREQUENTLY in the design of microwave aircraft antennas a void must be filled with material of low density, high dielectric constant and moisture resistance. These requirements are met by foamed isocyanates. They add to structural rigidity and eliminate expense of preforming since the material will rise to fill a cavity of the most intricate shape.

Commercially available isocyanates are easily processed by mixing prepolymer and catalyst in an agitator. The resulting density of the foamed plastic frequently affects the electrical performance of an antenna critically, because the resultant dielectric constant is a function of the density. Factors which contribute to the density of the foam include temperature, humidity and catalyst.

► **Effect of Temperature**—Room temperature alters density only



Weighing microwave antenna before filling with foam plastic



When electrical grade molding compounds are evaluated...

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is the standard of comparison

"Thirty-Seven Hundred" is the leading electrical grade molding material because it was planned *in-the-field*—developed by Monsanto research to match a bill of particulars set up by Monsanto's technical engineers calling on molders of critical electrical control parts.

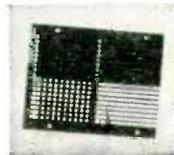
What these engineers said in effect was this: The electrical industry needs a high-performance molding material for magneto ignitions, motor control and transmission circuits, and other critical applica-

tions. They want high arc resistance combined with unusual dimensional stability . . . minimum after-shrinkage . . . moldability . . . superior heat resistance, impact resistance, mechanical strength. These properties were desired without any relative increase in price.

Result: Resinox 3700.

For complete information on Resinox 3700, write to Monsanto Chemical Company, Plastics Div., Dept. 409, Springfield 2, Mass.

*And in case
after case,
"THIRTY-SEVEN
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*RESINOX: REG. U. S. PAT.OFF.



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Contacts: Arrangement: 1 Form "C" (SPDT) Rating: 28 v DC, at 250 ma. Resistive Load.

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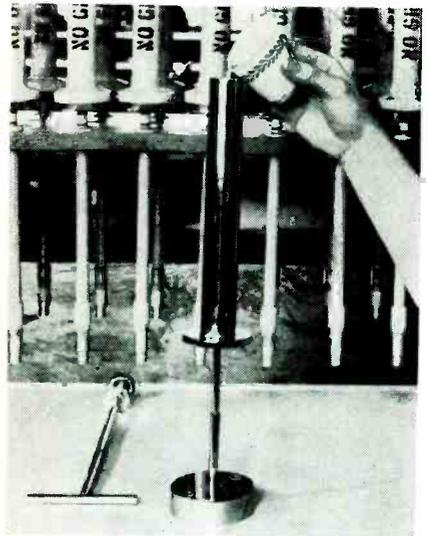
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Method of supporting applicator while pouring in isocyanate and catalyst. Brass plunger of applicator, on bench at left, has good slip fit. Antennas awaiting filling are on rack at rear

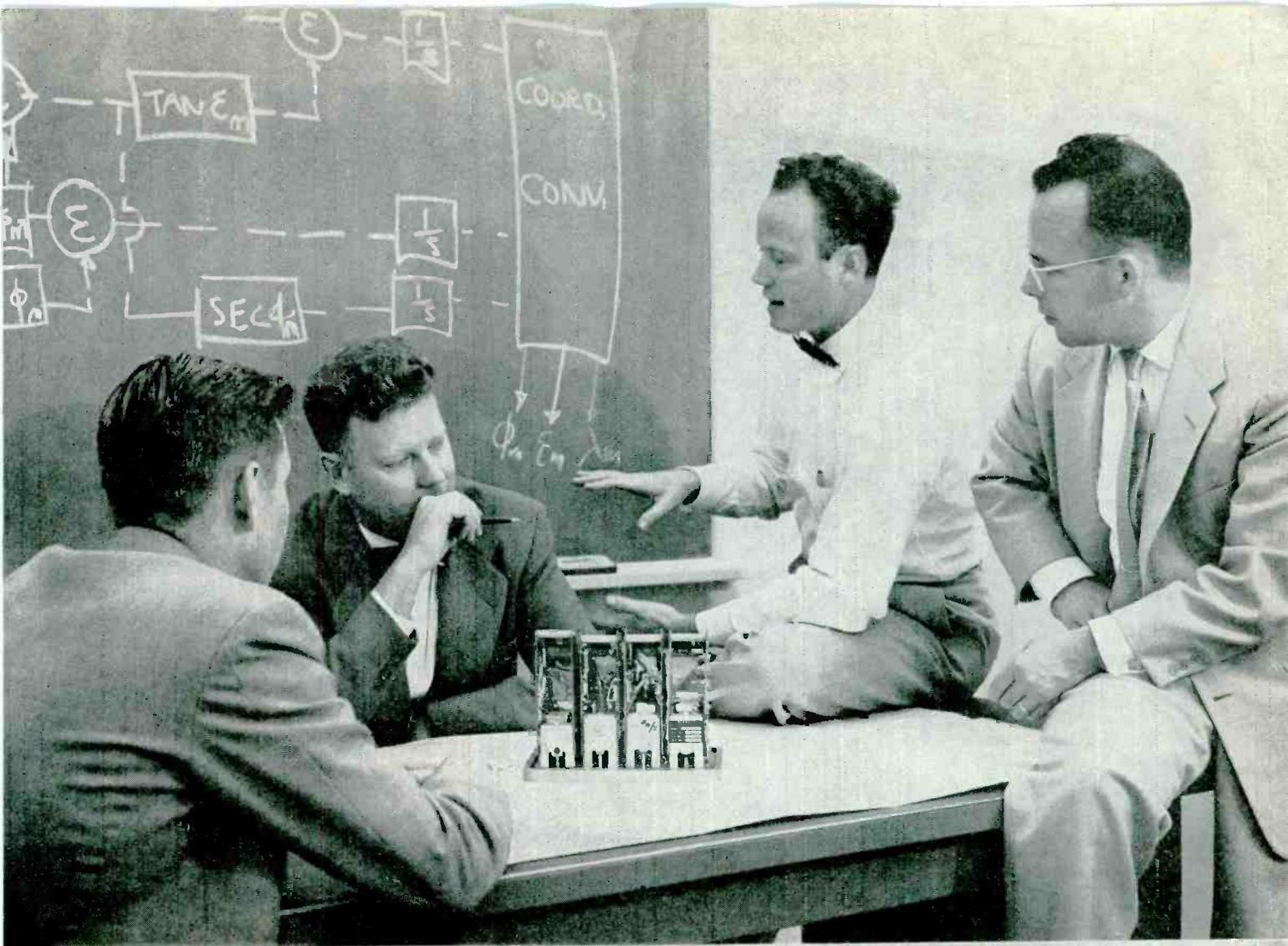
slightly, but it affects the agitation period tremendously. Higher temperatures cut down the mixing time and cause faster foaming.

► **Effect of Humidity**—Moisture in the air contributes the greatest variation in day-to-day work with this plastic. The greater the moisture content in the air the less dense the foamed plastic will be. Frequently water is added to the catalyst to produce a low-density foam which will compensate for certain electrical properties in antennas.

► **Effect of Catalyst**—More catalyst per unit of prepolymer will cause the mixture to expand faster, produce a foam of lower density and reduce the curing time. Less catalyst will produce the opposite results.

To obtain a uniform and homogeneous product, the catalyst should be uniformly distributed throughout the prepolymer in the shortest possible time.

► **Air Displacement**—The air to be displaced by the foam must be provided with sufficient vents. While injecting the mixture into a cavity it may rise in such a way as to create an air pocket. This can be controlled by holding the nozzle of the injector near the



G. D. Schott (second from left), Flight Controls Dept. Head, discusses new techniques in the mechanization of autopilots with R. D. Wertz (left), Flight Controls Research Engineer; R. J. Niewald, Flight Controls Analysis Section Head; and B. C. Axley, Servomechanisms Analysis Group Engineer.

MISSILE SYSTEMS FLIGHT CONTROLS

One of the most critical problems encountered in the development of a successful missile system involves attaining rapid responses of controls *consistent with system stability*. Moreover, it is a problem of increasing importance as new aerodynamic configurations require major advances in flight controls performance.

At Lockheed, Flight Controls engineers are developing unique control methods to cope with this growing problem. Their expanded activities have created new positions for those possessing experience and a high order of ability in:

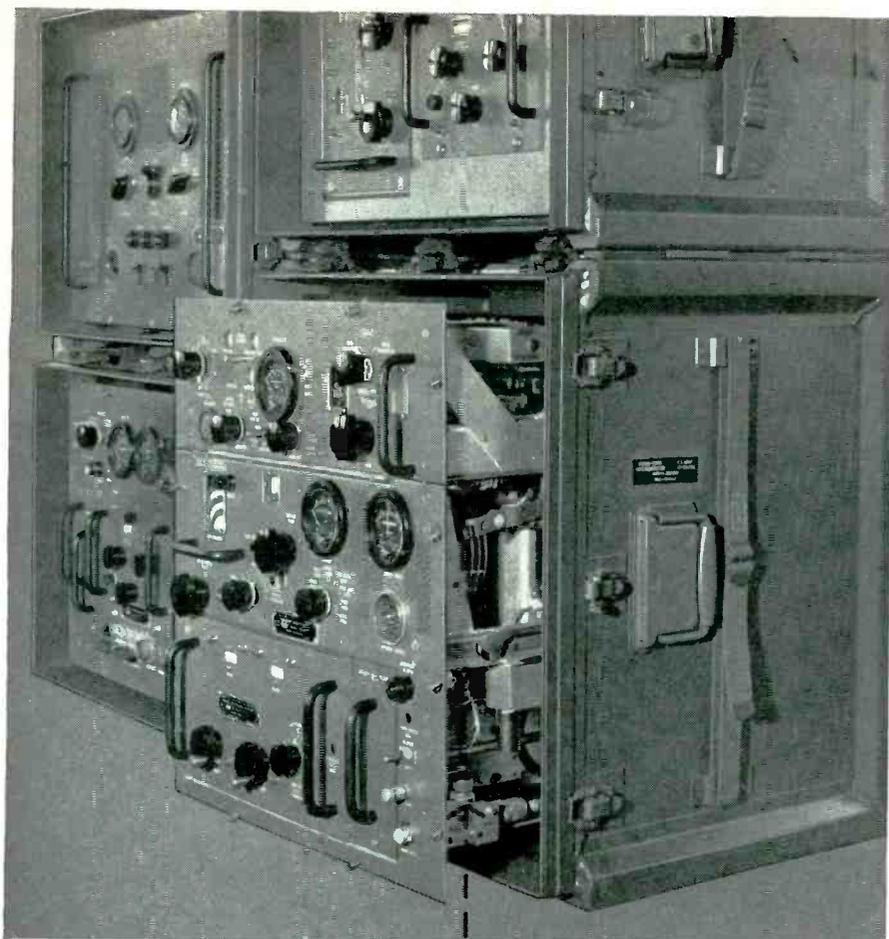
- Hydraulic servomechanisms
- Circuit design
- Aerodynamic stability and control
- Flight analysis
- Autopilot simulation

A number of the positions now open are on supervisory levels. Inquiries are invited for positions at Lockheed's Engineering Centers in Van Nuys and Sunnyvale, California.

Lockheed MISSILE SYSTEMS DIVISION *research and engineering staff*

LOCKHEED AIRCRAFT CORPORATION

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base of the cavity during the injection. If an air pocket should form, it may be eliminated by piercing the cavity with a pin hole while the mixture is still rising.

► **Equipment Maintenance**—All equipment coming in contact with foam should be immediately cleaned with lacquer thinner to prevent the foam residue from building up on parts. Once the foam is cured, it may be removed by soaking in acetone, which softens it.

► **Foaming Procedure**—(1) All metal surfaces are cleaned with methyl ethyl ketone.

(2) Polyester resin MIL-R-7575 type III is applied to the impregnated glass-fiber surfaces to be sealed or joined with an adhesive.

(3) The antenna is weighed prior to filling with foam. The volume is determined by measurement.

(4) A release agent such as Dow Corning No. 4 or No. 7 is applied to all surfaces where adhesion of

The Army's multi-channel AN/TRC-24 transmitter relies on Micro-Match Directional Couplers for continuous RF Power monitoring and VSWR indication. They give positive confirmation of the transmitter and antenna system's performance.

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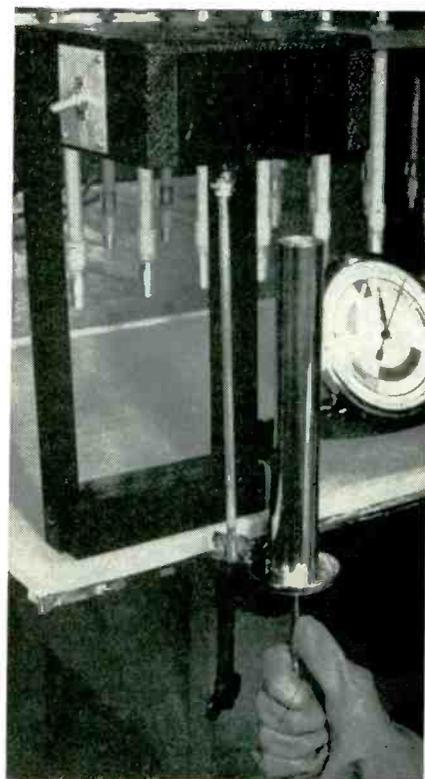
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directional couplers
monitor ANTRAC
right... here!



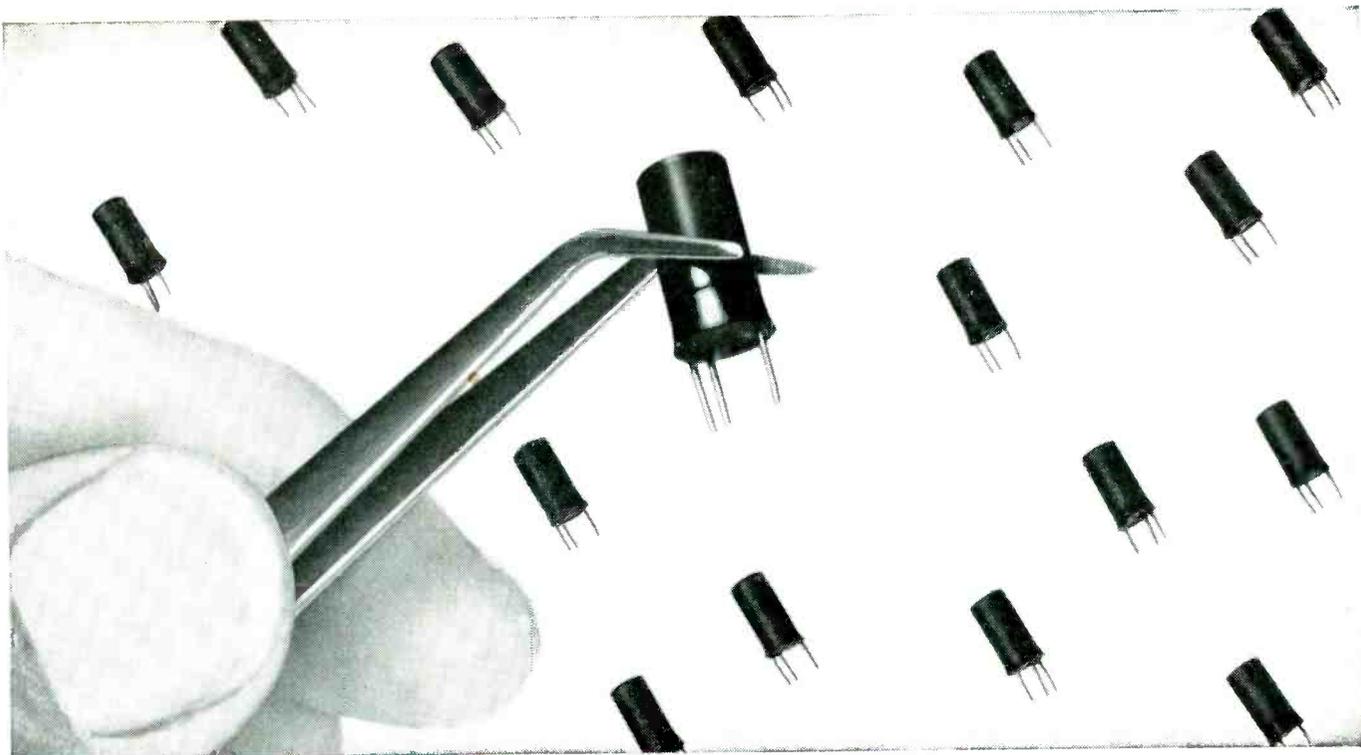
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Bringing filled applicator up to motor-driven mixer. Sawtooth-shaped paddle on mixer can be seen at left of base of applicator. Mixing time is about 1 minute



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Electronic Grade Chemicals

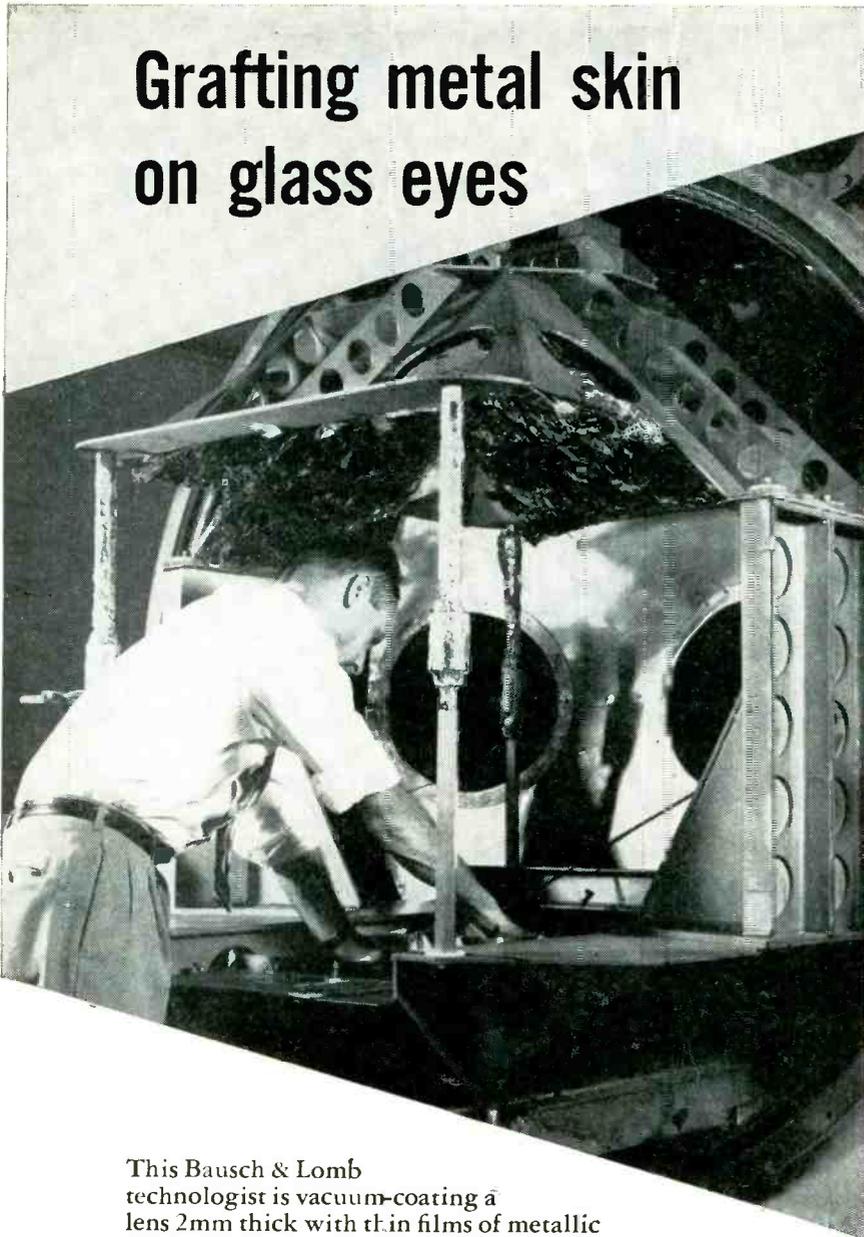
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Grafting metal skin on glass eyes



This Bausch & Lomb technologist is vacuum-coating a lens 2mm thick with thin films of metallic salts to increase control of light and color. If the lens were enlarged to the height of Mt. Washington (6,288'), the lens coating would be equivalent to a four-inch transparent layer. This submicroscopic surfacing method, developed by B&L, makes possible miracles in selective reflectance and transmittance of light of any specified wavelengths. Practical applications range from color TV to directional control of guided missiles. How does this kind of advance technology fit in with your contract plans?

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SINCE  1853



Metal can provides support for applicator while pushing down on plunger to force foam into antenna cavity. Scotch tape holds paper in position on antennas awaiting filling, to prevent surplus foam from overflowing down outside

foam is not desired. The glass fiber of the antenna is moistened with water to make it translucent so the rising foam inside can be seen.

(5) The foam is mixed. First, 50.5 grams of type I Scotchfoam expansible compound is weighed in a paper cup. (Only 50 grams of prepolymer are required, but the 0.5 gram compensates for the amount left in the cup when pouring into the gun.) Next, 5.5 ml of Scotchfoam catalyst type I-020 is measured in a graduate cylinder. (The 0.5 ml is for mixture that clings to the graduate.) The foam prepolymer is poured from the cup into the barrel of a plunger-type gun, the catalyst is poured over it and agitation is begun. For this an electric mixer is used for the prescribed time (usually about 1 minute).

(6) The plunger is inserted into the gun and approximately $\frac{1}{2}$ cup of foam is forced out to remove any impurities that might have collected at the bottom of the gun. The gun nozzle is inserted in the



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Corporation

239 West Orange Grove Ave., Burbank, California
 PIONEERS IN CUSTOM CAPACITOR ENGINEERING

Derated at 125°C as follows:

- 100 volts - 50%
- 200 volts - 50%
- 300 volts - 33 1/3 %
- 400 volts - 33 1/3 %
- 500 volts - 20%
- 600 volts - 16%

Tested and proved! Only Southern Electronics Corporation has developed a test procedure which insures built-in reliability! For your most exacting requirements—be sure—always specify S.E.C.

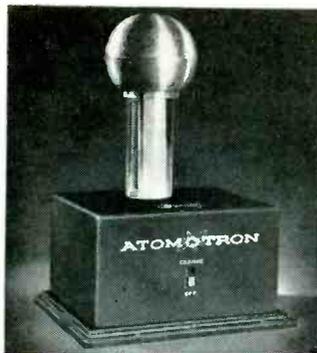
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 Tolerance to 1%—lowest temperature coefficient. Superior insulation resistance at high ambient temp. Good stability compatible with material.





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A working replica of the famous Aquarium Reactor with a genuine analog computer which automatically solves the pile kinetic equations. Neutron flux is read directly on the microammeter. 2 1/2 decade range. Blue light in tank represents Cerenkov radiation. Control rod regulates reaction, safety rod "screams" it when it reaches too high a level. Reactor syllabus, experiment manual included. 110 volt, A.C. operated. Introductory price, \$295.



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See Corona discharge, make artificial lightning with first miniature high-voltage machine. Only 7" high. Produces 75,000 volts on 2-inch diameter sphere. Operated by sturdy 110 volt A.C. motor. Comes complete with smog control Precipitron, gravity-defying paper strands and piñ ball, field reaction rotor, neon light wand, electric windmaker, experiment manual. An enduring, entertaining and highly instructive precision instrument for school and home.



Antenna after filling with foam

antenna cavity and the remainder of the foam is ejected. The gun is refilled with fresh mix for each antenna.

(7) After the foam has set, the overflow is removed with a razor or knife and all traces of the release agent are removed. The foam can be tested 1/2 hour after pouring, but requires about 24 hours for complete setting.

(8) The antenna is weighed, the results recorded and the density calculated. If the density and corresponding dielectric constant are not within tolerance the solidified foam is scraped out and the process is repeated with corrective modifications.

Single-Station Machine Inserts Forty Parts

A FERRIS-WHEEL arrangement of forty different component magazines on a self-indexing drum makes it possible to insert forty identical or different components, one after another, in a plated or etched wiring board. The machine was developed by GE's Light Military Electronic Equipment Department in Utica, N. Y.

► **Operation**—The operator moves the board to a new position after each insertion by means of a pantograph arrangement guided by a stylus that she moves over a master

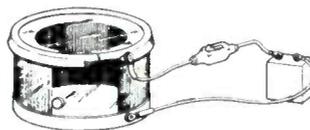
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Generator with beam tube removed produces 1/2 million volts, 16-inch sparks for high-voltage experiments. With beam tube inserted, Rayotron produces diffuse high-energy X-ray beam for all basic X-ray experiments. Height 2 1/2 ft. Comes with manual of 8 fascinating experiments and newly published Accelerator Syllabus. Rayotron, complete with beam tube, \$295; Generator alone, \$175. Small fluoroscopic screen and X-ray film, \$20. Optional instrumentation, \$25.00.

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New floating grid electrometer makes it possible to produce a precision ionization instrument at half the previous cost. Measures beta rays, gamma rays and X-rays—radiation intensities from 5 MR to 50 R. Built-in Alpha source for self-calibration. Designed to AEC specifications. Unconditional one-year guarantee. Special introductory price, \$119.50. Metal stand, \$2.00.

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give maximum energy . . . minimum size*

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And they're available in practically any size you want—from a fraction of an ounce to several hundred pounds. What's more, Crucible alnico permanent magnets can be sand cast, shell molded, or investment cast to your exact size, shape, or tolerance requirements.

Crucible has been a leading producer of these permanent magnets ever since alnico alloys were developed. And their manufacture is backed by over a half century of fine steelmaking experience. That's why so many magnet applications begin at Crucible.

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The Oliver Building, Mellon Square,
Pittsburgh 22, Pa.*

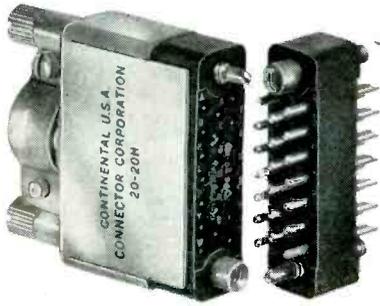


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Crucible Steel Company of America

new!... Continental Connectors



Series '18' connectors with polarizing screwlocks*

The new Series '18' provides a large, rugged contact with the same efficient spacing used on our Series '20'. The .053" diameter solder cups can accommodate two #20 AWG wires, if necessary. 20, 27 and 50 contact units are available.

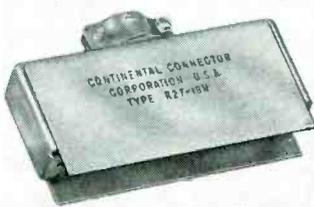
Our reverse type guide pin and guide socket arrangement provides positive polarization. To insure against accidental disconnection you can order the Series '18' with the exclusive Continental Polarizing Screwlock.

Anodized aluminum hoods with top or side openings are available for positive cable support and strain relief.



POLARIZING SCREWLOCKS

*PAT. NO. 2746022



GUIDE PIN and GUIDE SOCKETS



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CONTACTS: 20, 27 and 50—plus other contacts and arrangements (9, 14, 34 will be available soon).

Contact pins (brass) and sockets (spring temper phosphor bronze) are silver and gold plated for low contact resistance.

TERMINALS: Solder cup or turret.

ELECTRICAL RATINGS:

Voltage Breakdown	
At Sea Level	2100 Volts RMS
At 60,000 Ft.	750 Volts RMS
Current Rating	5 Amps

Additional information on these connectors, and special designs requiring the use of subminiature, printed circuit, hermetic seal, pressurized, high voltage, or power connectors are available on request. Write today for free catalog.

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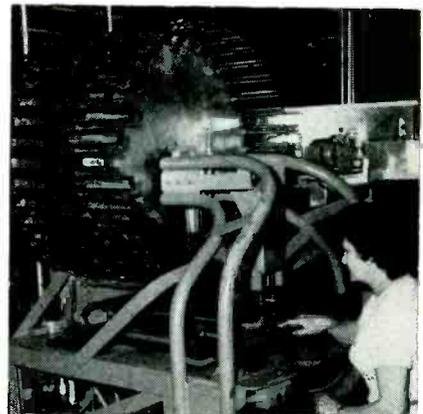
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DeJUR-Amsco Corporation
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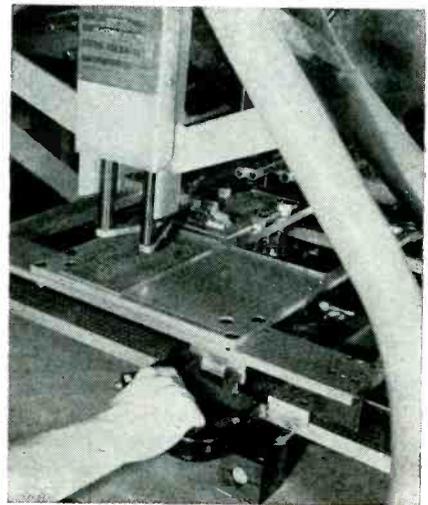
template. This can easily be done in the interval of time while the magazine drum is indexing to the next position. She then pulls a trigger to drop the stylus into the next hole in the template. This trips a snap-action switch that brings down the insertion head.

One air cylinder provides driving power for the insertion head, while another cylinder below the table actuates the clenching jaws after insertion. An electric motor and gear drive serve for indexing the drum.

► **Preparation**—Leads are cut, formed and loaded into a magazine automatically in one operation



All types of components having identical lead hole spacings can be inserted one after another on a wiring board merely by positioning a pantograph stylus in one hole after another on a template and pulling a trigger each time. Magazine-holding drum indexes one position after each insertion

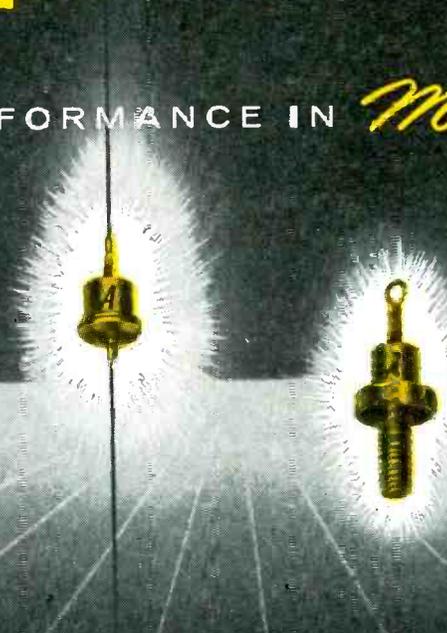


Trigger handle is bolted to table that holds master template (in foreground) and wiring board being loaded with components

AUTOMATIC

silicon power rectifiers

MAXIMUM PERFORMANCE IN *Midget* SIZE



TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (mA)	Reverse Leakage At Rated P. I. V. (μ A)	Mounting
1N440	100	300	0.03	Pigtail Leads
1N441	200	300	0.075	"
1N442	300	300	0.10	"
1N443	400	300	0.15	"
1N444	500	300	0.18	"
1N445	600	300	0.20	"
1N530	100	300	0.30	"
1N531	200	300	0.75	"
1N532	300	300	1.00	"
1N533	400	300	1.50	"
1N534	500	300	1.80	"

TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (mA)	Reverse Leakage At Rated P. I. V. (μ A)	Mounting
1N535	600	300	2.00	Pigtail Leads
1N560	800	300	1.50	"
1N561	1,000	300	2.00	"
1N550	100	500	.05	Stud-Mount
1N551	200	500	.10	"
1N552	300	500	.15	"
1N553	400	500	.20	"
1N554	500	500	.25	"
1N555	600	500	.30	"
1N562	800	500	1.50	"
1N563	1,000	500	2.00	"

Now, improve all your equipment designs . . . from one complete source, both stud mount and pigtail rectifiers . . . designed for dependable operation at ambient temperatures in the range of -55° to $+150^{\circ}$ C

Twenty-two types are now available in quantity.

- These All-Welded units perform efficiently at all frequencies encountered in power applications — have negligible reverse currents — withstand severe atmospheric conditions — have excellent resistance to shock and vibration — display no aging characteristics over extended periods of time.
- Quality Automatic Silicon Rectifiers are particularly suited for magnetic amplifier and power supply applications which require superior forward conductance, low reverse leakage currents and exceptionally high efficiencies and rectification ratios. Their small size and light weight make them ideal for use in all types of miniaturized equipment.
- Write today for performance data sheets giving complete technical details.



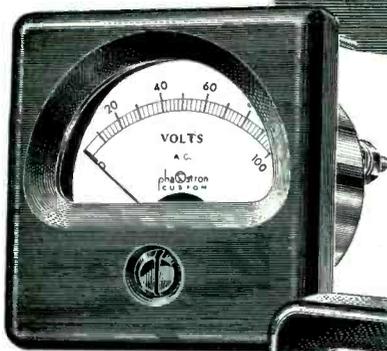
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ELECTRONIC COMPONENTS

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PHAOSTRON

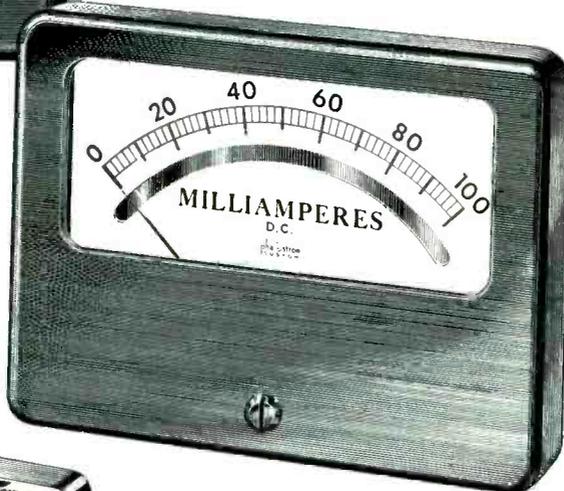
NONE FINER

CUSTOM PANEL METERS

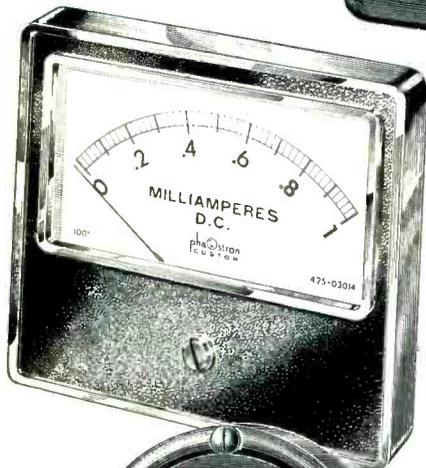


2 1/2" or 3 1/2" Square

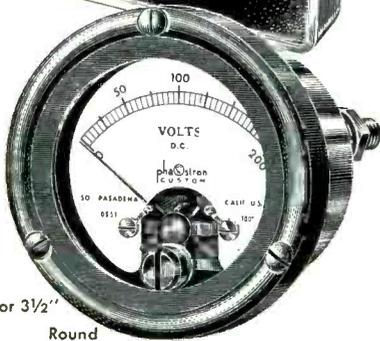
4" x 6" Rect.
with Mirrored Scale



4 1/2" Rect.
Chrome or Black
also available
illuminated



2 1/2" or 3 1/2"
Round



The appearance of your equipment will be enhanced by PHAOSTRON meters with their high style, die cast bezels and large easy-to-read scales.

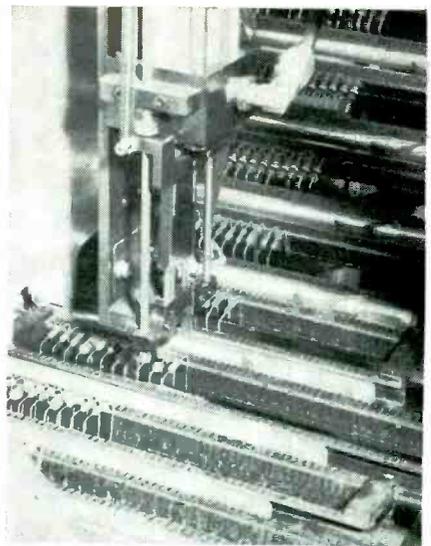
You can depend upon 2% accuracy because these meters are calibrated to within 1% of full-scale deflection with controlled, certified standards.

Continuous accuracy is assured by the UNITIZED METER MOVEMENT ASSEMBLY which provides integral mechanical stability. The aged alnico magnet of the meter is protected from the effects of stray magnetic fields by the steel case.

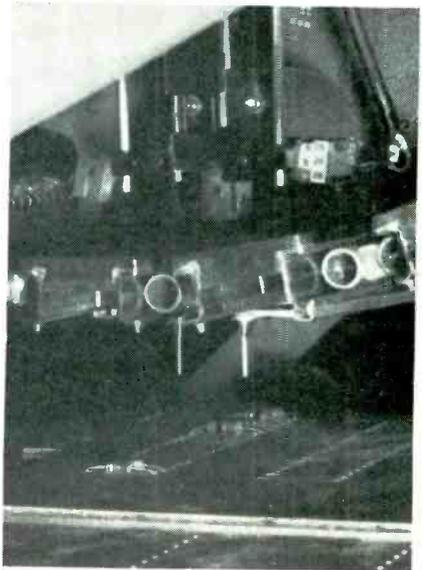
These units are also equipped with insulated zero adjustments.

Nine Types in 77 Standard Ranges are available at your Parts Distributor. If you have a special requirement, write to the Product Development Department for a practical recommendation.

PHAOSTRON INSTRUMENT AND ELECTRONIC COMPANY
151 PASADENA AVE., SOUTH PASADENA, CALIF.



Top view of insertion head, showing notched blades that push component down through magazine



Side view of insertion head, showing the two funnels that guide the leads into the holes of the wiring board

of a special air-actuated press. Components are purchased with their leads inserted in a corrugated cardboard strip. The magazine is placed in the holding fixture of the press, the strip filled with components is placed over the magazine, and the strip is removed so the leads can drop into position. Additional components can be loaded by hand if necessary, or all components can be loaded one by one from bulk shipments.

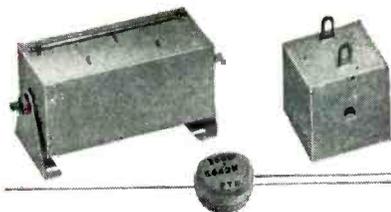
The descending press shears all leads to uniform length simultaneously, bends them and pushes the bent ends down into the molded grooves of the magazine. The

Standard Heavy-Duty Stacks



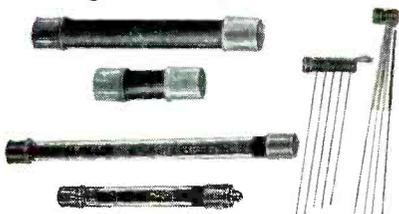
Extremely long life . . . with no maintenance problems. Thousands of voltage/ampere combinations available. Sizes from 1 1/16" square cells to giant 6" x 10" plates . . . Federal can provide a power rectifier for almost every type of industrial and military equipment.

Encapsulated Rectifiers



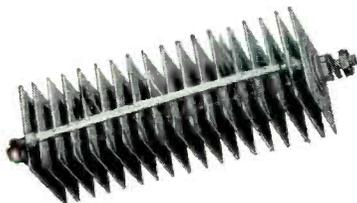
Maximum resistance to impact, acceleration, and vibration. Complete protection from harmful atmospheric conditions. Other electronic components may be encapsulated with rectifier to form a rugged, replaceable "potted" circuit.

High-Voltage Stacks



250 to 5000 volts/5 to 40 milliamps. Encased in paper, glass, Bakelite, nylon, or metal tubes. Simple fuse-clip mounting of ferrule terminal types. Also, hermetically-sealed types. Uses: CRT high-voltage supplies, photoflash, insulation testers, etc.

High-Temperature Stacks



For maximum operating life at ambient temperatures up to 150° C. A full range of voltage/current combinations for medium and high temperatures. Ideal for aircraft and military equipment.

Magnetic Amplifier Rectifiers

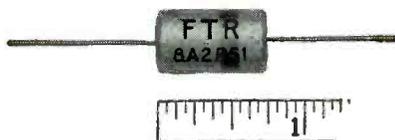


Selenium cells and stacks precisely manufactured, tested, and selected to assure a high degree of stability and very low reverse current. For use with saturable reactors, regulated DC power supplies, etc.

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Selenium Contact Protectors



Extend contact life by over 1000 times. Used in inductive circuits to prevent erosion of switch contact surfaces . . . to suppress arcing and rf transients. Minimum effect on release time. Hermetic sealing meets JAN specs. For relays, electromagnets, and telephone systems.

LET US KNOW your AC-to-DC conversion problems. For further information on Federal Industrial Rectifiers, call NUTley 2-3600, or write to Dept. F-813B

Why

Pioneering Leadership

Federal is the *original* supplier of selenium rectifiers in the United States . . . leading the field in research, development and production.

Facilities and Service

Federal's facilities can handle the largest and most complex orders . . . satisfy the rush requirements of customer production peaks. Every order—large or small—is processed through a skilled engineering staff.

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Federal's modern fabrication methods, mass production, intensive quality control, and rigid testing assure a product of highest quality and greatest economy.

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METALLIC CASES

- Tight-sealed with no rolled edges
- minimum axial case length for **MINIATURIZATION**
- surface insulated against voltage breakdown
- precision shaped for multiple stacking of cores

PHENOLIC CASES

- Tight-sealed rigid core protection
- free from case to coil capacitance

CERAMIC CASES

- Tight-sealed with maximum temperature endurance
- highest electrical insulation

Selection of suitable encasement will assure better uniformity of magnetic Centricore properties. Review of present core specifications to new case types should be made NOW. Write for data and prices.

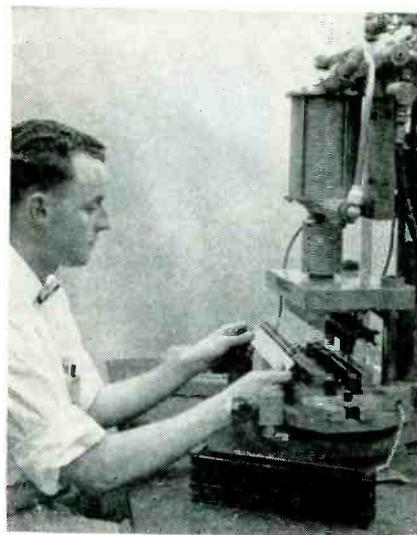
Centricores—Magnetic-engineered since 1930

○ NO ROLLED EDGES

○ SURFACE INSULATED

○ TIGHT-SEALED

○ RIGID CORE PROTECTION

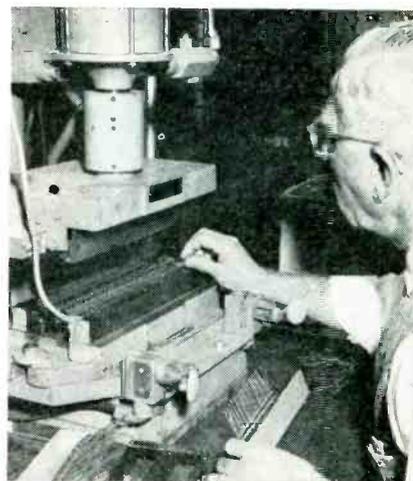


Bulk loading of components into empty magazine on press that shears and forms leads in one operation

springiness of the leads keeps the components in the grooves of the open magazine until they are pushed out by the descending insertion head.

► **Insertion**—The insertion head consists simply of two notched pushing bars that come down on the horizontal portions of the leads close to the body of the component. These serve simply to push a component down through the grooves of the magazine into funnel guides. These guides position the ends of the leads accurately so that they go into the holes in the waiting wiring board.

The descending pusher blades



Manual loading of components, as required when loading different components in a predetermined sequence. Press can operate only when one hand is on each control button in foreground

MAGNETIC METALS COMPANY

ELECTROMAGNETIC CORES AND SHIELDS

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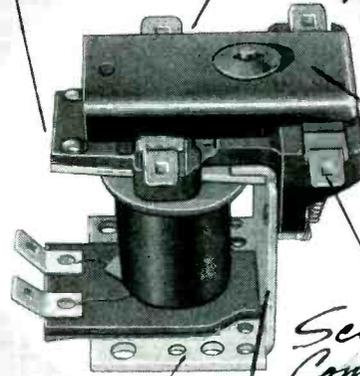
MEMO

TO *Engineering Dept.*

SUBJECT
**POWER APPLIANCE
RELAY (TYPE 75)**

*this should fit
in with our cost
reduction program.*
Wm S

*Molded Terminal
Block, Actuator
and Cover "Hammer-Blow" Action
on Contacts when Coil
is De-Energized*



*Dust or
Lint
contact
Cover*

*Screw or Quick
Connect Contact
Terminals*

*Rugged Magnet
Frame
Variety of Mountings*

Construction: Some of the outstanding design features of this Power Appliance Relay are a molded terminal block and actuator, a dust and lint hood over contacts, and a unique "hammer-action" on contact opening which actually forces contact open.

The R-B-M Power Appliance Relay is available either single pole normally open, or two pole normally open and will be furnished with screw or quick connect contact terminals.

A low wattage coil can be incorporated into the relay if ambient temperatures are higher than normal. All coil terminals are of the quick connect type.

Application: The Power Type 75 Appliance Relay has been designed for appliance applications where trouble-free operation and low cost are vital factors. Also, special ratings are available for inductive or motor loads. Pilot duty device normally connects coil to voltage source and contacts close the power circuit.



Screw Terminals



Exploded View
Screw Terminals



Exploded View
Quick Connect Terminals

ENGINEERING DATA

Specifications	Power Appliance Relay Type 75
Contact Form	S.P.N.O. or 2 P.N.O.
Contact Ratings	25 amps. per pole resistive at 230 volts 60 cycle Inductive ratings—Consult factory for special inductive ratings giving details of application
Contact Terminals	Screw type or Quick connect type
Coil Terminals	Quick connect type
Coil Ratings	Up to 240 volts, 50 or 60 cycle (Standard Pick up 85% Rated) Volt Ampere Ratings (Approximate) Armature Open Armature Closed 50 cycle 19 50 cycle 13 60 cycle 16 60 cycle 12
Design Ambient	120° F. Maximum*
Approx. Dimensions	2-31/64" x 2-35/64" x 2-1/4"

*Consult Factory Giving Specific Application Details for Higher Ambient.

Send for Descriptive Bulletin



RBM DIVISION
ESSEX WIRE CORPORATION, Logansport, Indiana

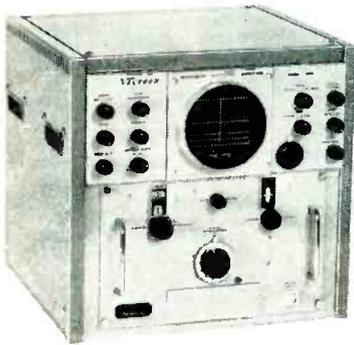
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 -  WIRE HARNESES
 -  MAGNET WIRE
- OTHER PRODUCTS

If you design, test or use any microwave generating equipment or component, you need a

MICROWAVE SPECTRUM ANALYZER

to give you these fundamental determinations:

1. Basic frequency of the carrier and all side bands.
2. Undesired frequencies being generated.
3. Relative intensity of all signals, wanted and unwanted.
4. Characteristics of signals, wanted and unwanted.



You should have information

on Vectron's new
MODEL SA30X5
MICROWAVE
SPECTRUM ANALYZER

This newest design of a highly sensitive microwave analyzer is specifically engineered as a precision test instrument for use in the design, manufacture, test, installation and maintenance of MICROWAVE:

- RADAR**
- ALTIMETER**
- GUIDED MISSILE**
- TELEVISION RELAY**
- COMMUNICATION and**
- CONTROL EQUIPMENT**

SA30X5 is available as an all aluminum, dual unit for standard rack mounting or as a portable 80-pound bench top package.

SEND FOR
BULLETIN
NO. SA30X5



FREQUENCY RANGE 8,500 to 9,660 mc/s

NEW — Simplified Control Panel with necessary operating controls conveniently available.

NEW — Frequency Difference Control for direct incremental measurements of 100 kc/s to 5 mc/s.

NEW — Direct Frequency Calibration without confusion, by new Image Check feature.

NEW — Separate Brightness and Intensity Controls for displayed signal and baseline.

NEW — Independent Regulated Power Supply for spectrum display unit.

NEW — Modified Cascade Input IF Amplifier for stability and high signal to noise ratio.

NEW — Direct Coupled Deflection Amplifiers for stable control at low sweep rates.

NEW — Flat Face Cathode Ray Tube and illuminated scale on all units.

NEW — Two-position IF Gain Switch permits optimum performance for all conditions.

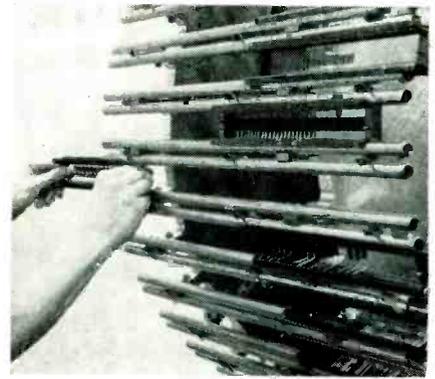
NEW — All aluminum construction for lighter weight and easier transport.

VECTRON, inc.

1609 TRAPELO ROAD • WALTHAM 54, MASS.



This is the tailpiece of an Air Force continuous-mapping Panoramic Camera for wide coverage aerial reconnaissance. Designed and manufactured by Vectron, it combines engineering and production knowledge in the fields of mechanics, electronics, electrical controls, and photography. Let Vectron's Contract Manufacturing Division help you solve your design and production problems.



Loading component magazine onto rotating magazine carrier of machine

also trip a switch that actuates the lower air cylinder. This brings up nippers that cut the leads precisely to the correct length, then brings in jaws that clinch the leads. In the preliminary cutting operation, the leads were simply cut to a standard length for loading into the magazine.

After an insertion, the magazine is indexed forward one position and simultaneously the drum is rotated to bring the next magazine into position. If a component is missing in that magazine, a switch detects the absence of its leads and keeps advancing the magazine until a component is in position for insertion. Another switch senses the presence of a magazine and keeps indexing the drum until a loaded position is found.

The magazines can be loaded with identical parts or with parts mixed in a desired sequence.

Although the manually controlled positioning system has proved highly satisfactory for small-volume military electronic orders, a certain amount of operator training is involved. Work is now under way on development of a punched paper tape control that will replace the template and pantograph. The tape will control a high-precision servo positioner on which the wiring board will be mounted.

Assembly Tray

FLEXIBLE PLASTIC connector caps, a piece of 2 by 4 and a piece of Masonite form the basis for a highly flexible parts tray used at many different work positions in the Long Island City plant of Ford



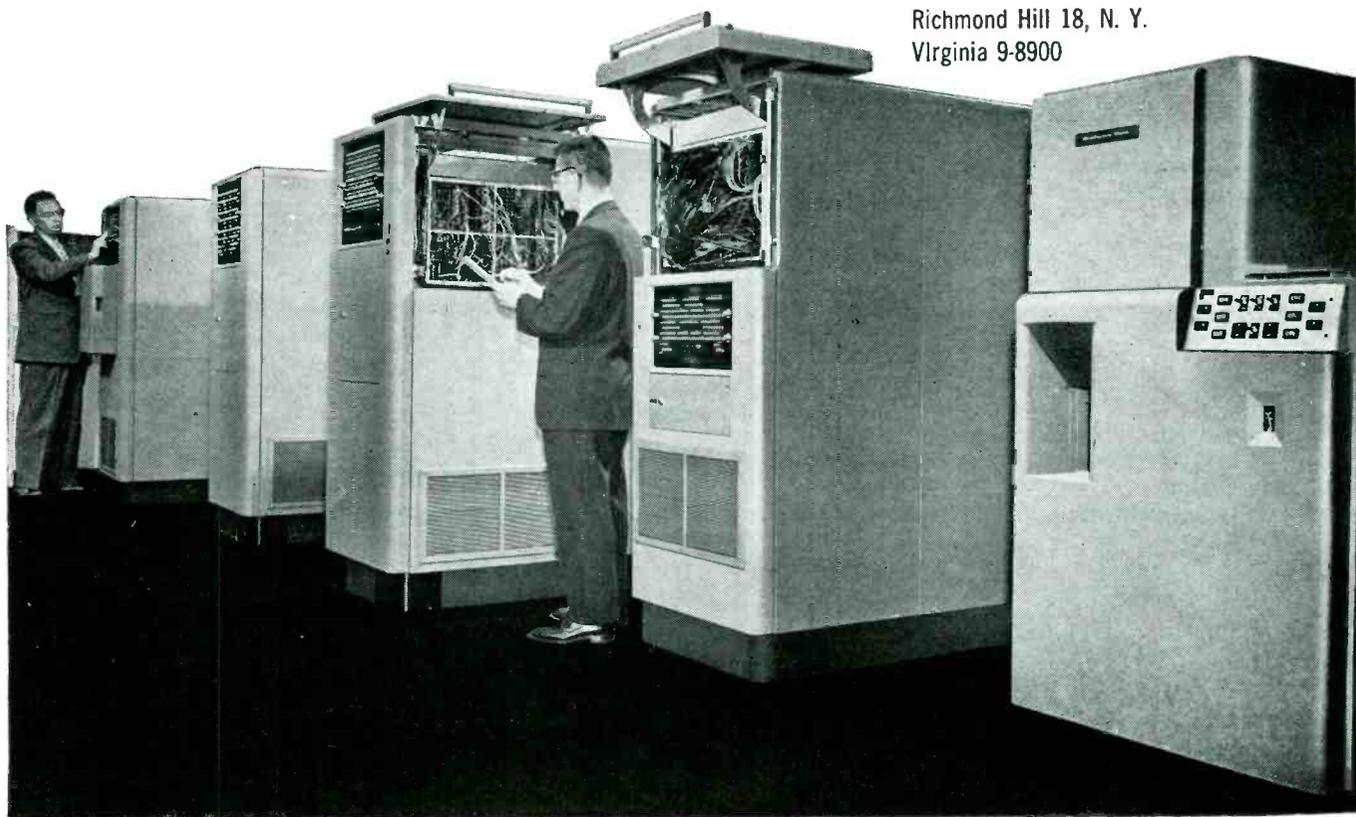
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FOR COMPUTER RELIABILITY IT'S GENERAL TRANSISTOR

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Write for Specification Bulletins covering your applications.

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Shown Actual Size

Greater Sensitivity, Vibration Resistance Engineered in



'Diamond H' Relays

Continuing development of "Diamond H" miniature, hermetically sealed, aircraft type relays is constantly widening their performance range. Now, for example, in a 4 PDT relay: sensitivity to 85 mw with vibration resistance of 500 cycles at 10 "G" and 30 "G" shock resistance; vibration resistance of 55 to 2,000 cycles at 20 "G" with 50 "G" shock resistance and maximum sensitivity of 1½ watts.

Excellent contact reliability makes "Diamond H" relays preferred choice for critical jobs in vital applications ranging from guided missiles to high speed camera equipment.

TYPICAL PERFORMANCE CHARACTERISTICS

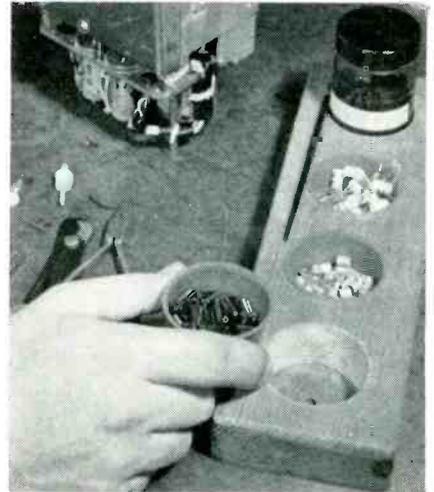
Vibration Resistance:	10-55 cycles at 1/16" double amplitude 55-500 cycles at 15 "G" 55-1,000 cycles at 15 "G" 55-2,000 cycles at 20 "G"
Temperature Range:	—55° to + 85°C. —65° to + 125°C. —65° to + 200°C.
Coils:	Resistances—1 ohm to 50,000 ohms Arrangements—single coil; two independent coils, either or both of which will operate unit
Insulation Resistance:	1,000 megohms at room temperature 100 megohms at 200°C.
Dielectric Strength:	450 to 1,250 V., RMS
Operating Time:	24 V. models 10 ms. or less; dropout less than 3ms.
Contacts:	30V., D.C.; 115V., A.C.; 2, 5, 7½ and 10A., resistive; 2 and 5A. inductive. Minimum 100,000 cycles life. Low interelectrode capacitance — less than 5 mmf. contacts to case; less than 2½ mmf. between contacts. Special Ratings: to 350 V., D.C., 400 MA., or other combinations including very low voltages and amperages or amperages to 20.
Operational Shock Resistance:	30, 40 and 50 "G" plus
Mechanical Shock Resistance:	up to 1,000 "G"
Mounting:	9 standard arrangements to meet all needs — plus ceramic plug-in socket.
Size:	1.6 cu. in.
Weight:	4 oz. or less

Call on "Diamond H" engineers to work with you in developing a variation to meet your specific requirements.

THE HART MANUFACTURING COMPANY
202 Bartholomew Avenue, Hartford, Connecticut

Instrument Co. Holes are drilled in the 2 by 4 to take the plastic cups and the Masonite is nailed across the bottom of the block to close the holes.

Blocks are cut in various lengths depending on the number of cups needed at work positions. This arrangement permits changing of individual cups as required,



Method of changing plastic cups in parts-holding tray. Jar at rear contains fungicide that is applied to terminals with brush

without emptying the contents of the cups or the entire tray.

The holes also hold small jars of fungicides, varnishes and other liquid chemicals used in assembly operations, minimizing chances for knocking over the jars. If a jar is taped to give a snug fit in the hole, so it does not rotate when the cover is loosened, the cover can be removed with one hand while the operator is holding the work with her other hand.

The plastic cups used are made by Protective Closures Co., 2207 Elmwood Avenue, Buffalo, N. Y. Though intended primarily for pushing over connectors to protect threads and terminals temporarily during assembly, they serve ideally for holding small parts.

Hot Staking of Eyelets On Printed Wiring Boards

EYELETS FOR terminal leads are staked and soldered simultaneously into holes of printed wiring boards by using a heated air-actuated staking tool in GE's Light Military

HUGHES PRODUCTS

proudly announces

TONOTRON

Full circle persistence
Displays complete spectrum
of gray shades
Controllable persistence
Controllable rate of decay
No hood needed, even in
direct sunlight
5-inch screen



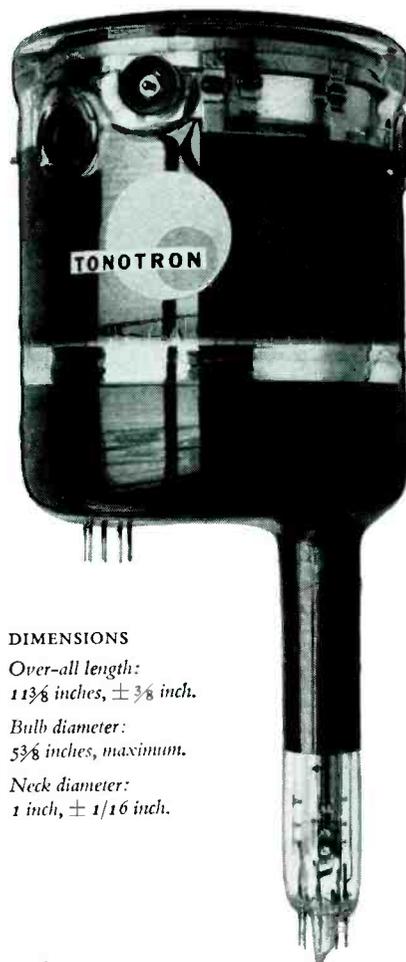
Weather radar with brilliant
half-tone picture.



Narrow band, slow scan.
Closed-circuit TV.



Freeze action until
intentionally erased.

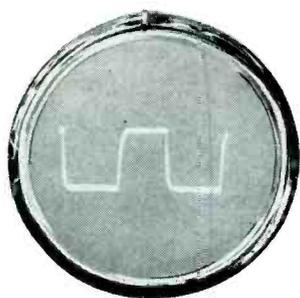


DIMENSIONS

Over-all length:
 $11\frac{3}{8}$ inches, $\pm \frac{3}{8}$ inch.

Bulb diameter:
 $5\frac{3}{8}$ inches, maximum.

Neck diameter:
1 inch, $\pm \frac{1}{16}$ inch.



Single transient pulse, 20 micro-seconds wide with a one micro-second rise time, showing writing capabilities of one million inches per second. This photo was taken in full daylight without a hood.



MEMOTRON

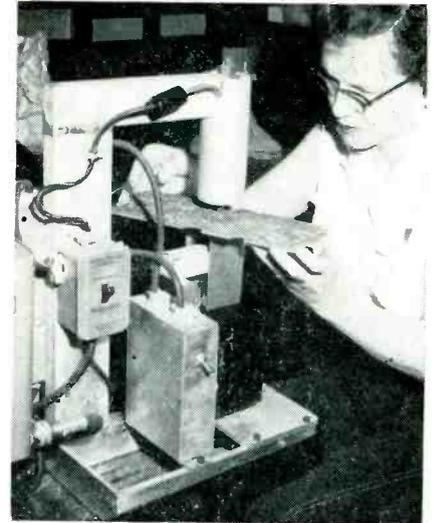
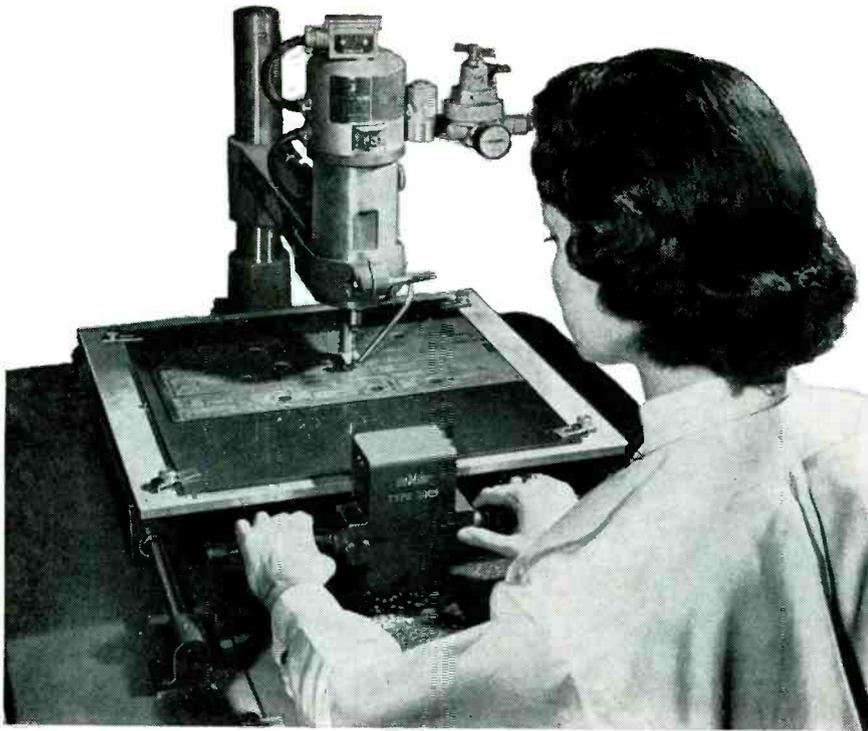
Memotron gives instant and permanent display of one or successive transients.

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

ELECTRON TUBES

For descriptive literature write to
HUGHES PRODUCTS
ELECTRON TUBES
International Airport Station, Los Angeles 45, California

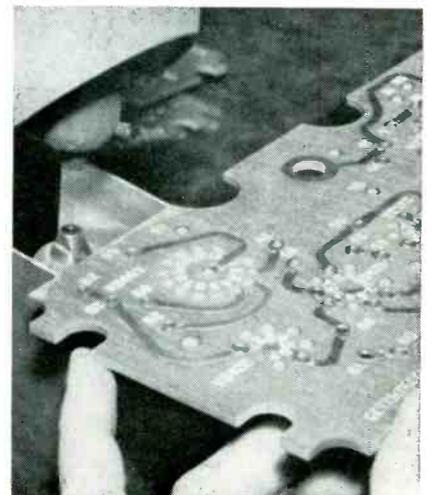


Hot staking setup for anchoring eyelets in holes of printed wiring board

Electronic Equipment Department in Utica, N. Y.

The printed wiring is solder-plated and the eyelets tinned and rosin-coated beforehand, to provide the required solder and flux for the operation. Eyelets are inserted by another operator at an adjacent work position, so that eyelets for an entire board can be staked quickly one after another.

Heating current for the hot staking die is controlled by a GE instantaneous current limiter. The temperature for the soldering operation is not critical, but has a marked effect on tool life. A constant and correct temperature minimizes corrosion of the die.



Both upper and lower staking dies are heated when wiring is on both sides of board. Only upper die need be heated when wiring is on one side

PANTODRILL CUTS COSTS

The answer to semi-high-speed production board drilling—at lowest possible cost . . .

The Du Mont Pantodrill requires no expensive tool or jig making. A simple template, made on a drill press, or the Pantodrill itself, serves as a guide to accurate drilling of up to thousands of production pieces.

The Pantodrill may be operated by unskilled personnel at a speed of up to 150 holes per minute with an accuracy of 0.010" center-to-center. The Pantodrill operates on a simple, foolproof principle which completely eliminates rejects due to misdrilling.

A pressure sensitive feed on the drill head automatically adjusts feed rate for all types of materials. Boards may be stacked up to 1" thickness so that a quantity may be drilled simultaneously.

The Pantodrill is the answer to economical pilot runs, or limited production runs.

SPEED
150 holes per minute

ACCURACY
0.010" center-to-center

TEMPLATE
Made in 1/2 hour or less.

Send for complete details on the Pantodrill. It costs only

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\$1995⁰⁰

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The diversification of the Los Alamos papers accepted at the Geneva Conference dramatically illustrates a few of the challenging research problems being explored at the Laboratory, which welcomes applications for employment from qualified scientists and engineers.

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Director of Scientific Personnel
Division 1503

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scientific laboratory

OF THE UNIVERSITY OF CALIFORNIA

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New Products

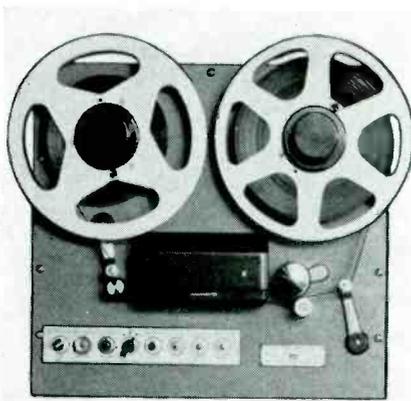
Edited by WILLIAM P. O'BRIEN

73 New Products and 64 Manufacturers' Bulletins Are Reviewed
... Control, Testing and Measuring Equipment Described and
Illustrated ... Recent Tubes and Components Are Covered

TAPE TRANSPORTS

with varied applications

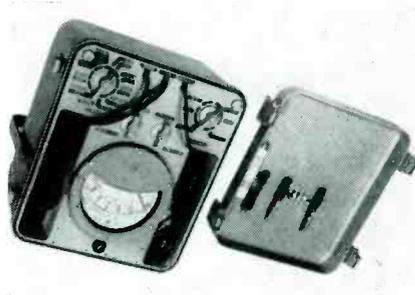
TELECTRO INDUSTRIES CORP., 35-18 37th St., Long Island City 1, N. Y., has introduced a new series of tape transport mechanisms suitable for broadcast studio work and for telemetering and data recorder applications. The series features unique applications of a 3-speed motor and specially designed circuitry for changing speed and compensation simultaneously. Vari-Synch front panel control permits precise setting of speed of specially designed hysteresis synchronous motor.



► **Technical Data**—Approximately 1 sec is required for stable tape motion at 15 ips; 3 sec at 30 ips; 5 sec at 60 ips. Stopping time is approximately 0.1 sec at all speeds. Flutter and wow are well under 0.1 percent rms, measuring all flutter components from 0 to 300 cps, using a 3,000 cycle signal. Rewind time is one minute for full 10½-in. reel. Pushbutton controls are provided for start, stop, wind, rewind and record. Tape transport mechanisms are available in any number and combination of channels up to 28. Complete data are available. **Circle P1 inside back cover.**

MULTIMETER

compact and portable



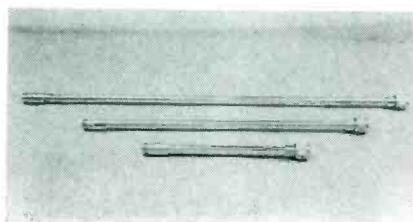
NORTHEASTERN ENGINEERING, INC., Manchester, N. H. Model No. 7-20-M electronic multimeter is a compact, portable multirange meter identical to the military model TS-505B/U for measuring the rms values of a-c voltages from 0 to 150 v, d-c voltages from 0 to 1,000 v and d-c resistance from 0 to 1,000 megohms. An r-f adapter is

furnished to extend the range into the values of r-f voltages up to 40 v rms with frequencies up to 500 mc. Overall accuracy is ± 4 percent in ohms, ± 5 percent in d-c volts and ± 6 percent in a-c volts. An added feature is a plus or minus d-c position, which enables the user to quickly check the polarity of d-c voltages or for zero voltage. Complete data are available from the company. **Circle P2 inside back cover.**

ATTENUATOR PADS

designed for high power

WEINSCHEL ENGINEERING, 10503 Metropolitan Ave., Kensington, Md. Models 502 and 503 attenuator pads are now available. They cover the frequency range of 1,000-10,000 mc and are designed for high power. Some of these pads are designed to take an input of 10 w average and 10 kw peak power. Other pads have a rela-



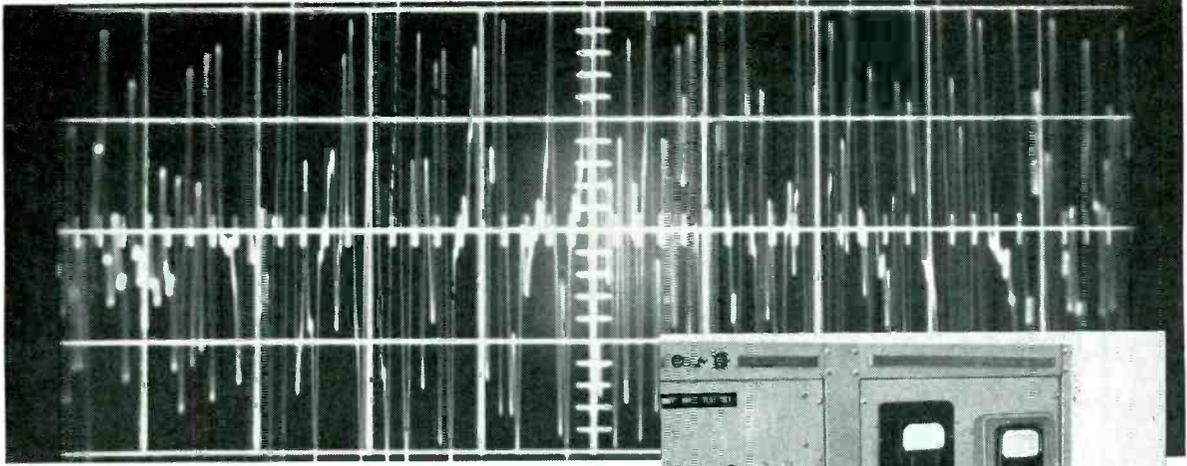
tively high attenuation such as 20 and 30db with low frequency

sensitivity from 1,000 to 10,000 kmc. Specifications and prices are available. **Circle P3 inside back cover.**

TRIODE

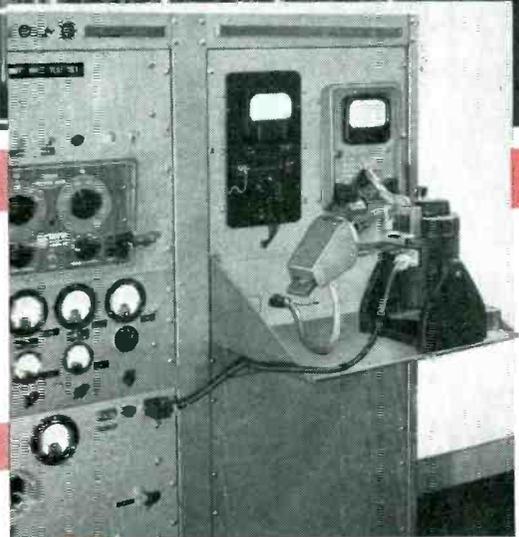
used in r-f generators

MULLARD LIMITED, London, England, has developed a new triode, the TY7-6000, for use in industrial



Untouched oscillogram demonstrates the wide spectrum and random nature of vibrations inherent in Sylvania's new "white noise" vibration test. It's approximation of flight conditions to which guided missiles are subjected is an important contribution to tube reliability.

The "white noise" test rack is compact and simple to operate. It provides direct noise output readings from both an R.M.S. and a peak-to-peak voltmeter across a wide frequency spectrum.



"White Noise"

*puts wings on a test rack,
advances tube reliability*



By providing a more realistic tube vibration test which can be adapted to large-scale production techniques, the "white noise" vibration test is contributing to greater tube reliability.

Developed by Sylvania engineers in conjunction with Naval contracts, the "white noise" vibration test meets important requirements for testing tubes used in guided missiles and other vehicular applications.

First, it simulates environmental conditions by presenting a wide range of vibrational frequencies. Secondly, it presents these frequencies at random g-levels. Thirdly, it provides specification limits through direct meter readings.

If you are interested in additional analysis of the "white noise" vibration test, write on your company letterhead. Please address Department M20P.



SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Bldg., Montreal
Eastern Hemisphere—Sylvania International Corp.
22 Bahnhofstrasse, Coire, Switzerland

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r-f generators. It delivers an output of 6 kw at frequencies up to 50 mc and has been conservatively rated to insure adequate margins of safety when used in industrial heating applications where tube

may be subjected to line and load variations which can result in intermittent overloads.

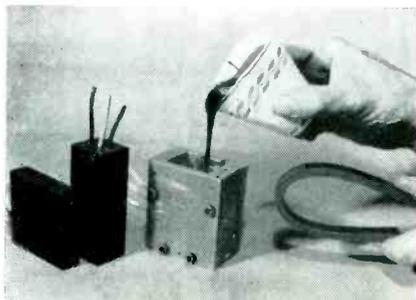
The new triode is available in two versions: the TY7-6000A, which is designed for forced air

cooling and the TY7-6000W which is a water-cooled version. Maximum permissible anode dissipation is 6,000 w in either case and anode voltages up to 7 kv may be used. **Circle P4 inside back cover.**

CASTING RESIN

flexible epoxide type

EMERSON & CUMING, INC., 869 Washington St., Canton, Mass. Controlled flexibility is possible when using Stycast 2741, a new epoxide casting resin. Supplied as two components, the material is extremely easy to use. Cure is effected at room temperature, but can be accelerated at elevated temperature.



Stycast 2741 retains flexibility at -70 F and is, therefore, recommended for encapsulating, potting and sealing applications requiring low temperature use. It can also be used at +300 F without harmful effects. Shrinkage during cure is negligible; adhesion to most materials is excellent. Stycast 2741 is quite effective in adhesive applications where some flexibility is advantageous. **Circle P5 inside back cover.**

SAMPLING COMMUTATOR

high speed device



ASCOP Typ. AB
Sampling Commutator Switch

APPLIED SCIENCE CORP. OF PRINCETON, P. O. Box 44, Princeton, N. J. Type AB high speed sampling switch provides single pole sampling of 60 contacts at rates up to 30 rps. Only 3 oz.-in. torque is required. This compact switch is built to provide long life under

the most rugged conditions of use. It is designed for direct mounting to standard servo appliance frames.

Complete shielding is provided with provision for potting all wiring when required. It has ball bearing construction throughout with glass base contact plate and pure coin silver contacts. **Circle P6 inside back cover.**

MULTIPLIER SECTIONS

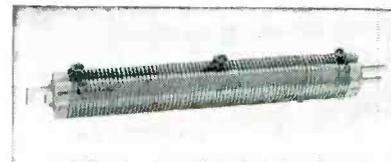
with plug-board programming

DIT-MCO, INC., 911 Broadway, Kansas City Mo., has incorporated plug-board programming in the model 850 multiplier sections to simplify both the pretest preparation and the actual test process in tests involving more than 200 circuits. This plug-board multiplier is used in conjunction with the model 200 circuit analyzer, which is now being used by manufacturers of aircraft, guided missiles and computers. It is designed to enable the user to keep up with product modification without ever having to modify or rebuild the adapter cables. The programming system permits rapid changes in test procedure and sequence with a minimum expenditure of time and effort.

The plugboard assembly is similar to a telephone switchboard, inasmuch as the desired circuitry connections are built up on the plugboard with phone-jack type



patchcords. Therefore, the terminations of an aircraft's electrical system can be connected, with simple cables, to the terminals of the analyzer without reference to circuitry. The desired circuitry can then easily be set up on the plugboard. **Circle P7 inside back cover.**

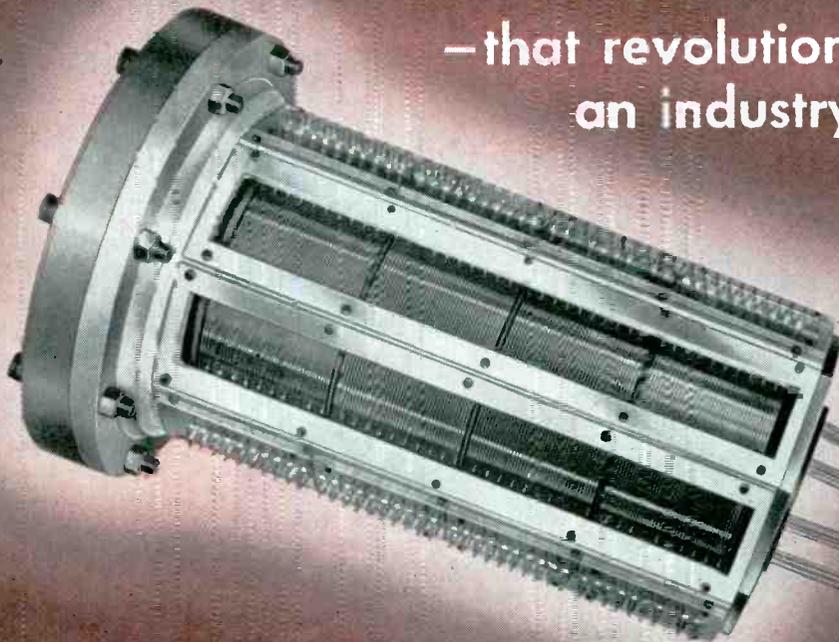


RESISTORS
for high-current uses

OHMITE MFG. Co., 3649 Howard St. Skokie, Ill., has announced a new line of resistors for high-current,

A DESIGN CONCEPT

—that revolutionized an industry!



ELECTRO TEC

PRECISION MACHINED
ONE-PIECE CONSTRUCTION

**SLIP RING &
COMMUTATOR
ASSEMBLIES**

Diameters of multi-ring
assemblies from .035" to 36"



Individual components
or complete assemblies
to precise electrical,
mechanical,
and environ-
mental speci-
fications.



An Unmatched Record of Performance

Today, Electro Tec Slip Ring and Commutator Assemblies are the choice of leading aircraft, instrument, and component manufacturers throughout the world. Our units are selected for Gyro and Servo applications, for Telemetry and Radar devices, for Guidance systems, and Automation equipment... where sustained and reliable performance is a requisite.

Facilities Available to Serve You

Plants in South Hackensack, N. J., Blacksburg, Va., and Ormond Beach, Fla., are currently producing a wide variety of Slip Ring, Commutator, and Brush Block Assemblies, Precision Selector Switches, and Miniature Relays. Complete Engineering Facilities and Branch Sales Offices in Los Angeles, Minneapolis, Chicago, and Waltham, Mass. are geared to service your requirements.

Write for fully illustrated literature.

Uniformly hard rings,
low noise, minimum
friction and dimen-
sional stability.



ELECTRO TEC CORP.
SOUTH HACKENSACK, NEW JERSEY



PRODUCTS OF PRECISION CRAFTSMANSHIP



*PATENT No.
2,696,570

ACEPOT*
ACETRIM*

Sub-Miniature Potentiometers and Trimmers

$\frac{1}{2}$ " size, precision wire-wound,
up to 250K, $\pm 0.3\%$ linearity

setting new standards
for dependability
in sub-miniaturization

Let the facts speak for themselves! ACE Sub-Miniature Precision Wire-Wound Potentiometers and Potentiometer Trimmers are the result of 4 years development and over a year of successful use by leading electronic equipment manufacturers. Users have conclusively proved that ACEPOTS and ACETRIMS meet requirements for space and weight saving compactness, while at the same time meeting MIL specs' most stringent qualifications for performance and dependability. Why invite trouble with untested components when you can protect your reputation with ACEPOT and ACETRIM . . . the subminiature potentiometers and trimmers proved in actual use.

Condensed Engineering Data

	ACEPOT (potentiometer)	ACETRIM (trimmer)
Resistance Range	200 \sim to 250K $\pm 2\%$	10 \sim to 150K $\pm 3\%$
Linearity	$\pm 0.3\%$	$\pm 0.3\%$
Resolution	extremely high	excellent
Ambient Temperature	-55° C to 125° C*	-55° C to 125° C
Torque	low or high	low or high

The above specifications are standard — other values on special order.

Available in threaded bushing, servo, flush tapped hole or flange mounting, and ganged units. All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN specs and MIL-E-5272A standards.

*New X-500 ACEPOT operates to a new high of 150° C.

Expedited delivery on prototypes; prompt servicing of production orders.
Send for Fact File and application data sheets.

*trademarks applied for

ACEPOT*
ACETRIM*

ACE ELECTRONICS ASSOCIATES

Dept. E.101 Dover St. • Somerville 44, Massachusetts

low-resistance applications. They are known as round-wire type, Powr-Rib resistors.

► **Construction**—The units consist of ceramic insulators assembled on a metal bar and wound with resistance alloy wire. Construction is designed to provide flexibility and resistance to shock, plus efficient heat dissipation. Brackets and terminals are heavily plated to prevent oxidation.

The new Powr-Rib resistors can be supplied in four lengths. Resistance values range from 0.69 to 25 ohms; current ratings from 5.1 to 18.4 amperes. The longest unit, $16\frac{1}{4}$ in. between mounting centers, is available from stock in 12 resistance values. Extra terminals are available to provide taps. Bulletin 144 is obtainable for more information. Circle P8 inside back cover.



JUNCTION TRANSISTORS with flexible leads

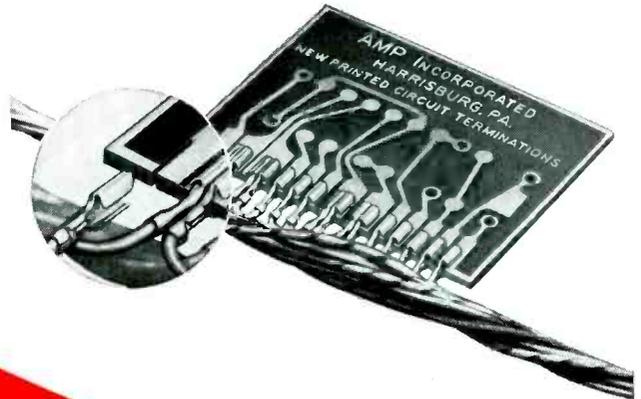
RADIO CORP. OF AMERICA, Somerville, N. J. The 2N215 and 2N217 junction transistors of the germanium *mpn* alloy type utilize flexible leads which may be soldered or welded into the associated circuit. They are hermetically sealed, utilize insulated metal envelopes and feature extreme stability and excellent uniformity of characteristics.

The 2N215 is particularly useful in low-power audio applications. In a common-emitter type of circuit this transistor has a current amplification ratio of 44, a 1-f power gain of 41 db and a noise factor of 6.5 db.

The 2N217 is intended for large-signal audio applications, especially in class B push-pull audio

AMP-EDGE HAS THE EDGE ON PRINTED CIRCUITS

Design-Engineered with
Positive Wiping Contact
and
Frictional Grippage



The new
AMP-Edge
Connector gives you . . .

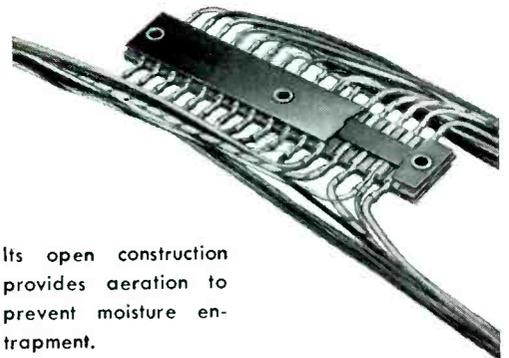
. . . greater flexibility—your printed circuit area and completed unit are not limited by the size of connection, as found in alternate methods of edge connection.

. . . greater design versatility—they can be applied in any arrangement to any section of the perimeter of the printed circuit.

. . . two-way cost reduction—production time and labor costs are reduced through solderless termination of the connector to the wire (4,000 terminations per hour) and the ease of applying the Edge Connector to the printed circuit.

amp's **C**reative **A**pproach
TO BETTER WIRING

Another of the many unique designs made available by the AMP-Edge technique is the new, low-cost, compact AMP-Edge Connector Block. It allows freedom of arrangement, with small area displacement.



Its open construction provides aeration to prevent moisture entrapment.

For more information on
AMP-Edge Connectors, contact:



AMP Incorporated

General Office: Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada, Ltd., 194 Wilson Avenue, Toronto 12, Ontario • Aircraft-Marine Products (G.B.) Ltd., London, England • Societe AMP de France, Courbevoie, Seine, France • AMP-Holland N.V., 's-Hertogenbosch, Holland
Japanese Distributor: Oriental Terminal Products Co., Ltd., Tokyo, Japan

Shaker system for complex motion tests

NEWEST TECHNIQUE in environmental testing is complex motion testing. It comes closest to reproducing actual vibrational environments encountered in operation of missiles, aircraft, vehicles.

An MB Vibration Exciter System designed for such service is one of optimum versatility. It fulfills not only the special needs of *random motion testing*, but virtually any other test specification as well . . . such as sinusoidal motion testing, fatigue testing, automatic cycling, and provisions of MIL-E-5272A.

HEART OF THE SYSTEM—THE EXCITER

The MB Model C-25HB (shown) is rated at 5000 pounds peak force. Its table assembly is unusually stiff to reduce resonances yet weighs only 75 pounds. Axial resonance lies well over 2000 cps operating range.

This and other MB Exciters for 200, 1200, 1700, 3500, 7000 and 15,000 pound force faithfully reproduce complex input signals when teamed with an MB amplifier and compensation console.

MATCHED PERFORMANCE

Other elements of the system are integrated with the exciter's high performance. An electronic *amplifier* fulfills the power demands. A control cabinet houses all necessary *instrumentation* plus frequency and amplitude *controls*. Circuits in a *compensation console* give automatic adjustment so that table acceleration remains proportional to input voltages. A top quality tape recorder for playback of the complex wave patterns may be used.

If you have any questions on vibration testing at all, come to a leading authority on the subject . . . the MB engineering staff.

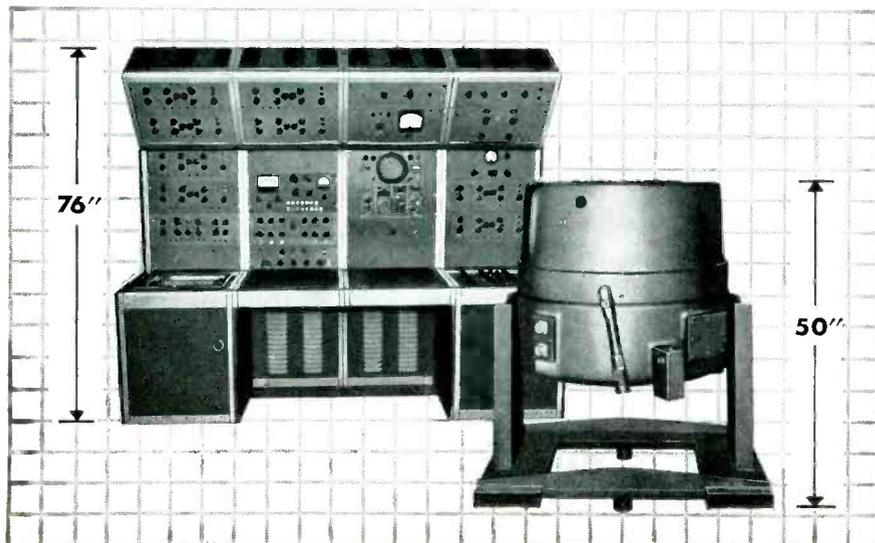


manufacturing company

A DIVISION OF TEXTRON INC.

1060 State Street, New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE . . . EXCITE . . . AND MEASURE VIBRATION

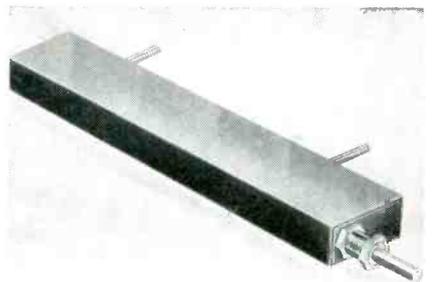


output stages of battery-operated portable radio receivers operating at power levels of approximately 150 mw. In a common-emitter type of circuit, this transistor has a large-signal d-c current amplification ratio of 70 (approximately linear to 50 ma), and a power gain of 33 db (for 2 transistors in a class B push-pull audio circuit). Circle P9 inside back cover.



MOLDED RESISTORS deposited carbon type

ELECTRA MFG. Co., 4051 Broadway, Kansas City, Missouri, has in production two new sizes of a molded deposited carbon resistor made to meet or exceed MIL-R-10509B. The new sizes are DMC $\frac{1}{4}$ ($\frac{1}{4}$ w) and DCM $\frac{1}{4}$ ($\frac{1}{4}$ w). They are ideal for applications requiring precision, stability and small physical size, plus the advantages of extra insulation. They are doubly insulated for better mechanical protection, longer load life, superior electrical insulation, plus greater resistance to moisture. Circle P10 inside back cover.



DELAY LINE continuously variable type

ESC CORP., 534 Bergen Blvd., Palisades Park, N. J., has announced the development and availability of a new continuously variable delay line, model 403. It is designed for use as a component or as test equipment in advanced computer and radar systems.

► **Application Flexibility**—The entire delay range, from zero to

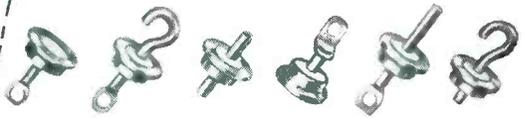
E-I

Specified
industry-wide for
DEPENDABILITY
PLUS!

COMPRESSION TERMINATIONS*



• **MULTIPLE HEADERS**



• **SINGLE LEAD TERMINALS**



• **PLUG-IN CONNECTORS**



• **COMPONENT END SEALS**



• **TRANSISTOR CLOSURES**



• **CUSTOM TERMINATIONS**

Hermetically Sealed miniature, sub-miniature or standard E-I terminals are specified for performance *plus* in military and commercial service. These dependable compression seals perform successfully under the most gruelling conditions . . . offer maximum immunity to shock, vibration and wide variations of temperature and pressures. Check your sealed terminal requirements with E-I—recommendations will be made on your specific applications without obligation.

 **ELECTRICAL
INDUSTRIES**
44 SUMMER AVENUE, NEWARK 4, N. J.,

*Patent pending - all rights reserved

SIE

MODEL C-6

RESISTANCE METER



DIRECT READING FROM 0 OHMS TO 10,000,000 MEGOHMS

- 3 TEST VOLTAGES: 1½, 50, 500 VOLTS
- ACCURATE WITHIN 3% TO 1,000,000 MEGOHMS
- PRE-SETTABLE "CHARGE ADJUST" CONTROL FOR RAPID GO, NO-GO CAPACITOR CHECKING

\$200

SIE



SOUTHWESTERN INDUSTRIAL
ELECTRONICS COMPANY

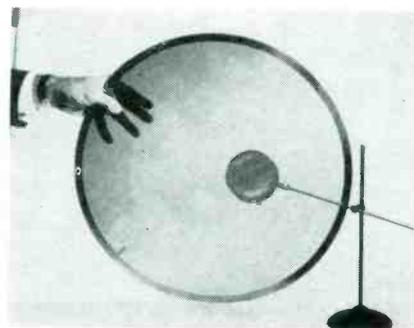
P. O. BOX 13058 2831 POST OAK ROAD
HOUSTON 19, TEXAS

NEW PRODUCTS

(continued)

maximum delay, is covered by a single control shaft, in ten turns. The unit may be locked at the desired delay by a locknut attachment which is available from the company. Thus, it can be used as a component in equipment with a fixed delay or as a continuously variable test unit.

► **Specifications** — Attenuation in the unit is less than 1.0 db. Resolution is better than 0.001 μ sec. Termination is external. Maximum delay is 0.70 μ sec. Maximum rise time is 0.060 μ sec. Impedance is 500 ohms. Outside dimensions are 6½ by 4 by 1½ in. The new unit meets all applicable Mil-Specs. Circle P11 inside back cover.



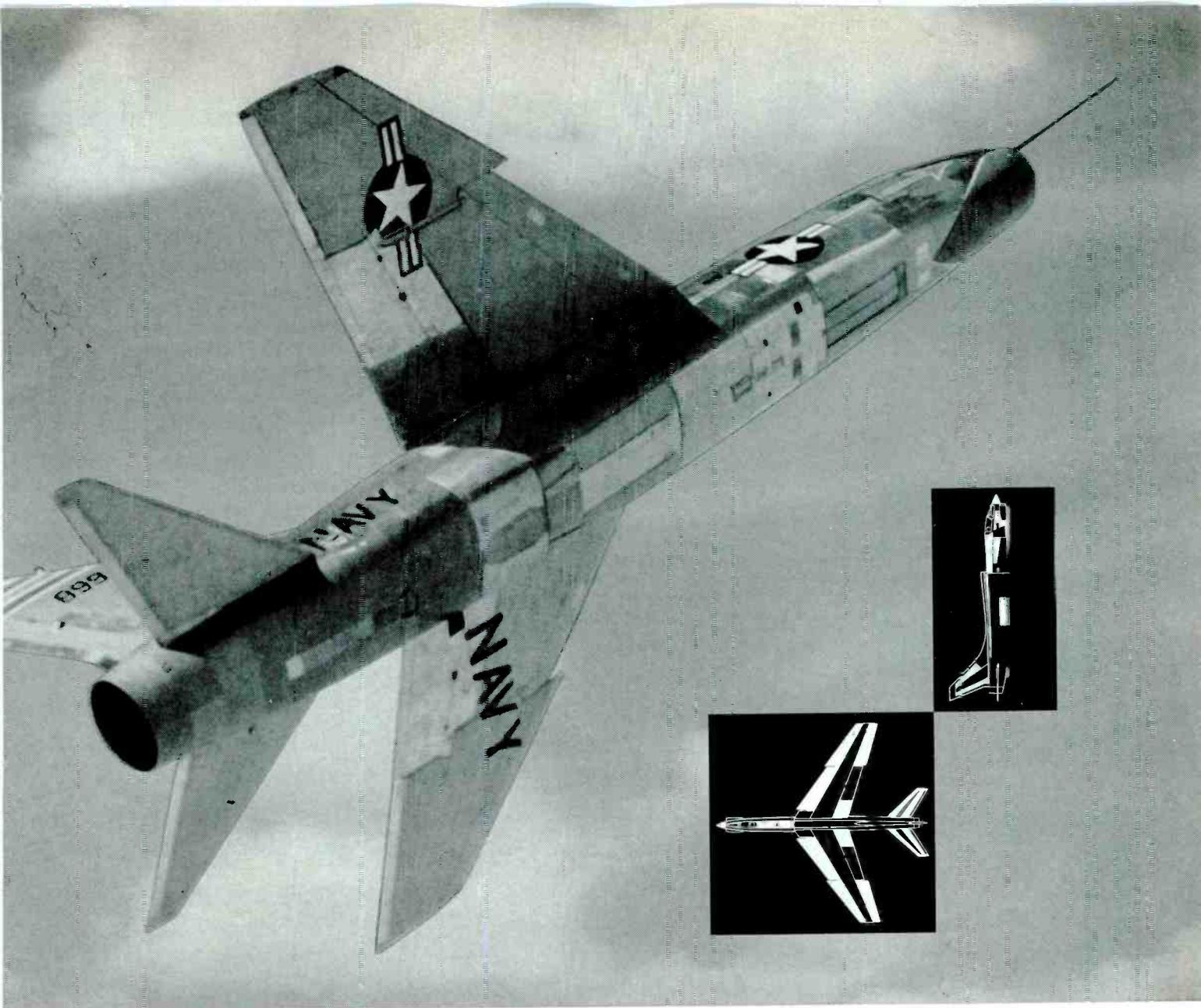
APERTURE MASKS for color television

SUPERIOR TUBE CO., Norristown, Pa. Consisting of a paper-thin metal sheet into which are etched 400,000 perfect holes, the new aperture mask guides electron beams to the phosphor-coated faceplate on the commercial tv picture tube.

Each hole in the mask is 1/100th of an in. in diameter. It focuses the tube's three electron beams on the right phosphor dot on the color screen. To make sure that the right beam hits the right dot, the holes are made to extraordinarily precise size, shape and location. Circle P12 inside back cover.

COAX TRANSMISSION LINE for high power, low loss

PRODELIN, INC., 307 Bergen Ave., Kearny, N. J., has available the new 6½ in. 50-ohm coaxial transmission line for high-power, low-loss military and commercial



Weight-saving magnesium sheet (white areas) is used for leading edges, empennage, wheel doors and many other parts of F8U-1 Crusader.

25% of external skin on record-breaking F8U-1 made with magnesium

In Chance Vought's F8U-1 Crusader, fastest U.S. fighter by official record, many precious pounds are saved by using magnesium. Designers called for a total of 166 magnesium external skin parts—25% of the wing and fuselage surface area. 275 magnesium sand castings ranging in weight from a few ounces to thirteen lbs. were used inside the skin.

Weighing one fourth as much as steel and only two thirds as much as aluminum, magnesium gives you the best combination of strength and rigidity per pound. Its stiffness-to-weight ratio is the highest of any structural metal.

Magnesium permits clean, simplified designs—eliminates many stringers and detail parts. A selection of finishes provides remarkable protection against corrosion. Machinability is excellent, too. Fabrication, fitting and joining problems are always at a minimum.

Magnesium can help you make better designs for fuselage, wings and interior parts. Sheet, extrusions, and castings can be readily produced to meet your requirements. Call your local Dow sales office, or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA363KK.

you can depend on **DOW MAGNESIUM**



NEW HICKOK PANEL METERS

4 5/8" Rectangular

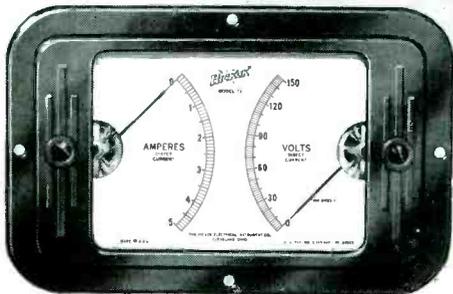
WITH OR WITHOUT ILLUMINATION



Molded-phenolic sealed cases for semi-flush or surface mounting. Has new miniature-type movement and extra long scale. DC scale length 3 3/4". AC scale length 3 3/8". Permits choice of two mounting stud locations for maximum versatility. Illumination technique permits easy bulb change from front panel. Also available without illumination feature.

4" x 6" Double Movement

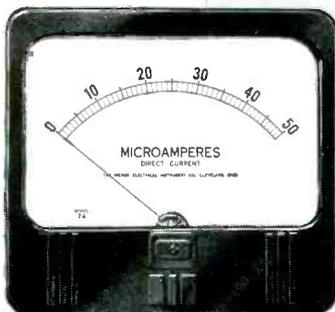
TWO SEPARATE INDICATORS



Molded-phenolic sealed case for flush mounting. DC scale length 2 5/8". AC scale length 2 1/4". This new space saving instrument facilitates reading two separate indications with minimum effort and permits great saving of valuable panel area without sacrifice to scale length.

7" Square

LARGE DIAL AREA



Molded-phenolic sealed case for semi-flush mounting. DC scale length 6 1/4". AC scale length 5 1/2". The large dial area of this instrument is ideal for multi-scale arrangements. Illumination is available.

It is reasonable to state that Hickok does or can produce almost every practical type of electrical indicating instrument. New plant expansions have doubled production. Open facilities now exist for quantity orders. Your inquiry is invited. Kindly list details of your requirements. New Catalog No. 33 is available.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10527 Dupont Avenue • Cleveland 8, Ohio

services. The RETMA line is built in accordance with standard TR-134 for the latest coaxial transmission lines. The pin-type reactance-compensated Teflon insulators provide constant impedance and broadband characteristics.

Dimensionally interchangeable with all other standard RETMA manufactured lines, these new lines are also available in other RETMA-specified sizes. A complete line of associated components and connectors is also available.

Write for specifications, performance data and prices. Circle P13 inside back cover.



TRANSISTOR CIRCUIT KIT
has 15 individual units

INSTANT CIRCUITS, a division of Alfred W. Barber Laboratories, 32-44 Francis Lewis Blvd., Flushing 58, N. Y. The basic kit of 15 individual transistor circuit design units permits general circuit synthesis and testing in the audio range. High-frequency units may be added to extend the range. Broadboarding of a circuit is eliminated since the system permits circuits to be set up in 3 to 5 minutes by color-coded pin tip leads and pin jacks connected to all circuit elements. Circuit design testing, experimenting, teaching and learning the feel of circuits are all carried out with a great saving of time.

A wide range of circuit components include potentiometers, fixed resistors, fixed capacitors, inductors, transformers, speakers, transistor and tube sockets, batteries, meters, junction tie points and various signal sources and test instruments. Color coding

Epoxy strengthens accelerometer

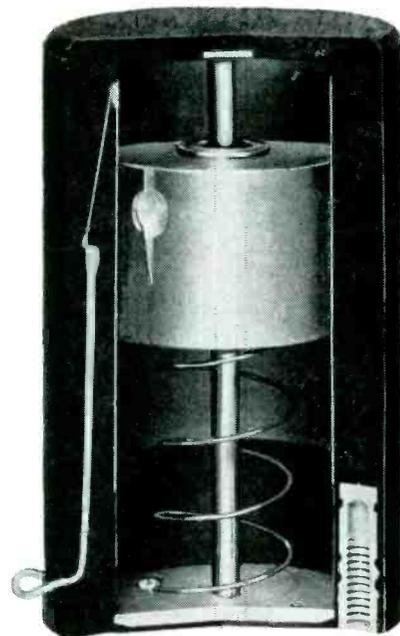
For violent aircraft maneuvers

This accelerometer or transducer is vital to the fire control mechanism of high-speed military aircraft. As part of an automatic computer, it measures rate of velocity change. The job demands absolute dependability.

To withstand the mechanical and thermal shocks of aircraft operation, the accelerometer is encapsulated in a hermetically-sealed housing made from a Rezolin compound based on BAKELITE Brand Epoxy Resin. Thousands of fine wire windings are held firmly and safely in position because this resin is compounded to match the thermal expansion characteristics of the assembly's working elements.

Encapsulation and sealing with compounds based on BAKELITE Epoxy Resin is a fast, simple operation; the liquid resin, mixed with its liquid hardener, is poured into place. It quickly cures into a hard, strong structure with outstanding dimensional stability.

Other advantages of BAKELITE Epoxy Resins include excellent adhesive properties, resistance to chemicals and moisture, high dielectric strength, and a wide operating temperature range. As a result, these materials are finding increasingly successful uses similar to the one described here.



The RAM accelerometer is a uniquely-designed, extremely low-friction type. Hermetic sealing with Rezolin compounds of BAKELITE Epoxy Resin provides a constant self-damping factor over a wide altitude temperature range. In cross section above, vertical white lines marking cylinder walls are formed by thousands of fine wire windings firmly embedded in epoxy.



Testing vibration characteristics of accelerometers at the Ram Meter factory. Compounds formulated by Rezolin, Inc., Los Angeles 45, Calif., for Ram Meter Inc., Ferndale 20, Mich.



BAKELITE COMPANY, A Division of Union Carbide and Carbon Corporation  30 E. 42nd St., New York 17, N.Y.

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

NEW**CALIDYNE
model 174 SHAKER****1500 lbs. force output**

**a basic shaker
for 6 different
CALIDYNE
Vibration
Test Systems**

SYSTEM NUMBER	1	2	3	4	5	6
	178/203	174/184	174/80	174/186	174/186	174/80
Type	Sinusoidal	Sinusoidal	Sinusoidal*	Sinusoidal*	Random or Sinusoidal	Random or Sinusoidal
Power Supply	Electronic	Rotary	Electronic	Electronic	Electronic	Electronic
Force Output	1250 lbs.	1500 lbs.	1500 lbs.	1500 lbs.	1500 lbs.	1500 lbs.
Frequency Range	5-3500 cps.	5-2000 cps.	5-3500 cps.	5-3500 cps.	5-3500 cps.	5-3500 cps.
Max. Load 10 g.	105 lbs.	130 lbs.	130 lbs.	130 lbs.	130 lbs.	130 lbs.
Max. Load 20 g.	42.5 lbs.	55 lbs.	55 lbs.	55 lbs.	55 lbs.	55 lbs.

*Also adaptable for Random Vibration Testing.

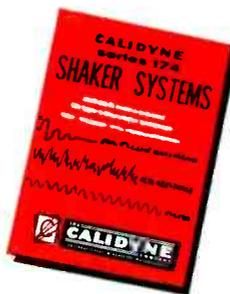
CALIDYNE'S Model 174 Shaker featuring high frequency operation and low input requirements has been so designed that it can be utilized in any one of six CALIDYNE Vibration Test Systems.

The versatility of the Model 174 Shaker extends the range of vibration testing for which this shaker can be used. It further advances CALIDYNE Systems of vibration control, enabling equipment manufacturers to create vibratory forces over a wide range, measure them, use them for testing and measuring the test results.

Typical vibration testing applications of these Model 174 CALIDYNE Shakers include:

1. **Brute force** shaking at frequencies simulating the worst conditions of ultimate operation.
2. **Structural response** to determine mode shape, frequency and damping characteristics.
3. **Fatigue testing** for high stress providing deflections many times greater than normal usage.
4. **Random vibration** testing for more exact simulation of true environment.

Complete performance data on each of these six CALIDYNE Series 174 Shaker Systems are contained in New Bulletin 17400. For engineering counsel in applying the destructive force of vibration to your own research and testing problems, call us here at CALIDYNE.



NEON LAMP

for computer applications

CIRCON COMPONENT Co., Santa Barbara Municipal Airport, Goleta, Calif., has available a new subminiature neon lamp (NE2C) with a midget flanged base. Electrical design of the lamp makes it of interest for a wide variety of indicator and computer applications. Power consumption is only 0.04w. Current drawn is extremely low at 0.0003 ampere. The lamp produces practically no heat. It is a long life unit with average



THE CALIDYNE COMPANY

120 CROSS STREET, WINCHESTER, MASSACHUSETTS

SALES REPRESENTATIVES

NEW ENGLAND, NORTHERN NEW YORK
Technical Instruments, Inc.
Waltham, Mass. (Twinbrook 3-1400)
Syracuse, N. Y. (Syracuse 3-7870)
NEW YORK CITY, LONG ISLAND,
NEW JERSEY, DELAWARE,
EASTERN PENNSYLVANIA
G. Curtis Engel & Associates
Ridgewood, N. J. (Gilbert 4-0878)
Spysse, L. I. N. Y. (Walnut 1-5095)
Philadelphia, Pa. (Chestnut Hill 8-0892)
OHIO, WESTERN PENNSYLVANIA,
EASTERN MICHIGAN
M. P. Odell Company
Westlake, Ohio (Trinity 1-8000)
Dayton, Ohio (Oregon 4441)
Pittsburgh, Penna. (Fremont 1-1231)
Detroit, Michigan (Broadway 3-5399)

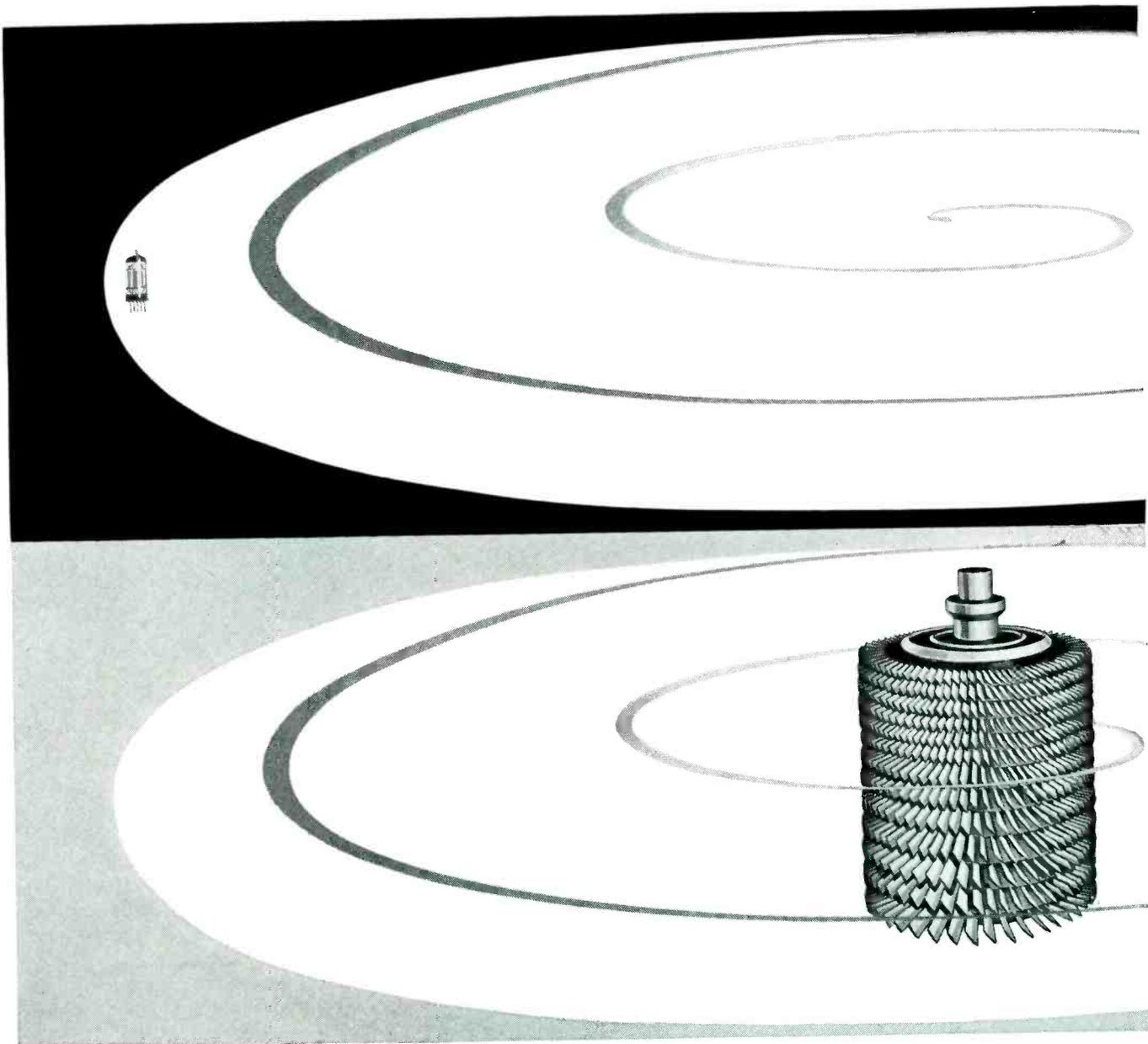
VIRGINIA, MARYLAND, WASHINGTON, D. C.
F. R. Jodan, Inc.
Washington, D. C. (Oliver 2-4406)

SOUTH CAROLINA, GEORGIA, ALABAMA,
FLORIDA, SOUTHERN TENNESSEE
Specialized Equipment Corp.
Cocoa Beach, Fla. (Cocoa Beach 3328)

INDIANA, ILLINOIS, WISCONSIN,
MINNESOTA, WESTERN KENTUCKY,
WESTERN MICHIGAN, N. DAKOTA,
S. DAKOTA, EASTERN IOWA
Hugh Marland and Co.
Chicago, Ill. (Ambassador 2-1555)
Indianapolis, Ind. (Glendale 3803)
Minneapolis, Minn. (Cotfax 7949)

ARKANSAS, LOUISIANA, OKLAHOMA,
TEXAS (Except El Paso)
John A. Green Co.
Dallas, Texas (Riverside 3266)
Houston, Texas (Jackson 3-1021)
Tulsa, Oklahoma (Riverside 2-4657)

CALIFORNIA, ARIZONA, COLORADO,
NEW MEXICO, NEVADA, OREGON,
WASHINGTON, IDAHO, WESTERN MONTANA
Gerald B. Miller Co.
Hollywood, Calif. (Hollywood 2-1195)
San Diego, Calif. (Academy 2-1121)
Belmont, Calif. (Lytel 3-3438)
Tucson, Arizona (Tucson 4-4255)
Denver, Colorado (Acama 2-9226)
Albuquerque, New Mexico
(Albuquerque 5-8606)



In centrifugal testing
 from sub-miniature electronic components to massive turbine rotors
AMF has experience you can use

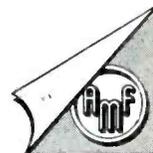
• The SIGHT LIGHT Division of AMF is now designing and producing centrifuges capable of developing forces in excess of 50,000 times gravity—Spin-Test equipment capable of speeds above 100,000 rpm. • And these are just a part of the highly specialized yet widely diversified activities of some 35 engineering and production facilities that provide AMF with a wealth of experience covering nearly every field of industry. Experience immediately available to you. • So call upon AMF with your problem. See for yourself why this all-around experience in answering the needs of government and industry alike has made AMF a "can do" company. • For further information, write to the Sight Light Division, Deep River, Connecticut.

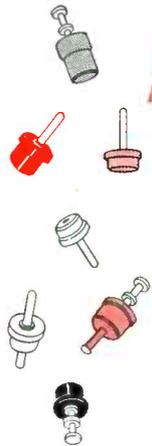
Research, Development
 Production in these fields:

- Armament
- Ballistics
- Radar Antennae
- Guided Missile Support Equipment
- Auxiliary Power Supplies
- Control Systems



Defense Products Group
AMERICAN MACHINE & FOUNDRY COMPANY
 1101 North Royal Street, Alexandria, Va.





SO MIGHTY...

Yes, mighty! That's why Sealectro subminiature "Press-Fit" terminals are found in critical assemblies where failure just can't be tolerated—in guided missiles, radar, communications equipment, electronic computers, etc.

Simplest installation—just press-fit, that's it. No brittle materials or seals breaking down. Dielectric strength of 1000 to 2000 volts per mil. No carbonization from arc-over, lowest losses. Moisture condenses in droplets—no continuous film. Plus other amazing electrical characteristics matching the ideal ruggedness. Yes, mighty!



Unbelievably so. A dozen of these subminiature stand-offs and feed-thrus fit comfortably on a quarter. Sizes from .093" to .179" bushing dia. All due to the proper application of Teflon, the "miracle insulator", by the pioneer and specialist—SEALLECTRO!

Get Your Copy! This handy "Press-Fit" Manual is yours for the asking. Likewise application engineering second to none, applied to your particular assemblies.

*Trademark of the original Teflon terminal manufacturer
†Reg. Trademark, E. I. Du Pont de Nemours & Co.

Sealectro
CORPORATION

610 Fayette Avenue, Mamaroneck, N. Y.



life over 25,000 hours. Starting voltage is 65 v a-c.

The new lamp has been tooled for automated production with segmented basing construction and electronically controlled spot-welded shell connections. Circle P16 inside back cover.

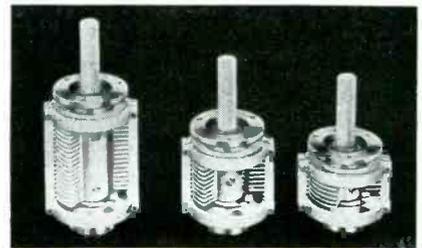


AUDIO OSCILLATOR

general purpose unit

WAVEFORMS, INC., 333 Sixth Ave., New York, N. Y., has announced a new general purpose sine-wave oscillator. Model 401 features wide tuning range (9 cps to 100 kc), high accuracy (2 percent with 0.5-percent stability), flat response ($\pm \frac{1}{2}$ db) and low distortion (0.5 percent).

Its unique output system affords unusual versatility of use. At full output the instrument deliver 20 v open circuit or $\frac{1}{2}$ w into 600 ohms. Output level is controlled by a logarithmic calibrated potentiometer in tandem with a 100 to 1 attenuator. Price is \$125. Circle P17 inside back cover.



AIR CAPACITOR

for instrument use

GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Improvements in electrical and



DESTINATION:

PEACE!

Heart of a new weapon system in America's inventory of counter-measures that guard the peace is an IBM airborne computer — specially designed to guide America's most powerful bombers with unbelievable precision.

To build *complete systems reliability* into this airborne computer, IBM submits the finest available components to tests of torturing extremes. Only those that survive are used. But, from this test data, IBM electronic computers figure ways to improve the failures and make those selected even better. In this way, IBM helps strengthen the general reliability of all electronic systems, and give to America's airborne defenders a mighty—and dependable — weapon for guarding the peace.

ENGINEERS:

IBM offers exciting opportunities to work on computers, control systems, inertial guidance, and microwave circuitry.

In addition to excellent starting salaries and on-the-job training with pay, IBM offers a chance for rapid promotion through its individual merit system. You'll work in some of the choicest locations in all America and enjoy the advantages of IBM's industry-famous employee-benefit policies.

WRITE, giving details of background and interests, to: R. A. Whitehorne, Room 412, International Business Machines Corporation, 590 Madison Avenue, New York 22, N. Y.

Positions available in Owego and Kingston, N. Y. IBM Laboratories and Manufacturing Plants also located in: Poughkeepsie and Endicott, N. Y.; San Jose, Calif.; Rochester, Minn.; and Lexington, Ky.



MILITARY PRODUCTS • DATA PROCESSING • ELECTRIC TYPEWRITERS • TIME EQUIPMENT



cores

+

engineering

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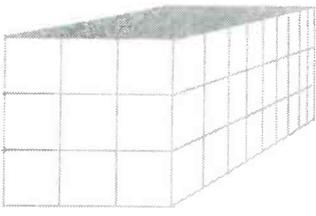
economy

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volume

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the leader



**ENGINEERED
ECONOMY*
IRON CORES
of course!**

*trademark

Also, custom iron cores
to your specifications.

We are proud as the originators of ENGINEERED ECONOMY* IRON CORES that we have been able to reduce the prices of our products so tremendously in the past few years. This has been achieved through constantly increasing volume production, reduction of costs through improved manufacturing techniques and the use of automation. We now have better and more uniform quality than ever before.

Now, you can select from over 19 types of ENGINEERED ECONOMY* IRON CORES where previously we had to produce over a hundred. Fewer varieties enables us to stock more and sell at lower prices. We invite your inquiry.

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Radio Cores, Inc.

Radio Cores, Inc.

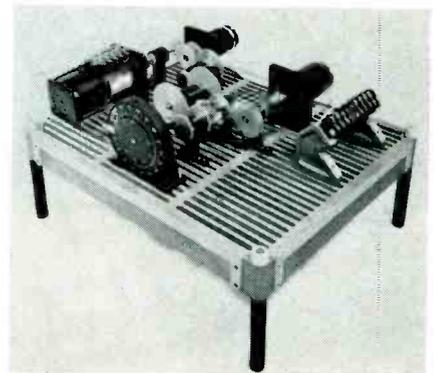
9540 Tulley Avenue Oak Lawn, Illinois



mechanical properties have been obtained in the type 1420 variable air capacitors by machining them from solid metal. Both rotors and stators are gang milled from shaped extruded aluminum rods. This method of manufacture allows close mechanical tolerance to be held and makes a sturdy structure with high mechanical stability.

Electrical gains include good linearity, lower metallic resistance and inductance than even a sold-cred stack, low thermal drift and a minimizing of microphonic tendencies. The insulators used are machined from a cast bar of cross-linked polystyrene for thermal adequacy. They are stressed in compression to eliminate crazing or structural failure. The rotor shaft is of glass-reinforced polyester with exceptional strength and stability as well as being good electrically. Double-shielded, full size ball bearings are used, making the capacitors suitable for continuous motor drives.

Three sizes are available: 70, 130, and 250 μf , maximum capacitance. Prices are \$20, \$21.50 and \$22.50 each, respectively. Circle P18 inside back cover.



BREADBOARD PARTS
rugged and precise in design

HELIPOT CORP., Newport Beach, Calif., has announced a line of Beckman standard electromechanical breadboard parts. Manufactured to standards set by government purchasing agencies, the parts are precision designed for extremely close tolerances. Aluminum parts are anodized and stainless steel parts are passivated.

Included in the product line are

**ONLY *Glass*
CAN DO THIS JOB
SO WELL . . .**



Type ML-2G
New all-glass miniature
Shown Actual Size

Type ML-300
Developed by Midland
for color television
Shown Actual Size



Only glass makes it possible to get and keep such high vacuum in a crystal holder.

Only glass gives complete and permanent protection against atmospheric enemies of crystal efficiency and service life.



Type ML-1G
New all-glass
sub-miniature
Shown Actual Size

**only *Midland* provides you
ALL-GLASS CRYSTALS FOR ALL APPLICATIONS**

Now you can have a new high level of crystal performance that just wasn't possible before. All-glass holders for crystals are another "first" resulting from Midland's advanced research. It is another step in our continuous effort to overcome whatever problems stand in the way of longer crystal life or more precise, constant and unfailing performance . . . in short, **better** frequency control units! Check with us on all your crystal needs — and any special requirements.



Manufacturing Company, Inc.

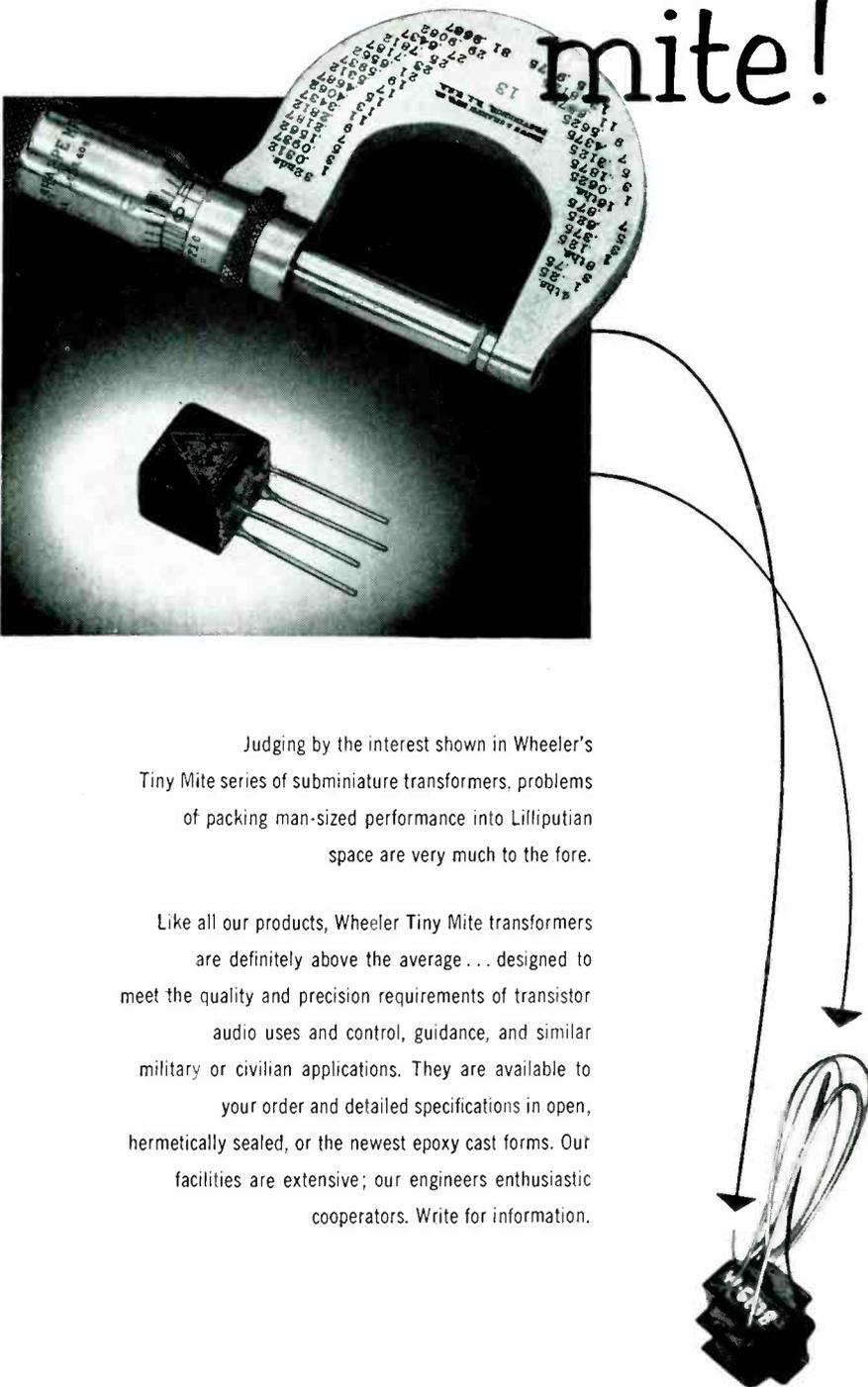
3155 Fiberglas Road

Kansas City 15, Kansas

WORLD'S LARGEST MANUFACTURER OF QUARTZ CRYSTALS

... every one produced to the industry's highest standards.

the electronic engineer's mite!



Judging by the interest shown in Wheeler's Tiny Mite series of subminiature transformers, problems of packing man-sized performance into Lilliputian space are very much to the fore.

Like all our products, Wheeler Tiny Mite transformers are definitely above the average... designed to meet the quality and precision requirements of transistor audio uses and control, guidance, and similar military or civilian applications. They are available to your order and detailed specifications in open, hermetically sealed, or the newest epoxy cast forms. Our facilities are extensive; our engineers enthusiastic cooperators. Write for information.

THE WHEELER
INSULATED WIRE COMPANY, INC.
Division of Sperry Rand Corporation
1101 East Aurora Street, Waterbury 20, Connecticut

NEW PRODUCTS

(continued)

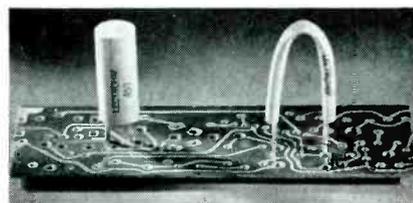
such basic components as grid plates, shaft hangers, component hangers, shaft couplings, shaft hardware, shafting, electric and electromechanical limit stops, dial assemblies, gears and differentials, as well as such special items as magnetic clutches and ball and disk integrators.

Breadboarding with these standard parts offers the advantage of step-by-step development of electromechanical devices or servo systems prior to final packaging. **Circle P19 inside back cover.**

MONITOR/ALARM

determines radiation level

NUCLEAR-ELECTRONICS CORP., 2632 W. Cumberland St., Philadelphia 32, Pa. Model RMA-3 is an a-c operated instrument for monitoring and determining radiation level. Featured is a 3-range rate meter with provision for sounding a warning alarm at any present level of radiation. Accuracy of meter readings on all ranges is ± 5 percent. Aural monitoring is provided by a built-in loudspeaker. The unit has a built-in calibrator and provision for an external pen recorder. Size of the instrument is 8 in. high by 11 in. wide by 9½ in. deep. Weight is 18 lb. **Circle P20 inside back cover.**

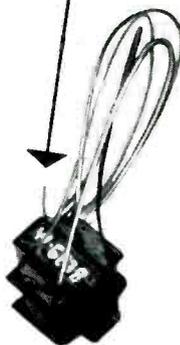


POWER RESISTOR

has special terminals

LECTROHM, INC., 5560 Northwest Highway, Chicago 30, Ill., has announced a new type of flexible power resistor specially developed for printed circuits. Light weight and flexibility of the resistors offer the advantages of easy assembly and simplicity of making changes in resistance and voltage without changing the holes in the mounting board.

The element is wound on a flexible fiberglass core. The sleeving, also of fiberglass, is heavily satur-





For a wide range of requirements

PIN TYPE ^{*}Capacitors

***Designed for upright mounting in**

PRINTED CIRCUITS

Rely on the experience of Good-All in supplying millions of capacitors for printed circuit use to the nation's leading manufacturers of:

- TELEVISION • HOME RADIOS • BUSINESS MACHINES
 AUTO RADIOS • TEST EQUIPMENT • MILITARY COMPUTERS

Case Style (Illustrated at Right)	TYPE DESIGNATIONS			
	Paper Dielectric		Mylar Dielectric	
	Type No.	Application Notes	Type No.	Application Notes
A	503PM 522PM	Paper dielectric designs are in most common use for general purpose applications. Types in the 503 "Marbelite" series are impregnated with solid plastic. Types in the 522 "Miracle X" series are oil impregnated.	620PM	Mylar dielectric is most often used where small physical size is essential. Also important, however, are such properties as high IR, low power factor, and stability with life. *Du Pont's trade mark for their Polyester Film.
B	503PS 522PS		620PS	
C	503E		600UPE	
D	503PB 522PB		620PB	
E	503PBK 522PBK		620PBK	
F	All ceramic disc types are available with leads spaced and cut to special dimensions. Good-All epoxy coated discs are ideal for printed circuit use because of the physical and electrical ruggedness of the coating material.			

Take advantage of these quality features of Good-All Pin Types:
 Accurately spaced leads • Lead treatment to make soldering easy
 Rugged, moisture-resisting case construction • Secure bonding to the leads and case • Conservatively designed capacitor elements.

Write or phone for consultation on specific design problems or to secure detailed specifications on the various capacitor types shown.



GOOD-ALL ELECTRIC MFG. CO.

A LEADER IN THE FIELD OF TUBULAR CAPACITORS

OGALLALA, NEBRASKA



PLASTIC IMPREGNATED PAPER CASE



CERAMIC CASE



MOLDED IN EPOXY



MOLDED BAKELITE CASE (cylindrical)



MOLDED BAKELITE CASE (with locating key)



EPOXY COATED CERAMIC DISCS

FM TELEMETRY TRANSMITTER



- SMALL SIZE
- LOW DISTORTION
- HIGH RELIABILITY
- HIGH FREQUENCY STABILITY

Frequency Range: 215-235 mc
 Power Output: 2 watts
 Weight: 1.7 pounds

An extremely rugged unit designed for high-shock impact and extreme environmental conditions. Subminiaturized and crystal-stabilized.

Write for complete data and prices

Personnel Inquiries Invited



RADIATION Inc.

Melbourne, Fla.
Orlando, Fla.

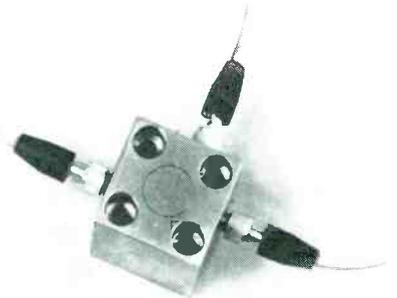
Electronics • Avionics • Instrumentation

NEW PRODUCTS

(continued)

ated with Silicone to pass requirements for above chassis mounting. Tapered semitubular terminals have been designed particularly for soldering in printed circuit boards. They eliminate popping-out problems experienced with solid type terminals.

Five-watt resistors in values up to 2,500 ohms and 10-watt units up to 5,000 ohms are in production. Circle P21 inside back cover.



TINY ACCELEROMETER a high-temperature unit

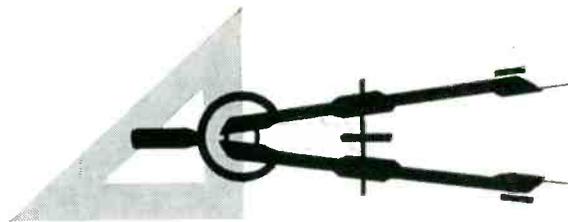
GULTON INDUSTRIES, INC., 212 Durham Ave., Metuchen, N. J., has developed a subminiature high-temperature accelerometer that will measure 3 mutually perpendicular accelerations simultaneously. The Glennite model AHT-30T will operate accurately in temperatures from -65 F to +350 F and features an acceleration range up to 500 g, frequency response from 25 to 20,000 cps and sensitivity of 0.8 mv per g.

Excellent linearity and stability characterize the AHT-30T which can replace three separate accelerometers formerly required to measure one longitudinal and two lateral accelerations at the same time. The unit weighs less than 1 oz and is less than 1 cu in. in volume. Circle P22 inside back cover.

EPOXIDE FOAM for potting purposes

EMERSON & CUMING, INC., 869 Washington St., Canton, Mass. An epoxide foam of extremely uniform and fine structure is produced from Eccofoam PT, "pack in place" foam. The foam is intended for use in potting electronic

*Engineered to meet
your specifications . . .*



Stupakoff CERAMIC PARTS

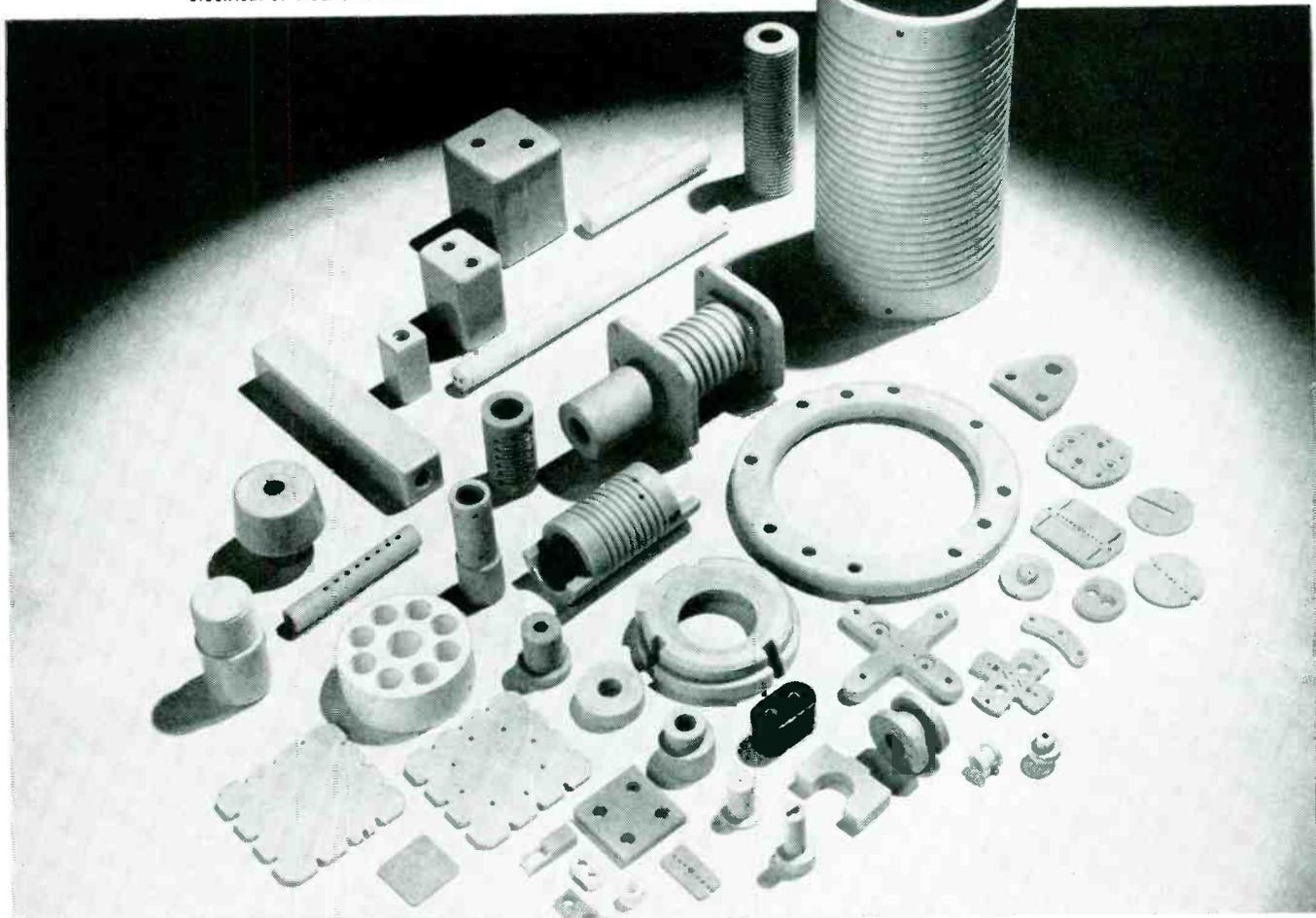
The best way to get ceramic parts exactly as you want them, is to utilize Stupakoff's facilities for research, engineering and manufacture.

You can use our laboratory facilities to determine the best material for your application; our engineering staff to design components that will be most economical to produce, and that will assemble best in your equipment; our modern manufacturing plant to produce the items you need in the quantities you want; our inspection and testing facilities to assure the highest degree of uniformity and quality.

We are thoroughly familiar with various grades of Alumina, Cordierite, Forsterite, Magnesia, Steatite, Stupalith and Zircon. Parts may be plain, ground, metallized, or assembled. For electrical and electronic applications, we make ceramic parts for all voltages, frequencies and temperatures. We specialize in large production runs of ceramic parts made to close dimensional tolerances.

Use Stupakoff's facilities to make your products better, more dependable and more economically.

A few of literally thousands of designs of ceramic parts produced by Stupakoff for assembly into electrical or electronic devices.



STUPAKOFF DIVISION OF

The CARBORUNDUM Company

WRITE DEPT. E LATROBE, PENNSYLVANIA



SOLDERING GUN TIP JOINTS BRAZED WITH

EASY-FLO 45

... the "GOOD CONDUCT" alloy!

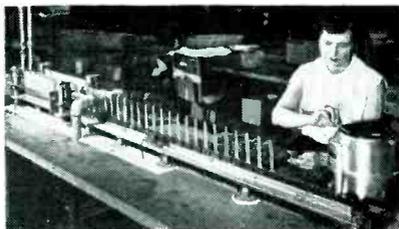
If anything needs good electrical and heat conductivity, it's a soldering gun tip. That's why Wen Products, Inc., Chicago, Illinois uses EASY-FLO 45 silver brazing alloy to join the *dissimilar* metals of steel and copper that make up the heat and current-carrying assembly.

Another service advantage of EASY-FLO is that it will not oxidize or corrode at working temperatures. The strength and ductility of EASY-FLO joints withstand "service abuse"—and soldering guns get plenty of it.

Here's the Way Wen Brazes 4000 Tips a Day

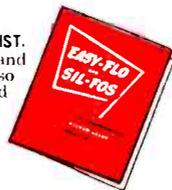
Steel tips, with EASY-FLO pieces preplaced on their ends, are inserted into the copper terminals and staked.

Operator dips assemblies into flux pot of HANDY FLUX — kept at proper dipping consistency by electricity — sets them in holders on moving conveyor. Assemblies pass through twin, city gas, compressed air burners after which they drop to a bin for cooling and defluxing. Present daily production of 4000 tips could be doubled or tripled by adjusting belt speed and heat and adding another operator.



Photos and data courtesy of WEN PRODUCTS, INC.

GET COMPLETE EASY-FLO FACTS AND DISTRIBUTOR LIST. BULLETIN 20 explains why high strength, speed and economy are inherent in EASY-FLO brazing. Also gives Handy information about joint design and fast brazing methods. Get your copy, with distributor list by writing today.



Your NO. 1 Source of Supply and Authority on Silver Brazing Alloys

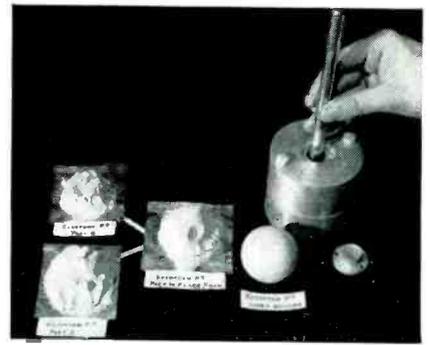


HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

DISTRIBUTORS IN PRINCIPAL CITIES

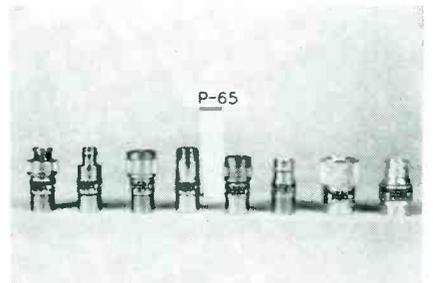
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TORONTO, CANADA
MONTREAL, CANADA



assemblies, for void filling in aircraft and insulation and buoyance applications.

Supplied as two components which are mixed together, the material resembles foundry molding sand prior to use. It is packed or tamped into place in the cavity to be filled. Complete and uniform filling is easily accomplished. Cure is effected at room or elevated temperature.

Cured Eccofoam PT is useable to 350 F. Density is less than 20 lb per cu ft; flexural strength is 800 psi. It is of low dielectric constant and low dissipation factor. Circle P23 inside back cover.



COAX TERMINATIONS with many applications

WEINSCHEL ENGINEERING, 10503 Metropolitan Ave., Kensington, Md. Model 535 coaxial terminations are available with male or female connectors in types N, C, BNC and QDS, with low vswr in 50-ohm systems at frequencies from d-c to 10 kmc. Accurate calibrations at seven or more frequencies are supplied for each unit.

Applications include precision vswr measurements of transmission lines; coaxial cables and connectors; insertion devices such as filters, attenuators, power dividers, slotted lines, directional couplers or transitions of wave-

NEW TYPE H
5-WATT
 molded composition
VARIABLE
RESISTOR

With this new development, you get all the advantages of the well-known Allen-Bradley Type J unit, but in a 5-watt rating. The Type H variable solid molded composition resistor is ideal for laboratory or industrial applications where reliability, velvet smooth control, and long life without resistance change are important. The dual track in the Type H control eliminates all moving metal-to-metal electrical contacts, making it outstanding for its low "noise" characteristics, both initially and after long use. The Type H control varies only insignificantly under changing temperature and humidity conditions. Its operating life is far in excess of 100,000 cycles, with no appreciable change in resistance.

You'll have many applications for this new Allen-Bradley *quality* control. Try it!

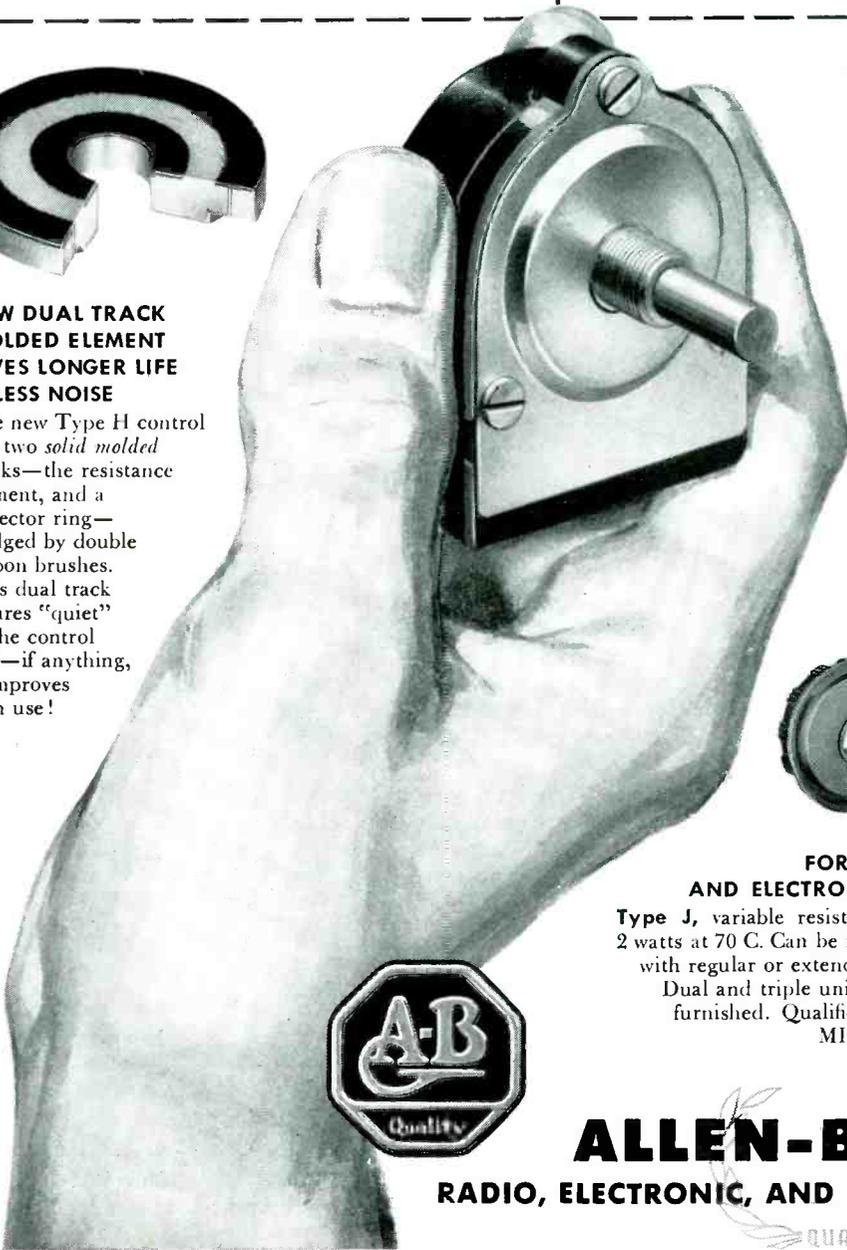
Allen-Bradley Co.

110 W. Greenfield Ave., Milwaukee 4, Wis.
 In Canada—Allen-Bradley Canada Ltd., Galt, Ont.



**NEW DUAL TRACK
 MOLDED ELEMENT
 GIVES LONGER LIFE
 ... LESS NOISE**

The new Type H control has two *solid molded* tracks—the resistance element, and a collector ring—bridged by double carbon brushes. This dual track assures "quiet" in the control and—if anything, it improves with use!



**OTHER ALLEN-BRADLEY
 VARIABLE RESISTORS**



FOR PRINTED CIRCUITS
Type F, 1/4-watt variable resistor (1/2-inch diam). Similar to Type G, below. Slotted screwdriver shaft.

**FOR SUBMINIATURE
 ASSEMBLIES**

Type G, 1/2-watt variable resistor (1/2-inch diam). Plain or lock-type bushing; plain or slotted shaft. Available with switch. Has qualified under MIL-R-94A.



FLAT, COMPACT DESIGN
Type T, 1/2-watt variable resistor (1-inch diam). Supplied for hand or screwdriver adjustment.

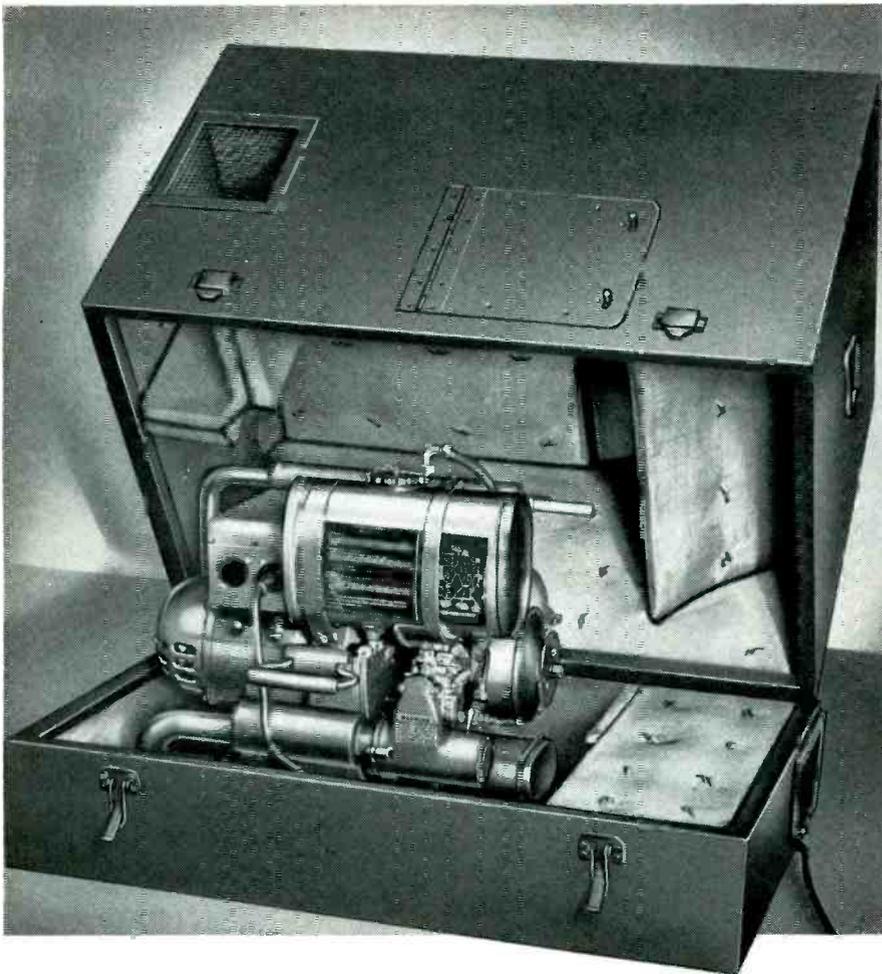
**FOR RADIO
 AND ELECTRONIC USE**

Type J, variable resistor, rated 2 watts at 70 C. Can be furnished with regular or extended shaft. Dual and triple units can be furnished. Qualified under MIL-R-94A.



ALLEN-BRADLEY
 RADIO, ELECTRONIC, AND TELEVISION COMPONENTS





HOMELITE GENERATORS

Get the silent treatment

The box shown above is an efficient acoustical housing designed to give an effective silent treatment to Homelite military gasoline-engine generator sets for applications where audio noise must be held to a minimum. At 50 feet, you have to have sharp ears to hear this .5KW generator operating even under full load . . . at 150 feet this unit is virtually inaudible. Specially designed acoustical housings are available to match all of Homelite's military generator-sets.

If you're looking for lightweight, gasoline-engine-driven generators (with or without acoustical housings) which will meet even the toughest MIL specifications, get in touch with Homelite.

With over 35 years' experience in designing and building hundreds of thousands of dependable gasoline-engine and electric-motor driven generators from .15KW to 5KW in all voltages and frequencies, you can be assured that Homelite will find a quick and correct solution to your most exacting electric power requirements.

Manufacturers of
Carryable Pumps,
Generators, Chain Saws,
Blowers

WRITE OR
CALL TODAY FOR COMPLETE DETAILS

HOMELITE

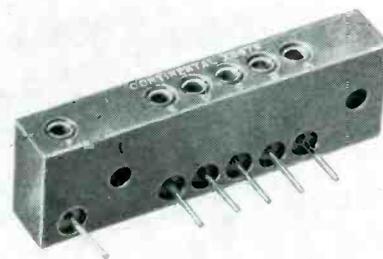
A DIVISION OF TEXTRON INC.
6812 RIVERDALE AVE., PORT CHESTER, N. Y.
Canadian Distributors: Terry Machinery Co., Ltd.

NEW PRODUCTS

(continued)

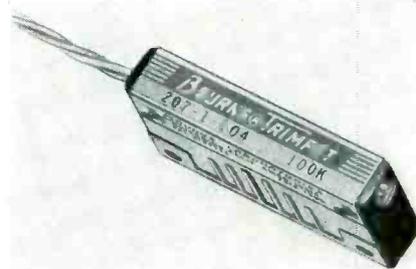
guide or flat lines to coaxial lines.

A maximum power of 1-w average or 1-kw peak can be dissipated in the model 535 termination. Excellent stability and shock resistance are additional features. Circle P24 inside back cover.



TEST POINT CONNECTOR for printed circuit board

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y., has announced a special design female test point receptacle for printed circuit wiring. The contact will accept and hold a standard 0.080-in. test probe. Molding body is mineral filled Melamine (MIL-P-14D, type MME) and is designed for right angle mounting. Six floating type contacts are made of spring temper phosphor bronze, gold plated over silver for low contact resistance and ease of soldering. Circle P25 inside back cover.



TRIMMING POT high-resistance unit

BOURNS LABORATORIES, 6135 Magnolia Ave., Riverside, Calif. The Trimpot model 207 Hi-R is a high-resistance unit (100K) featuring high power dissipation (2.0 w), high temperature operation (175 C) and a precision wire-wound element with low temperature coefficient resistance wire.

Subminiature in size, these units can be stacked seven deep in less

1957 1958 1959 1960 1961

DEPENDABILITY

Guaranteed for **5** years



The best guarantee in the business!
 The 401 is so dependable, we're backing it with a *five year guarantee* on all printed wiring and power transformers . . . and, all other components, including the cathode-ray tube, carry a full one-year guarantee.

DU MONT 401

- **IDENTICAL X- AND Y- AMPLIFIERS:** Sensitivity, 10 mv/cm. Sinewave response extends flat from dc to 150 kc. Calibration standards built-in for both amplifiers.
- **SWEEPS:** 18 calibrated ranges extending from 50 ms/cm to 4 us/cm. 3 times sweep expansion available.
- **RELATIVE PHASE SHIFT BETWEEN AMPLIFIERS:** Easily set for less than 1° at frequencies below 150 kc.
- **CATHODE-RAY TUBE:** Tight tolerance Type 5ADP-, operated at 3000 volts acceleration.
- **STABLE OPERATION:** Regulation of all power supply potentials, including heaters, provides complete stability.

Best buy in the medium price range—a general-purpose, low-frequency oscillograph for complete, high-quality quantitative measurement. The 401 offers a new high in precision, ease of operation and convenience as a result of “human engineering”—an exclusive of the Du Mont 400 philosophy of instrument design.

WRITE FOR DETAILS. **\$420.00**
 (slightly higher for 50-cycle areas)

DU MONT® One of the  Series
 TECHNICAL SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC. • CLIFTON, N. J.



MAKES THE DIFFERENCE

You can't see it . . . feel it or weigh it. Only by observing their unexcelled performance can you appreciate the assurance of super dependability that regular users of McCoy crystals have come to take for granted. Discover it for yourself. Next time you order crystals—insist that they be . . .

. . . the real McCoy

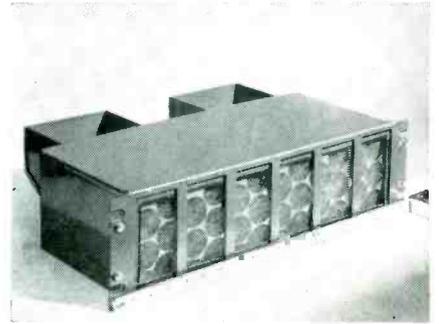
m^cCoy ELECTRONICS COMPANY

MT. HOLLY SPRINGS, PA.

DEPT. E-12

Phone 376 and 377

than 2 sq in. of front panel space. The instrument is screwdriver adjusted over 25 turns, with a self-locking shaft for stable settings. Exceptional vibration, acceleration and shock characteristics enable the model 207Hi-R to meet or exceed most government specifications. Literature is available on request. **Circle P26 inside back cover.**



COOLING CABINET

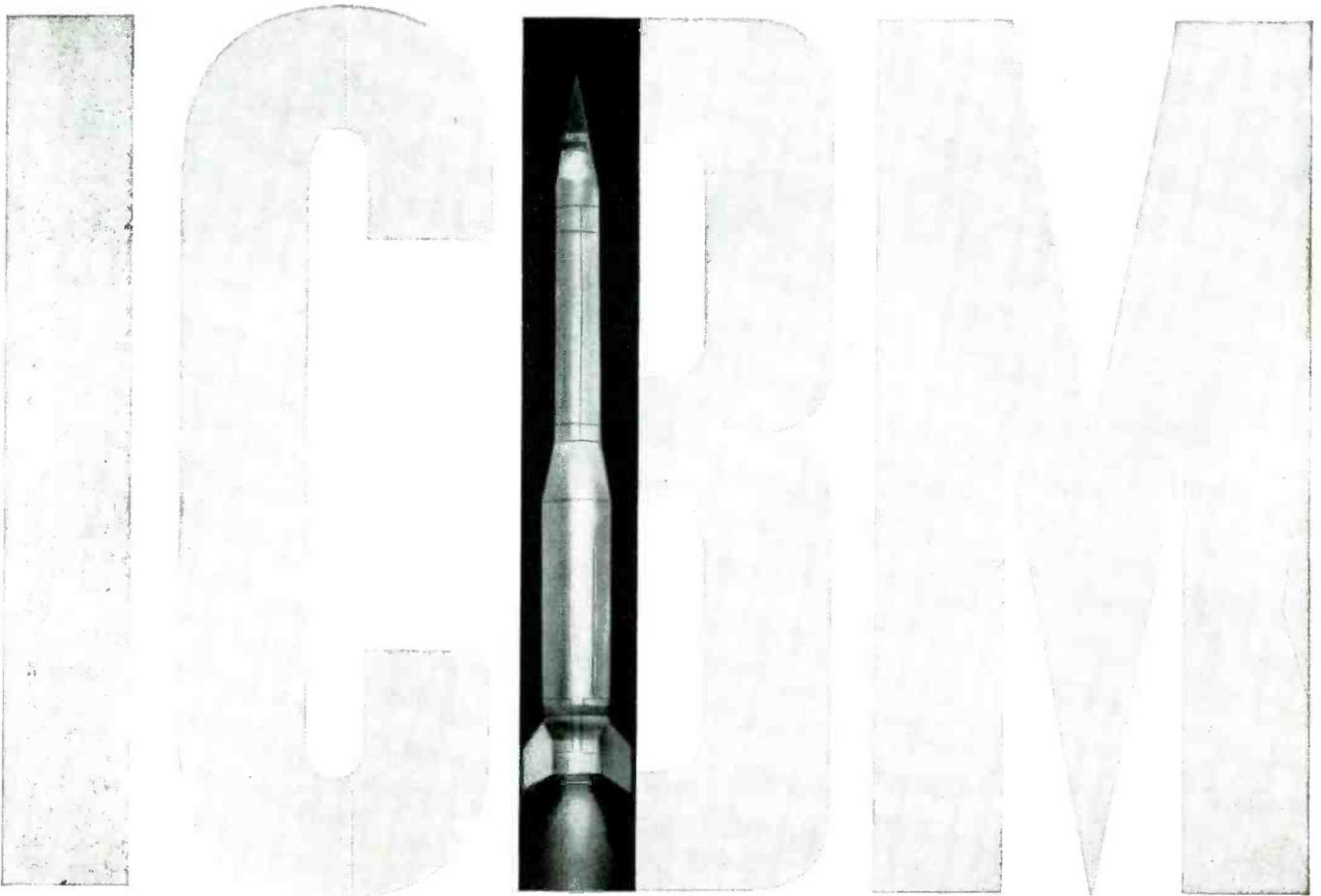
fits 19-in. relay rack

ROTATING COMPONENTS INC., 267 Green St., Brooklyn 22, N. Y., has available a new plug-in, high air volume cooling cabinet that fits standard 19-in. relay rack or other electronic equipment. It delivers 380 cfm filtered air at 60 cps, 115 v; also available for 400 cycle operation delivering 480 cfm. The compact blower meets military specifications.

The 18-in. steel welded cabinet is 19 in. wide, 5½ in. high, 12 in. over deflectors as illustrated, 8 in. without deflectors. It mounts in any position for desired air flow. The Fiberglas filter is replaceable without removing cooling cabinet from rack. Literature is available on request. **Circle P27 inside back cover.**

ELECTROLYTICS TESTER for production lines

MAGNAVOX Co., 2131 Bueter Road, Fort Wayne 4, Ind., has announced a go no-go electrolytic capacitor tester designed for manual operation or adaptation to automated production lines. It simultaneously measures capacitance and equivalent series resistance of any single or multiple section electrolytic ranging from 2 to 5,000



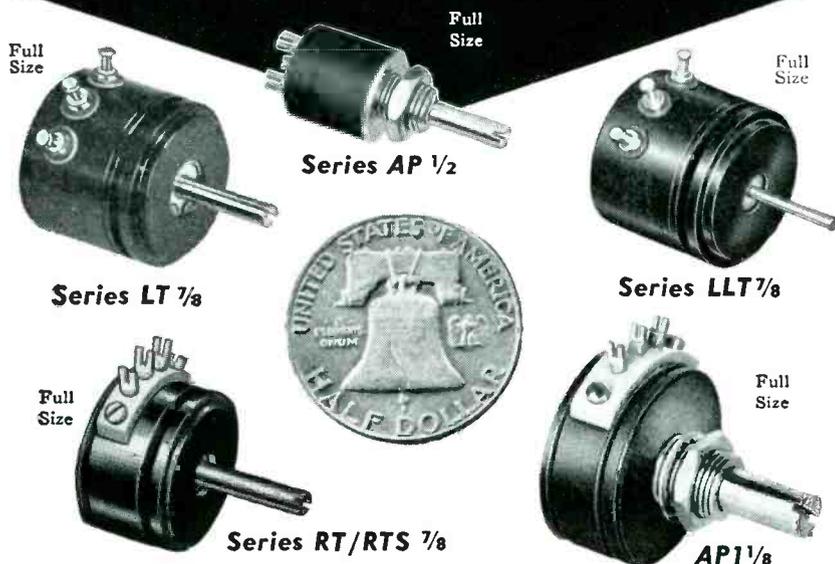
"LIFE INSURANCE" The preservation of the peace and security of this nation depends upon two things: Our diplomatic wisdom in a troubled world, and the power to protect ourselves if peaceful negotiation should fail.

Point 2 is part of *our* responsibility. This is

the Martin-U.S. Air Force TITAN program... one of the most advanced and critically important development projects in America today... an Inter-Continental Ballistic Missile conceived in peace and dedicated to the proposition that no aggressor shall ever take the life of this country.

MARTIN
BALTIMORE • DENVER

when you need a
SMALLER "POT"
 Try these for size and reliability...



**Waters miniature and micro-miniature
 wire-wound precision potentiometers**

are famous for accuracy, ruggedness, dependability and fast delivery in commercial and military uses. They are precision-machined, with anodized aluminum bodies, line-reamed phosphor bronze, ball or jewel bearings, centerless-ground stainless steel shafts, and gold-plated fork terminals; fully sealed and fungus-proofed. To meet your requirements Waters pots can be furnished ganged, tapped, servo or bushing mounts, with various electrical and mechanical angles, optional shaft locks, anti-rotation pins, 0 rings, and custom shaft or servo dimensions.

Series AP 1/2 — 2 watts continuous at 80°C; resistances 10 to 100,000 ohms, 5% tolerance standard; diameter 1/2", depth 1/2" standard, weight 1/4 ounce; fully sealed for potting.

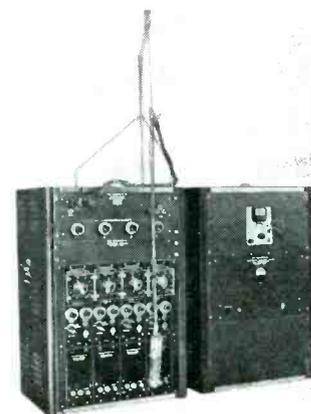
Series LT/LLT 7/8 — One watt at 80°C; resistances 100 to 100,000 ohms, ball or jewel bearing, for use in computers, servos, and selsyns where minimum torque is required. Weight is only 1/2 ounce; MAXIMUM torque is 0.01 inch-ounce per section. Ganging to six decks, internal clamps hold 7/8" diameter. Standard linearity 0.5%, on special order 0.25% above 1K; toroidal winding allows winding angles to 360°, standard is 354°.

Series RT/RTS 7/8 — 3 watts continuous at 80°C; resistances 10 to 100,000 ohms; diameter 7/8", depth 3/8", weight 1/2 ounce; standard linearity 2%.

Series AP 1 1/8 — 4 watts continuous at 80°C; resistances 10 to 150,000 ohms; diameter 1 1/8", depth 1/2", weight less than 3/4 ounce; standard linearity 1%.

Waters has advanced facilities for the design and manufacture of miniature toroidal potentiometers and windings for use in equipment of special design.

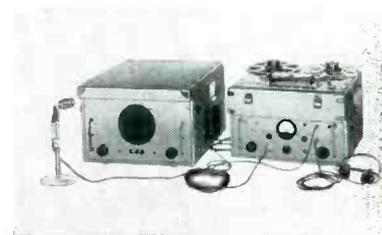
Write today for complete information on all Waters potentiometers.



μf with equivalent series resistance of 0.4 to 400 ohms. Accuracy is ±2 percent on capacitance and ±3 percent on resistance. It measures at 120 or 60 cps.

► **Other Features** — Capacitance tolerance span is fully adjustable within -20 percent to +300 percent of nominal. Resistance tolerance is adjustable through full range of 0.4 to 400 ohms.

The standard unit indicates quality of capacitor through signal lights plus simultaneous dial indication of capacitance in percent of nominal for each section of the capacitor under test. An operator manually manipulating the test probe can check approximately 1,900 four-section electrolytics per hour. Circle P28 inside back cover.



RECORDER-REPRODUCER
 for broadcast studios

TELECTRO INDUSTRIES CORP., 35-18 37th St., Long Island City 1, N. Y. Model 1000 is a portable dual-track magnetic-tape recorder and reproducer for making and reproducing sound recordings. The sound is recorded on and reproduced from a 2,400-ft magnetic moving at 7 1/2 or 15 ips. Frequency response is 30 to 10,000 cps ±2 db at 7 1/2 ips; 30 to 15,000 cps ±2 db at 15 ips.

The unit is supplied usually in

Waters
 MANUFACTURING, inc.

APPLICATION ENGINEERING OFFICES
 IN PRINCIPAL CITIES

Wayland, Massachusetts
 P. O. Box 368, So. Sudbury, Mass.



VERSATILE

Multi-channel—telegraph A1 or telephone A3

STABLE

High stability (.003%) under normal operating conditions

RUGGED

Components conservatively rated. Completely tropicalized



FROM GROUND TO AIR OR POINT TO POINT

Here's the ideal general-purpose high frequency transmitter! Model 446, suitable for point-to-point or ground-to-air communication. Can be remotely located from operating position. Coaxial fittings to accept frequency shift signals.

This transmitter operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.5-24.0 Mcs (1.6-2.5 Mcs available). Operates on one frequency at a time; channeling time 2 seconds. Carrier power 350 watts, A1 or A3. Stability .003%. Nominal 220 volt, 50/60 cycle supply. Conservatively rated, sturdily constructed. Complete technical data on request.

Now! Complete-package, lightweight airborne communications equipment by Aer-O-Com! Write us today for details!



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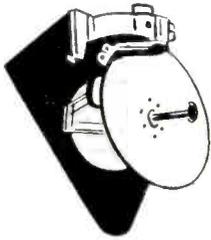
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JOSEPH D. SCHANTZ
Chief Electronics Engineer
is interviewing
qualified . . .

RADAR SPECIALISTS



for Research and Development
at Millimeter Wavelengths

Responsibilities will include :

- All phases of radar development for shipborne tracking radar.
- Shipboard stabilization techniques.
- Antenna and feed mechanisms.
- Development of microwave and modular circuitry.
- Synchronizer and tracking circuitry.

Knowledge of computers, servomechanisms, etc. desirable.

Salary commensurate with background and experience.

Bell's fast moving research and development program offers many other challenging openings for engineers and technicians in all fields. There is an interesting and secure future for you at Bell, with opportunities limited only by your own capability for accomplishment.

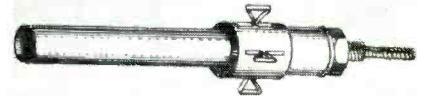
Write to Manager, Engineering Personnel, Dept. J

BELL AIRCRAFT CORPORATION

P.O. Box 1, Buffalo 5, N. Y. or
call Mr. H. Ackerman collect at
Niagara Falls 7851, Ext. 7216
Dept. J for a personal interview.



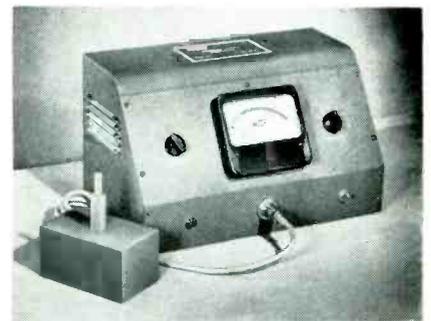
two aluminum-clad plywood cases, specially designed for extremely rugged requirements, but can be supplied in Fabrickoid covered plywood cases as shown. One case contains an a-f amplifier and the recorder-reproducer subassembly. The second case contains a monitor or power amplifier, a low-impedance directional-type microphone, connecting cables and spare components. Circle P29 inside back cover.



COIL FORM

general purpose type

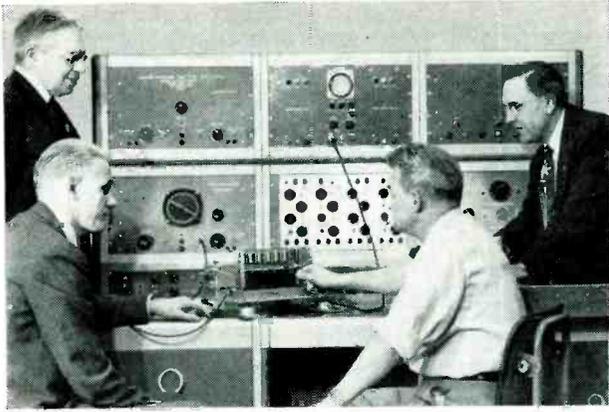
NORTH HILLS ELECTRIC Co., INC., 402 Sagamore Ave., Mineola, L. I., N. Y. General purpose coil form F-130 features a phenolic body, 3/2 in. diameter by 2 in. long, metal mounting bushing and terminal collar carrying four staple terminals. The built-in "perma-tune" tension device assures smooth stay-put tuning. Circle P30 inside back cover.



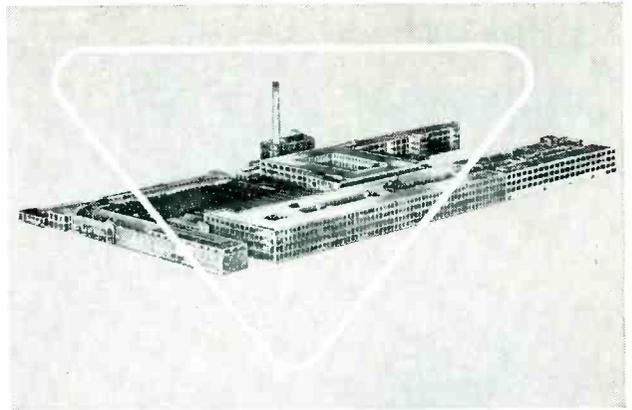
SHORTED TURNS INDICATOR tests coils in fast operation

B&K MFG. Co., 3731 N. Southport Ave., Chicago 13, Ill., has announced a new shorted turns indicator designed to test coils for shorts and open circuits in one fast simple operation before assembly. Model M-1 gives positive GO-NO GO indication for production testing, incoming inspection and laboratory use. It prevents losses in material and labor by finding shorts and open circuits before the

The right people with the right facilities produce the right solutions

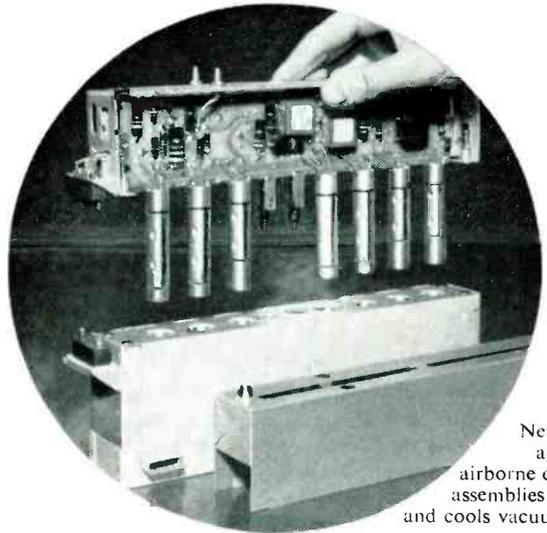


Observing measurement of circuit parameters in the Electronic Systems Division's Buffalo Engineering Laboratory. From left: H. S. Tittle, Manager—Buffalo Operations; M. C. Scott, Manager—Buffalo Engineering Laboratory; R. W. Ferry, Advanced Development Engineer; and A. W. Puttick, Engineering Manager.



Buffalo Engineering Laboratory and manufacturing facilities occupy nearly 170,000 square feet of floor space in this industrial center at 175 Great Arrow Ave., Buffalo 7, New York.

Keeping electronic equipment cool with controlled air flow "Packaging"



New "packaging" for airborne electronic assemblies insulates and cools vacuum tubes.

INTENSE HEAT generated by airborne electronic equipment and supersonic flight is posing new problems for the safety and performance both of crewmen and their planes.

An ingenious method for combating the heat menace was recently developed by Sylvania's Electronic Systems Division. Vacuum tubes are mounted in carefully sized ducts in light foam plastic material of the desired thermal properties. Accurately controlled air flow results in optimum cooling, while exhausting the air at high temperature.

Tests have proved that this is an ex-

remely effective method, giving cooling efficiencies of approximately 90 per cent. Through the use of such electronic "packaging" in supersonic aircraft, it is possible to reduce the amount of air-cooling equipment, with its accompanying weight penalties.

Problem solving, whether in research and development or in practical application, is the chief task of Sylvania's Electronic Systems Division. In all of its installations, the right people work with the right facilities, within a sound managerial environment. That is why they have produced right solutions to a vari-

ety of problems, and have made many important contributions in the fields of aviation electronics, guided missiles, countermeasures, communications, radar, computers, and control systems. Whether the problem is military or industrial, Sylvania's business is to come up with solutions that are producible.

The Electronic Systems Division has plant and laboratory facilities at Buffalo, N. Y., Mountain View, Calif., and Waltham, Mass. All are staffed with top-ranking scientists and engineers, backed with Sylvania's extensive resources in the electronics field.

SYLVANIA IS LOOKING FOR ENTERPRISING 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 Edward W. Doty, Manager of Personnel, Electronic Systems Division, Sylvania Electric Products Inc., 100 First Avenue, Waltham 54, Mass.



SYLVANIA



SYLVANIA ELECTRIC PRODUCTS INC.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY • CHEMO-METALLURGY

Kearfott Components

FOR EVERY SYSTEM
APPLICATION



KEARFOTT offers the systems manufacturer the most complete line of precision made components available anywhere. Quantity production enables quick deliveries and reasonable prices.

SYNCHROS—Transmitters, Control Transformers, Resolvers, Repeaters, and Differentials in Bu Ord Sizes 8, 11 and 15. High Accuracy and environmental resistance.

SERVO MOTORS—High torque, low inertia Servo Motors, Inertial and Viscous damped Servo Motors, in Bu Ord Sizes 8, 11, 15, 18 and 23.

TACHOMETER GENERATORS—Available as damping generators, rate generators and integrators. They feature high output to null ratio and extremely linear outputs. Temperature stabilization may be provided.

GYROS—Directional, floated rate integrating, free, vertical, and spring restrained rate gyros for all airborne navigation, stabilization or fire control applications.

Bulletins giving physical and technical data of the various Kearfott Products will be sent on request. The Kearfott organization is available to assist in the development and manufacture of other precision components you may require.



KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

coil is mounted onto a relay, transformer or other device.

A vtvm is provided as an indicating device. Sensitivity of the meter section is governed by the balance control. The M-1 has been designed so there is no shock hazard to the operator.

Size is 14 in. wide, 8 in. high and 8 in. deep. A $\frac{3}{8}$ -in. standard test rod is supplied. User net price is \$179.50. For further information write for bulletin No. M-1. Circle P31 inside back cover.



CONNECTOR

for printed circuit use

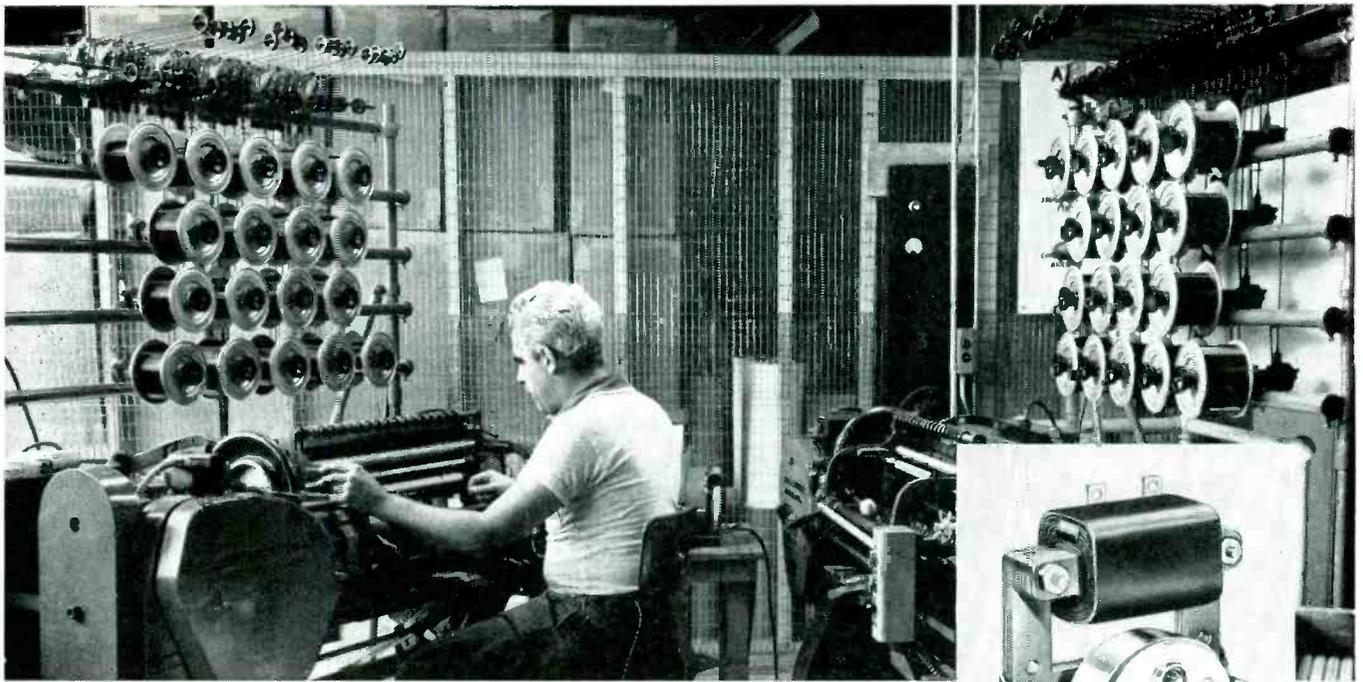
DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y., has introduced a new special design printed circuit connector for guided missile, pressurized printed circuit applications. The 15 coded contacts are mounted in Orlon filled Diallyl Phthalate molding compound. Design permits either horizontal or vertical mounting. A potting shell is supplied with the connector. Wiring feeds through holes in potting shell, which line up with right angle solder lugs. In assembly of printed circuit, a rubber boot fits over the printed circuit board to form an integrated, moisture-proof assembly. Circle P32 inside back cover.



MICROPHONE CALIBRATOR

gives two measurements

BRUSH ELECTRONICS Co., 3405 Perkins Ave., Cleveland 14, Ohio,



Two of the new Leesona No. 107 Automatic Coil Winders recently installed in the Clock and Timer Department of the General Electric Company, Ashland, Mass. The last word in automatic coil winder design, No. 107's wind paper-insulated coils in stick form. Automatic operation eliminates human error, reduces wire breakage to a minimum, cuts production time and costs. Inset shows a Type H3 Synchronous Motor, one of many Telechron timing units with coils precision-wound on Leesona No. 107 machines.

Clock and Timer Department, General Electric Company selects Leesona Coil Winders as standard equipment

General Electric Department adds No. 107 machines for proved production advantages

The synchronous timing motors made by the Clock and Timer Department of the General Electric Company are famous for accuracy and dependability.

One reason why is the high efficiency maintained by this department of the General Electric Company, in its wide range of coil winding operations. Leesona Coil Winders are

standard equipment at General Electric Telechron plants — and during a recent expansion of production facilities, Leesona No. 107 Automatic Coil Winders were important new additions.

Leesona No. 107 machines are fully automatic. Every feature is designed to produce compact, uniform, paper-insulated coils — in fastest time — with minimum operator attention — at lowest cost. This General Electric department reports:

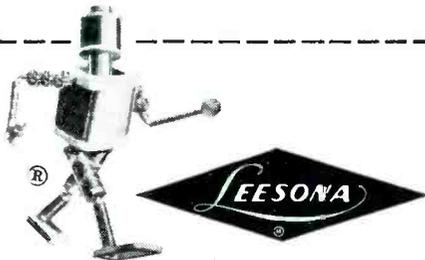
“The Short Paper Attachment on

our Leesona No. 107 Coil Winders is a big advantage. Allowing an initial paper insert of $1\frac{1}{16}$ " it eliminates the usual $2\frac{3}{4}$ " insert when starting winding. On these particular coils the result is considerable savings in wire.”

Get the Whole Story

on how Leesona No. 107 Automatic Coil Winders can bring new, profit-boosting efficiency to your own coil winding production. For complete details on this advanced machine — and other helpful coil winding information — check and mail the coupon today.

B.5.4



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These new Stancor Transformers were specifically designed to operate in Full-Wave Center-Tapped or Bridge Type power supply circuits, with the most popular size stock selenium rectifiers.

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They are recommended for all high current—low voltage applications: Variable tap arrangements permit an almost unlimited choice of voltages from 3.3V DC to 63.0V DC, up to 22.5 Amperes, DC, depending on the particular transformer the user selects.

These transformers may be used to heat tube filaments where filaments are not subject to any high voltage stresses.

Stancor selenium rectifier transformers are in stock for immediate delivery from your Stancor distributor.

WRITE FOR FREE BULLETIN 518 listing detailed information on the complete line of Selenium Rectifier Transformers.

has introduced a microphone calibration apparatus, model BL-4119. It is designed for accurate calibration of the condenser microphone model BL-4111 as well as the condenser microphone cartridge MK-0002.

The calibration apparatus enables both a calibration procedure which is a simplified form of the standardized reciprocity calibration technique in accordance with the ASA standard Z24.4, and the determination of the complete frequency response curve of the microphone by an electrostatic actuator.

The first measurement yields the accurate absolute sensitivity of the microphone at any arbitrary frequency without the use of any precalibrated standard by using three condenser cartridges. The second measurement gives the total frequency response of the microphone between 20 and 20,000 cps. Circle P33 inside back cover.



SYNCHRO BRIDGE
a passive comparison device

THETA INSTRUMENT CORP., 204 Market St., East Paterson, N. J., announces a new proportional voltage bridge. The device is a passive comparison bridge of high accuracy for measuring synchro electrical error and accuracy of position servos. Its elements are carefully aged, sealed in oil, and matched against NBS primary standards.

► Specifications—Each of its three arms have resistances of 50 K. Angular accuracy is given as 10 seconds of arc, maximum. Rotation

TYPICAL OUTPUT VOLTAGES (Stancor Transformer RT-201)		FULL-WAVE C.T.				FULL-WAVE BRIDGE			
RT-201		Output 2.0 A. D.C.				Output 1.25 A. D.C.			
Input 117vac Term. No.	Connect Term. No.	Resistive Load		Capacitive Load*		Resistive Load		Capacitive Load**	
		Secondary Volts AC	Output Volts DC	Secondary Volts AC	Output Volts DC	Secondary Volts AC	Output Volts DC	Secondary Volts AC	Output Volts DC
1-2	—	29.4	11.2	28.8	13.8	28.5	23.0	27.9	30.0
1-7	2-6	26.0	9.8	25.7	11.7	25.4	20.0	25.1	26.4
1-6	2-5	23.0	8.4	22.7	9.9	22.3	17.3	21.8	22.2
1-7	2-5	20.9	7.4	20.8	8.6	20.2	15.4	19.8	19.7
1-3	—	19.4	6.7	19.1	7.6	18.6	13.9	18.2	17.6
1-7	3-6	17.8	6.1	17.6	6.7	17.2	12.8	16.8	15.7
1-6	3-5	16.3	5.3	16.1	6.0	15.7	11.2	15.2	13.8
1-7	3-5	14.9	4.7	14.8	5.3	14.3	10.3	14.1	12.4
1-4	—	14.2	4.4	14.2	5.0	13.7	9.7	13.5	11.6
1-7	4-6	13.4	4.0	13.3	4.4	12.7	8.8	12.5	10.4
1-6	4-5	12.4	3.6	12.4	3.9	11.7	7.9	11.7	9.5
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*1000 MFD. ** 500 MFD.

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New trends and developments in designing electrical products . . .

General Electric thermistors and Thyrite* varistors have unique properties that apparently contradict normal electrical laws. Here's how they can be harnessed to improve your product.

General Electric thermistors and Thyrite varistors are ceramic-like semiconductor resistance materials. Each has unique properties — apparently disobedient to normal physical laws — that enable it to perform tasks in electrical and electronic circuits which otherwise would require costly, complex components.

The distinguishing feature of thermistors is their *thermal* sensitivity. Thermistors have large *negative* temperature coefficients of resistance (i.e., their resistance decreases tremendously when heated, instead of increasing slightly like other materials).

Thyrite varistors, on the other hand, are *voltage*-sensitive. Contrary to Ohm's law, a current through a Thyrite varistor varies as a *power* of the applied voltage (i.e., doubling the voltage through a Thyrite varistor can increase the current from 15 to 25 times, instead of the normal 2 times).

The applications based on the unique properties of these materials are almost limitless. In general terms, thermistors are used in the detection, measurement, and control of minute energy changes; Thyrite varistors are used to protect, stabilize, and control circuits.

To give a clearer understanding of the ways thermistors and Thyrite varistors can be applied, here's how they have solved two of the electrical engineer's most vexing problems — temperature compensation and surge suppression.

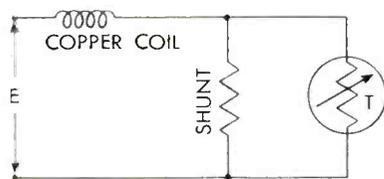


FIGURE 1 — Typical thermistor temperature-compensation circuit

The resistance of a conventional conductor is so affected by ambient temperatures that steady current flow cannot be maintained. For example, as the temperature of copper swings from -60°C to $+80^{\circ}\text{C}$, the resistance increases 53%.

However, when the copper is compensated with a properly selected thermistor, the maximum deviation

from the total average resistance at 25°C is only $3\frac{1}{2}\%$ — despite the 140° swing in temperature.

In the circuit in Fig. 1, the thermistor's negative temperature coefficient of resistance offsets the positive temperature coefficient of the copper to stabilize current flow. In other circuits, thermistors can be utilized for signal and warning devices, sequence switching, and other time delay applications, because of the inherent thermal inertia involved.

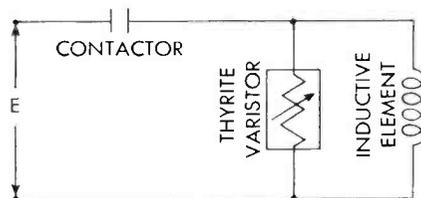


FIGURE 2 — Thyrite varistor surge voltage suppression circuit

Sudden interruptions of inductive circuits cause surge over-voltage, arcing, and high-frequency oscillations — all of which can cause trouble. The circuit in Figure 2 shows how a Thyrite varistor can be connected to hold these effects within safe limits.

With the Thyrite varistor out of the circuit, the surge voltage caused by interruptions of the current may rise to 9 times applied peak voltage (Oscillogram, Figure 3).

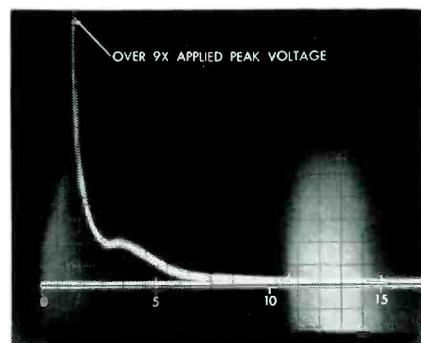


FIGURE 3

But with the Thyrite varistor in the circuit, (Figure 4), the surge voltage is limited to less than 3 times the normal applied peak voltage.

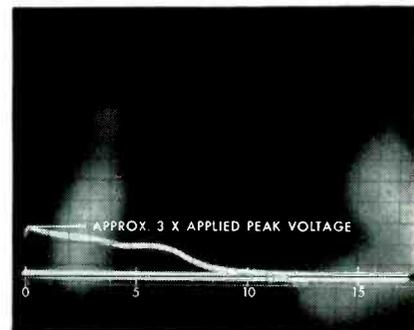


FIGURE 4

The Thyrite varistor draws negligible current at rated voltage, yet offers sufficiently low resistance at the peak current to limit the surge voltage to a safe value and to reduce arcing. Also, the Thyrite varistor quickly discharges circuit energy by providing increasingly higher resistance as the inductive current decays.

If a linear resistor were used to provide the same voltage suppression level, it would have to draw a current equal to more than 30% of the inductive element current.

In addition to surge suppression, a Thyrite varistor can be used as a nonlinear resistance parameter, a potentiometer, and a frequency multiplier. It can also be used as a bypass resistor to protect personnel and equipment from circuit faults.

Technical literature giving complete data on properties, applications, sizes, and shapes of G-E thermistors and Thyrite varistors is available. And, for the experimenter, there are two engineering test kits on each.

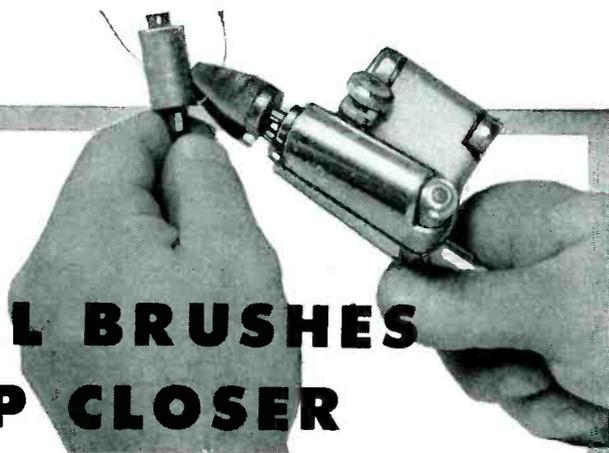
To obtain kits, literature, or the assistance of a General Electric Engineer on your problem, write: Metallurgical Products Department of General Electric Company, 11137 E. 8 Mile Street, Detroit 32, Michigan.

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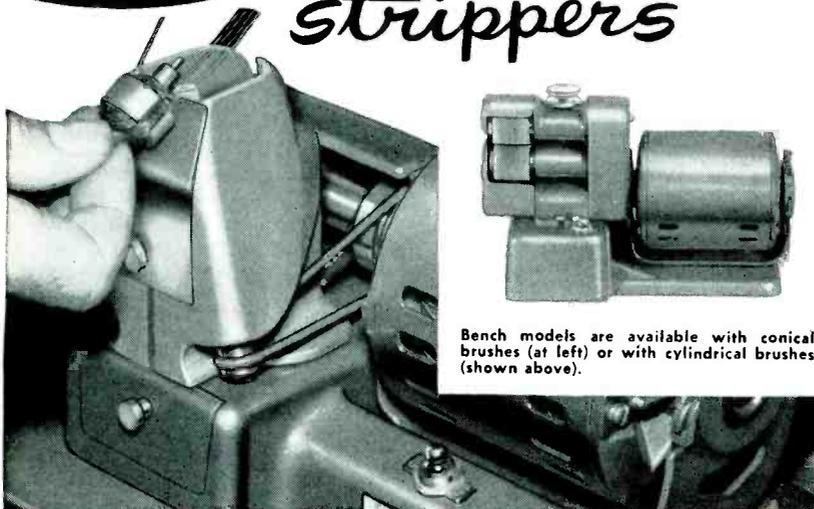
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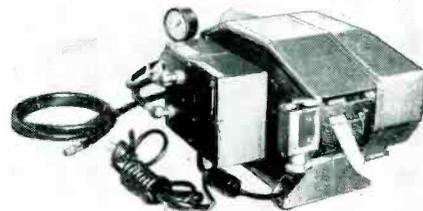
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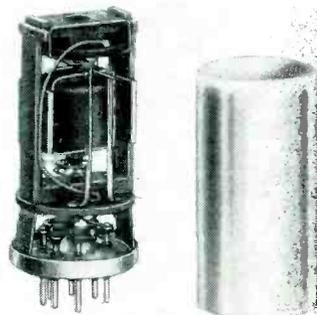


is in steps of 5 degrees, continuous throughout 360 degrees. The bridge is hand-set to each angle by a dent switch. Circle P34 inside back cover.



TAPE DISPENSERS fully automatic

AIR FIXTURES INC., 202 West Main St. North Manchester, Ind., has announced a new series (four models) of fully automatic air-operated tape dispensers for the electrical and electronic industries. They eliminate all push-buttons, levers and foot pedals. When the operator removes a length of tape, a microswitch automatically sets in motion the next delivery cycle. They are available for all types of pressure sensitive tape in widths up to 4 in., lengths up to 21 in. Model AFET-852, illustrated, handles widths up to 2 in., lengths up to 12 in. Circle P35 inside back cover.



SEALED RELAY sensitive, miniature type

WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. For applications where compactness and light weight are essential, or where external electromagnetic effects must be held to a minimum, the company offers the model 1081

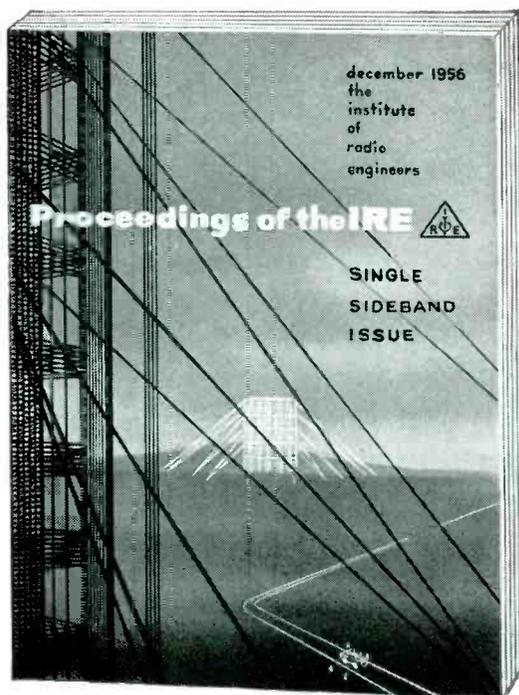
IRE reports on SINGLE SIDEBAND!

The December issue of *Proceedings of the IRE* presents a round-up of the most recent technical discoveries as presented by the Joint Technical Advisory Committee through its sub committee on single sideband techniques.

Because single sideband offers advantages over conventional AM systems for police radios, taxi radios, ship to shore radios, as well as in many other practical uses, the JTAC has launched a special study for the FCC on this new development in radio communication. Interest in single sideband systems is high because they:

1. Reduce the size and weight of equipment, allow effective communication when conditions limit the size of the installation.
2. Conserve the radio spectrum by not taking up as wide a band of frequencies as do AM signals.
3. Permit a reduction in the total radiated power required to accomplish a given communication function.

The December issue of *Proceedings of the IRE* begins with a guest Editorial by the Honorable George C. McConaughy,



Chairman of the Federal Communications Commission and will take its place in the record of radio-electronics growth. IRE gave you the color TV issues of October, 1951, and January, 1954, the scatter propagation issue of October, 1955, the earth satellite issue of June, 1956, and now December's special single sideband issue—a reference work of the decade!

Get the December Proceedings of the IRE and get the facts about SINGLE SIDEBANDS

Partial list of contents:

- "Factors Influencing Single Sideband Receiver Design" by L. W. Couillard, Collins Radio Co., Cedar Rapids, Iowa
- "Frequency Control Techniques for Single Sideband" by R. L. Craiglow, E. I. Martin, Collins Radio Co., Cedar Rapids, Iowa
- "A Suggestion for Spectrum Conservation" by R. T. Cox, E. W. Pappenfus, Collins Radio Co., Cedar Rapids, Iowa
- "Power and Economics of Single Sideband Equipment" by E. W. Pappenfus, Collins Radio Co., Cedar Rapids, Iowa
- "Automatic Tuning Techniques for Single Sideband Equipment" by V. R. DeLong, Collins Radio Co., Cedar Rapids, Iowa
- "Linear Power Amplifier Design" by W. B. Bruene, Collins Radio Co., Cedar Rapids, Iowa
- "Distortion Reducing Means for Single Sideband Transmitters" by W. B. Bruene, Collins Radio Co., Cedar Rapids, Iowa
- "Linearity Testing Techniques for Sideband Equipment" by P. J. Icenbice, H. E. Fellhauer, Collins Radio Co., Cedar Rapids, Iowa
- "Early History of Single Sideband Transmission" by A. A. Oswald, (retired) formerly Bell Telephone Labs., Inc., Murray Hill, N. J.
- "Comparison of Linear Single Sideband Transmitters with Envelope Elimination and Restoration Single Sideband Transmitters" by L. R. Kahn, Kahn Research Labs., Freeport, L. I., N. Y.
- "Application of Single Sideband Technique to Frequency Shift Telegraphy" by C. Buff, Mackay Radio & Telegraph Co., Inc., Brentwood, L. I., N. Y.
- "A Third Method of Generation and Detection of Single Sideband Signals" by D. K. Weaver, Stanford Research Institute, Stanford, Calif.
- "An Introduction to Single Sideband Communications" by J. F. Honey, Stanford Research Institute, Stanford, Calif.
- "Synchronous Communications" by J. P. Costas, General Electric Co., Syracuse, N. Y.
- "Synthesizer Stabilized Single Sideband System" by B. Fisk, C. I. Spencer, Naval Research Lab., Washington, D. C.

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All IRE members will receive this December issue as usual. Extra copies to members, \$1.25 each (only one to a member).



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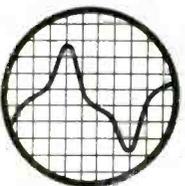
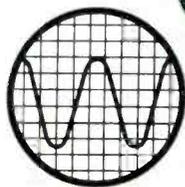
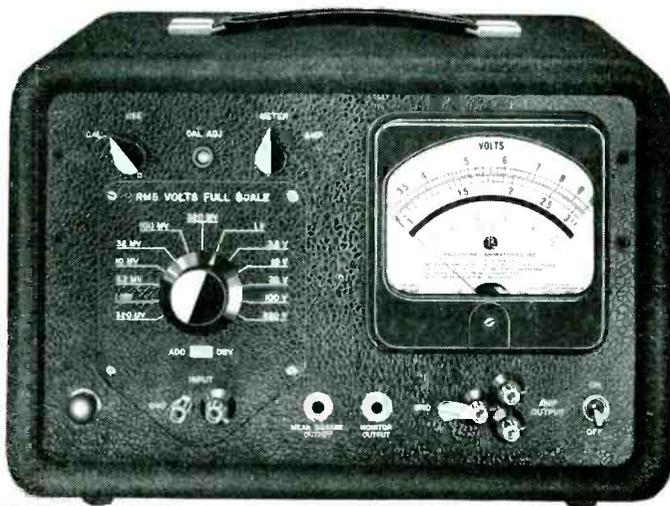
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Write for the New Ballantine Catalog describing this and other instruments in greater details.

relay illustrated. Housed in a brass, tinned finished case, it is supplied for miniature 7-pin socket operation or with curved terminals for solder connection. For maximum shielding mu-metal cases can be furnished. Ranges and contact adjustments are available to order.

► **Technical Data**—Sensitivities as high as 50-0-50 μa at a coil resistance of approximately 2,300 ohms are available. Nonmagnetic contacts carry 35 ma at 6 v d-c non-inductive at high sensitivity, while loads up to 0.5 ampere at 28 v d-c noninductive can be handled depending upon the moving coil sensitivity and number of operations. High and low contacts can be arranged for zero center, spot operation or suppressed zero with one contact normally closed. Circle P36 inside back cover.



PRECISION POT
has choice of windings

HELIPOT CORP., Newport Beach, Calif. The series 7700 precision potentiometer is a 10-turn unit, 1 1/8 in. in diameter for servo or 3-hole pilot mounting. A distinctive feature is the choice of windings: air-core winding with a range of total resistance from 200 to 5,000 ohms; copper-mandrel winding from 5,000 to 200,000 ohms.

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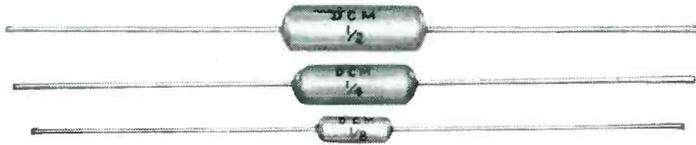
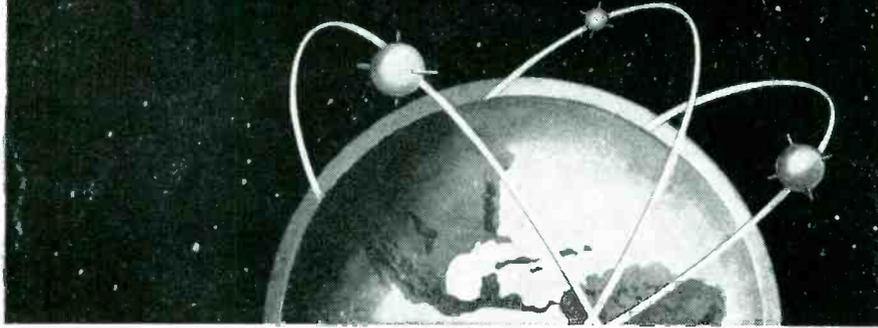
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DCM 1/2	10 Ohms to 2.5 Meg.	3/4"	.25"	.032"	1 1/2"

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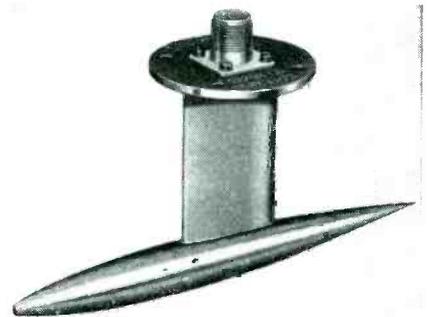


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G. M. GIANNINI & Co., INC., 918 E. Green St., Pasadena 1, Calif., announces a new addition to its line of Adiabatic temperature probes for the measurement of airstream stagnation temperatures in aircraft and missile applications. Designated model 49127, either of two fast response temperature elements is available to provide a voltage or resistance output proportional to airstream stagnation temperature.

Suitable for telemetering and control or the sensing of flight data for airborne systems, these precision instruments offer a recovery factor of 0.985 with response time of 0.25 sec or less, and repeatability within 0.5 percent.

Excellent aerodynamic configuration helps to provide superior performance over the wide velocity range of Mach 0.3 through 2.0, at altitudes as high as 60,000 ft. Circle P38 inside back cover.

RC BRIDGE

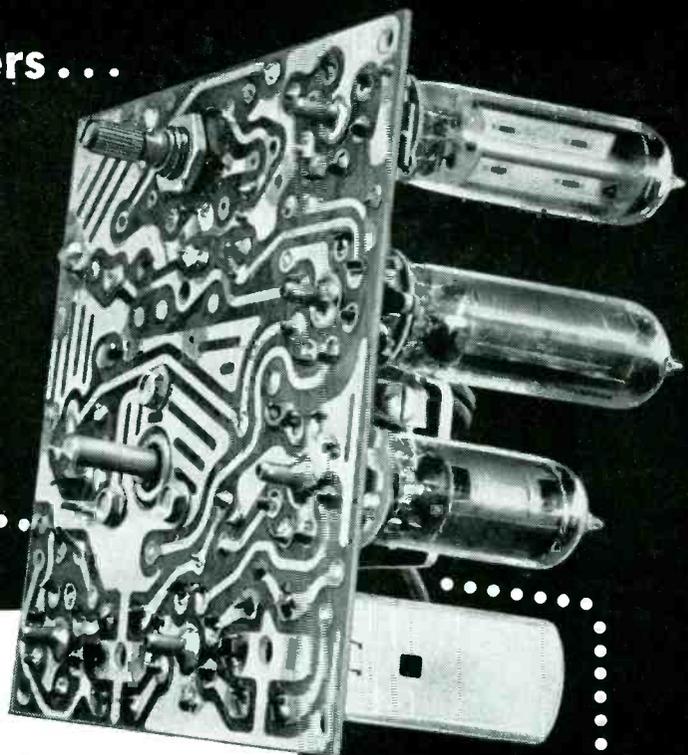
covers wide ranges

INDUSTRIAL DEVELOPMENT LABORATORIES, INC., 17 Pollock Ave., Jersey City, N. J., announces Signa-Glow model CR-10 capacitance-resistance bridge covering the ranges of 10 μmf to 200 μf and 5 ohms to 50 megohms. It is completely self-contained, including a 6-position range switch and an easy-to-read 2-color scale more than 5 in. long with large numerals and

Radio Manufacturers . . .

Jump into
print wire board
assembly

NOW



Be ready for quick market demand with a printed circuit 5-tube AM radio chassis board, with no engineering or design costs to you.

You can now buy a G-E print wire board with a 5-tube high-performance circuit for immediate use in your radio or communications line.

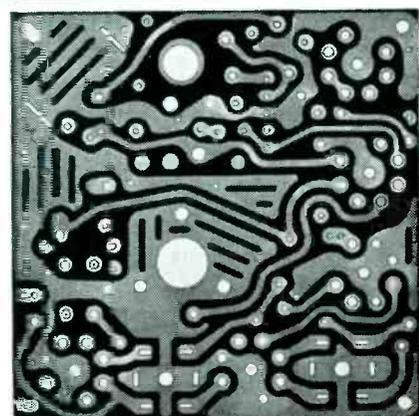
FAST DELIVERY —Initial quantity of this board can be shipped immediately.

EASY ASSEMBLY —Board design and use of standard parts permit hand or dip solder assembly techniques.

COMPACT SIZE —Two sided G-E "THRU-CON" board gives small size, and permits wide range of cabinet styles and applications: radio lamps, hobby kits, low-cost price leaders, intercom systems.

General Electric will supply you with a complete list of readily available standard components, as well as complete information on assembly and soldering techniques. The General Electric "Thru-Con" process of print wire board manufacture is a positive plating process which provides plating through the holes for superior solder filleting and less line rejects.

This standard 5-tube AM radio board is another product of the Specialty Electronic Components Department, a pioneer in the field of print wire manufacture. The services of our engineers are available to assist manufacturers in their application problems.



STANDARD 5-TUBE RADIO BOARD

Sample of this board and complete technical information on the assembly of an operating unit is yours on request.

General Electric Company
4126 Electronic Components Building
Auburn, New York
Please send samples and full technical information on General Electric standard 5-tube AM radio board.

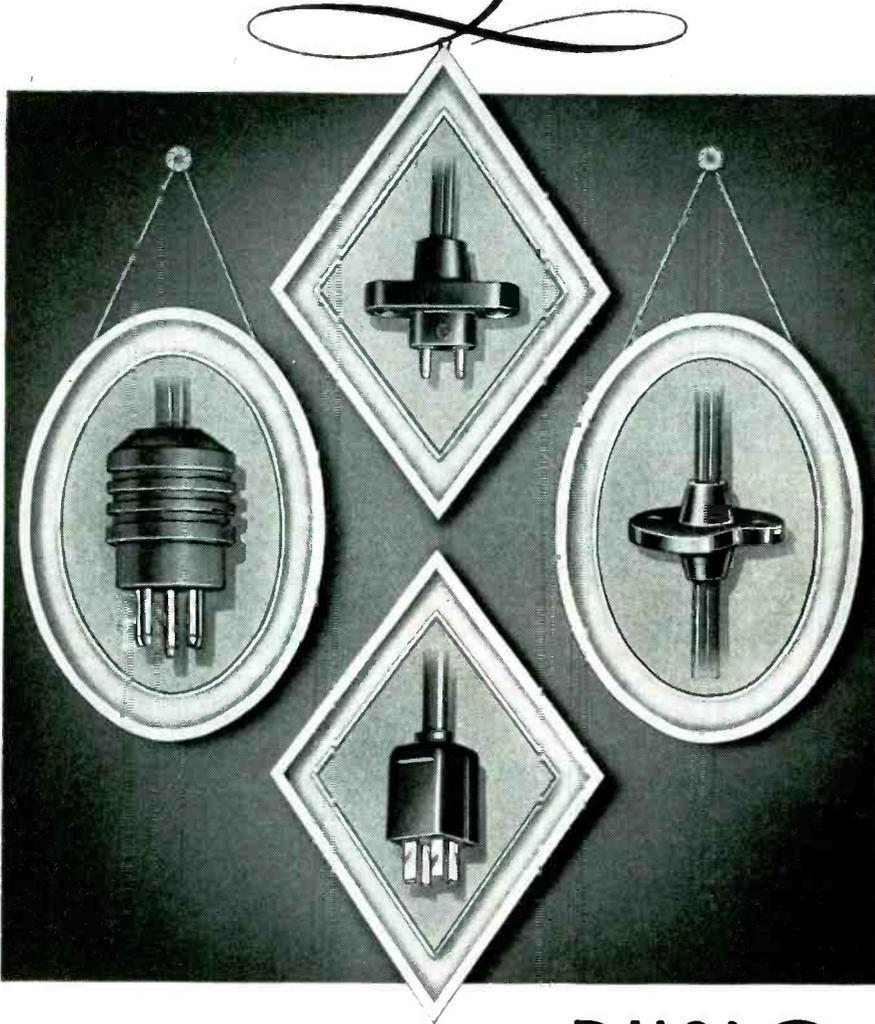
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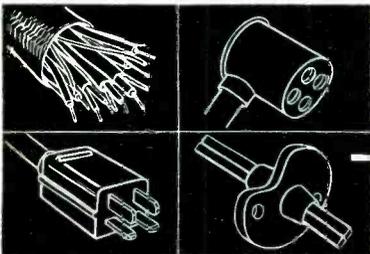
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NEW PRODUCTS

(continued)



convenient scale divisions. The unit uses no batteries, is always ready for use by plugging into a 115 v 60 cycle outlet.

The CR-10 incorporates a new null indicator, consisting of a pair of miniature glow lamps which show at a glance the degree and direction of unbalance. Voltage across the test terminals is less than 20 v a-c. The test terminals may be shorted indefinitely without damage to the instrument.

The unit is housed in a phenolic case only 3 1/4 in. by 6 in. by 2 in. Net weight is under 2 lb. A 5 ft line cord, pair of 18-in. test leads with pin prods and test clips and a pair of clip adapters are provided with each instrument. Circle P39 inside back cover.



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for aircraft and missiles

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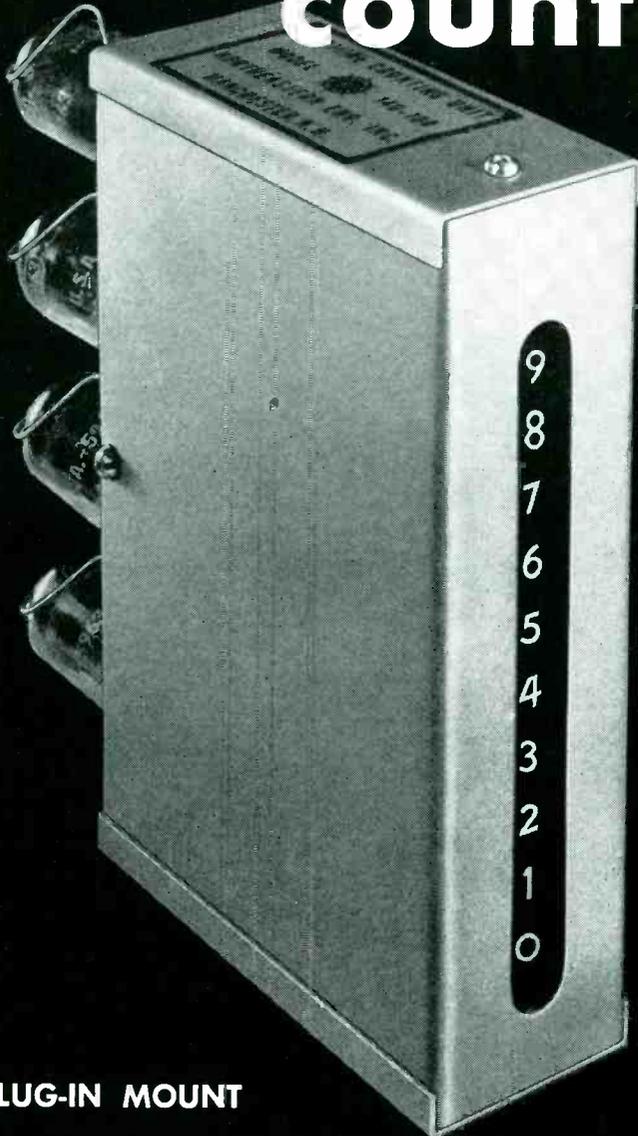
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Tubes	8 microseconds	4 microseconds
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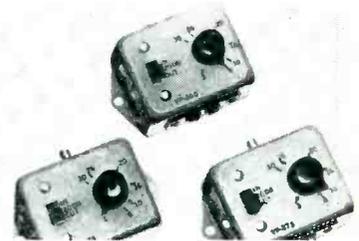
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airborne electronic systems, the GAB 1000 series of vacuum pressure switches respond to pressure as low as 2 in. of mercury absolute, retain their accuracy to ± 1 in. of mercury pressure under extreme environmental conditions in aircraft and missile systems.

► **Bellows**—Basic operating element in the design is the rigid miniature bellows. This bellows is supported in a manner which enables it to resist self-actuation under severe vibration up to 2,000 cps at 10 g. The series 1000 switch is specifically designed for use in inert gas vacuums.

For fluid vacuum and absolute pressures the series 2000 are used. This lightweight switch (less than 3 oz) has an approximate overall length of 3½ in. Complete price information or engineering consultation is available. Circle P40 inside back cover.



VARIABLE ATTENUATORS

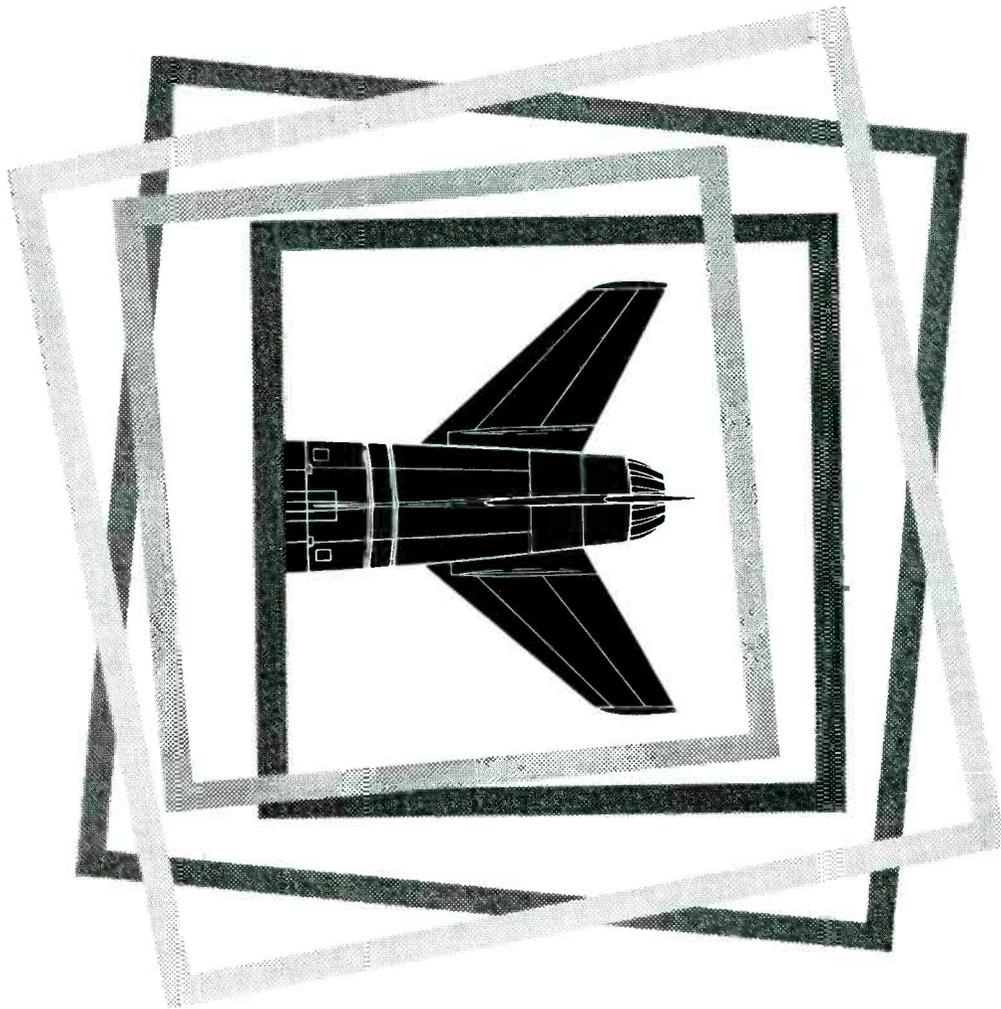
control r-f signals to 250 mc

ENTRON INC., P. O. Box 287, 4902 Lawrence St., Bladensburg, Md., is introducing a series of new, low cost Varipad 3 to 50 db variable attenuators to provide smooth, stable control of r-f signals up to 250 mc. Flat frequency response allows them to be used in wide-band applications.

A 3 to 30-db variable attenuator in conjunction with a switchable 20-db pad affords a continuously variable output in two ranges.

Three ruggedly built models are available for use on 75 or 300 ohm cables. One model also includes a broad band matching transformer for application in the 50-250 mc band.

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ALSO NEEDED: Aerodynamicists, Systems Engineers, Instrumentation Engineers, Aero-Thermodynamicists, Aeroelastic Engineers, Cycle Analysis Engineers

**Contact Les Stevenson, Engineering Personnel Office, Dept. 56-12EL
North American Aviation, Inc., Los Angeles 45, California**

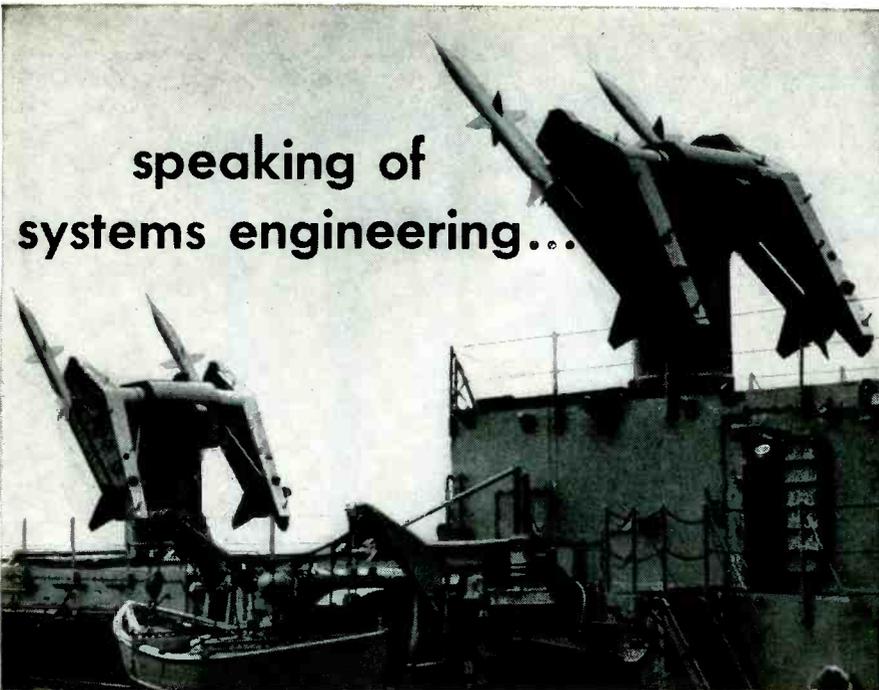
North American Aviation, Inc. is doing research and development on the X-15, a manned aircraft for investigation of speeds and temperatures at very high altitudes.

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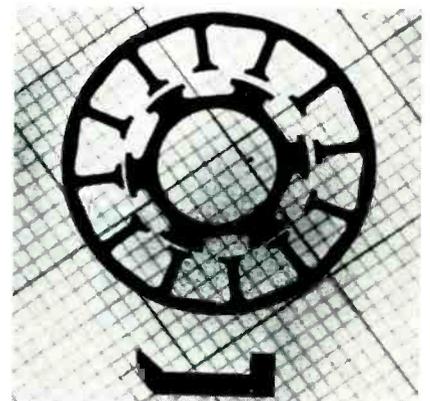
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finite number of settings. Circle P41 inside back cover.



COMPUTER TUBE
newest of 12-tube line

SYLVANIA ELECTRIC PRODUCTS INC., 1740 Broadway, New York 19, N. Y. The 6888, most recent in the company's line of computer tubes, has been announced. It is an octal based dual control pentode designed for long life and low failure rate and is utilized in pulse amplifier, core driver and coincidence circuit applications. Circle P42 inside back cover.



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MAGNETICS, INC., Butler, Pa., is offering rotor, stator and recording head laminations for rapid delivery. All laminations are made on sectional tungsten-carbide dies, carefully ground to eliminate burrs and provide good stacking characteristics. Concentricity of these high-permeability nickel-alloy stator laminations can be held to 0.001 in. total indicator

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Today all engineering recruiting advertisements talk of opportunity, yet most are, in spite of the most sincere intentions of the company seeking applicants, necessarily restricted to the offer of a chance to pursue substantially the same duties on another payroll. Moving to a new position may offer certain superficial advantages but the basic opportunity for long range growth may be restricted by the same factors which have limited advancement on the applicant's former job. We believe that we can offer an opportunity for analog computer operations engineers to utilize fully their previous experience in an area which offers broader responsibilities with commensurate increase in salary.

The adaptation of established analog computational techniques to the design of a permanent custom-built system for the simulation of a particular aircraft is the fundamental responsibility of our Engineering Division.

Staff Analog Computer Engineers (particularly those with aeronautical experience) are singularly qualified to accept major responsibilities in this area. The computer expert who fills this position will direct his efforts along the lines of product development and design on multi-million dollar projects; such an effort offers opportunities for advancement to upper management levels which are, we believe, denied most engineers working in a computer staff group. It should be recognized that by participating in this effort, an engineer is actively engaged in the direct support of our principal source of revenue rather than acting in an indirect supporting capacity with attendant lessening of overall responsibility. Lack of electronic design experience or the absence of a profound understanding of specialized electronic theory at a professional level should not be an appreciable handicap to the man who fills this position, as his efforts will be well-supported by an established team of electronic experts in our Research and Development organization.

It is essential that the applicant be capable of programming large-scale d-c analog systems for 3-dimensional real-time computation of flight dynamics. The applicant should also have full awareness of the shortcomings of analog computer elements and the effects of these faults on overall computer stability and accuracy. The successful applicant will probably find that his new responsibilities entail, in comparison to his previous job, greater emphasis upon accurate generation of functions of two or

more variables, maintenance of accuracy under unfavorable scaling conditions, and mathematical manipulation of standard equations to achieve improvements in accuracy or simplification of circuitry not feasible using a direct approach. Since the final result of his efforts will be embodied permanently in specialized computers manufactured in quantity, emphasis must be placed on optimization of equipment usage to an extent not commonly considered necessary in the temporary computer set-ups which characterize the operations of a computer laboratory staff group.

The responsibility for development of complex computer systems for production represents an additional challenge which increases the professional stature of the position and affords increased opportunity for growth.

Link Aviation, Inc. is located in Binghamton, New York, in an area of growing electronic and precision manufacturing activity. Several nationally known industries engaged in the manufacture of electronic equipment have moved to this area because of ideal living conditions, high standards of municipal and state government, excellent schools and absence of racial and delinquency problems. The Binghamton area traditionally has been favored by enlightened employee-management relationship techniques, a policy which has resulted in the absence of labor strife for over a decade.

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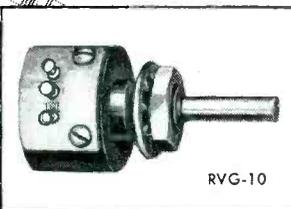
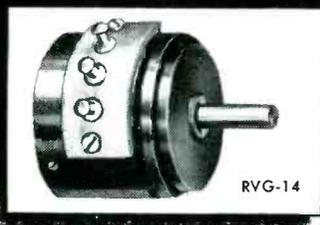
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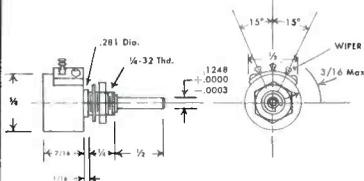
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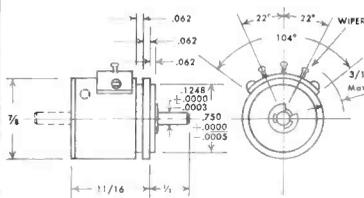
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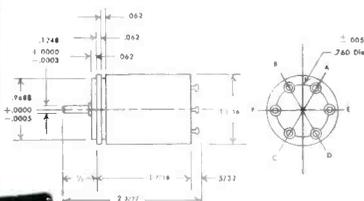
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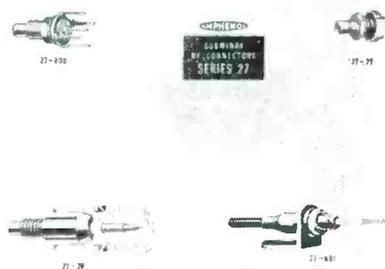
NEW PRODUCTS

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NEW R-F CONNECTORS added to the company's line

AMPHENOL ELECTRONICS CORP., Chicago 50, Ill., has added four new Subminax r-f connectors to its extensive line of subminiature components. The new connectors are the 27-27 hermetic seal panel receptacle, the 27-28 between series adapter designed to provide a transition between BNC and Subminax, the 27-800 printed circuit receptacle and the 27-801 cable termination. All have an impedance of 50 ohms.

Subminax connectors are available in 50 and 75 ohms, and in push-on and screw-on coupling. All are gold-plated. Circle P44 inside back cover.

CALIBRATOR with null balance system

ELECTRONIC MEASUREMENTS Co., Lewis St., Eatontown, N. J. Regatron calibrators are all electronic, employing no electromechanical elements. A detector and adjustment means are provided at the front panel to perform a null-bal-

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The 30 db variable attenuator illustrated, requires less than 3 watts control power.

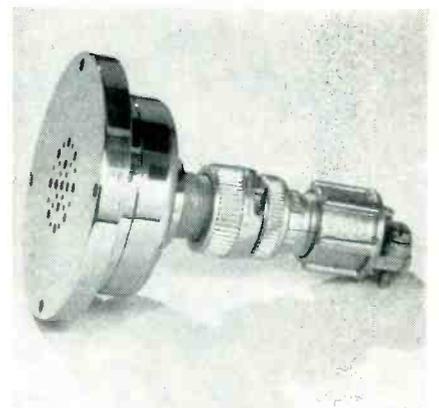
Write for Bulletin W-103 which gives full details of these Ferrite Microwave components.



ance check, even while the instrument is in use, to eliminate control system errors. By this means system accuracy is largely that of the internal reference.

In the bridge configuration used, a standard resistor and a control resistor form one arm, while a standard potential and a controllable potential form the other arm. A balanced detector senses the null points of the bridge and an error amplifier applies correction signals to the power control system. An aged reference tube is used as the internal reference.

► **Specifications**—Regulation is less than 0.03 percent or 0.03 v for line variations from 105 to 125 v; less than 0.02 percent or 0.02 v from zero to full load. Ripple and noise are less than 1 mv at any load within ratings. Size is 7 in. by 15 in. by 11 in. Weight is 33 lb. Three models are available. Circle P45 inside back cover.



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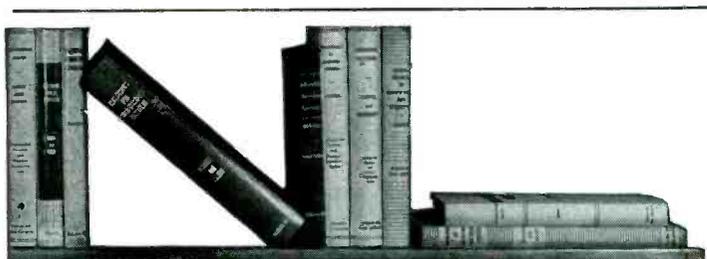
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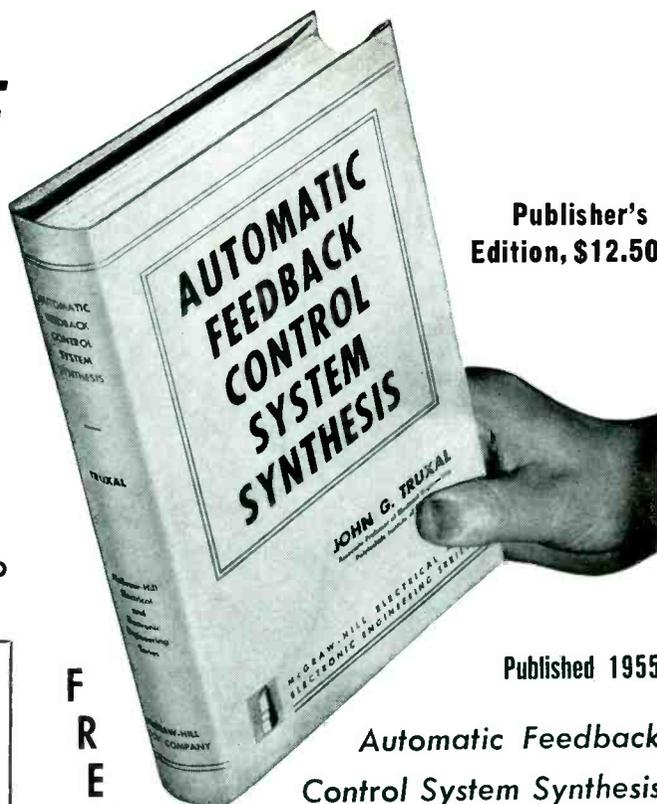
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I am to receive FREE with the book checked above a gift copy of *Automatic Feedback Control System Synthesis*. You will bill me for my first selection only at the special club price, plus a few additional cents for postage and handling. (The Club assumes this charge on prepaid orders.)

Forthcoming selections will be described to me in advance and I may decline any book. I need take only 3 selections or alternates in 12 months of membership. All further selections I choose will be at the member's special price.

No-risk guarantee. If not completely satisfied, I may return my first shipment within 10 days and my membership will be canceled.

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This offer is available only in the United States and its possessions. In Canada write McGraw-Hill Canada, 253 Spadina Road, Toronto 4.



AN UP-TO-EARTH VIEW OF THE FUTURE IN SERVO CONTROLS AND INSTRUMENTATION

The Martin launching vehicle of the first man-made Earth satellite will be the opening gun of a new and endless age of exploration into space.

There are many exciting new opportunities at Martin in the fields of servo controls development and instrumentation engineering.

If you are doing some down-to-earth thinking on this fabulous future you'd do well to contact J. M. Hollyday, Dept. E-12, The Glenn L. Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

from sonic vibrations, blast pressures, and water hammer in liquid-filled lines. In the new pickup, dynamic pressure applied to the diaphragm of a sealed liquid-filled cell causes an infinitesimal amount of polar liquid to flow through a porous disk, generating an electrical signal. This electrokinetic effect is known as the "streaming-potential" phenomenon.

About 1 in. thick and $1\frac{1}{2}$ in. in diameter, the new pickup will operate at a pressure range of 10^{-4} to 100 psig and temperature range of -10 F to $+140$ F. The 4-340 will respond flat between 3 cps and 25,000 cps. Other features of the pickup are its stability, low internal impedance and high output. Bulletin 1573 gives complete information. Circle P46 inside back cover.



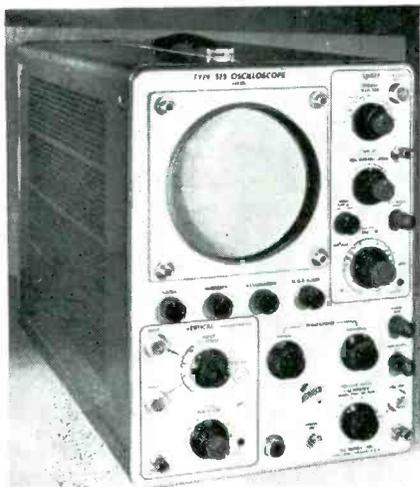
CALIBRATOR time/frequency unit

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. The new, accurate, reliable, compact and convenient type 1213-C calibrator comprises, with power supply and headphones, all the circuits necessary for the calibration of oscillators, receivers, and other wide-range devices up to frequencies above 1,000 mc. It also provides square-wave markers for oscilloscope sweep-time calibration at intervals from 0.1 μ sec to 100 μ sec.

New features include harmonic series with fundamentals of 10, 1, 0.1, and 0.01 mc; a crystal mixer good from low frequencies to frequencies above 1,000 mc; an amplifier for audible beats, and a video-frequency amplifier output for sweep-time calibrations. The

output pulse has adequate power to trigger most pulse generators and oscilloscope sweeps, thus providing a stable driving source for timing pulse systems for various applications.

Type 1213-C unit time/frequency calibrator is priced at \$195. Type 1203-A unit power supply is \$40; or the type 1201-A unit regulated power supply, \$80, for use with the calibrator. Circle P47 inside back cover.



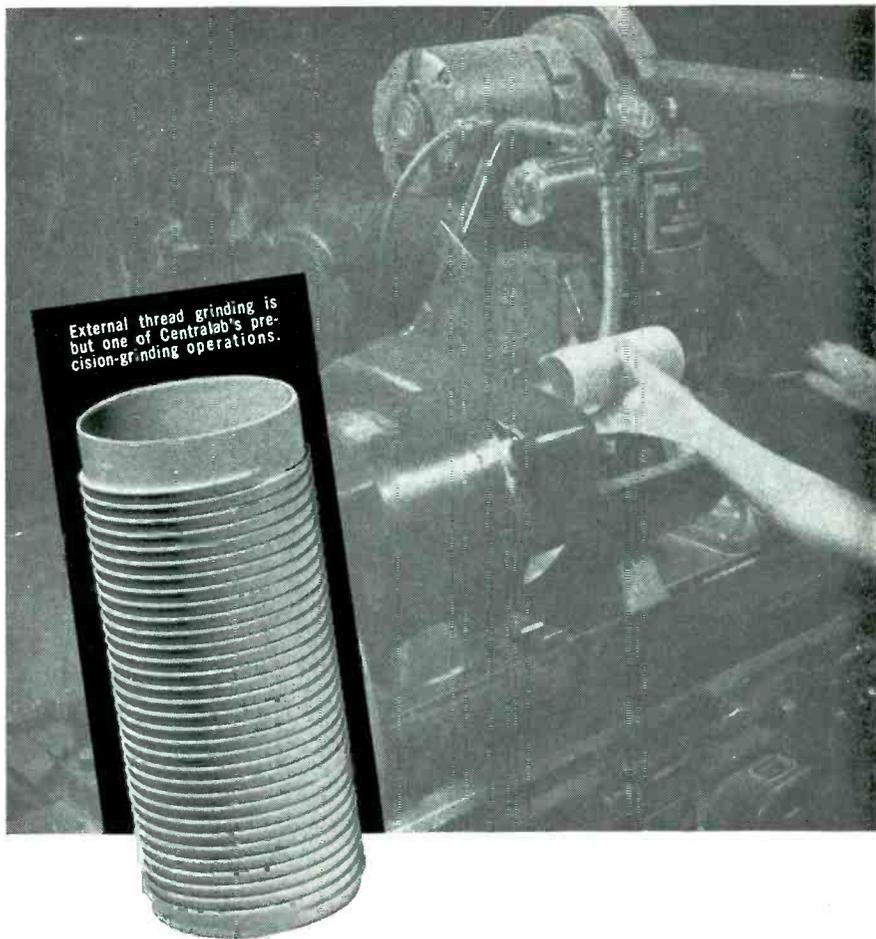
C-R OSCILLOSCOPE
takes little bench space

TEKTRONIX, INC., Portland, Oregon. Type 515 oscilloscope is a 5-in. d-c coupled general-purpose laboratory instrument occupying small bench space.

► **Specifications**—Size is 9½ in. wide, 13½ in. high, 21½ in. deep. Passband is d-c to 15 mc, with 0.023-µsec risetime; sensitivity, calibrated in 9 steps from 0.1 v/cm to 50 v/cm, continuously variable from 0.1 v/cm to 125 v/cm; 0.25-µsec balanced delay network.

Twenty-two calibrated sweeps from 0.2 µsec/cm to 2 sec/cm are accurate within 3 percent; 5X magnifier is accurate on all ranges; full sweep range is 0.04 µsec/cm to 6 sec/cm continuously variable; with trigger amplitude-level selection or automatic triggering.

Accelerating potential is 4 kv on the new precision crt. Power supply is electronically regulated. The square-wave calibrator has 11 steps from 0.05 v to 100 v accurate within 3 percent, frequency about



Now - threaded ceramics that permanently hold precision tolerances!

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Engineered
Ceramics . . .

- can be extruded or molded
- can be worked before firing the same as metal
- ground, drilled, threaded, or tapped
- can be metallized

Another reason to insist on Centralab

- ◊ Threads ground into the ceramic itself — after firing. There's no shrinkage to cause variations in width and depth.
- ◊ Other fired-ceramic precision-grinding operations include centerless, cylindrical, disc, surface, and lap grinding — to precision tolerances previously unavailable.
- ◊ Ask Centralab to quote on your requirements.

Write for Centralab's Ceramic Buyer's Guide, Bulletin 42-221. Or refer to it in Sweet's Product Design File.

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A DIVISION OF GLOBE-UNION INC.
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In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



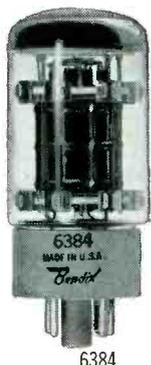
SPECIALLY BUILT TO WITHSTAND
SEVERE OPERATING CONDITIONS



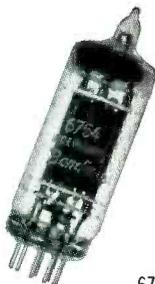
HARD GLASS TUBES



6094
BEAM POWER AMPLIFIER



6384
BEAM POWER AMPLIFIER



6754
FULL-WAVE RECTIFIER

- Ideal for modern high-performance aircraft and missiles.
- Processing at higher vacuum and under the higher heat permitted by the hard glass reduces gas and contamination and provides greater operating stability at higher temperatures.
- Ceramic element separators prevent emission loss from high heat and vibration.
- Solid aluminum oxide heater-cathode insulator eliminates shorts, reduces leakage.

For further information, write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

ELECTRICAL RATINGS*	6094 Beam Power Amplifier	6384 Beam Power Amplifier	6754 Full Wave Rectifier
Heater Voltage (AC or DC)**	6.3 volts	6.3 volts	6.3 volts
Heater Current	0.6 amp.	1.2 amp.	1.0 amp.
Plate Voltage (Maximum DC)	300 volts	750 volts	350 volts
Screen Voltage (Maximum DC)	275 volts	325 volts	—
Peak Plate Voltage (Max. Instantaneous)	550 volts	750 volts	—
Plate Dissipation (Absolute Max.)	14.0 watts	30 watts	—
Screen Dissipation (Absolute Max.)	2.0 watts	3.5 watts	—
Heater-Cathode Voltage (Max.)	±450 volts	±450 volts	±500 volts
Grid Resistance (Maximum)	0.1 Megohm	.1 Megohm	—
Grid Voltage (Maximum) (Minimum)	5.0 volts -200 volts	0 volts -200 volts	—
Cathode Warm-up Time	45 sec.	45 sec.	45 sec.

*For greatest life expectancy, avoid designs which apply all maximums simultaneously.

**Voltage should not fluctuate more than ±5%.

MECHANICAL DATA	6094	6384	6754
Base	Miniature 9-Pin	Octal	Miniature 9-Pin
Bulb	T-6½	T-11	T-6½
Maximum Over-all Length	2½"	3½"	2¾"
Maximum Seated Height	2¾"	2½"	2½"
Maximum Diameter	¾"	1½"	¾"
Mounting Position	Any	Any	Any
Maximum Altitude	80,000 ft.	80,000 ft.	80,000 ft.
Maximum Bulb Temperature	300°C	300°C	300°C
Maximum Impact Shock	500G	500G	500G
Maximum Vibrational Acceleration	50G	50G	50G

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales and Service:
Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P. O. Box 6102, Montreal, Quebec



NEW PRODUCTS

(continued)

1 kc. Weight of the entire unit is 40 lb. Price is \$750. Circle P48 inside back cover.



DELAY LINE with elliptical core

COLUMBIA TECHNICAL CORP., 61-02 31st Ave., Woodside 77, N. Y., announces a new delay line with elliptical core. Now it is possible to construct delay lines covering an impedance range from 75 to 7,500 ohms with delays ranging up to 2 μsec using the same compact core.

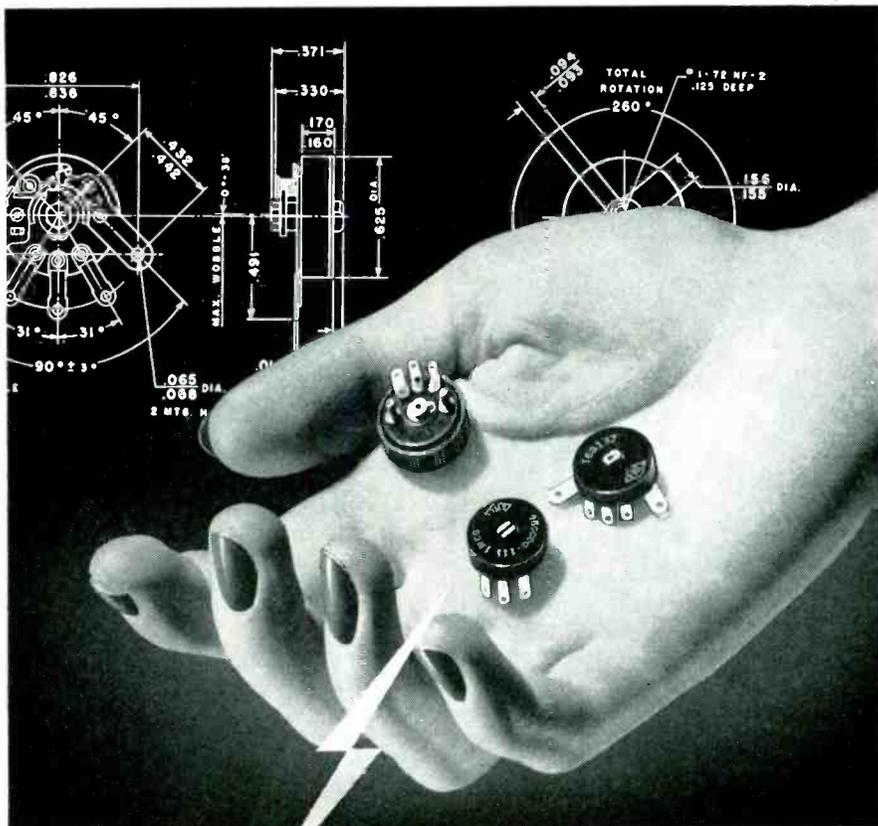
► Features—Major advantage of the delay-line Flat over the distributed-parameter delay line of circular cross section is the elliptical core which, for a given cross-sectional area, has a greater surface and a greatly increased capacitance per unit length. These Flats are characterized by extremely low insertion losses, wide bandwidths, compact size and rugged construction.

Write the manufacturer for additional data. Circle P49 inside back cover.



FORCE TRANSDUCERS with improved accuracy

DAYTRONIC CORP., 216 S. Main St., Dayton 2, Ohio. Improved accuracy and additional ranges are



Model 1
Variable Resistors
— they fit the tight spots

Adopted as standard
where only the best will
do, by designers of...

- Transistor circuits
- Telephone systems
- Hearing aids
- Car radios
- Military electronic devices
- Business machines
- Computers

- ◆ Centralab Model 1 Radiohms, with or without switches, can solve your variable resistor problems where size, ruggedness, and high quality are desired.
- ◆ Rated at 1/10 watt. Resistance range, 500 ohms to 10 megohms. Seven standard tapers.
- ◆ Enclosed in laminated phenolic dust cover. Metal electro-static shield available.
- ◆ Knob and slotted-shaft types.
- ◆ Not a laboratory curiosity — 6,000,000 are now in use.

Technical Bulletin 42-164 gives complete engineering data. Write for it.

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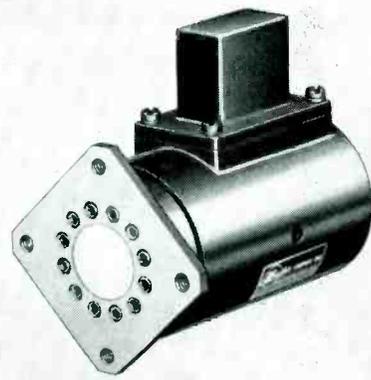
FERRITE ISOLATOR
lightweight, rotation type

KEARFOTT Co., INC., Western Div., 253 No. Vinedo Ave., Pasadena, Calif. Model W 152-2A, weighing only 6 oz, will handle 100 kw of peak power and give 25 db of isolation with an insertion loss of less than 0.25 over a 200 to 300 mc bandwidth in the 8 to 12 kmc band.

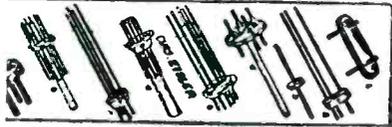
The new unit is one of a family of the company's isolators available for microwave, radar and communication fields. Circle P51 inside back cover.

PHASE ANGLE METER
completely self-contained

EASTERN SPECIALTY Co., Philadelphia 40, Pa., has available a port-

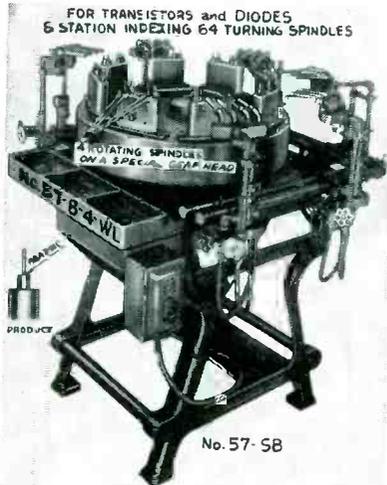


TRANSISTOR MAKING EQUIPMENT

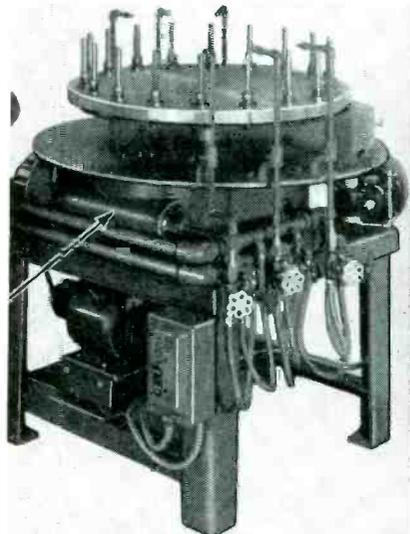


DIODE MACHINERY AUTOMATIC OR SEMI-AUTOMATIC

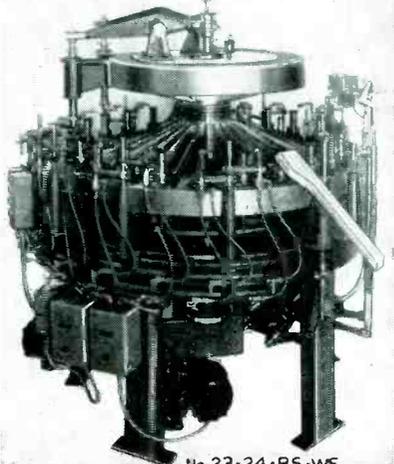
FOR TRANSISTORS and DIODES
6 STATION INDEXING 64 TURNING SPINDLES



No. 57-5B



24 POSITION TRANSISTOR OR DIODE SEALER FULLY AUTOMATIC
WIRE, GLASS AND SHELL & HOPPER FEEDS



No. 23-24-B5-WE

Send for Catalog Dr. Chas. Eisler, M.E. Founder
CHAS. EISLER, JR., PRES.

EISLER ENGINEERING CO., INC.
751 So. 13th St. NEWARK 3, N. J.

NEW PRODUCTS

(continued)



able phase angle meter which offers a direct way of checking relay and instrument connections, particularly directional over-current relays, differential relays or similar equipment. It may also be used to measure the prevailing power factor in each phase of a polyphase watt-hour meter installation.

► **Specifications**—The device has a frequency of 60 cps, with voltage ranges of 60, 120 and 240 v. Current ranges are 1, 2.5 and 5 amperes. Dimensions are 9½ by 6½ by 5½ in. Weight is 19 lb. It is also available in other voltage combinations. Bulletin No. 75 gives complete information. Circle P52 inside back cover.



TACHOMETER GENERATOR
features small size

SERVO-TEK PRODUCTS CO., INC.,
1086 Goffle Road, Hawthorne, N. J., has available a line of low-

REDUCE Your Rejects



USE "ACME" UNIFORM COMPONENTS

MAGNET WIRE
COIL WINDINGS
VARNISHED INSULATIONS
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COMPOUNDS

"Acme" stands for a half century of specialization in electrical insulations, with *uniformity* a first consideration.

Standardize on Acme-made components in your product and be 100% sure of a balanced assembly every time.

Submit us your product for a no-obligation analysis. Our engineers may be able to save you many dollars in its production. Our catalog should be in your planning. Let us send you one.

ACME WIRE CO.

NEW HAVEN, CONN.



cost d-c tachometer generators. With an overall diameter of 1½ in., they weigh only slightly more than 3 oz.

Although used principally as a rate generator in servo systems, they have many other uses. When combined with a standard 1,000 ohms-per-v voltmeter, they make an excellent direct-reading tachometer. The manufacturer provides information suggesting their use as under or over speed indicators, speed synchronizing controls and the like.

► **Accuracy**—Output voltage is proportional to speed to better than ½ of 1 percent, with ripple well under 3 percent. Various models are available with output voltages as high as 15 v per 1,000 rpm. Output voltage for either direction of rotation is held to a tolerance of better than ¼ of 1 percent.

Various mounting arrangements are provided, and a choice of models is ready for immediate delivery from stock, with single-unit prices starting at \$19.50. Discounts are offered for quantities. Literature is available supplying additional information. Circle P53 inside back cover.

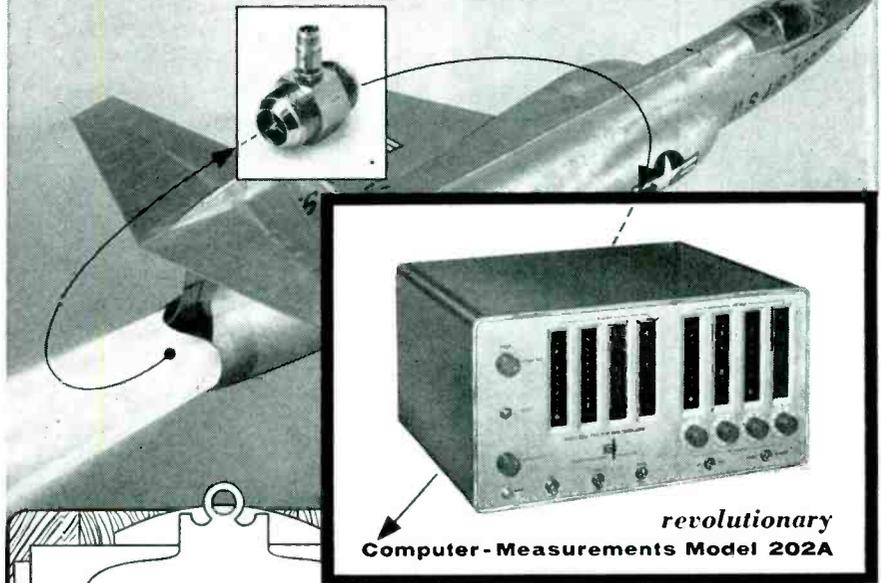


INVERTER

with ±5 -percent regulation

JOHN OSTER MFG. CO., Avionic Division, Racine, Wisc., has developed a unique smaller, lighter, more powerful, closely regulated inverter which produces unusually high wattage per lb of weight and per cu in. of volume. Input is 24 to 30 v d-c at 4.5 amperes maximum at -55 C. Ambient temperature range is -55 C to +71 C. Output is 115 v, 400 cycle single, 2 or 3 phase, 20 to 40 w. Complete

translate flow
... into pounds per hour
at a glance!



revolutionary
Computer-Measurements Model 202A

TIME-FUNCTION TRANSLATOR

Applications:

- ✓ Gallons per minute ... into Gallons per hour
- ✓ Gallons per minute ... into Pounds per hour
- ✓ Pulses per second ... into Gallons per minute
- ✓ Total Count of Gallons or Pounds
- ✓ Tachometer Applications
- ✓ Direct Frequency Measurement
- ✓ Many Others

Translating flow into weight as required for jet engine analysis is just one of the many uses for the all-new Model 202A TIME-FUNCTION TRANSLATOR. The 202A permits instant direct read-out of unknown quantities by translating one function of time into another function of time. It eliminates the need for conversion tables, graphs, charts, etc. The variable time base display may be illuminated or blanked at operator option. The versatile 202A fills a long recognized need in electronic measurement.

Write for complete information and detailed specifications on the Model 202A Time-Function Translator TODAY...

SPECIFICATIONS:

Frequency Range:	1-100,000 cycles per second 0-100,000 positive pulses per second
Input Sensitivity:	0.05 volt rms: 10-100,000 cps (5 millivolts optional) 0.07 volt rms: 1-10 cps Positive pulse rise time: ½ volt or more per sec.
Input Impedance:	0.5 megohm and 50 mmf.
Accuracy:	± 1 count ± stability
Stability:	Short Term: 1 part in 1,000,000 Long Term: 5 parts per million per week
Time Bases:	0.001 to 10 seconds in 1 millisecond steps 0.0001 to 1 second in 0.1 millisecond steps (0.0001 to 10 sec. in 0.1 millise. steps, 0.001 to 100 sec. in 1 millise. steps optional)
Read-Out:	Direct: Four digits. (Five digits optional)
Display Time:	Automatic: Continuously variable, 0.1 to 10 sec. Manual: Until reset
Power Requirements:	117 volts ± 10%, 50-60 cycles, 250 watts (50-400 cycles optional)
Dimensions:	17" W x 8¾" H x 13½" D
Weight:	35 lbs. net.
Finish:	Panel: Light grey baked enamel Case: Dark grey baked enamel <i>Data Subject to Change Without Notice</i>



*Model FL Flow Pickup: Courtesy—Vaugh Engineering Co., Van Nuys, Calif.

Computer-Measurements Corporation

5528 Vineland Avenue, North Hollywood, Calif. Dept. 78-P

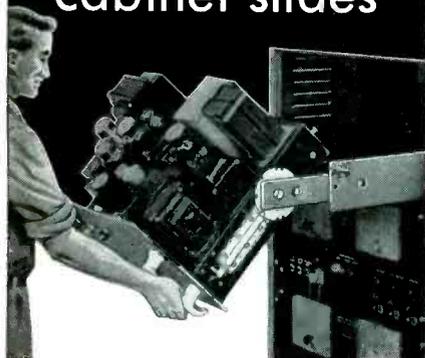
NEW

ultra-thin

CHASSIS-TRAK

"DETENT"

cabinet slides



give
easier access
and mounting
for
electronic equipment

Chassis-Trak "Detent" slides tilt down as well as up to give you ready access to any part of the instrument. Front panel trigger control locks chassis in 7 different tilting positions. Solid bearing surfaces are permanently dry lubricated, glide smoothly without brinnelling or peening under loads up to 175 lbs. Ideal solution to shock or vibration problems. Standard unit accommodates 17" chassis in standard width cabinets 11" to 25" deep. Meets JAN 50-hour salt spray requirements. Now used in many military installations. Available in light, medium, heavy-duty and roller slide models.

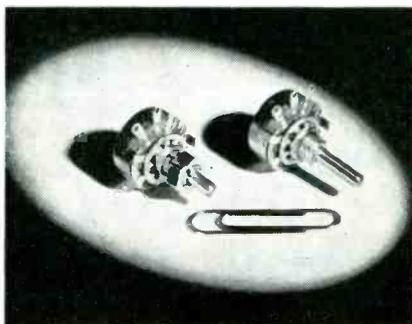
write Dept. E-1 for
equipment bulletin D-151A

CHASSIS-TRAK CORPORATION
525 SOUTH WEBSTER
INDIANAPOLIS, INDIANA

unit (inverter and radio noise filter with connector in enclosed box) weighs only 3½ lb and measures only 6.69 in. long by 2.87 in. wide by 3.89 in. high.

Efficiency is 40 percent at room ambient at 25 v. Voltage and frequency regulation are ± 5 percent over all conditions of load, voltage input and temperature variation. The unit can be rated at 5 minutes on, 5 minutes off.

Type INV-6601-02 is designed to meet MIL-E-5272A and MIL-I-7023C specifications and intended for guided missiles and other airborne applications requiring 400-cycle voltage and maximum power with minimum weight and size. Circle P54 inside back cover.



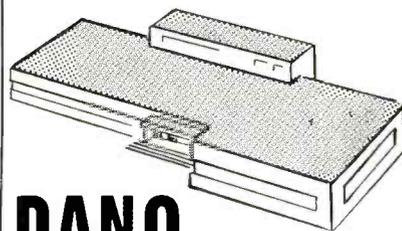
MINIATURE CONTROLS

can be sealed or potted

CENTRALAB, a division of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc., has available 4 w miniaturized controls designed to meet rugged military specifications. Completely closed, these units can be sealed or potted, making them ideal for miniature amplifiers, geophysical equipment, guided missiles and scores of other applications where small size and high quality are primary factors. There are 28 different selections, all with a tolerance of 20 percent and resistance ranges from 1,000 ohms to 2.5 megohms.

► **Two Models**—Type JP has a plain round shaft ½ in. in diameter and ½ in. long. Its bushing is ¼ in.-32, ¼ in. long, and is furnished with mounting nut and lock washer. Model JL has a screw-driver slotted shaft ½ in. in diameter. Its split locking bushing is ¼ in.-32, ¾ in. long, and is fur-

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makes all these coils
to exact specifications:

- ✓ Encapsulated Coils — in either Polyester or Epoxy Resins
- ✓ Coils for High Temperature Applications
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- ✓ Paper Section Coils
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Analyse YOUR coil problems carefully. If your products require any of these coils you'll do well if you "deal with Dano", leaders in electrical coil windings to customer specification.

TRANSFORMERS MADE TO ORDER



MODEL 80

STANDARD SIGNAL GENERATOR

2 Mc to 400 Mc

Individually calibrated Direct Reading Scales and Dials

A completely self-contained instrument with built-in power supply and modulator—provides accurate test signals for testing varied radio and television equipment; for laboratory work, production testing, and servicing.

Write for Bulletin 158

Laboratory Standards

MEASUREMENTS CORPORATION
BOONTON • NEW JERSEY

nished with a jam nut, mounting nut and lock washer. Circle P55 inside back cover.

PANEL INSTRUMENTS

all standard sizes, styles

WATERS MFG., INC., P. O. Box 368, South Sudbury, Mass., has available a complete line of panel instruments. The line, which includes instruments meeting requirements of MIL-M-6A and JAN-16, comprises d-c voltmeters, millivoltmeters, ammeters, millimeters, microammeters and rectifier-type a-c voltmeters, millimeters and microammeters. Round meters in 2½ in. and 3½ in. sizes and rectangular meters in 2½ in., 3½ in. and 4½ in. sizes are standard.

The instruments are available in steel, Bakelite, transparent-plastic and hermetically sealed cases. Scales can be furnished with special markings, graduations or colors to meet the user's requirements. Catalog No. G-855 gives detailed specifications. Circle P56 inside back cover.



FREE GYRO

is unusually rugged

G. M. GIANNINI & Co., INC., 918 E. Green St., Pasadena 1, Calif. Model 3416 free gyro offers unusual ruggedness and insensibility to mounting and dynamic loads. It features a cast steel frame mounted solidly inside a structural outer shell having an integral CG mounting flange. Shock specification is 50 g in all axes. Drift rate is less than 18 minutes of arc per minute, and the potentiometer pickoffs which supply outputs up to 70 v for telemetering and control operations have a linearity of ± 0.5 percent and resolu-

It's a mighty thin line...

... between optimum efficiency and chaos, when you're working with multi-component electronic assemblies. You want components on time ... dependably produced ... and you want to see your *own* production lines busy first, before farming out work.

But ... is it sensible to try to make *all* your own components? Can you afford setting up new lines ... hiring new people ... fussing for hours with dozens of different parts sources for just *one* component?

And what about those inevitable "end of run" slumps, when hands are idle, space goes wasting and costs pile up out of all proportion?

that's when
you need

a "balancer"

EED, an expert sub-contractor of electronic components for radio-TV and commercial-military manufacturers, enables you to plan a balanced production ... to put your own facilities to the fullest use, yet stay clear of the risks and harassments of sub-assembly production.

Our staff, trained up to the minute in time-saving, cost-saving methods, is experienced in every type of component assembly from amplifiers to zero adjusters.

Our facilities, modern and centralized, are geared to handle either limited quantity—high quality assemblies or volume—economy runs.

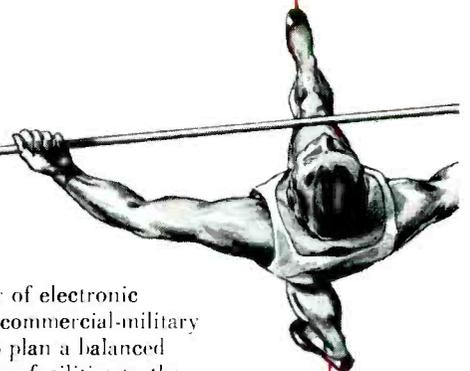
And of course, as a division of I.D.E.A., Inc. (where the world famous pocket-size Regency Radio is made) we're particularly adept in miniature production, including transistorized, etched circuit, dip soldered assemblies.

Unequaled, specialized staff, facilities and experience—they're ready to work for you. Just send us your drawings and full details and we'll be glad to submit complete cost and delivery estimates. For *Facilities Brochure*, write direct to:

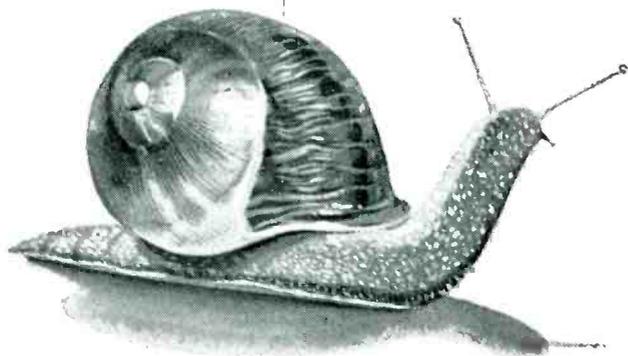
ELECTRONIC EQUIPMENT DIVISION

I.D.E.A., Inc., 7900 Pendleton Pike

INDIANAPOLIS 26, INDIANA



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DIGITAL COMPUTERS
LOGICAL DESIGNS
FIRE CONTROL SYSTEMS
SERVOMECHANISMS
OPTICS
TRANSISTOR PULSE
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MAGNETIC MEMORY
TECHNIQUES

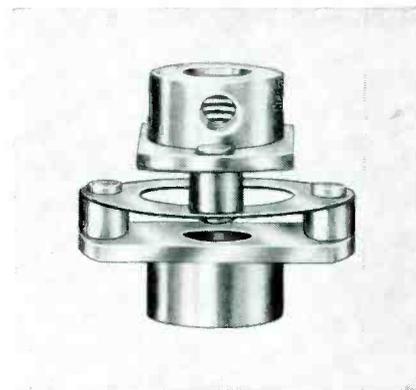
Strong subsidiary benefits—autonomous engineering divisions where you are close to management—see your projects through to completion.

A SUBSIDIARY OF



LIBRASCOPE
LIBRASCOPE INC. 808 WESTERN AVE.
GLENDALE, CALIF.

tion of 0.09 deg. A remote electrical caging mechanism automatically returns the gimbals to an accurately fixed reference position. Available as a single unit or as a pair in a free gyro set for indication in the three major axes, the model 3416 motor is powered by 115 v, 200 v, or 26 v three phase 400 cps voltage. Circle P57 inside back cover.



FLEXIBLE COUPLING
features zero backlash

GENERAL COMPONENTS INC., 233 E. 146th St., New York 51, N. Y., has announced a precision flexible coupling featuring zero backlash, low inertia, high flexibility and versatility. Applications include servomechanisms, computers, breadboards and electro-mechanical instruments. Circle P58 inside back cover.



IMPEDANCE COMPARATOR
completely self-contained

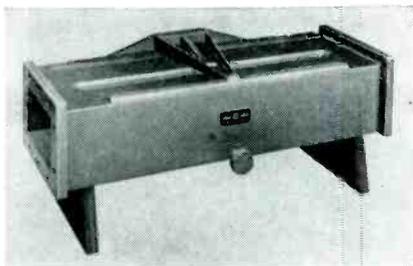
GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1605-A impedance comparator can be used to compare complex impedances of any phase angle.

► **Features**—It indicates not only the difference in magnitude be-

tween the two components being compared, but also indicates simultaneously the phase-angle difference. These differences are indicated directly on panel meters. On the most sensitive ranges the differences can be determined to 0.01 percent and 0.0001 radian, respectively.

The instrument is completely self-contained, including a calibrating voltage. The internal oscillator provides frequencies from 100 cps to 100 kc in decade steps. Meter voltages are available externally to operate recorders, remote indicators or selecting devices. The range of impedances which can be compared is nominally from 2 ohms to 20 megohms.

This versatile instrument is priced at \$790. Circle P59 inside back cover.



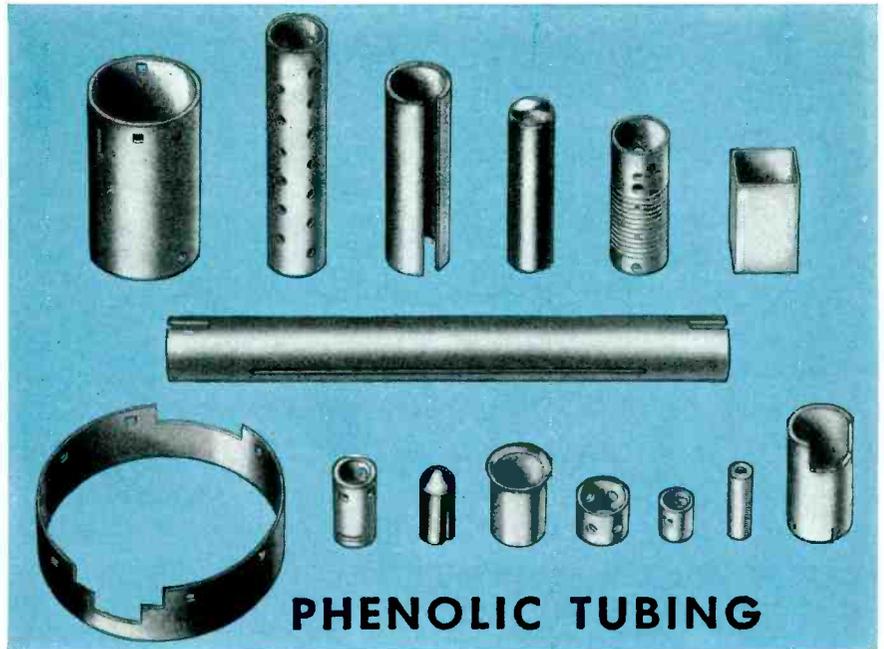
L-BAND EQUIPMENT
slotted section illustrated

F-R MACHINE WORKS, INC., 26-12 Borough Place, Woodside 77, N. Y., is now manufacturing a complete line of L-band equipment. This equipment uses 6.660 in. by 3.410 in. waveguide for optimum performance over the frequency range from 1,120 to 1,700 mc.

Instruments such as the type L101A slotted section (illustrated) designed for precise microwave measurements are available. The complete L-band line is described in a new catalog. Circle P60 inside back cover.

TOGGLE SWITCH
can control many circuits

MICRO SWITCH, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill., has introduced a new rotary toggle switch that offers a solution to the problem of



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It has high insulation advantages, uniformity and inherent ability to hold close tolerances which give you dependability.

CLEVELITE dependability is the answer for product performance at its best.

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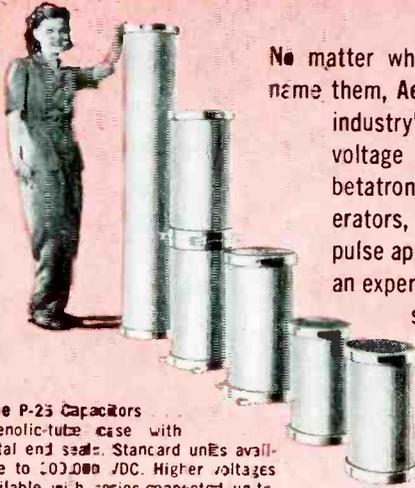
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 NEW ENGLAND: R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
 CHICAGO AREA: PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO
 WEST COAST: IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES



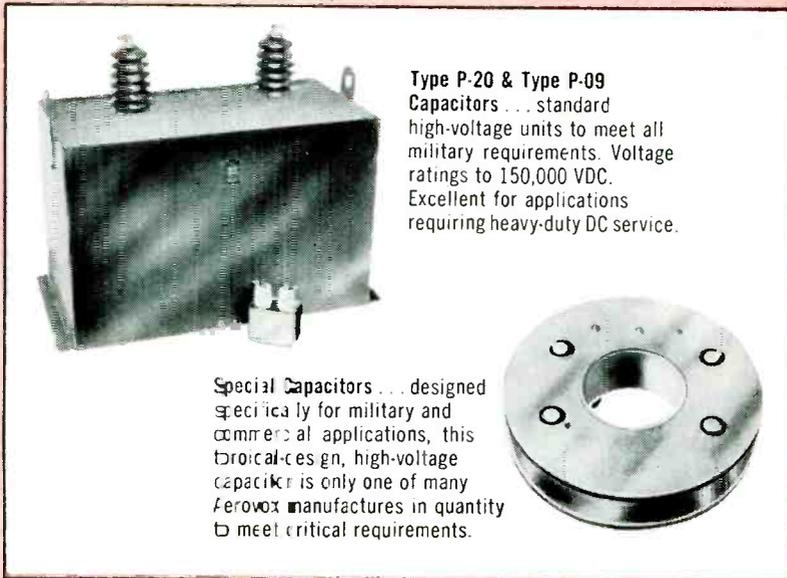
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CAPACITORS FOR DC OR HIGH-CURRENT DISCHARGE APPLICATIONS



Type P-25 Capacitors... phenolic-tube case with metal end seals. Standard units available to 100,000 VDC. Higher voltages available with series-connected units.

No matter what the voltage requirements—you name them, Aerovox meets them. Aerovox is the industry's leading supplier of special high-voltage capacitors for radio-transmitters, betatrons, X-ray equipment, nuclear accelerators, radar, sonar and all military and pulse applications. Which accounts for such an experienced engineering staff with wide-scale knowledge of high-voltage equipment for high-current pulsing and minimum inductive reactance applications.



Type P-20 & Type P-09 Capacitors... standard high-voltage units to meet all military requirements. Voltage ratings to 150,000 VDC. Excellent for applications requiring heavy-duty DC service.

Special Capacitors... designed specifically for military and commercial applications, this toroidal design, high-voltage capacitor is only one of many Aerovox manufactures in quantity to meet critical requirements.

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controlling many circuits with single-motion, mechanical actuation. The small switch can handle a high electrical load, thus eliminating the use of relays and other electrical devices. It is rugged enough for most industrial and airborne applications, having successfully passed impact, shock, acceleration and vibration tests.

The 4-pole, double-throw switch (designated 4TRI) is maintained in all three actuation positions: on-off-on. It has 12 terminals. Other models are available with up to 24 terminals (8 poles).

The switch has an operating force of 9 in. lb maximum. Electrical rating is as follows: continuous capacity of 30 v d-c; 20 amperes resistive; 5-ampere lamp or 12 amperes inductive. At 115 v a-c, 20 amperes resistive, 4 amperes lamp and 15 amperes inductive. Circle P61 inside back cover.

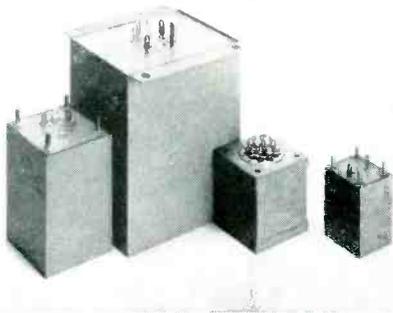


FREQUENCY METER for 100 to 10,000 mc range

NORTHEASTERN ENGINEERING, INC., Manchester, N. H. The No. 7-18 frequency meter is designed to measure frequency in the 100 to 10,000 mc range. It consists of a heterodyne oscillator using a 2C40 triode with waveguide type tuning elements continuously tuneable from 500 to 1,250 mc, a detector-mixer circuit, an audio amplifier, beat indicator and crystal calibrator circuit. Frequency is measured by zero-beating the signal against the output of the heterodyne oscillator. Zero-beat position is determined either aurally with a pair of head phones or visually with an oscilloscope (not supplied)

at the video output receptacle. A built-in beat indicator circuit using meter response is provided to indicate the presence of beat frequencies.

Calibration is provided by an internal crystal controlled oscillator using a 5,000-ke quartz crystal with an output at 20 mc. Check points against the oscillator are available every 5 mc over the entire range of the oscillator. Intermediate points are interpolated and presented in chart form for a total of 750 points distributed over approximately 16,500 dial divisions. Accuracy as high as 0.01 percent or better can be obtained in measuring frequencies. Crystal calibration check points are accurate to 0.002 percent. **Circle P62 inside back cover.**



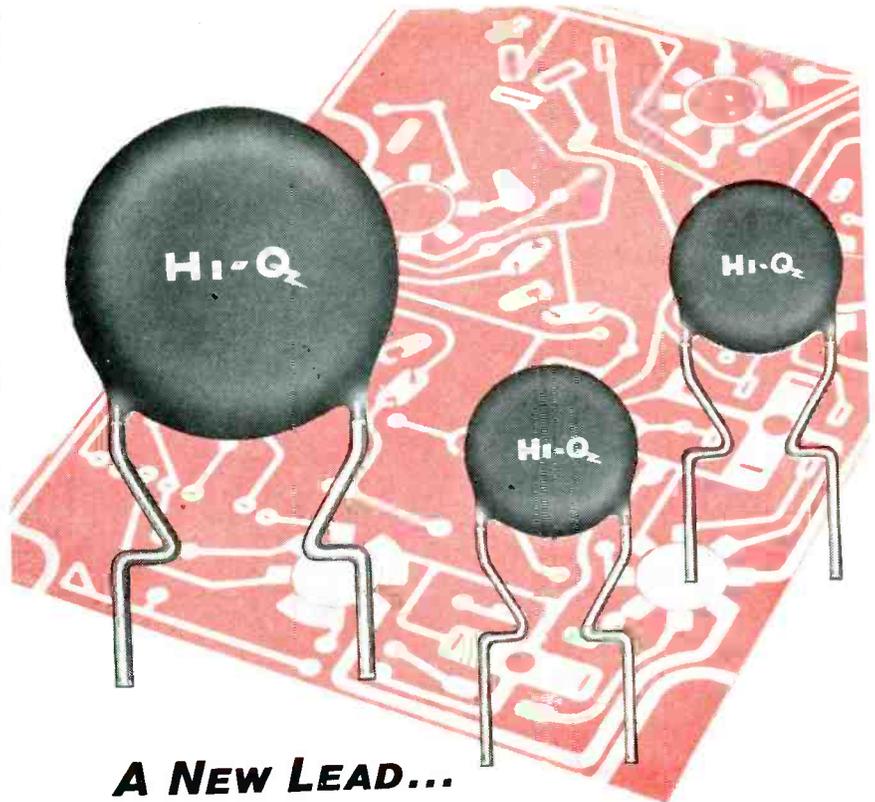
TRANSFORMERS

ruggedized and miniaturized

ELECTRO ENGINEERING WORKS, INC., 401 Preda St., San Leandro, Calif. A new resin-potted transformer will withstand temperatures up to 170 C. The units are hermetically sealed and designed for airborne use. They are impervious to humidity and altitude, and will withstand abuse without electrical or mechanical damage.

The potting material developed by Electro enables them to manufacture transformers of smaller size and weight due to the improved thermal conductivity. It also welds core, coil, case and terminals into an integral unit. Lack of shrinkage in epoxy resin potting, due to a special formula, eliminates separation from the case.

These resin potted transformers may be qualified under MIL-T-27A,



A NEW LEAD...

*to keep costs down
and quality up!*

Hi-Q DISK CAPACITORS

MAINTEINING quality and at the same time reducing the cost of small components is a problem facing many manufacturers of radio-TV and other electronic equipment. Cut-and-formed, or "crimped" leads are another example of ingenuity leading to cost reductions.

"Crimped" leads on Hi-Q ceramic disk capacitors make possible completely coated or dipped units without the expense of cleaning leads. In addition, these new "crimped" leads insure good solderability as well as easier insertions for all printed-wiring assemblies.

Many Hi-Q customers have already experienced significant economies while maintaining or actually improving product quality, through the use of these new "crimped" lead ceramic capacitors.

Interested in more information? Write:

Hi-Q[®]
DIVISION

AEROVOX CORPORATION
OLEAN, N. Y.

In Canada: AEROVOX CANADA LTD., Hamilton, Ont.
Export: Ad Auriema, 89 Broad St., New York, N. Y., Cable: Auriema, N. Y.

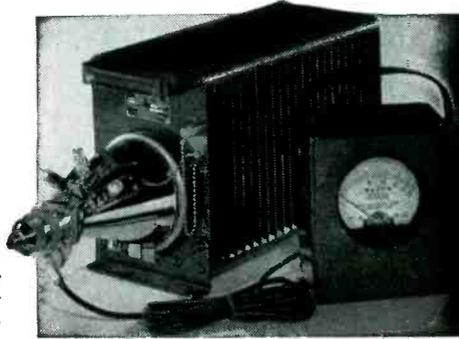
Simplifying HF Power Measurement
Model 67 TERMALINE
DIRECT-READING R-F WATTMETER

30 mc to 500 mc
 (to 1000 mc if specified)

50 ohms

Triple Range 0-25 watts
 0-100 "
 0-500 "

Type N Input Connector
 (Adaptor for PL-259 supplied)



NON-RADIATING

... Accuracy - 5%

RUGGED CONSTRUCTION

... Size - 17" x 9" x 6"
 Wght. - 30 pounds

● Model 67 is a larger type Wattmeter than the well-known AN-ME-11/U (our Model 611) R-F Wattmeter. Specifically designed for fixed station transmitters to 500 watts output, it may be used nicely on low range for mobile gear. Provided with an aluminum cased, shock-mounted meter, Model 67 is as simple to use as a DC voltmeter. Now in general use throughout the industry, TERMALINE Wattmeters may be depended upon for fast, accurate and repeatable power readings

Grade 1, 2, 4 or 5 as required. Less expensive commercial types may be supplied with most of the benefits required by military specifications. Circle P63 inside back cover.



SPECTRUM RECORDER

automatic gamma-ray type

DETECTOLAB, INC., affiliate of Borg-Warner Corp., 6544 N. Sheridan Road, Chicago 26, Ill. Model DZ46 automatic gamma ray spectrum recorder will scan and record through any 5 percent or multiple of 5 percent of the total energy range on either a single scan or repetitive scan basis. It can be set to operate at 5 different speeds. For easy chart reading with wide energy ranges, the chart is marked at each 5-percent step.

► **Other Characteristics**—It also features five counting ranges, fast or slow response, rapid resetting, and easy changes of speed and spectrum portion to be studied. The instrument is ideal for the study of short-lived isotopes.

The instrument consists of basic precision units such as linear amplifier, single-channel analyzer, a h-v supply and a counting rate meter. Circle P64 inside back cover.

POWER DIODES
 of the silicon type

THERMOSEN, INC., 361 West Main St., Stamford, Conn., has developed new silicon power diodes of 25, 50 and 75 ampere ratings.

Units in this versatile new prod-



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WELDED RIBBONS—Dissimilar metal ribbons of the same width can be continuously welded together, within close overlap tolerances.

Write for List of Products

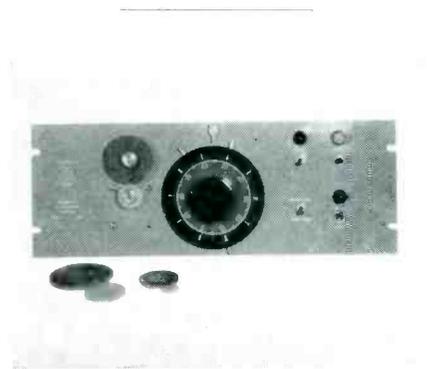


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uct group meet a wide range of applications, and are adaptable to meet unusual requirements. Complete specifications and performance data are available from the company. Circle P65 inside back cover.



AUTOMATIC SCANNER
rotates helical pots

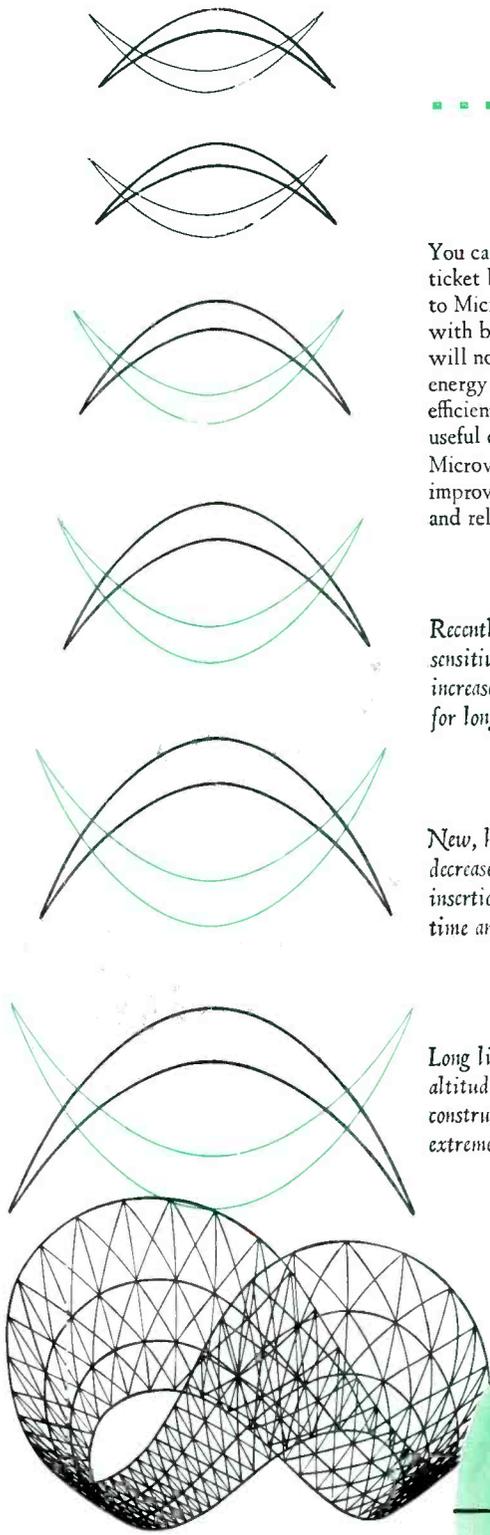
DETECTOLAB, INC., Affiliate of Borg-Warner Corp., 6544 N. Sheridan Road, Chicago 26, Ill., Model DZ45 is a mechanical scanning unit available to rotate helical potentiometers for scanning purposes or to convert manually operated single channel analyzers to automatic.

The unit can be set to scan through any 5-percent or multiple of 5-percent steps of the total energy range at any one of five predetermined speeds, and will either single scan and stop, or reset and scan repetitively. There is provision for generating a marking signal at every 5-percent step.

Designed primarily for use with a gamma-ray spectrum recorder, it also has unlimited application in a research laboratory, such as attaching it to a h-v supply for automatic plotting of Geiger tube characteristics. Circle P66 inside back cover.

RECORDING POTS
high-speed, self-balancing

THE BRISTOL Co., Waterbury 20, Conn., has announced high-speed self-balancing recording potentiometers for use with analog-to-digital conversion devices. Designed to give full-scale traverse in 0.4 sec, the electronic Dynamaster can be equipped with most of the



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TICKET**

You can obtain the obvious advantages of a round trip ticket by bringing your radar component problems to Microwave Associates. We are equally concerned with both legs of the radar journey. Our products will not only help insure maximum transmission of energy to the target but will contribute to most efficient conversion of available return signals into useful data.

Microwave Associates offers the following design improvements to increase radar efficiency, sensitivity and reliability:

Recently developed super sensitive E Mixer series offers increased burn out resistance for longer life.

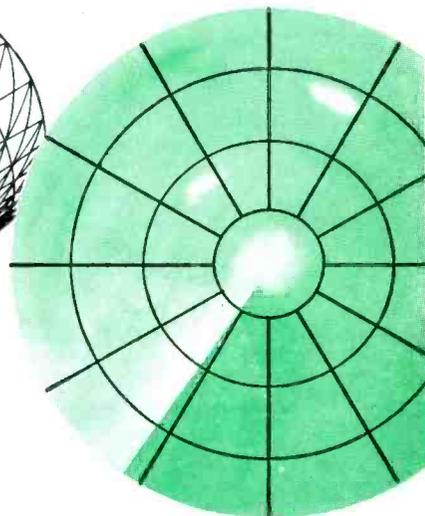
New, higher power designs, decreased spike leakage and insertion loss, faster recovery time and longer life.

Long life Philips cathode, high altitude designs, extra rugged construction for operation under extremes of shock and vibration.

**SILICON
DIODES**

**TR DUPLEXER
TUBES**

MAGNETRONS



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UNITIZED packaging

PAC reduces costs! PAC (Pre-Assembled Components) simplifies complex automation assembly lines by eliminating many of the insertion heads required for individual components. PAC groups capacitors and resistors into a unitized modular package for quick installation in a printed circuit board.

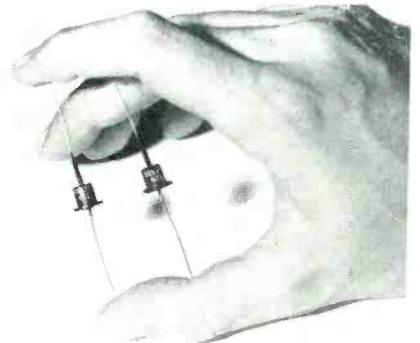
PAC (Pre-Assembled Components) not only reduces the number of insertions and eliminates insertion equipment; it also means fewer items to purchase, smaller chassis area, fewer chassis holes, and reduced inspection. ERIE has complete facilities for designing PAC into your circuits, and for manufacturing these modules efficiently on high speed equipment.

Manufacturers are saving money and producing more compact and attractive radios, TVs and other electronic products through the use of custom built PACs. Write for Engineering Bulletin 450-1.

Experimental PAC Design Kits are offered for sale in three models, with standard 5-10-20% values and tolerances, enabling engineers to make up their own breadboard designs. The PAC Design Kit is your key to cost savings. Write for full description and prices.

standard digital read-out devices presently available. Ample torque is available for operating retransmitting slidewires, alarm contacts and other auxiliary devices, without affecting the dynamic characteristics.

Round chart models are also available for such service, for use where prominent indication of the variables is needed while feeding digitized information to data handling equipment. Various pen speeds can be supplied, depending on the speed requirements and type of converter used. Circle P67 inside back cover.



SILICON RECTIFIERS

meet military requirements

GENERAL ELECTRIC Co., Syracuse, N. Y., has announced two new silicon rectifiers, RETMA type 1N537 and 1N538, designed to meet stringent military requirements. Occupying a total volume of only 0.03 cu in. and weighing 0.07 oz., the devices have axial leads for easy assembly.

► **Specifications**—Both rectifiers are rated at a maximum d-c output current of 250 ma at 150 C. However, the devices may be designed into circuits for outputs of up to 750 ma where lower temperature conditions are encountered. Maximum leakage current over the devices' entire ambient operating temperature range of from -65 C to 150 C is 0.5 ma.

► **Applications**—A prime feature is that high current loads can be carried without the use of any heat sink. Thus, the rectifiers are suitable for computer power supplies for many applications such as

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guided missiles; blocking applications; magnetic amplifiers; other low leakage applications and a wide variety of high temperature electronic equipment power supplies.

The 1N537 is rated at a maximum peak inverse voltage of 100 v. The 1N538 is rated at a maximum piv of 200 v. Maximum surge current for both rectifiers is 10 amperes. Full cycle average forward voltage drop is a maximum of 1/2 v for both devices. Further data are available from the company. Circle P68 inside back cover.

SOLDER CORE CONTACTS

for Continental connectors

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y., now offers solder-filled contacts for the complete line of miniature and subminiature Continental connectors. The amount of solder provided is automatically controlled. Merely apply heat to the solder clip and insert the wire. A noncorrosive resin flux in solidified form on the surface of each solder cup eliminates the need for adding flux during the soldering operation. This method resists internal tarnishing and eliminates costly tinning. Circle P69 inside back cover.



TELEVISION TESTER
multipurpose flybacker

SIMPSON ELECTRIC CO., 5200 W. Kinzie St., Chicago 44, Ill., has introduced a new tv tester that combines both an in-circuit horizontal system analyzer and a capacitor

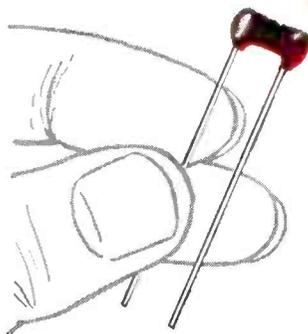
REMEMBER!

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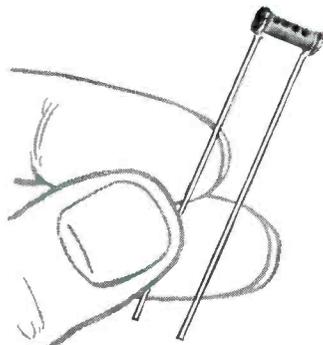
for

PRINTED WIRING APPLICATIONS



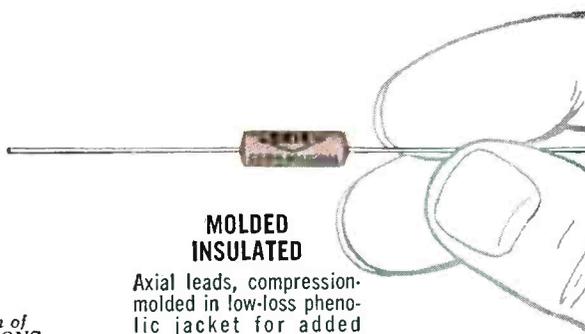
DIPPED PHENOLIC INSULATED

These Radial lead units are dipped in low-loss phenolic material which is baked and vacuum wax impregnated.



NON-INSULATED

Radial leads soldered to silver electrodes and sealed with moisture impervious coating to withstand humidity.



MOLDED INSULATED

Axial leads, compression-molded in low-loss phenolic jacket for added strength and protection against humidity.

- Leads are tin coated with a minimum of .001" heavy coating of solder to insure ease of solderability and to prolong shelf-life.
- ERIE TUBULAR CERAMICONS offer convenient form design, including 1/4" and 3/8" lead spacing, for printed wiring board applications where space is at a premium.
- Rugged construction of ERIE TUBULAR CERAMICONS features inherently strong dielectric design with leads wrapped around the dielectric and soldered to withstand stress and strain.
- Uniform case size of ERIE Molded Tubular Ceramicons is designed for automatic loading and is available packaged on tape called "Reel-Pack"—2000 to a reel.
- Temperature Compensating and General Purpose Ceramicons are available in a wide capacity range with tolerances as close as ±1% or ±.1 mmf and in Hi-K types for by-pass and coupling applications.

Write for 16 page Bulletin 313-2 for description of ERIE TUBULAR CERAMICONS. Also ask for our new 8 page Feed-Thru Ceramicon Bulletin 323.

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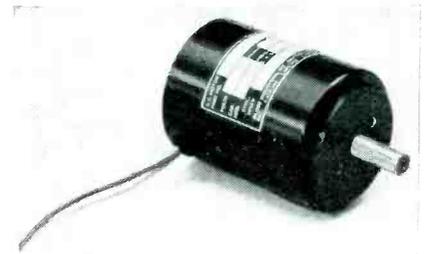
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checker in one unit. Model 382 will check an entire tv horizontal deflection system, in-circuit, test flyback transformers for opens and shorts, check deflection yokes for opens and shorts, measure capacitances from 10 μf to 0.1 μf by direct reading. It registers with better than 10 percent accuracy. The model 382 also can be used as a continuity meter, and will compare various flyback transformers and deflection yokes for relative Q by means of a logging scale.

Model 382 has a 4½ in. microammeter with 60 μa , full scale sensitivity. It uses a single 6K6 tube in an oscillator circuit for the measurement of Q of horizontal circuit components, and an a-c ohmmeter type circuit for continuity and capacitance measurements. Circle P70 inside back cover.



A-C MOTORS

operate at 400 cps

GLOBE INDUSTRIES, INC., 1784 Stanley Ave., Dayton 4, Ohio. Type FC 400-cycle a-c motors are compact, precision made units for applications where size, weight and high performance are the governing factors. They can be wound as follows: (1) Three-phase, two pole or four pole. (2) Two-phase, two pole or six pole. These motors can be furnished with induction or hysteresis rotors. The induction rotor will provide a unit with more output than one with a hysteresis rotor, but the hysteresis unit will operate at synchronous speeds.

Complete features and specifications are given in bulletin No. X-1170. The motors described are also furnished for operation at frequencies other than 400 cycle. Such specific applications should be submitted with complete oper-

ating details for determination of the final design. Circle P71 inside back cover.



FILM DIELECTRICS feature self-healing

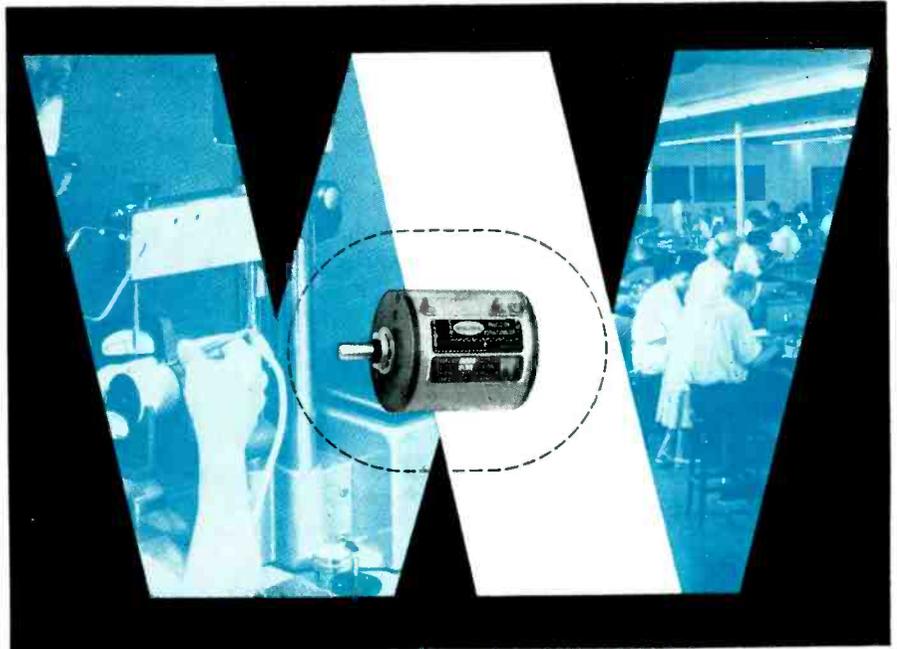
DEARBORN ELECTRONIC LABORATORIES, 231 S. LaSalle St., Chicago 4, Ill., announces a new series of metallized film capacitors. A new principle of self-healing is responsible for high reliability, and materials and methods used produce smallest sizes for a wide range of ratings.

Operating temperature range is -65°C to $+125^{\circ}\text{C}$, and insulation resistance is 50,000 megohm-microfarads at 25°C . The units are furnished in hermetically sealed tinned brass cases, glass to metal seals, bath tub or rectangular cases, single or multiple sections. Further information is given in bulletin DC-15. Circle P72 inside back cover.

PLASTIC INSULATION flexible glass reinforced

THE GLASTIC CORP., 4321 Glenridge Road, Cleveland 21, Ohio, has available a low-cost glass-mat polyester plastic insulation in flexible form for bending around corners or wrapping in cylindrical forms. This material, Glastic "Grade FM", is heavy enough to give substantial mechanical support, flexible enough to bend to a 3-in. diameter without loss in dielectric strength, and heat-resistant enough to withstand continuous exposure to Class B temperatures (130°C) without loss in dielectric strength.

Grade FM is available in standard thicknesses of $1/32$ in., $3/64$ in. and $1/16$ in. in sheet sizes up to 36 in. by 72 in. Circle P73 inside back cover.



Spectrol's* problem: to join .0006" nickel wire to gold-plated brass

*and how a weldmatic
solved it*

PROBLEM: to join .0006" nickel tap leads to gold-plated brass terminals in Spectrol's single- and multi-turn precision potentiometers. Connections must be extremely strong for reliability in severe environments.

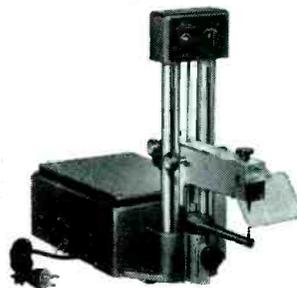
SOLUTION: Using a minute "sandwich" of beryllium copper, Spectrol sandwich-welds the three metals firmly and in millisecond time. Because the potentiometers must withstand heavy vibration and shock, Spectrol's customer specifies welding for this work. Weldmatic stored-energy welders are best, Spectrol finds, because they are easy to use (only two simple adjust-

ments)—they time each weld automatically, and they have very low maintenance factor.

Weldmatic stored-energy welders do many precision metal-joining jobs faster, better and cheaper than soldering, silver brazing, riveting or staking. Weldmatic-welded joints offer better mechanical performance, higher tensile strength and better fatigue resistance. Dissimilar metals, "problem" metals, and parts of widely varying thicknesses are easily joined without discoloration, metallurgical change or excessive deformation. Easy set-up and operation.

Metals require no preconditioning... constant output assures uniform welds. Speed of operation is limited only by operator response time.

*SPECTROL... Electronics Division of Carrier Corporation, manufacturers of high-precision single—and multi-turn potentiometers... one of many leading users of Weldmatic stored-energy welders.



Write for descriptive literature and details of sample welding service

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New Literature

Tropospheric Scatter Antennas. Prodelin Inc., 307 Bergen Ave., Kearney, N. J. A four page bulletin, No. 435, illustrates and describes parabolic antennas for tropospheric scatter and line-of-sight communications. Features, applications, electrical and mechanical specifications, radiation patterns for the 28-ft parabolic antenna and ordering information are included. **Circle L1 inside back cover.**

Electrical Delay Lines. Underwood Corp., Electronic Computer Div., 35-10 36th Ave., Long Island City 6, N. Y. Catalog 6-56 is a six page folder illustrating and describing a line of lumped parameter electrical delay lines. Included are specifications, a typical waveform and important features. **Circle L2 inside back cover.**

Industrial Compacting Presses. F. J. Stokes Corp., 5500 Tabor Road, Philadelphia 20, Pa. The complete line of industrial compacting presses, which are used for making a wide variety of products, from tiny ferrite rings and other subminiature electronic parts to large ceramic parts such as grinding wheels and brake inserts, as well as catalysts and other chemical preparations, carbon brushes, bimetallic contacts, plastics preforms, bearings and bushings and other powder metal parts are described in a new 24-page comprehensive catalog, No. 816. **Circle L3 inside back cover.**

Engineering House Organ. Hathaway Instrument Div., Hamilton Watch Co., 1315 South Clarkson St., Denver 10, Col. Current copies of the *Engineering News* are now being distributed. The publication reports new developments in measuring and testing equipment and techniques. It publishes technical articles and information valuable to those connected with instrumentation in science, industry and government.

Features in the issue described cover the S-25 oscillograph, the

SD-10 automatic record developer, the RS-9, RS9-fourteen and RS9-thirty automatic oscillographs. **Circle L4 inside back cover.**

Pushbutton Switch. Micro Switch, a Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. Data sheet 111 covers the 71PB series which provides ideal pushbutton control for commercial computers and light industrial equipment. The switches described will help manufacturers reduce assembly time by (1) providing a complete, ready-to-install unit; (2) permitting easy bracket-to-panel attachment and (3) enabling fast, snap-on wiring. **Circle L5 inside back cover.**

Wire-Wound Resistors. DMETER Mfg. Co., Inc., 22-24 Larkin Plaza, Yonkers, N. Y., has issued a four page bulletin, D-111, to assist engineers confronted with a resistance space problem. It features: (1) Small resistance sizes but larger wattage ratings as compared to other wirewounds of the same size. (2) Complete mounting dimensions include the length and diameter in inches and terminal thickness wherever applicable, also center hole clearance. (3) Complete wattage and maximum resistance range listed. (4) The bulletin states whether resistor style is inductive or noninductive. (5) Number of sections of the bobbin wherever applicable are listed. (6) Other pertinent information, such as resistance wire and operating characteristics, is included. **Circle L6 inside back cover.**

TV Resolution Chart. Radio-Electronics-Television Manufacturers Association, 777 14th St., N.W., Washington 5, D. C., has made available to the broadcasting industry a new tv resolution chart. It incorporates many improvements over previous issues: (1) resolution wedges to 800 lines; (2) highest grade 100-percent rag stock of extreme whiteness with no gloss; (3) careful ink selection

resulting in very flat blacks and greys with good uniformity over the area of each chart as well as from chart to chart and, (4) areas are defined for paste-on photographic grey scales of extreme accuracy.

The chart, used for checking out tv camera systems by tv studios, is designed to be televised by studio facilities and produced on suitable studio picture monitors. In this way the studios can check the image right through the entire studio facility.

The new resolution chart may be purchased at \$4 each and the paste-on grey scales at \$2 for a set of four. Circle L7 inside back cover.

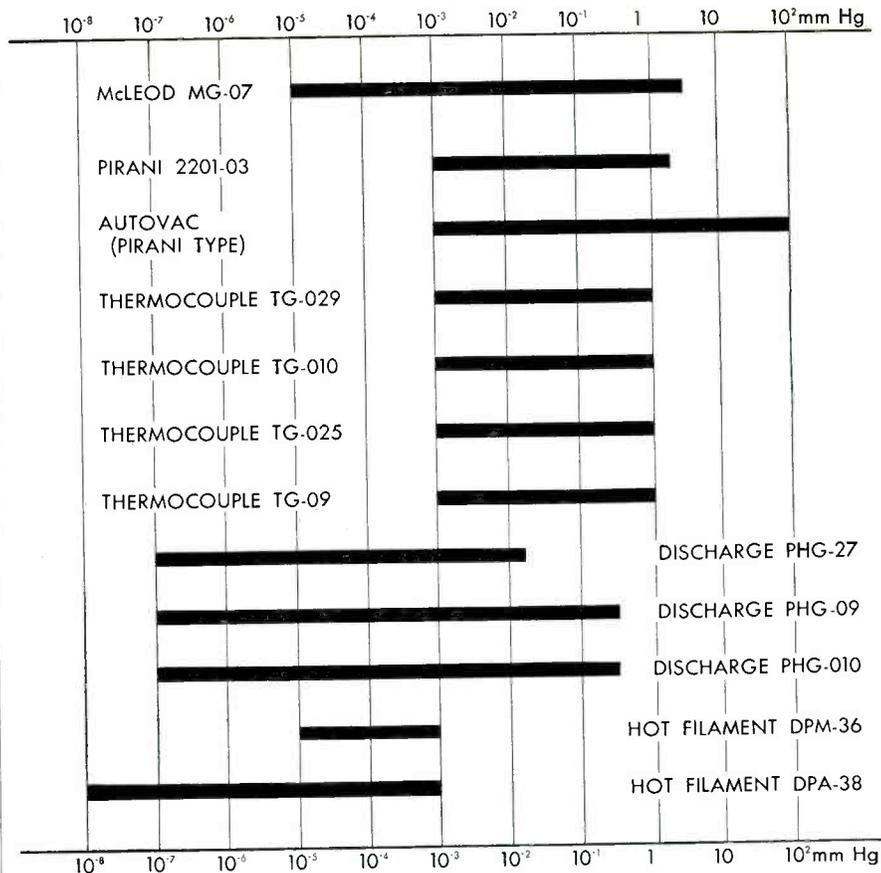
Tubes and Semiconductors. Philco Corp., 18th and Courtland Sts., Philadelphia 40, Pa., has released a 207-page manual (6 in. by 9 in.) entitled "Handbook of Tubes and Semiconductors". It is basically composed of six sections: (1) Servicing and maintenance aids; (2 & 3) locating specific tube base diagrams quickly; (4) listing of conventional tubes and their ruggedized equivalents, and showing differences which may exist between them; (5) tube characteristic charts, including data on receiving, transmitting and a variety of special-purpose tubes; (6) information on semiconductor devices.

The special-purpose tubes listed include cathode-ray, klystron, magnetron, TR, ATR, hydrogen thyatron, voltage regulator and voltage reference tubes.

Characteristics of over 1,950 tubes and semiconductors are given. Price of the manual is \$2. Circle L8 inside back cover.

Testing Facilities. Parameters, Inc., 195 Herricks Road, New Hyde Park, N. Y., announces a new environmental testing facility for conducting qualification tests in accordance with military specifications. Complete facilities are available for conducting tests in accordance with MIL-E-5272A, military environmental test specification.

The company maintains complete facilities for functionally testing components and systems while these equipments are under-



10² to 10⁻⁸ mm Hg ... 12 gauges that measure in this range

For quick, accurate readings in a range to match your high-vacuum work—and at a price to match your budget—make your choice from these 12 CEC gauges:

Absolute Manometer

MG-07—Three scales.

Thermal Gauges

Pirani 2201-03—(See caption at right)

Autovac—Automatic range switching. One to four stations.

TG-029—Printed circuit offers economy. One station.

TG-010—External circuit control. One station.

TG-025—Battery operated. One station.

TG-09—One to six stations.

Ionization Gauges

PHG-27—Printed circuit offers economy. Automatic voltage regulation. Three scales.

PHG-09—Four scales. One station. (Also available with two to six stations.)

PHG-010—Same as PHG-09, but with external circuit control.

DPM-36—Has tube degassing circuit.

DPA-38—Automatic filament protection. Tube degassing circuit.



A NEW Pirani Gauge. Continuous, direct readings over entire 1 to 2000 microns range. Single and one to four station models. Automatic voltage regulation. High sensitivity with greatly reduced zero drift. Serves as leak detector up to 10mm Hg.

Write for descriptive literature on all 12 of these gauges for performance charts and specifications.



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TYPE	$\mu\text{m F/ft}$	IMPED. Ω	O.D.
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C11	6.3	173	.36
C2	6.3	171	.44
C22	5.5	184	.44
C3	5.4	197	.64
C33	4.8	220	.64
C4	4.6	229	1.03
C44	4.1	252	1.03

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going environmental qualification or reliability tests.

Copies of the testing facilities brochure are available. Circle L9 inside back cover.

Rare Earths. St. Eloi Corp., (Research Laboratories, Inc., subsidiary), P. O. Box 307, Newton, Ohio. A recent four page brochure gives the latest data on high-purity rare earths. It is of particular interest to researchers in electron tubes, dielectric ceramics and so forth. The physical properties tabulated are the result of months of compilation and correlation. The table is concise and accurate. A price schedule for the oxides is included. Circle L10 inside back cover.

Mercury Jet Switch. Norwood Controls, 934 Washington St., Norwood, Mass. Technical data sheet S56-08 illustrates and describes the Deltaswitch, a unique commutating switch that uses a jet of mercury for a wiper arm. Outstanding features and specifications are given. Applications listed include data sampling, analog-to-digital converter, precision function generator, precision analog multiplier and high-power pulse generator. A price list is available. Circle L11 inside back cover.

Audio Testing. Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich., has available a bulletin discussing the principles and advantages of audio testing of gears, either singly or in clusters. The 4-page bulletin, No. 1126, also describes the electronic audio sound testers developed by the company. The testers discussed may be used directly in automated lines and eliminate the human element in accuracy of final sound testing. Circle L12 inside back cover.

Infrared Spectroscopy to Data Processing. Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif. Bulletin No. 18 features articles about both infrared spectroscopy and data processing. In addition, timely and fact-packed



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15/32" dia. x 1-3/4" long

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RELAYS



LONG BRANCH, N. J.

articles on the other subjects of particular interest to the analytical and process instrumentation fields are found in the quarterly publication.

Featured are infrared articles on the IR-4 double-beam, double monochromator infrared spectrophotometer plus unusual applications for the L/B infrared analyzers. The 111 data system with its accuracy, versatility and reliability, along with pinboard control, are described. Other articles are included. Circle L13 inside back cover.

Variable Resistors and Switches. Stackpole Carbon Co., St. Marys, Pa. Dimensions, mounting styles, ratings, standard modifications, and performance characteristics for the company's complete line of variable composition resistors and snap switches are contained in the new 30-page bulletin RC-10B.

A convenient fold-out chart at the rear of the bulletin serves as a quick guide to the most important features of each unit shown in detail on the inside pages. Circle L14 inside back cover.

Production Vacuum Tubes and Accessories. Eitel-McCullough, Inc., San Bruno, Calif. A new 12-page quick-reference catalog listing all Eimac production vacuum tubes and accessories is available. Eimac has also released a tentative data sheet and two brochures describing its new 4CX300A ceramic power tetrode.

The 4CX300A data sheet and brochures have been mailed to Eimac catalog holders. Others desiring these data, and those wishing the quick reference catalog may obtain them for the writing. Circle L15 inside back cover.

Products Catalog. Hathaway Instrument Division, Hamilton Watch Co., 1315 S. Clarkson St., Denver 10, Colorado, features its standard products in a new short form catalog. The eight page booklet contains brief but complete descriptions and specifications of oscillographs, strain gages and control units, galvanometers,

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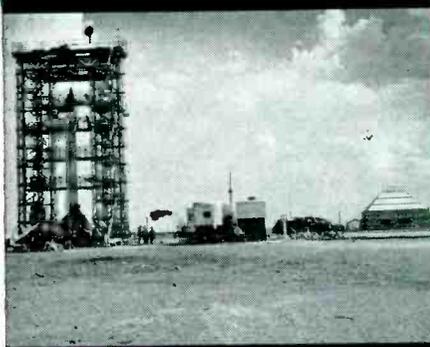


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SYSTEM FABRICATION

At this modern cable plant we build custom-made cable with facilities for fabricating and molding multi break-out harnesses and attaching and "potting" connectors so that a complete SYSTEM hook-up is provided.

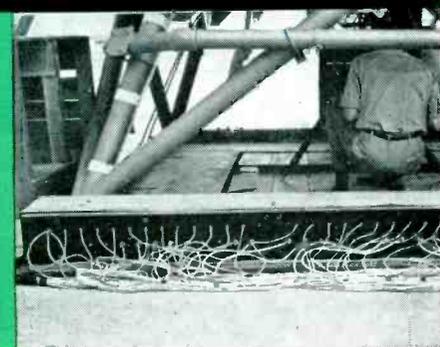


SYSTEM INSTALLATION

On-site installations in trailers and block houses of our custom-made cables and components are supervised by our field engineers to provide complete SYSTEM integration.

SYSTEM CHECK-OUT

Testing of on-site installations for circuitry by Pacific Automation Products engineers assures functional reliability of the electrical SYSTEM.



Write for Bulletin 158

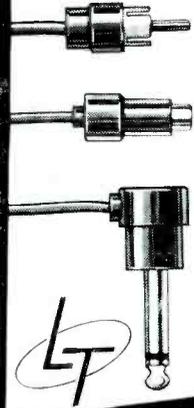


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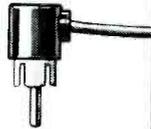
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LAB-TRONICS, INC., 3656 No. Lincoln Ave., Chicago 13, Illinois

transducers and other units. **Circle L16 inside back cover.**

Microwave Transmission Line. Prodelin Inc., 307 Bergen Ave., Kearney, N. J. Bulletin 433 illustrates and describes the type 905-2 G-line assembly for applications wherever coax or waveguide is used. Chief features, specifications and ordering information are given. **Circle L17 inside back cover.**

Tantalum Capacitors. Schweber Electronics, 122 Herricks Road, Mineola, N. Y., announces availability of an engineering guide for the selection of tantalum capacitors in order of microfarads. This listing is composed of over 250 different types in the 85 deg and new 125 deg high temperature types. **Circle L18 inside back cover.**

Molded Deposited Carbon Resistors. International Resistance Co., 401 N. Broad St., Philadelphia 3, Pa. Bulletin B-9 covers molded deposited carbon resistors in 4 pages. Comprehensive data on construction, applications, types, tolerance, resistance element, terminals, insulation, dimensions, performance and characteristics are given. Detailed charts and graphs are included. **Circle L19 inside back cover.**

Motor Data. Muirhead & Co. Ltd., Beckenham, Kent, England, has available on request 14 new data sheets for insertion in the Magslip data binder. Also available is a new binder which will accommodate existing sheets and provide for future issues.

The data sheets illustrate and describe a line of Magslips, synchro and servo motors. Mechanical and electrical data and mounting information are included. **Circle L20 inside back cover.**

Shielded Enclosures. Magnetic Shield Division, Perfection Mica Co., 20 N. Wacker Drive, Chicago 6, Ill. Data sheet No. 117 contains information on Fernetic Co-Netic leakproof shielded enclosures with newly designed telescopic door or lid, heliarc welded joints and a

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5,000 to d-c frequency range. Complete data include bench sizes, large sizes, prefabricated room information, applications, air conditioning method, and the special Fernetec Co-Netic construction which is non-shock sensitive, non-retentive, effective indefinitely without periodic annealing and which provides simultaneous high and low intensity shielding. **Circle L21 inside back cover.**

Precision Wire Wound Resistors. Eastern Precision Resistor Corp., 675 Barbey St., Brooklyn 7, N. Y., has completed a new catalog, featuring a complete handbook for engineers, designers and purchasing agents dealing with precision wire wound resistors. It contains a detailed glossary of terms; types of wire used—temperature coefficients, types of coatings; a-c characteristics — a-c equivalent, matching, measuring capacitance, measuring inductance, d-c matching only; reliability—encapsulation, installation precautions, wattage ratings, stability, operating characteristics; typical problems; and ordering information. **Circle L22 inside back cover.**

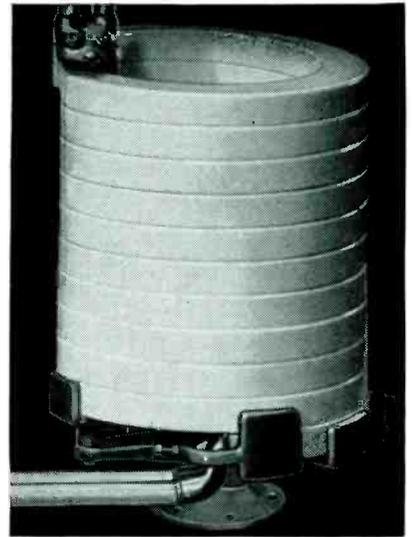
Coaxial Cables and Connectors. Progress Electronics Co., 296 Broadway, New York 7, N. Y. Catalog No. 7 is a 42-page ready reference of coaxial connectors, coaxial cables, and telephone plugs and jacks. The catalog makes it quick and easy to determine what connectors and cables should be used for each application. It also shows what mating connectors should be used to adapt between different series of connectors. Mechanical and electrical characteristics are listed. A price list for all the items will be sent upon request. **Circle L23 inside back cover.**

Semiconductor Power Converters. Power Sources Inc., 6 Schouler Court, Arlington, Mass. Catalog No. 56P illustrates and describes a line of semiconductor power converters. Showing the great capabilities of these d-c/d-c converters, the text is directed primarily at the designer of mobile systems including missiles, beacons, airborne systems, and other items

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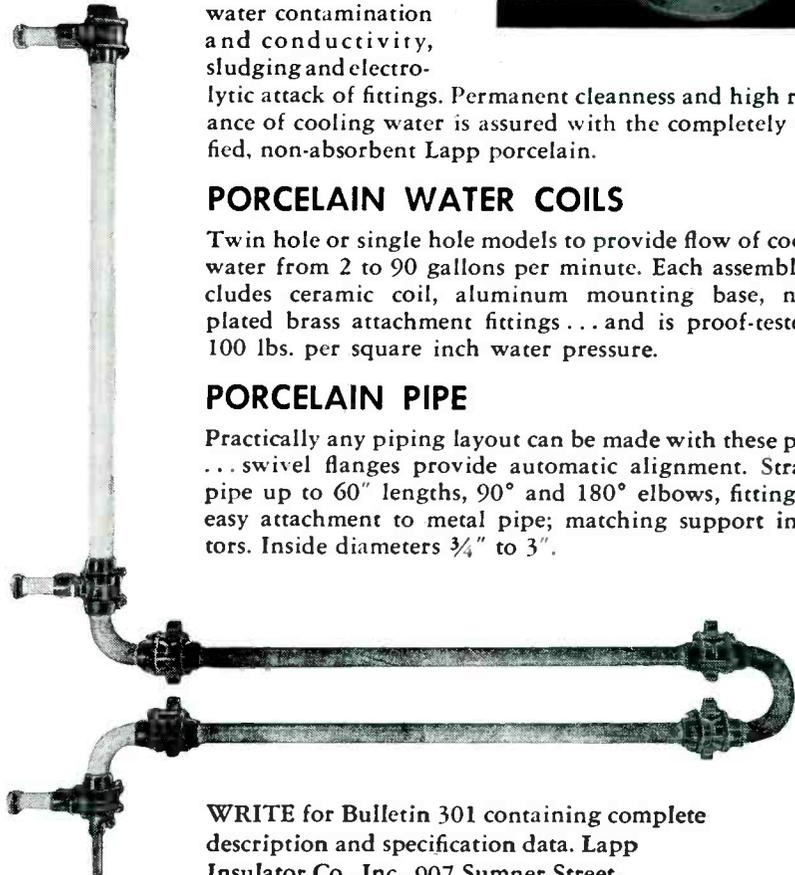
For carrying cooling water which must undergo a change in potential, use of Lapp porcelain eliminates trouble arising from water contamination and conductivity, sludging and electrolytic attack of fittings. Permanent cleanness and high resistance of cooling water is assured with the completely vitrified, non-absorbent Lapp porcelain.

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Twin hole or single hole models to provide flow of cooling water from 2 to 90 gallons per minute. Each assembly includes ceramic coil, aluminum mounting base, nickel plated brass attachment fittings... and is proof-tested to 100 lbs. per square inch water pressure.

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Practically any piping layout can be made with these pieces... swivel flanges provide automatic alignment. Straight pipe up to 60" lengths, 90° and 180° elbows, fittings for easy attachment to metal pipe; matching support insulators. Inside diameters $\frac{3}{4}$ " to 3".



WRITE for Bulletin 301 containing complete description and specification data. Lapp Insulator Co., Inc., 907 Sumner Street, Le Roy, New York.

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where severe operating conditions place a premium on efficient, reliable operation. Included are characteristics, a tabular comparison of basic receiver power supply types and a circuit diagram. Circle L24 inside back cover.

Magnetic Pickups. Electro Products Laboratories, 4500 N. Ravenswood Ave., Chicago 40, Ill. Magnetic pickups which generate electrical energy from mechanical motion without contact are the subject of a recent catalog sheet. The literature pictures and describes performance curves and specifications for the company's standard, high sensitivity and miniature pickups. Principles of operation and the diversified applications are discussed in detail. Circle L25 inside back cover.

Solving Servo Design Problems. Servo Corp. of America, New Hyde Park, N. Y., has available a 48-page pocket book (limited edition) which is a combination novelette (written in the lighter vein) and catalog. It recounts the solution of servo system and instrument design problems by use of Servo-board electromechanical assembly kits. Also included is a detailed description of the Servoscope servosystem analyzer which provides a direct method for measuring gain and phase, lead or lag of any component or system in the subsonic frequency ranges. Full specifications and application information are provided.

The booklet concludes with a technical presentation of the Servomation building blocks, a complete system simulating laboratory that cuts overall design time and gives more accurate evaluation of designs. Circle L26 inside back cover.

Modular System. Circle Dot Manufacturing Corp., P. O. Box 364 Shalvoys Lane, Danbury, Conn. Catalog A illustrates and describes the Root modular system of mechanically marked and prefabricated forms designed to save time, engineering, production and tooling costs. By using the system discussed for chassis cabinets or mockup, months of time can be

saved, decreasing the waiting period for tooling.

The system described is very simple. Metal is perforated and prepunched in standard dimensions, bent in standard widths and in standard lengths to be selected and cut to use by the engineer. The catalog shows how to use the system and also lists standard items available with standard marked thicknesses.

If modifications are required the company's engineering staff will cooperate. Circle L27 inside back cover.

Visualization Made Easier. Chart-Pak, Inc., 100A Lincoln Ave., Stamford, Conn. A new 20-page catalog describes the company's method of drawing charts, graphs and layouts with pressure sensitive tapes and templates. The tapes and templates discussed may be mounted on plastic planning boards which have printed grid lines. The completed charts and layouts may be displayed or may be reproduced by any standard method, since all the tapes, templates and boards are supplied in both transparent and opaque materials.

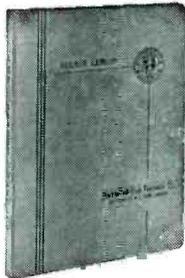
The Chart-Pak precision slit tapes described are used on master drawings for printed circuits. Circle L28 inside back cover.

Silicon Rectifiers. Sarkes Tarzian, Inc., 415 N. College Ave., Bloomington, Ind. Design notes No. 1 and 2 cover the M and MC series and the M-500 silicon rectifiers respectively. Features, ratings, dimensions and characteristics are included. Circle L29 inside back cover.

Custom Design File. NJE Corp., 345 Carnegie Ave., Kenilworth, N. J., has published a new custom design file, illustrating the range and variety of custom power supply work done by the company's engineering staff.

Included are series-tube-regulated supplies, constant-current supplies, unregulated h-v power supplies, semiconductor brute-force power supplies and thyatron-controlled supplies. Data given on each unit include voltage,

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NEW LITERATURE

(continued)

current, ripple, line regulation, load regulation and price.

From time to time the company will supplement this design file. Once a name has been added to the permanent mailing list, he will receive supplements as they are printed. Circle L30 inside back cover.

Precision Potentiometer. Helipot Corp., Newport Beach, Calif. Noise and life expectancy specifications for the T-10-A laboratory model precision potentiometer are included in data sheet 54-87. The new sheet supersedes 54-86. Several changes in model T-10-A also are mentioned. A tolerance of ± 5 percent rather than ± 10 percent is specified on wire turns. In addition, new dimensions for case length and height are given. Circle L31 inside back cover.

Instrument Eyelets. Circon Component Co., Santa Barbara Municipal Airport, Goleta, Calif. A single sheet bulletin covers a line of printed circuit and instrument eyelets. Description, chief features and application data are listed. Circle L32 inside back cover.

Adhesives for Mylar Film. E. I. duPont DeNemours & Co., Wilmington 98, Del. An eight page technical bulletin contains complete descriptions with tables of six adhesives for Mylar polyester film together with information on laminations, application, bonding, uses and safety precautions. Circle L33 inside back cover.

Electronic Instruments. Kay Electric Co., 14 Maple Ave., Pine Brook, N. J. The 1957 catalog is a 50-page booklet illustrating and describing a wide line of electronic instruments. Main categories covered are: sweeping oscillators and sweeping oscillators with marks, featuring birdie, pip and pulse type crystal marks; marker generators—crystal controlled; pulse and pulsed-carrier generators; signal generators; random noise generators and noise figure measuring equipment; generators for television, comprising low power, sound and picture trans-

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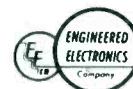


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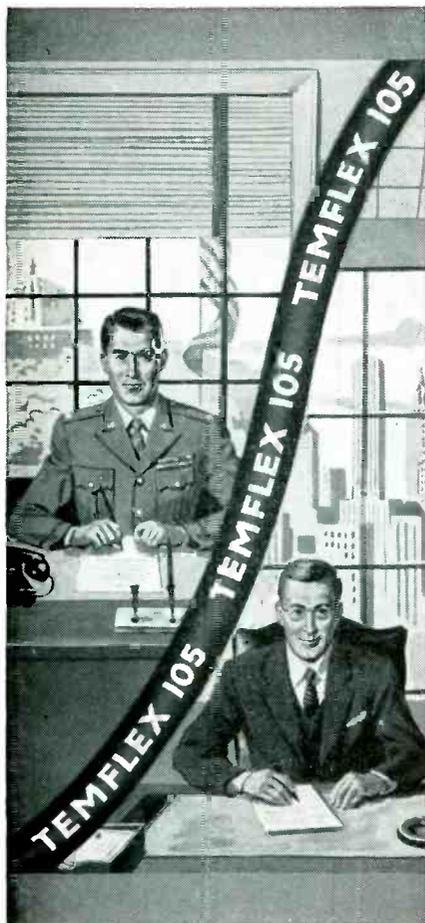
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11 Argyle Terrace, Irvington 11, N. J.

mitters for color, and color bar and dot generators; sound and vibration analysis equipment, voltmeters and other precision instruments like the Gain set, a whole series of h-f attenuators and high level signal sources. A price list is included. **Circle L34 inside back cover.**

Ionospheric Scatter. Marconi Wireless Telegraph Co. Ltd., Marconi House, Chelmsford, England. A six page folder, REF.SP.56, covers the company's ionospheric forward-scatter transmission system. The system discussed is designed around a high-power vhf transmitter employing type HS201 r-f amplifiers and a double diversity receiver, type HR16. Included are a data summary and schematic diagrams of the transmitter and receiver. **Circle L35 inside back cover.**

Temperature Indicators. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa., has published data sheet ND42-33(1) giving complete information about its portable, direct-reading thermocouple potentiometer indicators with automatic reference junction compensation. The publication describes how these indicators are measuring temperature up to 3,000 F with one type or different types of thermocouples—over a narrow or wide range span. A listing of specifications, available ranges and replacement parts complete the sheet. **Circle L36 inside back cover.**

Mobile Communication Antenna System. Andrew Corp., 363 E. 75th St., Chicago 19, Ill. Bulletin 8417 covers a mobile communication antenna system for 450-470 mc. Included are data on the type 201 base station antenna, Heliac flexible air dielectric cable and two types of omnidirectional mobile antennas. Specifications, ordering information and prices are given. **Circle L37 inside back cover.**

Power and Gas Tubes. Radio Corp. of America, Harrison, N. J. A revised edition of the popular 24-page booklet on power and gas tubes contains technical data on

175 types of tubes including: vacuum power tubes—air-cooled, forced-air-cooled and water-cooled, ranging in power-output capability up to 100 kw; rectifier tubes—vacuum, mercury-vapor and gas; thyratrons—gas and mercury-vapor; ignitrons; magnetrons; vacuum-gate tubes.

Each tube type is covered by a thumbnail text description — charted dimensions, ratings, operating values and a base or terminal-connection diagram. Photographs of representative tube types in each tube family are shown throughout the publication.

Booklet PG101C is available at 20 cents per copy. **Circle L38 inside back cover.**

Electrical Insulation Manual. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill., has announced a 300-plus page guidebook describing and evaluating all of the commonly used insulations for electrical and electronic equipment in a single volume. The manual is sectionalized and tab-indexed for convenience in locating the 16 different chapters, each devoted to different types of electrical insulating materials.

Original illustrations, drawings, specification tables and graphs help the user to determine how well a specific product will solve his electrical insulation need. A complete alphabetical index and a guide to official standards for electrical insulating materials are also provided. The manual is available on request to users and specifiers of electrical insulating materials. Price is \$5. **Circle L39 inside back cover.**

Electrolytic Capacitors. Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J. Form TMR-1 is a 2-color 18-page booklet containing pertinent information about the Twist-Mount electrolytic capacitor line, available in single, dual, triple and quadruple units.

The capacitors discussed are designed for 85 C operation and are assembled in aluminum containers which provide maximum protection against moisture. They are easy to mount and ideal for use in

applications where high temperatures, voltage surges and ripple currents are encountered such as in radio and tv receivers, amplifiers and similar equipment. Circle L40 inside back cover.

Industrial Retaining Rings. Industrial Retaining Ring Co., 57 Cordier St., Irvington 11, N. J. A new catalog lists 24 sizes in the No. 1000 series open-type retaining rings for shafts measuring 1/25 in. to 1 in.; 37 sizes in No. 3000 internal retaining rings, which conform to NAS50, for housings measuring 1/4 in. to 2 1/8 in. in diameter and 48 sizes in No. 3100 external retaining rings, which conform to NAS51, to fit shafts from 3/8 in. to 2 1/4 in. Circle L41 inside back cover.

Coil and Coil Forms. North Hills Electric Co., Inc., 402 Sagamore Ave., Mineola, L. I., N. Y. A 4-page illustrated bulletin describing stock coil and coil form products for audio, video and radio frequency applications is available free upon request. Circle L42 inside back cover.

Phano-Chargers. General Electric Co., Schenectady 5, N. Y. A new bulletin on Phano-chargers, adjustable self-regulating electronic battery chargers for maintaining storage batteries, is now available.

The 4-page publication, designated GEA-3179D, describes the G-E Phano-charger, discusses its operation and cites various customer benefits. In addition, special photographs and text are used to show details of the unit's construction. Performance curves and a schematic diagram of the Phano-charger are also included. Circle L43 inside back cover.

Miniaturized Temperature Controls. Fenwal Inc., Ashland, Mass. A 6-page brochure, MC-132, describes a complete line of miniaturized temperature controls designed for aircraft, airborne equipment, guided missiles and related applications requiring reliable temperature control in confined spaces. Described are two types of Thermoswitch units and a variety of tiny rectangular and

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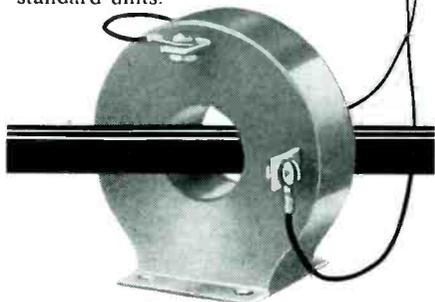
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Beckman®

Helipot Corporation
Newport Beach, California

a division of Beckman Instruments, Inc.

Engineering representatives in principal cities

845

circular thermostatic units. The brochure lists all applicable physical dimensions, current ratings, temperature ranges and other performance characteristics of these miniaturized controls. **Circle L44 inside back cover.**

Instruments Bulletins. Measurements Corp., Boonton, N. J., announces publication of five new technical bulletins describing its latest instruments; namely, the model 58-AS radio noise and field strength meter, 84-TVR uhf standard signal generator, 202-C standard barretter bridge, the 210 series of standard f-m signal generators and the model 505 standard test set for transistors. **Circle L45 inside back cover.**

Terminal Blocks. Curtis Development & Mfg. Co., 3250 No. 33rd St., Milwaukee 16, Wisc. Condensed catalog No. 556 was recently published to include the company's entire line of terminal blocks and terminal block kits. It is complete as to technical description, specifications and current prices and is accompanied by a new selector chart designed to pinpoint quickly the best block for each application. It contains suggestions for combinations of various types of terminals within the same block for most convenient terminating of high current, control and power circuits in a minimum space with reduced cost. High pressure solderless connectors, screw type, solder lug and feed-through terminals are included. **Circle L46 inside back cover.**

Dual Range D-C Power Supply. Opad Electric Co., 69 Murray St., New York 17, N. Y., has issued a 2-page catalog sheet designated as bulletin 103 which illustrates and describes their model KM 95 dual range d-c power supply. The unit discussed includes such features as a dual range d-c voltmeter with automatic switching, rectifier thermal overload protection, stepless output voltage control, provision for remote overload alarm and interlock, with choice of 115 or 230-v a-c input. The two-color bulletin includes detailed specifications as well as dimensions and

weights of both the rack and bench mount models. **Circle L47 inside back cover.**

Electronic Computers. Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., has announced a new 64-page publication dealing with the specifications and application of tubes and semiconductors designed for electronic computers. The new volume defines the company's philosophy on tube manufacture and its theories on transistor parameters as required for computer applications. **Circle L48 inside back cover.**

Magnetic Tape Recorders. Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. The Magnemite series, portable, battery-operated, spring-motor magnetic tape recorders are illustrated and described in a 4-page folder. The brochure completely describes in detail features of 15 models, all of which were especially designed for field applications. A variety of single and multispeed models are available. A complete listing with performance characteristics are tabulated for easy reference and to simplify selection. Various mechanical and electrical components are fully described and individually illustrated. The recorders' operating features are concisely explained and complete technical specifications as well as direct factory prices are included. **Circle L49 inside back cover.**

Thin-Wall Teflon Tubing. Birnbach Radio Co., Inc., 145 Hudson St., New York 13, N. Y. Bulletin No. 157 covers the new thin-wall Birflon T-500 Teflon tubing. Description, advantages, additional end uses, stock numbers, specifications and prices are shown. **Circle L50 inside back cover.**

Scientific Instruments. Electro-Measurements, Inc., 7524 S. W. Macadam Ave., Portland 1, Oregon, has announced a new 8-page ESI short form catalog. Prices and brief specifications are listed. Instruments and components described are precision impedance and comparison bridges, decade resistance and capacitance stand-

ards and high linearity decade voltage dividers. Circle L51 inside back cover.

Alloyed Junction Transistor. General Transistor Corp., 130-11 90th Ave., Richmond Hill 18, N. Y. The single-page technical bulletin No. G-3 covers the type GT-109 germanium *pn*p alloyed junction transistor, designed primarily for use in l-f push-pull stages such as audio amplifiers, portable radio receiver output stages and l-f r-f amplifiers. Features and electrical data are given. Circle L52 inside back cover.

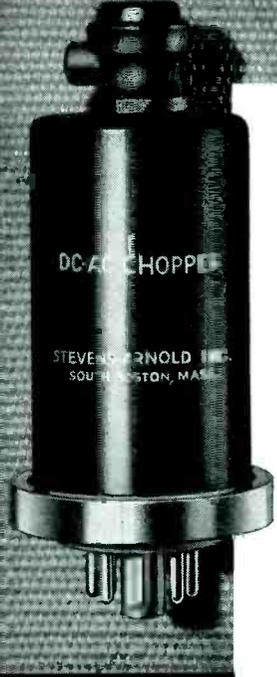
Single-Turn Potentiometers. Helipot Corp., Newport Beach, Calif. Standard specifications for four new single-turn precision potentiometers are included in summary data sheet 54-34. The new models discussed are the 1½-in. diameter 5300 series, the 1⅞-in. diameter 5400 series, the 2-in. diameter 5600 series and the 3-in. diameter 5700 series. Also included in the data sheet are specifications for two other single-turn models and 8 multiturn models.

Noise ratings and life expectancy specifications have been added for all models. In addition, several changes have been made in specifications for series AJ, B and T. Circle L53 inside back cover.

Cooling Effect Detector. Fenwal Incorporated, Ashland, Mass., has available literature describing a new cooling effect detector. Unlike conventional thermostatic detectors, the series 18801 detector discussed is designed to take into account a combination of conditions—ambient temperature, air velocity, humidity and power supply—all of which can affect the rate of heat dissipation from electronic equipment in aircraft.

The brochure describes the operating principle of the series 18801 detector and gives complete physical and performance specifications. Copies of bulletin MC-142 are available upon request. Circle L54 inside back cover.

Vibration Pickups and Meters. MB Mfg. Co., 1060 State St., New Haven 11, Conn., has published a



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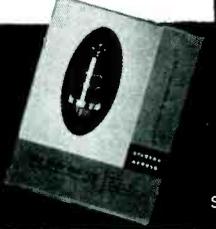
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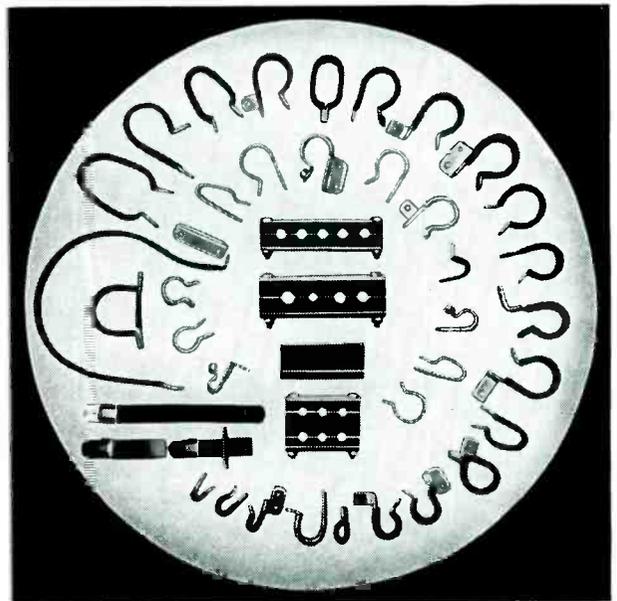
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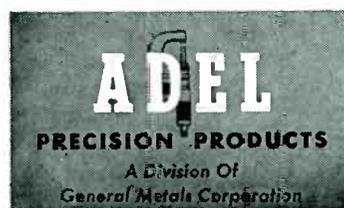


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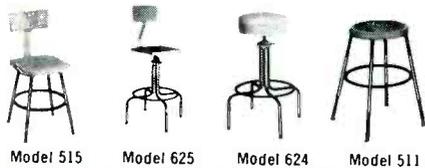




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6-page bulletin (No. 124E) describing both vibration pickups and meters. Technical information and illustration on the velocity-type pickups include design and method of operation, general specifications and typical frequency-response curves for damped and undamped types. The type 115 hand-held probe-type pickup is also described in detail. Design features and performance specifications are given for the models M-1 and M-3 vibration meters.

Of particular value in selecting the proper pickup for particular vibration test requirements is the detailed table giving natural frequency, damping factor, d-c coil resistance, available stroke and sensitivity for 16 of the many MB vibration pickups with ball-bearing or jewel bearing suspensions. **Circle L55 inside back cover.**

Cathode-Ray Tubes. Allen B. DuMont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J., has a catalog listing and describing a complete line of industrial crt's developed by the company.

Detailed specifications and circuit data for crt's used in precision laboratory equipment, radar and general industrial applications are included in the comprehensive 16-page catalog.

Illustrations, graphs, and circuit diagrams are included. Also listed are general characteristics, maximum ratings, typical operating conditions and circuit design values. The catalog is divided into four sections—general information on use of crt's and special applications, screen characteristics, DuMont crt's, DuMont gas triodes and special crt's.

Request for the catalog should be on company letterheads.

Digital Techniques. Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa. "Four Dimensions in Digital Design-Pulse Techniques for Modern Control," a 16-page booklet, should provide interesting reading for anyone involved in digital work. Yet it is basic enough to serve as an introduction to digital techniques for those who wish to learn more about how to use this art in their work. The

booklet shows how digital techniques, as applied through Burroughs pulse control systems, provide increased measures of precision, control, and many other functions of research and manufacturing.

A series of die-cut pages illustrates graphically how a single combination of pulse control units can be rearranged in a number of ways to perform a variety of digital operations, including coding, simulation and arithmetic problems. Free copies are available by letterhead request to the manufacturer. **Circle L56 inside back cover.**

Tantalytic Capacitors. General Electric Co., Schenectady 5, N. Y. Bulletin GEC-808C describes tantalytic capacitors designed for low-voltage a-c and d-c applications where small size and long life are major considerations. The publication includes a table of standard ratings, typical test data and application information. **Circle L57 inside back cover.**

High Potential Testers. Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill. Bulletin 14-2 illustrates and describes a line of d-c Hypots both portable bench type and mobile. The instruments described are specifically designed for dielectric strength testing on the production line, in plant maintenance departments, material laboratories, and for use in the field in the testing of wire and cable installations, and their related equipment. Included with the new bulletin are data sheets covering some of the very latest models, that have output voltage ranges of 0 to 70,000 v d-c. **Circle L58 inside back cover.**

Sensitive Relays. Hedin Tele-Technical Corp., 87 Dorsa Ave., Livingston, N. J., has available new literature on its line of sensitive relays. Sensitivity of the relays is described as starting as low as 5 mw per contact up to several watts and is available for either a-c or d-c applications in contact combinations from spst to tpdt. The relays discussed incorporate a complete wiping action on the

contact movement, providing the advantage of self-cleaning the contacts and insuring good contact connection. They have long life—well over 25,000,000 operations. Circle L59 inside back cover.

High-Temperature Electrolytics. Sprague Electric Co., North Adams, Mass. Bulletin 320A discusses the increased maximum rated operating temperatures of the company's Littl-Lytic subminiature electrolytic capacitors to 85 C. A complete list of the expanded capacitance ratings now available in these subminiature transistor capacitors at voltages of from 1 to 50 v d-c working is given. The bulletin is available on letter-head request. Circle L60 inside back cover.

Instrumentation Literature. Minneapolis-Honeywell Regulator Co., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa. Bulletin G-2 is an index of Industrial Division literature. It covers catalogs, bulletins, specification sheets, data sheets, illustrated lectures and articles from *Instrumentation* magazine. Circle L61 inside back cover.

Atomic Frequency Standard. National Co., Inc., 61 Sherman St., Malden 48, Mass. An eight-page folder describes the Atomichron, an atomic primary frequency standard for use in electronic research and manufacturing as an elapsed-time measuring instrument and for communications monitoring and control. The Atomichron discussed achieves a stability of frequency of 5 parts in 10^{20} parts, and it will maintain this stability over its operating life. Circle L62 inside back cover.

Power Supplies. Lambda Electronics Corp., 11-11 131 St., College Point, New York. Supplement 4A to catalog 56 covers the Com-Pak series (models C-200, C-400 and C-800) power supplies. The units described feature transient-free output, hermetically-sealed transformers, germanium rectifiers (except in the 200 MA models) and fuse-failure indicators. Illustrations, specifications and prices are included. Circle L63 inside back cover.

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BUILT-IN RESISTORS
(a patented Dialco feature)
for operation on 105-125V. or 210-250V.

The required **RESISTOR** is an integral part of the unit — **BUILT IN** (Pat. No. 2,421,321). Also, simple external resistors for all higher voltages.

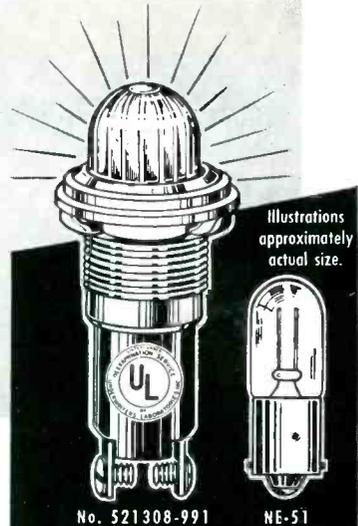
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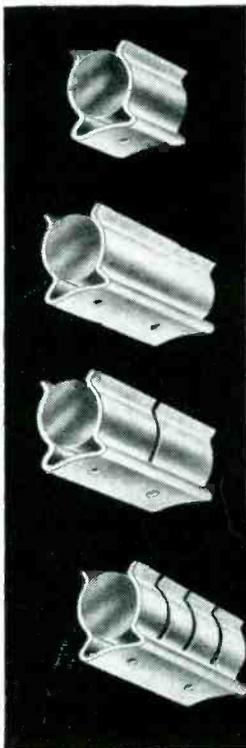


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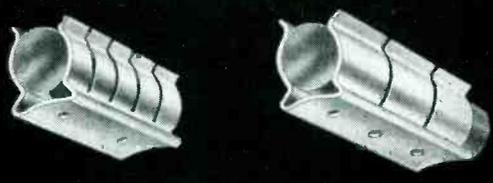


Augat cradles are life-savers for your sub-miniature tubes, resistors and capacitors. They hold components firm and steady and provide definite assurance of long life against shock and vibration.

You can order Augat cradles in many types, diameters ranging from .175 to one inch, normally made from 1065 hardened steel cadmium plated, beryllium copper alloy 25 heat treated and silver plated or heat treated silver magnesium nickel. Special finishes may be obtained to your specifications.

If your requirements are not listed in our catalog, write us for information on cradles made to your specifications.

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Plants and People

Edited by WILLIAM G. ARNOLD

Engineers and executives in the industry are promoted to new positions, move to new jobs. Electronics manufacturers open new plants, plan further facility expansions in the U. S. and abroad. Technical societies honor electronic engineers

Sylvania-Thorn Opens Color TV Labs In England

THE SYLVANIA-THORN color television laboratories in Enfield, near London, England, opened a new research building.

The laboratory project, owned equally by Thorn Electrical Industries, makers of Ferguson tv sets, and Sylvania Electric, was set up two years ago to carry out research on color television and semi-conductors, including transistors. It was also formed to take advantage of British research coupled with U. S. production techniques that could bring color tv within reach of British viewers within ten years.

President of Sylvania Electric, Don G. Mitchell, who opened the new laboratories, said that American color tv receivers were too complex and must be generally improved. The target of the laboratories is to design a color receiver with a cost comparable to that of black and white and which would be equally simple to operate and maintain. A completely new type color tube may have to be invented, Mitchell said.

The chairman of Thorn Indus-



New Sylvania-Thorn electronic research labs in Enfield, England

tries is Jules Thorn.

Special features of the lab include air-conditioning and dust-filtration systems to give correct conditions for the production of transistors.

Brian Fleming-Williams is head of Sylvania-Thorn research. He joined Thorn in 1954. Before that

he was in charge of an electronic research organization.

In the U.S. Sylvania is building a new tube manufacturing plant in Altoona, Pa.

The two-story plant will contain 190,000 sq ft of production space. Completion of the plant is scheduled for late 1957.

Carter Appointed Director Of Stanford Research Institute

E. FINLEY CARTER has been appointed the director of Stanford Research Institute. He has also been named to the Institute's board of directors.

The new chief executive of the applied research center joined SRI in 1954 as manager of research operations. Upon the resignation of Dr. J. E. Hobson, the Institute's head for eight years, in 1955, he was named associate director and since then has been responsible for



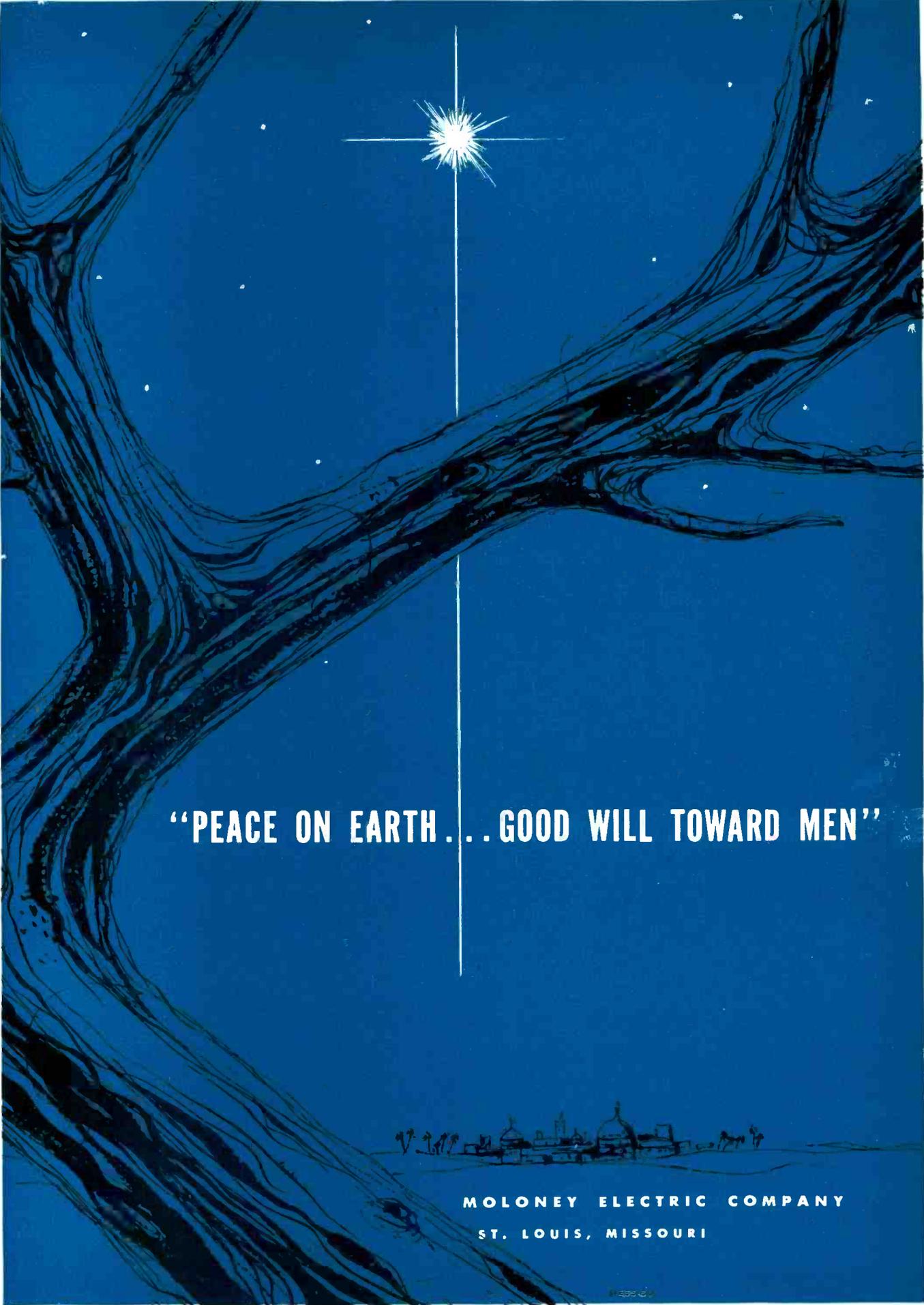
E. Finley Carter

over-all direction of the Institute's activities.

He began his career as a student engineer with GE. Successively he became a section leader and a division engineer in the firm's radio department.

In 1929 he joined the United Research Corp. in New York, where he was in charge of the radio division.

He joined Sylvania Electric Products Co. in 1932, starting as a



“PEACE ON EARTH... GOOD WILL TOWARD MEN”

MOLONEY ELECTRIC COMPANY
ST. LOUIS, MISSOURI

division engineer. In 1941 he was named director of industrial relations and in 1945 became vice-president in charge of industrial relations.

He was appointed vice-president

in charge of engineering at Sylvania in 1946 and advanced to the post of vice-president and technical director in 1952, which title he held until coming to SRI.

Carter has made twenty inven-

tions in the field of electronics and holds patents on single frequency duplex transmission and reception, automatic volume control, certain control circuits and various improvements in radio receivers.

New Superior Plant Nears Completion In Ohio

NEW plant under construction for Superior Tube Co. in Wapakoneta, Ohio, will more than triple the floor space of the company's present leased facilities and will boost by 30 percent its production of small tubing and electronic parts.

The 63,000 sq ft plant and office building is scheduled for completion in November.

In addition to its production of small tubing, the Wapakoneta plant makes nickel cathodes and provides production space for Johnson & Hoffman Corp., a Superior affiliate which manufactures stamped and deep drawn electronic parts.

Employment is expected to be stepped up in time from the present 155 to some 330.



New Superior Tube plant under construction in Ohio

Emerson Electric Expands Its Electronics Division

A NEW engineering building at the St. Louis, Mo. plant of Emerson Electric was completed and expansion of the company's research and development program was started.

The company plans to double its present annual rate of \$55 million in sales in the near future.

The new building for the firm's

electronics and avionics division, will allow an increase in the division's present 850 engineers and technicians. The new building, which has 40,000 sq ft of floor space, will accommodate 500 persons.

Edwin W. Logan has been appointed director of a newly-created

department of research. Logan has been an engineer with the company since 1937 and the chief electronics engineer of the electronics and avionics division since 1949.

He will be responsible for research work both in the company's commercial products and in its electronics and avionics projects for the military services.

Chief engineer Charles G. Philpott of the electronics and avionics division and chief electrical engineer Albert C. Dickson of the electrical division will continue to direct engineering programs within their divisions. Engineering work of the two divisions and of the new research department will be under the overall supervision of William L. Davis, vice-president in charge of engineering.

Logan is being succeeded as chief electronics engineer by Robert E. Kern, his former assistant. Kern



New plant addition for Emerson electronics division



**are you
killing
that still,
small
voice?**

When that voice prods your professional ego with, "You can do bigger and better things!," do you smother it with a wet blanket of doubt?

And when that same voice whispers to you of a gentle climate where the snow is yours just for the asking and sunshine is always yours for the basking, do you clobber it with the sledge hammer of self-denial?

Don't kill that voice! Its wisdom could lead you to a place where you'll find those bigger things, that better life—Firestone. If you've a mind that can matter in the guided missile field, Firestone needs you in its vital development program for the Army's "Corporal," first surface-to-surface guided ballistic missile. Here are just a few of our needs:

Flight Simulation
Electronics Systems
Missile Component Design
Systems Analysis
Structural Design
Field Engineering

Next time you hear that still, small voice, don't reach for your shotgun. Reach for your pen. Write—right now! Let that still, small voice guide you to big accomplishment for you, big happiness for your family!

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"Find your Future at Firestone"—Los Angeles • Monterey

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**This relay...
belongs in
your military
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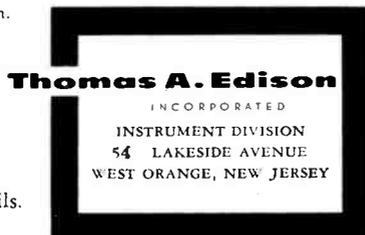
Edison time delay relay

Over a half million of these relays have been made for automatic pilots, gun platform stabilizers, and for protection of cathodes in high voltage electron tubes.

The superior reliability of Edison relays is backed by the facilities of the world-famous Edison Research Laboratory and a 100% quality control system. More than 400 different types have been developed to meet special deviation requirements. Standard models are made to these specifications:

- timing range—2 sec. to 5 min.
- ambient—60° to + 85° C.
- life—500,000 min. operations (rated load)
- vibration—1/16" amplitude at 55 cps, 50 g shock
- tolerance—15% on operating time

Write for complete details.



has been with Emerson since 1947.

The electronics and avionics division, which now accounts for one-third of Emerson's annual sales, is engaged in research, development and production of automatic electronic aiming devices, guided missiles, radar assemblies, servo devices, computers, rocket launchers, airframe structures and instrumentation for airborne, shipborn and landbased systems.

Addition of the new building gives Emerson a total floor space of almost 1.4 million square feet, including its plant at Washington Park, Ill., and its new manufacturing facility at Paragould, Ark., which went into production last fall.

Emerson has invested more than \$12 million in the past 11 years in a program of constant improvement of its machinery, equipment and tooling for its various plants. The new engineering building comprises part of further capital expenditures of \$12 million-plus projected for the next four years to further increase and modernize the company's facilities and to adapt automation to some of its manufacturing processes.

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IT&T Appoints Haggerty, Acquires New Plants

LAWRENCE G. HAGGERTY has been appointed president of IT&T's Farnsworth Electronics Co. of Fort Wayne, Ind. replacing Harvard L. Hull who resigned to become vice-



Lawrence G. Haggerty

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president of Litton Industries.

Haggerty joined IT&T in 1950 as director of operations in the Capehart-Farnsworth division. In 1952 he was elected vice-president, and in 1954 was elected president of that division and a member of its management advisory board.

Prior to joining the company he held the following positions: manager of manufacturing, radio and television instruments for RCA Victor; general manager of the home appliance division of F. L. Jacobs Co. and later general manager of its parts manufacturing division.

IT&T purchased the assets of Royal Electric Co. in Pawtucket and Woonsocket, R. I. and its subsidiary Electric Cords and Supply Co. of Los Angeles, Calif.

Royal Electric has been engaged in the manufacture of insulated wire and cable, cord sets, wiring devices and fuses.

The main plant in Pawtucket consists of 300,000 sq ft of factory space in which 650 persons are employed. In addition, a leased plant in Woonsocket, Rhode Island, has 80,000 sq ft and 150 employees. In the Los Angeles operation 40 persons are employed in a facility consisting of 27,000 sq ft of space.

IT&T has formed a new subsidiary, Royal Electric Corp., which has retained the services of Robert Riesman and Max Alperin, who were president and executive vice-president, respectively, of the present company, and who will continue in these same capacities in the new company.

IBM Expands Research, Selects Engineers

IBM PLANS to establish a new research center in Yorktown, N. Y. Options have been taken on 224 acres of land in the area for laboratories and administrative offices for a research staff which is expected to number approximately 1,600.

The announcement follows the creation earlier this year of a separate group within the IBM engineering organization to consolidate all fundamental research aimed at improving the company's products. The work of this group will be guided by Dr. Emanuel R. Piore, recently appointed IBM director of research and formerly chief scientist of the Office of Naval Research.

The research to be conducted at the new center covers a broad range. Much of it is in solid state physics, dealing with the ferromagnetic substances which are eliminating vacuum and cathode ray tubes in electronic computers and replacing them with transistors and magnetic core memories.

IBM formed a special engineering products division. Jerrier A. Haddad, director of advance machine development, who was in charge of the design and construction of the IBM 701 electronic data processing machine, has been



Robert W. Schubert

named general manager. Kenneth N. Davis, Jr. has been named controller of the new division.

Robert W. Schubert has been appointed director of laboratory operations for IBM. He was formerly assistant director. In his new post he will be responsible for working closely with all IBM research and development laboratories on administrative matters.

Schubert joined the company in 1950 as a technical engineer at the Watson Laboratory in New York City and subsequently became a member of the senior scientific staff. In this capacity he was responsible for the mechanical de-

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sign and development of the Naval Ordnance Research Calculator (NORC). After an assignment as a technical specialist in product planning, devoted mainly to studies in machine tool automation, he became manager of administrative services at the company's Poughkeepsie engineering laboratories. In February, 1956 he was named to the administrative training program and in June of the same year designated assistant director of laboratory operations.

Packard-Bell Appoints Kenneth Jones



Kenneth L. Jones

KENNETH L. JONES has joined Packard-Bell as assistant chief engineer for the technical products division.

Jones, formerly with Sylvania Electric as an engineering manager in its microwave laboratory, will be largely concerned with mechanical engineering activities in his new position. His experience also includes five years as a project engineer with the Dalmo Victor Co. in San Carlos, Calif.

Hallamore Elects Engineering Head

JOHN J. BURKE, formerly head of the guidance and electronics divisions of the U. S. Jet Propulsion Laboratory, has been elected vice-president in charge of engineering of Hallamore Electronics Co. in Anaheim, Calif., a division of The Siegler Corp.

He has been associated with the



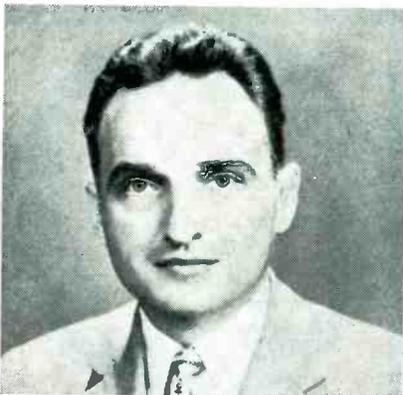
John J. Burke

Jet Propulsion Laboratory since 1948 and worked on the development of the U. S. Army's "Corporal" missile.

He has taught at the University of Houston, and participated in the development of guided missiles and airplane controls as a member of the research staff of the Hughes Aircraft Co.

Clevite Names Transistor Heads

JAMES F. BATTEY has been appointed general manager of Clevite Transistor Products, of Waltham, Mass. Allen J. Dusault has been

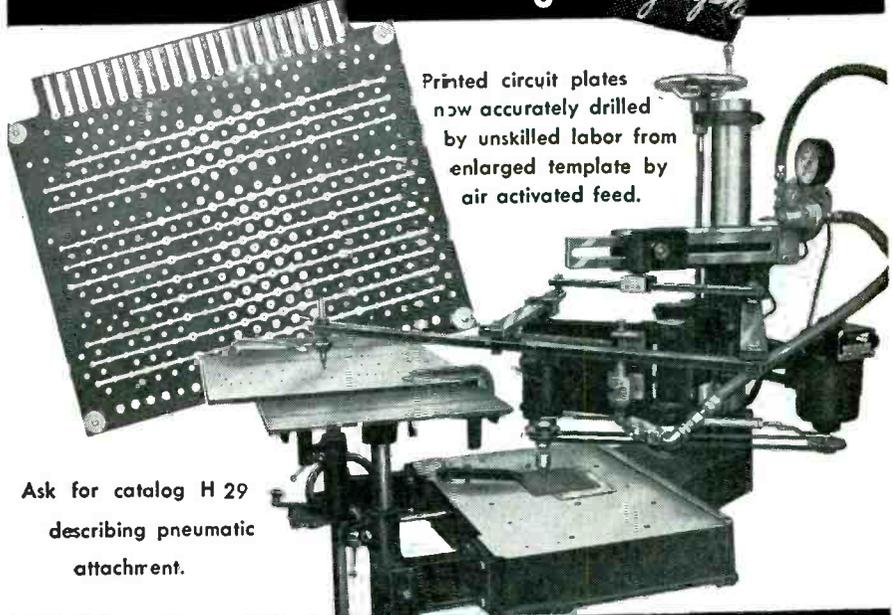


James F. Battey

placed in charge of the organization's sales division.

Dr. Battey will have over-all responsibility for the unit's operations. Dusault, as general sales manager, will have full charge of

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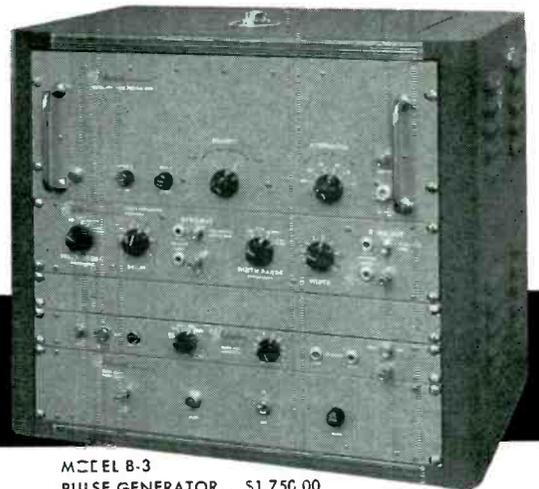
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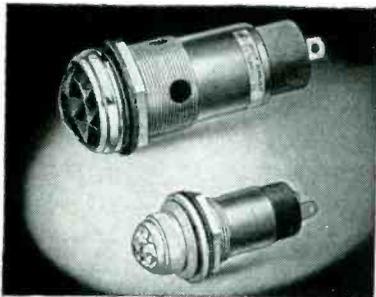
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sales activities under Dr. Battey. Roland B. Holt and Edmour F. Giguere have resigned as president and vice-president-sales, respectively.

**Scott Joins
Corvey Engineering**

CORVEY ENGINEERING CO., a subsidiary of Westinghouse Air Brake in Alexandria, Va., announced that Merit Scott has joined the company as chief scientist of the operations analysis department.

Until 1951, Dr. Scott was professor of physics at the Pennsylvania State College, and in that capacity



Merit Scott

supervised all graduate work in the physics department. While at Penn State, he also served as consultant to aircraft companies and government agencies. Since leaving the college, he has been associated with Vitro Corp. as a physicist and consultant, and has just resigned as director of research for International Electronics Engineering, Inc., to join Corvey.

**Cornell-Dubilier Buys
Tobe Deutschmann Stock**

CORNELL-DUBILIER ELECTRIC CORP. acquired the majority of stock in the Tobe Deutschmann Corp. of Norwood, Mass., producers of power capacitors. The company, which becomes a subsidiary of C-D, also makes electronic noise suppression devices and pulse networks. A recent development of the company

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ELECTRONICS — December, 1956

is the low inductance capacitor used in nuclear physics.

The manufacture of the Tobe Deutschmann line will continue at its Norwood plant. Tobe Deutschmann continues as president of the new C-D subsidiary.

**GE Forms New Group,
 Expands In Florida**

THE missile and ordnance systems department has been formed in the defense electronics division of GE.

Headquarters of the new department will be at Philadelphia, Pa.

The new department will have systems responsibility for surface-based weapon systems and associated equipment to be used on land or sea.

George F. Metcalf, formerly general manager of the special defense projects department, will be general manager of the new department.

GE's communication equipment section leased 15,000 sq ft of space in a former manufacturing plant in Gainesville, Fla. for a warehousing and training operation to begin in 1957.

The leased facilities will be used to train a small group of electronic technicians for future employment at the manufacturing plant which the company plans to build on a 158-acre site near Hague, Fla.

During 1957, the warehouse property will also be used to handle shipments of the company's mobile communication equipment from the firm's main two-way radio factory at Utica, New York.

**National Research
 Appoints Minault**

S. SYDNEY MINAULT has been appointed vice-president of National Research Corp.

He joined National in 1953 and has served as general manager of the company's equipment division for the past two years.

Prior to joining the firm Minault's business background included the position of manufacturing engineering superintendent of Sperry Gyroscope Co., and later

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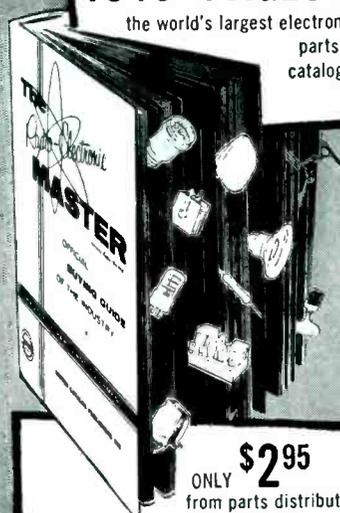
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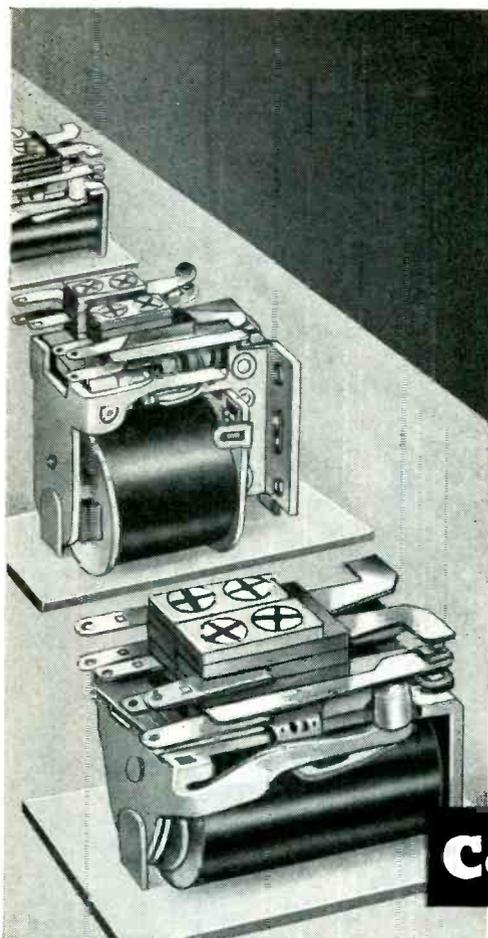
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WOUND



chief engineer of AnSCO division of General Aniline & Film Corp. More recently he served as vice-president of Tracerlab, Inc.

As vice-president, he will continue as general manager in charge of development, engineering, production and sales of the company's line of industrial processing equipment.

Tung-Sol Elects Executive V-P

MILTON R. SCHULTE, who has been a vice-president of Tung-Sol Electric since 1951 and a director since 1953, has been elected to the newly



Milton R. Schulte

created post of executive vice-president.

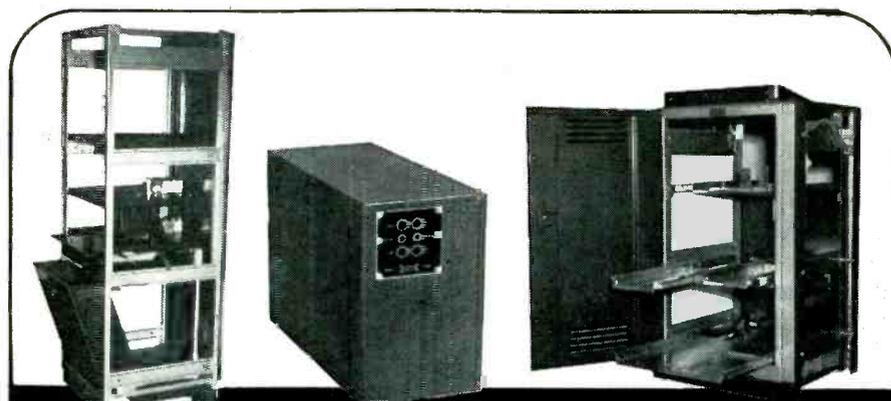
He joined the 52-year-old electron tube and automotive lamp manufacturer in 1923 and has worked for no other firm.

Starting at Tung-Sol as a draftsman, Schulte became foreman of the lamp, stem and mount department in 1925. Three years later he was made superintendent of radio tube manufacture. In 1937 he was named manager of radio tube production. In 1951 he was elected vice-president in charge of electron tube and flasher manufacture.

U. S. Dynamics Produces Transistors

UNITED STATES DYNAMICS CORP. officially dedicated its plant and production facilities in Boston, Mass.

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state devices including special purpose transistors and a line of 23 different silicon and germanium power rectifiers and semi-conductor diodes.

President of the company is Dr. Walter E. Strimling, who served for three years at Raytheon in coordinating research, development, production and sales. The first goal of the firm's research program is the development of new high temperature power rectifiers and semi-conductor diodes.

Franklin Institute Honors Bullington

KENNETH BULLINGTON of the systems engineering department of Bell Telephone Laboratories in New York, was named recipient of the Stuart Ballantine Medal of The Franklin Institute of the State of Pennsylvania.

The Institute honors Bullington for his "... advancement of space communications by means of beyond-the-horizon tropospheric wave propagation which resulted from his vision in recognizing the reliability of this means; his ability in planning and executing a broad experimental program; his engineering interpretation of the results which has led to effective design of communication systems employing this means."

In 1950 Kenneth Bullington announced the establishment of a comprehensive program designed to investigate the usefulness and reliability of microwave transmission beyond the horizon. After tests carried out by Bell Laboratories' personnel under his direction, he concluded that reliable communication over the frequency range 40—4000 megacycles is feasible at a distance up to 300 miles or more but that high transmitter powers and large antennas will be required for reliable voice channels beyond 200 miles.

Topp Industries Promotes McLucas

JOHN L. MCLUCAS, of Haller, Raymond and Brown, in State College, Pa., has been named vice-president

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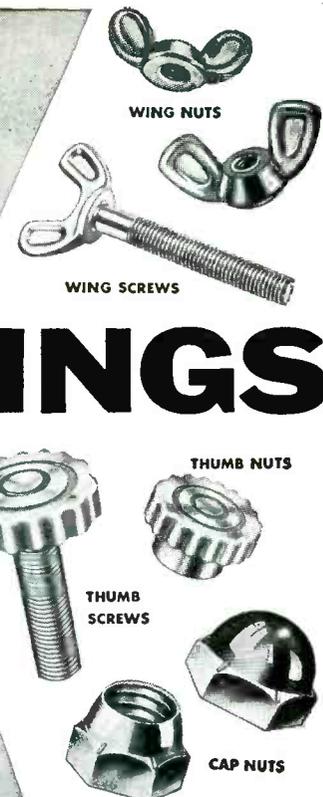
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BEEDE ELECTRICAL INSTRUMENT CO., INC. PENACOOK, N. H.

and technical director for Topp Industries, Los Angeles.

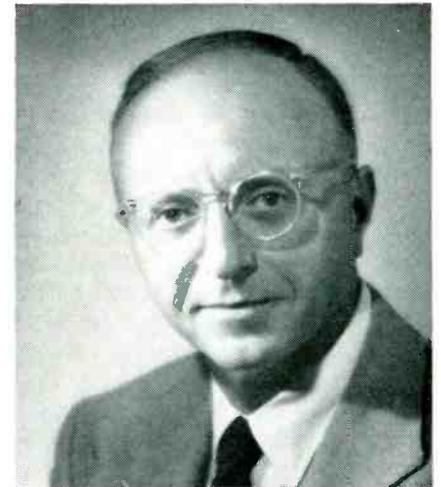
Dr. McLucas has been vice-president and technical director of Haller for the past six years and now becomes the research and development head of the over-all Topp organization, which includes HRB and may soon include Heli-Coil Corp. of Danbury, Conn.

Dr. McLucas will serve at the 'policy-making level' and will also handle engineering relations among the three companies. Prior to joining HRB as a project engineer on radio counter-measures in 1949, he worked at Air Force Cambridge Research Laboratory on servo system design, Penn State University as graduate assistant in physics, and served as consultant to HRB. He was elected vice-president and technical director of the company in 1950.

Airborne Instruments Appoints Salzberg

AIRBORNE INSTRUMENTS LABORATORY of Mineola, N. Y. appointed Bernard Salzberg, as chief scientist of their research and engineering division.

His honors and awards in the



Bernard Salzberg

field of electronics include the Modern Pioneer Award by the National Association of Manufacturers for "inventions of value to the radio industry;" and the Harry Diamond Award by the Institute of Radio Engineers for "contributions in the fields of electron tubes, circuits, and

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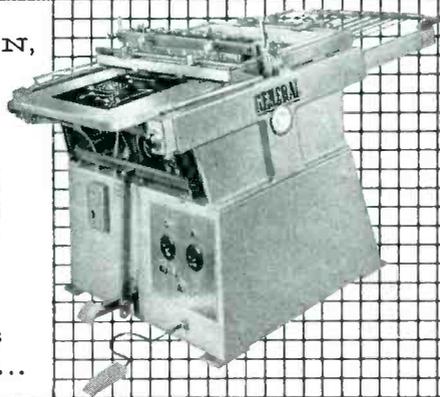
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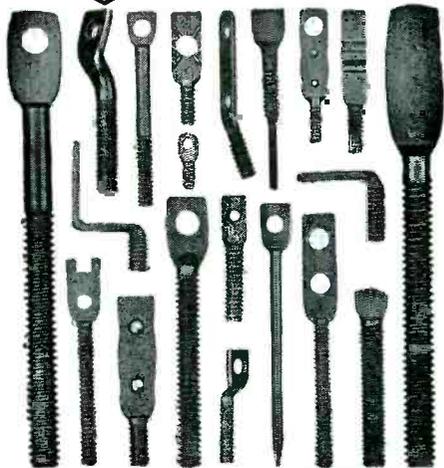
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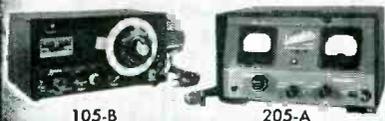
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military electronic systems."

Dr. Salzberg was for 15 years a consultant and associate superintendent of the electronics division of the Naval Research Laboratory in Washington, D. C.

Marvelco Selects Transistor Chief



George Roka

GEORGE ROKA has been named as director of the semi-conductor division of Marvelco electronics division of National Aircraft Co. at Burbank, Calif.

Prior to joining the firm, he was manager of semi-conductor activities at Delco radio division of GMC where he set up research, development and pilot plant facilities. For three years he was research supervisor in charge of the semi-conductor program at Minneapolis Honeywell.

Insulated Circuits Gets New Ownership

NEW ownership and new management have reorganized Insulated Circuits, formerly of West Caldwell, N. J. and now located in Pasaic, N. J.

While operating under the original name of Insulated Circuits, using the same equipment, but a new location, and retaining all the key men of the engineering staff, the top management of the company is in new hands. The new ownership consists of Koiled Kords, Inc., Hamden, Connecticut; Rolf K. Hansen, president, Leru Labs, Inc.,



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fci TYPE U CAPACITORS

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ELECTRICAL CHARACTERISTICS of fci TYPE U CAPACITORS

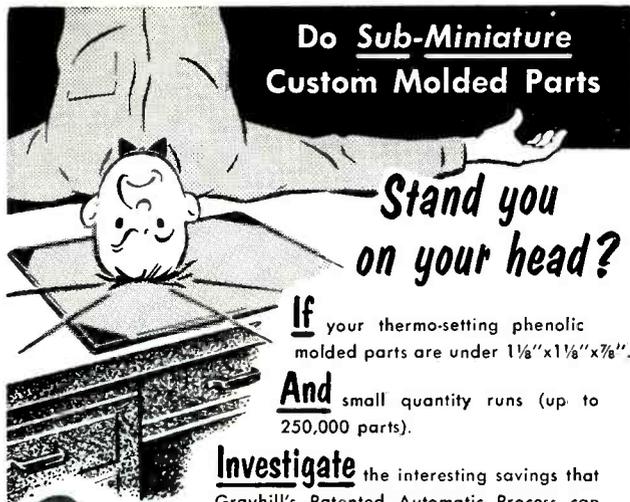
Operating Temp. Range	—55°C. to +65°C.
Voltage Range, A.C.	500 to 5,000
Capacitance Range	.0001 to 1 mf.
Power Factor	0.5% @ 20 kc.
Dielectric Absorption	0.1%
Temperature Coefficient	+500 ppm/°C.
I.R. at Room Temperature	10 ⁶ megohms/mf.
Capacitance Stability	0.5%
Power Capability	Approx. 5 kva per mf. at 500 volts A.C.

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PIECES ABOVE SHOWN ACTUAL SIZE

Wayne, N. J. and Robert A. Curran, former president of I.C.I. Curran is the only one of the former owners still associated with the company.

The new officers and directors of I.C.I. are: chairman of the board, John Brown Cook; president, Rolf K. Hansen; executive vice-president, Robert A. Curran; vice-president-sales, Edgar L. Love; treasurer, John H. Teeter. Other officers are: vice president-manufacturing, George F. McCarthy; secretary, George W. vonArx.

Cook became president of Reliable Electric Company, Chicago, in 1941. Since 1947 he has also been president of Whitney Blake Company, a wire and cable manufacturing firm in Hamden, Connecticut and president of Koiled Kords, Inc. an associated company in a wire and cable specialty business.

Hansen has worked in research and development with Westinghouse and RCA as well as with Bell Telephone Laboratories. In 1947 he became president of Leru Laboratories, Inc., Wayne, New Jersey which position he continues to hold.

Robert A. Curran founded the original I.C.I. He has pioneered in printed circuits. His experience includes government work in the electrical, electronics and communications field.

Bendix Opens Plant, Names Engineer

THE radio division of Bendix Aviation Corp. opened its new advanced engineering center in Baltimore.

Latest in a series of new facilities in a \$15-million engineering expansion program affecting several Bendix divisions, the new engineering center provides 100,000 sq ft of space for technical and laboratory projects covering guided missiles, ground and airborne radar, aviation communications and mobile two-way radio systems.

About 400 divisional engineers engaged in creative technical and laboratory projects are being transferred to the new center from the main Bendix radio plant.

At the opening of the center a new radar system called "gap-filler radar" AN/FPS-14 was shown. It

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FOR COLOR TV!

① Check the outstanding engineering design of this modern printed circuit Scope. Designed for color TV work, ideal for critical Laboratory applications. Frequency response essentially flat from 5 cycles to 5 Mc down only 1 1/2 db at 3.58 Mc (TV color burst sync frequency). Down only 5 db at 5 Mc. New sweep generator 20-500,000 cycles, 5 times the range usually offered. Will sync wave form display up to 5 Mc and better. Printed circuit boards stabilize performance specifications and cut assembly time in half. Formerly available only in costly Lab type Scope. Features horizontal trace expansion for observation of pulse detail — retrace blanking amplifier — voltage regulated power supply — 3 step frequency compensated vertical input — low capacity nylon bushings on panel terminals — plus a host of other fine features. Combines peak performance and fine engineering features with low kit cost!



MODEL O-10
\$69.50
Shpg. Wt. 27 lbs.

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SWEEP GENERATOR KIT
ELECTRONIC SWEEP SYSTEM

② A new Heathkit sweep generator covering all frequencies encountered in TV service work (color or monochrome). FM frequencies too! 4 Mc — 220 Mc on fundamentals, harmonics up to 880 Mc. Smoothly controllable all-electronic sweep system. Nothing mechanical to vibrate or wear out. Crystal controlled 4.5 Mc fixed marker and separate variable marker 19-60 Mc on fundamentals and 57-180 Mc on calibrated harmonics. Plug-in crystal included. Blanking and phasing controls — automatic constant amplitude output circuit — efficient attenuation — maximum RF output well over .1 volt — vastly improved linearity. Easily your best buy in sweep generators.



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fills in the 'blind' area half way between two long-range search radar sites.

Kirke W. Marsh has been appointed Bendix Aviation Corp. general project manager on a major guided missile project.

He joined Bendix in 1956 and was recently transferred to the Pacific division from the firm's research laboratories in Detroit.

Prior to joining Bendix, Marsh was senior project engineer for Fairchild Guided Missiles and a project administrator for Hazeltine.

**EECO Starts
New Construction**

CONSTRUCTION has started on a new lab and office building for Electronic Engineering Company of California. The seven-acre building site is located in Santa Ana, Calif.

Estimated cost of the 41,000 sq ft building will be slightly over



L. S. Preston

\$500,000. Completion is scheduled in March, 1957.

Engineered Electronic Company, a wholly owned subsidiary of Electronic Engineering, is located in Santa Ana, Calif.

L. S. Preston has been appointed chief engineer of the Electronic Engineering Company of California

D. R. Proctor was appointed assistant chief engineer.

Preston joined EECO in 1949 as a radar design engineer and later became technical staff engineer.

In 1950, he was appointed Florida division manager. In 1955 he was

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*T.M.

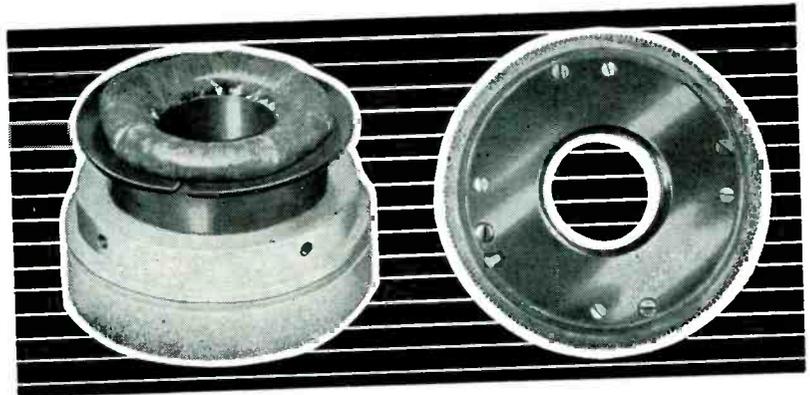
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The type AN/TRC-1 radio system transmits up to 5 frequency-division-multiplex voice channels on any one of 300 radio channels in the band from 70 to 100 mc. The original design was widely used by the U.S. Signal Corps in World War II, and an improved version is currently in production. This system has a frequency deviation of ± 30 kc. It transmits the band of 300 cycles to 20 kc with a maximum variation of 3db and negligible distortion. Power supply is 115 volts 50 to 60 cycles A.C. The units can be supplied for fixed-plant installation, or in tactical-type carrying cases.

The system has a self-contained 3-kc order-wire channel, and frequency space for four 3400-cycle voice circuits, derived from a separate carrier-telephone terminal. Suitable carrier-telephone and carrier-telegraph terminals are available.

Type T-14J/TRC-1 Transmitter: 40 watts output, crystal-controlled, -12 dbm input, 350 watts power requirement, dims. $10\frac{1}{2} \times 12\frac{1}{4} \times 17\frac{1}{4}$ ins., weight 95 lbs.

Type R-19J/TRC-1 Receiver: Double-conversion superheterodyne, crystal-controlled, +20 dbm output, 100 watts power requirement, dimensions $7\frac{3}{4} \times 12\frac{1}{4} \times 17\frac{1}{4}$ ins., weight 80 lbs.

Type TS-32D/TRC-1 Oscillator: Three-tube test oscillator giving modulated signal for aligning a receiver, from which it obtains its power supply.

Type AS-20B/TRC-1 Antenna: Three-element dipole array, adjustable over band 70-100 mc. Contained in carrying case with spare elements, tools, coaxial cables, and all accessories. Does not include mast.

Type AM-8C/TRA-1 Amplifier: Power amplifier for use with T-14 Transmitter, 200 watts output. Obtains power from PP-13 Power Supply. Dimensions $11\frac{1}{2} \times 12\frac{1}{4} \times 17\frac{1}{4}$ ins., weight 75 lbs.

PP-13D/TRA-1 Power Supply: Supplies power to one AM-8 Amplifier. Power requirement 800 watts. Weight 194 lbs. Dimensions $12 \times 12\frac{1}{4} \times 34$ ins.

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PLANTS AND PEOPLE

(continued)

named manager of the engineering department.

Proctor has a total of 15 years experience in engineering and engineering management. He joined EECO in 1951 as an electronic engineer; and later became a project engineer. He became assistant engineering manager in 1955.

New Firm Formed In California



John V. N. Granger

GRANGER Associates has been formed as a California corporation in Palo Alto to develop and manufacture electronic systems.

President of the firm is Dr. John V. N. Granger, until recently assistant director of engineering and head of the radio systems laboratory of Stanford Research Institute.

The new organization will initially work on new types of radio and radar systems for use by the military services and commercial air lines.

Other officers are Richard M. Leonard, secretary, and Ralph J. Halk, treasurer.

In addition to the officers, the board of directors includes: Dr. John T. Bolljahn, assistant director of engineering research, Stanford Research Institute; Dr. Allen M. Peterson, head of the special techniques group at Stanford Research Institute and assistant professor of electrical engineering at Stanford University; Dr. John R. Whinnery, chairman of the department of electrical engineering at the University of California, Berkeley; and Arthur Dorne, president of Dorne and Mar-

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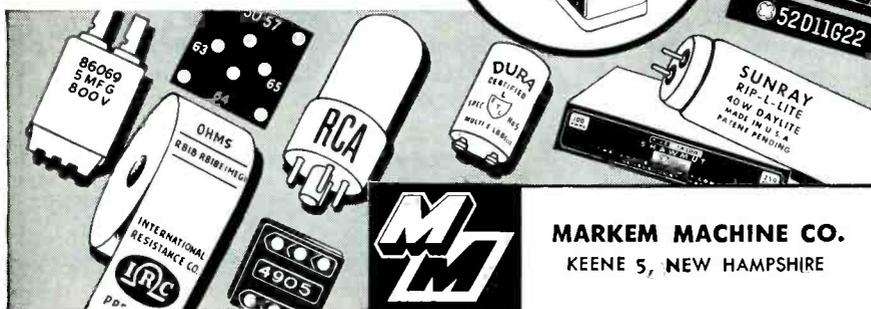
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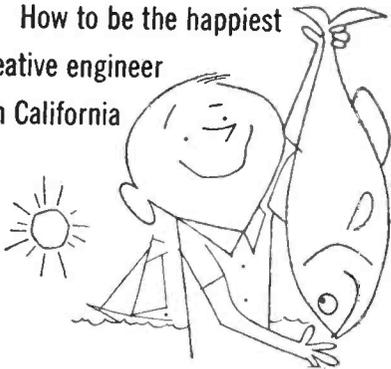
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*We're pacing the commercial electronics field (\$3,000,000 sales in 1949 to \$29,000,000 sales in 1955) and we'll be disappointed if you don't grow with us.

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golin, Inc., electronic manufacturers of Westbury, N. Y.

The new company has temporary offices in Menlo Park, Calif., and plans to erect its initial manufacturing facilities in the near future.

Chicago Telephone Elects Daily

ARTHUR M. DAILY has been elected vice-president in charge of research and development at Chicago Telephone Supply Corp.

He joined the firm in 1933. He



Arthur M. Daily

served as director of the test lab., assistant plant superintendent, acting plant superintendent and chief research and development engineer. He has been on the firm's board of directors for six years.

Minnesota Mining Forms New Division

FRANCIS C. HEALY has been appointed general manager of a newly formed division of Minnesota Mining & Manufacturing Co.

The division, to be known as Mincom, will continue electronic research and product development activities formerly conducted by the electronics division of Bing Crosby Enterprises, Inc. 3M took over these research programs from the Crosby group as part of an agreement concluded between the two organizations.

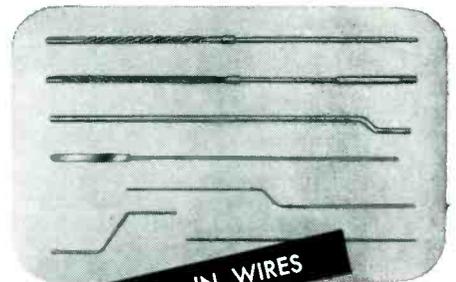
John T. Mullin was named re-

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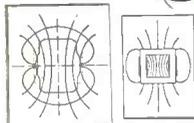
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search director of the new division.

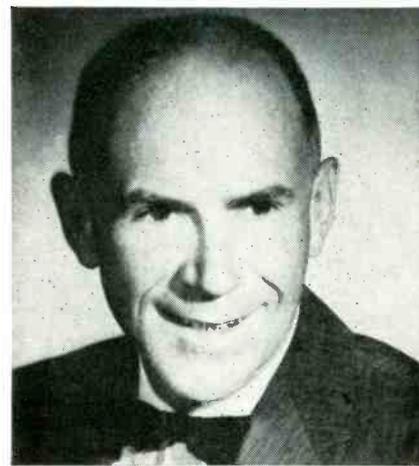
Healey, who formerly headed the Crosby electronics division, said that in addition to continuing the research and product development programs, the new Mincom division will distribute specialized 3M instrumentation tapes and other products. They include Douglas pen recorders, electronic oscilloscopes and the Mincom wide band recorder formerly produced by Crosby.

As previously announced, a group of Crosby research staff members have also joined 3M.

This group, headed by Mullin and Wayne R. Johnson, has engaged in a number of projects for several years in the field of color video recording.

The Mincom division will headquarter in new office and laboratory facilities in the Los Angeles area. The exact site has not been selected.

Motorola Appoints Transistor Engineers



Ben R. Gossick

BEN R. GOSSICK has been appointed chief engineer in charge of the circuitry department of the semiconductor products division of Motorola Inc.

In his new position, Dr. Gossick will be responsible for transistor electrical evaluation, testing procedures and specifications. His function also includes customer circuit engineering and transistor circuitry research.

He joins Motorola with a back-

ground of experience in electronic instrumentation at the Oak Ridge National Laboratory and at RCA. For the past several years he has been engaged in semiconductor research at Purdue University.

Also in the semiconductor products division, Earl L Steele has been appointed chief development engineer of the device development department.

In his new position, Dr. Steele will be located at the divisional headquarters in Phoenix, Arizona. He will be responsible for the development of transistors, diodes, and other semiconductor devices.

Prior to his association with the company, Dr. Steele spent 4½ years as a research physicist with GE.

Budd Expands Continental-Diamond

A \$1,750,000 expansion of the Bridgeport plant of Continental-Diamond Fibre division of The Budd Co. is underway in Bridgeport, Pa.

The basic purpose of the expansion is to make Continental-Diamond Fibre Division of The Budd Company the lowest cost producer in the fiber industry, according to the company. The new facility will result in the centralization of the entire sheet fibre making operations of the company under one roof, and a relocation of the vulcoid operation from a leased plant to the Bridgeport facility. Completion of the 65,000 sq ft structure is scheduled in ten months.

Western Electric Elects Top Officers

ARTHUR B. GOETZE was elected president of the Western Electric Co. succeeding Fred R. Kappel, who was elected president of AT&T.

Goetze has been a vice-president of the company since 1952 and a director since 1953. He is succeeded by Paul A. Gorman, who has been vice-president-finance. Paul R. Brousse was elected a vice-presi-



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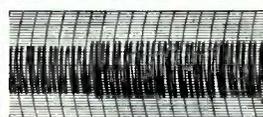
The Curtiss-Wright Model EE 100 Distortion Eliminating Voltage Regulator provides faster recovery time than any other regular on the market—less than 1/50th cycle, or 330 microseconds. It also reduces typical power line distortion to less than 0.3%. Capacity is 1.4 KVA.

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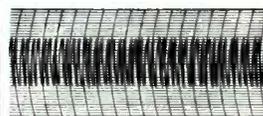
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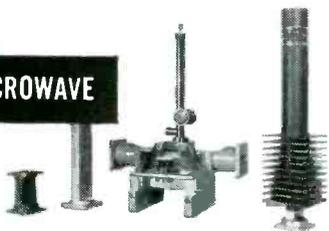
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dent. For the past year he has been comptroller of the company's manufacturing division and will replace Gorman as vice-president-finance.

Goetze has been vice-president in charge of manufacturing since May of 1956. He started with the company in 1917 as a draftsman at its Hawthorne Works in Chicago.

Hycon Appoints Staff Engineer Head



William Q. Nicholson

WILLIAM Q. NICHOLSON has been appointed chief staff engineer for Hycon Mfg. Co., Pasadena, Calif. He will direct the development, introduction and promotion of new products and implement the firm's expansion and growth plans.

Prior to his appointment to the newly created post, he was director of engineering for Hycon's instrument division. Before joining the firm in 1951, he was a research engineer for Hughes Aircraft Co., and an electrical engineer at Gillilan Bros., Inc.

Magnetic Research Promotes Wolfram

MAGNETIC RESEARCH CORP. of El Segundo, Calif. elected B. M. Wolfram as vice president.

Prior to his affiliation with MRC, Dr. Wolfram performed research and development work for Wright-



Frenchtown Metallized Terminals!

Here is Frenchtown's improved line of Annulated Type NICOTE Metallized Hermetic Terminals for use in controls, relays, transformers, capacitors, motors, and heater units. Custom-engineered of HIGH ALUMINA CERAMICS and metallized with our exclusive NICOTE, these terminals are available in six varying sizes with a choice of terminal hardware to fit any exacting application. Write for Engineering Bulletin 1055.

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December, 1956 — ELECTRONICS



B. M. Wolframm

Patterson Air Force Base as a specialist in magnetic circuits and components. After five years there, he joined the electronics section of North American Aviation as senior research engineer on magnetic amplifiers and related magnetic control equipment. He joined MRC in 1954.

Texas Instruments Names Carman

J. N. CARMAN has joined the semiconductor-components division of Texas Instruments as chief mechanical engineer.

He was formerly associated with



J. N. Carman

Pacific Semiconductors as manager of the engineering department. Previously, he had been associated with Hughes Aircraft as assistant head of the semiconductor division, and General Electric, as staff automation specialist.

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This Special Purpose Receiver is an improved version of the NEMS-CLARKE 167-J1 and 167-J2. This new Receiver incorporates the best qualities of both of the former types plus many new features including a BFO. A video bandwidth control is provided to greatly improve signal-to-noise ratio when full bandwidth is not needed. It is especially useful as a high quality general purpose laboratory receiver.

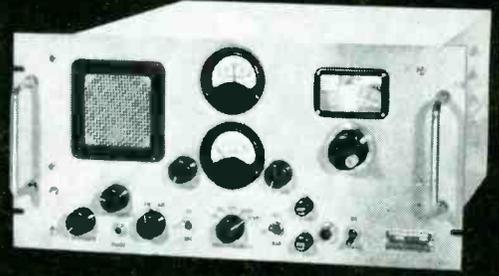
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TYPE 1501 SPECIAL PURPOSE RECEIVER



SPECIFICATIONS

Type of reception.....	AM, FM, or CW
Tuning range.....	55-260 mc
IF bandwidth.....	300 kc
Sensitivity (measured without band-restricting filters).....	8 uv produces at least 23 db S/N ratio with 100-kc deviation, 400-cycle modulation.
Noise figure.....	11 db, maximum
IF rejection.....	Not less than 70 db
Image rejection.....	Not less than 40 db below 130 mc; 30 db minimum at any frequency.
FM output.....	0.15 volt per kc deviation (Approx.)
AM output.....	12 volts for 10 uv input modulated 30% at 1000 c.p.s. (Approx.)
Squelch.....	Operates on monitor circuit



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New Books

Mechanical Design for Electronics Production

By JOHN CARROLL. *McGraw-Hill Book Co., Inc., New York, 1956, 348 p \$6.50.*

THIS book was written to fill a large void existing in the design engineering field as applied to electronic equipment. This void is due to the lack of experience, of the electronics engineer designing original equipment, with the mechanical aspects of the design requirement. Since, also, the mechanical engineer assigned to design electronic gear is unfamiliar with the electronic features of the system, a common reference for both has long been needed.

► **Approach**—To present a solution to this problem, this book approaches the subject from two points of view: 1) the mechanical design requirements of electronic equipment; 2) production methods and techniques of accomplishing these requirements.

The presentation of design requirement material is accomplished by discussing the various end uses of electronic equipment and the environments to which they are subjected. This material is subdivided into general types, i.e.: airborne, marine, laboratory instrument, commercial home instrument, etc.

An example of how the design principles mentioned may be employed is made visual by hypothetically designing a medium power navigational-radar set.

► **Contents**—Discussion of production methods and techniques occupies the bulk of this book. There is information offered which in detail describes the manufacturing techniques and methods employed in the production of chassis, panels, cabinets and enclosures.

A complete discussion of finishes as applied to metals and other construction materials is included.

The book brings together mechanical design data heretofore available only in technical articles, manufacturers' product literature, specialized design manuals, gov-

ernment and company engineering reports.

This book should also prove invaluable as a working tool to nonengineering personnel in electronics companies such as purchasing people, production men, who can now find the reasons for much of the designs that they either buy or produce.

This reviewer felt that the book should have had a bibliography at the end of each chapter rather than at the end of the book. Also an addenda giving the name of the manufacturer of the several trademark products and proprietary processes mentioned would be of great help to the reader wishing to investigate further.

This book should be in every engineering library, not as a seldom used reference book, but as a day to day handbook of valuable information.—JOHN LESSER, *Karp, Lesser & Co., Inc., New York, N. Y.*

Analog Computer Techniques

By CLARENCE L. JOHNSON
McGraw-Hill Book Co., Inc., New York, 1956, 264 p, \$6.00

HERE is a book which meets the need of qualifying the engineer or advanced student in the techniques of analog computer operation. Written in clear language the text describes the methods used in setting up problems on the Analog Computer, particularly the electronic differential analyzer. It also appears intended to familiarize the reader with the components and operation of this type of computer.

The book presupposes a knowledge of basic differential equations and fundamentals of electrical circuits on the advanced undergraduate or graduate level. Capt. Johnson has based the book on material used for the past two years in the computer courses taught at the U. S. Air Force Institute.

► **Material Covered**—The 250

pages of the book are divided into thirteen chapters and an appendix. A brief introduction gives the reader the historical development of the analog computer and classifies the existing types. The opening chapters contain descriptions of operational amplifiers and potentiometers, with design differences for specific computers including the matter of "problem frequencies" and the choice of time and amplitude scale factors.

The influence of the recorder characteristic is considered with regard to the time scale. Methods are shown for approximating the magnitude of the variables of a problem.

A single chapter is devoted to an introduction to the method of setup of various forms of representation of linear servomechanism systems. The author describes the servo multiplier and its extended use for division and the taking of square roots.

Description of the operation and construction of the resolver is limited to the d-c type. There is a discussion of analytic function generation, generalized integration and approximate differentiation. A section is devoted to computer instability.

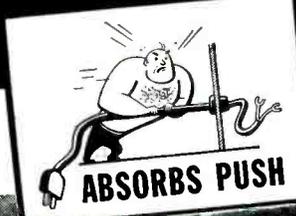
The representation of nonlinear phenomenon is treated with emphasis on the differential relay and the diode. Multipliers and function generators are also briefly described.

► **Applications**—The author presents a few miscellaneous applications of the electronic analog computer for handling simultaneous algebraic equations and partial differential equations. Use of the device for the solution of Eigenvalue problems and curve fitting is discussed.

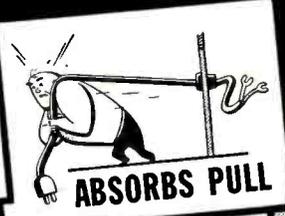
The closing chapters are devoted to a discussion of components whose characteristics are important to the machine operator. These include stabilized d-c amplifiers, overload warning systems and automatic programming.

The problem of checking computer results is discussed. The advantages and disadvantages of the repetitive computer is distinguished from the real-time com-

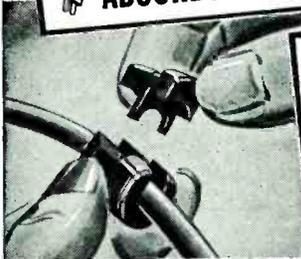
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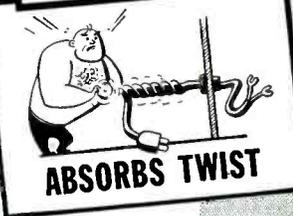
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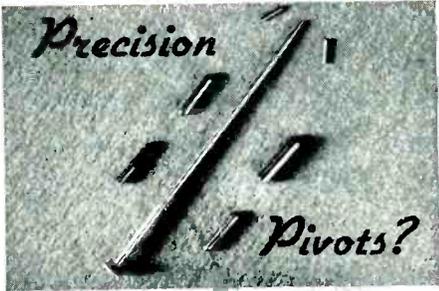
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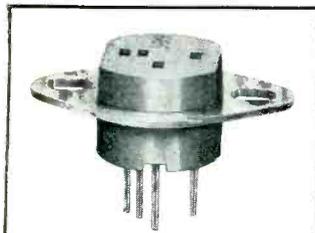
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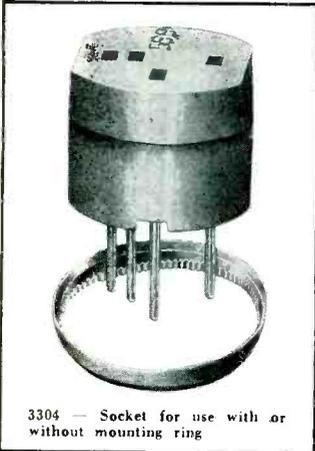
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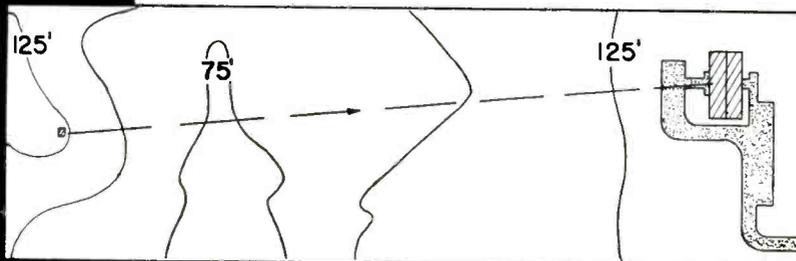
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puter. The text ends with a brief presentation of the operation of the digital integrating differential analyzer.

The appendix includes a review of the terminology of differential equations.

The scope of the discussion is understandably limited and is primarily descriptive with accompanying block diagrams. Numerous well chosen examples clarify the setup of typical problems. At the conclusion of each chapter problems are included to make the book useful as a text on the subject. References are listed for the reader seeking advanced information.

Because the treatment of the computer operation is presented in terms of computer components the engineer reader lacking foreknowledge of the analog computer system may find this book inadequate for an understanding of the composite system. Likewise this book may be of little value to designers of an analog computer. The engineer preparing to operate the differential analyzer will find this book contains excellent introductory material.—LEON HILLMAN, *Newark College of Engineering, Newark, N. J.*

Transistors in Radio and Television

BY MILTON S. KIVER. *McGraw-Hill Book Co., Inc., New York, 1956, 324 p., \$6.50.*

THIS book is intended as an introduction to the practical aspects and applications of transistors for radio and television technicians. The text is adequate to accomplish its purpose, although in some instances it seems to sacrifice accuracy to attain simplicity. The various topics are discussed qualitatively, practically no mathematics being employed.

The book might be suitable as a text in a technical or trade school, or as a home-study manual. Some knowledge of electrical and electronic circuits, on the technician's level, is desirable as preparation.

► Contents—Topics covered in-

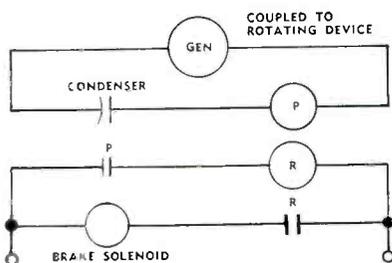


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ELECTRONICS — December, 1956

NEW BOOKS

(continued)

clude a brief survey of atomic theory as used in explaining semiconductor devices. Qualitative discussions of *p-n* junctions, junction transistors and point-contact transistors are given. An ingenious model using marbles aids in explaining the hole currents in a transistor.

Nonmathematical analyses of various types of transistor circuits, amplifiers, oscillators, multivibrators, etc., are included. Several commercial models of transistorized radio receivers are analyzed and the problems of transistorizing a television receiver are discussed.

Some of the later developments in the field of transistors, phototransistors, tetrodes, two-emitter point-contact units, thyatron transistor and the field-effect transistor, are discussed.

Chapters on the servicing of transistor receivers and a set of simple transistor experiments are included.

A few typographical errors make the book slightly more difficult to read.—HAROLD WOLF, *City College of New York, New York, N. Y.*

Thumbnail Reviews

Rayonnements de Particules Atomiques, Electrons, et Photons. By André Berthelot, Masson et Cie., Paris, 1956, 191 p. An introductory treatment of the physics of the interaction of radiation with matter. With a minimum of mathematics, the author discusses the stopping of fission products, light atoms and atomic particles, interactions of fast electrons and absorption of photons.

Basic Electronics: Laboratory Manual for Radio and Television Technicians. By Paul B. Zbar and Sid Schildkraut, McGraw-Hill Book Co., Inc., New York, 1956, 91 p, \$2.00. One of three RETMA prepared manuals for trade, vocational and technical schools. This volume starts with the basic operating principles of electron tubes and leads into power supplies, amplifiers and other simple circuits.

Kleines Handbuch Technischer Regelvorgänge (Small Handbook of Control Processes). By Winfred Oppelt, Verlag Chemie, Weinheim/Bergstr., Germany, 1956, 555 p, DM 36.40. Comprehensive and well organized treatment of control techniques with many

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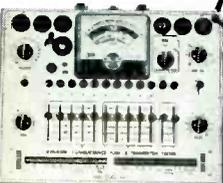
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fine illustrations and tables which would be useful even to those who read only a little German. Examples of mechanical, hydraulic and pneumatic, as well as electric instrumentations, are treated.

Information Theory. Edited by C. Cherry, Academic Press, Inc., New York, 1956, 401 p, \$11.50. Collection of 35 papers presented at the Third London Symposium on Information Theory. The material is divided into five sections dealing with fundamentals of information theory, coding and taxonomy, language analysis and mechanical translation, human senses, and behavior and its mechanism.

Basic Radio and Radio-Receiver Servicing: Laboratory Manual for Radio and Television Technicians. By Paul B. Zbar and Sid Schildkraut, McGraw-Hill Book Co., Inc., New York, 1956, 105 p, \$2.00. Continuation of "Basic Electronics" volume of this series covering a-m, f-m and auto radio circuit theory and servicing.

Profitable Radio Troubleshooting: A Professional Guide to the Technical and Business Methods of Operating a Radio-TV Service Business. By William Marcus and Alex Levy, McGraw-Hill Publishing Co., Inc., New York, 1956, 344 p, \$5.95. Business and technical aspects of starting a servicing business.

How to Make Good Tape Recordings. By C. J. Le Bel, Audio Devices, Inc., New York, 1956, 151 p, \$2.50. Elementary introduction to operating theory, characteristics and use of tape recorders. Covers selection of tape, microphone technique, tape editing and how to put together a recorded program. Book is available only directly from publisher.

Automatic Technology and Its Implications: A Selected Annotated Bibliography, BLS Bulletin No. 1198. By Division of Productivity and Technological Developments of the Department of Labor's Bureau of Labor Statistics, U.S. Government Printing Office, Washington, D. C., 1956, 78 p, \$45. Approximately 36 references to articles, books, pamphlets and reports on automation and its effects.

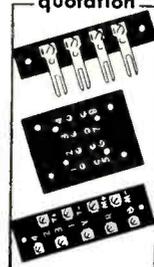
Kovar—Ein nützlicher Werkstoff der Hockvakuum—und Geratebau-Technik (Kovar—A Useful Material for High Vacuum and Apparatus Techniques). By Werner Espe, C. F. Winter'sche Verlagshandlung, 1956, 88 p. Monograph for vacuum technologists answers specific questions on compositions of almost-similar alloys, metallurgical properties, detailed expansion coefficients, etc.; much of material is compiled in tables. About half of book is devoted to techniques and procedures for making Kovar-to-glass seals.

Amplitude Modulation. Alexander Schure. John F. Rider Publisher, New York, 1956, 64 p, \$1.25 (paper). Review of basic principle and methods are of amplitude modulation explained on the technician level.

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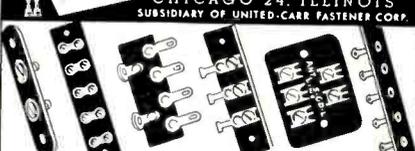
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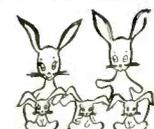
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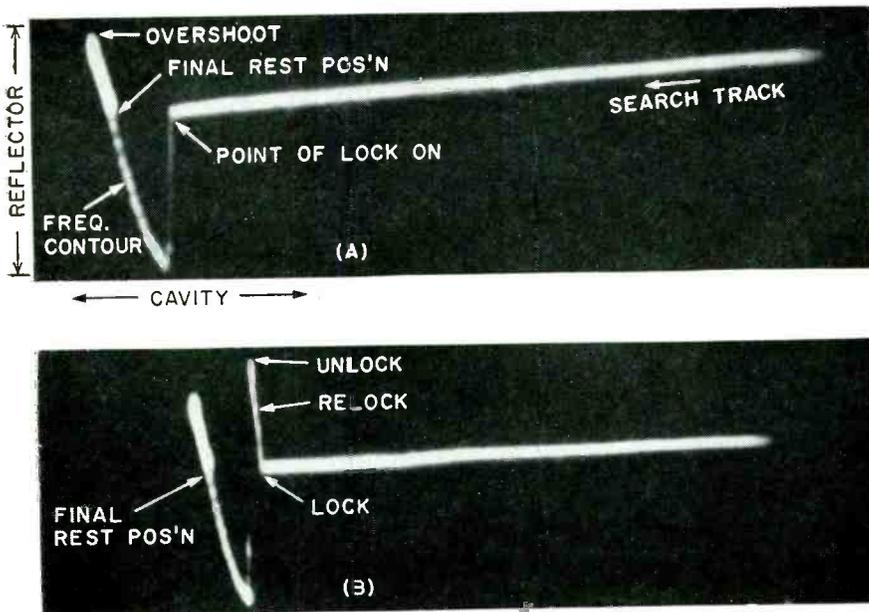
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Backtalk

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I WAS interested to see in the April issue, page 138, a search-follow afc system (Confalone and Rambo) using a scale of two for "trial and error" loop phasing.

This principle is featured in one of our own developments for X-band afc where the local oscillator is a klystron and two controls are manipulated. The search-follow transition is effected by a "lock-on" relay which is counted down by a relay scale-of-two to alternate the loop phase.

The ambiguity arises in the usual way from an incoherent frequency discriminator, and the photographs show the joint control setting in the control plane approaching (A) the channel for which it is correctly primed, and (B) the channel for which it is incorrectly primed. These photographs clearly show the smooth transition from search track to frequency contour in case (A) and the evasive transient which is quickly corrected in case (B).

We consider this approach to be a significant advance in circuit philosophy, representing as it does an elementary application of Dr. Ross-Ashby's principles of self-

adapting circuits and ultra-stability.

RAYMOND J. R. REEVES,
Project Engineer, Radar Laboratory
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More for Curbstone Physicists

DEAR SIRs:

AFTER getting to the bottom of the origin of the *Backtalk* on gravity, going through the October, July, March, and January 1956 issues of *ELECTRONICS*, I am surprised that electronic engineers as curbstone physicists lack confidence that gravity may ultimately be interpreted in electromagnetic terms.

Electromagnetism in retrospect may yield special relativity. However, it is much simpler to combine electrostatics with special relativity to yield magnetism with help from the conservation of energy.

Neither electromagnetism nor relativity have availed themselves of a useful factor analogous to Planck's constant which effectively though indirectly resolves the question, "How big is a person's head, as small as an atom or as large as the Universe?"

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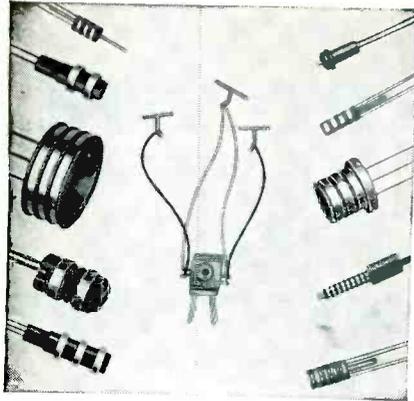
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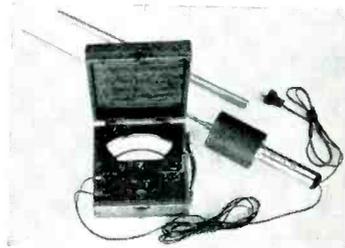
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tion in electromagnetism is the dielectric constant of space, which changes for very high electrical intensities (too small for laboratory determination). As it is, electric charge with appropriate velocities exhibits possible stabilities but lacks a factor determining discrete size, which an appropriate expression of the dielectric constant of space should be capable.

It should be noted that "magnetism" as derived from relativity indicates an additional component of force tending to "blind" an electric current as a "chain" in addition to the pinch effect. With the appropriate formula and expression of the dielectric constant, normally insignificant terms will appear for the force of attraction between charges. These insignificant terms represent or include gravity. This insignificant dielectric factor also determines the stability of primary charges.

Quantum Mechanics

Inasmuch as a high velocity of charge is required for the charge to enter into a stable geometric conformation, it retains this velocity as spin or magnetic moment of the primary particles. As this results in definite configurations for primary particles instead of smears or blobs, it appears to conflict with the uncertainties of quantum mechanics.

It is only apparent because analogous parallels to several celebrated findings of quantum mechanics can be found in special relativity (now assumed derived from electromagnetism) by a detailed "comic book" analysis carefully avoided by Einstein. These may be identified as matter waves, the uncertainty of the position or time of moving objects, and indications of quantization tendencies.

Actually, all that is required to answer all these questions is a valid concept of a mechanism, or of an ether, which clarifies the property of attraction and repulsion of electric charges. Fortunately for us, the ether is a unipolar pseudomagnetic fluid, or we would have not only matter and anti-matter, but also magnetic matter and anti-magnetic matter in addition to an impossible complexity of the hybrid

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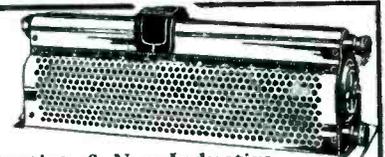


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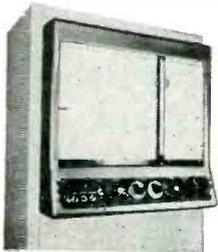
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Missile Mistake

DEAR SIRs:

IN looking over the Sept. 1956 issue, we notice an item on page 7 about the Regulus guided missile "made by Curtiss Wright".

Our pride of ownership was real hurt because we developed and perfected the Regulus missile, the Navy's first operational surface-to-surface missile. We also make the Regulus II, a larger supersonic missile.

The enclosed picture of our Regulus I is enclosed for the writer of the column to pin on his wall.

ARTHUR L. SCHOENI
Chance Vought Aircraft, Inc.
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Editor's Note: We should have known better. We had the Chance Vought Regulus on the April, 1956 cover.

Chopper Stabilization

DEAR SIRs:

WE here at Airpax are well pleased with the way ELECTRONICS handled my article in the September 1956 issue (p 182).

Unfortunately, I was unable to return your galleys with my corrections, hence I felt a few typographical errors should be brought to your attention.

Although obvious to most, a parenthesis was dropped after the second R , in Eq. 1 and again after the second R , in Eq. 3.

The coupling capacitor between chopper and grid of V_{4A} in Fig. 2 should be labeled C_7 and references to C_6 on p 184, col 3 and p 185, col 1 should be changed to C_7 . Also on p 185, col 1 the fraction bar between E_0 and m does not show up. In col 2, third line from the bottom, a dash is used in place of a hyphen and letter v.

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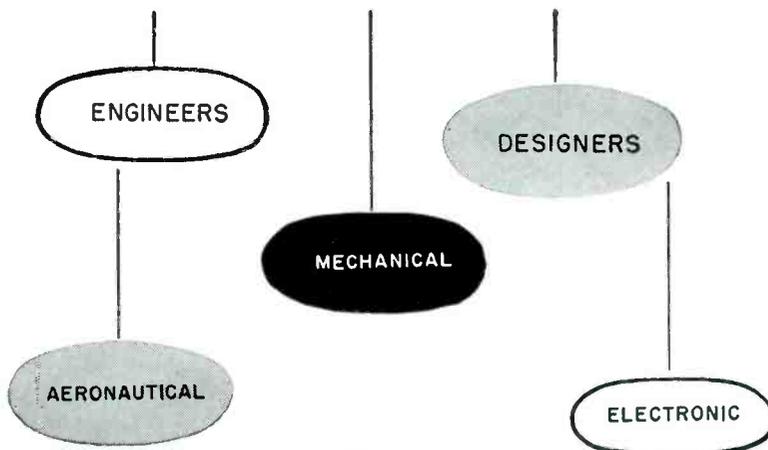
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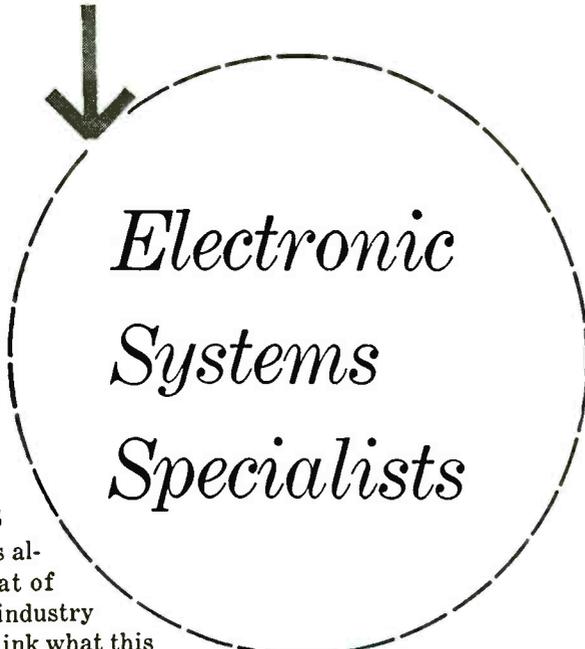
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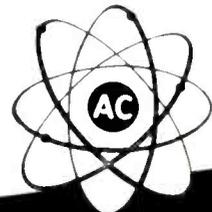
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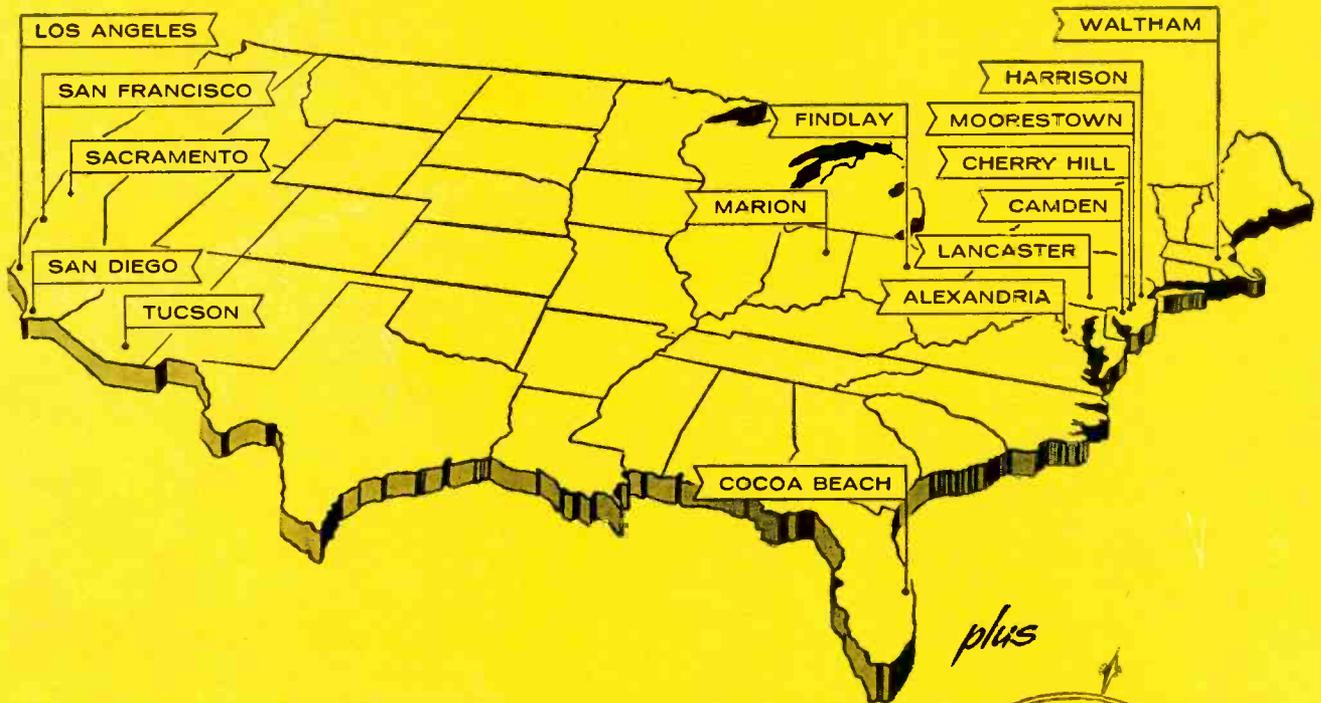
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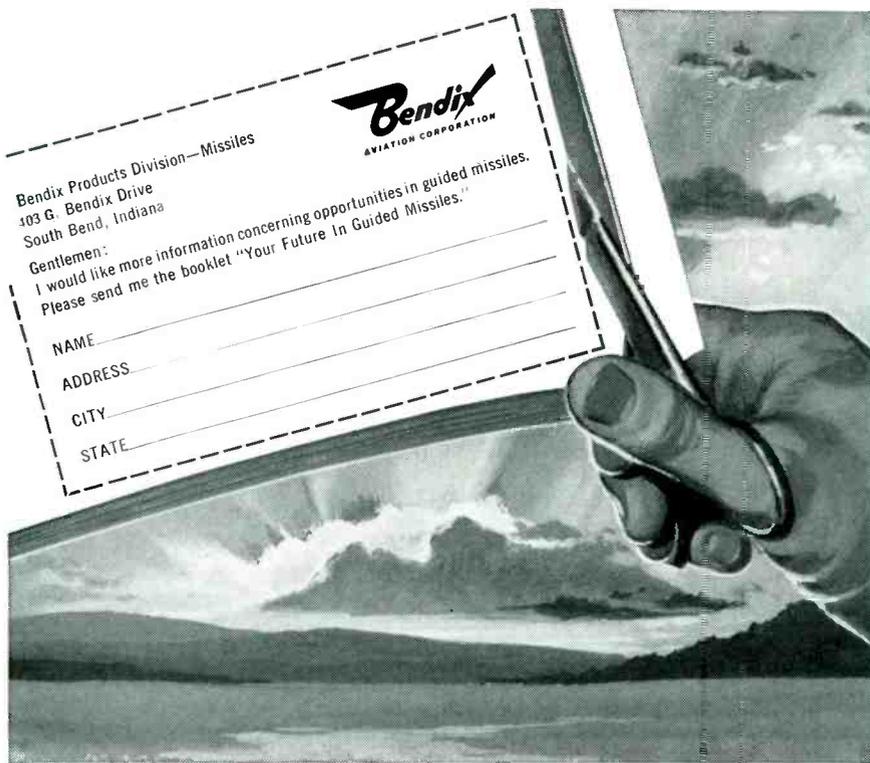
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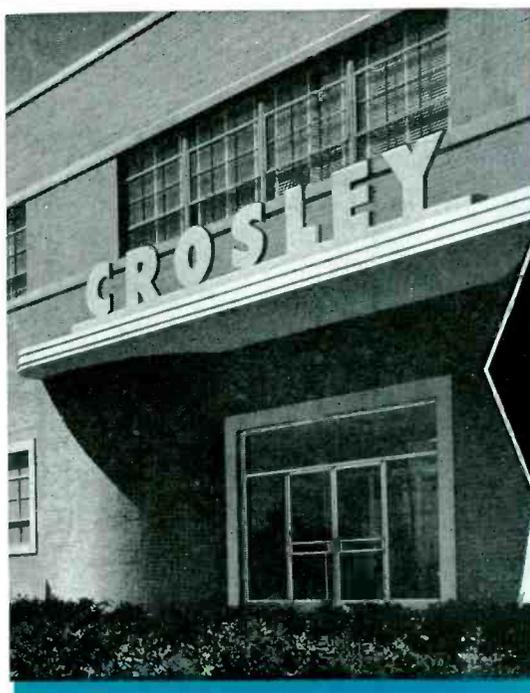
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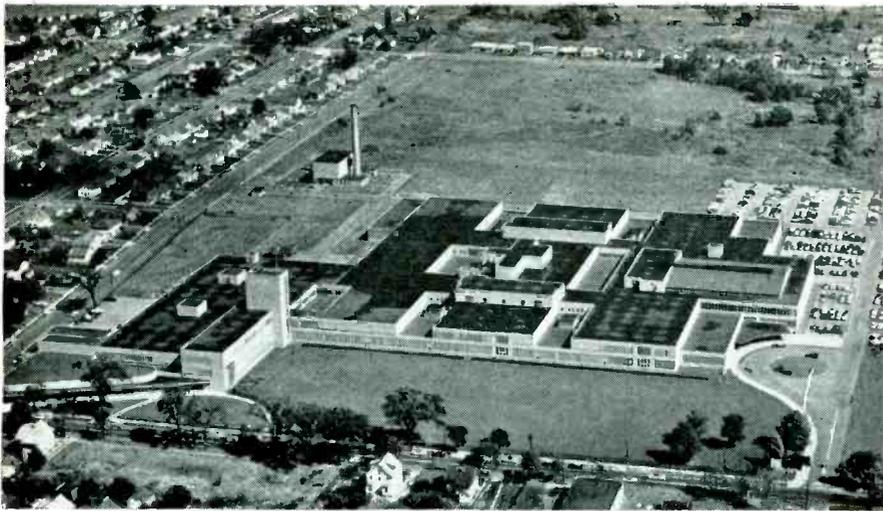
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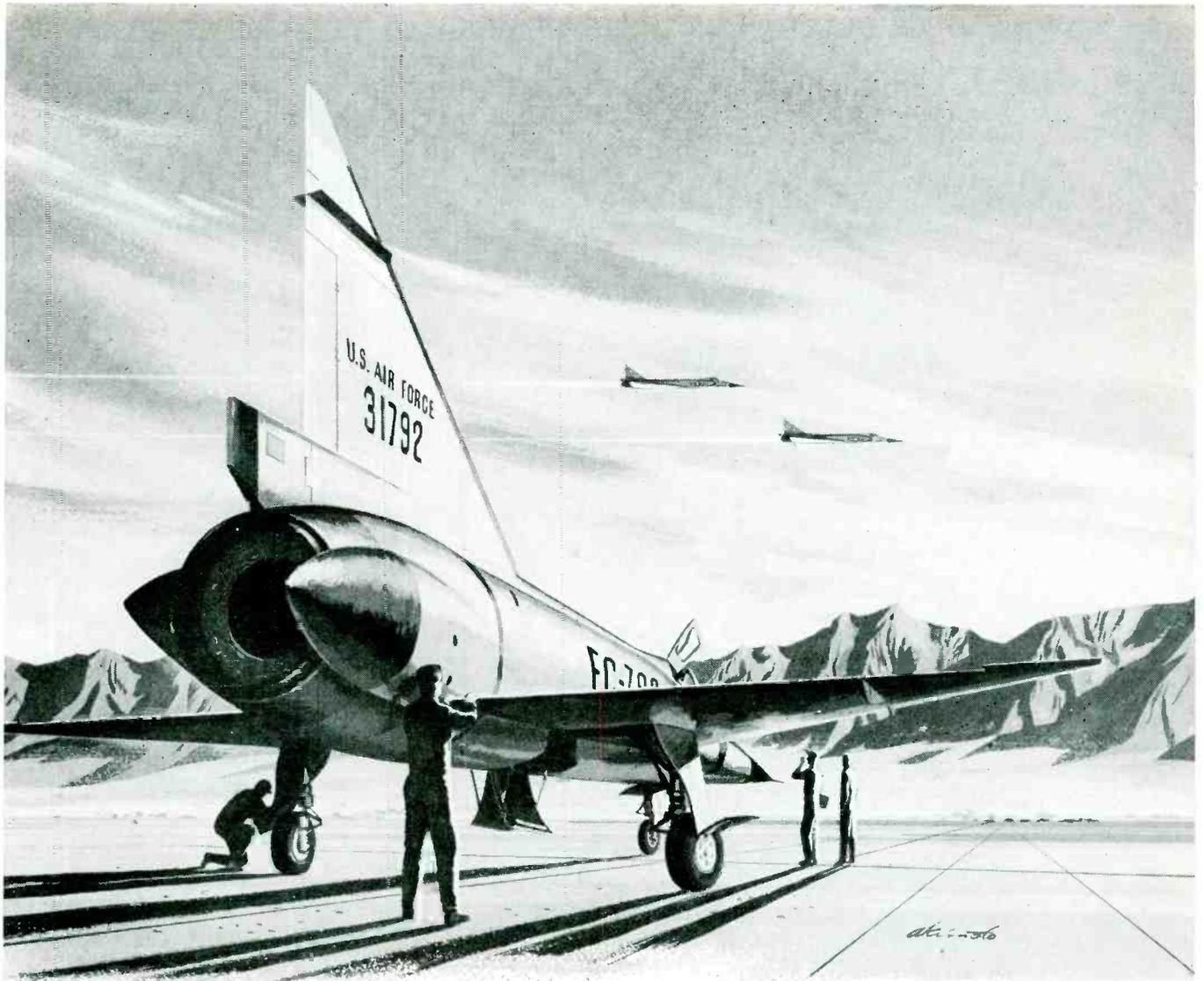
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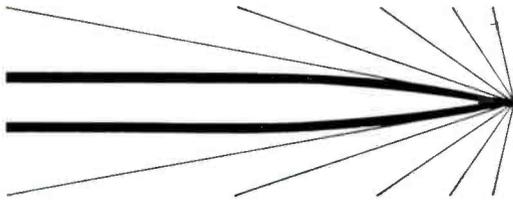
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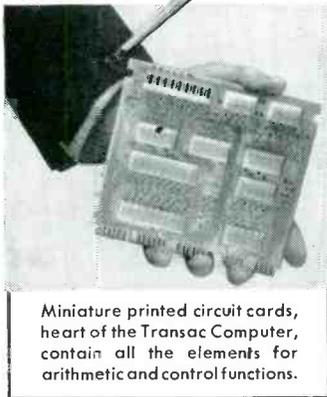
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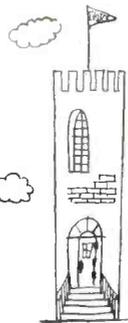
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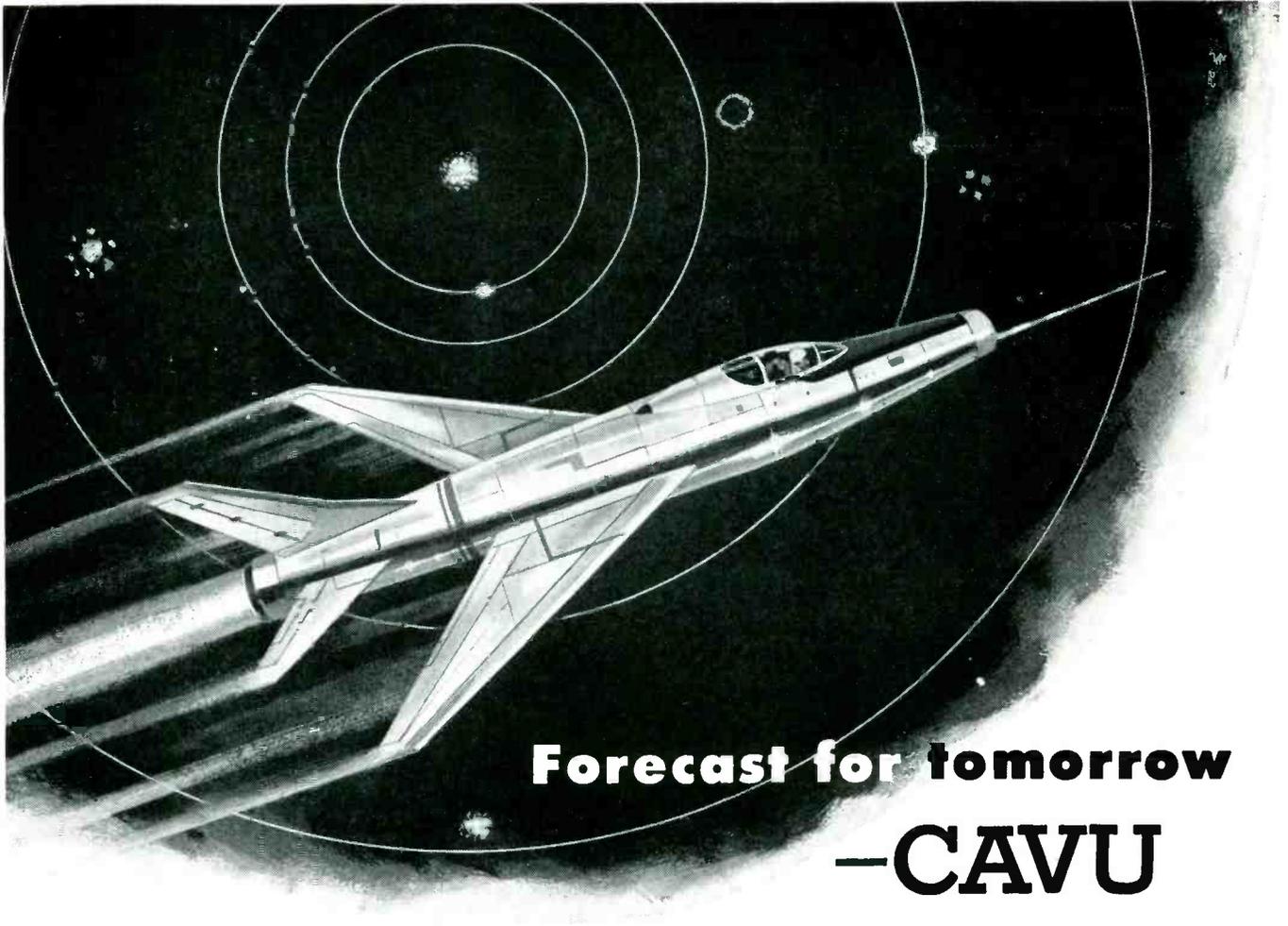
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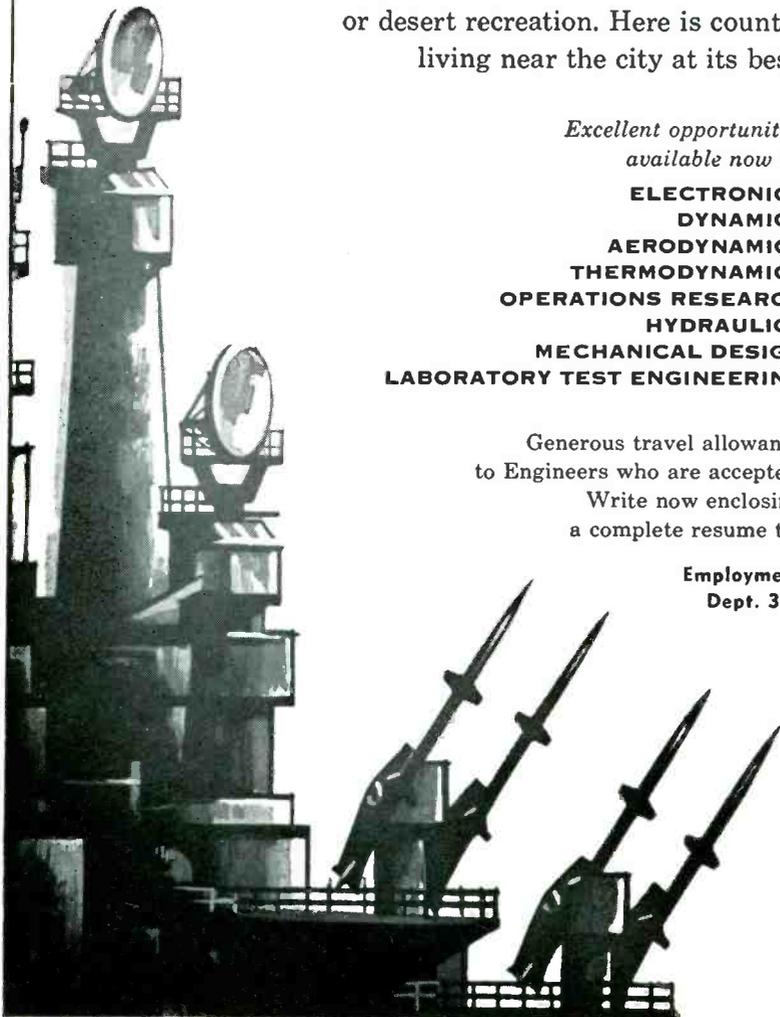
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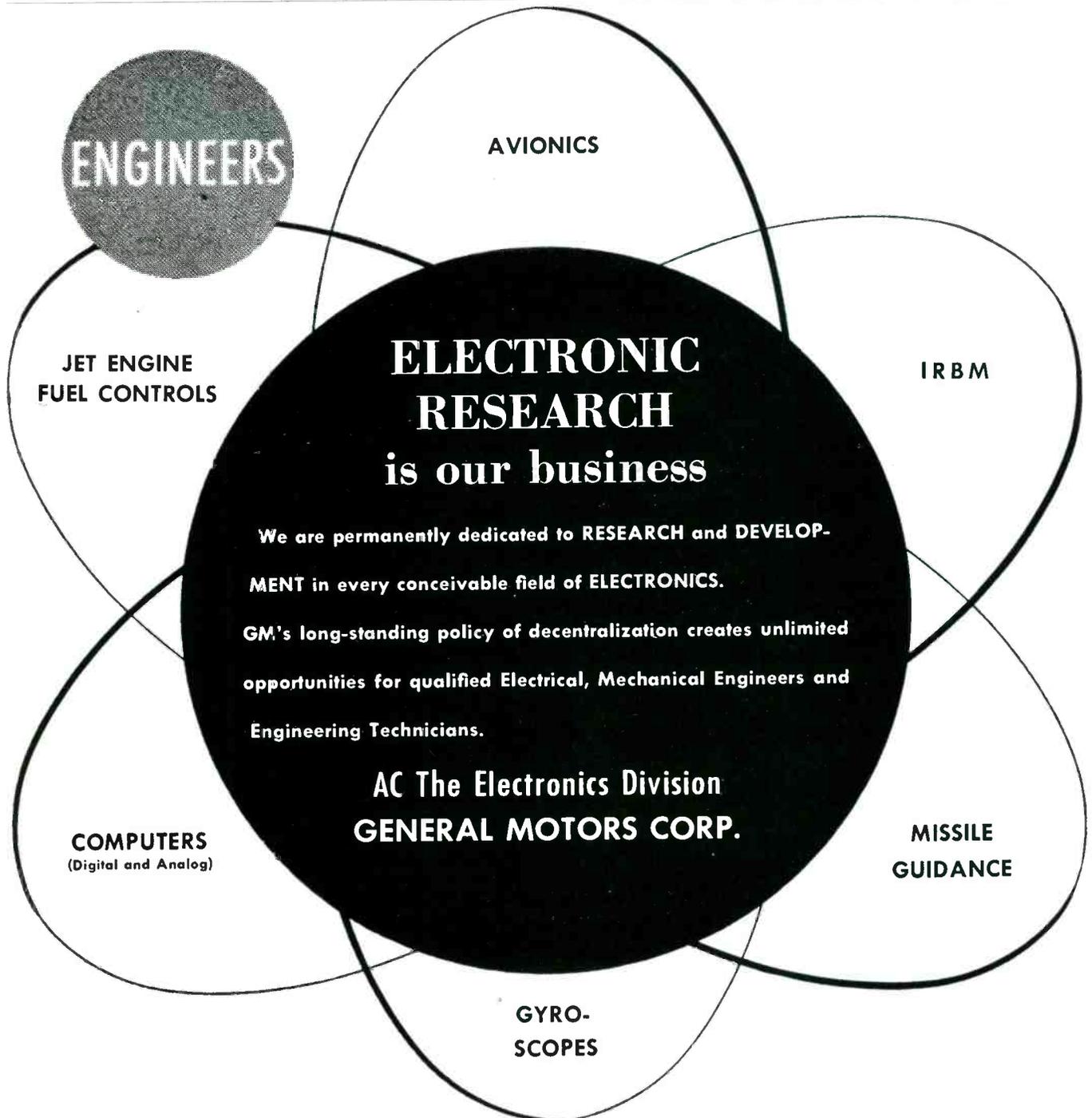
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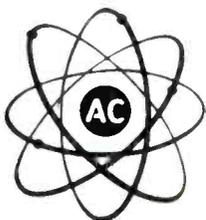
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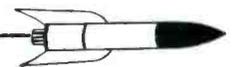
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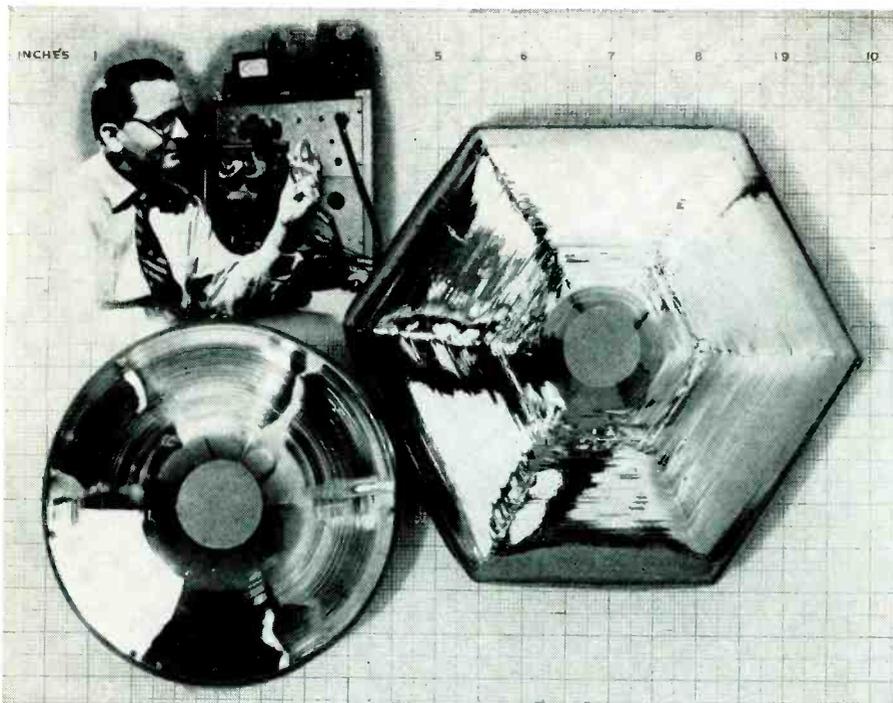


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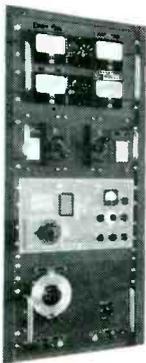


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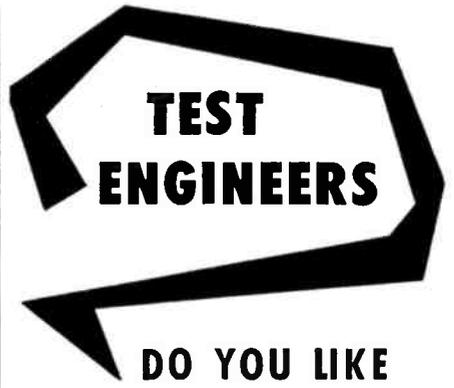
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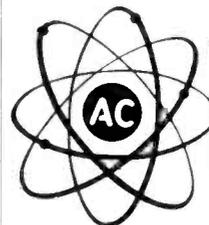
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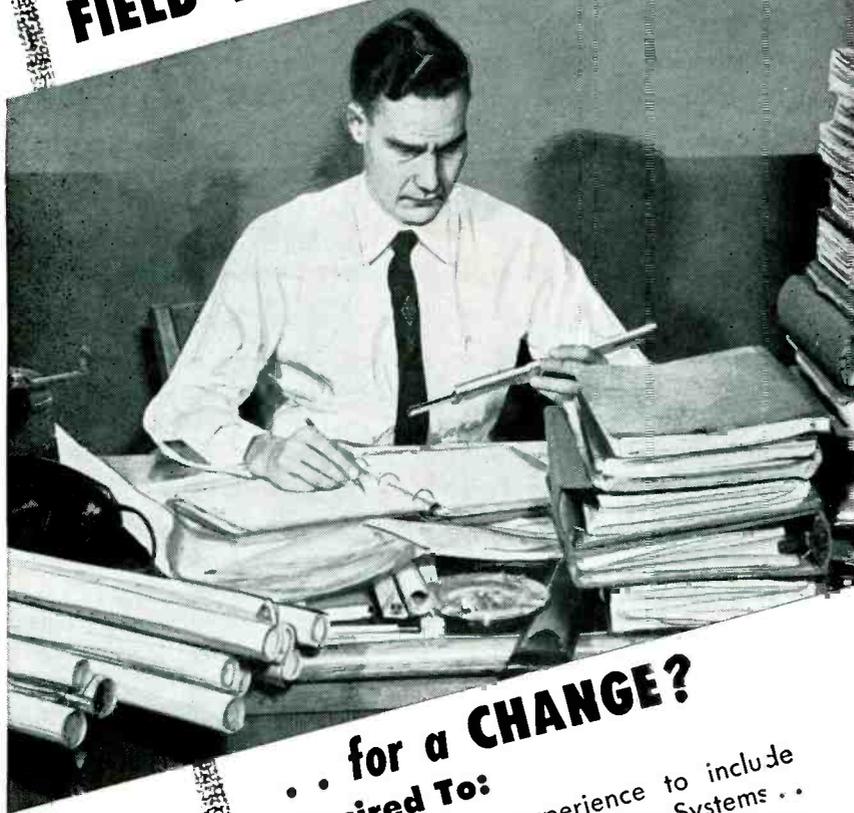


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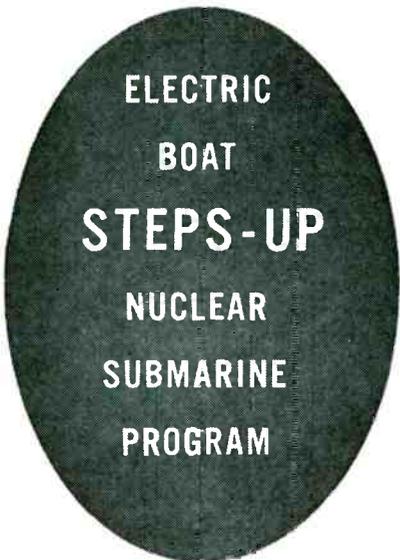
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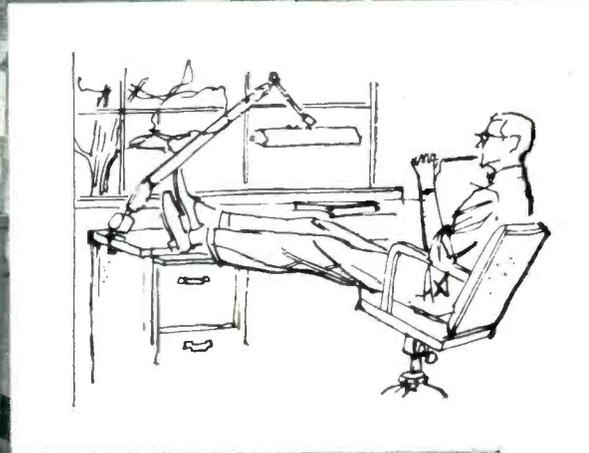
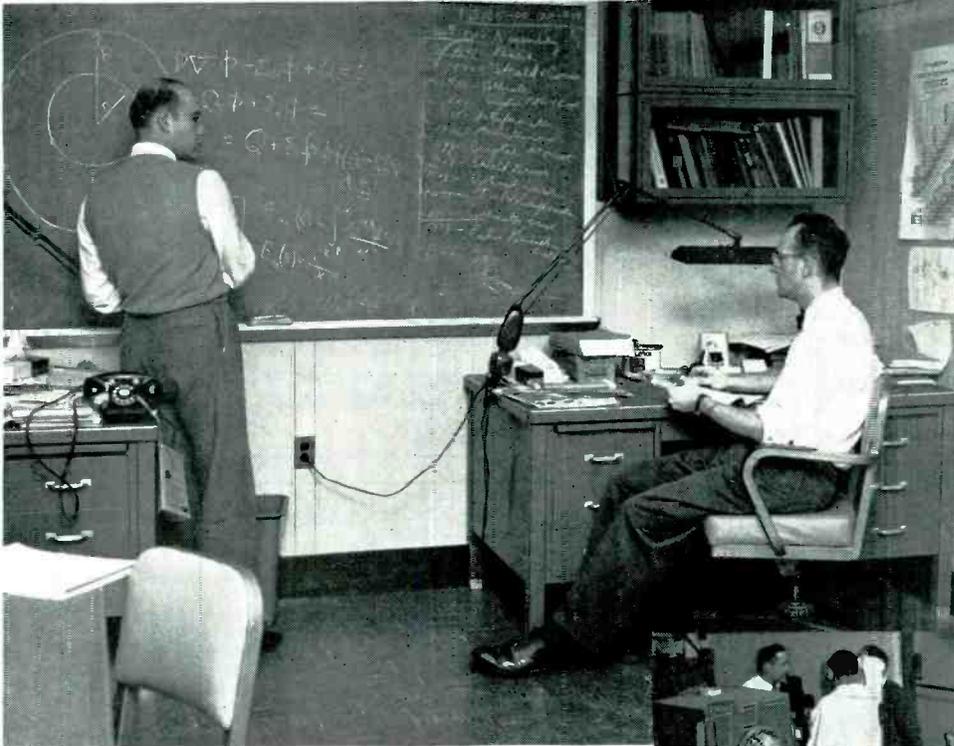
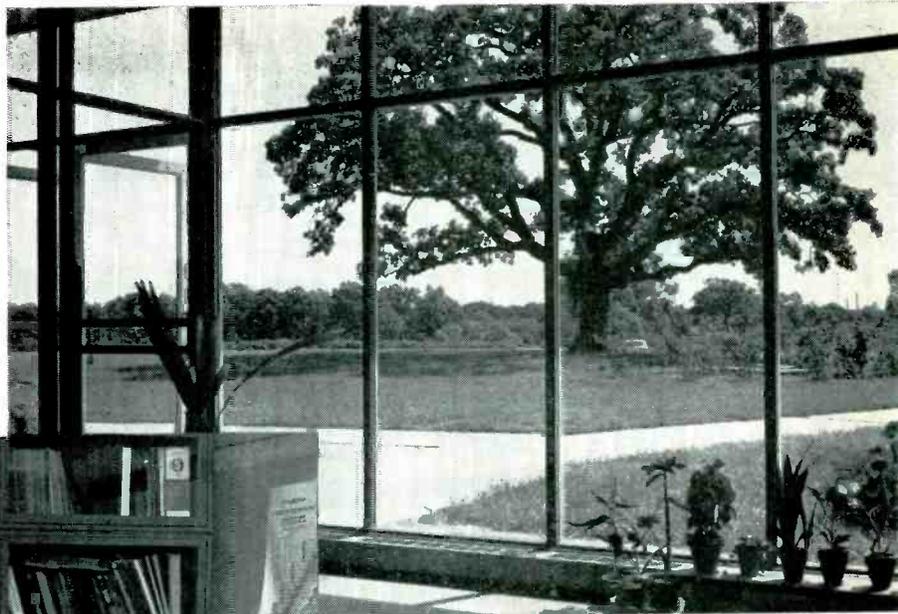
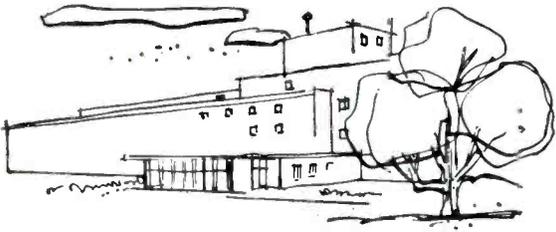
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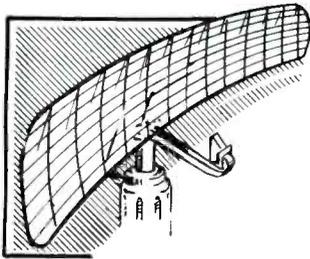


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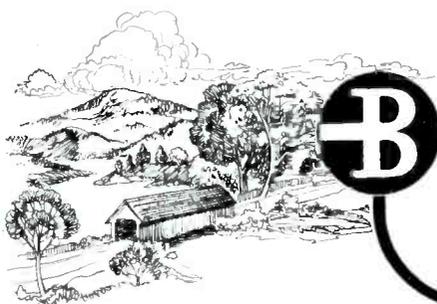
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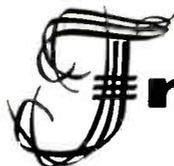
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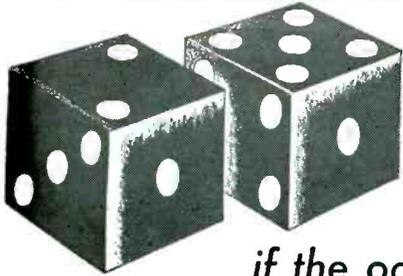
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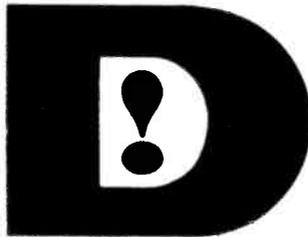
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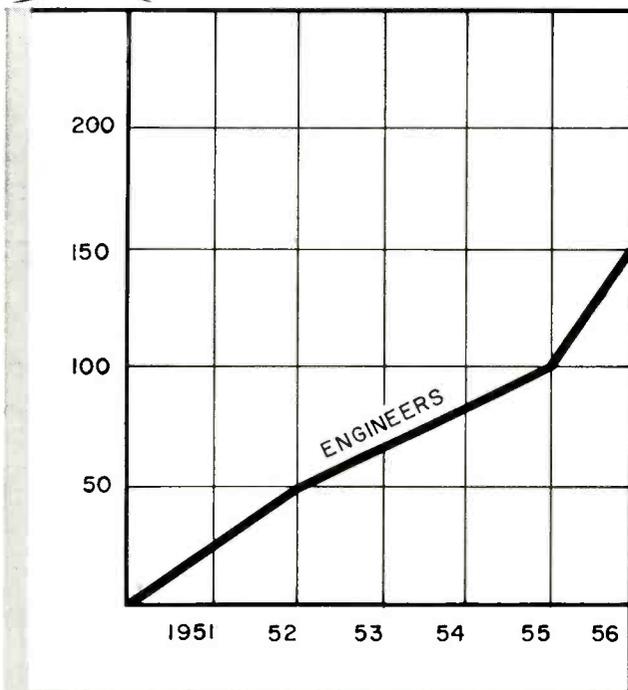
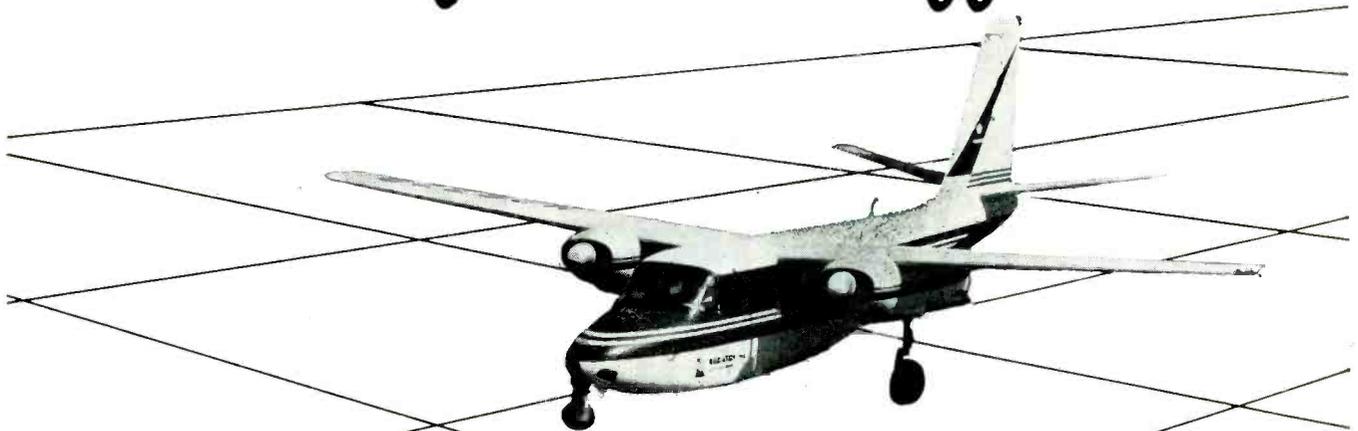
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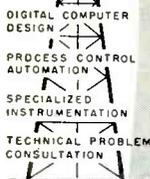
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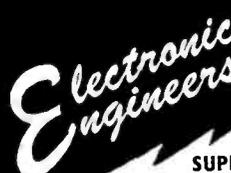
- • Mathematical and Statistical Analysis
- • Digital and Analog Computer Programming and Problems Analysis
- • Communications and Telemetry Programming and Problems Analysis
- • Radio Optics Analysis and Development
 - • Reliability Engineering
 - • Nuclear Reactor Power System Control
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OA2WA	3.00	2K33A	60.00	6F4	2.50	FP-265	20.00	WE-423A	5.75	812A	3.50	5683	5.75
OA5	3.75	2K33B	100.00	6J4	1.75	WE-269A	6.00	WE-428A	40.00	813	8.50	5686	1.85
OB2	.60	2K34	85.00	6J4WA	2.50	FG-271	25.00	GL-434A	5.00	814	1.35	5687	3.00
OB2WA	3.00	2K35	175.00	6J6W	1.00	271A	6.00	RT-434	16.00	815	1.50	5691	5.00
OB3VR90	.85	2K39	100.00	6K4	2.25	WE-274B	.90	WE-438A	40.00	828	8.00	5692	5.00
OD3	.60	2K41	100.00	6SK7W	1.50	WE-282A	2.75	445B	1.00	829	5.00	5693	4.50
1AD4	1.10	2K42	110.00	6SL7W	1.25	WE-282B	5.00	WL-456	59.50	830B	8.50	5702	1.50
ELC1B	1.00	2K43	110.00	6X5WG	1.25	WE-283A	3.50	464A	1.95	832A	5.00	5702WA	6.00
1B22	1.10	2K44	110.00	6X4W	1.00	OK283A	150.00	X-481D	50.00	834	5.00	5703WA	6.00
1B23	2.75	2K45	35.00	6X4WA	2.25	OK284A	150.00	CK501AX	1.00	836	1.25	5704	1.60
1B24	5.00	2K46	200.00	7YP2	150.00	WE-285A	5.00	RH-507	80.00	838	7.00	5718	1.75
1B24A	12.50	2K47	75.00	12AT7WA	3.00	WE-286A	5.00	508/6246	150.00	842	1.50	5719	1.50
1B26	1.25	2K48	55.00			287-A	2.20	527	22.50	845	3.00	RK-5721	150.00
1B27	10.00	2K50	150.00							849	17.50	5725/6A5W	2.75
1B29	2.50	2K54	5.00							851	7.50	5726/6AL5W	.60
1B32	1.00	2K56	50.00							852	4.00	5744	1.00
1B35	3.50	2X2A	90							861	15.00	5749/6BA6W	1.25
1B36	4.00	2AP1	1.50							865	.90	5750	3.00
1B40	2.00	VR-33	99.50							872A	1.35	5951	3.00
1B42	5.00	3B22	1.45							884	1.00	5763	1.20
1B45	25.00	3B24	4.75							GL-889	35.00	CK-5787	4.75
1B47	5.00	3B24W	1.00							GL-889A	50.00	5814	.65
1B51	6.75	3B26	3.00							902A	2.00	5814WA	3.00
1B52	4.00	3B29	4.75							902P1	2.00	5819	35.00
1B53A	19.50	3C22	60.00							905	3.00	5825	7.95
1D21/SN4	5.00	3C23	4.00							917	1.50	5829	1.00
1N21B	1.25	3C24	2.50							919	1.50	5837	50.00
1N21C	3.00	3C31	1.00							922	2.00	5840	4.00
1N23B	.90	3C33	7.50							927	1.00	5841	5.00
1N23BM	3.00	3C45	7.00	12AY7	1.70	WE-990A	7.00	WL-530	17.50	935	4.00	5844	1.50
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1N23CR	6.00	3D21A	3.00	12GP7	15.00	304TL	19.50	583		958A	.35	5842	6.00
1N25	2.20	3E29	8.50	FG-17	3.95	WE-305A	2.85	KU-610	3.50	959	1.25	5876	8.00
1N26	3.50	3FP7A	2.50	RX-21	3.50	307A/RK75	.75	KU-627	7.50	991	.35	5879	1.25
1N28	6.00	3J1P	7.50	PJ22	Q	WE-308B	12.50	KU-628	7.50	CK-1005	.35	5893	9.00
1N31	1.90	3J30	35.00	HK24	Q	WE-310A	4.00	WL-652	20.00	CK-1006	3.75	5896	4.00
1N32	9.00	3J31	35.00	26A7GT	3.00	WE-311B	1.50	HK-654	18.50	CK-1007	.45	5899	4.00
1N38A	.60	3K22	150.00	26E6WG	3.00	WE-312A	1.50	GL-672	20.00	1229	2.75	5902	5.50
1N42	8.00	3K23	150.00	RK-28A	2.50	WE-315A	10.00	WE-701A	2.50	1603	3.50	5902A	5.50
1N46	.60	3K30	100.00	BK29D	Q	WE-316A	.50	702A	.50	1614	1.50	5906	11.00
1N52	.65	4-65A	14.50	35T	3.00	WE-323A	10.00	WE-703A	1.25	1620	3.00	5915	.80
1N63	1.40	4-125A	19.50	D-42	40.00	WE-336A	5.00	WE-704A	.60	1622	2.00	5932	4.00
1N69	.40	4B23	4.00	RK47	3.00	WE-337A	5.50	WE-705A	.75	1623	1.25	5933/801W	5.00
1P21	40.00	4B26	7.50	V-50	75.00	WE-338A	5.00	706AY-GY	10.00	1624	1.15	5956	35.00
1P24	1.50	4B31	20.00	V-50XR	75.00	WE-348A	6.00	707B	2.50	1625	.30	5965	1.00
1P28	9.00	4C27	7.50	HK-54	2.00	WE-349A	5.00	WE-708A	.75	1626	.25	5977	3.00
1P30	1.35	4C28	25.00	OK-57	Q					1631	1.00	5977A	3.00
1V5	.90	4C35	13.50	OK-59	20.00					1636	.75	5981	70.00
1W5	.90	4D21	19.50	OK-60	20.00					1641	1.35	5982	149.50
1Z2	2.50	4E27	7.50	RK-60/1641	1.25					1945	65.00	5987	9.50
2AP1	4.00	4J22	100.00	KK-61	2.50					2000T	150.00	5993 TE-10	9.00
2AP1A	6.00	4J26	100.00	OK-62	20.00					2050	1.00	6005	
2AS15	4.75	4J27	100.00	HY-65	1.00					2051	.65	6AQ5W	1.75
2B24	.80	4J28	100.00	RK-65/5D23	7.50					HK3054	100.00	6C21-A	4.50
2C33	.75	4J29	100.00	FG-67	12.00					ZB3200	99.50	6028/408A	2.00
2C35	2.50	4J30	100.00	HY-69	2.25					4210	Q	6037/OK243	75.00
2C39A	9.50	4J32	45.00	RKR-72	.50					R-4330	9.00	6044	15.00
2C39A sealed	11.00	4J34	25.00	RKR-73	.50					R-4340	9.00	6046	.75
2C40	8.50	4J42	25.00	FG-95	16.50					5516	5.50	CK-6050	2.00
2C42	8.50	4J50	99.50	ML-100	50.00					5517	1.00	6081	
2C43	9.00	4J52	50.00	100TH	6.50					5551/FG271	25.00	ATR407	22.50
2C44	.30	4J63	49.50	WE101D	3.00					5553		6082	3.25
2C46	5.00	4J64	49.50	FG-104	29.50					FG258A	80.00	6096	1.30
2C50	6.00	4PR60A	45.00	FG-105	11.00					5559/FG57	10.00	6099	1.40
2C51	3.95	4X150A	20.00	F-123A	2.50					6100/6C4WA	10.00	6101/6J6WA	2.25
2C52	2.75	4X150G	30.00	F-128A	10.00					5560	16.50	6110	6.90
2C53	10.00	4X250M	35.00	FG-154	10.00					5561	29.50	6111	6.00
2D21	.75	5ABP1	20.00	FG-158	9.75					5586	110.00	6112	6.50
2D21W	1.00	5ADP1	20.00	FG-166	6.75					5588	80.00	6116	150.00
2D29	.80	C5B	1.00	FG-172	17.50					5591/403B	2.75	6130	7.50
2E24	2.50	5BP2A	2.95	OK-181	12.50					5606	125.00	6136	2.50
2E25	3.75	5CP1	1.95	HF-200	12.50					5611	45.00	6147	3.00
2E26	3.25	5CP1A	7.50	WL-200	75.00					5634	6.50	6159	3.00
2E27	.60	5CP7	6.00	CE-203	2.50					5636	2.95	6177	75.00
2E32	1.00	5CP7A	8.00	203A	3.50					5639	7.00	6189/	
2E41	2.25	5CP11A	9.50	204A	25.00					5639A	7.00	12AU7WA	3.00
2H21	60.00	5C22	27.50	205F	6.00					5643	5.00	6201/	
2J31	10.00	5J1P	10.00	207	75.00					5644	7.25	12AT7WA	3.00
2J32	10.00	5J22	5.00	211/VT4C	.50					5645	6.00	6203	2.75
2J33	29.50	5J24	5.00	212E	15.00					5647	5.00	6205	6.00
2J34	10.00	5J25	6.50	WL-218	15.00					5650/5981	70.00	6211	1.25
2J36	29.50	5J211A	7.50	OK221	150.00					5651	1.40	6246/508	200.00
2J48	10.00	5MP1	2.95	OK243	50.00					5654	1.50	6264	11.50
2J49	35.00	5N1P	2.00	OK-249	150.00					5654/6AK5W/		VA-6310/	
2J50	35.00	5R4GY	1.28	WE245A	6.45					6096	3.25	VZ60	75.00
2J51	200.00	5R4WGA	4.00	WE-2493	2.50					5656	7.00	8002R	15.00
2J54	25.00	5R4WGY	2.50	249C	3.00					5657	100.00	8012	1.00
2J55	32.50	6X5WG	1.75	250-R	3.50					5663	1.25	8025A	2.00
2J56	40.00	6AC7A	1.00	250TH	21.00					5665	35.00	9001	.85
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2J61A	50.00	6AN5	2.25	WE-251A	49.50					5670	2.00	9003	1.00
2J62	5.00	6AR6	1.50	WE-252A	7.50					5670WA	4.25	9005	2.50
2J62A	50.00	6AS6W/5725	2.70	OK253	Q					5675	7.00	D178461	50.00
2K22	13.50	6ASTG	9.50	WE-254A	2.50								
2K23	12.50	6AU6WA	2.50	FG-258A	80.00								
2K25	11.00	6BL6	30.00										

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P.P.I. REMOTE REPEATERS

VD-7" Upright
VE-7" Table Type
VF-5" "B" Scope "5" P.P.I.
VG-"24" Plotting Table
VJ-12" Upright
VK-12" Upright
VL-12" Upright R.H.I. I.N.D.
All indicators are 110v 60 cye.

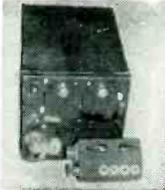
SHORAN

AN/APN-3-AN/CPN-2

The AN/APN-3 and AN-CPN-2 are Precision distance measuring installations. This equipment operates on 225 mc. The range is 250 miles with an accuracy of 25 feet. This equipment is widely used by geological companies for prospecting and mapping. Power input is 110v 400cye and 28v DC.

AN/GSQ-1 NAVY TYPE PF SPEECH SCRAMBLER

This is a unit designed to be attached to either a radio or telephone circuit to scramble speech or code. This equipment utilizes coded cards in each terminal equipment. Unless the properly numbered card is inserted on the receiving end the speech can not be unscrambled. This provides an excellent privacy system. 24 VDC input. Mfg. Western Electric.



SCR-536 HANDI-TALKIE

Freq. range 3.75 Mc crystal controlled battery operated handi-talkie. The range of this equipment is approximately 2 miles. We can supply these sets to your specified freq. Completely reconditioned and guaranteed.
WE CAN SUPPLY OVER 1500 OF THESE SETS

AN/ARC-12

AIRBORNE 225-350 MC TRANSCEIVER

These sets provide 10 chan channel communication from 225 350 mc. A guard channel is also provided. The AN/ARC-12 is a late set and is the V.H.F. version of the AN/ARC-1, and will communicate with the ARC-19, ARC-27, ARC-33 etc. Output is 8 watts. Input is 28 VDC.



RADALAB INC.

87-17 124th St., Richmond Hill 18, New York, N. Y.

Phone Virginia 9-8181-2-3

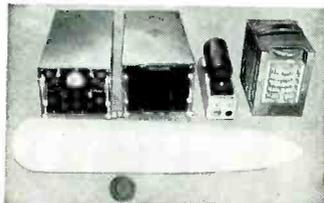
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MN-5

F.M. 30-42 MC MOBILE RADIO SETS

This set is ideal. For police, military or anywhere a compact reliable system of communication is desired. Power output is 5 watts. Set is completely remote controlled. Input is 12 VDC.

AN/ASQ-1 AIRBORNE MAGNETOMETER



This is an airborne chart recording magnetometer. The set consists of an amplifier, oscillator, detector head, chart profile recorder, power supply. The equipment has a sensitivity of 2 gamma. The AN/ASQ-1 records on an Esterline angus recorder disturbance in the earth's magnetic field. An indicator is provided that gives a bearing on a magnetic disturbance. Input is 28v DC. Weight about 130 lbs.

AN/APR-4 Search Receiver

The AN/APR-4 receiver is a precision laboratory instrument covering 38-4000 MC in 5 plug-in tuning units. The tuning units are calibrated directly in megacycles. A wide or narrow band width I.F. may be selected in the receiver enabling pulsed signals to be observed. Outputs for a pulse analyzer; pan-adaptor, etc. are provided. A tuning meter is also provided. Input 110v 60 cye.



CARRIER EQUIPMENT

CF-1 4 CHAN. VOICE AND TELEG. TERMINAL 115v 230v A.C. 12v D.C.
CF-2 4 CHAN. TELEGRAPH AND TELETYPE TERMINAL 115v 230v A.C. 12v D.C.
CF-3 4 CHAN. INTERMEDIATE REPEATER 115v 230 A.C. 12v D.C.
CF-4 CARRIER CONVERTER. Used to adapt the CF-1 and 2 for operation on a simple 2 wire trans. line instead of using spiral 4. 115v, 230v A.C. 12v D.C.
TH-1 TELEGRAPH TERMINAL

EQUIPMENT

AN/CPN-63 CM Beacon
AN/UPN-43 CM Beacon
AN/URC-4 VHF Rescue Set
AN/TRC-1, 2, 3, 4, 6, 7.
AN/GRC-9 Field Radio, many other AN equipts.
SCR-191, 300, 399, 499, 508, 608, 808, and others.
TEST SETS from TS-1 to TS-700 many late Types
PARTS SPARE and sets of equip. mfg. after 1948, radar, radio and special types write
NOISE MEASURING UNITS.

RDO

NAVY SEARCH RECEIVER

The RDO is a very elaborate radar search receiver greatly improved over the APR-4. The set uses APR-4 tuning units, but is much more versatile, having input metering, D.B. output meter, automatic noise limiter, and greater selectivity and sensitivity. The RDO is recommended when only the very best will do. Input 110v 60 cye.



RC-115B GROUND 75 MC MARKER BEACON TRANS.

This is a 75 C Marker Beacon Ground Station. This equipment comes mounted in a transporting trunk. The set can emit either inner, outer, or airways signals. The transmitter is crystal controlled. 110 Volts 60 cye. Late USAF equip.

RELIABLE TUBES

1B37	7.50	2K45	35.00	BL26	15.00	707A	3.00	5638	4.25	5839	8.00	6034	7.00
1B60	30.00	2K48	65.00	FG27A	12.00	715B	3.75	5639	6.50	5840	4.00	6035	30.00
1P21	50.00	2K50	175.00	VX33A	4.50	720AY	30.00	5641	5.00	5851	4.00	6037	195.00
1P22	6.50	2K56	60.00	V45	700.00	793A/B	9.00	5643	6.00	5852	6.00	6038	10.00
1P25	65.00	3B26	5.00	V-57	250.00	795A	5.00	5645	6.50	5857	30.00	6101	9.50
1P41	1.50	KCA/5625	50.00	RK71/6D21	160.00	804	8.00	5646	6.50	5876	11.50	6111	5.00
2C33	7.5	4B31	19.50	BL77	35.00	807	1.25	5657	95.00	5893	15.00	6115A	90.00
2C39A	11.00	4C33	95.00	QK103	90.00	807W/5933	3.00	5670	2.00	5894	20.00	6116	207.00
2C40	9.50	4J61	125.00	QK181	25.00	829B	8.50	5675	10.00	5896	5.00	6161	55.00
2C43	10.00	5Y3WGTA	1.75	QK185	75.00	832A	6.50	5702	1.75	5896	5.00	6167	25.00
2C46	6.00	6AJ5	1.25	QK202	200.00	CK1026	3.00	5721	195.00	5899	5.00	6177	90.00
2C52	3.50	6BF7W	4.00	QK243	195.00	R1111	3.50	5744	1.25	5901	7.50	6199	30.00
2J30	40.00	6BL6	32.50	250TL	15.00	R1131C	10.00	5751	1.75	5902	4.75	6201	3.25
2J36A	90.00	6BM6	37.50	261A	10.00	1620	3.00	5764	45.00	5906	12.00	6229	350.00
2K25	15.00	6J4	1.75	268A	6.00	1633	.50	5777	220.00	5937	70.00	6247	15.00
2K26	37.50	6J4WA	3.00	312A	1.50	1636	.75	5787	6.00	5962	10.00	6263	15.00
2K28	26.00	6SK7W	1.25	339A	7.00	CG1984	10.00	5794	6.95	5976	50.00	6326	400.00
2K29	30.00	6X5WGT	1.25	QK381	110.00	R4340	25.00	5814A	1.50	5981	75.00	6383	70.00
2K33	125.00	7F8W	3.50	397A	60.00	5550	20.00	5819	35.00	5993	7.50	6524	15.00
2K39	95.00	PJ8/5556	9.00	412A	3.75	5563	30.00	5837	75.00	6021	4.00		
2K40	90.00	BL17	7.50	416B/6280	40.00	5636	3.00	5838	6.00	6032	150.00		

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 .5 microsecond, 2000 PPS 50 ohms impedance. \$6.50
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 PPS, 67 ohms impedance 3 sections. \$7.50
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 200 PPS, ohms, imp. 3 sections. \$12.50

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352-7150. Primary 50 ohms, Secondary
 1000 ohms, 1200V, 12.0
 Amp. Pulse: 1 or 2 usec, at .001
 duty ratio. Fitted with magnetron
 well and bifilar winding for fila-
 ment supply. \$32.50



MAGNETRON PULSE TRANS.
 #984: Prim. imp. 30 ohms, 1600 v.
 pulse, Secondary imp. is 1250 ohms, 12 KV pulse. Turns
 ratio sec. pri. is 7.5:1 Duty ratio is 0.001 at 1.2 usec.
 Bifilar winding 1.2A. \$8.50
RAYTHEON WX 4298E: Primary 4KV, 1.0 USEC.
 SEC. 16KV-16 AMP DUTY RATIO: 001-400 CYCLE
 FIL. TRANS. "BUILT-IN" \$22.50
WECO: D-163247 For Modulator of SCR 720. \$22.50

G.E. #K-2449A
 Primary: 9.33 KV, 50 ohms Imp.
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 Pulse length: 1.05/5 usec @ 635/120
 PPS. PK Power Out: 1.740 KW
 Bifilar: 1.5 amps. \$62.50

G.E. #K-2748-A, 0.5 usec @ 2000 PPS
 Pk. Pwr. is 32 KW impedance
 40:100 ohm output. Pri. volts 2.3 KV Pk. Sec. volts
 11.5 KV Pk Bifilar rated at 1.3 Amp. Fitted with
 magnetron well. \$24.50

K-2745 Primary: 3.1/2.8 KV, 50 ohms Z. Secondary
 14/12.6 KV 1025 ohms Z. Pulse length: 0.25/1.0 usec
 @ 600/600 PPS. Pk. Power 200/150 KW. Bifilar: 1.3
 Amp Has "built-in" magnetron well. \$32.50

K-2461-A. Primary: 3.1/2.6 KV-50 ohms (line). Secondary
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K35145-Pulse Inversion: TM: 5 KV PK. Pulse Inver-
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54J318-1-3 w/dgs Ratio: 1:1:1, 1.10 uh. /wdg 2.5
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UTAH X-1517-1: Dual Transformer, 2 Wdgs per sec-
 tion 1:1 Ratio per sec 15 MH inductance 30 ohms
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68G711: Ratio: 4:1 Pri: 200V, Sec. 53V, 1.0 usec Pulse
 @ 2000 PPS, 0.016 KVA. \$4.50

TR1049 Ratio 2:1 Pri. 220 MH, 50 Ohms, sec 0.7:1
 DCR 100 Ohms. \$6.75
K-904695-501: Ratio 1:1. Pri. Imp. 40 Ohm. Sec. Imp.
 40 Ohms. Passes pulse 0.6 usec with 0.05 usec
 rise. \$8.95

MICROWAVE ANTENNAS

3 CM ANTENNA ASSEMBLY: Uses 17" paraboloid
 dish, operating from 24 vdc motor. Beam pattern: 5
 deg. in both Azimuth and elevation. Sector Scan:
 over 160 deg. at 35 scans per minute. Elevation Scan:
 over 2 deg. Tilt. Over 24 deg. \$35.00
3cm. Horn, 1 x 1/2" with twist and 180 deg. bend
 With dielectric window connector. \$22.50
AT49/APR—Broadband Antenna, 300-3300 MC. Type
 N Feed. \$8.95
Discone Antenna, AS 125 APR, 1000-3200 mc. Stub
 supported with type "N" Connector. \$14.50
AS14A/AP, 10 CM pick up dipole assy. complete w/
 length of coax and cable. \$4.50
AS46A/APG-4 Yagi Antenna, 5 element array. \$22.50
30" Parabolic Reflector Spun Aluminum Dish 10 1/2"
 Focus. \$4.85
AN/APA-12—Sector Scan adaptor for APS-2 radar.
 Complete Kit. \$37.50
LP-24 Allford loop, for use with glide-path transmitters
 (MRN-1), etc 100-108 mc. \$32.50
18" PARABOLIC DISHES, spun aluminum, Focus ap-
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Butterfly tank unit: Tunes 60-300
 mc. Ideal for frequency meter,
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 New, complete with
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Model JR-1 Hydrophone is a piezo-electric device using
 an array of 20 barium titanate cylinders enclosed in a
 rubber cylinder 46 inches L and 2 1/2 inches in diam.
 Sensitivity—105 db/microbar relative to 1 v/microbar.
 Frequency response: 200-15,000 cps. Impedance
 100-150 ohms. The response at rt. angles to axis is
 uniform over an azimuth of 360 deg. The Hydrophone
 may be operated at depths up to 1000 ft. \$52.50
 temperatures of -1 deg. C. to 35 deg. C.

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Rubicon Shadow Galv. Bridge
 Radiart TR11 Direct Ant. Cont. Box
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 Sensitive Research Model F Fluxmeter
 Sensitive Research Model GM Mutual Cond.
 Dynamometer
 Shallcross Power Factor % Standard
 Siemens & Halske Galvanometer
 Signal Corps I-22A Signal Generator
 Simpson 276 Osc. Oscillator
 Spencer Kennedy 212CTV TV Amplifiers
 Sylvania 400 Oscilloscope
 Sylvania 302 Polymer
 Sylvania 221 Z Polymer
 Tarc VS-100 Video Line Selector
 Tarc DA-7100 Video Line Amplifier
 Telenatic UH14-83 UHF Booster
 T.E.C. T601 Oscilloscope
 Tech. Apparatus Nobatron DC Power Supply
 Telechrome 600-AR Patch Panel
 General Electric 8K79F3 Timer
 Harvey 201 S Oscilloscope
 Industrial Transformer 1230 AC High Voltage Tester
 Instrument Electronics AC VTMV
 J.B.T. 30FX Line Freq. Meter (48-52; 58-62) in case
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 Jones 711-N Micromatch
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 Measurement 67 Peak VTMV
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 Monarch 14 Signal Generator (Broadcast Band)
 Monarch 60-cycle Multi-Vibrator
 A.T. 110PT 286 Balun
 Beta Electric 102 Kilo Voltmeter
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 Boonton 509-B 20 db Attenuator
 Boonton 509-A 20 db Attenuator
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 Cornell-Dubilier CDC-5 Decade Cap. Box
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 107-D General Radio Variable Ind.
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 Tarc Res. Power Supply
 Tarc 1051-AR Distribution Amplifier
 Telechrome 1603A B1164 RE-13 AWM+Rack—Phase
 Delay Line Generator
 Telechrome 1600-AR Cal. Phase Shifter
 Tel-Instrument 2113 Signal Generator
 1211 Tel-Instrument UHF Wobulator
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Receiver front end cavity resonator:
 Tunes 2700 to 3400 mc with a loaded
 Q of 3000. 50-ohm, type N Input.
 Video output from 1X27 crystal. May
 be used at quarter wave (1.1 to 1.4 kmc) \$22.50



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(All Primaries 115V, 400 Cycles)			
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	6.3V/0.2A		\$3.85
KS13104	1450VCT/0.2-83A, 1050VCT/0.217A		7.50
KS9615	6.3V/4A, 3V/1A		1.57
KS9318	6.3V/4A, P/O R-55/ARQ-9		1.35
KS9608	1233/35MA, 1140VCT/07A		5.79
352-0102	6.3V/2.5A		1.45
M-7472426	1450V/10MA; 1.5V/75A; 6.4V/3.9A		
	5V/2A, 6.5V/35A; P/O 1D-39/-		4.95
	APG-13		
352-7039	640VCT @ 3 0MA; 6.3V/9A; 6.3V/-		5.49
	V6A 5V, 6A		8.95
702724	9500/8500 @ 32MA		22.50
K59584	5000V/290MA, 5V/10A		6.79
KS9607	734VCT/107A; 1710VCT/170A		
352-7273	700VCT/350MA; 6.3V/0.9A; 6.3V/-		6.95
	25A, 6.3V/08A, 5V/CA		
352-7070	242.5V/2.5A (2K) TEST 6.3V/-		7.45
	2.25A, 1200/100/750V @ 005A		
352-7196	1140/1.25MA; 2.5V/1.75A, 2.5V/-		3.95
	1.75A—5KV TEST		
352-7176	320VCT/50MA, 4.5V/3A, 6.3V/CT		4.75
	20A, 2x6.3VCT/6A		2.39
RA6400-1	2.5/1.75A, 6.3/2A—5KV Test		2.49
901699-501	13V/9A @ 62MA		3.45
901698-501	2.77V @ 4.25A—10KV Test		4.29
Ux8855C	900V/75MA, 100V/0.04A		3.79
RA6405-1	900VCT/067A, 5V/3A		3.89
T-48852	800VCT/65MA, 5VCT/3A		3.69
352-7098	700VCT/806MA, 5V/3A, 6V/1.75A		4.25
KS9336	2500V/6MA, 300VCT/335MA		5.95
M-7474319	110V/50MA TAPPED 62.5V/5A, 3.95		
KS80984	6.3V/2.7A, 6.3V/66A, 6.3VCT/21A		4.25
52C080	27V/4.3A, 6.3V/2.9A, 1.25V/0.2A		2.95
	650VCT/50MA, 6.3VCT/2A, 5VCT/-		3.75
	2A		
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/-		3.85
	1.5A		
68G631	1150-0-1150V 2MA		2.75
80G198	6VCT/0.0006 KVA		1.75
302433A	6.3V/3.1A, 6.3VCT/6.5A, 2.5V/3.5A,		4.85
	2.5/3.5A		
KS9445	592VCT/183MA, 6.3V/8.1A, 5V/2A		5.39
KS9685	6.4/7.5A, 6.4V/3.8A, 6.4/2.5A		2.69
70G30G1	600VCT/36MA		4.75
M-7474318	2100V/0.27A		4.95
352-7069	Eico 249 Wdgs at 2.5A, Each Lo-Cap,		5.95
	22Kv Test		
352-7096	2.5V/1.79A, 5V/13A, 6.5V/6A,		4.95
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342-7099	360VCT/20MA, 1500V/1MA, 2.5V/-		6.45
	1.75A, 6.3V/2.5A, 6.3V/6A, P/O		
	BC-929		

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90 degree elbows. "E" or "H" Plane
 2 1/2" radius \$8.50
 AT-68/U P 3 Cm Horn with Type N
 feed for receiver measurements, etc.
 New \$7.45
ROTARY JOINT (APS-6) Sperry PT #58275, 180 deg.
 rotation, choke-torque. Has "Built-in" Di-Coupler,
 20 DB, with "N" Takeoff. \$22.50
PARABOLOID DISH, 18" diam. Spun Aluminum, 8"
 Focus. For AN/APS-6. \$4.95
3CM. DIPOLE and Feed Assembly. (May be used with
 above dish.) 8 inches long. \$5.00
FLEXIBLE SECTION 9 in. long. Cover-to-Cover. \$5.50
ROTARY JOINT (APS-6) Sperry PT #58275, 180 deg.
 rotation, choke to choke. Has "Built-in" Di-Coupler,
 20 DB, with "N" Takeoff. \$22.50
3 CM. DIPOLE FEED, 15" L. for APS-15. \$14.50
MITRED ELBOW, Cast aluminum, 1 1/2" x 1 1/2" W.G.
 W.E. Flanges. "E" Plane. \$3.50
3 CM ANTENNA ASSEMBLY: Uses 17" paraboloid
 dish, operating from 24 vdc motor. Beam pattern: 5
 deg. in both Azimuth and elevation. Sector Scan:
 over 160 deg. at 35 scans per minute. Elevation Scan:
 over 2 deg. Tilt. Over 24 deg. \$35.00
Bulkhead Feed-Thru Assembly. \$35.00
Pressure Gauge Section with 15 lb. gauge. \$30.00
Directional Coupler, 10-40/U Take off 20db. \$17.50
MAGNET AND STABILIZER CAVITY For 2J41 Mag-
 netron. \$24.50

10 CM.—RG48/U Waveguide

100M ECHO BOX: Tunable from 3200-3333 Mc. For
 checking out radar transmitters, for spectrum analy-
 sis, etc. Complete with pickup antenna and coupling
 diodes. \$17.50
POWER SPLITTER for use with type 726 or any 10-CM
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 connectors. \$12.50
LHTR. LIGHTHOUSE ASSEMBLY: Parts of RT33
 APG 5 & APG 15, Receiver and Trans. Cavities w/
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 ver Plated. \$15.00
BEACON LIGHTHOUSE cavity p/o UPN-2 Beacon. 0
 cm. Mfg. Bernard Dice, each. \$27.50
MAGNETRON TO WAVEGUIDE Coupler with 721-A
 Duplexer Cavity, gold plated. \$31.50
721A TR BDX complete with tube and tuning plun-
 gers. \$12.50

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JOHN OSTER TYPE C 24A-1B-KS-5829-01-27 VDC 1/100 HP, 7000 RPM DC Series Motor 2" D x 2" L. Shaft Size: 1/8" x 1". Wt. 1 lb. **\$2.95**

GENERAL ELECTRIC 5BA25A132B—Flange type mount, 24 VDC @ 2.9 A, 7000 RPM, 3 wire reversible with Magnetic brake. Size: 2-1/4" x 1-1/4" L. Shaft size: 3/16" x 3/8". Splined. Wt. 2-1/4 lbs. Price **\$3.95**—Motor only.

GENERAL ELECTRIC 5BA25D2300—Flange type mount, 24 VDC @ 2.9 A, 1000 RPM. Governor controlled with Magnetic brake. Size: 2-1/2" D x 5-3/4" L. Shaft size: 3/16" x 3/8", Splined. Wt. 2-1/2 lbs. Price—Motor only **\$3.95**

AIR ASSOCIATES EE1430M2 SPEC. No. KS-5875L01—Flange mount, 27 VDC @ 20 A. 3/4 HP 3800 RPM. Size: 4-3/4" x 4-1/4" x 6-3/4" L. Keved shafts 1/2" x 1-1/2" with gear attached. **\$7.95** Wt. 9-3/4 lbs.

GENERAL ELECTRIC 5BA25M1424—Type RA—21 V @ 4.2 A, 7100 RPM 1/20 IHP. Flange mount. Motor size: 2-1/2" x 5". Shaft size: 1/4" x 1". **\$3.95** Wt. 2-1/2 lbs.

MINIATURE BLOWERS:

MOTOR and BLOWER—DELCO 5068571—27 VDC Reversible PM Motor, 6000 RPM, with Blower. Overall size, including Blower: 2 3/4" x 2 3/4" x 3". Wt. 0 oz. As pic—**\$4.50** shipped to left. Price.

DELCO 5069267—27 VDC, 6000 RPM, 1.5 oz. in. torque. Reversible Shunt Motor, Flange Mounted. Size: 1 3/4" x 2 3/4" L. Flange 2 1/4" D. Shaft: 3/4" x 1". Blower Fan attached. No. 10D267 **\$2.95**

24 VOLT 10 CFM BLOWER—Housed in a cast aluminum case. Shunt Type Motor 24 VDC @ .6 A, 5000 RPM with motor noise filter. Size: 3 1/2" D x 4 1/2" L x 4 1/2" H. Wt. 1 lb. 10 oz. No. **\$5.95** SS2345

115 VAC 400 CY. 10 CFM BLOWER—7200 RPM 1/100 HP. Bakelite Blower Housing. Overall size: 3 1/2" x 3 1/2" x 4 1/2". Wt. 1 lb. 7 oz. East—**\$5.95** em Air Develop No. J31A

10 CFM BLOWER—OSTER MOTOR G2BP-1A—27.5 VDC 1/100 HP, 7000 RPM. Bakelite Blower Housing. Overall size: 3 1/2" x 3 3/4" x 4 1/2". Wt. **\$5.95** 1 lb. 4 oz. Price.

115 V. 60 CYCLE BLOWERS:

115 VAC 60 Cycle SINGLE TYPE—100 CFM—2 1/4" Intake; 2" outlet. Complete size: 5" x 6". No. 1C939 **\$8.95**

115 VAC 60 Cycle DUAL TYPE—100 CFM—4" Intake; 2" Dis. Each Side. Complete size: **\$13.95** 8" x 6". No. 1C883

115 VAC 60 cycle COMPACT TYPE—108 CFM Motor built inside squirrel cage; 4-1/8" Intake; 3-3/8" x 3" Dis. Complete size 4-1/2" x 8-3/8" H **\$14.95** 8-3/8" D—No. 2C067

115 VAC 60 cycle FLANGE TYPE—140 CFM; 3-1/2" Intake; 2-1/2" Dis. Complete size: 7-1/2" **\$13.95** 7-1/4" H x 6-3/4" D—No. 1C807

115 VAC 60 cycle FLANGE TWIN—275 CFM; 4-1/2" Intake; 3-1/2" x 3" Dis. Complete size: 11-3/4" W x 2-3/8" H x 8-1/16" D—**\$21.95** No. 2C069

DYNAMOTORS

INPUT VOLTS	OUTPUT VOLTS	MA	STOCK No.	PRICES USED	NEW
12 VDC	220	70	DM-34	\$2.95	\$4.95
12	625	225	DM-35	9.95	
12	230	90	PE-133	4.95	6.95
12 or 24	540	450	DA-12		14.95
12 or 24	320	100	DA-14		8.95
14	220	70	DM-24	4.95	7.95
14	375	150	DM-25	3.95	4.95
14 VDC	330	150	BE-87	9.95	5.95
14	250	50	DM-25	6.95	8.95
24	250	60	PE-86		8.95
28	1000	350	PE-73	8.95	

Gear Reduction MOTORS:

DELCO 5069370 (Shown at left) 27 VDC Reversible PM Motor and Gear Assy. in an aluminum case. Output speed is 50 RPM through a friction clutch to a double shaft, 1/2" x 3/4" on one side, 3/4" x 1 1/2" on the other. Size complete Assy. 3 3/4" x 2" x 1 1/4" excluding shaft. Has built-in noise filter system. Wt. 1 lb. **\$5.95** 2 oz. Price.

Same Motor as used in above Assy. Size: 1 1/2" x 1 1/2" x 2 3/4". Wt. 4 oz. **\$3.95**

REVERSIBLE SHUNT MOTOR—Oster Type KU-IL-IR, 28 VDC @ 8 A. Heavy duty gear reduction motor, 2 1/2 lb. ft. torque, to 100-200 RPM. Size: 10" L x 7" W x 4 1/4" H. Shaft size: 7/16" D x 3/4" L. Wt. 1 1/4 lbs. **\$7.95**

PHILCO Gear Reduction No. 441-1008—24 VDC—Output speed 3.7 RPM 40 lb. inch torque. Size 4" x 3 3/4" x 5 1/2". Shaft size: 5/16" x 3/8". Wt. 3 lb. 12 oz. **\$5.95**

WINDSHIELD WIPER MOTOR—24 VDC. Very popular. May be used wherever an oscillation motion is desired, such as stirring or agitation. Size: 2" x 3 1/4" x 3 3/4". Shaft extends out 1 1/2" from motor. Wt. 1 lb. 10 oz. Stock No. 10D24. **\$2.95**

EMC 41314 110 VAC 60 Cy. Induction Motor with mounting feet. 1550 RPM through a gear reduction to 24 RPM. Right angle drive. Size: 4" x 3 1/2" x 7 3/4". Shaft size: 5/16" x 3/8" with removable Gear. Wt. 5 lb. 13 oz. **\$9.95**

WESTERN ELECTRIC RWC 2505 1—Holtzer Cabot No. KS5978-01. 115 VAC 60 Cy. 11 Watt. 65 RPM 7 1/2 oz. inch torque—Reversible. Size: 2 1/2" x 2 1/4" x 2 3/4". Shaft size: 3/16" x 1/2". Wt. 2 **\$9.95** lb.

GENERAL ELECTRIC 5BA10A152—27 V @ .85 A Gear reduction 145 RPM Output on a 1/4" x 3/8" Splined shaft, 1 1/4 oz. inch torque. Motor size: 1 1/2" x 3 1/2". Wt. 8 oz. (Pictured at right) **\$4.95**

G E 5BA10A1370 **\$4.95** —250 RPM

DELCO APPLIANCE 5069625—27 VDC—Gear reduction to 120 RPM output. Governor controlled speed. Size: 1 3/4" x 4 1/2". Shaft size: 1/4" x 3/8". Wt. 8 oz. **\$10.00**

HOLTZER CABOT Type 2505—115 VAC 60 Cy. 9 Watt 1.9 RPM Reversible 75 oz. torque. Has multiple disc cover wheel with micro switch mounted on bracket assy. Overall size: 3 3/4" x 4 3/4" x 4". Wt. 3 lb. 2 oz. **\$9.95**

AIR ASSOCIATES EE1530—Gear reduction, 24 VDC @ .8 A, 25 lb. inch torque, 5 RPM Reversible. Size: 4 1/2" x 3 3/4" x 5 1/2". Keved shaft: 1/2" x 1 1/4" with a 4" arm attached. Wt. 5 lb. **\$7.95**

JOHN OSTER Shunt Motor B-9-1—27 1/2 VDC @ 7 A, 5000 RPM. Aluminum cast motor and gear assy. Motor is flange mounted to gear case. Two gear reductions 22 and 5 1/2 RPM on 1/4" x 1 1/4" shafts. Size: 2 3/4" x 3" x 7". Wt. 5 lb. **\$3.95**

BENDIX LM108J—24 VDC 1/25 HP—15000 RPM Series Motor. General Loc. Actuator. Shaft rotates 1/2 revolution and stops. is locked in place until next contact is made, then the cycle is repeated. Time per cycle: approx. 3 seconds. Size: 4" x 2 1/4" x 5 1/2". Shaft size: 1/4" x 1/2". Wt. 1 lb. 14 oz. **\$7.95**

24 VAC Gear Motor No. 14-343—3 RPM output. Motor is flange mounted to gear case. Two gear reductions 22 and 5 1/2 RPM on 1/4" x 1 1/4" shafts. Size: 2 3/4" x 3" x 7". Shaft size: 5/32" x 1/2". Wt. 1 lb. 2 oz. **\$1.95**

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VTVM. Hewlett-Packard model 410B. L.N.	\$180.00
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FM SIGNAL GENERATOR. Measurements mod. 78FM. Very good condition.	\$175.00
UHF SWEEP GENERATOR. RCA WR-41B. Vy good.	\$225.00
TV SWEEP GENERATOR. RCA WR-59A. Very good.	\$85.00
TV SWEEP GENERATOR. RCA WR-59B. Very good.	\$125.00
TV SWEEP GENERATOR. RCA WR-59C. Very good.	\$150.00
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TRANSFORMER. 3100-0-3100 volt@ 1/2 amp! A real bratlet! PRIMARY 98-104-110-118-125 volts 60 cycles 600 ma. SECONDARY 0-3100-0-3100 @ 600 ma. 15 KV impregnated mica insulation. Conservatively rated. 9" x 8" x 7 1/2". NEW! 20 original mfg. wood boxes. 60 lbs. FOI NYC. **\$34.50**

10KV OIL FILLED "POWER" XFMR. New! Original Gen'l Electric. For radio station or industrial PRIMARY: 220 volts 3 phase 80 cycles. SECONDARY: 9800 v. @ 3.2 A OR 9850 @ 1 A. PLU 4025 @ 8 A. Meas. (Unrated) abt. 4 1/2" high x 3" x 2 1/2" deep. Wt. 1000 lbs. New! F.O.B. Phila. (worth \$4,200) our Price Only **\$250.00**

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Same high quality, same guarantee as before. Over 1000 other types in stock at sensible prices. Write for complete price list. Quotation requests invited

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3.6 RPM. \$3.15	60 RPM ... 4.85

Laboratory Special 1 of Each Motor \$25

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General Radio **VARIACS** in stock. Special Sale on a few 200-B (1 amp.) removed from equip't. **\$8.95**

HAND WOUND 10 Sec. to 24 Min. TIMER SWITCH. \$1.35

6 Watt Most POWERFUL TELECHRON MOTOR 110V 60 CY

1 RPM	\$6.50
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HAYDON TIMING MOTORS

110v 60 cycle 30 RPM.	\$2.60
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230v 52 RPM	1.00
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HANSEN Synchron 4 rpm \$4.24
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1 Amp. Mercury Switches ... 2 for \$1.00

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P. M. motors. Made for 24 volts. Will work at lower speed at 12v. or 6v. Battery or Rectifier. Size 1"x1"x2". **\$375**

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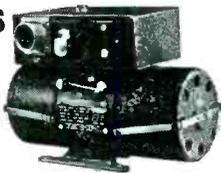
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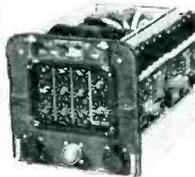
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- 12117 Bendix
Output: 26 volts; 400 cycles, 6 volt amperes, 1 phase. Input: 24 VDC; 1 amp. **\$15.00**
- 12121 Bendix
Input: 24 volt D.C. 18 amp. 12000 r.p.m. Output: 115 volts, 400 cycle, 3-phase, 250 volt amp, 7 pf. **\$49.50**
- 12123 Bendix
Output: 115 V; 3 phase; 400 cycle; 45 amp. .5 Input: 24 VDC; 12 amp. **\$49.50**
- 12126-2-A Bendix
Output: 26 volts; 3 phase; 400 cycle; 10 VA; 6 PF. Input: 27.5 volts DC; 1.25 amps. **\$24.50**
- 12130-3-B Bendix
Output: 125.5 VAC; 1.5 amps. 400 cycles single phase, 141 Va. Input: 20-30 VDC. 18-12 amps. Voltage and frequency regulated. **\$49.50**
- 12137 Bendix
Output 250 VA, 115 volts, 3 phase, 400 cycle, 1.25 amp., 0.8 pf. Input 27.5 volt DC, 20 amp. **\$59.50**
- 12147-1 Pioneer
Output: 115 VAC 400 cycles; single phase. Input: 24-30 VDC; 8 amps. **Price \$39.50 each**
- 778 Bendix
Output: 115 volt 400 cycle; 190 VA; single phase and 26 volt, 400 cycle, 50 VA, single phase. Input: 24 VDC. **\$37.50**
- 10285 Leland
Output: 115 volts AC; 750 VA, 3 phase, 400 cycle, .90 pf and 26 volts. 50 VA single phase, 400 cycle, .40 pf. Input: 27.5 VDC 60 amps. cont. duty, 6000 rpm. Voltage and frequency regulated. **\$59.50**
- 10339 Leland
Output: 115 volts; 190 VA; single phase; 400 cycle, .90 pf. and 26 volts; 60 VA; 400 cycle, .40 pf. Input: 27.5 volts DC, 18 amps. cont. duty, voltage and freq. regulated. **\$49.50**
- 10486 Leland
Output: 115 VAC; 400 cycles; 3-phase; 175 VA; .80 pf. Input: 27.5 DC; 12.5 amps.; cont. duty. **\$70.00**
- 10563 Leland
Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 pf. Input: 28.5 VAC; 12 amps. **\$35.00**
- PE109 Leland
Output: 115 VAC, 400 cyc.; single phase; 1.53 amp.; 8000 rpm. Input: 13.5 VDC; 29 amp. **\$50.00**
- PE218 Leland
Output: 115 VAC; single phase pf. 90; 380/500 cycle; 1500 VA. Input: 25-28 VDC; 92 amps.; 8000 rpms.; Exc. Volts 27.5. **BRAND NEW \$30.00**
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Output: 26 VAC @ 250 VA; 115 V. @ 500 VA; single phase; 400 cycle. Input: 24 VDC @ 36 amps. **\$40.00**
- MG153 Holtzer-Cabot
Input: 24 VDC; 52 amps. Output: 115 volts -400 cycles, 3-phase, 750 VA. Voltage and frequency regulated. **\$95.00**
- DMF2506M Continental Electric
24-30 volts input; 5.5-45 amps.; cont. duty. Output: 115 volts; .44 amps.; 400 cyc.; 1 phase; pf. 1.0; 50 watts. **\$39.50**
- 940702-1 Eicor, Class "A"
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component control type W-2 mfr's part No. 82455

This is the famous autopilot used on the F86 aircraft. Unit contains two gyros: a vertical and a directional mfgd. by Minneapolis-Honeywell. Unit also contains 5 plug-in Servo amplifiers, with a total of 30 tubes. Unit is in excellent condition, removed from the aircraft. Approximate Government cost \$3,000.00. Limited quantity available at **\$250.00 each**

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- 2.1FA1 Gen. 115/57.5V 400 cy. **5.00**
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Size: 2-5/32" long x 1 1/4" dia.; bearing one end 1/2" O.D.; Shaft Size: 1" long, threads 8-32-3/4" long, with bearing shaft 1/8" dia. x 1/4" long. Gear on shaft end 1-7/16" dia., gear on bearing end 1 1/8" dia. Drive gear 25/32" dia.

\$3.95 ea.

Stock No. 101

SIMPLE DIFFERENTIAL



1:1 reverse ratio, 60 teeth on large gear; 1/4" shaft. Size: 3" long with 1-15/16" dia.

\$3.95 ea.

Stock No. 106

SIMPLE DIFFERENTIAL



size 2-3/8" long, 1-1/8" diameter, 1/4" shaft each end 1-1 reverse ratio 32 teeth on input and output gear price **\$3.50 ea.**

Stock No. 149

Dual Simple Differential



1:1 reverse ratio or both. Size: 3 1/4" long x 1-7/16" dia. Shaft size 1/8" and 5/32".

\$7.50 ea.

Stock No. 110

SMALL DC MOTORS



- (approx. size overall 3/4" x 1 1/4" dia.~)
- 5069600 Delco PM 27.5 VDC 250 rpm **12.50**
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 - 5068571 Delco PM 27.5 VDC 10,000 rpm (1x1x2") **5.00**
 - 5069625 Delco 27.5 VDC 120 rpm w/governor **15.00**
 - 5BA10A118 GE 24 VDC 110 rpm **10.00**
 - 5BA10AJ37 GE 27 VDC 250 rpm reversible **10.00**
 - 5BA10AJ52 27 VDC 145 rpm reversible **12.50**
 - 5BA10AJ50, G.E., 12 VDC, 140 R.P.M., reversible **15.00**
 - 5BA10FJ32, G.E., 12 VDC, 9.5 R.P.M., reversible **15.00**
 - 5BA10FJ33, G.E., 12 VDC, 56 R.P.M., reversible **15.00**
 - 806069 Oster series reversible 1/50 h.p. 10,000 rpm 27.5 VDC 1 5/8" x 3 1/2" **5.00**
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Special Prices to Quantity Buyers. Most of Our Tubes are Jan.—95% are Original boxed — Brands such as R.C.A., G.E., Ken-Rad., Sylvania, Tung-Sol and Raytheon.

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
AB150	\$1.99	OB2	.89	2K25	18.99	5BP1A	2.99	12AU7	.76	274A	5.95	706A	6.75	815	1.99	1616	.59			C3J	6.35	1B22	1.69	2K28	29.50	5BP4	2.99	12CP7	12.95	274B	1.79	706B	14.50	816	1.05	1619	.92			C5B	.49	1B24	5.99	2K33A	59.95	5C22	25.00	15E	1.25			706C	17.50	826	.75	1625	.29			C6J	7.89	1B29	9.95	2K41	72.50	5CP1	3.99	15R	3.99			706DY	35.00	829B	9.95	1629	.29			CK-551AX/		1F30	1.99	2K45	32.50	5CP1A	12.49	26A/GT	1.19			707A	3.55	830B	2.49	1631	.59			2E41	1.79	2A4/G	1.10	2K54	8.95	5CP7	9.99	26C6	1.19			707B	3.95	832A	2.49	1634	.79			CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																		
C3J	6.35	1B22	1.69	2K28	29.50	5BP4	2.99	12CP7	12.95	274B	1.79	706B	14.50	816	1.05	1619	.92			C5B	.49	1B24	5.99	2K33A	59.95	5C22	25.00	15E	1.25			706C	17.50	826	.75	1625	.29			C6J	7.89	1B29	9.95	2K41	72.50	5CP1	3.99	15R	3.99			706DY	35.00	829B	9.95	1629	.29			CK-551AX/		1F30	1.99	2K45	32.50	5CP1A	12.49	26A/GT	1.19			707A	3.55	830B	2.49	1631	.59			2E41	1.79	2A4/G	1.10	2K54	8.95	5CP7	9.99	26C6	1.19			707B	3.95	832A	2.49	1634	.79			CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																						
C5B	.49	1B24	5.99	2K33A	59.95	5C22	25.00	15E	1.25			706C	17.50	826	.75	1625	.29			C6J	7.89	1B29	9.95	2K41	72.50	5CP1	3.99	15R	3.99			706DY	35.00	829B	9.95	1629	.29			CK-551AX/		1F30	1.99	2K45	32.50	5CP1A	12.49	26A/GT	1.19			707A	3.55	830B	2.49	1631	.59			2E41	1.79	2A4/G	1.10	2K54	8.95	5CP7	9.99	26C6	1.19			707B	3.95	832A	2.49	1634	.79			CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																										
C6J	7.89	1B29	9.95	2K41	72.50	5CP1	3.99	15R	3.99			706DY	35.00	829B	9.95	1629	.29			CK-551AX/		1F30	1.99	2K45	32.50	5CP1A	12.49	26A/GT	1.19			707A	3.55	830B	2.49	1631	.59			2E41	1.79	2A4/G	1.10	2K54	8.95	5CP7	9.99	26C6	1.19			707B	3.95	832A	2.49	1634	.79			CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																														
CK-551AX/		1F30	1.99	2K45	32.50	5CP1A	12.49	26A/GT	1.19			707A	3.55	830B	2.49	1631	.59			2E41	1.79	2A4/G	1.10	2K54	8.95	5CP7	9.99	26C6	1.19			707B	3.95	832A	2.49	1634	.79			CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																		
2E41	1.79	2A4/G	1.10	2K54	8.95	5CP7	9.99	26C6	1.19			707B	3.95	832A	2.49	1634	.79			CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																						
CRP RK-		2AP1	3.99	2K55	9.50	5CP11A	14.99	28D7	1.89			708A	2.99	833A	31.50	1641	1.88			72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																										
72	.49	2APIA	6.44	2K57	1.39	5D21	6.99	78P7	5.00			708A	2.99	833A	31.50	1641	1.88			EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																														
EC1	1.99	3B22	1.89	2V3/G	1.39	5FP7	3.99	91P7	5.00			713A	1.69	837	1.99	1642	.39			EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																		
EF-50	.80	2BP11	7.99	2X2	.34	5JP1	2.49	10Y	.39			714AY	24.95	839	3.50	1644	.49			E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																						
E148	.29	2C21	.49	2X2A	.89	5JP4	14.99	24R	1.89			715A	2.65	841	.49	2050W	2.40			EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																										
EM-3GA	39.50	2C22	.39	3A5	.69	5J32	65.00	35T	4.99			715B	2.65	843	.49	2051	.95			F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																														
F123A	5.99	2C26	.39	3AP1	5.95	5J33	7.99	35TG	7.25			717A	14.50	845	6.49	2051	.76			FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																		
FG17	4.50	2C26A	.49	3AP11A	4.95	5LP1	13.99	53A	2.29			718AY/CY	.49	851	16.50	5651	1.39			FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																						
FG-105	14.99	2C39	4.99	3B22	1.49	5NP1	6.99	53A-62	24.50			EY/DY	29.75	861	19.00	5656	1.40			FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																																										
FG-154	14.99	2C39A	11.50	2B24	3.25	5R4WGY	3.19	RK65/	14.95			EY/DY	14.65	864	.49	5670	2.20			HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																																																														
HF-100	7.49	2C40	10.99	3B24W	4.99	6C21	19.95	5023	14.99			720CY/DY/		866A	1.19	5687	1.79			HK-24	3.69	2C42	9.75	3B25	3.99							EY	29.75	866A	1.19	5702	1.49			HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																																																																																		
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HK-54	3.99	2C43	10.99	3B27	3.49							721A	1.49	866JR/		5702WA	3.10			HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																																																																																																																										
HY-65	1.20	2C44	1.35	3B27	4.69							722	1.99	2B26	1.40	5703	1.39			HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																																																																																																																																														
HY-114B	69	2C46	7.49	3B27	2.99							723A/B	8.99	869E	30.00	5725	1.99			KU-610	3.49	2C51	2.75	3BP1A	6.35							724A	1.45	872A	1.29	5744	.91			MY-65	1.70	2C53	9.90	3C21	1.29							724B	1.45							REL-21	1.00																																																																																																																																																																																																																																																																																																																																																																																																																																		
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CRYSTAL	DIODES	IN21	IN21A	IN21B	IN22	IN23A	IN23B	IN27	IN34	IN34A
		.19	.55	.69	.49	.49	3.55	.69	.89	.84
		.39	.55	.69	.49	.49	3.55	.69	.89	.84
		.49	.55	.69	.49	.49	3.55	.69	.89	.84

Manufacturers, exporters, and large quantity users—Inquire on your letterhead for our inventory listing of receiving tubes, special purpose tubes, resistors, condensers, and other radio and television parts.

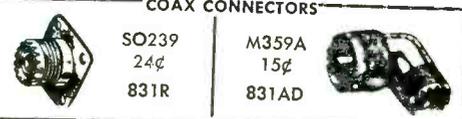
RK-34	.39	2E24	2.49	3C22	64.95	6AC7	.64	89Y	.15	394A	2.99	725A	3.99	874	1.25	5751	2.1
RK-39	3.63	2E27	.95	3C23	1.50	6AC7W	1.50	100TH	6.95	WL-417A	2.74	726A	9.50	876	.99	5760	2.9
RK-60	1.99	2D21	1.79	3C24	5.95	6AG7	.79	203A	5.99	GL-434A	6.66	726B	25.00	878	.80	5763	1.2
RK-61	2.50	2D22	2.29	3C33	8.99	6AJ5	1.19	205B	1.99	446A	1.49	728A/B/Y	24.50	884	1.00	5814	1.39
RK-65/5D23	14.99	2J21	2.99	3C45	6.25	6AK5W	1.35	207	49.50	446B	1.79	CV/DY		885	1.10	5851	3.25
RK-73	.89	2J21A	4.95	6AN5	2.25	6AK5	1.49	215A	3.25	WL-460	8.99	802	3.99	902P1	.69	5879	1.10
RX-233A	.69	2J22	4.99	6AR5	2.25	6AN5	2.12	211	4.99	WL-464A	4.25	801	1.29	902P1	2.99	5933	2.95
VT25/10	.49	2J26	2.99	6AS5	4.99	6AS5/G	1.19	217A	2.99	CK-508AX	1.25	801A	4.29	911	1.99	5963	1.19
VT25A/10Y	.39	2J27	1.88	6AST/G	2.49	6B6	2.49	217C	4.99	CK-521AX	1.10	802	2.89	927	2.99	5972	.74
VT67/30 Spec	.26	2J30	14.50	6B6W	39.50	6C4	49	233A	1.19	WL-530	19.50	803	4.90	958A	.33	8005	18.50
VT-158	17.50	2J31	14.50	6D4	2.99	6D4	2.99	242C	8.00	WL-531	19.50	804	9.99	957	.33	8005W	3.90
VT-111	.19	2J32	14.00	6E4	2.49	6E4	2.49	249B	2.99	70A/B/C/D/	.99	805	4.90	958A	.33	8012	4.50
1B32/532A	.99	2J33	13.50	6J4W	49.94	6J4W	3.75	250TH	24.95	70A/B/C/D/	.99	807	1.25	959	.39	8012	1.85
QK-59	29.50	2J34	13.50	6HP7	4.69	6J6W	1.29	250R	4.99	70A/B/C/D/	.99	807A	3.25	991	.39	8013	2.50
QK-61	32.00	2J35	11.00	4A-11	4.99	6K4	3.99	253A	3.39	70A	10.99	808	1.78	CK1005	1.99	8013	3.49
QK-185	99.00	2J49	39.50	4B36	4.69	6K4	1.49	254A	5.99	70A	4.99	809	3.15	CK1006	.46	8020	2.99
VF-78	.89	2J61	16.40	4C27	35.50	6K4W	5.95	263A	3.90	70A	2.25	810	12.95	1500T	94.50	8041	1.99
VF-90	.99	2J62	9.60	4C28	5.95	7B1	9.95	265A	3.90	70A	1.90	811	3.19	1608	2.99	9001	.79
VF-105	.79	2K22	14.50	4E27	3.95	12A6	.99	269A	13.50	70A	1.59	813	11.49	1614	2.49	9002	.69
VF-150	.79	2K23	16.50	5BP1	2.49	12A7	.85	271A	12.99	70A	1.25	814	2.49			9006	.19

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6211	1.00	12AY7	1.50
5965	1.00	12AX7	.75
5844	1.00	12BH7	.75
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		EL6B/NL618	5.50

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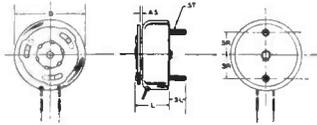
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other Radar equipment. New, in original boxes.
\$25.00 each*

Ledex & Oak Rotary Solenoids

	BDOE	BD3E	BD5S	BD6S
D Diameter.....	7/8"	1-5/16"	1-7/8"	2-1/4"
L Length.....	5/8"	25/32"	1-1/64"	1-5/16"
AS Axial Stroke (Approx.)..		.0315"	.055"	.066"
SL Stud Length.....		7/16"	1/2"	5/8"
SR Stud Radius.....		7/16"	5/8"	23/32"
ST Stud Thread.....		5-40	8-32	10-32
Weight (Approx-Bare).....		3-1/2 oz	9 oz	18 oz
Torque lbs-inches*		1.0	4.0	7.5
Finish.....	Nickel or Black Nickel			



*The Torque values given are average and are based on the ampere-turns for a normally intermittent duty cycle.

In the Ledex rotary solenoid the magnetic pull moves the armature along the solenoid axis. This linear action is effectively converted into a rotary motion by means of ball bearings on inclined races.

Listed below are Ledex solenoids from our stock. These all have a 45° stroke. Both continuous and intermittent duty voltages are indicated. The intermittent voltage listed is for ten seconds or less and the "off" time is nine times the "on" time. Under these circumstances the units should be installed so that there is free circulation of air around them.

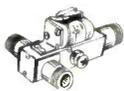
Type	Rot.	Stroke	Wire Size	Ohms	Volts DC Cont.	Return Int.	Spring	Finish	X Features	Stk #	Ea*
BD6SR45-22X7X8	CW	45°	22	2.2	8.3	26	yes	Cad.	Dust Cover	R1219	3.75
BD5SL45-23X3	CCW	45°	23	2.0	6.0	19	no	Blk	5/16"L. Shaft Extension	R1220	2.00
BD5SL45-25X3	CCW	45°	25	5.0	9.5	30	no	NKL	5/16"L. Shaft Extension	R824	2.00
BD5SL45-26X3	CCW	45°	26	7.7	12	38	no	NKL	5/16"L. Shaft Extension	R825	2.00
BD5SR45-33X2	CW	45°	33	185	60	190	no	NKL	Forward Engaging Pawl	R597	2.00
BDOER45-29X5	CW	45°	29	5.0	5.2	16	no	Blk	Offset Drive Pin	R827	1.50
BDOEL45-30X5	CCW	45°	30	8.0	6.6	20	no	Blk	Offset Drive Pin	R1221	1.50
BDOER45-32X5	CW	45°	32	2.2	11	32	no	NKL	Offset Drive Pin	R826	1.50

LEDEX & OAK STEPPERS

Ledex Rotary Solenoids provide the mechanical power to drive the gang of rotary, wafer type switches. Self-imposed oscillation of the solenoid operated relay is obtained by the cam operated Commutating Switch combined with a Solenoid armature return spring. Ratchets transmit the oscillating action of the rotary solenoid to the switch rotor shaft. A Control Wafer may be used on the Ledex Relay to determine the position of the switch rotor shaft when the oscillation of the solenoid is stopped. Circuit wafers may be designed for specific applications thereby making many switching patterns possible.

All units with shafts are supplied with hardware for mounting standard wafer switches.

Type	Rot.	Shaft Length	Self Pulsing Deck	Wire Size	Ohms	Volts Cont.	Int.	X Features	Stk #	Ea*
BD3ER30-28X8	CW	7/8"	yes	28	8	8.4	26.5		R1222	4.75
BD3ER30-28X8X9	CW	7/8"	yes	28	8	8.4	26.5	Dust Cover	R1223	5.00
BD3ER30-37X9	CW	1-1/4"	no	37	426	67	210	Mtg Flange	R1224	5.00
BD5SR30-33X6	CW	1-1/4"	yes	33	176	60	190	Threaded Holes	R1225	4.00
BD5SR30-34X6	CW	1-1/2"	yes	34	270	76	240	Threaded Holes	R1226	4.00
BD5SR45-26X9	CW	7/8"	yes	26	5	8.4	26.6		R1227	5.00
BD5SR30-26X7	CCW	1-1/2"	yes	26	5	8.4	26.6	Terminal Board	R1228	5.50
BD5SR30-26X7	CCW	1-1/2"	yes	26	5	8.4	26.6	Mtg Flange	R1229	5.50



**CO-AXIAL
RELAYS**

For operation on 52 ohm lines.

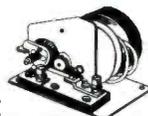
ADVANCE: SPDT (1C); BN Connectors; Standing Wave Adjustments

- #R1217: 10 ma; 10,000 ohm.....\$10.00*
- #R1218: 24VDC; 160 ohm.....\$ 8.50*
- #R1239: 6VDC; 25 ohm.....\$ 8.00*

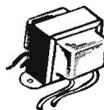


CLARE 55476: 24VDC; SPDT- (1C); 275 ohm; S0239 Connectors; #R751.....\$8.50

**KURMAN
TIME DELAY**



R-300, motor driven 110 V 60 cycles; continuously adjustable delay 10 to 60 seconds; SPST (1A); #R671\$7.95* ea

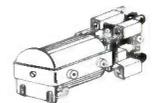


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24V. 1.5 Amp Transformer (#T120), Rectifier, and 200mf Capacitor; #P5103.....\$3.95 ea.

PRICE

45A: 24VDC; SPDT(1Z) double break; 50 ohm; Conservatively rated at 9000 volts, RMS, working; #R1216\$10.00*



WESTERN ELECTRIC

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D151624: 24VDC; SPST(1X) double break; 200 ohm; rated at 5000 volts, RMS, working; #R1215\$8.00*

HIGH-VOLTAGE RELAY

LEACH

1421 & 1521



Volts	Stk #	Ea*
6DC	R26	6.00
12DC	R27	6.00
24DC	R07	6.00
48DC	R28	6.50
100DC	R29	7.00
110AC	R08	7.00

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Universal general corp.

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SO-239.....	.40	UG-88/U.....	.65
M-359.....	.30	UG-146/U.....	1.75
UG-211/U.....	.85	UG-201/U.....	1.50
UG-27/U.....	.65	UG-255/U.....	1.70
UG-29/U.....	.75	UG-260/U.....	.65
UG-58A/U.....	.75	UG-273/U.....	1.10
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10K 10 Turns 0.5% Linearity—Helipot.....	\$6.95 Ea.
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Helipot Duo Dials available for above.	

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5CT.....	34.50	7DG.....	47.50
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1N21A.....	.05	2C38.....	4.90	EL5BHD/4B23.....	3.50	100TH.....	5.00	717A.....	.34	5636.....	1.75
1N23.....	.10	2C39.....	5.50	5B21.....	.65	100TL.....	5.00	721A.....	.45	5637.....	3.90
1N27A.....	.79	2C39A.....	8.00	5C30.....	2.00	114B.....	.10	721B.....	3.95	5653.....	1.10
1N31.....	.80	2C43.....	8.00	5J29.....	2.50	VU120.....	.15	722A.....	.48	5659.....	2.50
1N82.....	.29	2C44.....	.20	5J30.....	1.20	VU23A.....	2.00	CHS724A.....	.79	5676.....	.95
HD2070.....	.69	2C46.....	4.25	5J33.....	2.25	VXR130.....	1.10	725A.....	2.90	WL5684.....	5.90
HD2071.....	.69	2C52.....	2.00	ELC6A.....	2.10	152TL.....	2.00	728CY.....	9.50	5686.....	1.20
HD2072.....	.69	2D21.....	.60	6BP7.....	1.00	203A.....	1.50	801.....	.25	5691.....	2.25
3EP1.....	.95	2E26.....	1.90	6BG7.....	1.00	211W.....	.49	801A.....	.42	5692.....	4.50
5BP4.....	2.50	2J21A.....	2.00	6BG7.....	1.00	CEP217C.....	1.50	CRC814.....	1.98	5693.....	3.50
5CP1.....	1.95	2J22.....	2.50	6J6W.....	.59	RX-233A.....	1.25	815.....	1.20	5696.....	.79
5CP7.....	2.95	2J32.....	6.00	6P5G.....	.40	274B.....	1.10	SD828A.....	2.50	5718A.....	.79
5GP1.....	3.00	2J38.....	6.50	6SK7W.....	.65	282A.....	3.50	830B.....	.28	5719.....	1.60
5JP7.....	4.50	2J59.....	4.95	6SK7Y.....	.55	EL302.5.....	1.75	832A.....	2.75	5722.....	3.50
5JP7AC.....	4.50	2K25.....	10.00	6X4W.....	22.50	TR317.....	.39	836.....	1.00	5726.....	.50
5Z2P5.....	4.95	3B22.....	1.05	10E/CV92.....	1.00	358A.....	.69	837.....	1.10	5744.....	.95
7BP7.....	1.00	3B23.....	2.25	10E/222-VCR97.....	.95	WE408A.....	5.95	838.....	.35	5763.....	.95
9GP7.....	3.90	3B25.....	2.50	10E/222B-VCR97.....	1.10	WL417A.....	1.95	CRC842.....	1.00	5844.....	1.10
9JP1.....	1.10	3B25.....	2.50	10E/231.....	1.00	WE403B/5591.....	2.00	843.....	3.00	5851.....	3.00
9LP7.....	2.50	EL3C.....	2.00	12C8.....	.30	471A.....	.60	851.....	5.50	5852.....	4.50
10CP4.....	2.95	3C24.....	1.00	RK20A.....	2.50	CK501AX.....	.50	852.....	3.50	5933/807W.....	2.95
OA3.....	.85	3C45.....	5.50	RK21.....	5.00	RH507.....	12.50	864.....	10.50	5944.....	.95
OB2.....	.59	3D21A.....	2.50	CE25A/B.....	1.10	WL532A.....	2.00	869B.....	.50	6147.....	1.50
1B26.....	.98	3K30.....	39.50	26A6.....	.59	WL532A.....	2.50	878.....	4.00	6186.....	1.95
1B32/532A.....	.49	ML3W.....	.75	FG32.....	1.79	CK574AX.....	.89	884.....	.75	6187.....	1.95
1B36.....	3.50	4J21.....	22.50	RP60.....	.30	702B.....	.79	SC968.....	2.50	6189.....	2.25
1B41.....	22.50	4J22.....	23.00	RK60/1641.....	2.50	705A.....	.89	CK1090.....	.69	6197.....	1.50
1B63A.....	14.80	4J23.....	13.50	OK61.....	4.95	707A.....	1.25	L201.....	.65	6211.....	.95
1B35A.....	1.28	4J27.....	29.50	OK62.....	7.95	707B.....	.69	1611.....	.79	7193.....	.30
ELIC.....	.55	4J28.....	39.50	HY65-5D23.....	.69	708A.....	.79	1619.....	.79	8025.....	.90
2C22.....	.55	EL51/4B22.....	3.50	RKR72.....	.20	713A.....	.49	1629.....	.49		

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AC-181—AC-281—RB-212 S2—RB-312 S2—RC-9R—RS-14-1R
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New G.E. 115-v 60-c selenium rectifier unit. Will supply DC voltage by lab. work, signaling, power supply systems, experiments, radio and TV test benches, etc. Furnishes pure, well filtered direct current adjustable from 25 to 210-v. Also AC voltage adj. from 50 to 230-v. Attractive cabinet. Rough and fine adjustments. Govt. Cost over \$200. SALE \$15.61 F.O.B.

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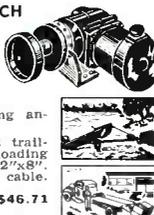
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Finest large 110-v 60-c powerful Selsyns. Marvelous for experimental use. Make wonderful wind direction weather units. Transmit mechanical motion electrically. Run on small AC generators, etc. Many uses. Size 4"x6". Wt. 8 lbs. each. Runs directly off 110-v 60-c. Govt. cost \$19.50. SALE, \$15.41 per pair Ppd. or \$8.00 each.

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Operates from 6 or 12-v battery or 1000-lb. capacity. Powerful expensive fully reversible Govt. ball bearing motor with built-in 100% rated precision reduction gear. Gives smooth powerful pull on winch cable. Hundreds of applications. Mount on boat trailers, boat docks, raising anchors, etc. Ideal for trucks, farm equipment trailers, industrial uses. Cuts labor loading costs 90%. Wt. 54 lbs. 17"x12"x8". Drum holds 40' 1/4", or 75' 3/16" cable. Govt. Cost over \$200. F.O.B. Lincoln. SALE \$71.46



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- Gear Reduction Unit 85 to 1 (\$60) \$8.91
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Amazing buy! Will operate golf cars, factory personnel carriers, boys auto, and 00s other uses. Powerful expensive ball-bearing gear reduction motor runs on any 6-v or 12-v storage battery. Full instr. Easily reversible. Wt. 34 lbs. Govt. cost over \$200. Sale \$19.46 F.O.B.

GEAR-HEAD MOTOR

Brand new. Will operate air dampers, valves, remote heat steering window and door locks, garage doors. Remote tuning, rotate antenna arrays, etc. 9000 mm all ball-bearing motor driving a worm gear, rotary double shaft. Very powerful due to high (1000 to 24) reduction ratio. Output speed is 6-10 rpm. Will operate on 6 to 24 volts DC or 8 to 12 volts AC. Fully reversible. Has limit switches to control travel limit. Splined dble. shaft 3/8" dia. Overall dimensions 9"x5"x4". Marvelous equipment buy. Govt. cost over \$100. SALE \$8.72 ppd



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Elaborate expensive laboratory type tube tester. Model OQ2. Test hundreds of types including industrial, home receiver, TV, etc. Attractive oak case 8"x12"x24". Three precision meters, rectifiers, etc. Works on 110-v 60-c. Full instructions. Slightly used—perfect. Wt. 35 lbs. Govt. cost over \$100. SALE \$14.90 F.O.B. Lincoln

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New 110-v 60-c electronic unit. Push-pull amplifier-rectifier. Useful in lab. control circuits. In A-C control application, voltage applied to input will produce a DC voltage for motor or relay operation at output. Ideal for study Servo-Selsyn circuits, etc. 10 1/4"x 9 1/4"x5 1/4". Govt. Cost over \$150. SALE \$6.96 Ppd

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Genuine Kellogg standard dial telephone. Will work on any modern system either main phone or as remote extension phone. Completely self contained transmission circuit, signal bells. Easy to connect. Complete with cord. List \$30.50. SALE, \$13.91 Ppd.

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4X150G	25.00	828	9.00
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4-25A	18.00	330B	.69
4-250A	36.00	836	1.25
4-400A	50.00	838	1.00
6A3	4.00	843	5.00
100TH	6.00	845	1.50
F129B	14.50	849	17.50
203A	2.50	851	15.00
250TL	15.00	852	4.00
250TH	24.00	858	275.00
348A	5.00	860	3.00
358	6.00	86A	1.45
450TH	40.00	872A	1.15
450TL	35.00	880	250.00
508	275.00	898A	100.00
575A	10.00	1500T	75.00
HA-654	17.50	1603	4.75
750TL	39.95	811	2.50
807	1.25	1620C	2.95
5763		1.15	

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1C	1.20	FG-172	19.95
2D21W	1.20	FG-271	37.50
3B22	2.50	FG-627	10.00
3C45	3.00	677	10.00
4B25	8.00	715C	11.95
CSB	7.00	VT-158	11.75
SC22	26.00	2059	1.00
CGM/5528	7.00	811	2.00
FG-105	53.75	2051	1.00
	10.00	5528/C6L	10.00

5,000 SERIES & UP			
5517	\$13.35	5829	\$10.00
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5559	9.00	5842/404A	13.00
5588	POR	5844/417A	12.50
5591	1.75	5845	4.00
5596	12.00	5851	4.00
5607	250.00	5854	1.30
5610	1.50	5876	11.00
5611	48.00	5896	5.00
5633	6.00	5896A	5.25
5635	1.00	5898	7.50
5636	2.95	5899	4.00
5637	5.50	5899A	7.00
5640	6.00	5902	6.00
5641	6.00	5902A	6.00
5642	1.00	5932	5.00
5643	1.00	5935	2.85
5644	7.50	5987/175A	25.00
5645	6.00	5960	40.00
5646	4.50	5967	10.00
5647	4.50	5969	2.00
5651	1.40	5977	3.75
5654/6A5W/		5977A	4.50
6095	5.00	6025	4.00
5663	1.25	5998	5.00
5670	1.00	5995	4.50
5670WA	4.50	6005	2.00
3678	.90	6028/408A	2.00
5687	115.00	6032	6.00
5691	4.75	7044	30.00
5692	5.00	6328	3.50
5693	4.75	6080	4.75
5696	1.00	6098	1.40
5702	1.65	6098CT	1.90
5702WA	6.00	6099	1.40
5703	1.50	6100	2.00
5703WA	4.50	6101	4.25
5718	4.85	6112	6.00
5719	1.75	6116 Klvs	125.00
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5726	2.00	6161	70.00
5726	.60	6189	2.50
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5807	3.50	6211	1.45
5732	2.50	6232	15.00
5744	1.25	6263	12.50
5749	1.25	6293	POR
5750	3.00	6326	POR
5763	1.15	6328	POR
5783	1.50	6364 Phot.	40.00
5783WB	5.50	Mult.	40.00
5784	4.00	6374	5.00
5784WA	6.50	6392	3.00
5787	4.85	Mult.	30.00
5794	5.00	8005	5.00
5797	8.50	8020/100R	2.95
5799A	POR	9002	.60
5814	7.5	9003	1.35
5814WA	3.25	9006	.20

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OC3	.65	1001G	12.50
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2X2	.50	314A	80.00
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5R4V	1.35	850R	2.00
5R4WGY	4.00	869B	32.50
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2J26	4.50	4J59	165.00
2J27	4.50	4J64	250.00
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2J55	45.00	6K60	22.50
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3DP7	5.00	5F7A	2.50
3DP7S2	15.00	5J1P	10.00
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902P1	2.50		

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	6211	1.35	

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1N25	2.25	1N38A	.60
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GAC7V	2.00	6K4T	.35
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GAG7	.70	6L6CA	1.15
GAG7V	1.25	6L6C	1.00
GAG6	1.00	6Q5G	3.95
6AJ5	1.15	6SK7GT	.69
6AK6	.65	6SK7	.75
6AL5W	.60	6SN7GT	.65
6ANSWA	3.75	6SN7	1.20
6AQ5W	1.70	6SWGT	1.95
6AT5	2.75	6SK7W	1.90
6A7S	.55	6X4W	1.75
6BA5	.58	6X5WGT	1.40
6BA7	.79	7F8W	2.00
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2C46	6.00	RT-434	25.00
3E29	8.50	592A	18.50

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2K28	27.50	3K10	100.00
2K45	45.00	V-45	POR
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2K54	15.00	V-82	POR
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6BM6	32.50	6116	250.00

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1B35	4.25	1Q22	70.00
1B35A	7.50	G4A	2.50
1B40	2.00	5Z22	POR
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3—2000 Watt —37 1/2 KVA

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111 LIBERTY ST., N. Y. 6, N. Y.

On Wednesday
Dec. 12th 1956 at 10 A.M.

SOME OF THE MORE IMPORTANT
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ARMY, NAVY, AIR, End Equipment, Power Supplies, Receivers, TS Sets & others.

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RESISTORS, in excess of 100,000 fixed & Variable, Wirewound, Carbon, Ceramic, Precision, all types & mfg'r's.

SWITCHES, in excess of 25,000 MICRO, Mu, CH, Toggle, Push, gang all types.

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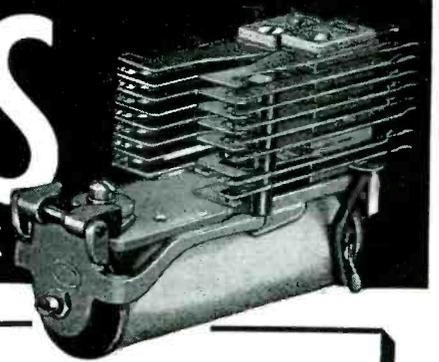
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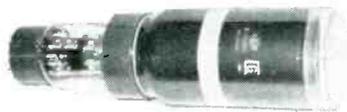
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- TS-24 TS-251
- TS-32 TS-268
- TS-33 TSX-45E
- TS-34 I-56
- TS-35 I-122
- TS-36 I-177
- TS-45 I-222
- TS-47 IE-12
- TS-59 IE-19
- TS-89 IE-36
- TS-110

GROUND ELECTRONICS

- ARB BC-342
- ART-13 BC-344
- APR-4,-5
- BC-191 BC-348
- BC-222 BC-375
- BC-224 CRT-3
- BC-312 TC5-12
- BC-374

AIRCRAFT ELECTRONICS

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- ARC-3 MN-62
- ARC-4 MN-53
- ARC-5 LP-21
- ARC-12 LP-31
- ARN-6 AS313-B

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- Pioneer 12133
- Pioneer 12137
- Pioneer 12123
- Pioneer 12117
- DY-11 PE-2 06
- DY-12 5D2IN3A
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| RF4/AP | 1-96A | TS125/AP | TS251 | |
| TS12/AP | TS-45 | TS126/AP | TS258 | |
| TA13/AP | TS47/APR | TS147 | TS270 | |
| TS14/AP | TS65/AP | TS174/AP | TS418 | |
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SPECIAL PURPOSE TUBES

OA2	\$.75	9K55	5.00	5J31	15.00	FG-32	3.50	WE-286A	3.50	804	7.50	2050	1.00
OA3/VR-75	1.00	9P91	50.00	5J32	7.50	VX-32B	7.50	WE-287A	2.00	805	6.00	2051	.65
OA4G	1.00	2V3G	1.25	5J31	10.00	FG-33	15.00	GL-299	2.00	806	10.00	R-4330	7.50
OA5	3.50	9X2	.25	5J32	5.00	VX-33A	5.00	WE-300B	5.00	807	1.10	5517	1.50
OB2	.75	2X2A	.85	5J32A	10.00	35T	3.00	304TH	10.00	807W	1.50	5528	7.50
OB3/VR-90	.75	3A4	.50	5J34	5.00	35TG	2.50	304TL	15.00	808	1.00	5550	25.00
OC3/VR-105	.60	3A5	.50	5J35A	10.00	RK-39	1.20	WE-305A	2.50	809	2.25	5551	40.00
OC3W	2.50	3ABP1	75.00	5J37A	25.00	VX-41	2.50	307A	.50	810	10.00	5553	75.00
OD3/VR-150	2.50	3AP1	2.00	5J37A	10.00	RK-49	2.50	WE-310A	4.00	811	2.85	5556	6.75
OD3W	2.50	3AP11A	5.00	5LP1	10.00	FP-54	25.00	WE-310B	6.00	811A	3.50	5557	3.50
EL-C1A	6.00	3B21	3.50	5LP1A	25.00	HK-54	3.00	WE-311A	5.00	812	2.50	5558	3.50
EL-C1B	1.00	3B24	1.00	5LP2A	10.00	T-55	3.00	WE-313C	3.50	813	10.00	5559	10.00
EL-1C	1.25	3B24W	4.00	5LP5	10.00	VX-55	6.00	WE-316A	.50	814	2.00	5560	15.00
1AD4	.90	3B24WA	8.00	5LP11A	20.00	RK-60/1641	1.00	WE-323A	9.00	815	.90	5584	3.00
1AE4	1.00	3B25	4.50	5NP1	1.00	RK-61	3.50	WE-323B	5.00	816	1.10	5610	1.00
1AF4	2.50	3B26	3.00	5R4GY	1.20	RK-62	2.00	WE-328A	3.50	826	5.00	5632	7.50
1AG5	2.00	3B27	2.00	5R4WGY	2.50	HY-65	.75	WE-328A	3.50	828	7.50	5634	6.50
1B22	1.25	3B28	4.50	5RP1A	35.00	RK-65/5D23	6.50	WE-336A	4.50	829	3.50	5637	3.75
1B24	5.00	3B29	4.50	5RP7A	35.00	FG-67	9.00	WE-337A	6.00	829B	8.50	5638	6.50
1B27	10.00	3BP1	1.50	5RP11A	35.00	HY-69	2.00	WE-338A	4.50	830B	.50	5640	6.50
1B32	1.00	EL-3C	5.00	5SP1	50.00	RK-69	2.00	WE-339A	7.50	832	2.50	5642	1.00
1B35	3.50	EL-C3J	7.50	5X3	2.50	RK-72	.50	WE-347A	2.50	832A	5.00	5644	6.50
1B36	3.75	3C22	50.00	5X3P1	35.00	RK-73	.75	WE-349A	5.00	833A	29.75	5645	3.50
1B38	25.00	3C23	3.75	5XP1	50.00	HY-75	3.00	WE-350A	2.50	834	7.50	5647	5.00
1B42	4.00	3C24	3.50	5XP2	35.00	RK-75/307A	.50	WE-350B	15.00	836	1.25	5650	60.00
1B46	1.75	3C33	7.50	5XP5	35.00	75TL	7.50	WE-352A	15.00	837	1.25	5651	1.35
1B47	4.00	3C45	6.00	5XP11	50.00	VR-78	.75	WE-353A	3.50	838	1.00	5654	4.50
1B59	10.00	3D21A	3.00	5YP1	35.00	FG-81A	3.50	WE-355A	10.00	842	1.25	5670	1.25
1C21	2.00	3D22	7.50	5Z2P7	25.00	VR-91A	2.00	WE-356B	3.50	843	5.00	5672	1.00
1D21/SN4	5.00	3DP1	3.00	5Z4P11	50.00	FG-95	15.00	WE-368AS	1.25	845	3.50	5675	7.00
1D85	2.50	3DP1A	5.00	EL-C6A	10.00	100R	2.50	371B	1.50	849	25.00	5676	1.25
1P21	35.00	3E22	4.85	EL-C6J	12.00	100TH	5.00	WE-388A	1.50	850	7.50	5678	1.00
1P22	5.00	3E29	8.50	EL-C6L	7.50	100TL	12.50	WE-393A	4.50	851	10.00	5678	1.00
1P25	50.00	3EP1	1.50	EL-6C	7.00	WE-102B	2.50	394A	2.50	852	2.50	5685	12.00
1P28	7.50	3FP7	1.50	6AC7W	1.00	FG-105	10.00	WE-396A	3.50	860	2.50	5687	2.50
1P29	1.50	3FP7A	2.50	6AD4	2.50	VU-111	1.00	WE-403A	1.35	861	15.00	5691	4.50
1P30	1.00	3GP1	1.85	6AJ5	1.25	RX-120	10.00	WE-403B	3.00	865	7.50	5692	5.00
1P34	1.75	3GP1A	10.00	WE-6AK5	1.35	WE-121A	2.50	WE-404A	15.00	866	1.25	5693	4.50
1P36	2.50	3HP7	3.00	6AK5W	1.25	WE-122A	1.50	WE-409A	1.25	866A	1.20	5696	1.00
1P37	2.25	3HP14J	2.00	6AL5W	.75	F-123A	5.00	GL-415	25.00	866 JR	1.00	5702	1.50
1Z2	1.50	3J21	50.00	6AN5	2.25	WE-123A	2.50	WE-416B	35.00	868	2.00	5703	1.00
2A4G	1.15	3J31	40.00	6AQ5W	1.75	WE-124A	3.50	WE-417A	15.00	WL-8698	50.00	5719	2.25
2AP1	3.50	3JP12	10.00	6AR6	1.35	VT-127	1.50	WL-417A	2.50	GL-872A	2.00	5720	15.00
2AP1A	5.50	3K27	150.00	6AR6WA	2.50	F-128A	7.50	WE-418A	16.50	872A	1.25	5725	2.25
2AS-15	4.25	3KP1	7.50	6AS6	1.25	VXR-130	1.50	WE-420A	7.50	874	1.00	5726	.75
2BP1	7.50	3X2500A3	100.00	6AS6W	2.25	HK-154	3.00	WE-421A	5.00	876	7.50	5727	1.25
2C33	.50	4-65A	14.00	6AS7G	3.00	VT-158	10.00	GL-434A	10.00	878	1.00	5728	9.00
2C36	30.00	4B22	6.50	6AU6WA	2.50	FG-166	7.50	446B	1.00	884	1.00	5734	12.50
2C38	5.00	4B23	3.50	6BA5	2.50	FG-172	20.00	450TH	45.00	885	.85	5740	25.00
2C39	5.00	4B24	5.00	6BA6W	1.25	QK-181	12.50	450TL	40.00	902A	2.00	5744WA	5.00
2C39A	10.00	4B25	7.00	6C21	15.00	FG-190	5.00	WL-460	10.00	902P1	2.00	5749	1.25
2C40	8.00	4B27	2.25	6J4	1.50	QF-196	.75	464A	2.00	905	2.50	5750	2.50
2C42	8.50	4B31	17.50	6J4WA	2.50	HF-200	10.00	WL-468	10.00	913	17.50	5755	7.50
2C43	8.75	4B32	10.00	6J6W	1.00	CE-203	5.00	CK-503AX	.75	917	1.50	5762	125.00
2C44	.50	4C22	5.00	6K4A	3.50	203A	3.50	CK-510AX	.75	918	1.50	5763	1.25
2C46	5.00	4C27	7.50	6L3	3.50	6C4Z	5.00	527	25.00	920	2.00	5771	275.00
2C50	6.00	4C33	75.00	6L6GAY	1.25	204A	20.00	WL-530	20.00	922	1.75	5798	10.00
2C51	3.50	4C35	17.50	6L6WGA	3.75	207	75.00	WL-531	5.00	923	1.40	5800	7.50
2C52	2.75	4E27	7.00	6Q5G	2.50	WE-211C	8.00	GL-546	1.50	925	2.00	5801	5.00
2C53	10.00	4J21	50.00	6XC7GTY	1.75	WE-211D	8.00	GL-559	.50	927	7.50	5803	6.00
2D21	.70	4J26	15.00	6SK7W	1.00	211	.50	GL-575A	10.00	931A	3.50	5819	35.00
2D21W	.95	4J30	50.00	6SK7WA	2.00	WE-212E	50.00	575A	5.00	SN-947C	6.50	5820	450.00
2E22	1.00	4J34	25.00	6SN7WGT	1.50	217A	2.00	631	6.00	SN-948B	6.50	5827	5.00
2E23	2.50	4J35	50.00	6SU7GTY	2.50	217C	3.50	WL-632A	15.00	956	.25	5828	6.50
2E24	2.25	4J38	100.00	6V67	1.50	WL-218	15.00	KX-642	10.00	957	.35	5829	1.00
2E26	3.25	4J39	100.00	6X4WA	2.00	WE-222A	100.00	WL-652/57	40.00	958A	.35	5830	85.00
2E29	1.00	4J46	35.00	6X5W	1.25	CE-235A	5.00	WL-655/58	75.00	959	1.25	5842	15.00
2E36	1.25	4J47	35.00	7BP7	3.50	WE-242A	8.00	WL-681/86	25.00	972A	5.00	5847	15.00
2E39	2.50	4J52	50.00	7BP7A	7.00	WE-242C	10.00	WE-701A	1.50	SN-976D	8.50	5876	7.00
2E41	2.50	4J61	150.00	7CP1	5.00	QK-243	50.00	702A	.50	991/NE-16	.30	5915	.75
2E42	2.50	4X100A	10.00	7EP4	10.00	WE-244A	7.50	702B	1.00	CK-1005	.25	5932	3.75
2E47	5.00	4X150A	20.00	7HP7	1.75	WE-245A	6.50	703A	1.25	CK-1006	2.50	5933	1.50
2E49	10.00	4X300F	55.00	7HP7	10.00	WE-249B	3.00	704A	.50	SN-1006	6.50	5948/1754	250.00
2E50	50.00	EL-C5B	1.00	9GP7	5.00	WE-249C	2.00	WE-705A	.75	CK-1007	.35	5949/1907	75.00
2E51	10.00	5A6	2.25	9LP7	5.00	250R	5.00	706AY-GY	5.00	SN-1007A	6.50	5962/BS-101	5.00
2E52	35.00	5ABP1	20.00	9MP7	5.00	250TH	20.00	707B	2.00	SN-1007B	8.50	5963	1.40
2E53	125.00	5AP1	5.00	10KP7	25.00	250TL	10.00	WE-708A	.75	CK-1009/BA	3.00	5977	3.50
2E54	50.00	5B21	5.00	10Y	.25	WE-251A	5C.00	WE-709A	1.00	SC-1016C	6.50	5979/BS-1	10.00
2E55	25.00	5B21	2.50	12A6	.60	WE-252A	7.50	713A	.50	SC-1017C	6.50	5980/BS-2	8.50
2E56	35.00	5B21A	7.50	12AP7	50.00	HK-253	7.50	714A	7.50	CK-1026	2.50	5981/5650	60.00
2E57	50.00	5B22A	5.00	12DP7	15.00	WE-253A	2.00	715B	2.50	SN-1039A	6.50	5998	5.00
2E59	50.00	5B24	2.00	12DP7A	35.00	WE-254A	2.75	717A	10.00	SC-1156A	6.50	6005	1.75
2E61	15.00	5C22	25.00	12GP7	15.00	WE-257A	3.00	719A	.35	1500T	100.00	6037	50.00
2E61A	30.00	5CP1	2.50	12J5WGT	2.00	FG-258A	75.00	719A	7.50	1608	4.00	6098	2.50
2E62	5.00	5CP1A	7.50	LM-15	50.00	WE-262B	5.00	720AY-EY	35.00	1611	1.50	6136	2.50
2E64	100.00	5CP2A	15.00	VG-15A	10.00	WE-264C	3.00	721A	.50	1612	1.50	6280	35.00
2K22	12.50	5CP7	6.00	15E	1.25	721B	10.00	722A/B	7.50	1613	1.00	6328	5.00
2K25	12.50	5CP7A	8.00	FG-17	3.50	267B	5.00	WE-268A	5.00	723A/B	7.50	8002R	15.00
2K28	25.00	5CP11A	9.50	RK-19	1.00	WE-268A	5.00	WE-794A	.75	1616	.50	8005	4.50
2K29	25.00	5CP12	10.00	RK-20A	6.75	FG-271	40.00	WE-794B	.75	1619	1.30	8012A	3.50
2K30	50.00	5D21	5.00	RK-21	1.00	WE-271A	6.00	WE-725A	2.59	1624	1.50	8013	2.50
2K													

INDEX TO ADVERTISERS

Ace Electronics Associates.....	282	Borg Corporation, George W.....	33
Acme Wire Co.....	334	Bristol Co.....	226
Adams & Westlake Co.....	34	Brush Electronics Company.....	55, 56, 57
Adel Precision Products, a Div. of General Metals Corp.....	359	Burnell & Co., Inc.....	105
Admiral Corporation, Molded Products Div.....	46	Burroughs Corp.....	106
Aeronautical Communications Equipment, Inc.....	307	Bussmann Mfg. Co.....	50
Aerovox Corp.....	310, 341		
Aircraft-Marine Products, Inc.....	283		
Air Express Division Railway Express Agency.....	243	C B S-Hytron, a Division of Columbia Broadcasting System, Inc.....	87
Airpax Products Co.....	63	Calidyne Company.....	290
Allegheny Ludlum Steel Corp.....	52	Cambridge Thermionic Corp.....	96
Allen-Bradley Co.....	301	Cannon Electric Co.....	196
American Airlines.....	40, 41	Carolina Power & Light Co.....	391
American Electronic Laboratories, Inc.....	95	Celco-Constantine Engineering Laboratories Co.....	198, 377
American Gas Furnace Co.....	355	Centralab, A Division of Globe-Union Inc.....	331, 333
American Lava Corporation.....	247	Century Plating Co.....	357
American Machine & Foundry Co.....	291	Chase Brass & Copper Co.....	89
American Television & Radio Co.....	348	Chassis-Trak Corporation.....	336
American Time Products, Inc.....	128	Chicago Standard Transformer Corp.....	312
Ampex Corporation.....	121	Chicago Telephone Supply Corp.....	39
Amphenol Electronics Corp.....	200	Cinch Mfg. Corp.....	183
Armeo Steel Corp.....	215	Clare & Co., C. P.....	65
Arnold Engineering Co.....	13	Clarostat Mfg. Co., Inc.....	101
Assembly Products, Inc.....	207	Clearprint Paper Co.....	115
Associated Spring Corp.....	199	Cleveland Container Co.....	339
Atomic Laboratories.....	261	Clevite Transistor Products.....	213
Augat Bros., Inc.....	361	Clifton Precision Products Co., Inc.....	223
Automatic Mfg. Div. of General Instrument Corp.....	267	Cohn Corp., Sigmund.....	342
Autonetics a Div. of North American Aviation.....	241	Collectron Corp.....	390
		Communication Accessories Company.....	49
		Communication Products Company, Inc.....	45
		Computer-Measurements Corp.....	335
		Consolidated Electrodynamics, Rochester Div.....	349
Bakelite Company, A Division of Union Carbide & Carbon Company.....	289	Continental-Diamond Fibre Div. of the Budd Company, Inc.....	60
Baker & Adamson Products, General Chemical Div., Allied Chemical & Dye Corp.....	261	Cornell-Dubilier Electric Corp.....	203
Baker & Co., Inc.....	346	Cosmic Condenser Co.....	392
Ballantine Laboratories, Inc.....	316	Coto-Coil Co., Inc.....	372
Barber-Colman Company.....	387	Cross Co., H.....	374
Barry Controls, Inc.....	21	Crucible Steel Company of America.....	265
Bausch & Lomb Optical Co.....	262	Curtiss Wright Corp.....	212, 381, 453
Beckman Instruments, Inc.....	379		
Beede Electrical Instrument Co., Inc.....	373	D & R Ltd.....	357
Bell Aircraft Corp.....	308	Dale Products, Inc.....	368
Bell Telephone Laboratories.....	72	Dano Electric Co.....	336
Bendix Aviation Corp.....		Daven Company.....	3rd Cover
Eclipse-Pioneer Div.....	86	DeJur-Amsco Corporation.....	266
Red Bank Div.....	332	Delco Radio, Div. of General Motors.....	58
Bentley, Harris Mfg. Co.....	32	Dialight Corporation.....	361
Berkeley Div., Beckman Instruments, Inc.....	82	Dow Chemical Company.....	287
Bird & Co., Inc., Richard H.....	204	Doty Acoustical Electronic Laboratories.....	452
Bird Electronic Corp.....	342	Driver Harris Co.....	125
Black Light Eastern Corp.....	387		
Boesch Mfg. Co., Inc.....	389		
Boonton Radio Corp.....	64		

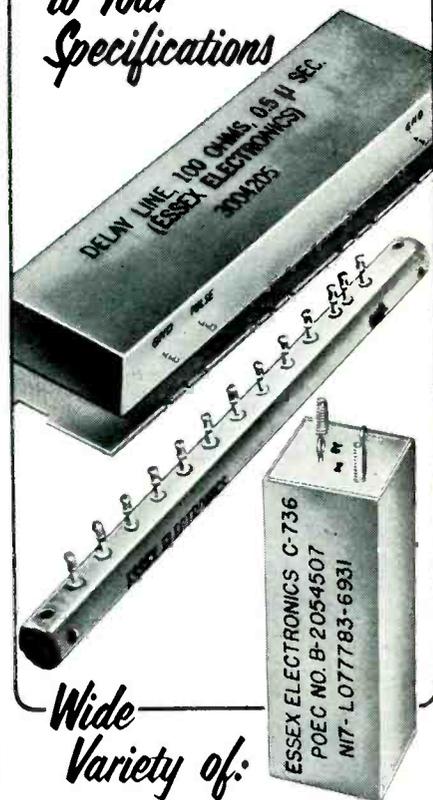
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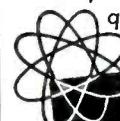
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Dumont Laboratories, Inc., Allen B.	276, 303
Dunlee Corporation	382
DuPont de Nemours & Co., (Inc.) Polychemicals Dept.	237
Durant Manufacturing Co.	192
Dyna-Empire, Inc.	368

Eastern Industries, Inc.	219
Eastman Kodak Company	201
Edison, Inc., Thomas A.	366
Eisler Engineering Co., Inc.	334
Eitel-McCullough, Inc.	135
Elco Corporation	386
Electra Manufacturing Company	318
Electrical Industries	285
Electro-Snap Switch & Mfg. Co.	79
Electro Tec Corp.	281
Electronic Associates Incorporated	78
Electronic Equipment Division, I.D.E.A., Inc.	337
Electronic Instrument Co., Inc. (EICO)	388
Electronics	92, 93
Elgin National Watch Co., Electronics Div.	258
Engineered Electronics Company	355
Engineering Co., The	379
Eric Electronics Division, Eric Resistor Corp.	344, 345
Essex Electronics	449
Esterline-Angus Company, Inc.	346

F-R Machine Works, Inc.	227
Fairchild Controls Corp., Components Division	235
Federal Telephone & Radio Company	269
Ferroxcube Corp. of America	236
Film Capacitors, Inc.	375
Firestone Guided Missile Div.	365
First Six	43
Freed Transformer Co., Inc.	456
Frenchtown Porcelain Co.	382

Gamewell Co.	326
Garrett Corporation	232, 233
Gee-Lar Manufacturing Company	450
General Ceramics Corporation	27
General Electric Co.	
Apparatus Dept.	23, 30, 31, 103, 132, 133
Electronics Components Div.	319
Laminated & Insulation Products Dept.	127
Metallurgical Products Dept.	313
Semiconductor Products	47
General Mills, Mechanical Div.	239
General Radio Co.	17
General Research & Supply Co.	374
General Transistor Corp.	273
Good-all Electric Mfg. Co.	297
Grant Pulley & Hardware Corp.	102

December, 1956 — ELECTRONICS

Grayhill	376
Greenleaf Manufacturing Co.	69
Gries Reproducer Corp.	373, 450
Guardian Electric Mfg. Co.	70
Gudebrod Bros. Silk Co., Inc.	377
Gulton Industries, Inc.	205

Handy & Harman.	300
Harper Company, H. M.	99
Hart Manufacturing Co.	274
Harvey Hubbell, Inc.	195
Haydon Mfg. Co., Inc.	214
Heath Company	376
Helland, a Div. of Minneapolis-Honeywell	116
Hellpot Corp., Div. of Beckman Instru-	189, 358
ments, Inc.	
Hewlett-Packard Company	51, 131
Heyman Manufacturing Co.	385
Hickok Electrical Instrument Co.	288
Hoffman Laboratories, Inc.	123
Homelite, a Division of Textron, Inc.	302
Houghton Laboratories, Inc.	222
Hughes Products, a div. of Hughes Air-	275
craft Co.	120
Humphrey, Inc.	208
Hunt Company, Philip A.	210
Hycon Eastern, Inc.	238
Hycor, Div. of International Resistance	370
Co.	

I-T-E Circuit Breaker Company	74
Ideal Industries, Inc.	314
Industrial Retaining Ring Co.	452
Industrial Test Equipment Co.	352
Industrial Timer Corp.	68
International Business Machine Corp.	293
International Electronic Research Corp.	124
International Rectifier Corp.	90
Iron Fireman	354
Irvington Div. Minnesota Mining & Manu-	356
facturing Co.	

Jennings Radio Manufacturing Corp.	108
Jet Propulsion Laboratory	251
Johns Hopkins University Applied Physics	246
Laboratory	
Johnson Company, E. F.	370
Jones Div., Howard B., Clinch Mfg. Co.	388
Jones Electronics Co., Inc., M. C.	260

Kable Engineering Co.	15
Kay Electric Co.	29

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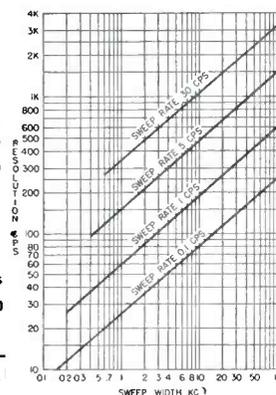
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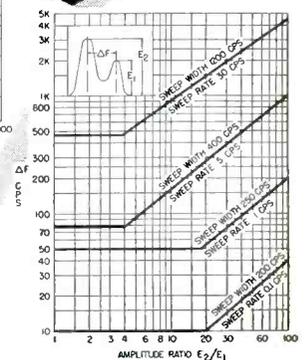
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- Sweep width: 100 kc maximum, continuously reducible to 0 kc
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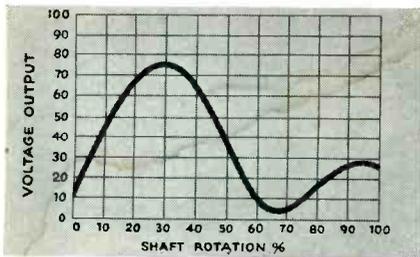
Resolution (in cps) vs sweep width (in kc)

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Kay Lab	249
Kearfott Co., Inc.	310, 328
Kepeo Laboratories	187
Kester Solder Co.	229
Keystone Carbon Company	83
Kinney Mfg. Division, New York Air Brake Company	91

Lab-Tronics, Inc.	352
Lampkin Laboratories, Inc.	375
Lapp Insulator Co., Inc.	353
Leach Corporation	197
Librascope, Inc.	338
Linde Air Products Co., a Div. of Union Carbide & Carbon Corp.	371
Link Aviation, Inc.	325
Lockheed Missile Systems Div.	259
Los Alamos Scientific Laboratory	277

M B Manufacturing Co., a Division of Tectron, Inc.	284
MacDonald, Inc., Samuel K.	391
MacLen Corp.	391
Magnafran, Inc.	381
Magnetic Amplifiers, Inc.	220
Magnetic Metals Company	270
Magnetic Research Corp.	202
Magnetics, Inc.	209
Maine Dept. of Development of Industry & Commerce	252
Mallory and Co., Inc., P. R.	136, 185
Marconi Instruments, Ltd.	122
Marion Electrical Instrument Co.	117
Markem Machine Co.	378
Martin Company, Glenn L.	305, 330
McCoy Electronics Company	304
McGraw-Hill Book Co.	329
Measurements Corporation	336
Melpar, Inc.	218
Metals & Controls Corp., General Plate Div.	134
Micro Switch a Div. of Minneapolis-Honeywell Regulator Co.	85
Microwave Associates, Inc.	343
Midland Mfg. Co., Inc.	295
Mid-West Conveyor Co., Inc.	372
Milford Rivet & Machine Co.	355
Millen Mfg. Co., Inc., James.	225
Minneapolis-Honeywell Regulator Co. Industrial Div.	98
Moloney Electric Co.	363
Monsanto Chemical Co.	257
Moseley Co., F. L.	392
Muirhead & Co., Ltd.	5
Mullard Overseas, Ltd.	104

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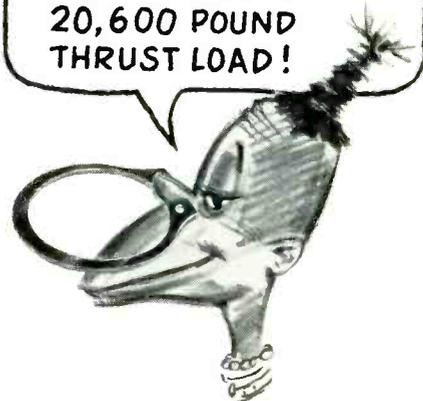
- Units can be used as a plug-in or may be soldered into bails to form computers or allied electronic circuits
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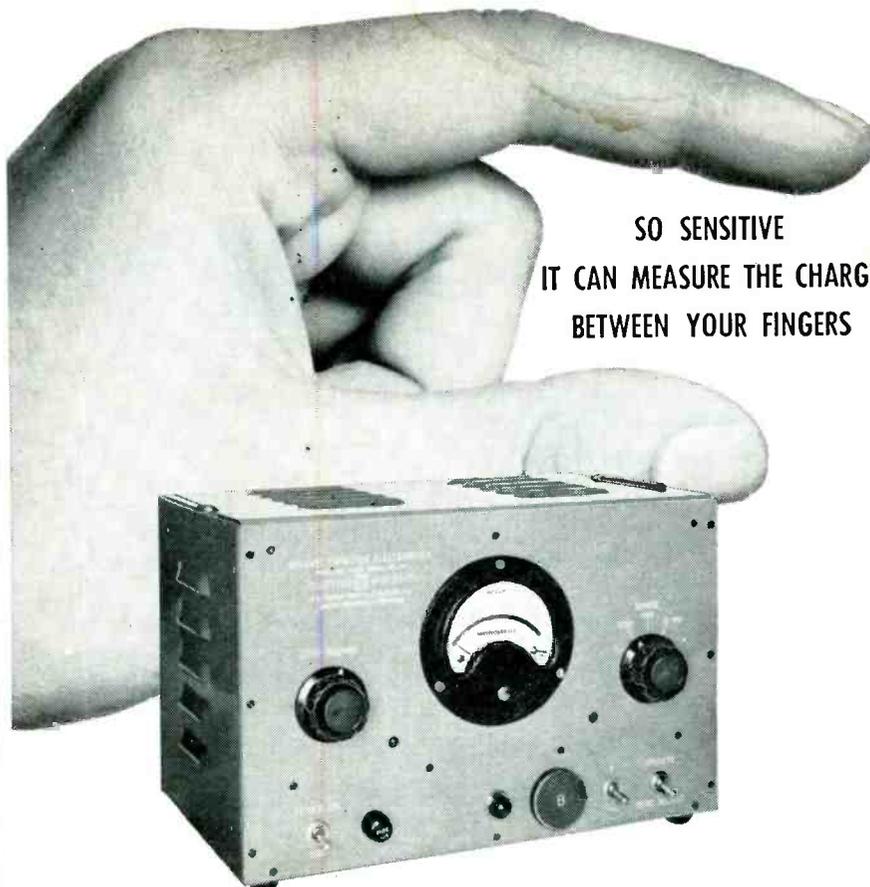
Want more information? Use post card on last page.

N J E Corporation	107
National Lead Company	38
National Moldite Company	221
Natvar Corporation	211
Navigation Computer Corp.	367
Nems-Clarke, Inc.	383
New Hermes Engraving Machine Corp.	369
North American Aviation, Inc.	323
Northeastern Engineering	322
Nothelfer Winding Laboratories, Inc.	216

Oak Mfg. Co.	37
--------------	----

Pace Electrical Instrument Co.	454
Pacific Automation Products, Inc.	351
Panoramic Radio Products, Inc.	451
Perkin-Elmer Corp.	452
Perkin Engineering Corp.	25
Phalo Plastics Corp.	320
Phaostron Instrument & Electronic Co.	268
Phelps-Dodge Copper Products Corp., Inca Mfg. Div.	118, 119
Phllamon Laboratories, Inc.	54
Photographic Products, Inc.	371
Pittsburgh Lectordryer Co.	42
Polarad Electronics Corporation	67, 253
Potter & Brumfield	97
Precision Capacitors, Inc.	385
Proceedings of the I. R. E.	315

R-B-M Division, Essex Wire Corp.	271
Radiation, Inc.	298
Radio Corporation of America	114, 4th Cover
Radio Cores, Inc.	294
Radio-Electronic Master	371
Radio Engineering Laboratories, Inc.	111
Radio Engineering Products	378
Radio Frequency Laboratories, Inc.	194
Radio Materials Corp.	245
Radio Receptor Co., Inc.	44
Ramo-Wooldridge Corp.	231
Rawson Electrical Instrument Co.	390
Raytheon Mfg. Company	19, 35
Reeves Instrument Corp.	71
Remington Rand Univac Div. of Sperry Rand Corp.	317



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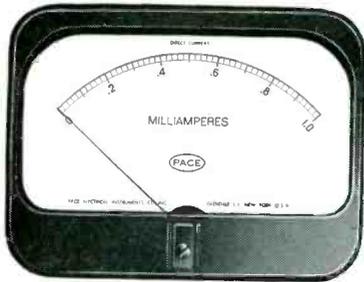
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Rex Rheostat Co.	391
Richardson Company	110
Royal Metal Manufacturing Company	360
Rutherford Electronics Co.	369

Sams & Co., Inc., Howard W.	380
Sanborn Company	109
Sarkes Tarzian, Inc.	256
Sealectro Corp.	292
Shielding, Inc.	240
Sierra Electronic Corp.	242
Sigma Instruments, Inc.	254
Simmons Fastener Corp.	36
Sola Electric Co.	126
Somers Brass Company	234
Sorensen & Co., Inc.	4
Southeo Div., South Chester Corp.	94
Southern Electronic Corp.	263
Southwestern Industrial Electronics Co.	286
Sprague Electric Co.	11, 191
Stackpole Carbon Co.	59
Standard Record Mfg. Co.	130
Stevens Arnold, Inc.	359
Stupakoff, Div. of the Carborundum Company	255, 299
Superior Electric Company	129
Superior Tube Co.	113
Switchcraft, Inc.	383
Sylvania Electric Products, Inc.	6, 7, 88, 279, 309
Syntronic Instruments, Inc.	380

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Technicraft Laboratories, Inc.	224
Technology Instrument Corp.	244
Tektronix, Inc.	100
Telechrome, Inc.	61
Texas Instruments Incorporated	193
Transitron Electronic Corp.	73
Transradio, Ltd.	350
Tung-Sol Electric, Inc.	112
Uconite Co.	76
Union Switch & Signal Div. of Westinghouse Air Brake Company	250
United-Carr Fastener Corp.	77
U. S. Stoneware Alite Div.	84
United States Gasket Co.	455
United States Radium Corp.	366
United Transformer Co.	2nd Cover
Universal Winding Co.	311

Van Keuren Company	385
Varian Associates	81, 217
Vectron, Inc.	272
Veeder-Root, Inc.	48
Vitro Corp. of America	324
Vulcan Electric Company	379

Wac Line, Inc.	382
Waldes Kohlnoor, Inc.	53
Ward Leonard Electric Co.	80
Waterman Products Co., Inc.	206
Waters Manufacturing, Inc.	306
Waveline, Inc.	451
Weckesser Company	390
Weldmatic a Division of United Corp.	347
Wenco Manufacturing Co.	375
Weston Electrical Instrument Corp., a Subsidiary of Daystrom, Inc.	62
Wheeler Insulated Wire Co., Inc.	296
Wheeler Laboratories, Inc.	386
Wheelock Signals, Inc.	350
White Dental Mfg. Co., S. S.	248, 384
Wincharger Corp.	75

MANUFACTURERS' REPRESENTATIVES	391
--------------------------------	-----

PROFESSIONAL SERVICES	391
-----------------------	-----

CLASSIFIED ADVERTISING
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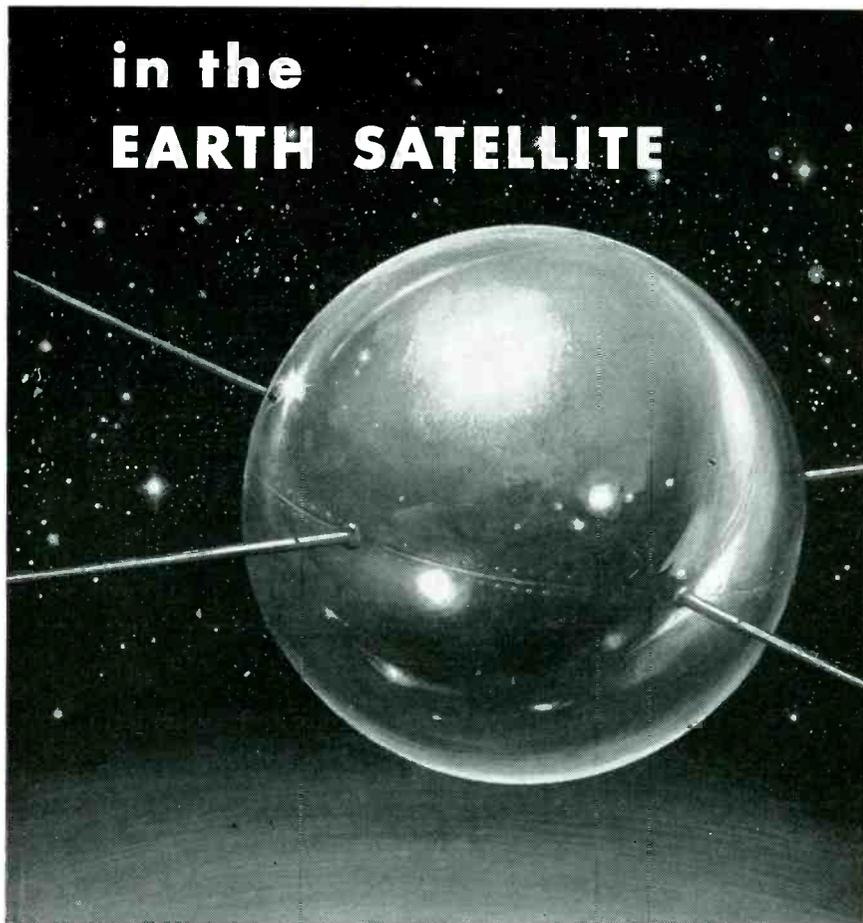
EMPLOYMENT OPPORTUNITIES	393-434
Goodyear Atomic Corp.	428

EDUCATIONAL	434
-------------	-----

BUSINESS OPPORTUNITIES	434
EQUIPMENT (Used or Surplus New) For Sale	434-448

WANTED Equipment	444
---------------------	-----

SEARCHLIGHT SECTION ADVERTISERS INDEX	
Algeradio Electronics	443
Arrow Sales Inc.	444
Barry Electronics Corp.	438
Blan	438
Binneweg Television	434
Bolton Labs Inc.	443
C&H Sales Co.	439
Carruthers Inc., Clarence	440
Communications Equipment Co.	437
Dutchess Labs	440



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MGP2	650	✓	260	.070	6.3/5	2	6.3	4	JB
MGP3	650	✓	245	.150	6.3	5	5.0	3	KB
MGP4	800	✓	318	.175	5.0	3	6.3	8	LB
MGP5	900	✓	345	.250	5.0	3	6.3	8	MB
MGP6	700	✓	255	.250					KB
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MGF3	5.0	3.0	2,500	FB
MGF4	5.0	10.0	2,500	HB
MGF5	6.3	2.0	2,500	FB
MGF6	6.3	5.0	2,500	GB
MGF7	6.3	10.0	2,500	JB
MGF8	6.3	20.0	2,500	KB
MGF9	2.5	10.0	10,000	JB
MGF10	5.0	10.0	10,000	KB

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Cat. No.	Block & Osc. Int. Coupling	Low Pow. Out.	Pulse Voltage Kilovolts	Pulse Duration Microseconds	Duty Rate	No. of Wdg.	Test Volt. KV RMS	Char. Imp. Ohms
MPT1	✓	✓	0.25/0.25/0.25	0.2-1.0	.004	3	0.7	250
MPT2	✓	✓	0.25/0.25	0.2-1.0	.004	2	0.7	250
MPT3	✓	✓	0.5/0.5/0.5	0.2-1.5	.002	3	1.0	250
MPT4	✓	✓	0.5/0.5	0.2-1.5	.002	2	1.0	250
MPT5	✓	✓	0.5/0.5/0.5	0.5-2.0	.002	3	1.0	500
MPT6	✓	✓	0.5/0.5	0.5-2.0	.002	2	1.0	500
MPT7	✓	✓	0.7/0.7/0.7	0.5-1.5	.002	3	1.5	200
MPT8	✓	✓	0.7/0.7	0.5-1.5	.002	2	1.5	200
MPT9	✓	✓	1.0/1.0/1.0	0.7-3.5	.002	3	2.0	200
MPT10	✓	✓	1.0/1.0	0.7-3.5	.002	2	2.0	200
MPT11	✓	✓	1.0/1.0/1.0	1.0-5.0	.002	3	2.0	500
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		Prim Ohms	Sec. Ohms	ct.	Split		
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MGA2	Line to Voice Coil	600	4.8, 16	Split	✓	0	33
MGA3	Line to Single or P.P. Grids	600	135K	Split	✓	0	15
MGA4	Line to Line	600	600	Split	✓	0	15
MGA5	Single Plate to Line	7.6K 4.8T	600	Split	✓	40	33
MGA6	Single Plate to Voice Coil	7.0K 4.8T	4.8, 16	Split	✓	40	40
MGA7	Single or P.P. Plates to Line	15K	600	Split	✓	10	33
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MGA9	P.P. Plates to Line	60K	600	Split	✓	10	27

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Want more information? Use post card on last page.

Emeltone Electronics	434
Empire Electronics Co.	445
Engineering Associates	440
Eveready Supply Co., The	434
Fair Radio Sales	438
Fay-Bill Distributing Co.	440
Finnegan, H.	444
Harjo Sales Co.	444, 447
Houde Supply Co.	440
Industrial Liquidating Co.	446
Instrument Service Co.	440
Inter-American Dye & Chemical Corp.	444

JSII Sales Co.	435
Kato Engineering Co.	445
Klein & Schwab	444
Leetronic Research Laboratories	442
Legri S. Co.	447
Liberty Electronics, Inc.	447
M. R. Co., The	447
Mautner Laboratories	440
Microwave Equipment Co.	446
Monmouth Radio Labs	447

Pacific International University	434
Page Electronics	436
Radalab Inc.	436
Radio & Electronics Surplus	444
Radio Research Instrument Co.	434
Raway Sales	443
Relay Sales Inc.	446

S. & R. Electronics Inc.	442
Sannett, R. E.	444
Surplus Center	445

"TAB"	443
Trans-International Forwarders Inc.	444

Universal General Corp.	441
V&H Radio Electronics Supply	445

Western Engineers	448
Wilgreen Industries	436

EMPLOYMENT OPPORTUNITIES

Aaler Electronics Inc.	434
Aeroflex Laboratories Inc.	432
Aircraft Radio Corp.	434
American Machine & Foundry Co.	412
Argonne National Laboratory	419
Arma Div., American Bosch Arma Corp.	422
Armour Research Foundation of Illinois Institute of Technology	414
Austin Co.	433
Avco Manufacturing Corp., Crosley Div.	401

Battelle Memorial Institute	433
Bendix Aviation Corp	
Cincinnati Division	424, 428
Pacific Division	406
Products Division	393, 400
Radio Division	411
York Division	408
Bogue Electric Mfg. Co.	428
Burroughs Corp.	421

Chance Vought Aircraft Inc.	399
Channel Master Corp.	432
Collins Radio Co.	406
Consolidated Avionics Corp.	408
Continental Oil Co.	432
Convair, A Div. of General Dynamic Corp	
Pomona, Calif.	408
San Diego, Calif.	403
Cooper, J.	402
Cornell Aeronautical Laboratory	423

Decision Inc.	424
---------------	-----

Edison Inc., Thomas A.	426
Edwards Employment Agencies	430
Electric Boat Div., General Dynamics Corp.	418
Emerson Electric, Aircraft Div.	427

Farnsworth Electronics Co.	398
Ferroxcube Corp., of America	430

Gates Radio Co.	430
-----------------	-----

General Electric Co.	
Schenectady, N. Y.	418
Syracuse, N. Y.	431
Utica, N. Y.	420, 433
General Electronic Lab., The	420
General Motors Corp.	
AC Electronics Div.	394, 409, 142, 424
General Precision Laboratory Inc.	422
Goodyear Aircraft Corp.	
Akron, Ohio	407
Phoenix, Arizona	401
Goodyear Atomic Corp.	428

Haller Raymond & Brown Inc.	408
Honeywell Brown Instruments	398
Hoover Electronics Co.	425
Horizons Inc.	430

Industrial Nucleonics Corp.	414
-----------------------------	-----

John Hopkins University	404
-------------------------	-----

Kollsman Instrument Corp.	428
---------------------------	-----

Martin Co., Glenn L., (Baltimore Div.)	406, 426
Martin Co., Glenn L., (Denver Div.)	424
Monarch Personnel	430
Motorola Inc.	414

National Cash Register Co.	417
New York State Employment Service	428
Northrop Aircraft Inc.	404

Oster Manufacturing Co., John, Avionic Div.	430
Otis Elevator Co.	410

Page Communications Engineers Inc.	426
Pennsylvania State University	426
Perkin Engineering Corp.	433
Philco Corp.	405
Philco Technical Representative Div.	416

Radiation, Inc.	429
Radio Corporation of America	396, 397
RCA Service Co., Inc.	413
Ramo-Wooldrige Corp., The	426
Raytheon Manufacturing Co.	
Waltham, Mass.	395, 415
Wayland, Mass.	420
Reeves Instrument Corp.	431

Schlumberger Well Surveying Corp.	428
Serdex Inc.	420
Standard Coil Products Co., Inc.	414
Stavid Engineering Inc.	400
Stromberg-Carlson Co., A Division of General Dynamics Corp.	402
Suburban Employment Agency	430
Sylvania Electric Products Inc.	
Buffalo, N. Y.	394
Waltham, Mass.	394, 410

Texas Instruments Inc.	410
------------------------	-----

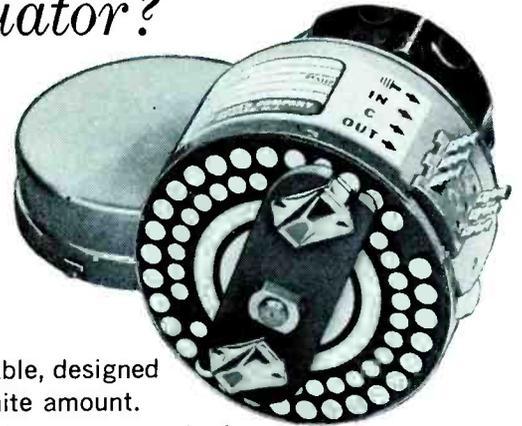
University of Michigan	404
------------------------	-----

Varo Manufacturing Co.	402
------------------------	-----

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Q

What is an attenuator?



A

An attenuator is a resistive network, either fixed or variable, designed to reduce the power output of a signal system by a definite amount. Furthermore, it can keep the input impedance or output impedance, or both impedances, constant, depending on the type of network.

Q

What are the uses of attenuators?

A

- Volume controls in multi-channel mixers • Meter multiplier controls
- Equalizer controls • Sound level controls • Video and R. F. line controls
- Controls in transmission systems and transmission measuring equipment

Q

Why use a step-type attenuator?

A

A high degree of accuracy and repeatability is obtainable in a step-type, since the resistors are individually calibrated • The switch contact noise is practically eliminated by the use of precious metal contacts • Life of the unit is increased greatly over units in which the rotor arm makes contact with the resistor elements • Indexing by positive detent action is available for resetting of readings at an exact resistive position, or a position with a specific decibel loss.

Q

Where can complete information be obtained on the various types and designs of attenuators?

A

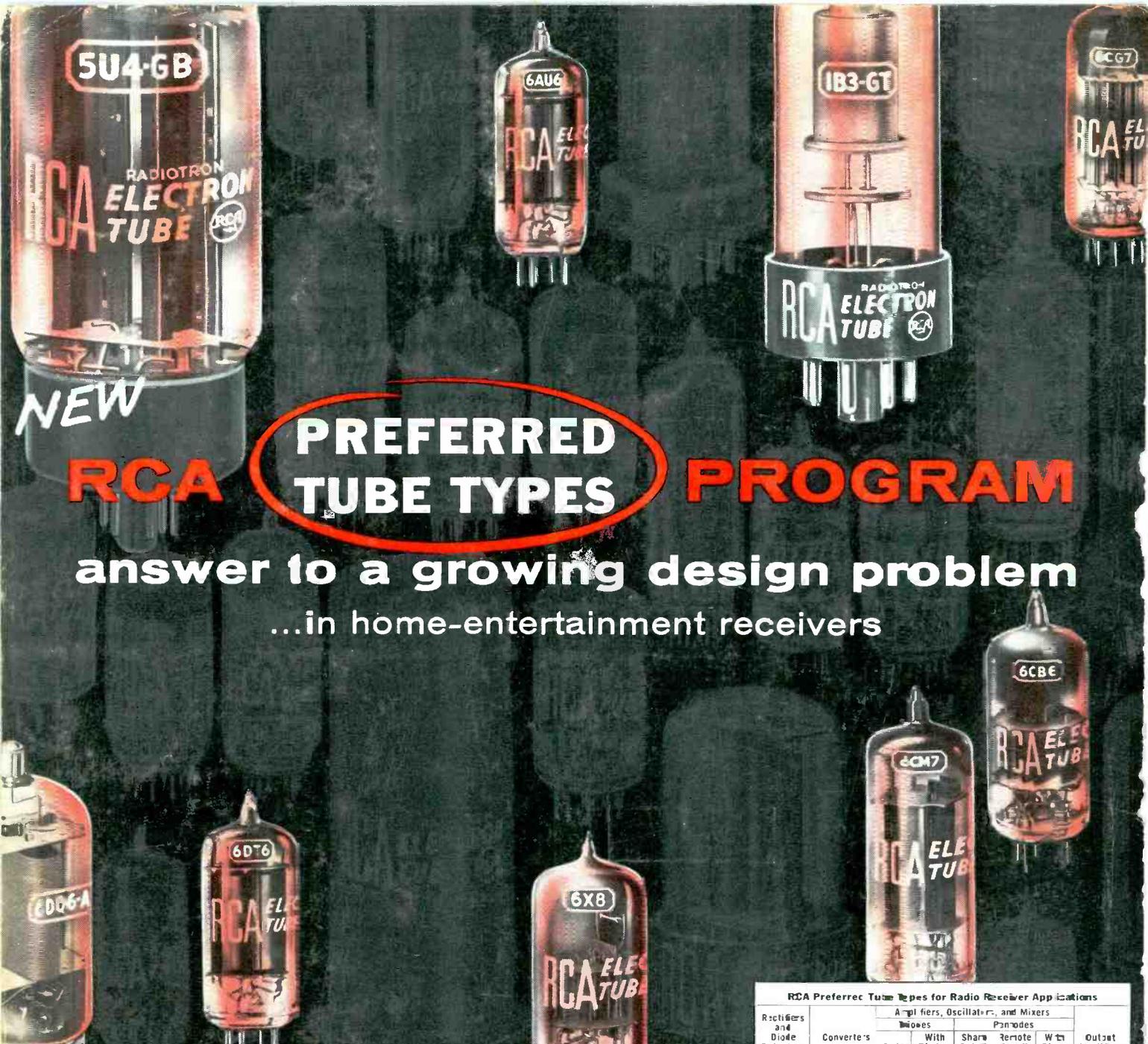
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...in home-entertainment receivers

Again RCA meets the needs of TV, AM, FM receiver designers and manufacturers... with the new and up-to-date Preferred Tube Types List tailored to the industry's requirement for a minimum number of tube types having the greatest over-all usefulness.

First introduced by RCA in 1940, the Preferred Tube Types Program aimed at concentrating production on the most useful radio receiver types to improve tube quality by longer, more efficient production runs—and to increase tube availability by decreasing stocking requirements. Was it effective? Yes! By the end of 1940, five million receivers had been designed and built around 36 RCA Preferred Tube Types—and 20 receiver manufacturers publicly endorsed the program!

Today—after two years of careful engineering analysis of radio and TV requirements—RCA offers a comprehensive selection of 61 Preferred Tube Types capable of handling

virtually every TV, AM, and FM receiver circuit function now covered by hundreds of types available to the industry. The benefits to you: (1) Lower tube costs, (2) More uniform tube quality, (3) Standardization on fewer types of circuit components, (4) Better tube availability and faster delivery to support continuous production schedules, (5) Simplification of stocking and warehousing problems, (6) Increased customer satisfaction through ready tube availability from RCA Tube Distributors.

So whether you are interested in black-and-white or color TV receivers, portables or car radios, AM or FM sets or phono amplifiers, it will pay you to design around RCA Preferred Tube Types. For technical data on any Preferred Tube Type, refer to your RCA Tube Manual or RCA Receiving Tube Handbook. For further details on the RCA Preferred Tube Types Program, call your RCA Field Representative.

RCA Preferred Tube Types for Radio Receiver Applications

Rectifiers and Diode Detectors	Amplifiers, Oscillators, and Mixers						Output Amplifiers
	Converters	Diodes		Pentodes			
		With Diodes	Share Cutoff	Remote Cutoff	Wt. Diode		
5Y3-GT 6AL5 12X4 35W4	1R5 6BE6 12BE6 6X8	6CG7 12AX7	6AV6 12AV6 12BF6	1U4 6AU6	1T4 6BA6 12BA6	1N5	3V4 6AQ5 35C5 50C5 12AB5

RCA Preferred Tube Types for TV Receiver Applications

Amplifiers and Detectors						
IF	Video	Audio	Deflection	HV Reg. Type		Deflection Oscillators & Control Types
3CB6 6CB6 3AU6 6AU6 5BZ6 6BZ6	6AW8-A 12BY7-A	6AQ5 6AV6	6S4-A 6W6-GT 12WB-GT 6CM7 12DQ6-A 12DQ6-GA 6DB5-A**	6BK4**		6CG7 3BY6 6BY6 6CM7
Tuner Tubes			Rectifiers		Dampers	
RF Amplifiers		Osc.-Mixers	High Voltage		Low Voltage	
6BZ7 3BC5 6BC5	2AF4-A* 6AF4-A*	6U8 5X3 5CC8 6CC8	1B3-GT 3A3** 1V2**		5U4-GB	6AX4-GT 12AX4-GTA 6AU4-GTA

*For UHF Oscillator **For Color TV only

NEW RCA BROCHURE ON PREFERRED TUBE TYPES

New book outlines the new RCA Preferred Tube Types Program. For your copy, write RCA, Commercial Engineering, Section L19Q, Harrison, N. J. Or ask your RCA Field Man.



RADIO CORPORATION OF AMERICA
Tube Division
Harrison, N. J.