electronics

JULY 1, 1957

A McGRAW-HILL PUBLICATION • PRICE 75 CENTS

ULTRASONIC BEER FOAMER

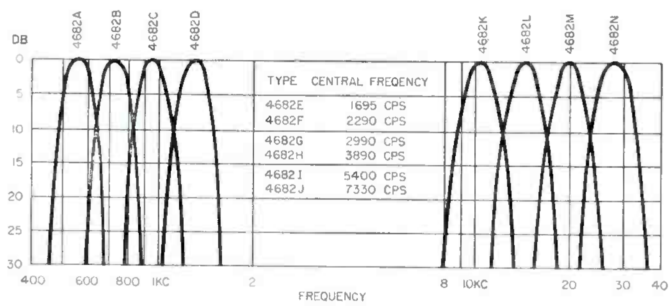
OUR MILLIONTH FILTER SHIPPED THIS YEAR...

FILTERS

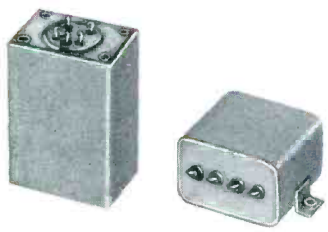
FOR EVERY APPLICATION

TELEMETERING FILTERS

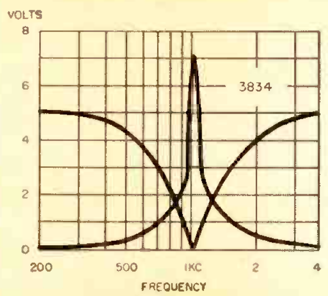
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.

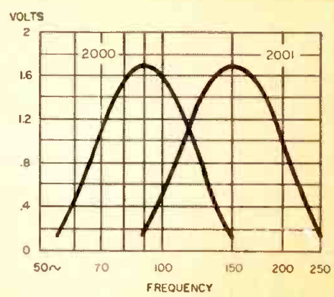


Dimensions:
(4682A) 1½ x 2 x 4″



Dimensions:
(3834) 1¼ x 1¾ x 2-3/16″.
(2000, 1) 1¼ x 1¾ x 1⅝″.





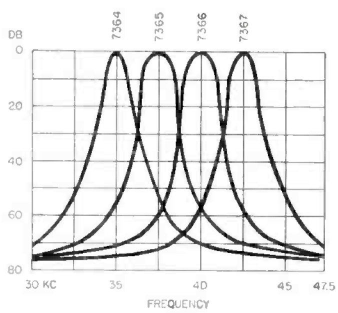
AIRCRAFT FILTERS

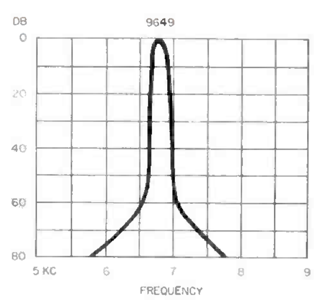
UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

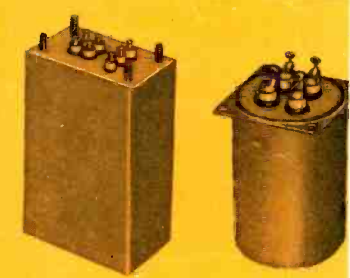
Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

CARRIER FILTERS

A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.



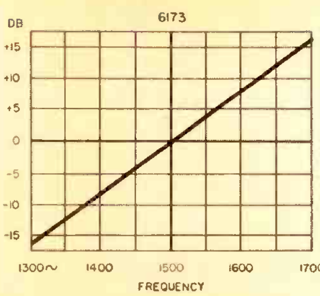


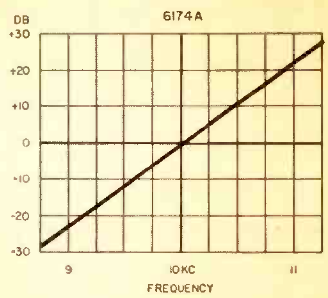


Dimensions:
(7364 series) 1⅝ x 1⅝ x 2¼″.
(9649) 1½ x 2 x 4″.

DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.





Dimensions:
(6173) 1-1/16 x 1⅜ x 3″.
(6174A) 1 x 1¼ x 2¼″.

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.

UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y. CABLES: "ARLAB"
PACIFIC MFG. DIVISION: 4008 W. Jefferson Blvd., Los Angeles 16, Calif.

electronics

JULY 1 • 1957

A McGRAW-HILL PUBLICATION

ULTRASONIC BEER FOAMER—Magnetostriction transducer, driven by 22-kc ultrasonic generator, vibrates bottles on filling machine to cause foaming that drives out unwanted air prior to capping in Ballantine's Newark, N. J. plant. Equipment was designed and installed by Mack Electronics Division (see page 162) .... COVER

FEATURES

CONTINUED ON NEXT PAGE

contents

continued

SHOP

▶ WE'D LIKE TO — In a recent editorial survey, we asked a question "How can we make ELECTRONICS more useful to you?" A very high percentage of readers replied that we shouldn't change anything, leave it strictly alone. Others made constructive suggestions that will guide us in our planning of future issues.

A number of readers put us right smack on a spot, though. They say, "Find me more time to read it thoroughly!"

▶ WORTHY . . . One of our recent authors (Punch Card Reader for the Blind, Nov. 1956, p 148) who is blind tells us enthusiastically that a blind electrical engineering student at Manhattan College, N. Y. is using a braille slide rule for his calculations.

The rule, which is twenty inches long and has two percent accuracy, was developed by Brother Albert of the college's staff. Some firm might be interested in manufacturing the item?

▶ DATA MEMORY . . . Occasionally we get a letter from a recent subscriber regarding his desire to obtain past issues. Our own supply never dates back more than a few months, since we depend on bound volumes for our own reference needs.

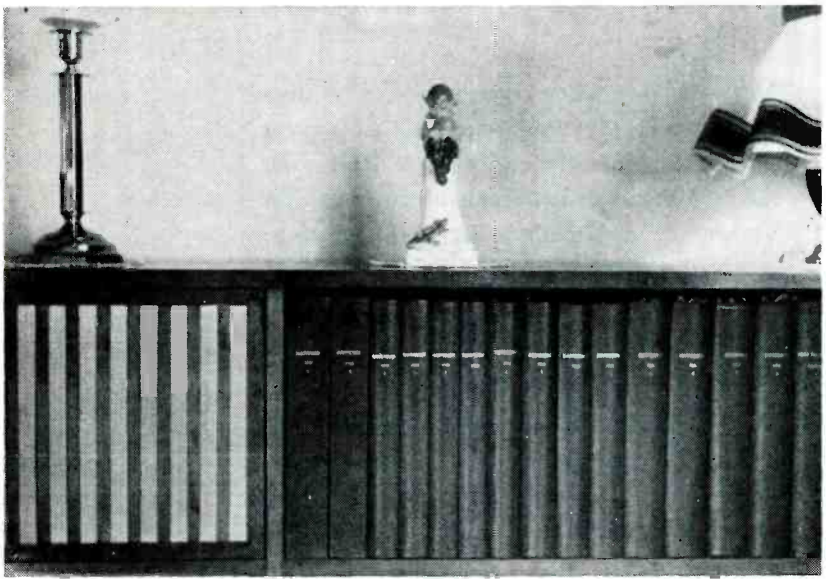
Some time later an engineer about to retire may write in and

electronics

JULY 1, 1957 Vol. 30, No. 7

Member ABC and ABP

TALK



ELECTRONICS reader in Sweden designed this neat arrangement of bound editorial material from the magazine. It accommodates 90 issues on two feet of shelf space

offer to donate his back issues to a library or sell them piecemeal or in toto.

Of course, the two letters never coincide in timing.

Perhaps we should publish such letters hereafter in *Backtalk*, rely on interested readers to contact one another.

▶ **COMPACT SOLUTION . . .** Nicest system we've seen recently for binding technical material from our magazine has been developed by Karl Remi, of Goteborg, Sweden. He read *Shoptalk* in the March 1 issue regarding shelf space and sent in the accompanying photograph and the following how-to-do it:

"Take the issues of a year and make a note of the different articles.

"Open the brackets of the first issue on her backcover, take out that cover and all pages within *Backtalk* and nip off the wires with a pair of tongs.

"*Backtalk* and *New Books* sections are saved and then the further leafs within *Production Techniques* are separated.

"After cutting out the front cover of the issue, push out the brackets without damaging the contents page and take out all leafs after *Crosstalk*.

"Six issues give a handy bind and this is arranged as follows: First a paper for further notations, then the six contents pages from the issues, (in earlier volumes, also a written content of the sections *Electrons At Work* and *Production Techniques*) ; after that every issue begins with her front cover, followed by *Crosstalk*, technical articles, *Electrons At Work*, *Production Techniques* and *Backtalk*.

"The bookbinder gives the volumes an ordinary library cover, f. inst. in dark red plast, and for a moderate price I have two very useful and decorative books every year, being also a personal memory to me from a good friend, instead of "that dusty stacks of old papers in every corner" the eyesore for our orderly wives.

"The annual index (December issue) I save together with other indexes in a separate loose-leaf cover to have an easy accessible reference book. The *New Books* section and the technical part of the *Buyers Guide* are saved in special covers.

"Out of the rest of all issues and *Buyers Guide* I take care of all interesting notices and announcements and save them in a systematic register."

Published three times a month, with an additional issue in June, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 W. 42 St., New York 36, N. Y.** Longacre 4-3000. Publication Office, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription or change of address. Donald C. McGraw, President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Single copies 75¢ for Technical Edition and 50¢ for Business Edition in United States and possessions, and Canada; $2.00 and $1.50 for all other foreign countries. Buyers' Guide $3.00. Subscription rates—United States and possessions, $6.00 a year; $9.00 for two years. Canada, $10.00 a year. All other countries $20.00 a year. Three-year rates accepted on renewals only, are double the one-year rate. Entered as second-class matter August 29, 1936, at the Post Office at Albany, N. Y., under act of Mar. 3, 1879. Printed in U.S.A. BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11; 68 Post Street, San Francisco 4; McGraw-Hill House, London E. C. 4; National Press Bldg., Washington, D. C. 4; Architects Bldg. 17th & Sansom Sts., Philadelphia 3; 1111 Henry W. Oliver Bldg., Pittsburgh 22; 1510 Hanna Bldg., Cleveland 15; 856 Penobscot Bldg., Detroit 26; 3615 Olive St., St. Louis 8; 350 Park Square Bldg., Boston 16; 1321 Rhodes Haverty Bldg., Atlanta 3; 1125 West Sixth St., Los Angeles 17. ELECTRONICS is indexed regularly in The Engineering Index.

Subscriptions: Address correspondence to Subscription Manager, Electronics, 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address, stating old as well as new address. Subscriptions are solicited only from persons engaged in theory, research, design, production, maintenance and use of electronic and industrial control components, parts and products. Position and company connection must be indicated on subscription orders.

Postmaster: please send form 3579 to Electronics, 330 W. 42 St., New York 36, N .Y.

NOW-PORTABLE 400 cycle power

This new frequency changer makes it possible to provide well regulated 400 cycle power conveniently and quickly. This unit, Model FCR 250, is extremely useful in a wide variety of applications including testing, production, airborne frequency control, computers, missile guidance system testing, and in practically any application where the use of 400 cycle power is advantageous.

Model FCR 250 is only one of a complete line of frequency changers available from Sorensen . . . the authority on controlled power for research and industry. Write for complete information.

ELECTRICAL CHARACTERISTICS

Input	105-125 VAC, 1 phase, 50-65 cycles
Output voltage	115 VAC, adjustable 105-125V
Output Frequency	320-1000 cps in two ranges
Voltage regulation	±1%
Frequency regulation	±1% (±0.01% with auxiliary frequency standard fixed at 400 cycles)
Load range	0-250 VA

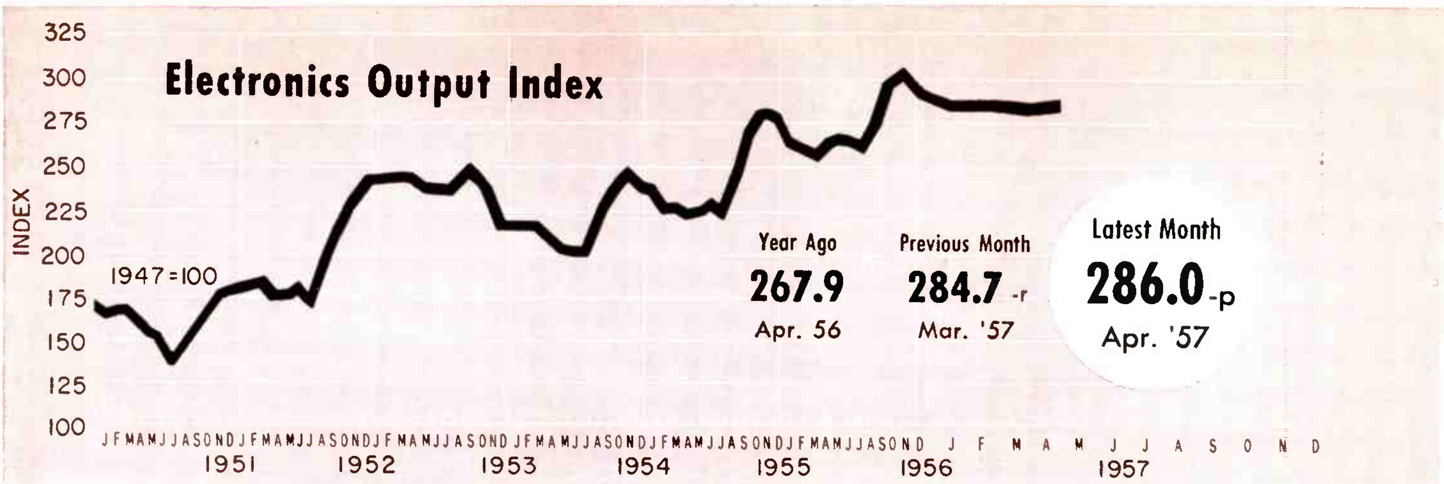
MODEL FCR 250

SORENSEN & COMPANY, INC. Sorensen **STAMFORD • CONN.**

In Europe, contact Sorensen-Ardag, Eichstrasse 29, Zurich, Switzerland, for all products including 50 cycle, 220 volt equipment.

Want more information? Use post card on last page.

Want more information? Use post card on last page.



FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RETMA)	Latest Month April '57	Previous Month Mar. '57	Year Ago April '56
Television sets, total	361,246	559,842	549,632
With UHF	42,374	62,815	74,102
Color sets	nr	nr	nr
Radio sets, total	1,115,813	1,609,073	992,982
Auto sets	380,452	597,532	299,253

RECEIVER SALES

(Source: RETMA)	April '57	Mar. '57	April '56
Television sets, units	337,965	534,115	347,630
Radio sets (except auto)	543,092	730,584	471,193

RECEIVING TUBE SALES

(Source: RETMA)	April '57	Mar. '57	April '56
Receiv. tubes, total units	27,970,000	43,010,000	35,184,000
Receiv. tubes, value	$25,384,000	$37,007,000	$28,616,000
Picture tubes, total units	629,838	833,088	830,902
Picture tubes, value	$11,394,043	$14,847,798	$15,141,461

INDUSTRIAL TUBE SALES

(Source: NEMA)	Quarterly Figures — Latest Quarter 4th '56	Previous Quarter 3rd '56	Year Ago 4th '55
Vacuum	$12,408,371	$8,895,012	$9,967,411
Gas or vapor	$3,223,612	$2,936,765	$3,251,621
Magnetrons and velocity modulation tubes	$15,890,681	$14,948,477	$13,726,323
Gaps and T/R boxes	$1,242,745	$1,196,369	$1,578,767

MILITARY PROCUREMENT

(Source: Defense Dept.)	1st '57	4th '56	1st '56
Army	$69,381,000	$56,185,000	$40,490,000
Navy	$21,426,000	$34,210,000	$28,700,000
Air Force	$159,829,000	$145,962,000	$124,828,000
Total—Electronics	$250,636,000	$236,357,000	$194,018,000

BROADCAST STATIONS

(Source: FCC)	Latest Month April '57	Previous Month Mar. '57	Year Ago April '56
TV stations on air	515	515	489
TV stations CPs—not on air	126	126	114
TV stations—new requests	72	60	29
A-M stations on air	3,049	3,040	2,872
A-M stations CPs—not on air	154	145	118
A-M stations—new requests	306	308	275
F-M stations on air	529	526	534
F-M stations CPs—not on air	22	23	13
F-M stations—new requests	22	17	6

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Mar. '57	Feb. '57	Mar. '56
Aeronautical	50,940	50,859	45,488
Marine	61,818	61,246	55,175
Police, fire, etc.	22,625	22,500	20,216
Industrial	34,316	33,879	28,454
Land transportation	9,505	9,484	8,849
Amateur	159,896	158,232	146,699
Citizens radio	24,782	23,888	16,262
Disaster	343	343	327
Experimental	765	735	666
Common carrier	2,696	2,666	2,185

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Mar. '57	Feb. '57	Mar. '56
Prod. workers, comm. equip.	393,300-p	395,600-r	303,500
Av. wkly. earnings, comm.	$80.19 -p	$79.98 -r	$74.96
Av. wkly. earnings, radio	$76.80 -p	$76.40 -r	$71.82
Av. wkly. hours, comm.	40.5 -p	40.6 -r	40.3
Av. wkly. hours, radio	40.0 -p	40.0	39.9

SEMICONDUCTOR SALES ESTIMATES

	April '57	Mar. '57	April '56
Transistors, Units	1,774,000	1,904,000	832,000

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	April '57	Mar. '57	April '56
Radio-tv & electronics	50.48	47.26	64.13
Radio broadcasters	68.04	63.46	75.47

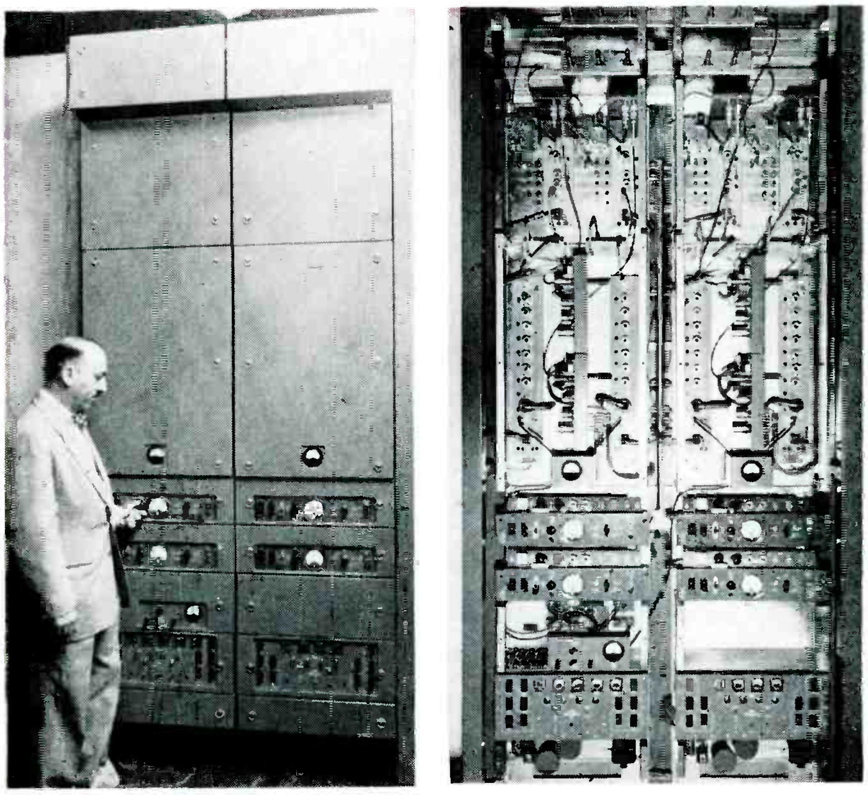
p—provisional r—revised nr—not reported

FIGURES OF THE YEAR

	TOTALS FOR THE FIRST FOUR MONTHS 1957	1956	Percent Change	1956 Total
Television set production	1,835,975	2,394,264	—23.3	7,357,029
Radio set production	5,075,180	4,525,225	+12.2	13,981,800
Television set sales	2,020,878	2,006,808	+ .7	6,804,756
Radio set sales (except auto)	2,362,068	1,984,915	+19.0	8,332,077
Receiving tube sales	153,011,000	155,604,000	— 1.6	464,186,000
Cathode-ray tube sales	2,952,149	3,469,405	—14.9	10,987,021

INDUSTRY REPORT

electronics—July 1 • 1957



VIEWS of the outside and inside of the quadruple-diversity receiver used in commercial broad-band microwave tropospheric scatter system reveals that . . .

Tropo-Scatter Begins to Hop

Florida-Cuba link marks start of broad-band systems for both telephone and tv

LONG-DISTANCE radio transmission of tv information has long been the aim of electronic engineers; the ultimate being world-wide transmission of such signals. One step in this direction was recently taken by Federal Telecommunication Laboratories when it introduced a broadband, microwave, tropospheric scatter link, capable of transmitting 120 telephone channels or one tv channel. Equipment cost is slightly over $1 million.

By including operating spares in the system the television channel can be handled simultaneously with the telephone channels.

▶ **Equipment**—End terminals consist of two 60-ft parabolic reflectors to provide space diversity transmission and reception, two dual-diversity receivers for frequency diversity reception, a quadruple combiner and two converter-amplifiers which translate the incoming signal to two final vhf signals that drive separate power amplifiers.

▶ **Others**—Among extensive broadband over-the-horizon microwave links now planned or in process of installation are a 238-mile system between Puerto Rico and the Dominican Republic and a 240-mile system between the islands of Sardinia and Minorca in the Mediterranean. The latter system will eventually tie in with a communication network between Spain and Italy. Military systems are now being installed in North Africa.

Radio, Phonograph Sales Zoom

Phenomenal increase in demand for portables, phonographs help offset tv sales loss

SALES of portable radios increased 40 percent and phonograph sales registered a 50 percent increase over last year, according to the RETMA market data annual report. Last year, 2,670,201 portable radios were produced, compared to 3,750,000 units produced during the current fiscal year.

Total radio sales gained nearly 10 percent by virtue of 15,350,000 units produced during fiscal 1956-57 compared with the 1955-56 figure of 14,129,053 units.

Continuing a detailed analysis of electronics manufacturers, the market data reports show that factories produced television sets at a reduced rate during the current fiscal year: 6 million units this year versus 7,342,930 units last year.

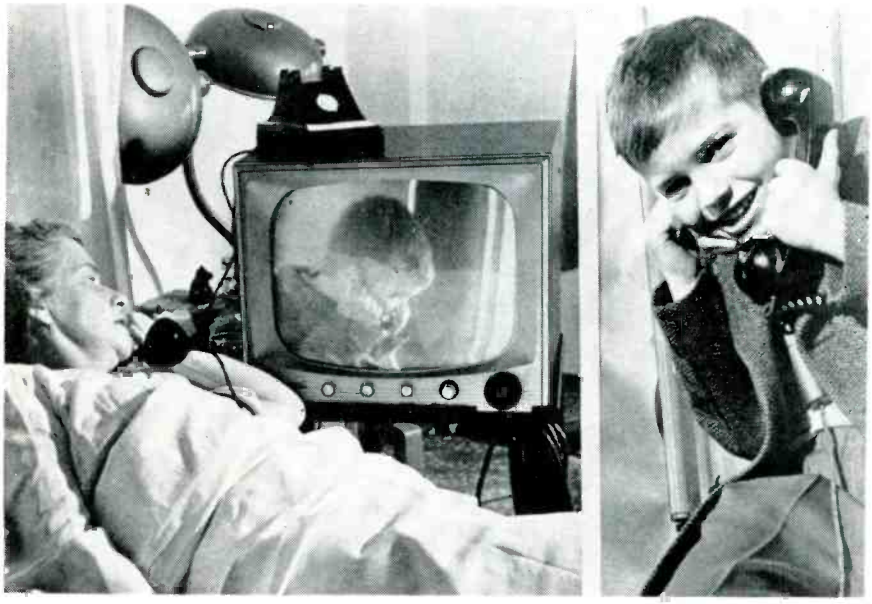
The total dollar value of all

amusement devices: radios, tv and phonographs, is $1.5 billion this year, was $1.4 billion last year. Industrial and commercial products are up from $850 million to nearly $1 billion. Replacement parts sales continue to grow and will reach $900 million, up from $800 million last year.

▶ **In Britain**—Leading British manufacturers expect that public demand for television sets this year will mean a new retail sales peak of not less than 1.5-million units, against 1.48-million units last year. Overseas markets for television sets are opening and shipments may be four or five times the 11,200 exported in 1956.

Sales of record players have expanded considerably. More manufacturers have entered this field, which until about two years ago was a comparatively limited market.

Export to dollar markets of sound reproduction equipment has been a big feature of the past year. In the first quarter of 1957 almost 375,000 record players were exported, in contrast to 246,000 in the same period of 1956.



VISIT-VISION in a hospital allows boy, not admitted upstairs, to see and hear his mother from a booth in the lobby; while in the operating room . . .

Television Scans Medical Skills

Electronic techniques are now indispensable to modern hospitals

FULL-COLOR, closed-circuit tv at St. Luke's Hospital in Chicago, brings medical students in unlimited numbers as close to an incision as the doctor's own elbow. The immediacy of the surgical routine, with the doctor's commentary, is transmitted to students in the classroom.

▶ **Cameras** — Two cameras are utilized in the Dage system installed at St. Luke's, one of which receives its impressions from films or slides. The surgeon's unit, carried by special suspension equipment, can be rotated as well as moved in three directions and is manipulated by remote control. The operator remains in a special observation booth.

▶ **New Technique** — A new heart catheterization method, developed at the Cleveland, Ohio, clinic, reduces surgical time for this delicate operation by 20 to 30 percent. A standard fluoroscopic image amplifier is used in conjunction with a special closed-circuit tv system also devised by Dage. Cleveland doctors have succeeded in eliminating much of the strain and tension once attendant upon probing the living human heart.

Formerly the surgeon worked in a darkened room, crouched over the tiny 1.5-in. periscopic image of the patient's heart. Now, he can work in a normal position in a well-lighted room, watching his own operative progress on a large screen.

The tv camera is mounted above the operating area and transmits to a large-screen monitor placed across the table from the surgeon.

Simultaneous viewing of the heart by both the doctor and his assistant speeds diagnosis and lessens the operating ordeal for both doctor and patient. Consultants may view the procedure on a 14-in. tv screen in a separate room. X-ray requirements are cut by one-third.

▶ **Therapy**—Patient morale moves a giant step forward at Benjamin Franklin TB Hospital in Columbus, Ohio, now equipped with its own tv system which transmits throughout the hospital entertainment once restricted to ambulatory patients able to attend programs in the assembly room. The goal of the Trudeau Guild, the charitable organization which made the closed-circuit television system possible, is to double the present number of receivers to extend the service to all patients.

Devised by Dage, this system serves also as a medium of communication from doctor to patients. Hospital news and educational programs are also transmitted.

▶ **Microscopy** — At Walter Reed Army Medical Center, a microscope and tv camera combination is opening the field of the subvisual for the scientist and student.

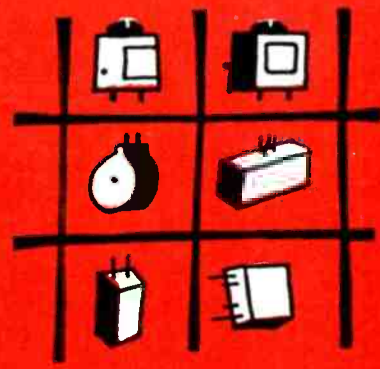
(Continued on page 10)

HIDDEN TREASURE!

. . . the engineering skill in every component by Burnell. Burnell files contain thousands of special designs in regular and subminiature filters.

TOP OF THE LADDER . . .

Burnell products incorporate the highest standards of engineering know-how and precision manufacturing in toroids, filters and related networks.

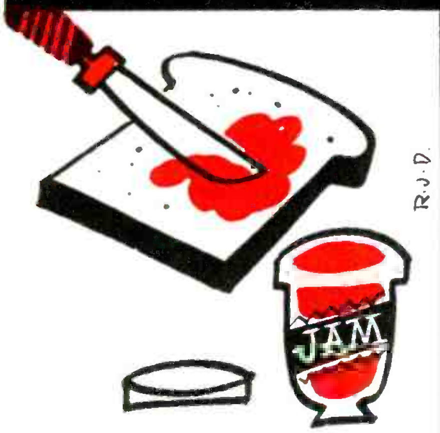


CROSS-SECTION OF A HUGE SELECTION!

Burnell has over 8,000 filter designs in stock, including subminiature filters for aircraft and guided-missiles, communications filters for receivers, and side-band filters for carriers . . . in addition to an array of other new, specialized components.

WHICH AD DO YOU LIKE BEST?

they all tell the same basic story



WANT JAM ON IT?

Burnell supplies the extras in service, courtesy and sheer engineering value. Your inquiries on toroids, filters and related networks will be handled promptly.

HOW ABOUT SOME ICING?

Burnell provides the "top layer" that makes all the difference. Your toroid and filter problems are solved by the most advanced engineering in the field—by Burnell.

LIKE THE GRAVY TOO?

Burnell success depends on meeting your exact needs. If the toroidal component you require is not already on our files, we will make it to your exact specifications.

BEFORE YOUR WIRES GET CROSSED . . .

. . . consult Burnell about your networks problems. Or write for technical information and catalog, without cost or obligation, with details on our toroidal components in regular down to subminiature sizes.

CREAM COSTS NO EXTRA

Depend on Burnell for toroids, filters and related networks whether you require standard components, or special, custom-designed equipment.

Burnell & Co., Inc.

Dept E-77
10 PELHAM PARKWAY
PELHAM MANOR, N. Y.
TELEPHONE PELHAM 8-5000

PACIFIC DIVISION
720 MISSION STREET, SOUTH PASADENA, CALIF
TELETYPE: PASADENA 7578
TELEPHONE: RYAN 1-2841

firsts in toroids, filters and related networks

YOU ARE CORDIALLY INVITED TO VISIT OUR BOOTH #3101 AT THE *WESCON* SHOW

Want more information? Use post card on last page.

Adaptable for the normal study of slides, the camera is used for the unusual study of tumor effects in the coursing blood stream of a live mouse as seen through a plastic window in its skin, for dark-field microscopic viewing of the elusive syphillis spirochete seen in its weirdly-illuminated world of ultra-violet light.

▶ **Dentistry**—One large dental college is using closed-circuit television to speed instruction, to keep abreast of the changing profession and to broaden subject courses.

Since the system was installed seven months ago by General Electric industrial television engineers, faculty members are able to make more efficient use of academic time.

The 21-inch tube has been found the most effective for viewing. Demonstrations are televised from a central studio at the college and piped into several lecture halls on various floors of the building. Two cameras are used in the studio, one equipped with a wide-angle lens for overall viewing, the other with a Perkin-Elmer variable focal length Zoom lens for closeup viewing.

The Auto-Zoom lens enables viewers to peer directly into the patient's mouth via the tv screen and to watch the instructor's hands as he demonstrates dental techniques. Students can view comparative position of patient, dentist and equipment, as well as the close-up views.

▶ **Color x-ray viewer**—The development of a color x-ray viewer system that increases the readability of x-ray pictures through the use of contrast enhancement and color tv techniques, has been announced by Philco Corp.

▶ **Exicon** — Dr. J. Gershon-Cohen, chief of radiology of the Einstein Medical Center at Philadelphia, Pa. said that the system enhances x-ray contrast in gray scale variations, increases readability by utilizing full color and magnifies an area being viewed.

Business Briefs

▶ **Private placement** is made by General Transistor of 18,000 shares of common stock and $400,000 of 5½-percent convertible subordinated notes, due in 1969, through Kidder Peabody & Co. Proceeds will be used to finance expansion program

▶ **Cash dividend** payments to Webcor stockholders are planned for resumption in last quarter of 1957. Last cash dividend was paid July, 1956. A five-percent stock dividend was paid last December

▶ **New division** for process instruments with headquarters in Fullerton, Calif., is established by Beckman Instruments. In past year Beckman's process instrument sales increased 100 percent. By divisional specialization, company feels it can provide better customer service and better tap the growth potential of the market

▶ **Stock purchase** plan for employees is re-established by Westinghouse. It will be similar to previous plan discontinued in 1955. Employees will be able to purchase Westinghouse stock regularly through payroll deductions. Price of initial offering will be $6 less than average market price from Nov. 1-20, 1957

▶ **Name change** of Air Associates to Electronic Communications goes into effect. New name was chosen because it more accurately describes company future aims

▶ **Registration statement** filed with SEC by Microwave Associates covers proposed public offering of 50,000 common stock shares. Proceeds would be used to reduce bank loans and swell working capital. Lehman Brothers would be the underwriter

▶ **Net earnings** of Consolidated Electrodynamics for first four months of 1957 are up 78 percent. Sales are up 51 percent

X-Rays Analyze Tiny Parts Failures

Nondestructive tests of components spot electronic failure

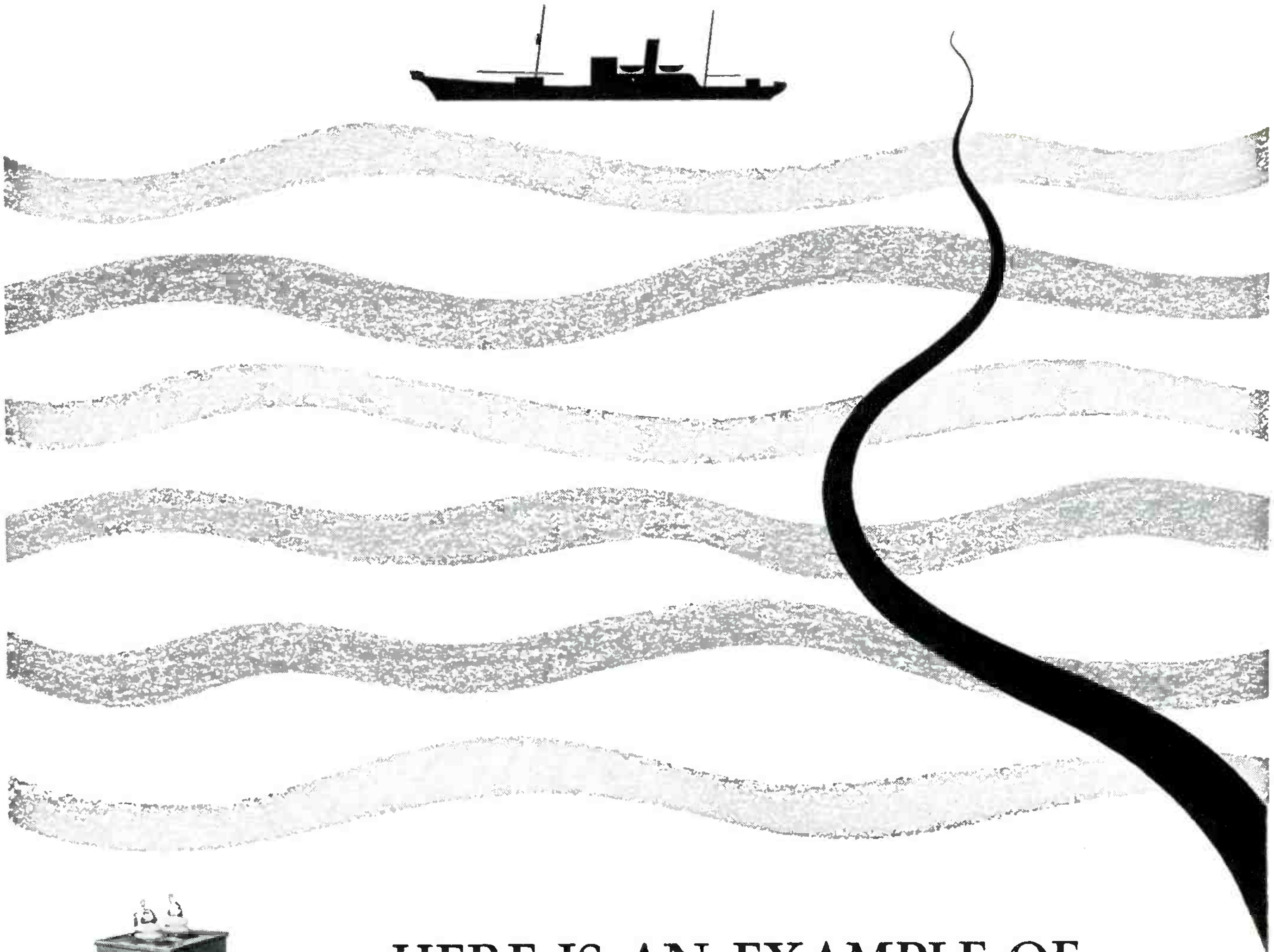
EFFICIENT tool in reliability engineering research on miniature electronic components has been found in the use of x-rays coupled with photographic enlargement of the radiograph.

Technologists at Battelle Institute, Columbus, Ohio find that the technique, used as a preliminary check on the cause of component failure, yields useful information in about 75 percent of cases. Components examined are about 0.25 inch long.

The photographic enlargements are about 2.5 inches long, a 10-diameter enlargement.

▶ **Types**—Components particularly suitable for inspection by this method are transistors, diodes, capacitors, silicon rectifiers and photodiodes. The radiographs will show such types of failure as:

(Continued on page 12)



HERE IS AN EXAMPLE OF

Reliability in Capacitor Design

This Sprague Vitamin Q capacitor has an expected service life of more than twenty years. It was made for the shore end filter which feeds high-voltage direct current to operate the amplifiers in the new Trans-Atlantic Telephone Cable.

In all phases of this outstanding communications accomplishment, reliability is the only valid standard of performance. Failure of this capacitor can cause serious and costly interruption of service on the cable.

The Sprague Electric Company is honored to have merited the confidence of the Bell Telephone Laboratories and the Western Electric Company in having been selected to make this capacitor for such a critical application.

SPRAGUE COMPONENTS:
CAPACITORS • TRANSISTORS • MAGNETIC COMPONENTS
RESISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUITS

SPRAGUE®
the trademark of reliability

Want more information? Use post card on last page.

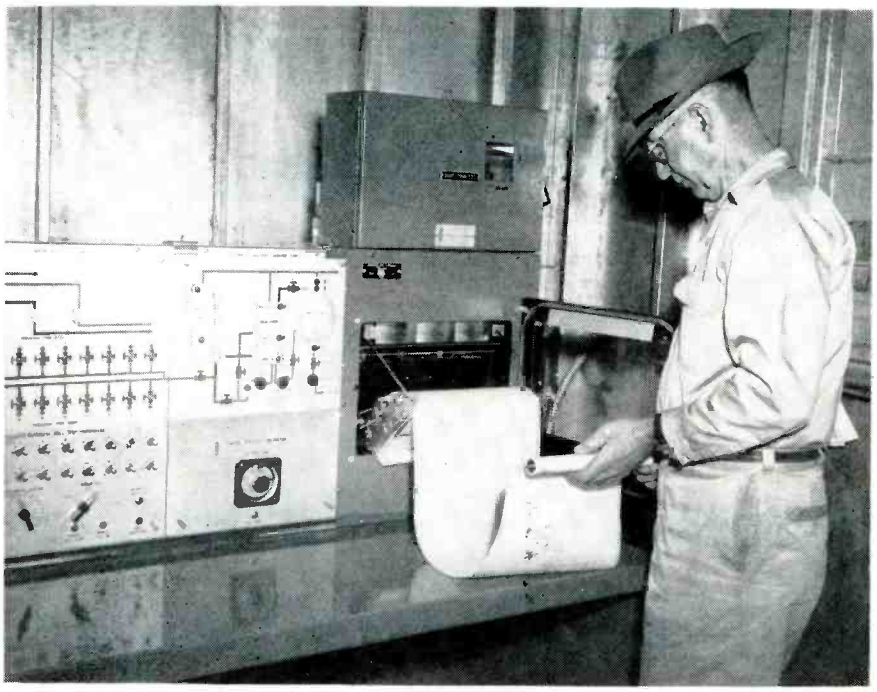
burned out leads, displaced capacitor elements, reworked leads, and separations of many kinds.

Battelle technologists point out that in addition to being a relatively inexpensive and rapid method of checking component failures, radiographic inspection is nondestructive and can be conducted on components prior to load life testing and then correlated with failures occurring during such experimentation.

When miniature electronic parts must be opened for visual inspection after failure, the reliability engineer runs considerable risk of destroying in the opening process the very evidence he is seeking. By changing his experimental procedure to utilize radiography, he can reduce this problem.

▶ **Method**—According to Merle Rhoten, head of Battelle's radiographic laboratory, the x-ray process employs essentially standard procedures. For best resolution, a small focal spot tube and a focal spot-to-object distance of at least 72 inches should be used.

This tends to collimate the x-ray beam so that after passing through the object it will produce as small a penumbral shadow as possible. Through use of extremely fine grain, high contrast film, magnifications up to 50 diameters have been obtained.



RECORDER charts production at Phillips Petroleum Company wells in Texas Panhandle, one way in which . . .

Electronics Shares Oil Spending

Products bought by oil firms range from geophysical gear to process control computers

OIL COMPANIES report higher spending than ever before on oil exploration and capital expansion. One firm's 1957 budget is $1.4 billion. Electronics gets a share every step of the way.

▶ **Geophysics**—Texas Instruments in May air-freighted a seismic magnetic automatic computer worth $185,000 to a French geophysical firm. Three more seismic MACs will go overseas this year. Oil explorers use them to prepare seismic records for interpretation.

▶ **Hydrodynamics** — An oil well flooding study at New York University is sponsored by Arabian American Oil Company. It now costs up to $400,000 to get only half the oil from a deep well with oil and water pressure. NYU, seeking a high yield method, says the mathematics are so complex the study would be hopeless without the aid of a computer.

▶ **Pumping** — On the Texas Panhandle, Phillips Petroleum Company is operating what it believes is the first fully automatic production lease. Electronic switches guide oil, gas and water flow from ground to pipeline. Recorders chart production and quality test records.

▶ **Well Testing** — Westronics has developed a down-hole logger to measure temperature, natural radiation and artificially induced radiation for both slow and fast recorders. These identify oil strata. The logger fits in a tube little larger than a rake handle.

▶ **Refineries** — Electronic controls will run Tidewater Oil Company's new $200 million refinery, 11 major processing plants in Delaware. Panellit Service Corp. got a contract to keep track of and maintain instruments and controls at the eight-square-mile plant.

Esso is installing electronic level indicators on sulfide dichloride tanks after testing a Robertshaw-Fulton unit for a year. Mechanical indicators clogged in a week, the electronic units needed no maintenance.

▶ **Computer** — The third IBM 650 used by Gulf Oil Company started operating in June. The company has two more computers in Texas. The latest will keep inventory of the 700 tanks at Gulf's Philadelphia refinery, handle bookkeeping, oil analysis and yield estimating chores. Ultimate objective is to simulate refinery operations on the computer. Esso Standard S A's

(Continued on page 14)

...SENDUST POWDER CORES

They use NON-STRATEGIC MATERIALS ...you can avoid alloy shortages

Try SENDUST CORES in these typical applications

- **Cores for loading coils**
- **Cores for filter coils**
- **Transformer cores for voice and carrier frequencies**

Write for a copy of the Sendust Core Bulletin SDC-110, containing data on standard core sizes, electrical and magnetic properties, standard permeabilities, etc.

ADDRESS DEPT. E-77

Arnold sells SENDUST Powder Cores in this country under exclusive license from The Tohoku Metal Industries Co., Ltd., of Japan. They are available in a wide selection of sizes, ranging from .800" O.D. to 3.346" O.D.—and in permeabilities of 10, 13, 25, 30, 50 and 80, although not all sizes are available in all permeabilities.

SENDUST cores possess magnetic properties that are generally superior to iron powder cores, but inferior to Mo-Permalloy powder cores in the audio and carrier frequency range. The eddy current loss for SENDUST cores is lower than that of Mo-Permalloy powder cores, but the hysteresis loss of SENDUST cores is substantially higher, and they also have higher values of electrical resistivity. In other characteristics of powder cores, the two types are somewhat similar, but SENDUST cores contain *no scarce or strategic materials and can offer a core source in times of alloy shortage.*

Sample SENDUST cores as well as production quantities are available from stock. *For more detailed information, send for technical data sheet* SDC-110.

WSW 6320

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois

Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.

District Sales Offices:

Boston: 200 Berkeley St. Los Angeles: 3450 Wilshire Blvd.
New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

Want more information? Use post card on last page.

refinery near Havana, Cuba, gets a Fischer & Porter-designed computer. It will log 101 process variables and calculate 11 operating guides hourly.

PANEL BOARD of Westinghouse electrical generator for jet airliners uses transistors and solid state devices in place of mechanical relays as . . .

Transistors Aim For Industrial Controls

Manufacturer tries transistors in logic circuits, finds aging is key to reliable performance

GOING GREAT in auto radios, portables, hearing aids, other communications-in-motion, transistors have been slow in cracking into industrial applications. But the situation is changing.

▶ **Generators**—An initial $1.5-million Westinghouse contract will supply transistorized electrical power generators for Boeing's 707 jet airliners. To reduce wear, transistors and other static devices replace mechanical relays, silicon rectifiers replace brushes, commutators and slip rings.

▶ **Control**—In logic circuits for industrial control, some transistors have achieved four billion switching operations. Reliability is achieved by pre-aging. Units passing the test were still good at 7,200 hours. They are very reliable at low power in certain applications, save space and will soon appear in specialized industrial control systems.

▶ **Drawbacks** — Executive of Motorola blames slow adoption in industrial circuits on three things:

First production transistors were essentially audio amplifiers. Now transistors are available for applications to 12 mc and lab models have operated as high as 2,000 mc.

They can't simply be substituted for tubes, need new circuits. This means engineers designing industrial control circuits need time to familiarize themselves with use.

Germanium transistors, available in commercial quantities and price, are limited to 60 C environment. It's not practical, he says, to mix them with heat-producing vacuum tubes.

▶ **Modules**—One trend contributing to use of transistors in military equipment is modular construction. With transistors, entire circuits can be sealed into modules for easier field servicing.

▶ **Autos** — The millionth power transistor was shipped by Motorola this spring, it reports that two million were used by then in auto radios. Delco pre-

(Continued on page 16)

Military Electronics

▶ **Lincoln Lab** reports reliability for SAGE prototype computer averages 87.8 percent over five-month period operating 17 hours a day. Mean free time between machine failures during programming operations is 2.4 hours. Improvement of maintenance personnel and techniques is expected to increase reliability

▶ **Signal Corps** will get airborne vidicon strip camera from Hycon under $100,000 contract to televise reconnaissance information to rear areas. Future possibility: miniaturized equipment for use in drones

▶ **BuShips** has ordered a $3½ million UNIVAC-LARC, general purpose electronic digital computer, for delivery to David Taylor Model Basin the end of next year. Applied Mathematics Lab will use LARC primarily to solve design and shipboard installation problems associated with nuclear reactors

▶ **Airborne** infrared detection equipment designed by Servo will be used by Army Corps of Engineers to detect surface-covered crevasses in glaciers. Differing temperature of ice over crevass will warn military personnel of danger. Initial testing of equipment will take place this year in Greenland

▶ **Standards** for design and reliability of airborne electronic equipment will be developed by RCA under USAF contract. Three phases consist of establishing and developing:

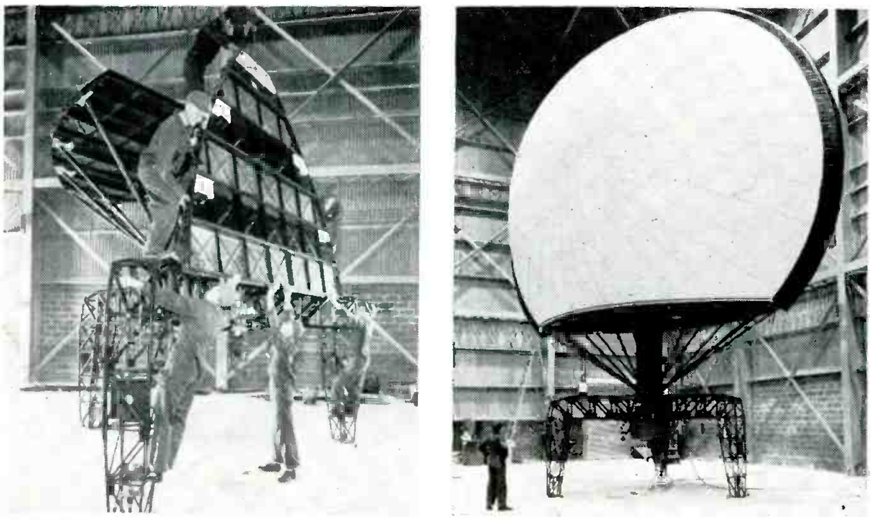
Uniform standards for design of future airborne communication, navigation and identification systems. Goal: to reduce repackaging and redesigning required to adapt current equipment to specific weapon systems

Numerical measurements to gauge reliability

Improved uhf airborne voice communications system—advanced version of ARC-34

dicts three million will be made in 1957, including one million by Delco. Its new Cadillac radio uses 13 transistors, three germanium diodes.

Next year's auto fuel injection system, reports CBS-Hytron, will use five transistors, two diodes. Other uses in prospect are transistorized ignition systems, voltage regulators and automatic transmission controls.



COLLAPSIBLE magnesium base aids mobility of this new portable paraballoon radar antenna with an inflatable reflector, developed by Westinghouse for the Air Force as . . .

Electronics Boosts Magnesium Sales

Industry becomes major market for the metal as military requirements stiffen

THIS YEAR the amount of magnesium used by the electronics and electrical industry is expected to approach 2.5 million pounds. About 2 million pounds were used in 1956 by the industry while in 1949 approximately 1.1 million pounds were consumed. This growth has put electronics among the top ten markets for structural magnesium.

▶ **Why**—Magnesium is the lightest commercially available metal. Its specific gravity is 1.8 compared to 2.8 for aluminum. Military requirements call for further reductions in the weight of electronic equipment particularly for portable and aircraft use. It is estimated 80 percent of all castings going into aircraft today are made of magnesium. Nearly every electronics manufacturer now producing military electronics equipment uses magnesium to some extent.

▶ **Use**—Chassis, housings and structural bases for military radar equipment comprise some of the leading applications of magnesium in electronics. Magnesium die castings are also well established in electronic calculators and business machines.

▶ **Growth**—Use of magnesium in electronics and other industries is expected to increase faster in the future. The President's Material Policy Commission has predicted an 18-fold expansion in the consumption of the metal by 1975, equivalent to a 14-percent per year growth rate.

Magnesium makers are already expanding for this expected increase. A new corporation, Alabama Metallurgical Corp. was recently formed to build a $7-million plant in Selma, Ala., adding 15 percent to the U. S. magnesium commerical production total. Brooks and Perkins and Dominion Magnesium of Toronto, Canada, will jointly own the new firm. The plant, with a $1 million payroll, will have a rated annual production capacity for high purity magnesium of 10,000 tons.

Europe's TV Keeps Growing

More network stations pepper continent as demand increases

EUROPE'S television network shows marked extension in 1956 and in the first quarter of 1957. Here are some of the highlights:

▶ **Italy's** broadcasting authority, Radiotelevizione Italiana (RAI), completed its chain of 98 tv stations—27 main stations and 71 satellite relay stations. Italy now has one tv station per 1,200 sq mi.

▶ **France** has 17 tv transmitting stations, nine of which were opened in 1956. Peak effective radiated power of these stations are 20-kw vision, 5-kw sound for such stations as Paris, Lille and Lyon; 50-kw vision, 12-kw sound for Toulon's experimental station.

▶ **Austria's** tv network, with four stations in service, reaches 50 percent of her population. Three operate with 60-kw peak vision power and 12-kw sound carrier power, in Vienna, Salzburg and Graz and a fourth in Linz, with 3-kw vision, 0.6-kw sound.

▶ **West Germany** recently put into service a series of low-power transposers for towns and other small areas with 50-mw output. By adjusting radiated power between 10 and 300 mw with antennas of appropriate gain, ranges of one-half to 3 miles can be served with field strength sufficient for good picture reception.

▶ **Sweden** has set up a five-year

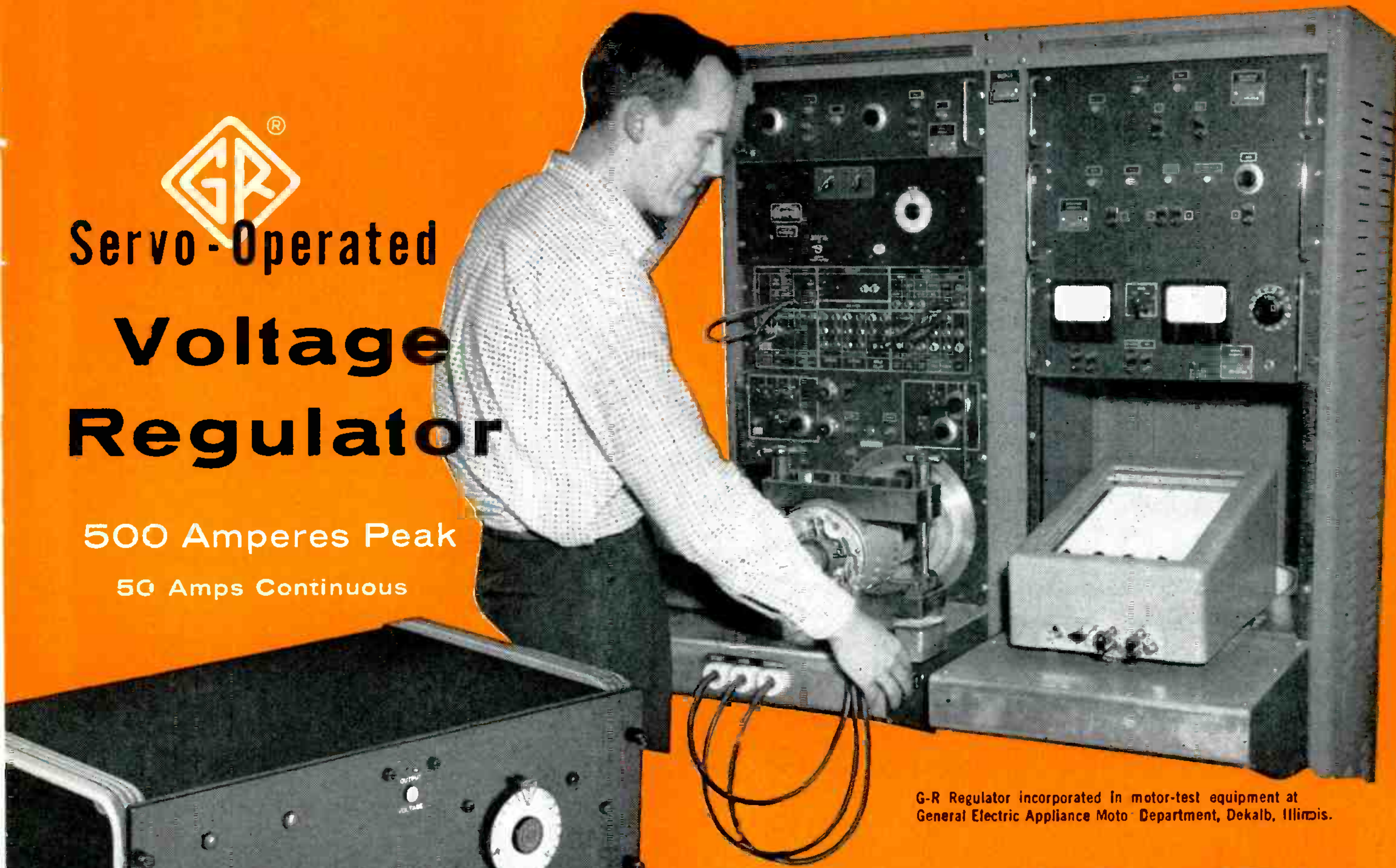
(Continued on page 18)

Servo-Operated

Voltage Regulator

500 Amperes Peak

50 Amps Continuous



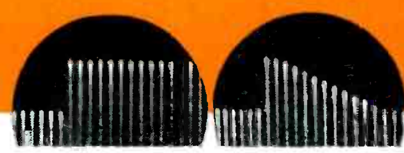
G-R Regulator incorporated in motor-test equipment at General Electric Appliance Motor Department, Dekalb, Illinois.

The excellent transient overload characteristic of the G-R Automatic Line-Voltage Regulator ideally suits it for loads with high peak currents.

The short-period overload rating — *up to ten times the steady-state rating* — makes this electro-mechanical device particularly useful in motor testing where starting currents many times normal running currents are encountered. Fast response and high accuracy make for accurate measurements of motor output torque and input current at various line voltages.

This Regulator's output impedance is essentially zero for steady-state conditions and less than 0.02 ohm during load transients. Consequently, the regulator transient at double load is only about 2% and this is corrected within 0.2 second, resulting in an almost ideal voltage source.

The application of proportional-control servomechanisms to voltage-regulator design has produced a rugged device offering many operating advantages for industrial or laboratory application. High accuracy, excellent transient response, large power-handling capacity, freedom from power-factor restrictions, and very low cost per KVA rating are all to be found in this one compact unit.



Two-percent change in 60c voltage input (left oscillogram) is corrected in 12c or 0.2 sec (right) by G-R Line-Voltage Regulator.

Fluctuating line voltages as small as 0.25% are corrected by a buck-or-boost voltage supplied from a motor-driven Variac. There is no chattering, there can be absolutely no introduction of distortion, and there are no power-factor restrictions as in saturable-reactor regulators.

Type 1570-A
Automatic Line-Voltage Regulator

115v or 230v models for table top or relay rack, **$480**
Militarized Type 1570-ALS15 unit, **$625**
3 units may be used to regulate each phase of a 3-phase circuit

- Accuracy is ±0.25%, independent of load
- 6 KVA load rating
- Speed of correction is 10v per second
- Output voltage is adjustable ±10%
- Input voltage range is ±10% (or ±20%*)
- Efficiency is 98%
- Full accuracy at any load power factor
- Weighs considerably less per KVA than other types
- Costs less per KVA

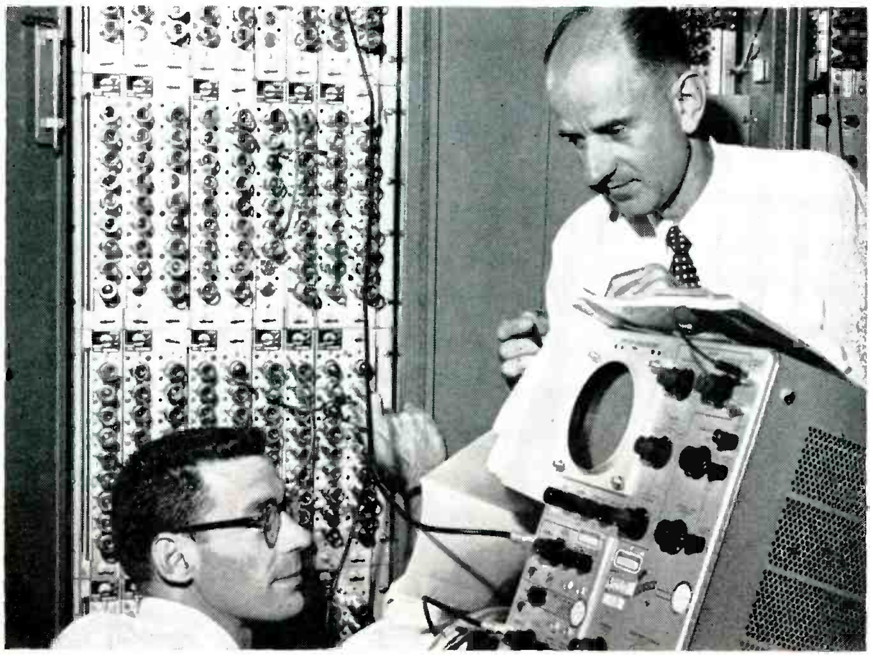
*±20% range must be specified on order; speed of correction is doubled, power capacity and accuracy are halved.

GENERAL RADIO Company

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

Broad Avenue at Linden, Ridgefield, N. J. **NEW YORK AREA** — 1000 N. Seward St. **LOS ANGELES 38**
8055 13th St., Silver Spring, Md. **WASHINGTON, D. C.** — 1150 York Road, Abington, Pa. **PHILADELPHIA**
6605 W. North Ave., Oak Park **CHICAGO** — 1182 Los Altos Ave., Los Altos, California **SAN FRANCISCO**

All G-R Products are now covered by a *2-Year Warranty* tv development plan. Main emphasis is on the Stockholm-Malmö link which will connect Swedish tv with Eurovision, the European program exchange network, via Copenhagen, Denmark. Projected network will have 19 stations with effective radiated powers between 100 kw and 1 kw. Two stations presently in operation are Stockholm, 60 kw, and Goteborg, 1.3 kw now, 60 kw, later.



ENGINEERS check out circuits of new computing device as . . .

Computer-Converter Aids ICBM Tests

Device ties analog and digital computers in both directions to use best attributes of each

DESIGNED to help simulate flight performance of the Atlas intercontinental ballistic missile, a \$200,000 computer-converter named Addverter will bridge the analog and digital computing equipment required for this.

▶ **How It Works**—Missile action is calculated continuously on the analog computer until interception. The computer-converter periodically samples missile directional information several times a second and converts it into digital form. Each conversion takes about 100 μsec.

The digital computer calculates the trajectory whereupon this corrective data is then returned to the Addverter for reconversion to analog form and subsequent transfer to the simulator. The latter data conversion take about 30μsec. Need for this device stems from a desire to simulate in real time using a digital computer.

▶ **Applications** — The equipment, originated at Convair-Astronautics and designed and produced by Epsco, is also used to solve many other scientific problems, especially in systems engineering and mechanization.

Applications Pace Computer Market

Government counts heads, university creates center and industry buys more equipment

GROWTH in any industry may usually be attributed to growth in applications of a given product. This is certainly borne out in the field of electronic computers where many special-purpose units are designed and produced to satisfy one application or a limited number of related applications while the general-purpose units must be modified and/or updated to be used in a new application.

▶ **Census**—Nucleus of the electronic equipment to be used in tabulating the 1960 census of the United States, two new Univac Scientific computers will replace the older Univacs initially used during the final stages of the 1950 census tabulations.

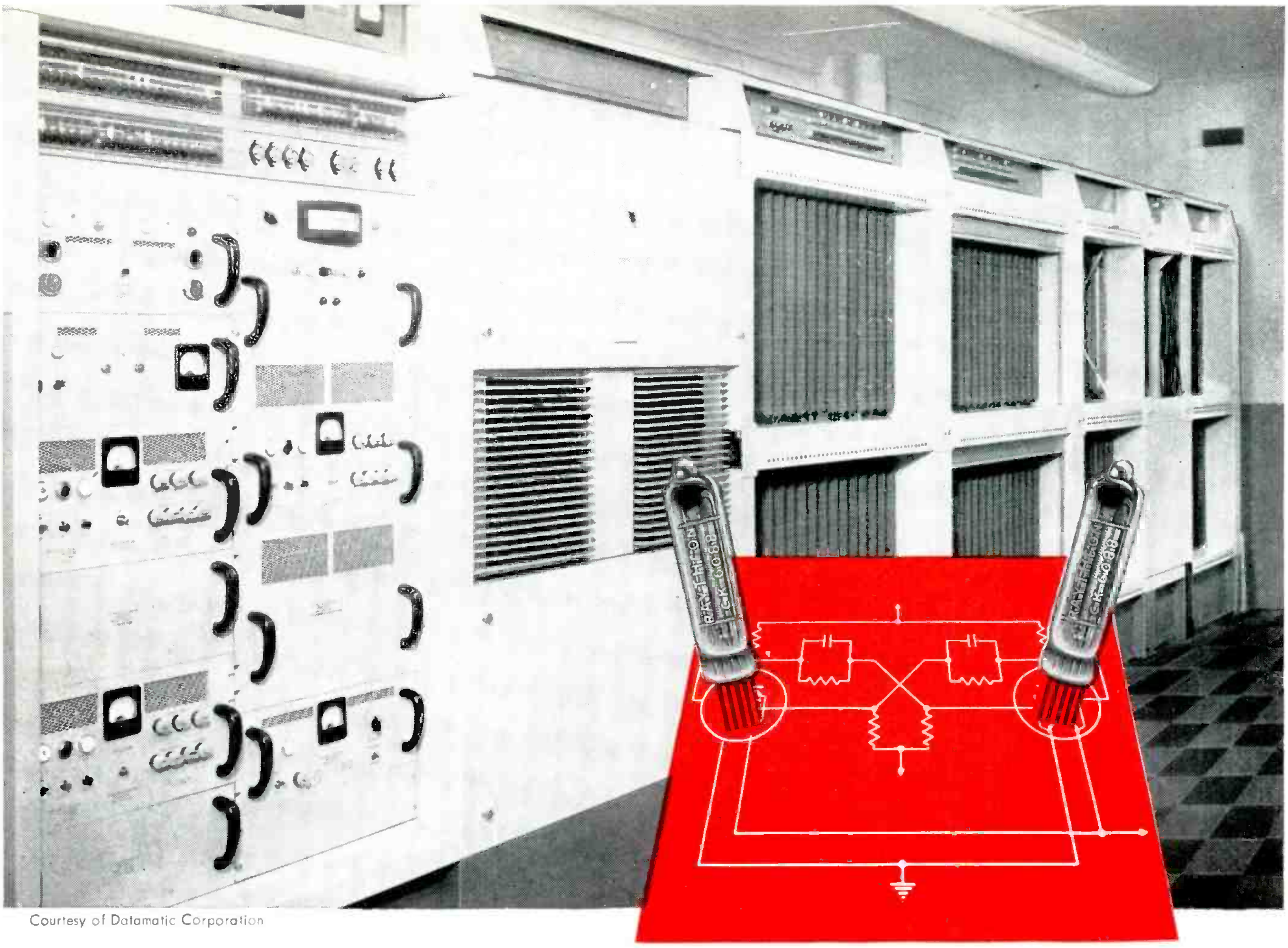
The new computers will have double the input-output speed and greater internal computing speed than the ones now in use by the Bureau to enable faster tabulation than achieved in the past. During peak periods, the Bureau intends to lease additional equipment.

▶ **Taxes**—In Los Angeles County, California, a Datamatic 1,000 edp system will be installed in the county assessor's office to process tax records and data. It is expected to save the county government an estimated \$500,000 yearly over and above the \$47,305 monthly rental.

▶ **School**—The University of Pennsylvania, birthplace of the Eniac twelve years ago, recently dedicated a computing center built around a gift of a \$1.5-million Univac. Initial projects of the center include exploring the chemistry of respiration, analyzing certain labor statistics bearing on family finances and problems in electromagnetics.

▶ **Industry**—Production testing of rocket engines at Bell Aircraft will be handled by a \$75,000 high-speed edp system produced by Berkeley Division of Beckman Instruments. The system uses a high-speed printer that logs information at the rate of 1,800 digits a second. It will monitor propellent flow, temperature, pres-

(Continued on page 20)



Courtesy of Datamatic Corporation

Cut flip-flop circuit power requirements 95% increase reliability and eliminate the heat rise problem

with RAYTHEON FILAMENTARY SUBMINIATURE TUBES

Here are the figures on CK6418 and CK6088 power input as compared with a popular heater-cathode tube such as CK5814

	plate supply	power per 1000 flip-flop circuits
CK6418	30 volts	29.5 watts (2000 tubes)
CK6088	45 volts	63.5 watts (2000 tubes)
CK5814	150 volts	2500. watts (1000 tubes)

Raytheon Filamentary Subminiature Tubes are distinguished by low power requirements, high efficiency, instant heating, no interface resistance, small size, exceptional ruggedness and long life. They are insensitive to ambient temperature change.

Raytheon *Flat Press*, the *Seal of Reliability*, provides a longer glass-to-metal seal, reduced glass strain, no lead burning, flexible, in-line leads tinned right to the seal. Faster, neater wiring and socketing are assured. Ideal for assembly in printed circuits with dip soldering.

Here are results in actual computer service:

190 tubes after 13,000 hours of operation: no tube failures, all tubes still operating

120 tubes after 11,000 hours, with daily on-off cycles: no failures, all tubes still operating

50 tubes after 16,000 hours: no failures, all operating

10,000 hour factory life tests on these low filament current types normally show no inoperative rejects including no filament or glass failures.

This is RELIABILITY +

RAYTHEON

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
NEW YORK: 589 Fifth Ave. • PLaza 9-3900
CHICAGO: 9501 Grand Ave., Franklin Park • TUxedo 9-5400
LOS ANGELES: 5236 Santa Monica Blvd. • NOrmandy 5-4221

Want more information? Use post card on last page.

sure, time and frequency.

Beckman, through its Helipot Division, is also producing five servo computers to be used in a Navy radar system under a $400,-000 contract with Hughes Aircraft.

Microwave System Eases Overload

Solid state devices will help solve crowded conditions of radio spectrum

PROMISE of relieving the overcrowded radio spectrum is held out by a new microwave system that will see its first commercial use in 1959.

Using solid state electronic devices, Bell Telephone Laboratories' TH system carries more than 10,000 telephone conversations, or 12 television programs plus more than 2,500 conversations.

Engineers see the chance of increasing capacity to more than 13,000 conversations, or 12 tv programs plus more than 4,000 conversations. Television broadcasts could be either in color or black-and-white for homes or theatres.

▶ **Advantages** — System has three times the information-handling capacity of present systems occupying comparable space.

The first commercial installation, replacing a section of the present TD-2 transcontinental system, will be fully equipped for tv, radio and telephone transmission. Location of the link has not been disclosed.

New system will also provide more capacity for teletypewriter, facsimile and data transmission. Fast switching gear can bring in alternate equipment or channels in case of component failure or atmospheric disturbances.

▶ **Prophecy** — In a Rome address apropos of the new system, Dr. M. J. Kelly, president of Bell Labs, told a European symposium on radio links that solid state electronics will almost completely instrument telecommunication in the coming decades.

▶ **Band** — Operating in the 5,925-6,425 mc microwave band, the TH system provides eight 10-mc broadband channels in each direction, and two 0.5-mc narrowband channels for order wire and alarm facilities. Six of the eight bands will be used, the other two held in reserve.

Alternate horizontal and vertical polarization of adjacent channel signals provide isolation between channels of 20 db more than would otherwise be available. This, says Bell Labs, allows channels to be placed much closer to one another, make better use of available frequency spectrum.

Each broadband channel, says Bell Labs, could provide: 1,860 voice channels with 4 kc spacing; a black-and-white or color tv signal plus 420 voice channels; or a broadband tv signal such as might be required to transmit a color tv picture of theater-screen size.

▶ **Equipment**—New traveling wave tube with 30-db gain provides r-f output of 5 watts, frequency modulated, at each transmitter. Frequency converter drives twt, boosts i-f of 74.1 mc to final transmitted frequency. New gold-bonded diode accomplishes conversion and can provide gain, if desired, but is operated at low bias to give uniform impedance over i-f range and so gives neither gain nor loss.

Microwave ferrite isolators, each with insertion loss of 0.25 db or less in forward direction and at least 27 db in reverse, provide isolation between forward and reflected signals at various points in the system.

Switching time of less than one millisecond between regular and standby equipment is accomplished by a ferrite switch.

ELECTRONIC weather paratrooper, new type of high-altitude sonde, is checked in flight position by General Instrument engineer. The equipment is a . . .

Parachuting Weather Station

Sondes, master keys to weather secrets above the earth, add up to a $4 to $5 million business

SHOT out of an airplane flying as high as 11½ miles up, the radiosonde shown above glides to earth by parachute. As it falls, it takes soundings of temperature, humidity and air pressure. These readings are sent out automatically as radio-pulse signals which are received by weather reconnaissance

(Continued on page 22)

Designing to total dynamic environment . . .

A NEW CONCEPT in shock and vibration protection

for missiles and jets

The total dynamic environment against which equipment must be protected in missiles and jets is so violent that protection by conventional unit isolators is impractical. Unit isolators built to meet the demands of this service would be relatively huge, yet there is no room for even admittedly inadequate present-day isolators.

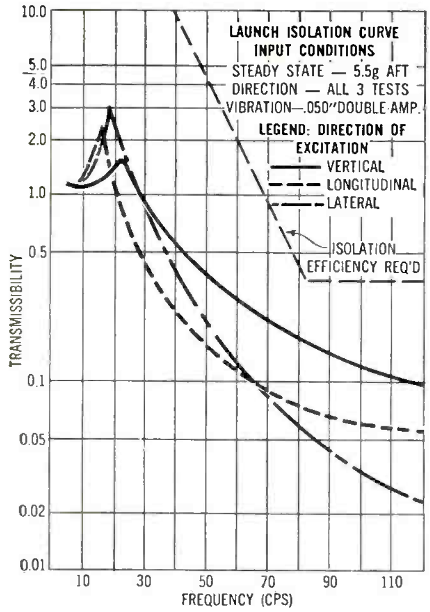


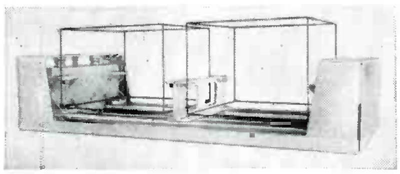
Figure 1. Graph showing specified limits of isolation efficiency during missile launching and the performance of distributed-element mounting system.

The total dynamic environment

Severe shock during launching, high *g* values of sustained acceleration with superimposed vibration, high-amplitude vibrations, and operation through all flight attitudes from horizontal to vertical — these are the elements of the dynamic environment met in currently operational missiles and detailed in the following specifications.

- Effective vibration isolation under steady-state acceleration of 6 g
- Shock transmissibility not over one for 15-g, 11-millisecond half-sine-wave shock, per Procedure I, MIL-E-5272A
- No snubber contact under high-amplitude low-frequency vibration input
- Low transmissibility at resonance
- Effective vibration isolation for all frequencies above 50 cycles per second
- Compliance with these requirements for every mounting position or attitude
- Provision of the required characteristics in an isolation system of minimum size and weight.

Obviously, MIL-spec isolators are inadequate to meet these stringent requirements.



A distributed system

A totally new design concept — a distributed-element isolation system — not only does the necessary job but provides substantial space savings as well. This is how it works. A number of small, single-degree-of-freedom, spring-and-friction-damper elements are so disposed about the mounted units that spring rates are equal for all directions of loading. This makes the isolation characteristics the same for every operating or installation position.

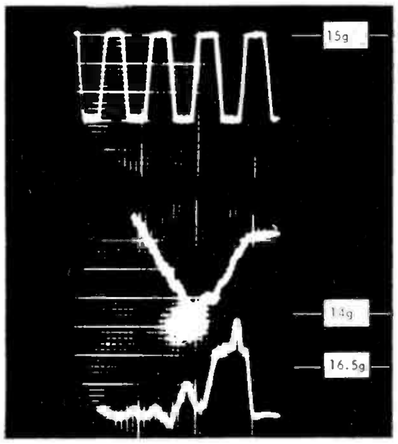


Figure 3. Typical oscillogram for shock test along vertical axis for an integral mounting system carrying two, six-pound electronic units. Upper trace: amplitude calibration at 60 cps. Middle trace: output from mockup of equipment. Lower trace: input to mounting assembly.

Matching the environment

With this new design concept, both the stiffness and the damping of the individual isolation elements can be selected so that the system is matched to the application. Thus it becomes feasible to provide greater shock protection in one plane, to design for different vibration inputs from different directions, or to provide whatever compensation is needed to suit the total dynamic environment. And because the separate elements can be located wherever space is available, this system minimizes space requirements.

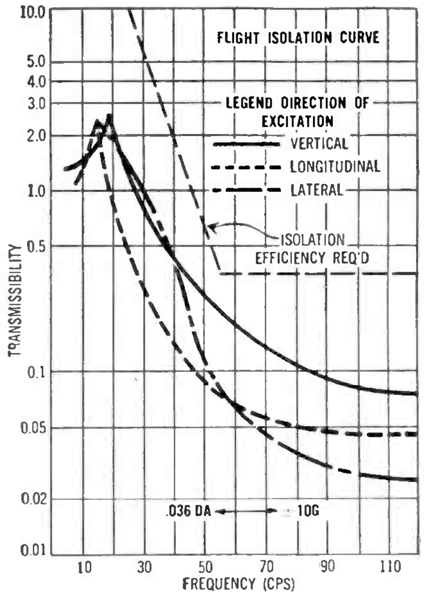


Figure 2. Graph showing in-flight performance characteristics of the distributed-element mounting system.

A further advantage of this protection system is the ability to accommodate large vibration amplitudes without snubber contact. This is a result of the non-linear friction damping that can be set to limit the movement of the equipment under resonant conditions. This type of damping also allows efficient isolation of low-amplitude, high-frequency vibration because only slight damping occurs at the higher frequencies.

Additional design data

Detailed information on the specifications that are being met by Barry Integral Bases using the "distributed-element isolation" concept of characteristic selection are available on request. Ask for Report No. 602.

Barry's new Western Division, in Burbank, California, offers fast, on-the-spot design and prototype service, and production of special systems.

BARRY CONTROLS INCORPORATED

BARRY MOUNT

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

707 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

Want more information? Use post card on last page.

ing within a 250-mile range.

This weather data is transmitted immediately to weather-central stations, collated and made available to the Pentagon, giving the armed-services a comprehensive hour-by-hour picture of the weather. These newest sondes are used in remote or isolated areas, or during wartime in enemy territory, to radio back weather information otherwise unobtainable due to lack of ground-based or ship-based weather posts.

► **Storm Trooper**—The Dropsonde contains a miniature parachute pack with its own pilot chute. Electronic temperature and humidity-sensing instruments are located on a horizontal-bar projection.

The automatic radio station is battery-powered with antenna projecting from the bottom of the device. Divided into three main compartments, the equipment contains the parachute compartment at the top, the battery section in the center and instruments in the bottom section.

► **Sondes**—Weather sounding devices are now a $4 to $5-million annual business. This amount includes the free-floating balloon and airplane-ejected types, as well as the wiresondes or anchored balloons.

► **Military** — Air Force contracts have been awarded for 7,816 Dropsondes with expected orders of about 30,000 units annually. Each unit costs about $60.

The Air Force uses about 125,000 and the Navy uses about 10,000 balloon-type sondes per year. They cost about $18 each.

► **Commercial**—The Weather Bureau spends over $2 million per year on all types of sondes, which it considers basic tools for weather forecasting. Within the past year the Weather Bureau has taken over 24 weather stations formerly operated by military agencies, mostly the Air Force. These include former military weather stations at Idlewild Airport, N. Y.; Norfolk, Va.; Rome, N. Y.; Flint, Michigan; Dayton, Ohio; and Peoria, Illinois.

FCC Actions

► **Extends** renewal license periods in Public Safety, Industrial and Land Transportation Services by one more year. With these now at five years, all stations in the Safety and Special Radio part of the spectrum are on a five-year basis for licenses

► **Permits** aviation flight personnel without operator licenses to operate radio altimeter, airborne radar and transponder equipment

► **Proposes** to permit taxicab stations to use their radio facilities for civil defense communications when other facilities are inoperative or inadequate

► **Considers** allowing railroads to install mobile units in vehicles of non-railroad companies which give some sort of service to the railroads

► **Splits** divisions of its own Office of General Counsel. Being done for administrative purposes, it sets up four branches where formerly there were only two

► **Grants** to RCA Communications special permission to establish rates and regulations for international teletype service between U.S. and Poland

► **Okays** officially public use of devices, such as voice silencers, with telephones

Electronic Strategist Directs Defense

Matabe, real time digital computer, performs 200,000 7-digit-number additions per second

ELECTRONIC control system, designed by Burroughs as part of nation's anti-aircraft defense system, performs in one second 200,000 additions using 7 digit numbers.

Known as Matabe (Multi-weapon Automatic Target and Battery Evaluator), the equipment can handle 720 multiplications, 714 additions and five divisions in less time than it takes a mechanical adding machine to do one addition problem.

Conceived by Army Signal Engineering Lab, Matabe will aid anti-aircraft officers to calculate in milliseconds information needed to make most favorable use of anti-aircraft weapons.

► **Computations**—Information Matabe will calculate: time it will take a missile to get from the battery to its burst point; how much time a battery needs to carry out its assignment (firing on attacking planes); at which point a missile will intercept a target; whether a target is within effective range of a battery; kill probability of a battery-target assignment; percentage of total bomb damage attacking planes are capable of inflicting; and military worth of a target according to strategic goals.

(Continued on page 24)

21"

SlaveScope

- FOR LECTURES
- DEMONSTRATIONS
- PRODUCTION LINE TESTING
- COMPUTER READ-OUTS, ETC.

Show the patterns big, bright and clear . . . so everyone can see!

The Du Mont SlaveScope may be used with any standard low-frequency oscilloscope for applications such as group viewing, production line testing, or computer read-outs. Signals from the deflection plates of the driving oscilloscope are fed through a cathode-follower adapter to the SlaveScope. The oscilloscope pattern is accurately reproduced on the large screen of the SlaveScope.

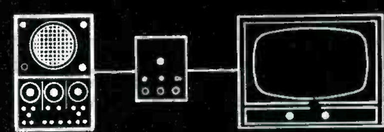
The SlaveScope is supplied with a 10′ connecting cable, but may be used for remote viewing up to 100′ from the driving oscilloscope.

ACCURATE REPRODUCTION: X and Y amplifier linearity of 1% full scale.
HIGH VISIBILITY: Accelerating potential of 6 KV produces bright trace, even under high ambient light conditions.
DEFLECTION FACTOR: Dependent upon driving oscilloscope. For example, when used with Du Mont Type 401, 100 millivolts full scale; when used with Type 403, 1 millivolt full scale.
FREQUENCY RESPONSE: DC to 100 KC, dependent upon deflection amplitude.
IDENTICAL AMPLIFIERS: Identical X and Y amplifiers.

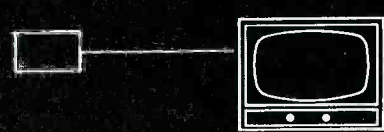
TYPE 343 17" rectangular CRT, rack mounted **$980.00**

TYPE 345 21" rectangular CRT, for bench use **$870.00**

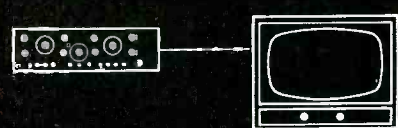
(with P4 screens. P1, P2, P7 screens available at slightly higher cost.)



For coupling SlaveScope to master oscilloscope, Type 2622 Cathode Follower Adapter prevents loading of deflection circuits, assuring accurate reproduction of test patterns. Type 2622, $105.00



Signals from high output, low-frequency transducers may be fed directly into SlaveScope. X and Y amplifier sensitivity 1 volt/inch.



SlaveScope used with Type 2628 Amplifier-Sweep Adapter as a complete, laboratory quality, general purpose low-frequency oscilloscope.

DU MONT®

Write for complete details

TECHNICAL SALES DEPARTMENT

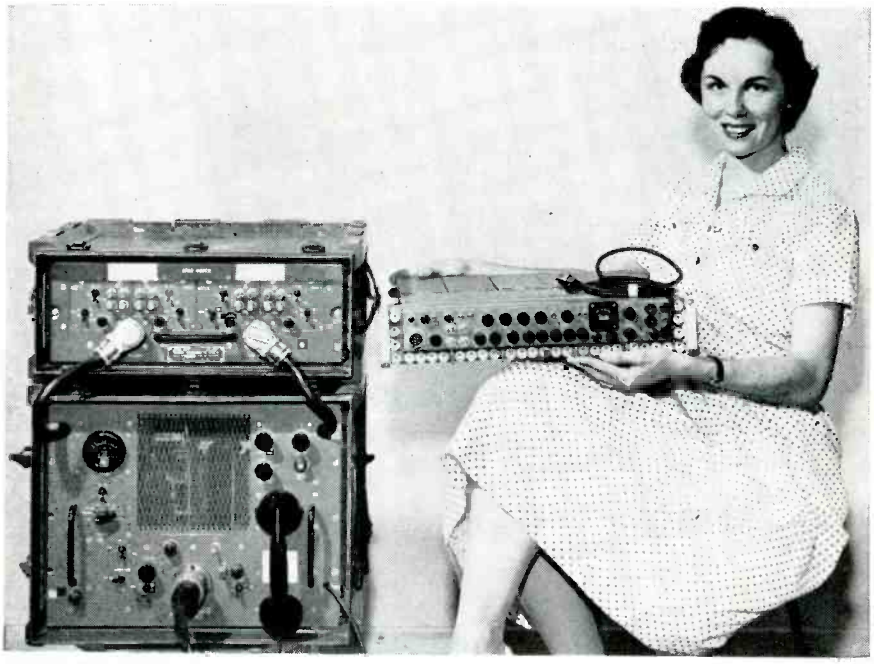
ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J., U. S. A.

Want more information? Use post card on last page.

Matabe keeps a running account of the history of fire on each target. As machine is informed by operators of a kill, it automatically drops that target from the system before making its next assignment.

Results of any type of raid are recorded on punched paper tape for reference in mapping defense against future attacks.

Matabe is 29 feet long, over 7 feet high, consists of seven cabinets housing more than 20 miles of wiring and thousands of electronic tubes, relays, resistors and other components. Heart of system is real time digital computer.



FIELD TELEPHONE carrier terminal equipment (left) in present use compared with new equivalent (right) shows one way in which . . .

Miniaturization Trend Continues

Transistors and egg-crate chassis construction reduce weight by more than half

MILITARY demands for lighter, more compact field equipment act as a continuing spur to the production of miniaturized electronic equipment. An example of this trend is the new multiple-channel tactical telephone terminal equipment recently unveiled by the Army Signal Corps and Lenkurt Electric Co.

▶ **Operation**—The system uses frequency-division multiplexing to provide four voice channels for use with either microwave radio relay or cable. A maximum of four terminals may be stacked to give a 16-channel capacity system operating between headquarters.

▶ **Components**—The Army Signal Engineering Laboratories are also presently developing a new piezoelectric ceramic i-f bandpass filter that is ideally suited to use in transistorized circuits owing to its close impedance match to semiconductor devices. Operation of the units is based on their mechanical resonance when subjected to an electric field.

▶ **Materials**—Suitable for this application are barium-titanate and solid-state solutions of lead-titanate, lead-zirconate. These materials are permanently polarized by first heating to specific temperatures and then applying a high-strength electric field as they cool.

The material is shaped into a disk the diameter of which determines its resonant frequency. For a fundamental 455-kc unit this diameter would be about 0.2 inch.

Temperature and aging properties of the materials are the present limiting factors for military use. It is expected that the upper temperature extreme will reach 150 C without modification of design criteria as work on temperature stability of materials progresses.

Forward Scatter Links NATO Nations

Over-the-horizon and line-of-sight will integrate entire chain

SUPREME Headquarters Allied Powers Europe is planning one of the most modern and extensive military communications systems in the world.

This new network will combine over-the-horizon tropospheric forward scatter and line-of-sight radio relay links to further integrate, from a communications viewpoint, certain international and national military agencies and installations extending from Eastern Turkey around the broad crescent throughout NATO Europe to northern Norway.

Officials of International Standard Electric Corp., the overseas management subsidiary of IT&T and Hycon Eastern signed contracts at SHAPE for their respective companies. The combined estimated contract cost for their services is $9,000,000.

▶ **Headquarters**—The main center of this gigantic undertaking will be established in Paris, France. Most planning, engineering and general supervision will be conducted there. In addition, there will be field teams for testing, exploration, installation and supervision which will be deployed in the many NATO European countries where the forward scatter and radio relay station sites are projected.

(Continued on page 26)

There's a standard PERKIN model for your every need!

In addition to the 28 volt models featured at the right, the following units are also available:

OTHER 28 VOLT MODELS

Model	Volts	Amps	Reg.	AC Input (60 cps)	Ripple rms
28-5VFM	0-32 V	5	20% (24-32 V range)	115 V 1 phase	2%
28-10WX	24-32 V	10	±½%	100-125 V 1 phase	1%
28-15VFM	0-32 V	15	20% (24-32 V range)	115 V 1 phase	5%
28-50WX	24-32 V	50	±½%	230 V* 3 phase	1%
MR2432-200	24-32 V	200	±½%	230 V* 3 phase	1%
MR2432-300	24-32 V	300	±½%	230 V* 3 phase	1%
MR2432-500	24-32 V	500	±½%	230 V* 3 phase	1%

*±10%. Also available in 460 V ±10% AC input. Will be supplied with 230 V input unless otherwise specified.

6, 12, 115 VOLT (NOMINAL) MODELS

	Model	Volts	Amps	Reg.	AC Input (60 cps)	Ripple rms
6 Volt	6-5WX	6 ±10%	5	±1%	95-130 V 1 phase	1%
6 Volt	6-15WX	6 ±10%	15	±1%	95-130 V 1 phase	1%
6 Volt	6-40WX	6 ±10%	40	±1%	95-130 V 1 phase	1%
12 Volt	12-15WX	12 ±10%	15	±1%	95-130 V 1 phase	1%
115 Volt	115-5WX	115 ±10%	5	±½%	95-130 V 1 phase	1%
115 Volt	MR15125-5	15-125	5	±1%†	95-130 V 1 phase	1%†
115 Volt	G125-25**	115-125	25	1½-4%	230/460 V 3 phase	5%

**Germanium Rectifier Unit †Increases to 2% @ 15 V.

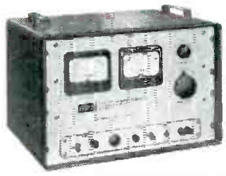
PERKIN SALES OFFICES

New York Area
N. J.—MAkt 3-1454
New England Area
Mass.—MUrdk 3-3252
Philadelphia
BR 5-2600
Chicago
PA 5-6824
Seattle
LA 9000
St. Paul
MI 6-2621
Atlanta
TR 6-3020
Winston-Salem
4-0750
Charlotte
ED 2-7356
San Diego
AC 2-0301
Redwood City, Cal.
EM 9-3354
Albuquerque
8-1724
Denver
AL 5-1196
Phoenix
AM 5-0274
Euclid, O
RE 2-7444
Dayton
WA 5426
Canada
Agincourt, Ontario
AX 3-7011
Foreign
N. Y. BR 9-1296

PERKIN... THE LEADER in tubeless magnetic amplifier regulated DC POWER SUPPLIES

IMMEDIATE DELIVERY FROM STOCK

No Moving Parts • No Vibrating Contacts



Model MR532-15A

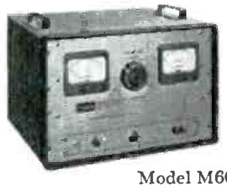
2-36 VOLTS @ 15 AMPS SPECIFICATIONS

Regulation: 5-32 Volt Range: ±½%
2-5 Volt and 32-36 Volt Range: ±2%

AC Input: 105-125 Volts, (for 2-32 V.DC), 110-125 V, (for 32-36 V.DC), 1 phase, 60 cps (8 amps)

Ripple: 1% rms max. (@ 36 volts and full load. Increases to 2% @ 2 volts and full load).

Remote Sensing • Vernier Control



Model M60V

0-32 VOLTS @ 25 AMPS SPECIFICATIONS

Regulation: ±1% @ 28 Volts (Regulation increases to 2% over range of 24-32 volts; does not exceed 2 volts over 4-24 volt range. Not stabilized for AC line changes.)

AC Input: 115 Volts, 1 phase, 60 cps (12 amps).

Ripple: 1% rms (@ 32 volts and full load—2% rms max. @ any voltage above 4 volts).

Model MR1040-30A

5-40 VOLTS @ 30 AMPS SPECIFICATIONS

Regulation: ±1% (over entire 5-40 volt range)

AC Input: 100-130 Volts, 1 phase, 60 cps

Ripple: 1% rms

Model 28-30 WXM

24-32 VOLTS @ 30 AMPS SPECIFICATIONS

Regulation: ±½%

AC Input: 100-125 Volts, 1 phase, 60 cps (20 amps). (Unit rated for DC output of 28 volts ±10% for 95-130 volt input.)

Ripple: 1% rms

Model MR2432-100XA

24-32 VOLTS @ 100 AMPS SPECIFICATIONS

Regulation: ±½%

AC Input: 208, 230 or 460 Volts, ±10%, 3 phase, 60 cps (14, 12 and 6 amps respectively). 230 volt input will be supplied unless otherwise specified.

Ripple: 1% rms

Wire factory collect for prices... Write for catalog.

PERKIN

LEADER IN TUBELESS MAGNETIC AMPLIFIER REGULATION

Representatives in Principal Cities

PERKIN ENGINEERING CORPORATION

345 KANSAS ST. • EL SEGUNDO, CALIFORNIA • PHONE: OREGON 8-7215

The system design will employ the most modern techniques known. Consideration is given to high circuit reliability and to physical and electronic security to provide the greatest degree of transmission dependability attainable.

Among the features of this operation will be wide employment of technical personnel from among the many NATO countries, the procurement to the maximum practicable extent of equipment on an international competitive bidding basis and the direct coordinated cooperation and participation of the respective European NATO nations.

Financial Roundup

HIGHER earnings in 1957 over comparable 1956 periods are shown by 16 of the 18 firms that released statements last month.

All 18 were in the black although three had deficits in same periods last year. Two companies, Minneapolis-Honeywell and Tung-Sol reported record first quarter earnings in 1957.

Company	Net Profit 1957	Net Profit 1956
Advance Industries 6 m	$103,261	*$274,426
American Bosch Arma 3 m	1,341,615	1,039,860
Beckman Instruments 9 m	770,751	1,144,888
General Precision 3 m	1,107,732	346,973
Hoffman Electronics 3 m	512,802	467,944
General Transistor 3 m	510,135	153,723
International Resistance 15 wk	117,845	*2,066
Jefferson Electric 3 m	186,252	179,952
Jerrold Electronics 12 m	166,133	119,838
W. L. Maxson 6 m	125,973	*390,423
Minneapolis-Honeywell 3 m	5,255,119	4,536,014
Minnesota Mining & Mfg 3 m	9,762,181	8,704,518
R C A 3 m	12,810,000	12,727,000
Rome Cable 12 m	2,256,000	2,023,000
Siegler Corp. 9 m	747,427	896,276
Sylvania 3 m	3,069,944	4,250,243
Tung-Sol 3 m	944,755	715,035
Varian Associates 6 m	427,515	153,970

* Deficit

Meetings Ahead

June 27-July 1: British IRE Convention, "Electronics In Automation", University of Cambridge, England.

Aug. 20-23: 1957 Western Electronic Show and Convention, IRE, WCEMA, Cow Palace, San Francisco, Calif.

Aug. 22-Sept. 5: International Scientific Radio Union, Twelfth General Assembly, Boulder, Colo.

Sept. 4-6: Special Tech. Conference On Magnetic Amplifiers, Penn Sheraton Hotel, IRE, AIEE, Pittsburgh, Pa.

Sept. 9-13: Twelfth Annual Conference Instrument-Automation Conference, Cleveland Auditorium, Cleveland, Ohio.

Sept. 24-25: Sixth Annual Conference On Industrial Electronics, IRE, AIEE, Morrison Hotel, Chicago, Ill.

Oct. 7-9: National Electronics Conference, IRE, AIEE, RETMA, SMPTE, Hotel Sherman, Chicago.

Oct. 7-11: American Institute of Electrical Engineers, Fall general meeting, Chicago, Ill.

Oct. 9-11: Fourth Annual Symposium on High Vacuum Technology, Committee On Vacuum Techniques Hotel Somerset, Boston, Mass.

Oct. 16-18: IRE Canadian convention, Automotive Building, Exhibition Park, Toronto, Canada.

Oct. 21-26: Institution of Radio Engineers Australia, annual convention, IRE, Hotel Australia, Sydney, Australia.

Oct. 21-26: International Conference on Ultra High Frequency Circuits and Antennas, Societe Des Radioelectriciencs, Paris, France.

Oct. 31-Nov. 1: Professional Group on Nuclear Science, fourth annual meeting, Henry Hudson Hotel, New York, N. Y.

Oct. 31-Nov. 1: 1957 Electron Devices Meeting, PGED, Shoreham Hotel, Washington, D. C.

Nov. 2-10: 1957 International Congress of Measuring Intrumentation and Automation, Interkama, Dusseldorf, Germany.

Nov. 4-6: Third Annual Symposium on Aeronautical Communications, PGCS, Hotel Utica, Utica, N. Y.

Nov. 11-13: Third Instrument Conference, IRE, PGI, Biltmore Hotel, Atlanta, Ga.

Nov. 11-13: Radio Fall Meeting, PGBTS, PGBTR, PGED, PGRQC, RETMA, King Edward Hotel, Toronto, Canada.

Nov. 18-20: Conference on Magnetism and Magnetic Materials, AIEE, APS, IRE, ONR, Sheraton-Park Hotel, Washington, D. C.

Dec. 4-5: Professional Group on Vehicular Communications, annual meeting, Statler Hotel, Washington, D. C.

Industry Shorts

▶ **Danish** television stations to be built at Aalborg, Vestjylland and Naesved will be supplied with $270,000 dollars worth of transmitting equipment by Wireless Telegraph Company, Essex, England.

▶ **Licenses** for tv stations in Britain have been issued at the rate of 100,000 a month. At present there are some seven million licenses for tv sets and seven and a half million for radios.

▶ **Production** of transistors and semiconductors in Britain will advance with the organization of a combine between Philco Corp. of the U. S. and Plessey Company of Britain, to be known as Semiconductors Ltd. Fifty-one percent interest will be held by Plessey and 49 percent by Philco.

▶ **Color** tv sales increased almost 800 percent in Milwaukee during a five-week nation-wide color campaign promoted by RCA.

▶ **WMGM**, N. Y. is broadcasting tests of the Kahn system of ssb-transmission on weekdays before 6 a.m.

▶ **Magnetic** pills are being used at the University of California to study the effects of emotional disturbances in the alimentary canal. The swallowed pill is traced by a magnetometer developed by Irwin Laboratories, Los Angeles.

KAY

Noise Figure Measurement
10-3000 mc

KAY
Mega-Node-Sr.

- **Absolutely no modulation on noise output**
- **Built-in stability**
- **Longer life on noise diode**
- **Ease of operation due to front panel design**
- **All power supplies regulated**

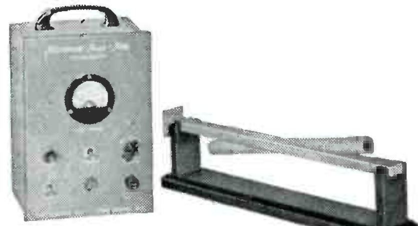
A calibrated random noise source providing an output from 10-3,000 mc, the *Mega-Node Sr.* may be used to measure noise figure and receiver gain and for the indirect calibration of standard signal sources.

At the lower end of the frequency range noise figure may be obtained directly from the meter. For greater accuracy at higher frequencies, corrections for diode transit time and termination mismatch are available from charts supplied with each instrument.

SPECIFICATIONS

Frequency Range: 10 mc to 3,000 mc
Output Impedance: 50 ohms unbalanced into Type N Connector
Noise Figure Range: 0 to 20 db
Filament Voltage Supply: From regulated supply
Meter Calibration: Linear in db noise figure; logarithmic in D.C.M.A.
Fuse Protection: One Type 3AG, 2 amps
Tubes: 1 Eclipse Pioneer TT1 Diode
Power Supply Source: 117 Watts ±10% 60 cps A.C. Available for 50 cps
Power Consumption: 200 Watts
Price: $790.00 FOB Plant

Kay Electric Now Manufactures Improved Versions of New London Noise Figure Measurement Instruments. See Future Advertisements and Write for Detailed Specifications and Prices.



KAY *Microwave Mega-Nodes*

Calibrated random noise sources in the microwave range, used to measure noise figure, and receiver gain and calibrate standard signal sources in radar and other microwave systems. Available in following waveguide sizes to cover range of 960-26,500 mc.

RG-69/U	**$400**	**†RG-51/U**	**$195**
†RG-48/U	**$195**	**†RG-52/U**	**$195**
†RG-49/U	**$195**	**RG-91/U**	**$250**
†RG-50/U	**$195**	**RG-53/U**	**$250**

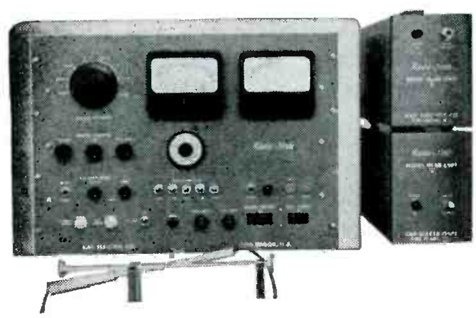
Available with fluorescent or inert gas (argon or neon) tubes. Noise output fluorescent tubes 15.8 db ±.25 db; argon gas tubes, 15.2 db ±.1 db*; neon tubes, 18.0 db ±.5 db*.
*Noise output of inert gas tubes independent of operating temperature. Universal power supply for both fluorescent or argon gas and all wave-guide sizes: $100.

† $167. per Guide when 3 or more are purchased with $100. power supply.

NEW! WR-770, WR-650—**$595.00 each;** WR-510, WR-430, WR-340—**$495.00 each.** All WR numbers fluorescent only.

KAY *Mega-Node*

Calibrated random noise source reading direct in db, for measurement of noise figure, receiver gain and for indirect calibration of standard signal sources. Frequency range, 5 to 220 mc; Output impedances, unbalanced—50, 75, 150, 300, Infinity; balanced—100, 150, 300, 600, Infinity; noise figure range, 0-16 db at 50 ohms, 0-23.8 db at 300 ohms. Price: $295.00 FOB Plant.



KAY *Rada-Node*

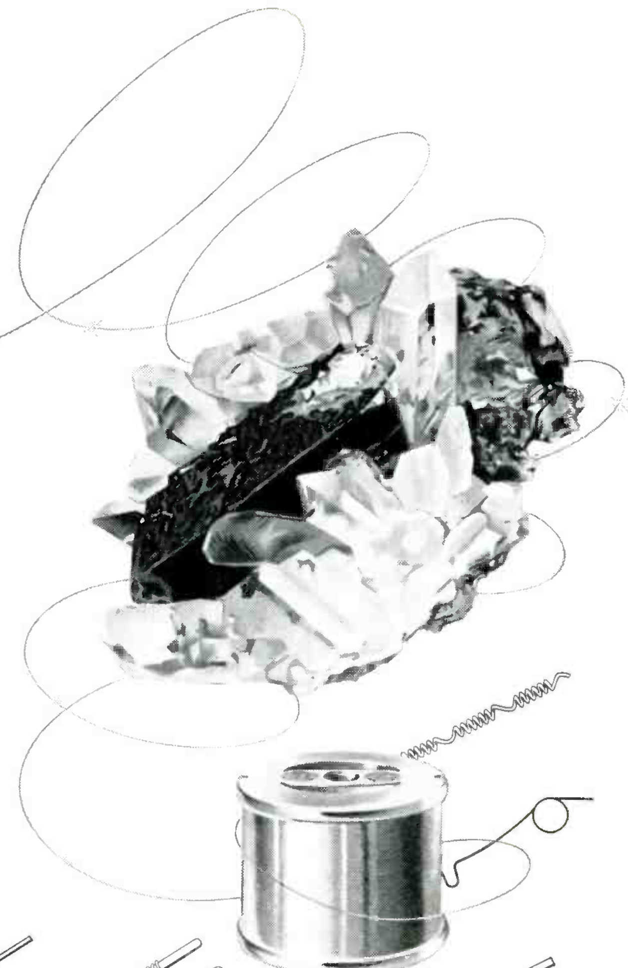
Complete radar noise figure measuring set for I-F and R-F, including attenuators, detector and noise sources. Complete with power supplies. Frequency range: 5 to 26,500 mc; noise figure range, up to 21 db, in lower part of spectrum.
Prices on request.

KAY ELECTRIC COMPANY

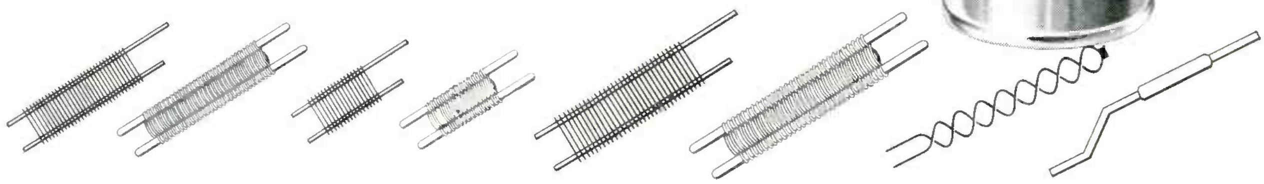
Dept. E-7 14 Maple Avenue Pine Brook, N. J.
CAldwell 6-4000

Want more information? Use post card on last page.

Plated wire



quality controlled from ore to finished product



...for critical electronic applications...

When you are considering plated tungsten wire for its many applications in critical electronic requirements, remember that Sylvania *manufactures* the base wire every step of the way from the ore . . . and consequently can control its characteristics to meet your special needs. For example—Sylvania plated tungsten wires have exceptional uniformity of dimension and properties necessary for highly automated production equipment.

Sylvania exercises far-reaching control on all plated wires in nickel and nickel alloys, molybdenum, 50-50 tungsten-molybdenum, stainless steel, and other alloy base metals. That's because, in most cases, Sylvania draws its own base wires. Platings available include gold, silver, nickel, and rhodium. Wire diameters range from 0.0005 in. to 0.012 in. Plating thickness can be supplied from ½% to 10% of base wire weight.

Sylvania offers you a wide range of wires, to meet almost any requirement in the production of tube elements, electrostatic precipitators, and other electronic devices. Each is made under the same exacting standards known to be required for producing the world's finest vacuum tubes.

Next time you need plated wires call in your Sylvania sales engineer. *He'll be happy to serve you.*

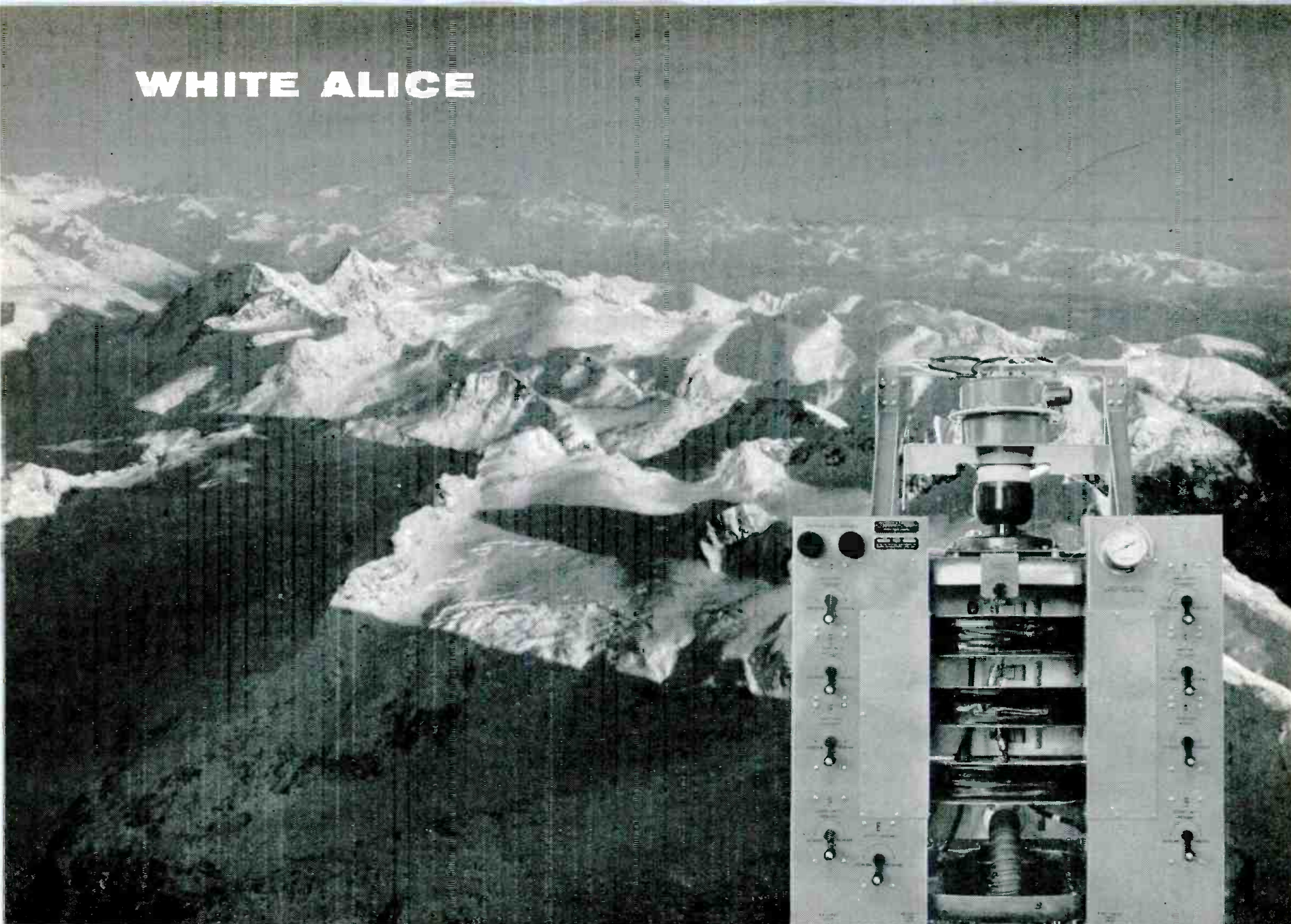
SYLVANIA ELECTRIC PRODUCTS INC.
Tungsten and Chemical Division, Towanda, Penna.

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS

SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

WHITE ALICE



nother in a series on the extensive use of Eimac Klystrons in tropospheric communication systems

Type 7[illegible]9[illegible]A 10 KW Klystron Amplifier Designed and Manufactured for Western Electric Co. by Radio Engineering Laboratories, Inc.

Eimac one and ten kw klystrons power Alaska tropospheric communication system

In the minds of the engineers and construction men who fought Alaska's frozen terrain, "White Alice" was no lady. Linking 33 far-flung communities, "White Alice" will have 3000 miles of communications upon completion. Up to 132 channels are provided over this route thanks to a combination of point-to-point microwave and scatter communication systems.

For tubes to power the "White Alice" one and ten kw installations, engineers turned to Eimac klystrons. The success of Eimac tubes in the other tropo-scatter networks made it easy for the engineers to make such a decision. Today, Alaska speaks . . . a feat made possible by tropospheric communications powered by Eimac klystrons that "can take it."

Designers of electronic equipment are finding out more and more that Eimac has the answer to their tube problems regardless of what such problems involve. An inquiry to our Application Engineering Department will bring fast, informative information.

EITEL-McCULLOUGH, INC.

SAN BRUNO · CALIFORNIA

Eimac First for klystrons for tropospheric communications

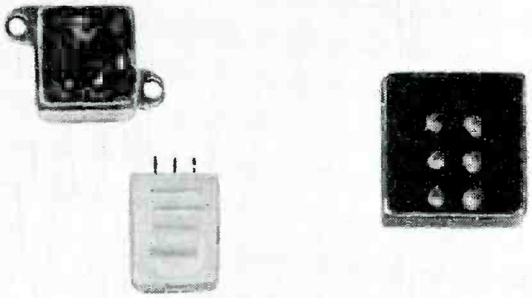
Eimac

3K3000LQ

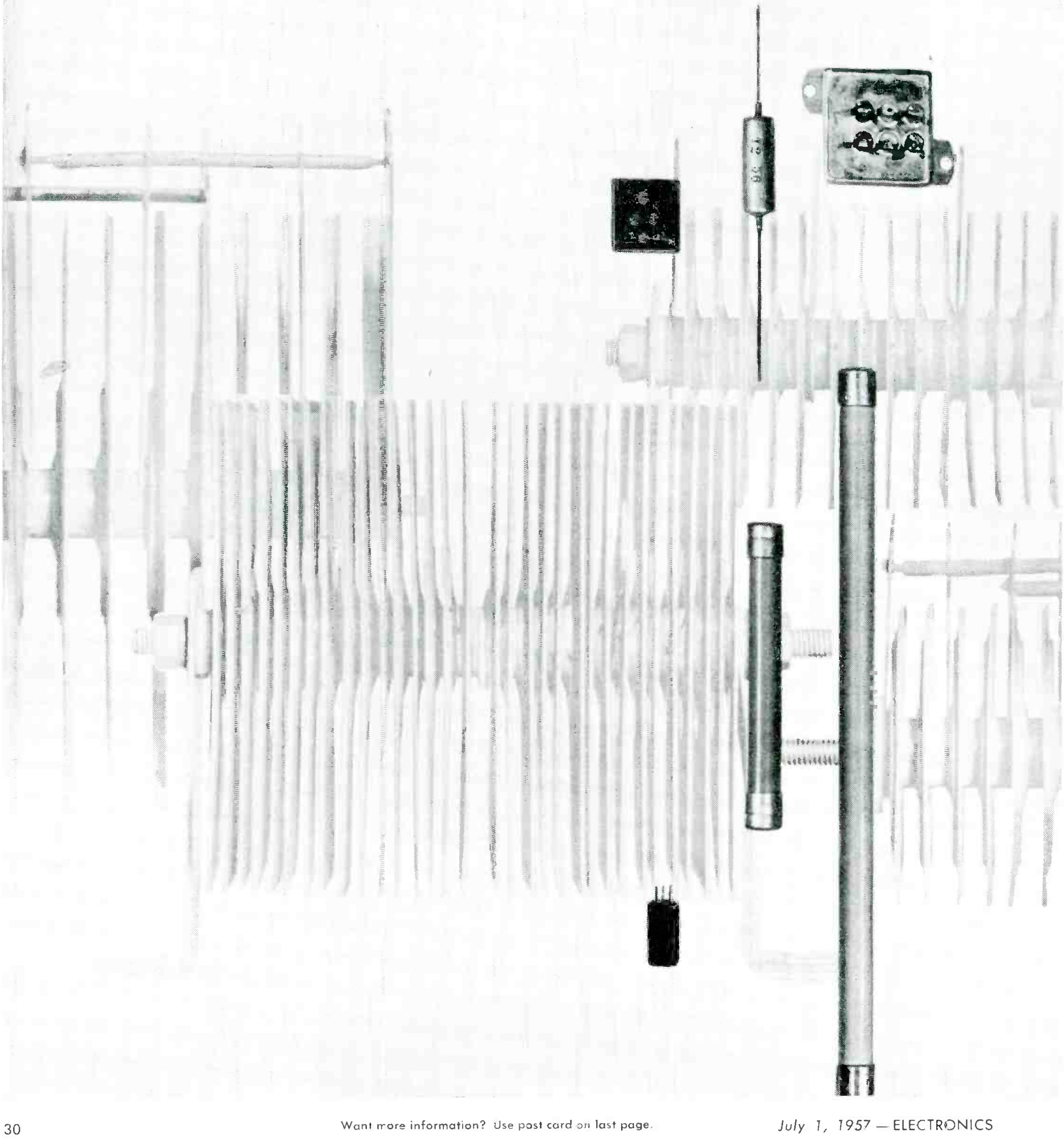
DC Beam Volts	8000	Power Output Watts	2000
DC Beam Amps	0.57	Collector Dissipation	3000
Driving Power Watts	4.0	Power Gain	25 db
		Efficiency	45%

4K50,000LQ

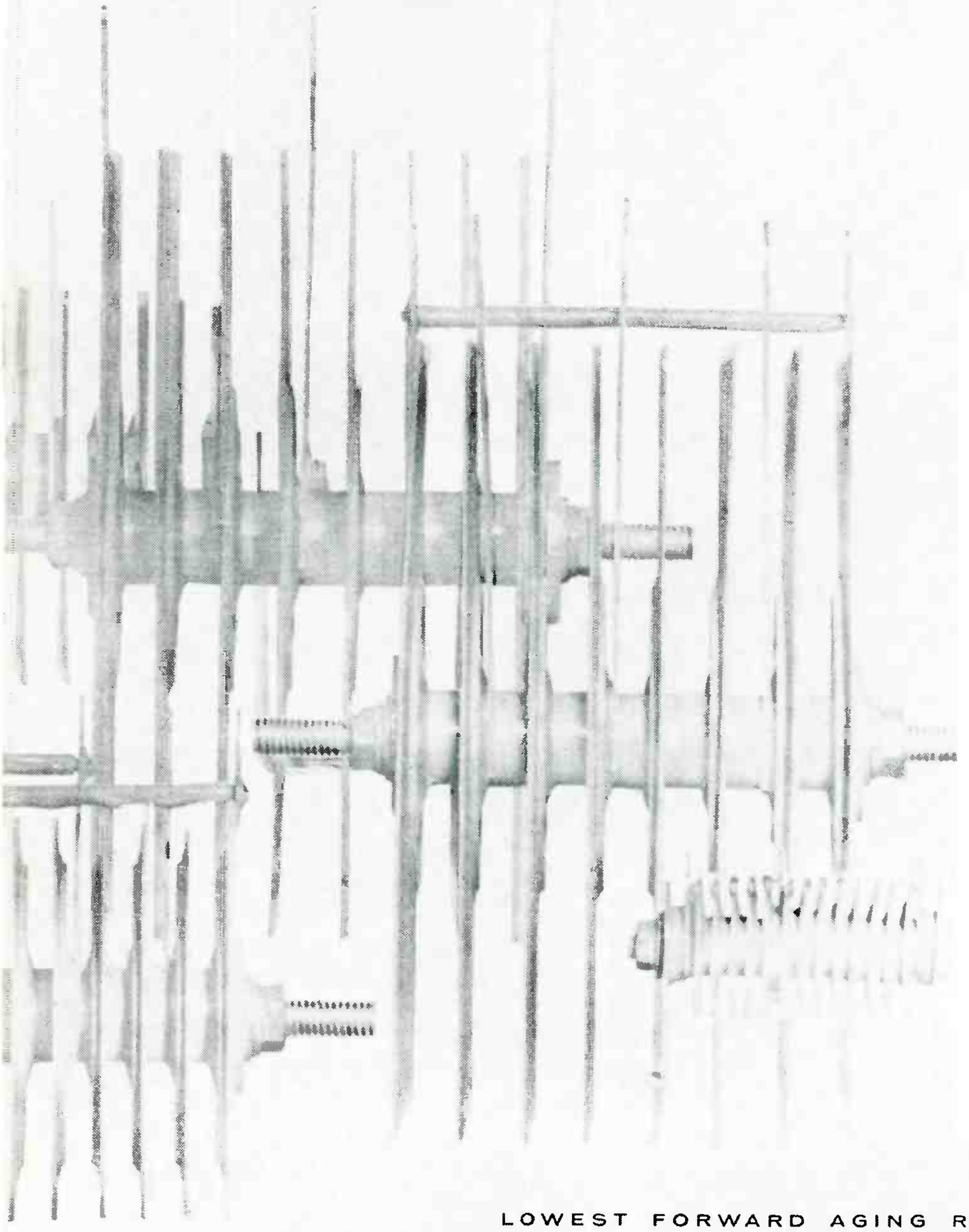
DC Beam Volts	16,000	Power Output Watts	11,000
DC Beam Amps	1.6	Collector Dissipation	50,000
Driving Power Watts	0.10	Power Gain	50 db
		Efficiency	43%



Industry's most complete line of



control and power rectifiers



Now available from a single source . . . a *complete* line of selenium rectifiers for d-c power supply, battery chargers and electronic circuitry.

Whether your needs are for 6 to 100,000 volts; 1.5 milliamp or 10,000 amperes; stacks, cans or cartridges (with a wide range of configurations), Westinghouse has a rectifier to meet your specific requirements.

Extensive life tests prove that in 20,000 continuous hours of service, the change in forward voltage drop of Westinghouse rectifier cells is less than 5%. Reverse leakage actually decreases with use. This superior performance . . . with up to 90% conversion efficiency . . . is assured by the vacuum evaporation deposit process and carefully controlled manufacturing conditions in making Westinghouse selenium cells.

For complete design and application information, call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P. O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

J-22089

LOWEST FORWARD AGING RATE IN THE INDUSTRY!

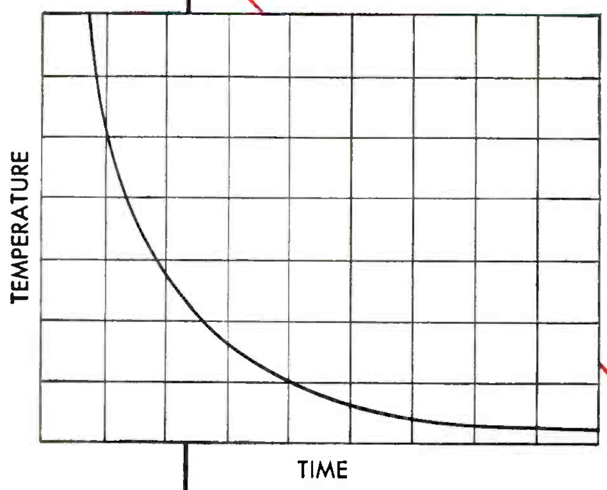
YOU CAN BE SURE... IF IT'S

Westinghouse

Want more information? Use post card on last page.

here's the Vinyl Glass Sleeving with unequalled **HEAT-AGING** *properties*

BH VINYL-SIL 8000



BH Vinyl-Sil 8000 Fiberglass Sleeving offers outstanding resistance to heat-aging, a major factor in insulation breakdown. It retains flexibility and its minimum guaranteed dielectric strength of 8,000 volts even after these exposures:

2,000-plus hours at 130°C.
320 hours at 150°C. 115 hours at 180°C. 4 hours at 232°C.

Here's Class B protection at Class A cost . . . plus these additional advantages:

- High Flow Resistance
- Unequalled Non-corrosiveness
- Excellent Low Temperature Flexibility (—45°C.)
- High Chemical and Oil Resistance
- Varnish and Wire Enamel Compatibility

The same formulation used in manufacturing BH Vinyl-Sil 8000 is also available in two other BH quality sleevings:

BH Vinyl-Sil 105 — the only vinyl-glass sleeving U/L rated for continuous operation at 105°C., with the supporting glass fiber braid specially treated to prevent capillary attraction to water.

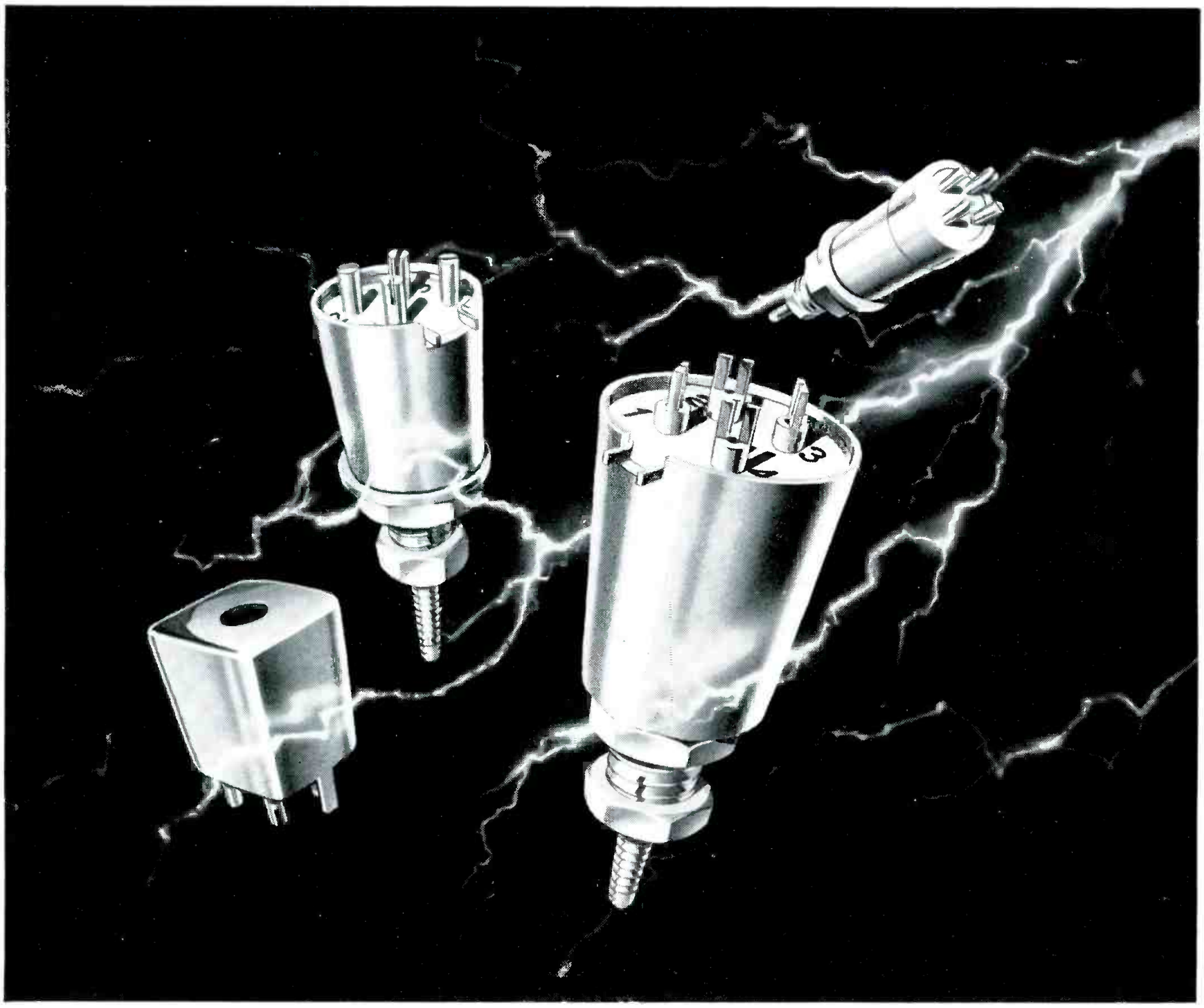
BH Vinyl-Flex — a low-cost, high-quality sleeving specially formulated for applications up to 4000-volt minimum dielectric breakdown.

Get complete details for the sleeving *you* need. Write for data sheets and testing samples today. FREE, while supply lasts: New NEMA Standards Publication for Varnished Tubing and Saturated Sleeving. Ask for it.

Bentley, Harris Manufacturing Co.
1307 Barclay Street
Conshohocken, Pa.
Telephone: TAylor 8-0634

BENTLEY, HARRIS *Flexible** **SLEEVINGS**

*BH Non-Fraying Fiberglass Sleevings are made by an exclusive Bentley, Harris process (U.S. Pat. Nos. 2393530; 2647296 and 2647288).



These shielded coil forms offer the utmost in reliability due to their unique design and construction. Dimensions when mounted, including terminals, are: LS-9, 7/16″ diameter x 1/2″ high; LS-10, 5/8″ x 15/16″; LS-11, 15/16″ x 17/32″. Each form mounts by a single stud. The LS-12 is a square type for printed circuits and measures 1/2″ x 1/2″ x 1/2″. Single layer or pie-type windings to your specifications.

Reliability – under any condition!

CTC miniaturized shielded coil forms are highly shock resistant. With mechanically enclosed, completely shielded coil windings, they bring all the ruggedness and dependable performance you require for your "tight spot" applications — IF strips, RF coils, oscillator coils, etc.

CTC combines *quality control* with *quantity production* to supply exactly the components you need, in any amount. CTC *quality control* includes material certification, checking each step of production, and each finished product. And CTC *quantity production* means CTC can fill your orders for any volume, from smallest to largest.

For samples, specifications and prices, write to Sales Engineering Dept., 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, Cal.

TYPE SPC phenolic and ceramic printed circuit coil forms can be soldered after mounting. Phenolic forms: ¾″ high when mounted, in diameters of .219″ and .285″. Ceramic forms: ¼″ diameter, in mounted heights of 5/8″ and 13/16″, with 10/32″ powdered iron core, and collars of silicone fibreglas. Forms come with threaded slug and terminal collar. Units mount through two to four holes, as required. Available as forms alone or wound as specified.

CTC

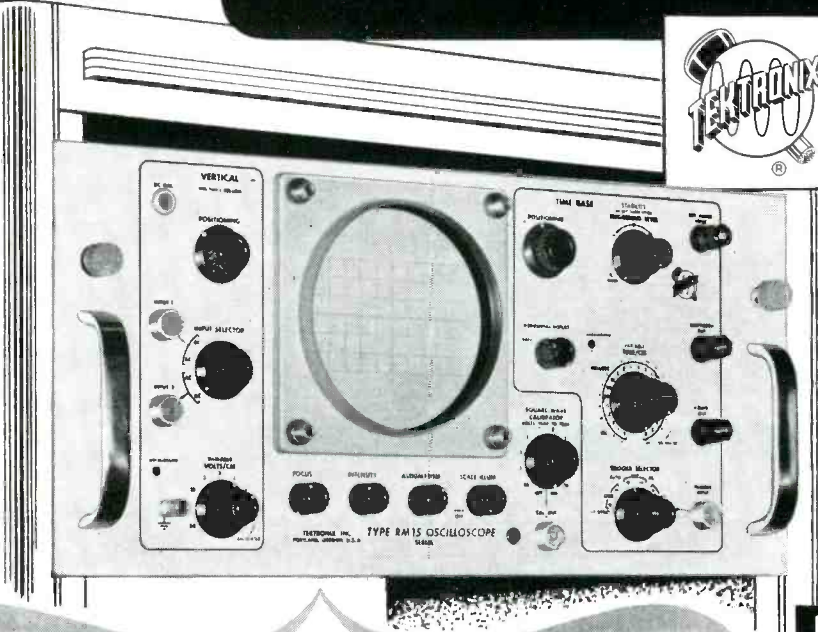
CAMBRIDGE THERMIONIC CORPORATION

makers of guaranteed electronic components
custom or standard

New

RACK-MOUNTING OSCILLOSCOPE

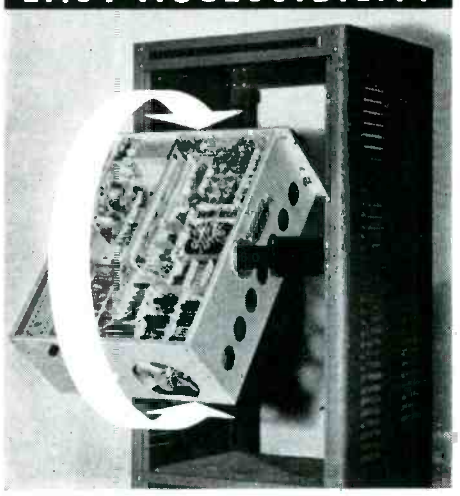
TYPE RM15 . . . DC to 15 MC



The Tektronix Type RM15 is a high - performance 5 - inch oscilloscope, electrically identical to the Type 515. It mounts in 8¾ vertical inches of the standard instrument rack, is supported on a slide-out mounting, and can be tilted and locked in any of seven positions for servicing convenience.

The Type RM15 has excellent transient response, 0.023-μsec risetime. Its 22 calibrated sweep rates are selected with one knob, which also indicates the new sweep rate when the 5x magnifier is in use. Controls are arranged for maximum operator convenience.

EASY ACCESSIBILITY



BASIC SPECIFICATIONS

VERTICAL CHARACTERISTICS

Passband—dc to 15 mc.
Risetime—0.023 μsec
Signal Delay—0.25 μsec
Deflection Factor—0.1 v/cm. Calibrated attenuator, 9 steps from 0.1 to 50 v/cm. Continuously adjustable from 0.1 to 125 v/cm.

HORIZONTAL CHARACTERISTICS

Sweep Range—0.2 μsec/cm to 6 sec/cm.
Calibrated Sweep Rates—0.2 μsec/cm to 2 sec/cm in 22 steps.
Magnifier—5x magnifier increases calibrated sweep range to 0.04 μsec/cm.

Four-Way Triggering

1. **Amplitude-Level Selection**—adjustable amplitude-level and stability controls for triggering at a selected level on external, internal, and line signals—either polarity—ac or dc-coupled.
2. **Preset Stability**—same as above, except stability is preset at the optimum triggering point and requires no readjustment.
3. **Automatic Triggering** — Automatic level-seeking trigger circuit provides dependable triggering for most applications, even on very small signals, through wide changes in amplitude, frequency, and shape of the triggering signal. Provides a reference trace on the screen when no trigger signal is present.
4. **High-Frequency Sync**—Assures a steady display of sine-wave signals up to approximately 20 mc.

OTHER FEATURES

4-KV Accelerating Potential
DC-Coupled Unblanking
Square-Wave Amplitude Calibrator
Electronically-Regulated Power Supplies
Dimensions—8¾" high, 19" wide, 23" rack depth, 25" overall depth.

TYPE RM15 (50 to 60 cycle supply) **$825**
TYPE RM15-S1 (50 to 800 cycle supply) **$860**
Prices f.o.b. Portland, Oregon

TYPE 515 CATHODE-RAY OSCILLOSCOPE

Same instrument electrically, in the portable form preferred for most field and laboratory applications. Weight, 40 pounds.

TYPE 515
(50 to 60 cycle supply) . . **$750**
TYPE 515-S1
(50 to 800 cycle supply) . **$785**
Prices f.o.b. Portland, Oregon

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon
Phone CYpress 2-2611 • TWX-PD 265 • Cable: TEKTRONIX

See the Type RM15 and other new Tektronix Instruments at WESCON, booths 1701, 1702.

ENGINEERS—interested in furthering the advancement of the oscilloscope? We have openings for men with creative design ability. Please write Richard Ropiequet, Vice President, Engineering.

FULL LINE DEPTH

Magnetrons from 1 to 5,000,000 Watts — Klystrons from 600 to 60,000 Mc — Backward Wave Oscillators from 1,000 to 15,000 Mc. Plus, a broad line of special tubes including storage tubes, rectifiers, square law and traveling wave tubes. Write for complete data booklet on the most complete line in the industry.

Excellence in Electronics

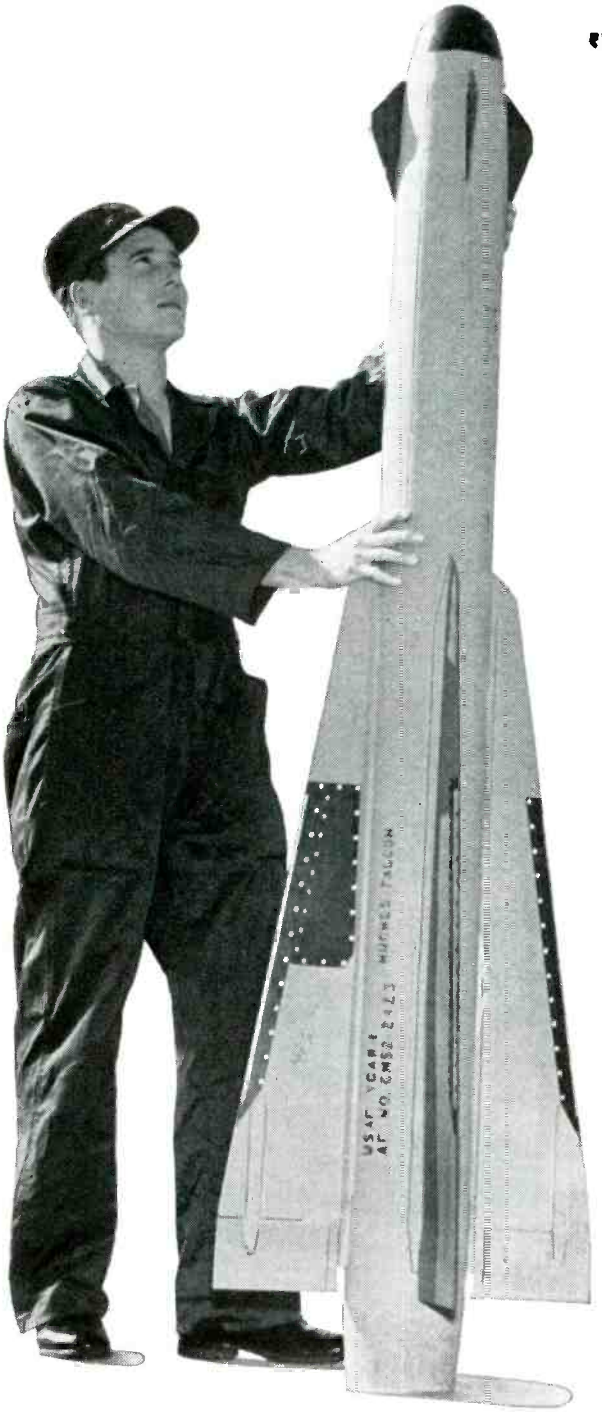
RAYTHEON

RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-06, Waltham 54, Mass.

Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Illinois; 5236 Santa Monica Blvd., Los Angeles 29, California

ATLAS *Precisioneers*



"HUSH-HUSH" ASSEMBLIES FOR

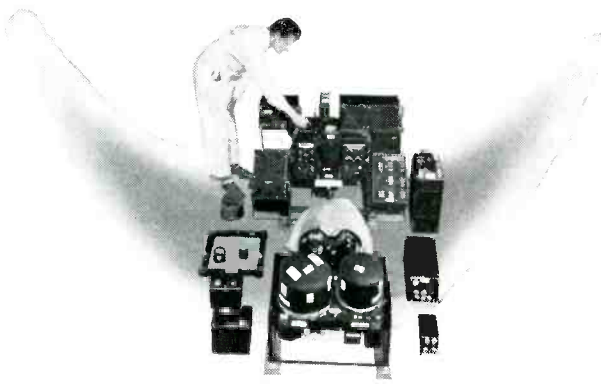
THE FALCON

NO HIDING place "upstairs" for enemy bombers with The Falcon on the hunt. This newest guided missile is being produced for the U. S. Air Force by Hughes Aircraft Company.

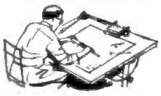
Some of the "innards" of this bird of prey are ATLAS-Precisioneered and classified "confidential." But there's no secret as to how ATLAS can help you develop parts and assemblies from pilot stage to production efficiency for radar . . . sonar systems . . . computers . . . correctors . . . all types of electro-mechanical devices. Just bring your designs to ATLAS. At your disposal on a job basis are our men, equipment, techniques; facilities available for prototype, pilot run, and or volume production.

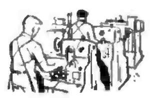
When war or peace demands a product, call on ATLAS Precision Products Co. (Div. of Prudential Industries), Philadelphia 24, Pa.

Send for booklet, "Precisioneering Electro-mechanical Equipment."



ENGINEERING • PRODUCTION • ASSEMBLY





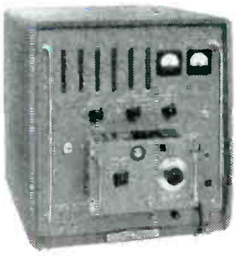
ATLAS *Precision Products*

SERVICE ATLAS DEPENDABILITY QUALITY

Measure faster, more accurately with *-hp-*

ELECTRONIC COUNTERS

A wide variety of ordinary and extraordinary measurements can now be made easily and exactly with electronic counters. *-hp-* offers you the world's most complete line of quality counters; your local *-hp-* representative can show you the newest measuring techniques. Call him today for practical, knowledgeable help in simplifying your measurements with electronic counters.



-hp- 524B Electronic Counter. Regarded by many engineers as the world's finest electronic counter, *-hp-* 524B with plug-in Frequency Converters measures frequency 10 cps to 220 MC; with *-hp-* 540A Transfer Oscillator measures frequency to 12 KMC; with *-hp-* 526B measures interval 1 μsec to 100 days; with *-hp-* 526C measures period with greatly increased accuracy.

-hp- 521A Industrial Counter. Direct reading, 1 cps to 120 KC. Measures frequency, speed, rpm, random events, other phenomena with transducers. Time of count 0.1 or 1 second, variable display time. Sturdy, rugged, simple to use, low cost. Also *-hp-* 521C, 5 place registration, crystal controlled time base.

CHECK THIS LIST OF -hp- COUNTERS

Instrument	Primary Uses	Frequency Range	Characteristics	Price
-hp- 521A Industrial Electronic Counter	Measure frequency, speed, time interval	1 cps to 120 KC	Direct reading, accuracy within ±1 count ±0.1%, 4 place registration	$475.00
-hp- 521C Industrial Electronic Counter	Measure frequency, speed, time interval	1 cps to 120 KC	Direct reading, accuracy within ±1 count ±0.01%, 5 place registration	650.00
-hp- 522B Electronic Counter	Frequency, period, time interval measurements	10 cps to 120 KC	Direct reading, accuracy ±1 count ±0.001%	915.00
-hp- 523B Electronic Counter	Frequency, period, time interval	10 cps to 1.1 MC	Direct reading, accuracy ±1 count ±2/1,000,000	1,175.00
-hp- 524B Frequency Counter	Frequency, period measurements	10 cps to 10 MC (Freq.) 0 cps to 10 KC (period)	Direct reading, no interpolation, accuracy about 2/1,000,000/week	2,150.00■
-hp- 525A Frequency Converter	Extends 524B's range to 100 MC; increases basic sensitivity	10 cps to 100 MC	Accuracy ±1 cps ± stability; 0.1 v rms min. input	250.00
-hp- 525B Frequency Converter	Extends 524B's range from 100 to 220 MC; high sensitivity	100 MC to 220 MC	Accuracy ±1 cps ± stability; 0.2 v rms min. input	250.00
-hp- 526A Video Amplifier	Increases 524B's sensitivity to 10 millivolts	10 cps to 10 MC	Accuracy same as basic counter; 10 mv rms min. input	150.00
-hp- 526B Time Interval Unit	Measures interval 1 μsec to 100 days	1 μsec to 10^7 sec	Accurate 0.1 μsec ±0.0001%	175.00
-hp- 526C Period Multiplier	Period measurement	Extends range of 524B to measure 10,000 periods	Greater accuracy in period measurement	225.00
-hp- 540A Transfer Oscillator	Frequency measurements	10 MC to 5 KMC	Extends range of 524B to 12.4 KMC	615.00

∆Rack mounted instrument available for $15 less. ■Rack mounted instrument available for $25 less.

HEWLETT-PACKARD COMPANY

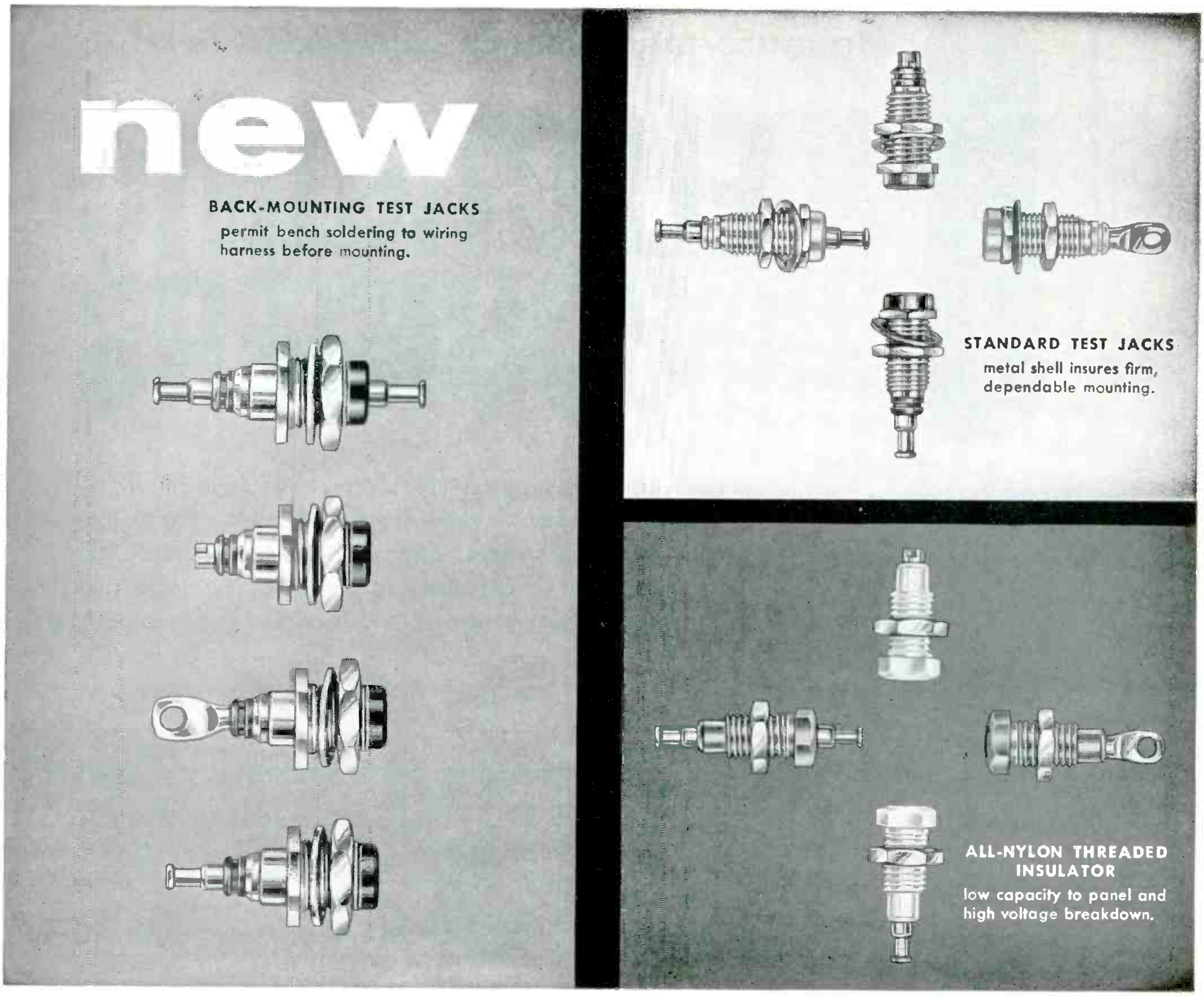
4052A PAGE MILL ROAD • PALO ALTO, CALIFORNIA

Cable "HEWPACK" • DAvenport 5-4451

Field engineers in all principal areas

Complete coverage in electronic counters

Want more information? Use post card on last page.



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 soldering. 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.

ELECTRICAL ASSEMBLIES
Ucinite
RADIO AND AUTOMOTIVE

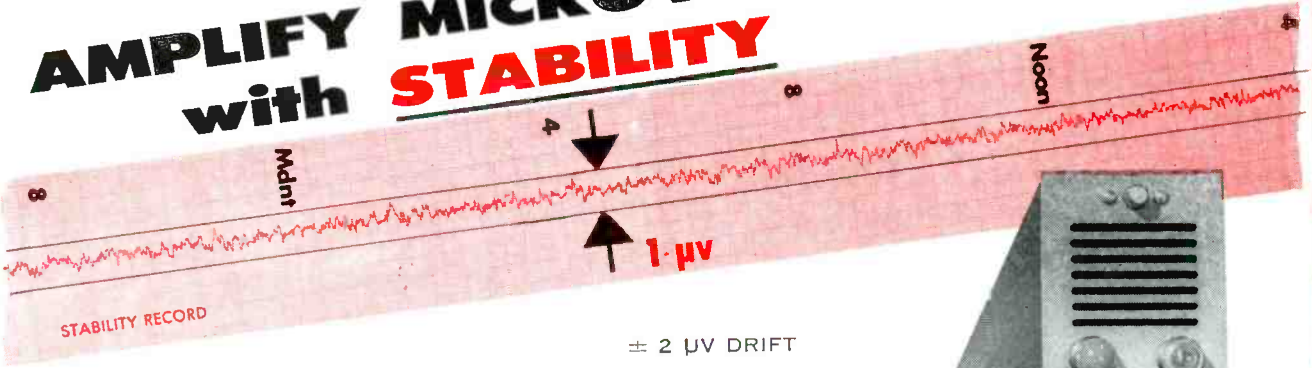
The UCINITE CO.
Newtonville 60, Mass.
Division of United-Carr Fastener Corp.

Specialists in Electrical Assemblies, Radio and Automotive

KIN TEL [KAY LAB]

FOR DRIFT-FREE DC INSTRUMENTATION

AMPLIFY MICROVOLTS with STABILITY



± 2 µV DRIFT

INTEGRAL POWER SUPPLY

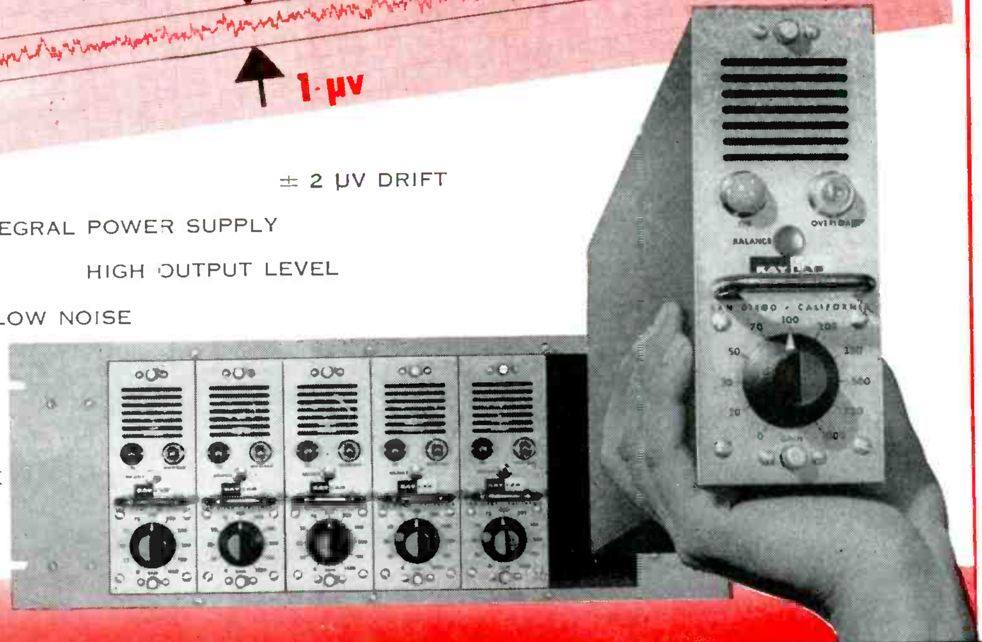
HIGH OUTPUT LEVEL

EXTREMELY LOW NOISE

BROAD BANDWIDTH

10 ACCURATE GAIN RANGES

HIGH INPUT IMPEDANCE



The **KIN TEL** Model 111 amplifier provides maximum stability and the lowest drift of any commercially available broadband d-c amplifier. It is the end result of years of research in the field of chopper stabilized broadband d-c amplifiers. Thousands of **KIN TEL** amplifiers are in daily use. The Model 111 incorporates **KIN TEL's** proven chopper amplifier circuitry and provides ten extremely precise, feedback controlled gain ranges. Several feedback loops assure high accuracy, stability and uniform frequency response. The completely new and unique circuit provides rapid recovery from severe overloading and unsurpassed dynamic performance—unaffected by load or gain changes.

The Model 111 is available in a single-unit cabinet or in a six-unit rack-mountable module. The amplifiers are extremely compact; the six-unit module occupies only a 19-inch rack width.

APPLICATIONS: The Model 111 is ideal for permanent low level d-c instrumentation, telemetering, or as a strain gage amplifier, transducer amplifier, scope preamplifier, recorder driver amplifier, or general purpose laboratory amplifier.

SPECIFICATIONS

Gain	0, 20, 30, 50, 70, 100, 200, 300, 500, 700, 1000
Gain Accuracy	± 1% DC to 2 KC
Input Impedance	100,000 Ω
Output Capability at DC	0 to ± 35 V where R_L > 1000 Ω 0 to ± 40 MA where R_L is 10 to 400 Ω
Output Impedance	Less than 1 Ω in series with 25 µh
Equivalent Input Drift	± 2 µv with regulated line
Equivalent Input Noise	0 to 3 cps, less than 5 µv peak to peak 0 to 750 cps, less than 5 µv RMS 0 to 50 kc, less than 12 µv RMS
Chopper Intermodulation	Less than 0.1%
Linearity	Better than 0.1% to 2 KC
Frequency Response	± 3% (0.3 db) DC to 10 KC, less than 3 db down at 40 KC

Power Requirements:	
Amplifier	117 V – 60 cycles – 70 VA
Cabinet	117 V – 60 cycles – 15 VA
6 Unit Rack Adaptor	117 V – 60 cycles – 45 VA
Dimensions: Amplifier Unit	2⅞″ wide, 7⅝″ high, 14⅝″ deep
Rack Adaptor for 6 Units	19″ wide, 8¾″ high, 18¼″ deep
Net Weight – Amplifier	11 pounds
PRICE: Amplifier Unit	$550.00
19-inch Rack Adaptor for 6 amplifier (with fans and connectors)	200.00
Cabinet for single amplifier (with fan and connector) is available.	

. . . the Standard in chopper-stabilized instruments

KIN TEL [KAY LAB]

STABILITY *locked in!*

WITH CHOPPER AMPLIFIERS

Representatives in all major cities.

5725 KEARNY VILLA ROAD, SAN DIEGO 11, CALIFORNIA · BROWNING 7-6700.

Want more information? Use post card on last page.

ACCURACY ± 0.25%!

Beckman® / *Berkeley*
Expanded Scale Voltmeters

MODELS 101 AND 101-50

FEATURES: ★ Accuracy of ±0.25%
★ True rms Reading
★ 0-1 ma Recorder Connection
★ Rugged design to withstand vibration, rough usage

Portable Models 101 (100-500 v) and 101-50 (50-250 v)

DESCRIPTION:

Available as either portable or rack-mounted units, these rugged instruments provide true rms readings at an accuracy of ±0.25% of input voltage over a range of 100-500 v in 10 v steps (Model 101), or 50-250 v in 5 v steps (Model 101-50). Large scale divisions reduce reading errors; results may be permanently recorded on a 0-1 ma recorder. Use of a unique thermal bridge circuit provides ± 0.25% accuracy with standard meter movement, eliminating delicate special movements. The result is unusual ruggedness for an instrument of such high accuracy.

APPLICATIONS:

These Expanded Scale Voltmeters are invaluable for all types of testing and development work where high accuracy is a requisite; production quality control of components and circuits, developing new circuits, servicing electronic instruments and systems, measuring voltages in a-c power systems, as a reference instrument in the standards laboratory, and for measurements of line voltage variations in the field. They are adaptable for use in aircraft where vibration might damage more delicate meter movements.

Rack-mounted Models 101-R and 101-R-50

SPECIFICATIONS

	MODEL 101	MODEL 101-50
RANGE:	100 v to 500 v	50 v to 250 v
SCALE RANGE:	12 v	6 v
SMALLEST SCALE DIVISION:	0.2 v	0.1 v
ACCURACY:	±0.25% of Input Voltage	
VOLTAGE INDICATED:	True rms	
FREQUENCY RESPONSE:	50 to 2000 cps	
SOURCE LOADING:	Approximately 2 watts	
METER DAMPING:	0.8 of Critical Damping	
TIME RESPONSE:	0.5 seconds	
RECORDER CONNECTIONS:	0-1 ma dc recorder	
POWER REQUIREMENTS:	115 v ac, 50-2000 cps, 20 watts	
DIMENSIONS: (PORTABLE)	8"W x 9¾"H x 9"D (14 lbs. net)	
DIMENSIONS: (RACK)	19"W x 5¼"H x 9"D (15 lbs. net)	
PRICE: (PORTABLE)	$360.00 f.o.b. factory	
PRICE: (RACK)	$400.00 f.o.b. factory	

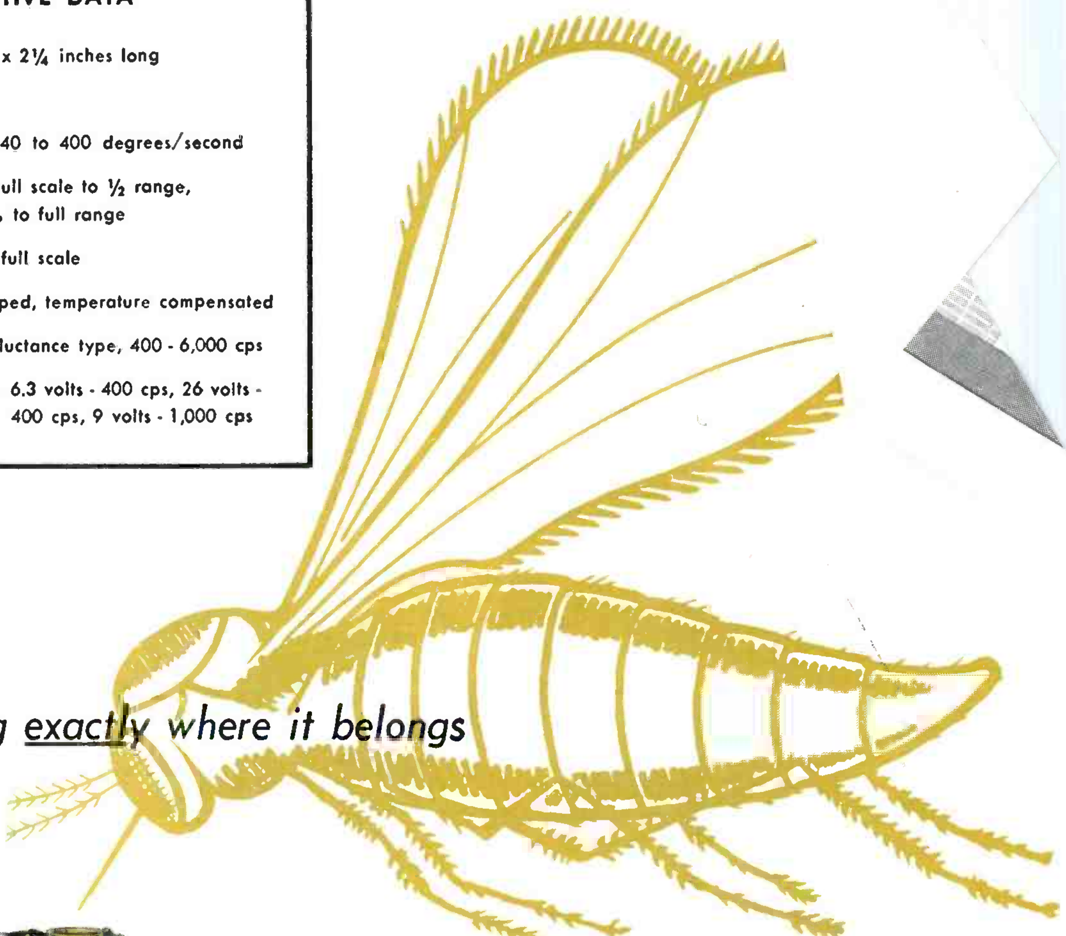
Complete technical data is yours for the asking; why not write us now? Please address Dept. G7.

Beckman® *Berkeley Division*
2200 Wright Avenue, Richmond 3, California
a division of Beckman Instruments, Inc.

136

DESCRIPTIVE DATA

- **SIZE:** 1 inch diameter x 2¼ inches long
- **WEIGHT:** 3.8 ozs.
- **FULL SCALE RANGE:** 40 to 400 degrees/second
- **LINEARITY:** 0.1% of full scale to ½ range, within 2% to full range
- **RESOLUTION:** 0.01% full scale
- **DAMPING:** Fluid damped, temperature compensated
- **PICKOFF:** Variable Reluctance type, 400 - 6,000 cps
- **MOTOR EXCITATION:** 6.3 volts - 400 cps, 26 volts - 400 cps, 9 volts - 1,000 cps



Putting the sting exactly where it belongs

Gnat Rate Gyro
Shown actual size

GOLDEN GNAT

Miniature Rate Gyros for Missiles and Aircraft

Here is a precision, minature rate gyro. It's tiny . . . measures only 1 inch in diameter and 2¼ inches in length. It's rugged . . . withstands 100G shock and 10G vibration to 2,000 cps. It has a record of proven performance.

Even under the most severe environmental conditions the Golden Gnat will perform as required. To make this possible many unique design details have been incorporated. One such detail is the Gnat's *gold plated* steel housing for improved corrosion resistance and positive hermetic sealing.

Wherever the need exists for high performance miniature rate gyros such as for autopilot stabilization in missiles and aircraft, antenna stabilization and fire control applications, the Golden Gnat is ideally suited. Write for Bulletin GN . . . Minneapolis-Honeywell, Boston Division, Dept. 7, 1400 Soldiers Field Road, Boston 35, Mass.

MINNEAPOLIS **Honeywell** H HONEYWELL
BOSTON DIVISION

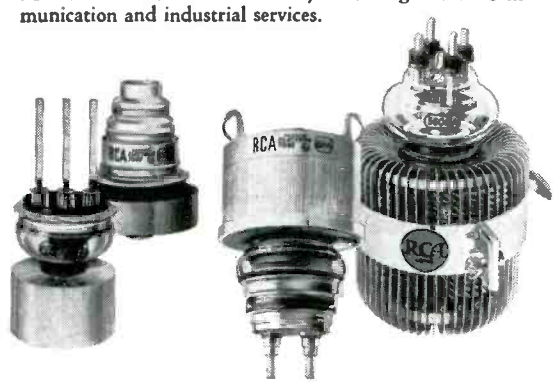
Want more information? Use post card on last page.

DATA FOR

RCA Power Tubes Open New Horizons for Electronically Controlled Power

RCA-6949* ***Super-Power Type***...capable of generating useful continuous rf power in the order of 500 kw at high efficiency and with exceptionally low driving power. Bulletin in preparation.

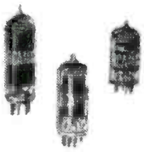
RCA-6181*, RCA-6166, RCA-5762, RCA-5604-A—***Large-Power Tubes***...feature reliability and long life in communication and industrial services.



**Features ceramic-metal construction.*

RCA-6816*, RCA-6884, RCA-6161, RCA-6146, RCA-6883, RCA-6417, RCA-5763—***Small-Power Tubes***...for compact, light-weight, high-efficiency equipment designs.

"Premium" Tubes and "Special Red" Types for Exacting Requirements of Military and Critical Commercial Services



RCA "Premium" Tubes and "Special Red" Tubes are specially processed, rigidly monitored by 100% *microscopic inspection* of 24 or more categories of workmanship—to weed out early-hour failures, assure dependable performance. RCA "Premium" Tubes and "Special Red" Tubes are quality-controlled for reliability under tough conditions of vibration, impact, humidity, and wide temperature variations. For complete listing of RCA's comprehensive line of "Premium" Tubes and "Special Red" Types contact the RCA District Office nearest you, or write RCA, Commercial Engineering, Harrison, N. J.

For information on how these and other RCA products may be applied to your designs, contact the RCA District Office nearest you.

EAST	MIDWEST	WEST		GOVERNMENT	
744 Broad Street, Newark 2, N. J. HUmboldt 5-3900	Suite 1181, Merchandise Mart Plaza Chicago 54, Illinois WHitehall 4-2900	6355 E. Washington Blvd. Los Angeles 23, Calif. RAymond 3-8361	224 N. Wilkinson St. Dayton, 2, Ohio Hemlock 5585	1625 "K" St., N. W. Washington, D. C. District 7-1260	415 South 5th St. Harrison, N. J. HUmboldt 5-3900

For technical bulletins presently available on the products shown here, write RCA Commercial Engineering, Section G19R-1, Harrison, N. J.

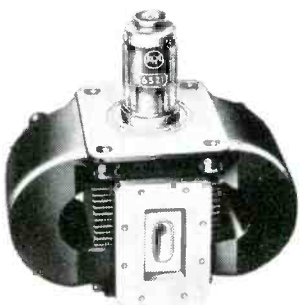
DESIGNERS

RCA Magnetrons and Traveling-Wave Tubes Spur New Advances in Microwave Designs

RCA-6521—*Weather-Radar Magnetron*...for reliable service in airborne electronic equipment. 2000-hours warranted life.

RCA-6865-A—*Tunable-Type Magnetron*...for pulsed-oscillator service. Provides essentially uniform peak power output over the tuning range 8750 Mc to 9600 Mc. Limited to government end use. For further information, contact the RCA District office nearest you.

RCA-6861—*Low-Noise Traveling-Wave Tube*...extraordinarily low noise figure of 6.5 db in the 2600 Mc to 3500 Mc range.

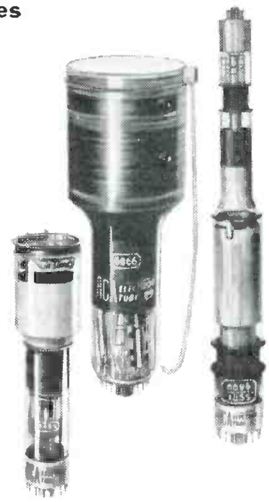


RCA Storage and Display Tubes Extend the Design Boundaries of Electronic Data-Processing Devices

RCA-6499—*Radechon*...a charge storage tube of the barrier-grid type intended for use in a wide variety of information processing systems.

RCA-6896/1855—*Graphechon*...a charge storage tube for use in data-processing applications where signal information must be transformed continuously from one time-base to another. Bulletin in preparation.

RCA-6866—*Display Storage Tube*...with average display brightness of 2750 foot-lamberts for use in applications where it is desired to have a non-flickering display of stored information for about 60 seconds after writing has ceased.



Camera and Image-Converter Tubes Probe New Frontiers for Industry

RCA-6198-A—*Vidicon*...small-size camera tube without side tip for compact industrial television applications.

RCA-6849—*Image Orthicon*...with exceptionally high sensitivity and spectral response approaching that of the eye for operation under extremely low light levels.

RCA Infrared Image-Converter Tubes...available for government end-use. For further information, contact the RCA District Office nearest you.

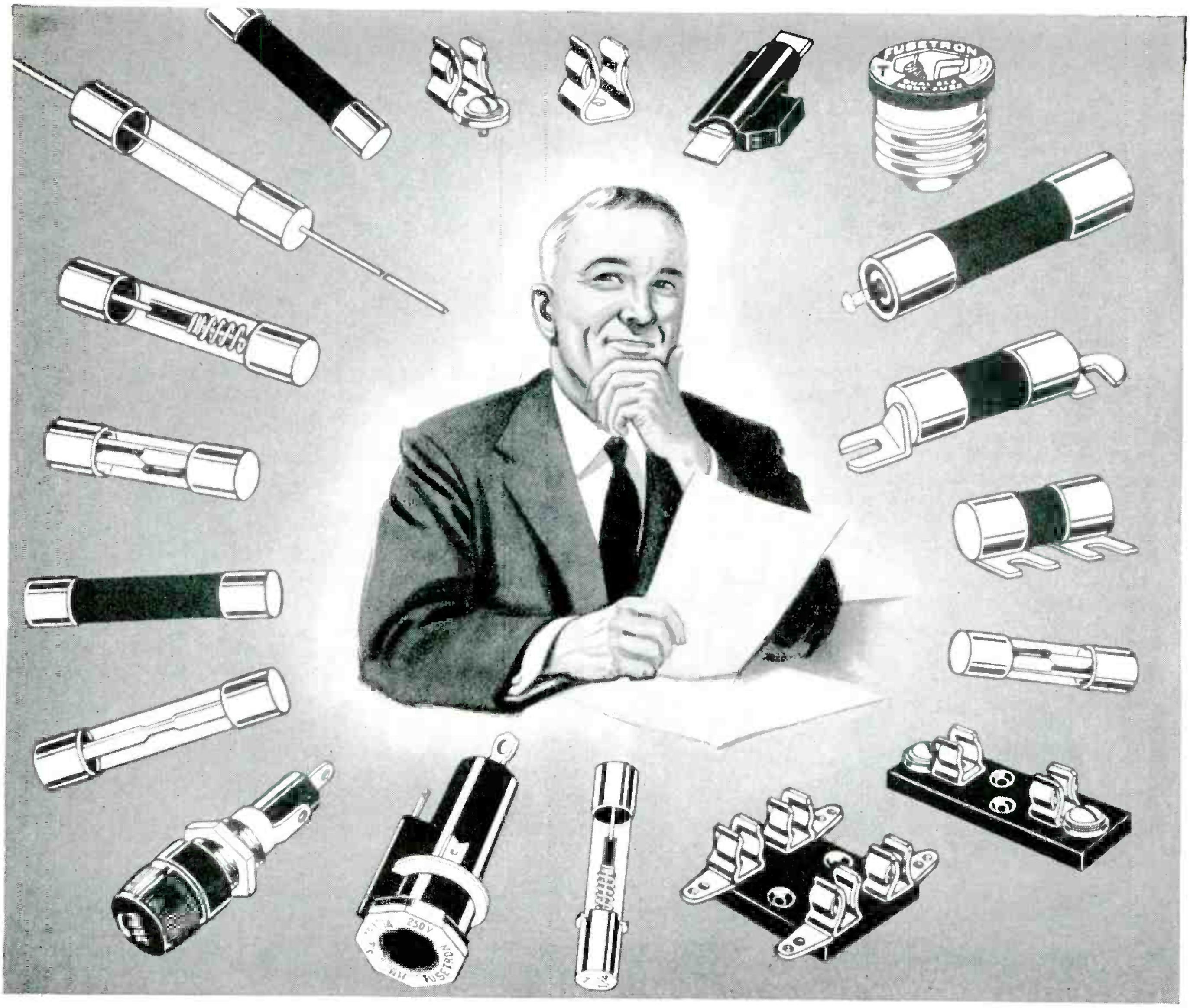
Superior-Quality Transistors for Designs Where Performance-Reliability is of Prime Importance

RCA-Type No.	Application
2N77*	Class A AF Amplifier Type.
2N104, 2N215*	Class A AF Amplifier Types.
2N105*	Class A AF Amplifier Types. Small size for compact designs.
2N109, 2N217*	For large-signal Class A or B, AF Amplifiers. Power Output: two 2N109's in class B Push-Pull, 150 milliwatts.
2N139, 2N218*	Class A 455-Kc IF Amplifier Type.
2N140, 2N219*	Converter and Mixer-Oscillator Types for 540—1640 Kc Band.
2N175, 2N220*	Extremely Low-Noise Types for Preamplifiers or Input Stages of Audio Amplifiers.
2N206*	Class A AF Amplifier Type (Tested for temperature cycling and moisture resistance). Meets MIL-T 25380/4 USAF specification.
2N247*	"Drift" RF Amplifier Type for AM Broadcast Band up into the Shortwave Bands.
2N269*	For Medium-speed switching Applications in Electronic Computers.
2N270*	For Large-Signal Class A or B, AF Amplifiers. Power Output: one 2N270 in class A, 60 milliwatts; two 2N270's in class B, Push Pull, 500 milliwatts.
2N301	High-Power Type for Class A or B, AF Amplifiers. Power Output: one 2N301 in class A, 2.7 watts; two 2N301's in class B, Push Pull, 12 watts.
2N301A	Like 2N301 but operates at peak collector voltages as high as 60 volts.

* Flexible-lead type

RADIO CORPORATION of AMERICA
Electron Tube Division, Harrison, N. J.
Semiconductor Division, Somerville, N. J.

Want more information? Use post card on last page.



You can save time and trouble by standardizing on BUSS fuses.

The BUSS fuse line is most complete

You'll find the right fuse every time, when you turn to BUSS. There are BUSS fuses of all types and sizes for the protection of television, radio, instruments, controls, avionics and other electronic and electrical equipment. A companion line of fuse blocks, clips and holders is most complete.

Buying fuses from one source saves you time, trouble and simplifies your stock handling records.

Safeguard the reputation of your equipment for quality and service

BUSS fuses are tested in a sensitive electronic device that automatically rejects any faulty fuse. As a result, there are never any 'kicks' or complaints from users about BUSS fuses failing to protect or faulty fuses causing needless shutdowns of your equipment.

Why take a chance on anything less than BUSS quality in fuses? Specify BUSS fuses and be sure of dependable electrical protection for your equipment.

If your protection problem is unusual . . .

. . . . . let the BUSS fuse engineers work with you and save you engineering time. If possible, they will suggest a fuse or fuse mounting already available in local wholesalers' stocks, so that your device can be serviced easily.

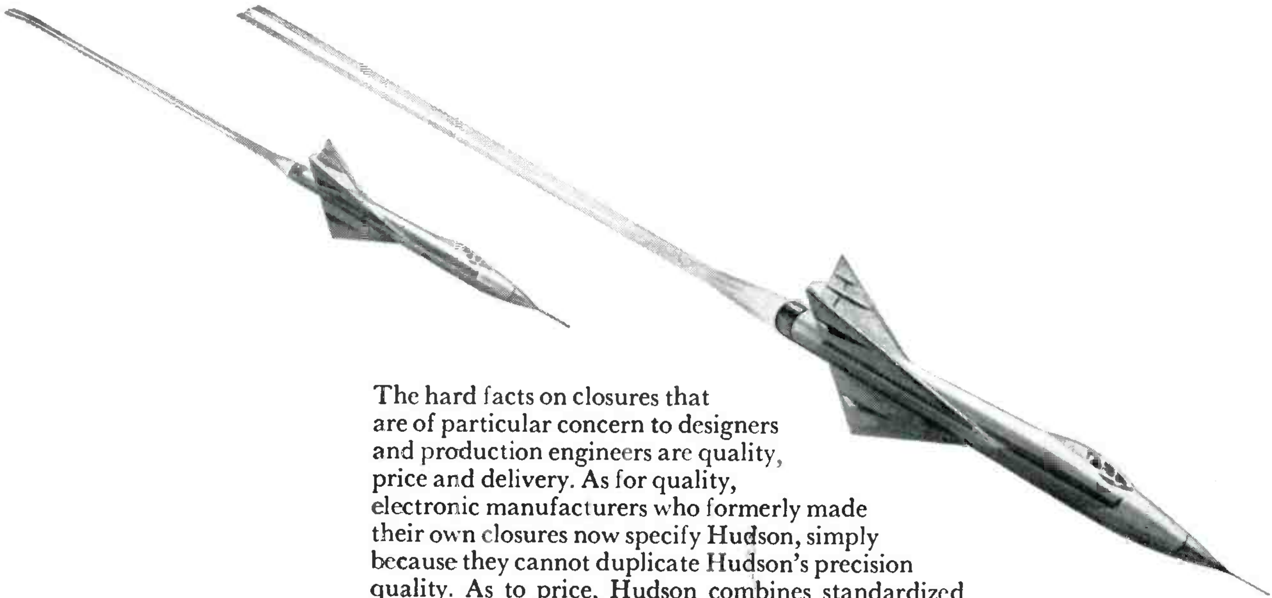
For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders . . . Write for bulletin SFB. Bussmann Mfg. Division (McGraw-Edison Co.) University at Jefferson, St. Louis 7, Mo.

BUSS fuses are made to protect—not to blow, needlessly

757

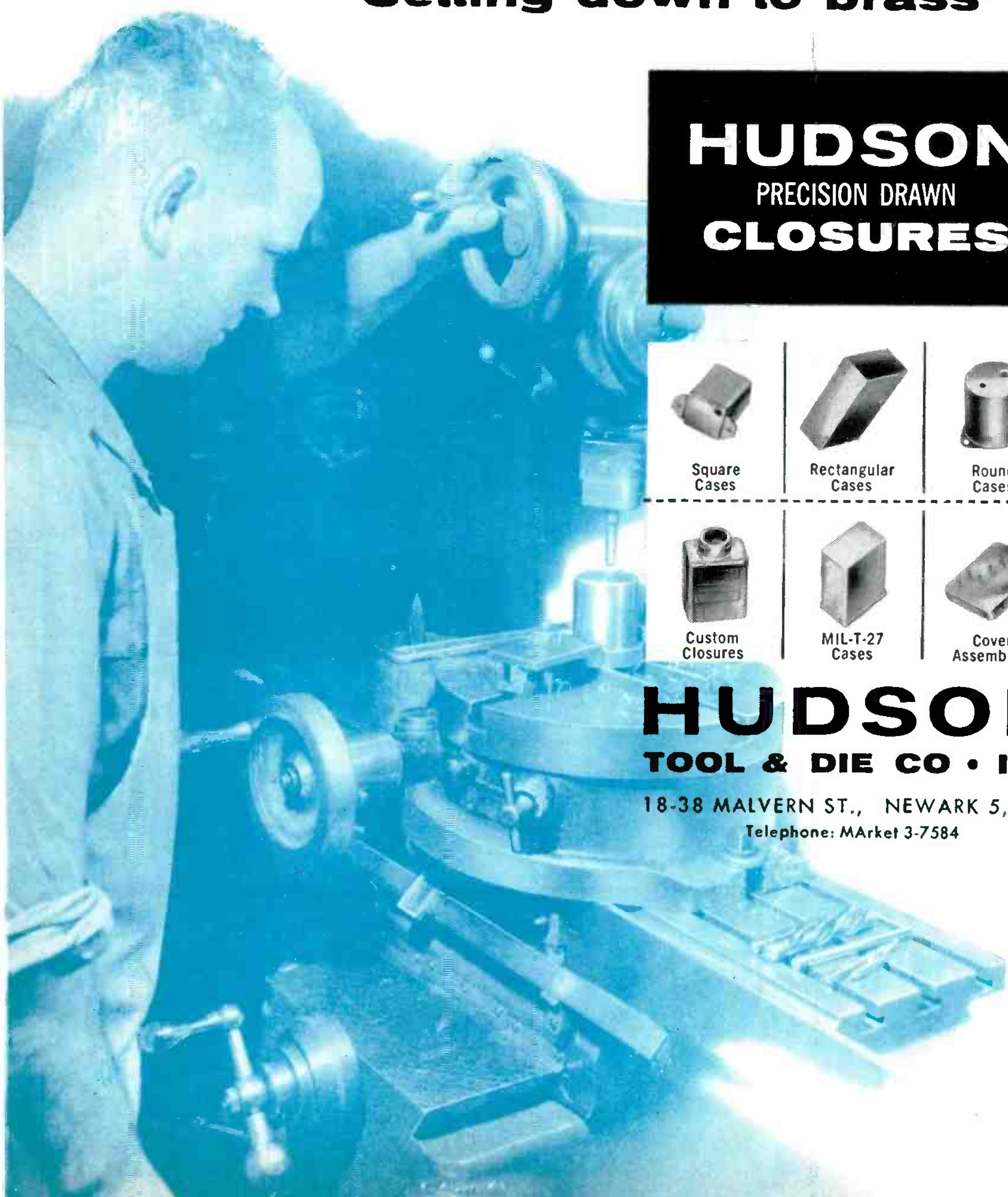
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

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



The hard facts on closures that are of particular concern to designers and production engineers are quality, price and delivery. As for quality, electronic manufacturers who formerly made their own closures now specify Hudson, simply because they cannot duplicate Hudson's precision quality. As to price, Hudson combines standardized designs with mass production methods to attain custom quality at commercial prices. Deliveries are timed to your assembly line schedules — in fact, practically all Hudson standard designs are carried in stock!

Getting down to brass* facts!

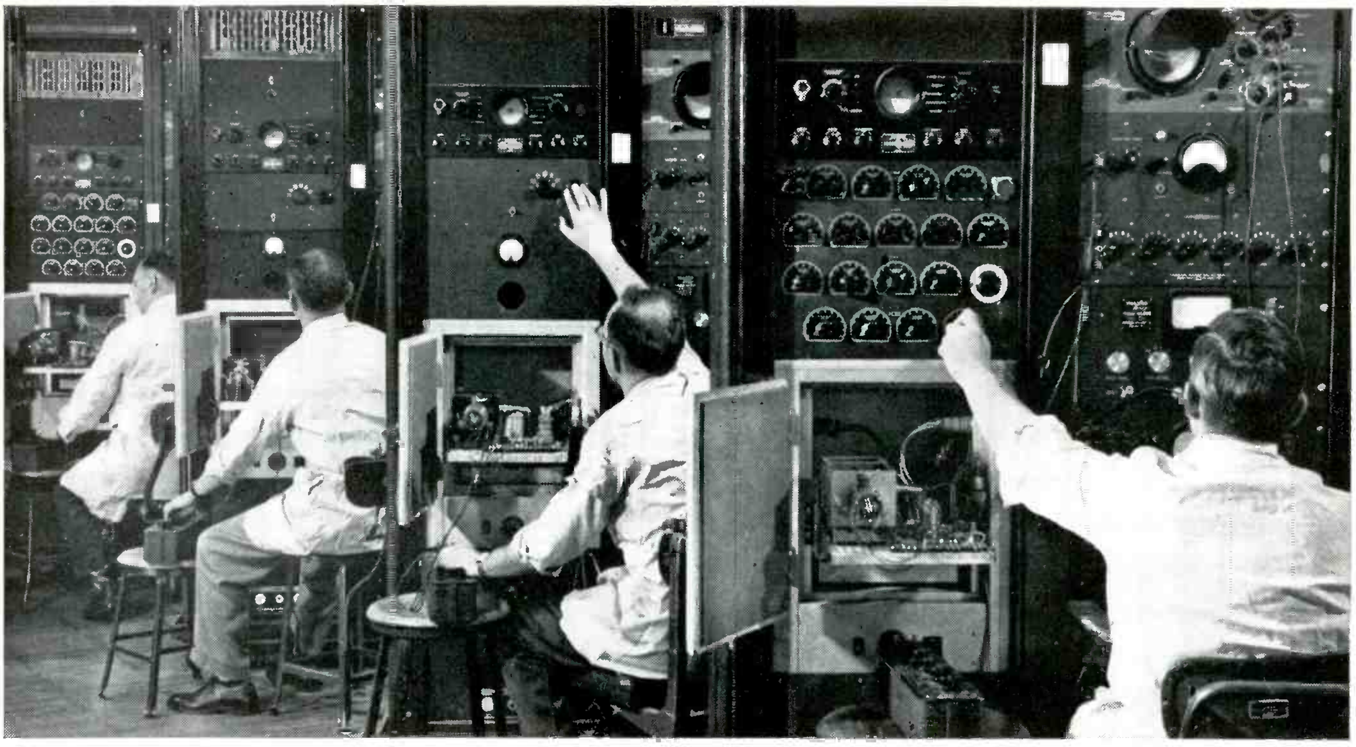


HUDSON
PRECISION DRAWN
CLOSURES

*Precision Metal Products of Steel, Stainless Steel, Aluminum, Copper, Brass and Mu Metal. Call or write for Catalog.

HUDSON
TOOL & DIE CO • INC

18-38 MALVERN ST., NEWARK 5, N.J.
Telephone: MArket 3-7584



Bendix-built production test equipment calibrates precision induction rate generators and temperature compensating networks as a team.

GET FAST DELIVERY ON HIGH PRECISION RATE GENERATORS AT BENDIX "SUPERMARKET"

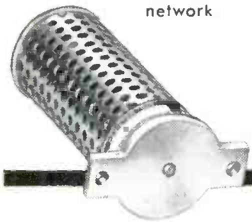
You're used to fast delivery at minimum cost from the Bendix Synchro "Supermarket", but maybe you don't know that this applies to such specialized, high-precision equipment.

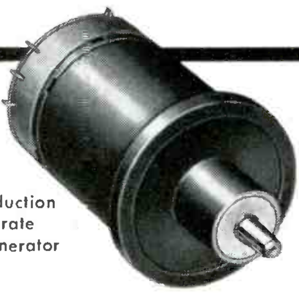
The photo above shows the extensive production facility used to test Bendix induction rate generators and temperature-compensating networks as a matched pair. It's your assurance that precision rate generators you buy from Bendix will have the accuracy of laboratory-built instruments. Yet we produce them at almost assembly-line speed.

Extensive calibration enables us to promise generator accuracy within .15 of 1 per cent up to 3,600 rpm, unmatched in a production model such as this. Actually, at 4 volts and 3,000 rpm—the range at which the instrument will more commonly operate—linear accuracy is even greater: within .05 of 1 per cent.

District Offices: Burbank and San Carlos, Calif.; Dayton, Ohio; Seattle, Wash.
Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

Temperature-compensating network





Induction rate generator

AVERAGE ELECTRICAL CHARACTERISTICS

Rated excitation	115 volts, 400 cycles
Output voltage gradient	2 volts per 1000 rpm
Output voltage	6 volts ± 0.05% at 3000 rpm
Phase shift	0 ± 0.1 degrees

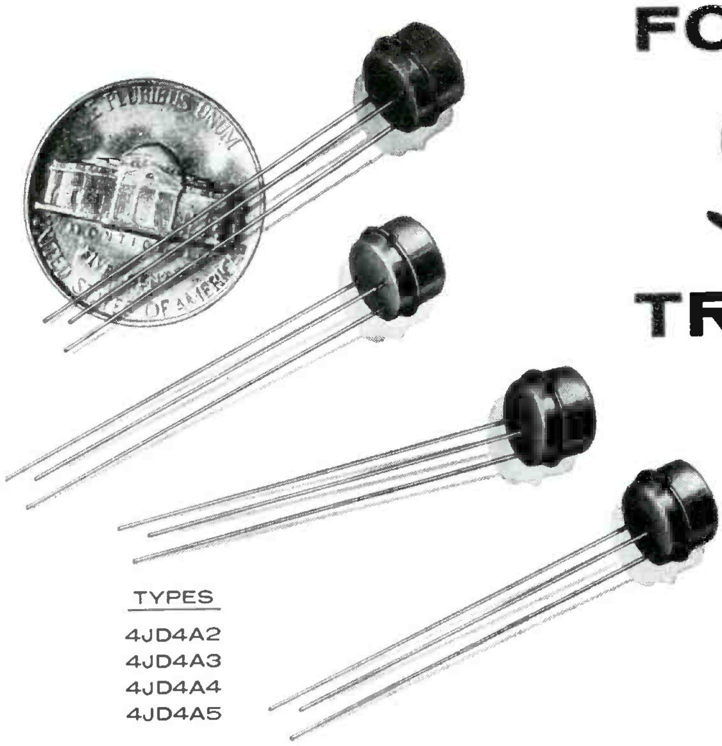
AVERAGE MECHANICAL CHARACTERISTICS

Rotor moment of inertia	0.57 oz.-in.^{2}
Operating temperature range	15°C. to 75°C.
Weight:	
Rate generator	1¾ pounds
Compensating network	¼ pound

Eclipse-Pioneer Division
TETERBORO, N. J.

Bendix AVIATION CORPORATION

Want more information? Use post card on last page.



TYPES

4JD4A2
4JD4A3
4JD4A4
4JD4A5

FOUR NEW G-E *Silicon* TRANSISTORS

- ***Operation below zero and up to 150°C***
- ***25 mc alpha cutoff***
- ***Low leakage current***
- ***Easy automatic insertion in printed circuit board***

DESIGN FEATURES

High Temperature Performance . . . maximum ambient operating temperature 150° C, storage temperature up to 200° C

New Package Design . . . for automatic insertion in printed circuit boards

Package Hermetically Sealed . . . no moisture seepage from outside air

Package Seams Are Welded . . . for great strength, long wear

Long Life and Stable Performance . . . when used within specified ratings

Small Size . . . extremely compact design provides added flexibility for most applications

Here are just a few typical applications for the NPN silicon triode transistors: wide band and d-c amplifiers, oscillator circuits, computer switching.

And now *all* General Electric transistors are a better buy than ever. Because of mechanized production lines, G-E transistors are made in less time and at a lower cost than before. Thus you benefit from lower prices.

Besides, machine methods used on the General Electric production lines promote the strictest adherence to top quality standards. As a result, characteristics are controlled and narrow limits are built into the production transistor for a more uniform product. Therefore, General Electric is able to give a one-year written warranty.

For specifications and application engineering assistance, call your G-E Semiconductor District Sales Manager, your G-E Semiconductor distributor, or write the General Electric Company, Semiconductor Products, Section S2577, Electronics Park, Syracuse, N. Y.

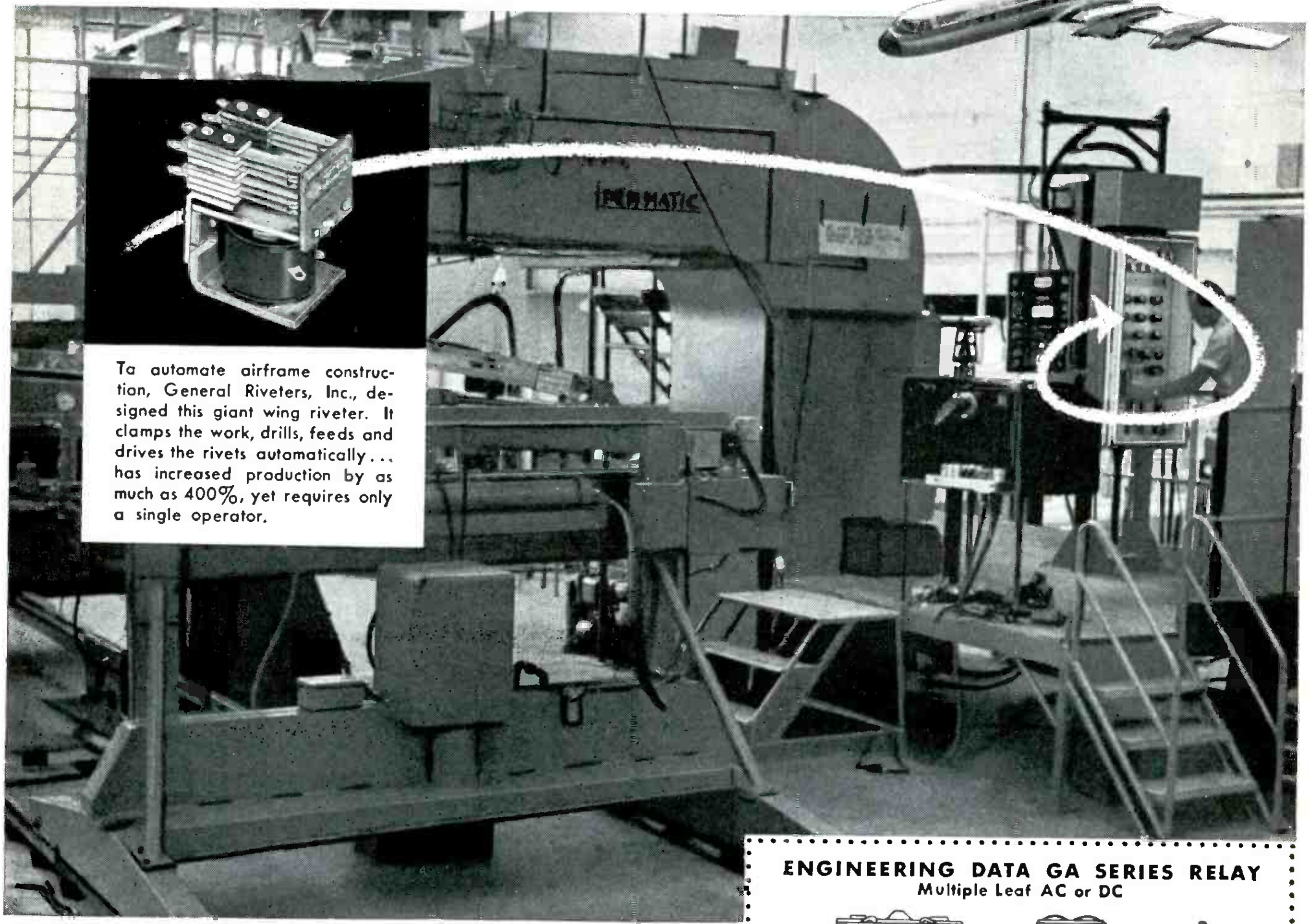
Progress Is Our Most Important Product

GENERAL ELECTRIC

ECG-226

Want more information? Use post card on last page.

Potter & Brumfield *engineering is in this picture*



To automate airframe construction, General Riveters, Inc., designed this giant wing riveter. It clamps the work, drills, feeds and drives the rivets automatically... has increased production by as much as 400%, yet requires only a single operator.

P&B RELAYS AUTOMATE THIS GIANT RIVETER *for new Lockheed Electra Wings*

This new automatic riveter will be used to make wings for the new Lockheed Electra, a prop-jet luxury liner, as well as many other modern aircraft. The heart of this riveter is a relay circuit that "takes orders" from a pattern of holes punched in 35 mm film strips.

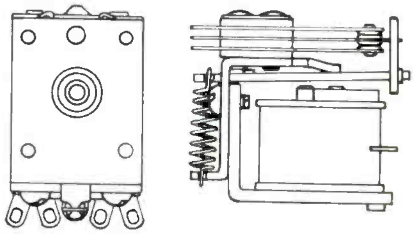
General Riveters, Inc. selected the GA Series P&B relay for the control circuits of this riveter because of its unusual dependability and versatility. In adapting this relay to a specific application, P&B's engineers again demonstrated how 25 years of creative engineering can pay off by providing a standard type or completely new relay to solve your particular problem. Write today for new compact catalog or engineering consultation.

P&B Standard Relays are available at your local electronic, electrical and refrigeration distributors

Potter & Brumfield, inc.

PRINCETON, INDIANA *Subsidiary of* AMERICAN MACHINE & FOUNDRY COMPANY
Manufacturing Divisions also in Franklin, Ky. and Laconia, N. H.

ENGINEERING DATA GA SERIES RELAY
Multiple Leaf AC or DC



CONTACTS
Material: 3/16" fine silver (other contact materials can be furnished for specific applications)
Rating: 5 amp. 115 V. 60c non-inductive load
Arrangements: 4 Form C Max., AC; 6 Form C Max., DC
Breakdown: 1000 V. RMS between all elements

COIL
Resistance: 30,000 ohms max.
Power req'd: 6 W. max., 2 W. min. DC at 25° C. ambient
V range: DC to 110 V.; AC to 230 V.

DIMENSIONS, MAX.
1 23/32" L. x 1 1/16" W. x 1 25/32" H.

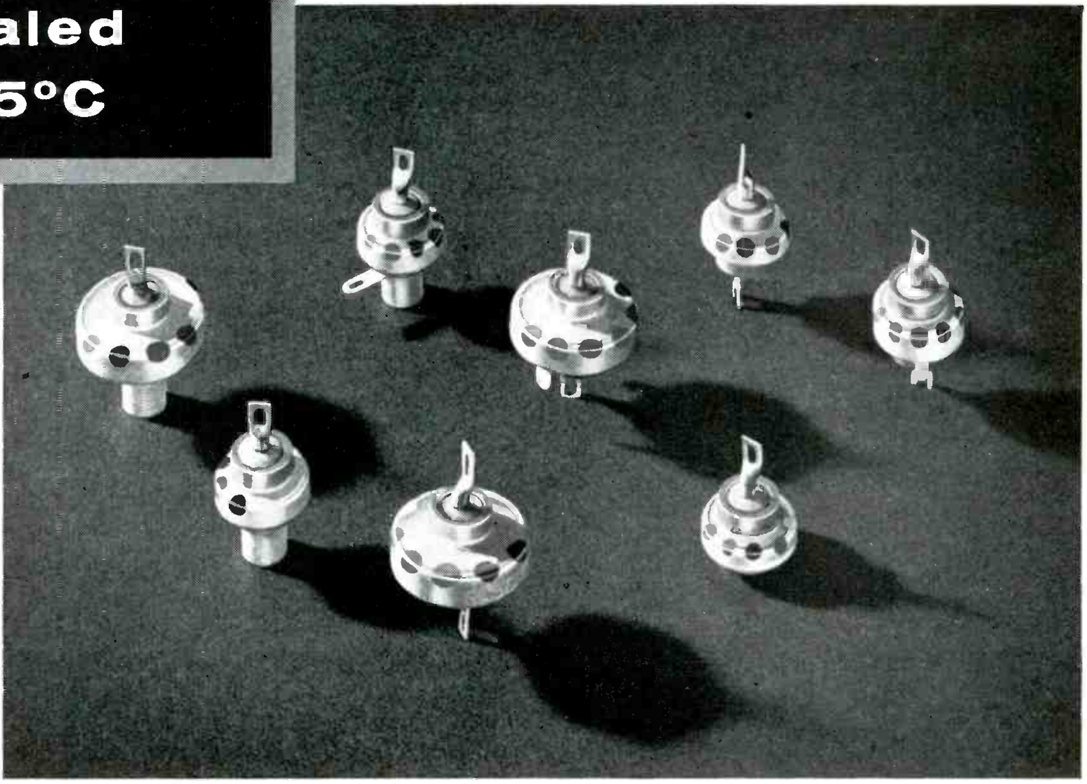
MOUNTING DATA
4 tapped #6-32 holes, .750" x .875" o.c. 1 tapped #8-32 core

ENCLOSURES
Hermetically sealed, octal plug: 2 17/32" x 1 29/32" x 1 25/32"
Multiple solder header and miniature plug-in: 2 15/32" x 1 29/32" x 1 25/32"
Special container required for 6 Form C

TERMINALS
Contacts: two #16 AWG wires
Coil: two #20 AWG wires

See our catalog in Sweet's Product Design File

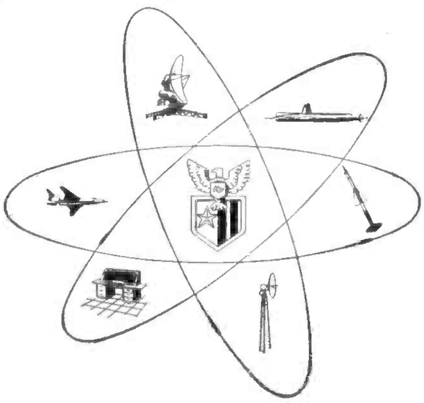
Hermetically Sealed 125°C



SANGAMO SILVERED MICA BUTTON CAPACITORS

HIGH RELIABILITY MANUFACTURING FACILITIES

Sangamo's "controlled conditions" facilities for the exclusive manufacturing of high reliability capacitors assure really fine capacitors for your most critical military or industrial applications.



Sangamo's design engineers have developed these hermetically sealed mica button capacitors especially for high frequency applications under severe humidity and temperature conditions.

The unique internal design results in low inherent inductance —ideal for application at frequencies up to 500 megacycles per second in tuning, coupling and by-pass circuits. The silver plated case serves as both the low potential terminal and as an electrostatic shield.

These units meet all requirements for V.H.F. and U.H.F. applications and meet Joint Army-Navy specification MIL-C-10950B (proposed). Operating temperature range is from —50°C to 125°C. Specify these high reliability capacitors for your most critical applications. Write today for your file copy of Engineering Bulletin TS-115.

FIVE TYPES AVAILABLE—Stand-off with ground lug, Stand-off without ground lug, Feed-thru without mounting lugs, Stand-off without pedestal, and Feed-thru with mounting lugs.

SANGAMO ELECTRIC COMPANY
Electronic Components Division
SPRINGFIELD, ILLINOIS

SC57-6

CBS Power Transistors are mass-produced,[1] uniform,[2] stable,[3] dependable[4]...they are your logical choice.[5]

1. They look and are alike because of controlled mass-production techniques.
2. They are uniform electrically because of these techniques.
3. Over 10,000 hours of life have demonstrated their stability.
4. Hundreds of thousands have proved their dependability in actual use.
5. CBS power transistors are *your* logical choice, too . . . for uniformity, for stability, for over-all dependability.

CBS semiconductors®

CBS-HYTRON
Semiconductor Operations, Lowell, Massachusetts
A Division of Columbia Broadcasting System, Inc.

Want more information? Use post card on last page.

ESSEX® *has all the* MAGNET WIRE TYPES!

ENAMEL . . . Class A 105° C
An oleo-resinous enamel, used primarily in ignition coils, relays, small transformers, radio and electronic coils and similar applications.

FORMVAR . . . Class A 105° C
A film composed of polyvinyl formal resins with good electrical and chemical qualities and exceptional adhesion, flexibility, toughness and abrasion resistance properties.

Self-Bonding FORMVAR . . . Class A 105° C BONDEX
A Formvar insulation with a "bonding" film added. All the desirable Formvar characteristics are retained plus the "self-bonding" of the coil wound wires.

NYLON . . . Class A 105° C
Comparable with Formvar, this polyamide insulation features self-fluxing properties; has an extremely smooth finish, and good electrical, chemical, and physical properties.

FORMVAR-NYLON Combinations . . . Class A 105° C NYFORM®
A Nylon film applied over a Formvar insulation gives these wires outstanding physical properties and is well suited to applications where pre-heating before dipping and baking is not practical.

SOLDERABLE FILMS . . . Class A 105° C SODEREX
These smooth red insulations with a modified isocyanate or polyurethane base have outstanding physical, chemical and electrical characteristics plus self-fluxing properties which permit hot solder connections without prior stripping.

ENAMEL . . . Class B 130° C (Isonel) THERMALEX
Constructed with a polyester, this insulation has a very long thermal age life and compares with Formvar in physical, chemical and electrical characteristics.

SILICONE . . . Class H 180° C
This insulation, constructed with a silicone base material and accommodating extreme temperature requirements, is modified with other materials, insuring its physical, chemical and electrical properties.

HERMETIC FILMS . . . Class B 125° C ACRYLEX
Based on acrylic resins, these insulations are excellent for hermetic applications. Their non-crazing, high cut-through, long heat age life and excellent solvent resistance indicate a bright future for hermetic applications.

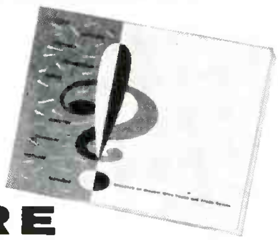
TEXTILE INSULATIONS . . . Class A, Class B, Class H
Cotton, paper, fiber glass, nylon, silk or combinations of them, are applied over bare or film insulated magnet wires for various physical, chemical and electrical requirements.

ROUND, SQUARE, RECTANGULAR
All types of the above wire, both bare, film insulated, and textile covered are available from Essex.

"Extra Test®" Insulations for every application!

Whatever your winding requirements, for prompt delivery of the exact wire and insulation . . . look to Essex! Essex "Extra Test" Magnet Wire is available in metal, fiber container (MAGNA-PAK)®, commercial reel or spool putups.

WRITE TODAY . . .
for new "Directory of Magnet Wire Types and Trade Names."



ESSEX *EXTRA TEST®* MAGNET WIRE

DIVISION ESSEX WIRE CORPORATION, Fort Wayne 6, Indiana

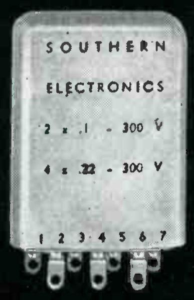
MANUFACTURING PLANTS — Birmingham, Alabama; Anaheim, California; Fort Wayne, Indiana; Detroit, Michigan; Hillsdale, Michigan.

SALES OFFICES AND WAREHOUSES*

*Birmingham, Ala.
*Chicago, Illinois
Cleveland, Ohio
Dallas, Texas
Dayton, Ohio
Detroit, Michigan
Fort Wayne, Indiana
Fort Worth, Texas
Hartford, Conn.
Indianapolis, Ind.
Kansas City, Mo.
*Los Angeles, Calif.
Milwaukee, Wisc.
*Newark, N. J.
*Portland, Oregon
Rochester, New York
*Saint Louis, Mo.
*San Francisco, Calif.
Upper Darby (Philadelphia), Pa.

Distributed nationally to the repair and maintenance industry through Insulation and Wires, Incorporated

Want more information? Use post card on last page.



CONDENSE AND SAVE!

SEC Plastic condenser block capacitors save you space, labor, money!

Multiple capacitors in one block! Now you can install one capacitor case and use 125% less space than before — at a saving in labor costs of up to 300%.

Let us solve your condenser block problems. Send us your requirements. Many case sizes and configurations are available with polystyrene or MYLAR* dielectric to tolerances as close as 1%.

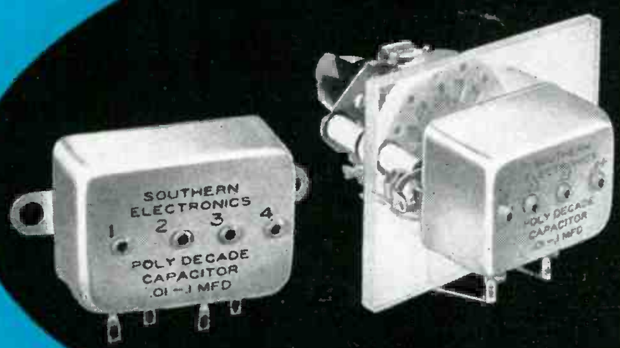
now after years of intense research and development of military requirements

SEC offers you **RC NETWORKS**

PITCH FILTERS
INTEGRATOR NETWORKS

RC NETWORK as low as ½% capacitors and ½% resistors for reliable RC value of 1%.

- Hermetically sealed and potted
- Meets exacting military specifications
- SAVES SPACE & LABOR



SEC PRECISION DECADE CAPACITORS with attached rotary switch or completely boxed!

Now on special order! Decade capacitors with higher voltage ratings, closer tolerances and capacitance from .001 to 10 M.F.D. with polystyrene or MYLAR* dielectric to tolerances as low as 1%.

CHECK THESE OUTSTANDING FEATURES:

- Standard voltage rating . . . 200 V.D.C.
- Very high insulation resistance
- Low dissipation factor
- Low dielectric absorption
- Small sizes

*DuPont T.M.

SOUTHERN ELECTRONICS *Corporation*

POLYCON SEC MYCON

For your most exacting requirements— always specify S.E.C.

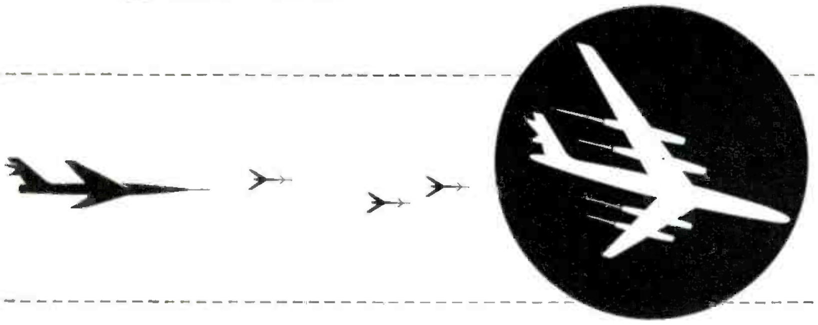
Wire, write or phone for a complete catalog today!

150 West Cypress Ave., Burbank, California

Want more information? Use post card on last page.

Extend your future in

CIRCUIT DESIGN



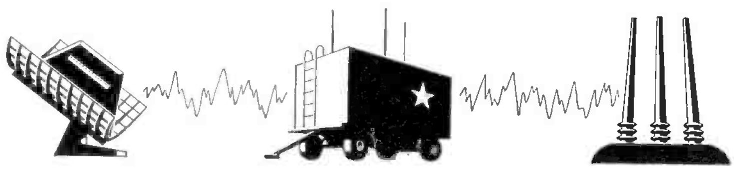
At Hughes we have undertaken development of a system in which advanced radars using array antennas and newer traveling wave tube developments are combined with digital data handling and processing equipment to solve the complex problems of aircraft detection and assignment.

We are already in an enviable position in the intercept and destruction phase of defense through the Hughes airborne radar fire control systems and the Hughes Falcon guided missile. Achievement of these objectives in the very limited space and stringent environmental conditions of the modern defense system provides an unusual challenge to the creative circuit design engineer.

If you are interested in joining us you should have experience in one or more of the following circuit areas:

Transistor—Video—Microwave—Pulse—IF and RF—Switching—Clamping—Phase Shift—Power Supply—Modulator—Electromechanical.

VACATIONING IN SOUTHERN CALIFORNIA? YOU ARE INVITED TO VISIT HUGHES.



Scientific Staff Relations

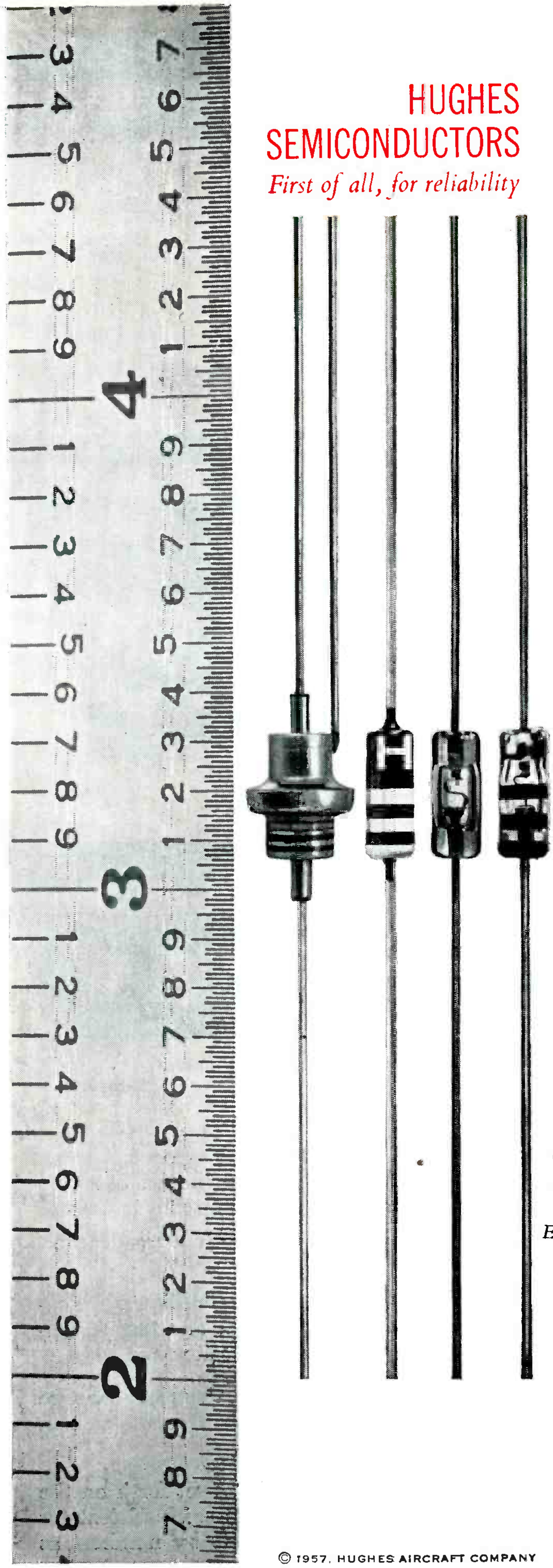
HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

HUGHES SEMICONDUCTORS

First of all, for reliability



RELIABILITY

WHAT IT IS. At Hughes, reliability is the probability that a device will give satisfactory performance during a specific period of time when used in the manner intended. And at Hughes, the probability is high, approaching certainty.

HOW HUGHES ACHIEVES IT. With meticulous consideration to every detail, Hughes has accumulated extensive knowledge of the semiconductor art, extensive knowledge of all the subtle and delicate, yet critical, factors involved. To *really* know is essential. Then, and only then, reliability becomes an automatic result—built into every unit.

HOW HUGHES MAINTAINS IT. Hughes Quality Control is the "watchdog," checking and rechecking every phase of production on a carefully regulated statistical basis. This extensive effort ensures prompt discovery of any variation which might affect the ultimate quality—and the *reliability*.

HOW YOU OBTAIN IT. Specify Hughes, for the greatest possible assurance. For additional information, please write:

SEMICONDUCTOR DIVISION
HUGHES PRODUCTS
International Airport Station, Los Angeles 45, California

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

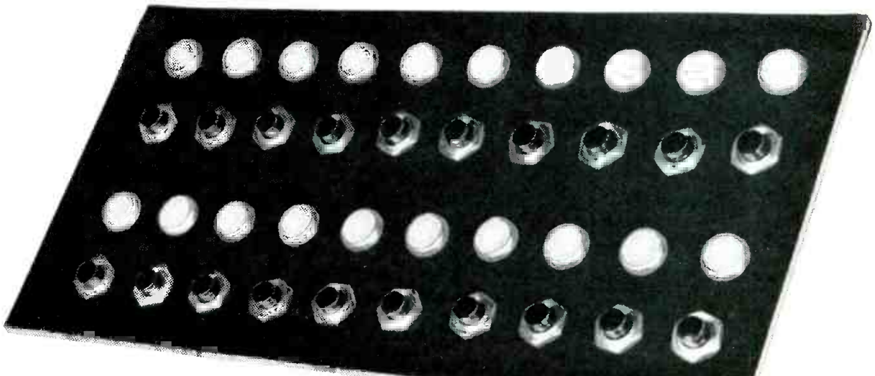
HUGHES
SEMICONDUCTORS

MICRO SWITCH Precision

...FIRST IN PRECISION SWITCHING

Here is WHY you can *CUT PANEL SPACE* **50%** with MICRO SWITCH Illuminated Pushbutton Switches

Study this illustration... it shows how you can install a given number of MICRO SWITCH Pushbutton Switches—with illumination integral with the button in one-half the panel area necessary when push buttons requiring auxiliary on-and-off lights are used.



The center-to-center space required for 20 push buttons and auxiliary lights is 4 in. x 10 in.—40 square inches.

The center-to-center space required for 20 MICRO SWITCH Illuminated Pushbutton Switches is 2 in. x 10 in.—20 square inches.

FOUR SHAPES OF PUSHBUTTONS AVAILABLE IN FIVE DIFFERENT COLORS

These four translucent button styles are available for MICRO SWITCH Type 52 PB switches.

From the top they include (1) ¾ in. round; (2) ⅝ in. hexagonal; (3) ½ in. round; and (4) ¾ in. square.

They are available in red, yellow, green, blue and white.

(Send for Data Sheet #117)

The savings in space, in time; the difference in operating ease and surety—all commend the use of MICRO SWITCH Illuminated Pushbutton Switches instead of combinations of switch and separate auxiliary on-and-off signal lights.

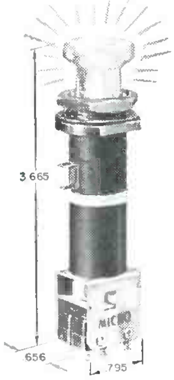
Here are four NEW MICRO SWITCH Illuminated Pushbutton Switches with many unique and specific features, detailed for you on the opposite page.

In addition to their other features, these switches are obtainable with any one of four different shaped buttons, in five different colors.

Read the specific details of each as set forth on the opposite page. If this information is insufficient for your purpose, ask for Data Sheets by numbers as shown on opposite page.

Switches have uses unlimited

HONEYWELL



#52PB7-T2

NEW!

MICRO SWITCH Turn-to-Lock-Down Lighted Pushbutton Switch

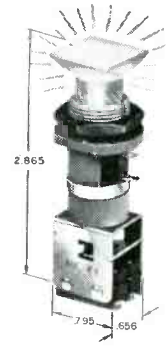
This MICRO SWITCH lighted pushbutton switch is a dual-purpose switch. Pushed straight down, it functions as a conventional momentary pushbutton. A push and clockwise twist of the finger tip holds the switch in the operated position. A counter-clockwise twist returns the switch to the unoperated position. The low operating torque required permits the switch to be mounted flush or underflush on a panel without impairing ease of operation . . . This versatile switch can take the place of conventional push button, holding relays and separate indicator lights in many applications. Or it can take the place of an alternate-action pushbutton and provide optional momentary action.

CHARACTERISTICS: Operating force 34 oz. max. Pretravel .220 in. min. Overtravel .120 in. max. Two subminiature switches are SPDT.

(Send for Data Sheet #116)

NEW!

MICRO SWITCH "Space Saver" Lighted Pushbutton Switch —only 2 in. max. below Panel



#52PB51-T2

This MICRO SWITCH lighted pushbutton switch is invaluable in applications where space is at a premium. The switch has no pretravel spring mechanism which permits length to be reduced to 2.35 in. (less button). Only 2 in. max. required below mounting panel . . . This switch has a very definite snap-action "feel" and comparative high-force characteristics. Switch body contains a removable subminiature socket for the indicator lamp. Lamps are available for 6, 12 and 28 volts.

CHARACTERISTICS: Operating force—32 oz. max. Pretravel—.070 in. max. Total travel—.110 in. max. Two subminiature switches are SPDT.

(Send for Data Sheet #123)

ELECTRICAL DATA

The subminiature basic switching units used in these four assemblies have SPDT contact arrangement. Contact break distance is .010 in. min. Underwriters' Laboratories list the switches at 5 amps. 125 vac. 30 vdc ratings are: Inductive 3 amps.—sea level, 2.5 amps. —50,000 ft. Maximum inrush rating: 15 amps. 125 or 250 vac and 30 vdc.

#53PB8-T2

NEW!

MICRO SWITCH Magnetic Hold-in Lighted Pushbutton Provides Three Functions

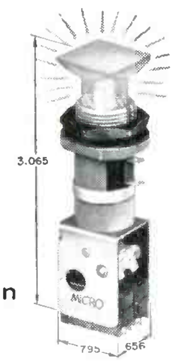
MICRO SWITCH lighted pushbutton switch combines the functions of a three-pole double-throw pushbutton switch, indicating light, and holding relay into one compact unit which panel mounts on one-inch centers, both horizontally and vertically. Thus, the cost, wiring, maintenance and added space of these separate components are eliminated . . . A 28-volt dc solenoid is incorporated into the switch shaft. After the button is manually operated, the solenoid holds the switches in the operated position until electrically released. This feature gives the designer complete freedom in panel layout by eliminating the restrictions found in conventional mechanical release designs.

CHARACTERISTICS: Operating force—35 oz. max. Pretravel—.050 in. approx. Total travel—.090 in. max. Three subminiature switches are SPDT.

(Send for Data Sheet #128)

NEW!

MICRO SWITCH Alternate Action Lighted Pushbutton Switch— for Multiple Circuit Control



#52PB61-T2

This MICRO SWITCH lighted pushbutton switch provides on-off control of up to four circuits. With each push of the button, both basic switches are alternated between actuated and unactuated maintained positions, thus providing double-pole double-throw action. Every two pushes of the button completes a cycle of operation. Variations in the long-life nylon index cam are possible which will permit a number of other sequences.

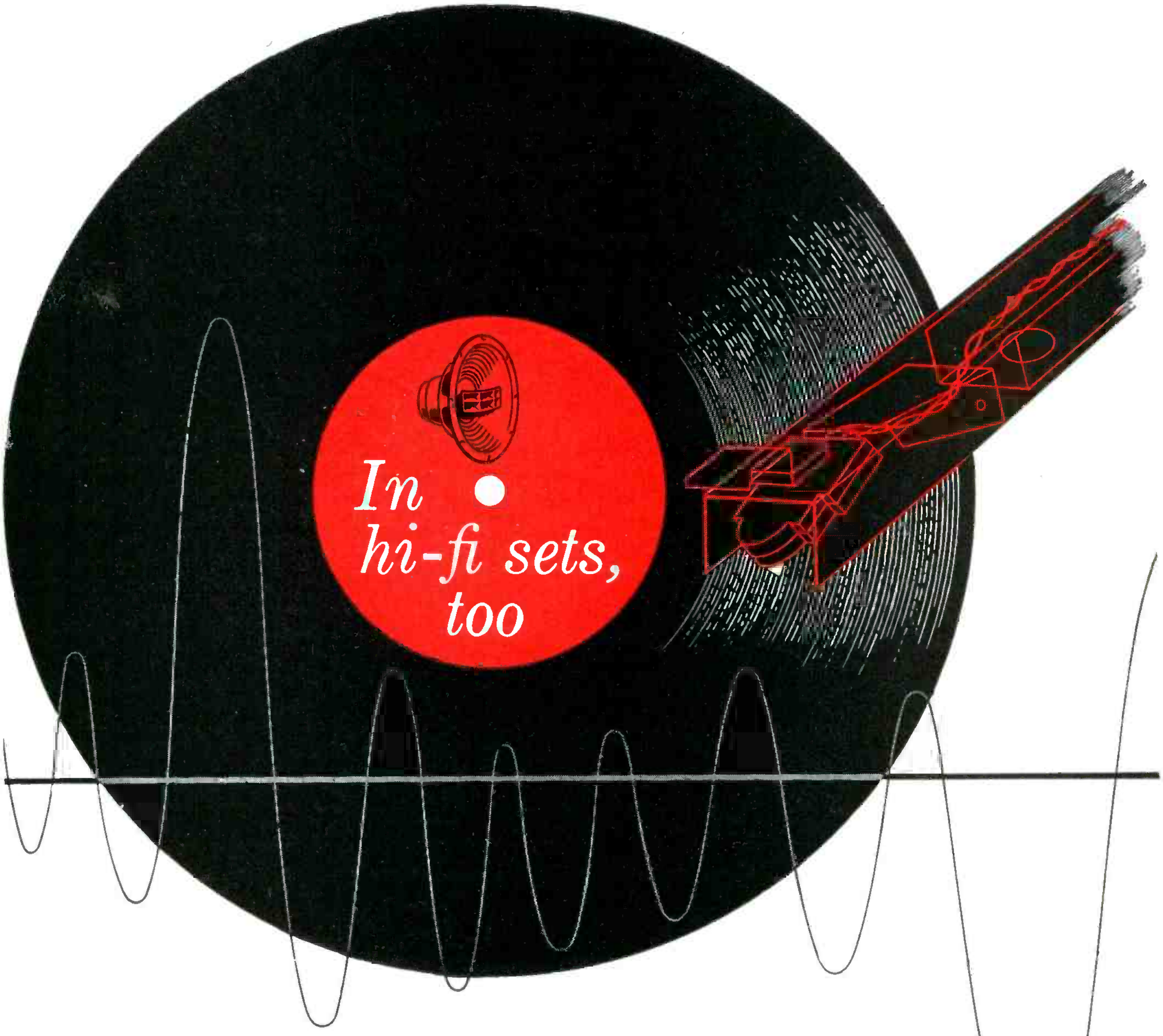
CHARACTERISTICS: Operating force—40 oz. max. Total travel—.100 in. max. Two subminiature switches are SPDT.

(Send for Data Sheet #124)

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



CRUCIBLE PERMANENT MAGNETS

give maximum energy . . . minimum size

Crucible *prescription-made* Alnico permanent magnets provide *consistently higher* energy products.

This means greater design freedom . . . more compact products for manufacturers of high-fidelity sound equipment, instruments, controls, motors, and other magnet equipped devices.

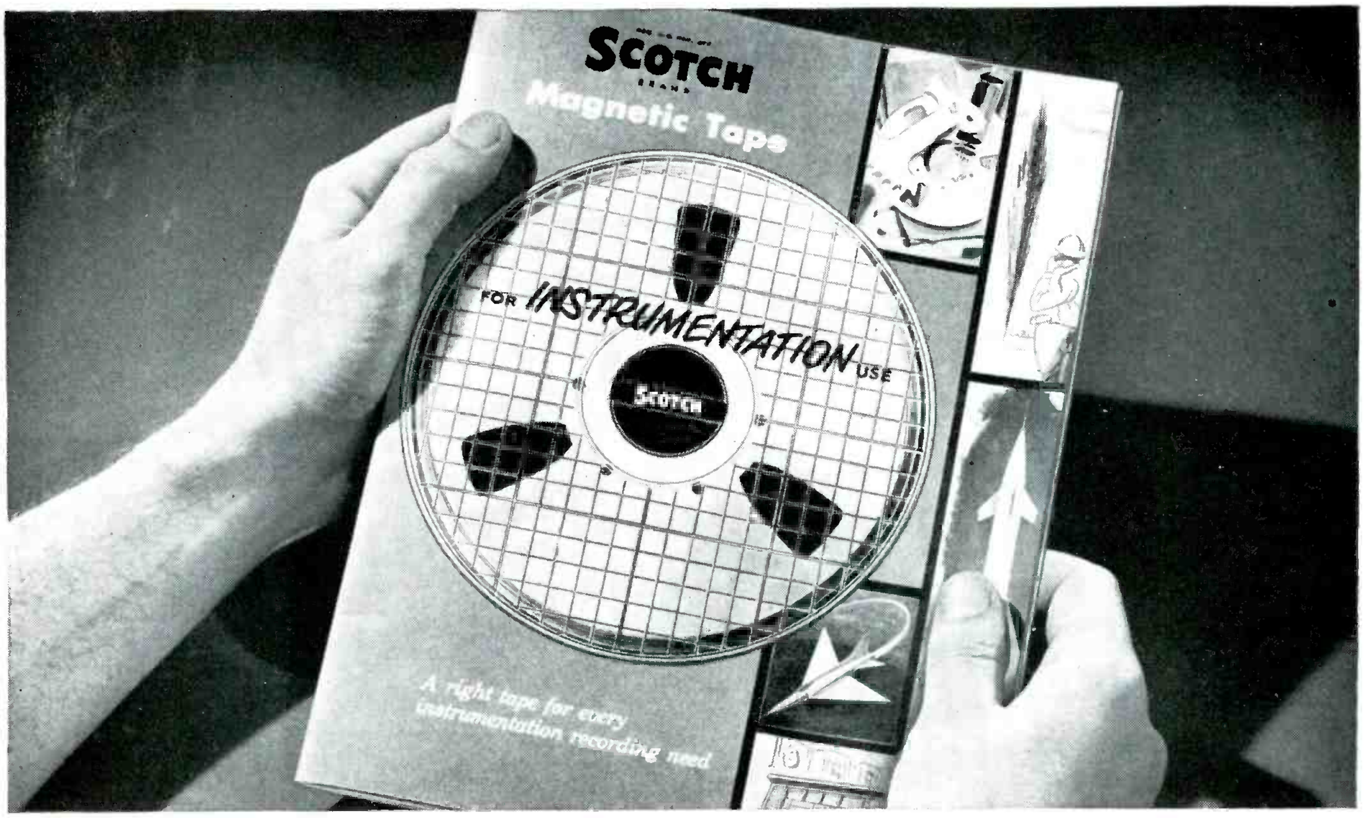
Crucible has been a leading producer of these quality magnets ever since Alnico alloys were first developed. You can get them sand cast, shell molded, or investment cast to meet every size, tolerance, shape and finish need.

Next time you need top quality magnets, or help with magnet applications, call Crucible. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 30, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

FREE



FREE BOOKLET answers your basic questions about instrumentation tape!

Get all the latest information about America's most dependable, most complete line of instrumentation tapes! Error-free tapes! Minnesota Mining and Manufacturing Company wants to mail you its new, illustrated instrumentation tape brochure. In this reference book you'll find technical specs and analyses on tapes for industry and defense . . . answers to questions, suggestions on instrumentation applications. Mail the coupon for your free copy now.

- **How to solve rub-off problems**
- **What tape to use for high, medium, low speeds, pressures and temperatures**
- **What tape to use for long or short wave length recording**

FILL OUT AND MAIL

Minnesota Mining & Mfg. Co.
Dept. PL-77, St. Paul 6, Minnesota
Send me the 3M Instrumentation booklet at once.

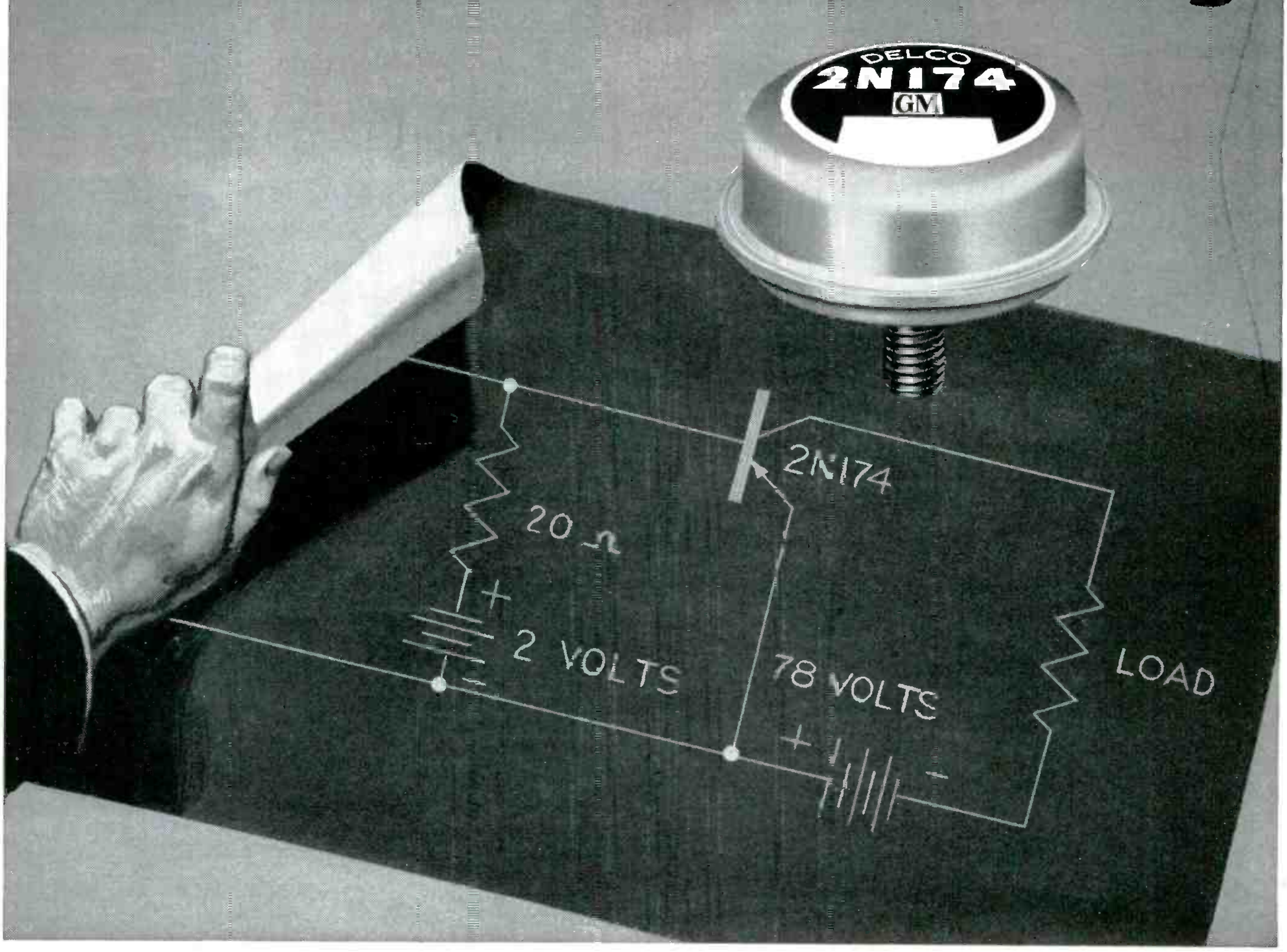
NAME______________________
POSITION______________________
COMPANY______________________
ADDRESS______________________
CITY______________ZONE___STATE__________

REG. U.S. PAT. OFF.
SCOTCH BRAND Magnetic Tapes

INSTRUMENTATION DIVISION

Want more information? Use post card on last page.

1 KW Transistor Switching



Industry's Highest Power Transistor

Eliminate arcing at switch points. Stop switch deterioration while increasing the efficiency and reliability of all electronic control equipment!

A single Delco 2N174 transistor can switch 1 kw with one watt of control power.

Because transistor switching eliminates arcing, switch life is longer and more reliable.

This switching performance is possible because of the excellent electrical characteristics of the 2N174; in particular, the high collector breakdown voltage, extremely high maximum collector current, and very low input impedance.

You may employ Delco 2N174 high-power transistors with confidence in their reliability and uniformity. These transistors, normalized to retain better performance characteristics regardless of age, are currently being produced by the thousands every day. Write for engineering data.

Power Switching Characteristics	
Switching Power	1000 watts
Current in "on" position	13 amperes
Input Control Power	1 watt
Power Gain	30 db
Dissipation in "on" position	8 watts
Switching time	60 microseconds

DELCO RADIO — DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

FORMULA for LONG LIFE

$I = \frac{E}{\sqrt{R^2 + (\omega L - \ldots}}$

THE KEY COMPONENT

$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$

$f = \frac{1}{2\pi\sqrt{LC}}$

7/16 Thick — 1-7/8 Long
29/32 Ht.

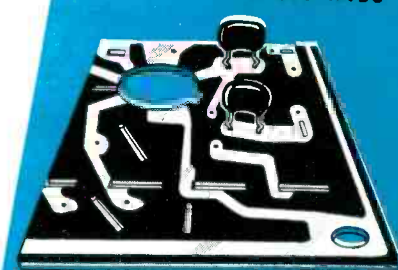
ACTUAL SIZE

DM 42
Up to 65,000 mmf
at 300 WVDC
Up to 40,000 mmf
at 500 WVDC

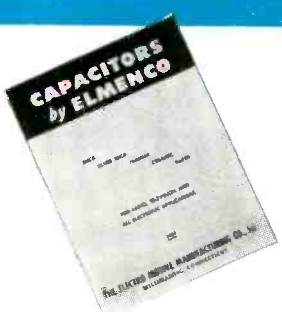
El-Menco *Dur-Mica* CAPACITORS

Rugged Endurance up to 18 years!

A series of the toughest trials prove El-Menco Dur-Mica DM15, DM20 and DM30 capacitors outlast all others under accelerated conditions of 1½ times rated voltage at ambient temperature of 125° centigrade. Can be used at higher operating temperatures with slight voltage derating. Longer life and greater stability made possible by specially treated phenolic casing.



El-Menco Dur-Mica Capacitors meet all humidity, temperature and electronic requirements, including military specifications.



Write for FREE samples and catalog on your firm's letterhead.

El-Menco Dur-Mica DM15, DM20, DM30, DM40 and DM42 Capacitors Provide:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY — SILVERED MICA
5. PEAK PERFORMANCE

Take Your Own Word For It by making your own test of El-Menco Capacitors. Write for Free Samples and Catalog.

WITH NEW CRIMPED LEADS.

DM20

ACTUAL SIZE

DM 15

Improved parallel leads for greater rigidity and faster assembly. These parallel leads simplify use on miniature printed circuit boards in television, guided missiles, hearing aids, electronic brains, air conditioning and other government and civilian applications.

El-Menco *Capacitors*

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors

WILLIMANTIC CONNECTICUT

• molded mica • mica trimmer • tubular paper • ceramic • silvered mica films.

Arco Electronics, Inc., 64 White St., New York 13, N. Y.
Exclusive Supplier To Jobbers and Distributors in the U.S. and Canada

Want more information? Use post card on last page.

Want more information? Use post card on last page.

Want more information? Use post card on last page.

APPROVED RADIO INTERFERENCE FIELD INTENSITY MEASURING EQUIPMENT

STODDART designed and manufactured to Military Equipment Specifications to meet the requirements of Military Measurement Specifications.

APPROVAL DATA

STODDART & MILITARY TYPE	FREQUENCY	MIL-I-16910 (Ships)	MIL-I-6181	S.A.E.	A.S.A.	C.I.S.P.R.
NM-40A (AN/URM-41)	30cps-15Kc	CLASS '1'	Not Req'd	Not Req'd	Not Req'd	Not Req'd
NM-10A (AN/URM-6B)	14Kc-250Kc	CLASS '1'	Not Req'd	Not Req'd	C63.2 (Proposed)	Not Req'd
NM-20B (AN/PRM-1A)	150Kc-25Mc	CLASS '1'	CLASS '1' *CATEGORY 'A'	Not Req'd	C63.2 (Proposed)	**
NM-30A (AN/URM-47)	20Mc-400Mc	CLASS '1'	CLASS '1' *CATEGORY 'A'	APPROVED	C63.3 (Proposed)	**
NM-50A (AN/URM-17)	375Mc-1000Mc	CLASS '1'	CLASS '1' *CATEGORY 'A'	Not Req'd	C63.3 (Proposed)	Not Req'd

**MIL-I-6181C (Proposed)*
***Can be supplied to C.I.S.P.R. Recommendations*
S.A.E. (Society of Automotive Engineers)
A.S.A. (American Standards Association)
C.I.S.P.R. (Comite International Special des Perturbations Radioelectriques) (International Special Committee on Radio Interference)

STODDART'S 5 self-contained Radio Interference Measuring Equipments, each designed for its specific frequency range, provide:
5 instruments, which can be used by—
5 engineers, to measure over—
5 different frequency ranges, at—
5 different locations, at—
1 time.

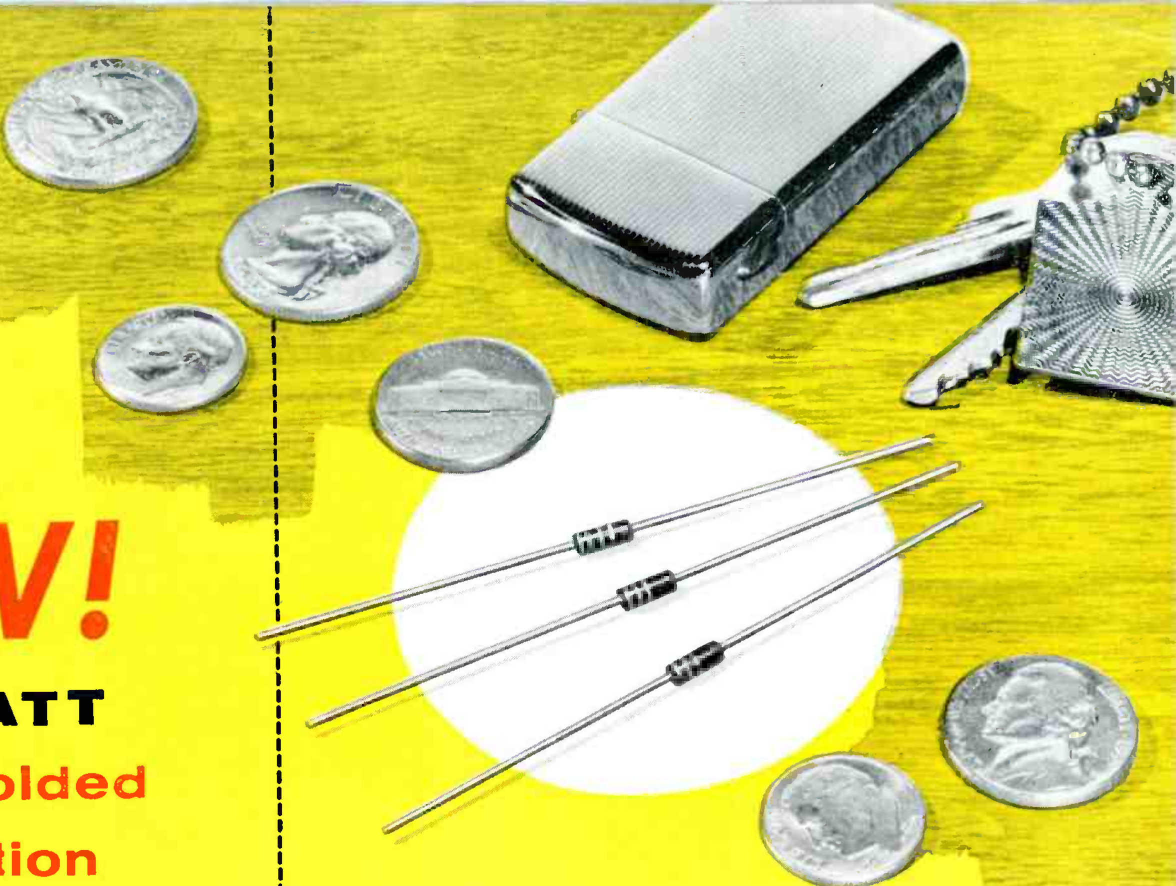
FEATURES:

- Each equipment performs Quasi-Peak, Peak, and Average (Field Intensity) measurement functions.
- Approved for use by all Departments of the U. S. Department of Defense.
- Commercial and military equipments are identical.
- Precision laboratory equipment with rugged all-weather design for field use.
- **Immediate delivery from stock.**

—Serving 33 countries in radio interference control—

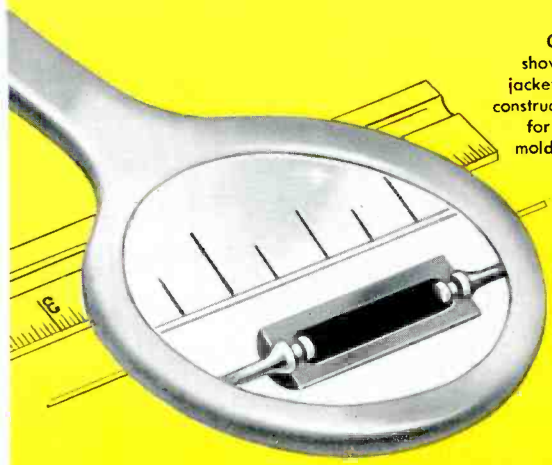
STODDART
AIRCRAFT RADIO CO., INC.

6644 Santa Monica Blvd., Hollywood 38, California HOllywood 4-9294



NEW!

1/4-WATT hot-molded composition resistor only 1/4" long!



Cross section shows insulating jacket—the same construction as used for all A-B hot-molded resistors.

Here's a new ¼-watt, solid *insulated* composition resistor in a truly *small* size . . . ONLY ONE QUARTER OF AN INCH LONG . . . that provides the same superlative performance, reliability, and uniformity which have made the Allen-Bradley hot-molded resistor preferred the world over.

Although exceptionally small, Allen-Bradley Type CB hot-molded resistors are rated for "continuous operation" at 70°C ambient temperatures. The hot-molded construction of this Type CB resistor makes impregnation unnecessary . . . it also provides the most reliable protection against extended periods of high humidity, as encountered in practical applications. Available in all RETMA resistance values from 10 ohms to 22 megohms. Tolerances: 5%, 10%, and 20%.

Where space is at a premium . . . and where failures would be disastrous . . . you owe it to yourself to investigate this new addition to the Allen-Bradley *quality* line. Please write today for complete specifications. Samples available for your tests.

Allen-Bradley Co.
222 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

A-B QUALITY

OTHER HOT-MOLDED RESISTORS IN THE A-B FAMILY

Allen-Bradley fixed, molded resistors rated at 70°C ambient are available in standard RETMA values from 2.7 ohms to 22 megohms in ½ and 1-watt sizes . . . and from 10 ohms in the 2-watt size. In 5%, 10%, and 20% tolerances.

Allen-Bradley solid-molded resistors are packaged for either automatic or manual assembly. A-B carton packaging prevents bent or tangled leads. Pressure sensitive tape used to hold resistors in place on reels—for most economical assembly.

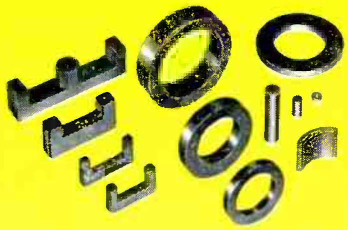
ALLEN-BRADLEY

HOT-MOLDED COMPOSITION RESISTORS

QUALITY

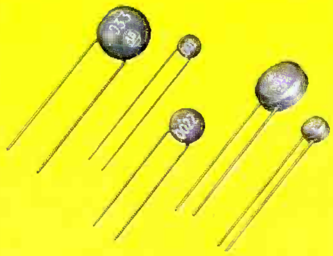
4-57-E

FERRITES



FERRITE CORES—In various shapes and sizes, including new lightweight flared yokes, for black and white, and color TV. Also U, L, and O cores for color convergence and shielding; U and E cores for fly-backs and QR cores for deflection yokes and many others.

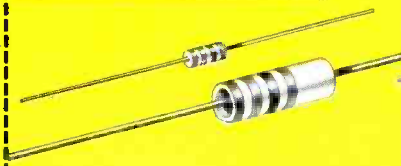
CAPACITORS



CERAMIC CAPACITORS—In nominal capacitance values from 10 mmf to .02 mf Also available in stable, MIL, and TC types. A-B ceramic encased capacitors operate at full ratings in temperatures up to 150°C ambient.

FEED-THRU & STAND-OFF CAPACITORS—In standard nominal values from 4.7 to 1000 mmf. No parallel resonance effects up to 1000 mcs, as normally encountered with tubular types. Rugged construction, with solder tabs or screw thread mountings.

SEALED RESISTORS



HERMETICALLY SEALED RESISTORS—Hot-molded composition resistors sealed in ceramic tubes for protection against humidity and moisture. Type ES rated 1 watt; Type TS rated 1/8 watt. No-load operating temperatures: ES, 165°C; TS, 110°C.

COPPER-CLAD RESISTORS

TYPE GM & TYPE HM—For mounting on metal panel. Type GM—3 watts at 70°C, 4 watts at 40°C; Type HM—4 watts at 70°C, 5 watts at 40°C.

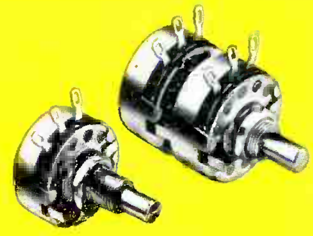
ALLEN-BRADLEY ELECTRONIC COMPONENTS

"tops" in reliability

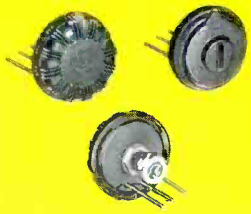
Throughout this *quality* line, conservative ratings and stable characteristics assure you unequaled reliability. It is *the* reason Allen-Bradley components are most frequently specified for critical military and industrial applications. Write direct, or call your nearest Allen-Bradley office for complete technical data.

You can't go wrong when you write "Allen-Bradley" into your specifications!

HOT-MOLDED VARIABLE RESISTORS



TYPE J & TYPE K—Type J rated 2 watts 70°C. Type K rated 2 watts at 100°C, 3 watts 70°C—derates to zero at 150°C. Total resistance values from 50 ohms to 5 megohms. Taps can be provided. Single, dual, and triple units, with various types of shafts, and with built-in line switch.



TYPE T—Rated 1/2 watt at 70°C. Total resistance values from 100 ohms to 5 megohms. Standard tapers. Molded plastic cover also serves as actuator. This makes unit extremely flat and compact. Screw-driver slot or knurled surface. Operating life in excess of 50,000 cycles.

TYPE H—Industrial potentiometer. Rated 5 watts at 40°C. Total resistance values from 50 ohms to 2 megohms. Operating life in excess of 100,000 cycles with less than 10% resistance change. Less than 5% change after 100 hrs. at 40°C and 98% humidity. Max. voltage 750 v, d-c.

TYPE F—Rated 1/4 watt at 70°C. Diameter 1/2", length approx. 1/2". Total resistance values from 100 ohms to 5 megohms. Standard tapers. Made for screwdriver adjustment. Terminals and grounding lug, also used for mounting, spaced for 0.1" printed circuit layout. Non-magnetic.

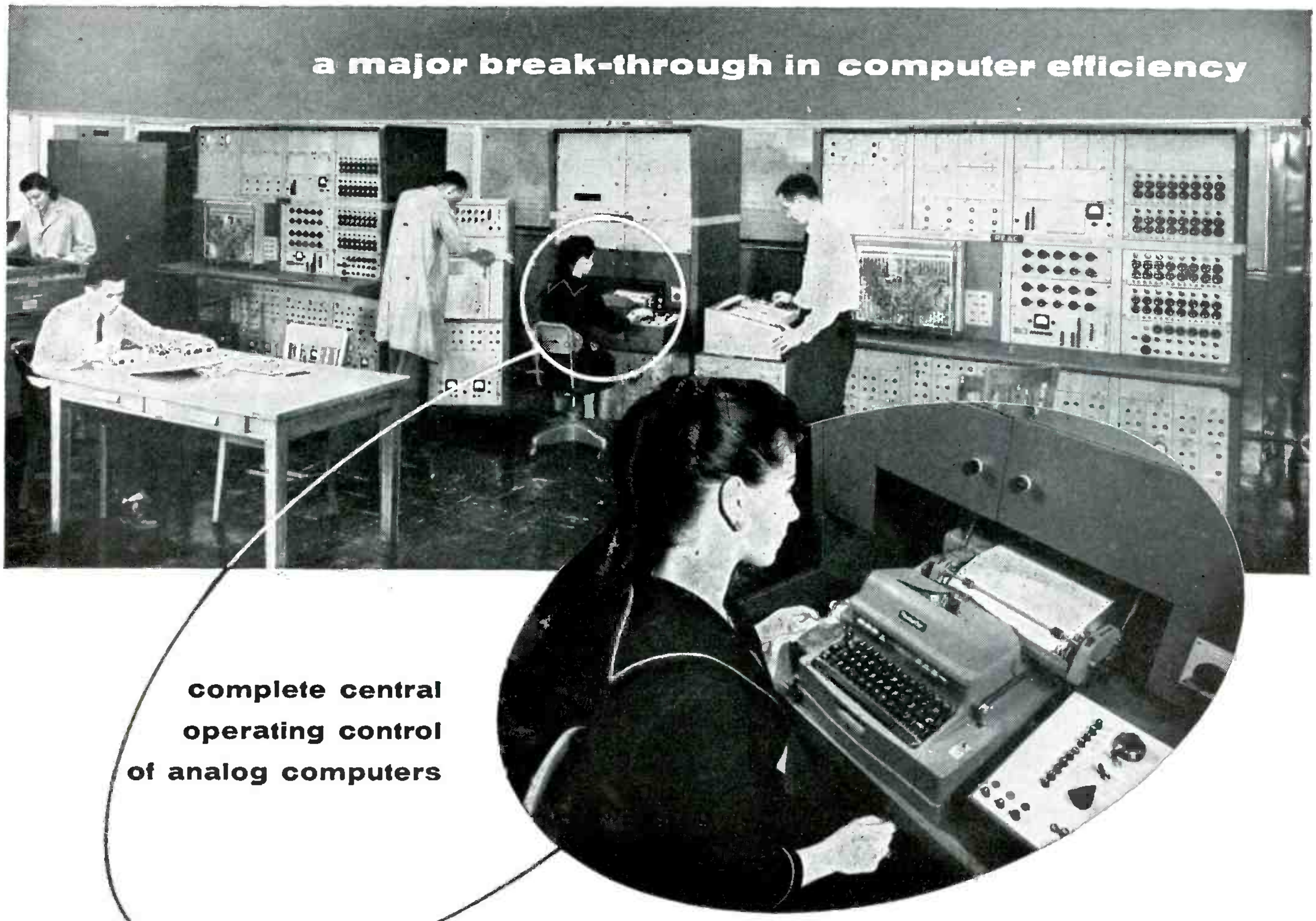
TYPE G—Rated 1/2 watt at 70°C. Diameter 1/2". Total resistance values from 100 ohms to 5 megohms, in standard tapers. Made with lock type or plain bushings; with plain, flatted, or slotted shafts up to 2 1/2" long. All metal parts nonmagnetic. Available with built-in line switch.

Allen-Bradley Co.
222 W. Greenfield Ave.
Milwaukee 4, Wis.
In Canada:
Allen-Bradley Canada Ltd.
Galt, Ont.

A-B QUALITY

ALLEN-BRADLEY
RADIO, ELECTRONIC, AND TELEVISION COMPONENTS
QUALITY

4-57-E



complete central operating control of analog computers

with the new REAC®

AUTO-CONTROL SYSTEM

Here in brief are the capabilities of this new auto-control system.

From typed command or punched tape

Set any scale factor or problem check pot under load. • Read out setting of any scale factor or problem check pot under load. • Read actual voltage of any pot under load. • Measure voltage at any amplifier or selected point in computer. • Put computer into any operating mode.

Auto-cycle automatically reads out

All amplifiers. • All integrators. • All scale factor pots onto tape or hard copy. • All problem check pots onto tape or hard copy. • All amplifiers *and* all pots, as above. • Auto-set all pots to zero . . . and, in addition, the system permits automatic programming of computer operation.

Increases time computer is available for actual running of problems.

Not a press agent's dream, nor an artist's conception, but an actual working system, this new REAC Auto-Control System is showing the way to new levels of analog computer efficiency. Used in conjunction with the REAC Problem Check, Time Scale Check and Voltage Scale Check Systems, it allows a problem to be inserted and checked out in a fraction of the normal time. Problems can be taken off and reinserted fast enough so that trouble-shooting of computer problems, re-scaling of time and voltage parameters, and preliminary evaluation of results can be done while the machine is busy on another problem. Multi-shift operation becomes really practical, too.

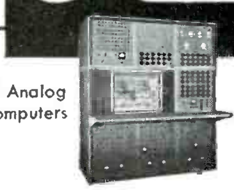
The REAC Auto-Control System adds a completely new dimension to the analog computer technique. Write for complete details on what it can mean to you.

Reeves INSTRUMENT CORPORATION

REEVES INSTRUMENT CORPORATION

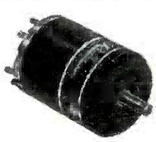
A Subsidiary of Dynamics Corporation of America, 201 East 91st St., New York 28, New York

6RV57



REAC Analog Computers

Precision Floated Gyros



Precision Resolvers and Phase Shifters

Servo Mechanical Parts

Want more information? Use post card on last page.

What Research Means to American Business

American industry plans to invest $150 billion in new plant and equipment during the next four years—more than in the five years 1952-1956. It plans to carry out this record investment even though manufacturing capacity has nearly doubled since World War II. These facts are reported in McGraw-Hill's tenth annual survey of Business' Plans for New Plants and Equipment. They contradict many long-established theories about investment in capital goods.

According to the textbooks, a high and rising level of capital investment is generally followed by a decline. The bigger the rise—so the old theory goes—the bigger the decline will be. But, after a decade of high-level investment and an especially strong rise in the past two years, industry now has plans to keep right on with near-record outlays for plant and equipment. Does this mean some new factor has been added, to change the investment cycle?

The New Factor—Research

The latest McGraw-Hill survey points out one new factor which, more than any other, is changing the nature of the investment process. This is the record outlay planned by U.S. corporations for **scientific research and development**—to create new products and develop new industrial processes. The rapid growth of research in industry, and plans for even more remarkable growth in the years ahead, are shown by the accompanying table.

This year industry plans to spend $7 billion on research and development — up 20% from 1956. By 1960 it will spend $9 billion — enough to create a major new industry.

By 1960 manufacturing industry expects sales to be up 26% — with half the increase in products that were not made in 1956.

Growth of Research and Development Expenditures
(Millions of Dollars)

	1955	1956	PLANNED 1957	PLANNED 1960
Machinery	408	506	577	704
Electrical Equipment	950	1,149	1,310	1,637
Aircraft and Parts	1,038	1,558	2,274	3,161
Fabricated Metal Products and Ordnance	134	165	174	210
Professional and Scientific Instruments	185	252	300	453
Chemicals	440	498	528	617
Paper, Rubber, Stone, Clay and Glass Products	149	174	196	233
Petroleum Products	171	205	225	277
Other Manufacturing	1,038	1,279	1,388	1,557
Non-manufacturing industries	254	310	347	419
ALL INDUSTRIES	4,767	6,096	7,319	9,269

What Research Is Doing

Here are some examples of how industrial research is opening up new markets, or compelling the modernization of old facilities:

New automatic controls in petroleum refining will raise the quality of gasoline and reduce the time required for production. A new process for recovering oil from depleted wells promises to multiply our potential reserves.

A new process for treating iron ore will permit the ore to be fed directly into steel furnaces—without the need for blast furnaces or coke ovens.

New turbine engines—made possible by the development of heat-resistant alloys for turbine parts—offer greatly increased power for aircraft, ships and automobiles.

Altogether, industry plans to introduce more new products in 1957-1960 than in any previous four-year period. It also plans new processes on a scale that will make much of our present capacity obsolete. These new products and new processes are the secret behind continuing plans for high investment.

One-third of all manufacturing firms are building new plants this year to produce new products, and by 1960 this may account for 10% to 20% of all capital expenditures. At the same time, manufacturing companies report that over half their capital expenditures in the next four years will be for modernization of equipment and introduction of new processes. Thus the preponderant share of new investment will be based on developments growing out of research.

A New Kind of Prosperity

The keen interest of U.S. business firms in scientific research points the way to a new kind of prosperity for our economy—a prosperity based on deliberate creativeness. As long as we can create new products that will offer better value to consumers or cut costs to manufacturing firms, business will continue at a high level—not at fever pitch, perhaps, and it is to be hoped not at an inflationary pitch. But based on a steady stream of new products and processes, we can have a high level of general prosperity that defies the old laws of boom and bust.

It's Not Automatic

Of course, there is no guarantee. New products do not spring up by magic as the medieval alchemists hoped they would. They are found as the result of long and expensive effort in laboratories and pilot plants. This effort requires an increasing number of trained scientists and engineers. In 1957 alone, manufacturing companies report they will need 7% more of these highly trained people in research and development. And by 1960, they will need an additional 15% to carry out planned research programs.

The effort to maintain prosperity — as well as the national defense effort — will depend increasingly on this supply of scientific and technical personnel. But if we can supply the people, industry now has the plans for a research effort that will put an end to the spectre of idle plants and idle workers.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C McGraw
PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

Here, in Admiral's Nucleonics Laboratory, radiation tests are conducted with a cobalt 60 source rated at 20,000 curies. The observer is shielded by 41 inch walls of magnetite ore within steel shells, and a 42 inch lead glass window.

Admiral® research

foretells the future of components traveling in outer space

What kind of power will drive man's first vehicle through outer space? It may be an ion propulsion device powered by a nuclear reactor. Ionic drive is now under investigation for the Air Research and Development Command. Investigators recognize the need to shield the human cargo against radiation if a nuclear power source is carried aboard. They also know that efficient design will not permit shielding the space ship's complex electronic equipment.

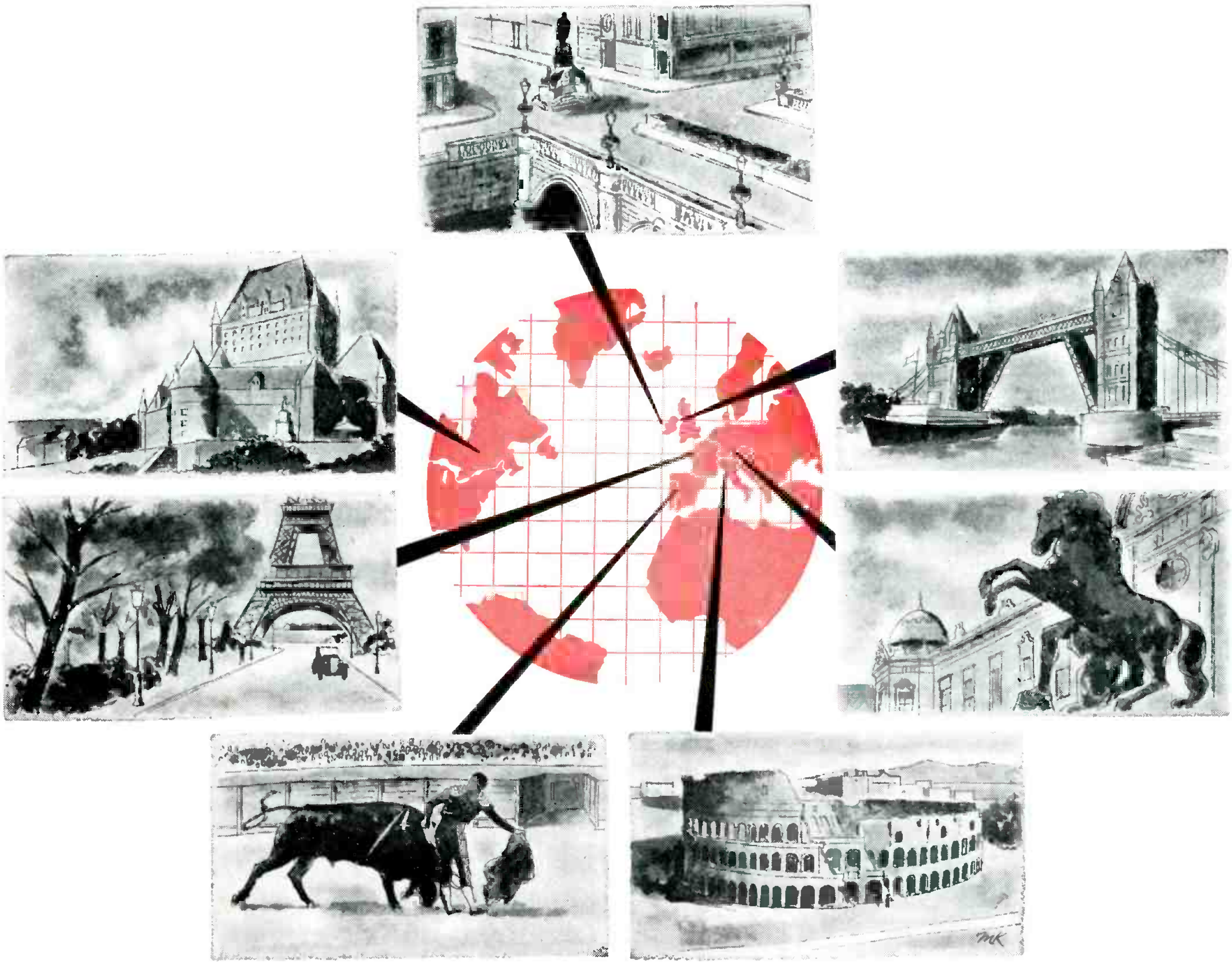
Then how will electronic components behave when exposed to nuclear radiation? The facts are being established by a continuing study now in progress at Admiral for the U.S. Air Force. This study provides advance knowledge to engineers charged with designing the space ship's electronic complement.

Admiral has equipped a special Nucleonics Laboratory which includes one of the world's largest cobalt 60 sources of gamma radiation. New instrumentation and techniques have been developed for measuring radiation environments. The project furthers Admiral's leadership in the field of fundamental and applied nuclear research. Detailed information is available to authorized persons.

LOOK TO *Admiral* FOR RESEARCH • DEVELOPMENT • PRODUCTION IN THE FIELDS OF: MILITARY TELEVISION COMMUNICATIONS UHF AND VHF • RADAR RADAR BEACONS AND IFF • RADIAC TELEMETERING • DISTANCE MEASURING MISSILE GUIDANCE • CODERS AND DECODERS CONSTANT DELAY LINES • TEST EQUIPMENT ELECTRONIC COUNTER MEASURES

ENGINEERS: The wide scope of work in progress at Admiral creates challenging opportunities in the field of your choice. Write Director of Engineering and Research, Admiral Corporation, Chicago 47, Illinois.

Admiral CORPORATION • GOVERNMENT LABORATORIES DIVISION • CHICAGO 47



Want more information? Use post card on last page.

F.M. DEVIATION
Directly Measured

with this time-saving and accurate MARCONI instrument

If you haven't a deviation meter you can use the Bessel Zero or "Disappearing Carrier" method of measurement; this, however, required complex monitoring equipment, an accurately-known modulation frequency, and, finally, mathematical interpretation of results.

With the compact and easy-to-use Marconi Deviation Meter, the modulation frequency need not be known and deviation is directly read on a meter scale.

F.M. DEVIATION METER
TYPE TF 934/2

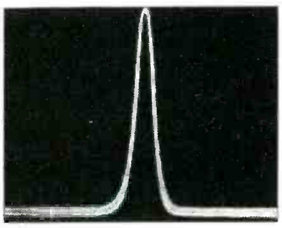
Carrier Frequency Range:
2.5 to 500 Mc.

R. F. Input Level:
55 mv to 10 v.

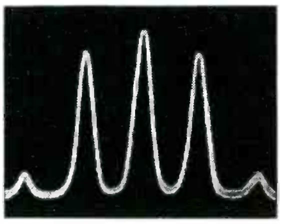
Deviation Measurement Ranges:
5, 25, and 75 kc full-scale.

Accuracy of Deviation Measurement:
±3% from full-scale to half-scale up to 12 kc and ±6% up to 15 kc.

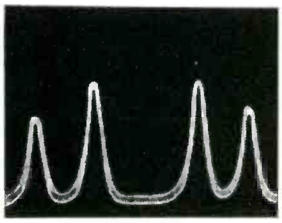
BESSEL ZERO METHOD



Unmodulated Carrier



Modulation Index 1.3



Modulation Index 2.4
The Carrier "Disappears"

MARCONI INSTRUMENTS

VACUUM TUBE VOLTMETERS · FREQUENCY STANDARDS · OUTPUT METERS · F.M. & A.M. SIGNAL GENERATORS
DEVIATION METERS · WAVEMETERS · WAVE ANALYSERS · Q METERS · BEAT FREQUENCY OSCILLATORS

Full data and prices will be mailed immediately on request.

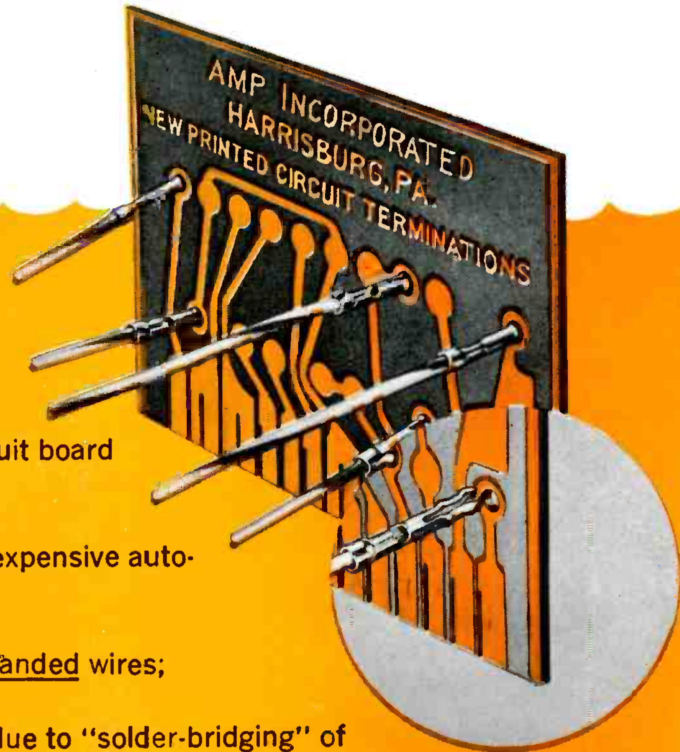
44 NEW STREET · NEW YORK 4

CANADA: CANADIAN MARCONI COMPANY, 6035 COTE DE LIESSE, MONTREAL 9.
ENGLAND: Head Office: MARCONI INSTRUMENTS LTD., ST. ALBANS, HERTS.

TC 40

WELL I'LL BE DIPPED...better

...because the NEW A-MP SNAPIN



- Gets leads to the printed circuit board in one assembly operation;
- Eliminates an investment in expensive automation equipment;
- Can be applied to solid or stranded wires;
- Eliminates danger of shorts due to "solder-bridging" of insecure leads;
- Has construction details that promote good capillary flow of solder during the dipping process;
- Is self-retaining, with no damage to the printed circuit board during pre-assembly operations;
- Is self-aligning—no further positioning or deformation is required.

Write today for additional information on the NEW A-MP SNAPIN, *the* AMP-EDGE *Connector and other A-MP products designed for printed circuit applications.*

AMP INCORPORATED

GENERAL OFFICE:
3312 **Eisenhower Boulevard, Harrisburg, Pennsylvania**

A-MP

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada • Aircraft-Marine Products (Great Britain) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP—Holland N.V. 's-Hertogenbosch, Holland

Distributor in Japan: Oriental Terminal Products Co., Ltd., Tokyo, Japan

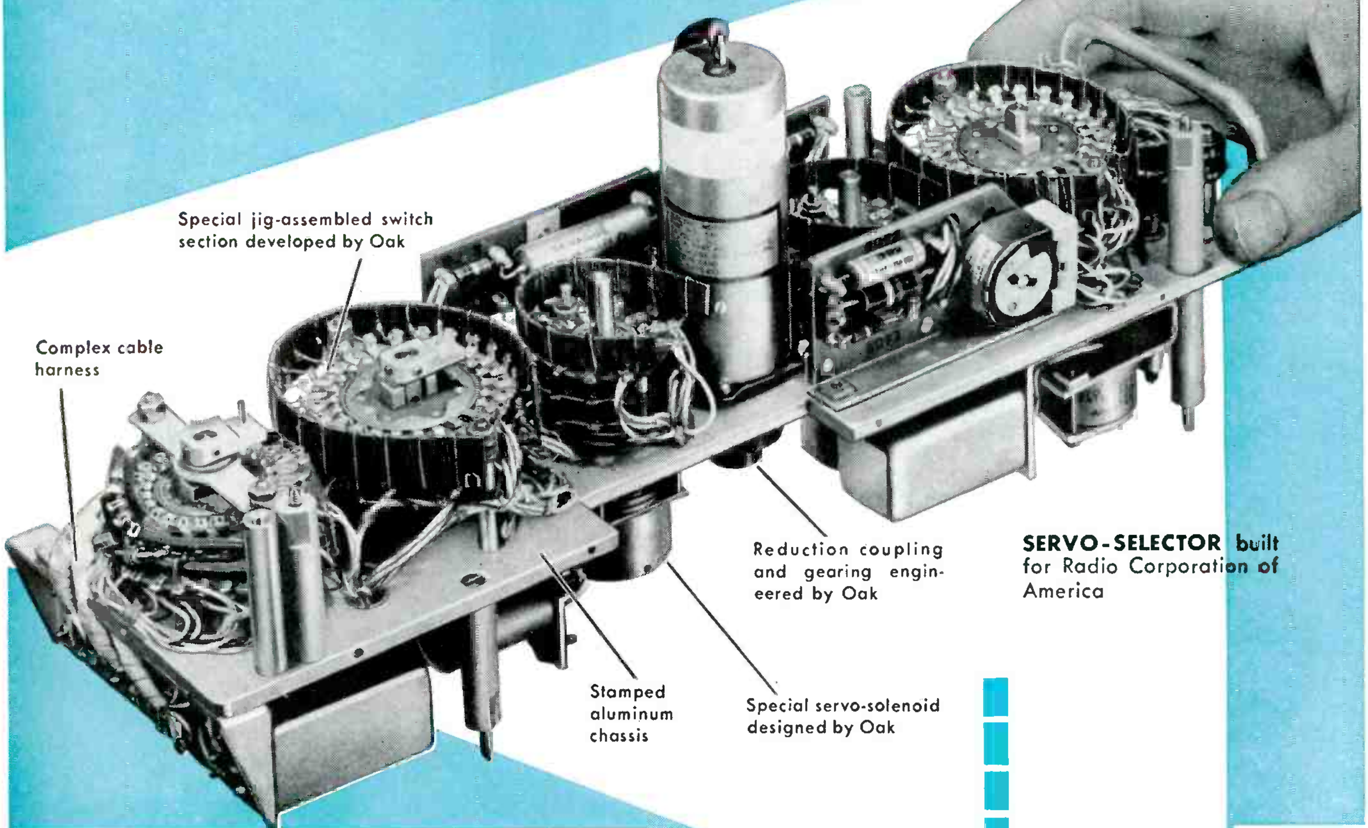
Want more information? Use post card on last page.


Expanded line of stock Sola transformers regulate filament loads up to 25 amperes
Sola Constant Voltage Filament Transformers are now available *from stock* in six different output ratings from 2.4 to 25 amperes. Now, even sizable banks of electron tubes may be supplied from one compact source of ±1% regulated filament voltage.
Because of the current-limiting characteristics of Sola transformer design, cold filament inrush current is restricted to a safe level at loadings within 75-100% of the transformer's full-load current rating.
The static-magnetic Sola filament transformer, furnished with separate capacitors, is designed for simple mounting as a component of manufacturers' products. The dependable tube performance and longer filament life these units offer is available at only a moderate increase in cost over conventional filament transformers.
For further information and specifications, contact your Sola representative, or write for Circular CVF-269.
SOLA Constant Voltage TRANSFORMERS
SOLA ELECTRIC CO.
4633 W. 16th Street
Chicago 50, Illinois

Want more information? Use post card on last page.

Want more information? Use post card on last page.

OAK can engineer and manufacture your special SUBASSEMBLIES



SERVO-SELECTOR built for Radio Corporation of America

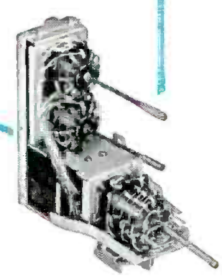
one responsibility *for the design and production of your electromechanical requirements . . .*

In the servo-selector, shown above, Oak engineers solved three different design problems. They developed (1) an ingenious jig-assembly for fastening the clips to the switch sections, giving exceptional accuracy in placement and retention; (2) lower speed operation through special reduction coupling and gears; and (3) special solenoids for positive clutching.

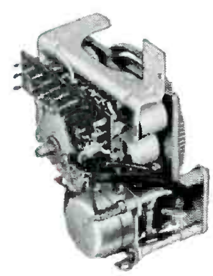
Oak then produced the assembly . . . stamping the aluminum chassis . . . manufacturing screw machine parts . . . making the complicated cable harnesses, switches, and solenoids . . . assembling all parts . . . then running vibration, cold (-55°C), humidity, and life tests.

Why not contact Oak engineers about your own requirements? But, do it *early* in the design stage . . . take full advantage of Oak's 25 years of experience in solving electromechanical problems.

Phone or Write Our Mr. Howard Olson, Today, on *Any Aspect* of Your Subassembly Projects



CHANNEL SELECTOR switch built for Sylvania Electric Products Inc.

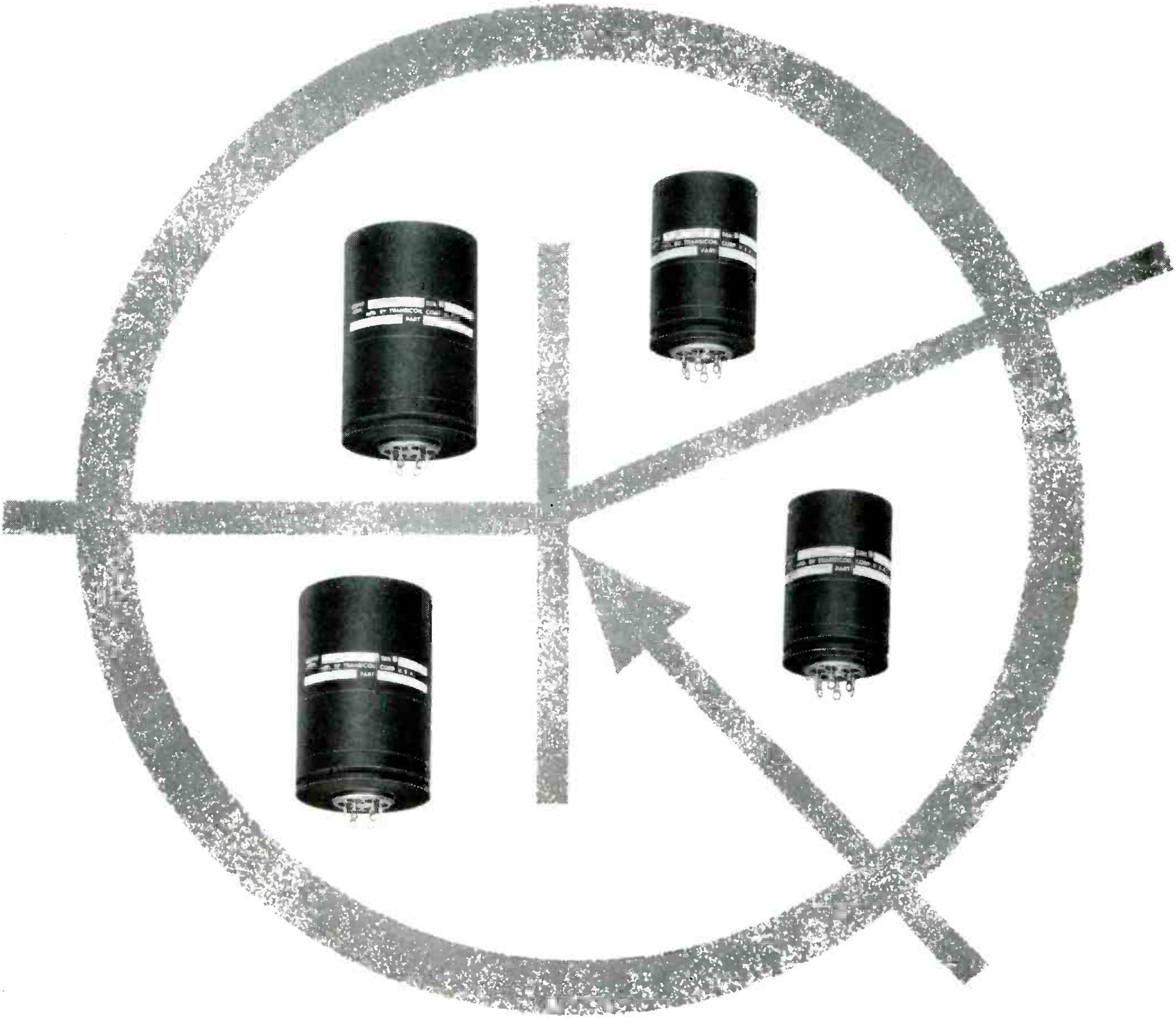


CAPACITOR SWITCH built for Radio Corporation of America

OAK MFG. CO.

1260 Clybourn Ave., Dept. G, Chicago 10, Illinois
Phone: MOhawk 4-2222

SWITCHES • ROTARY SOLENOIDS • CHOPPERS • SPECIAL ASSEMBLIES • VIBRATORS • TUNERS



For greater miniaturization, higher performance . . .

new TRANSISTORIZED servo amplifiers

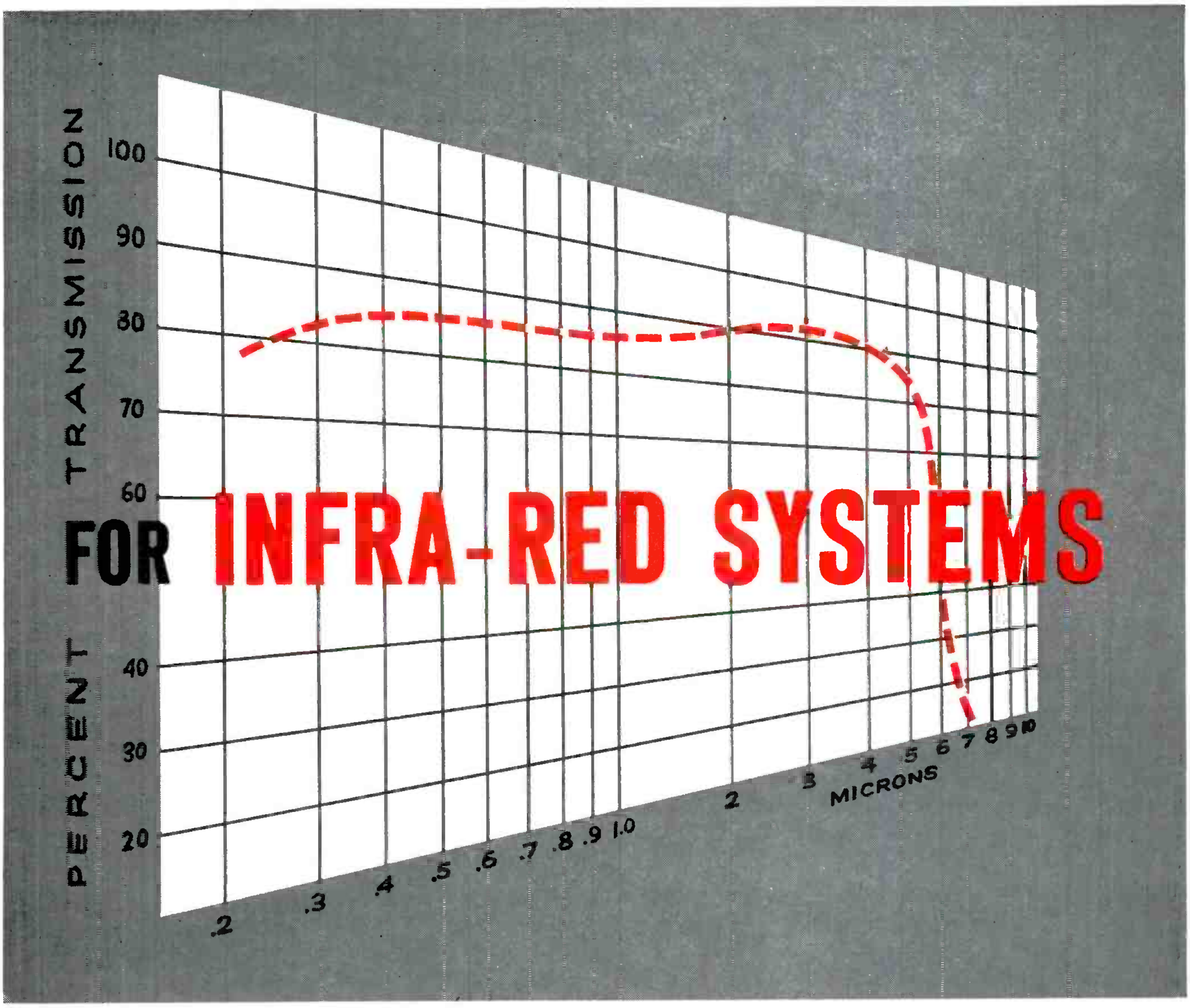
Transicoil introduces four new, completely transistorized Servo Amplifiers for use in applications requiring the highest order of precision, miniaturization, and dependability. Measuring a mere 3″ or less in length, these servo amplifiers help you keep assemblies within the severe space limitations of many types of military and industrial applications.

The new amplifiers produce voltage gains of 100:1, 200:1, 2000:1, and 4000:1. They are specifically engineered for use with Transicoil Motors and Motor Driven Induction Generators in sizes 8, 9, 11, 15, and 18. To insure maximum accuracy and dependability, Transicoil supplies these servo amplifiers only as part of its own miniaturized servo assemblies. All amplifier units are hermetically sealed and are made with the same care, materials, and precision that have made Transicoil a recognized leader in the manufacture of custom built servo components and assemblies.

For more complete information on Transicoil's new Transistorized Servo Amplifiers, write for Bulletin 101. And when you have control problems involving miniaturization or control complexity, be sure to get in touch with Transicoil. You profit most when you let Transicoil design and supply your complete servo package. You will be under no obligation—you pay only for results, on a fixed fee basis, for equipment delivered and operating properly.

TRANSICOIL CORPORATION

Worcester • Montgomery County • Pennsylvania



SPECIFY LINDE Sapphire

TRADE-MARK

LINDE Sapphire is . . .

Hard—Moh 9

Transparent, single crystal, pure aluminum oxide

Nonporous—0% porosity

Easily sealed to metals and ceramics

Priced competitively with sintered materials

LINDE Sapphire has . . .

Strength at elevated temperatures

High melting point—2040° C.

Excellent IR transmission at high temperatures (above 500° C.)

LINDE Sapphire is available as . . .

Windows

Domes

Rods and tubes

Special shapes—to order

For more information about LINDE Sapphire . . . Write "Crystals Dept. BD-7," LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited

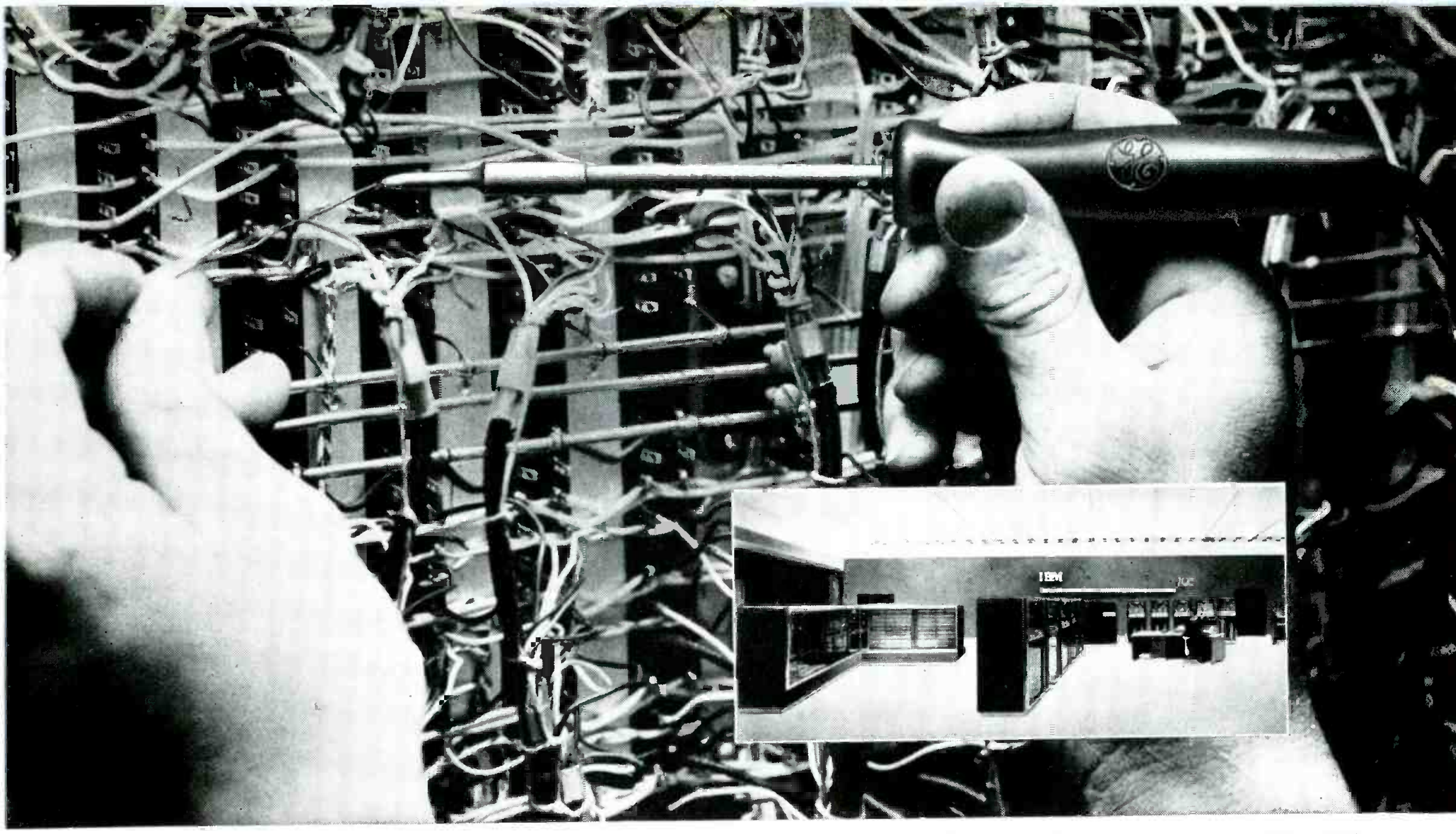
Linde

UNION CARBIDE

ENGINEERS AND SCIENTISTS interested in working in Synthetic Crystal Sales & Development, contact Mr. A. K. Seemann, Linde Company, 30 E. 42nd St., New York 17, N.Y.

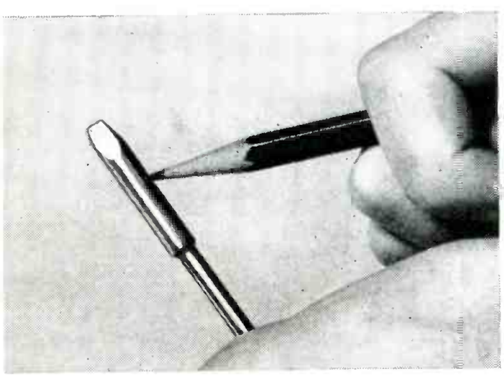
The terms "Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Want more information? Use post card on last page.

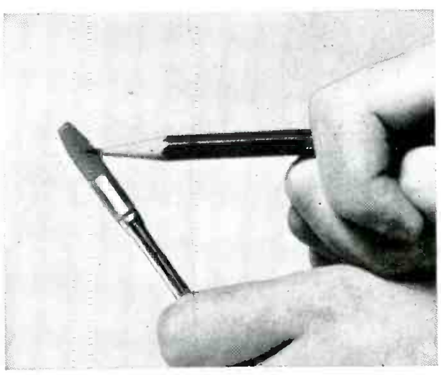


NEARLY 500 G-E MIDGET SOLDERING IRONS are helping to speed assembly of IBM's giant 704 and 705 "electronic brains" by providing fast, efficient heat to thousands of intricate joints. Each complex data processing machine demands perfectly soldered joints to assure dependable operation. IBM found that the G-E Midget irons provide excellent heat recovery, even with repetitive soldering. Result: uniform temperature with minimum loss of heat from joint to joint. Heat can be varied by simply setting transformer taps. In addition, the G-E Midget is multi-purpose, since tips are interchangeable. Its maneuverable, light-weight design speeds soldering, even in almost inaccessible areas, with reduced risk of damage to adjacent parts.

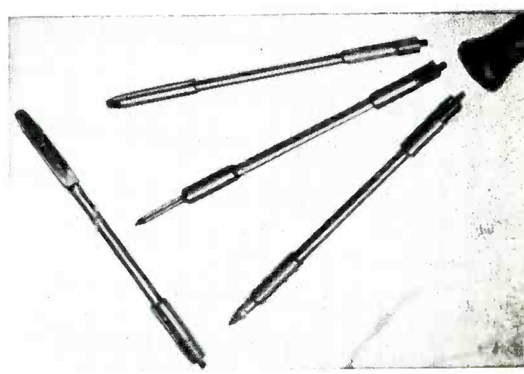
500 General Electric midget irons speed assembly of giant IBM "Electronic Brains"



IRONCLAD tip needs no filing. And by actual production-line test, a General Electric Midget soldering iron tip lasts up to ten times longer than an ordinary tip.



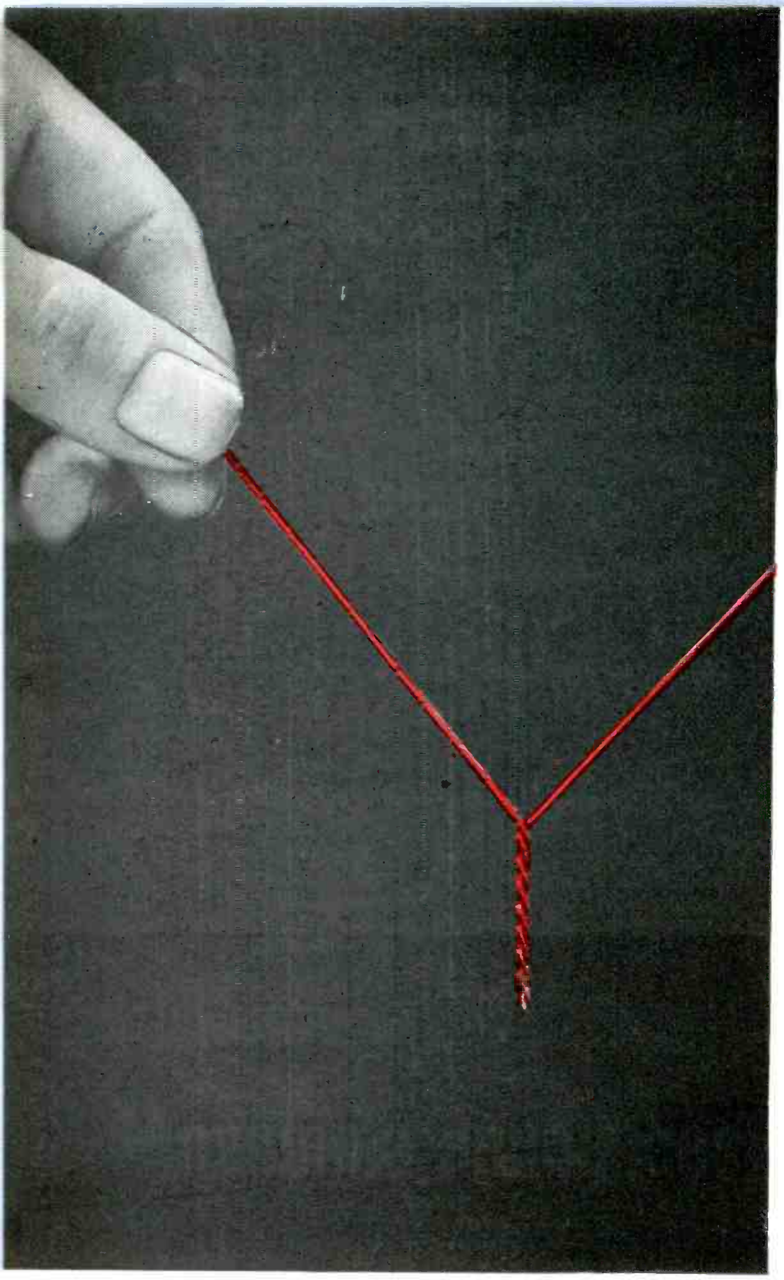
RAPID HEAT TRANSFER is achieved through a tubular heater located in the copper tip. Result: the General Electric Midget's heat efficiency is 90%.

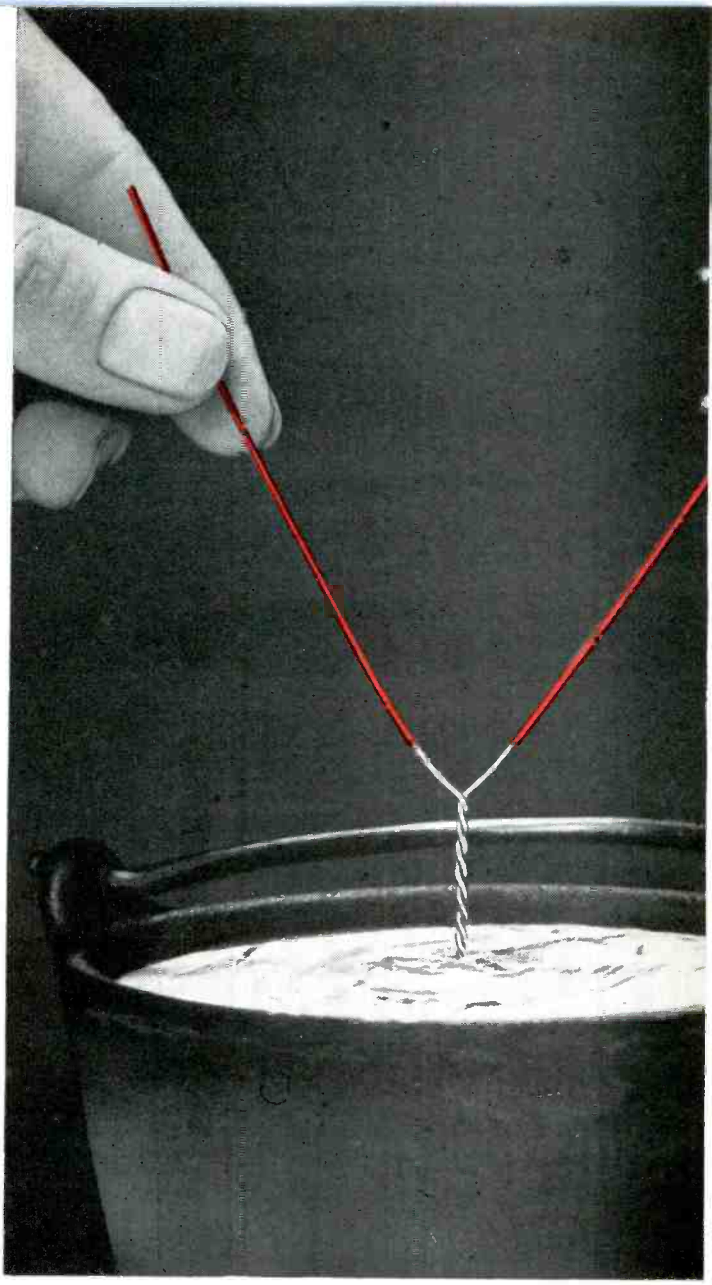


FOUR-IN-ONE IRON with $\frac{1}{8}$", $\frac{1}{4}$", $\frac{3}{16}$" tip sizes. Weighing less than three ounces, the General Electric Midget iron speeds production by reducing operator fatigue.

For more information, write for GED-2263, G-E Midget Soldering Iron, Section 724-6, General Electric Co., Schenectady 5, New York.

GENERAL ELECTRIC





Anaconda announces Analac an improved

New Analac* film-insulated, solderable magnet wire can be used similarly to Formvar or Plain Enamel—except that it is solderable without stripping!

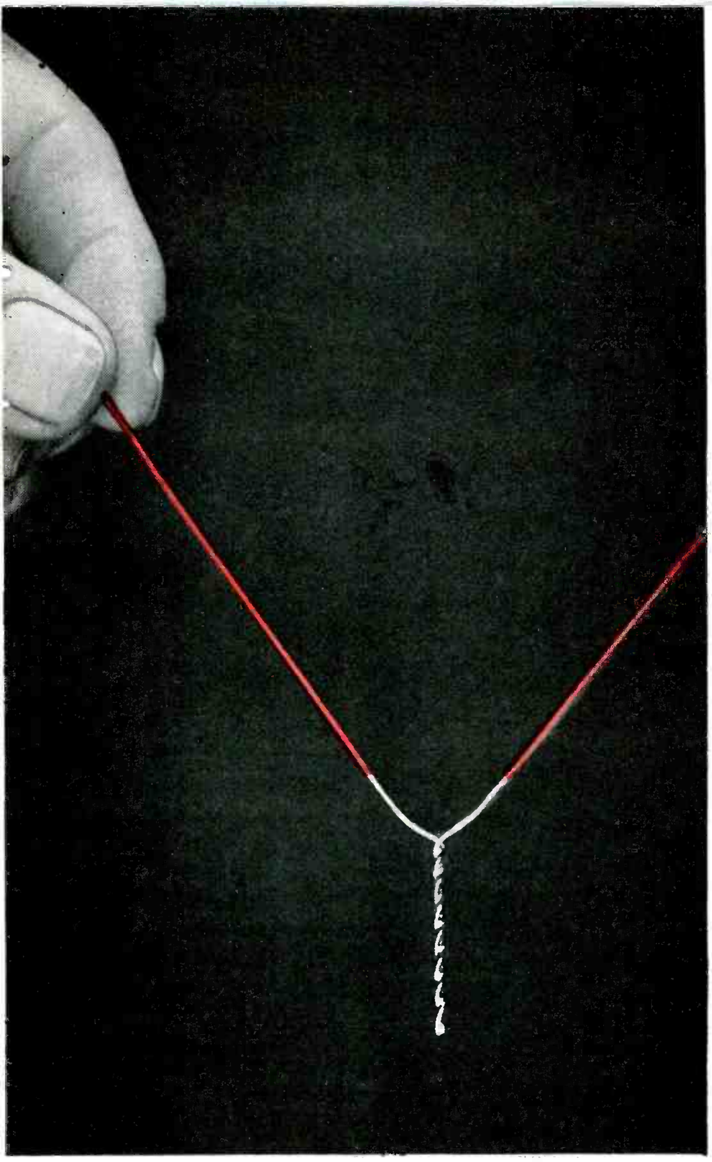
Soldering by dipping, iron or gun produces a perfect joint—in just one second in finer sizes—without prior removal of the insulation. Analac reduces labor, saves time and money wherever many soldered connections are made, or where small diameter wire makes other means of insulation removal hazardous to the insulation or wire.

Not only this, Analac has the excellent abrasion resistance and other good mechanical properties of the enamel wire you're now using. It handles readily, performs well in high-speed winding.

Analac is colored a bright red with stable dye used many years for identical applications—making it highly visible even in finest sizes. This helps operators feel more secure, results in higher quality work. Distinctive color simplifies its identification, too, from nonsolderable wires.

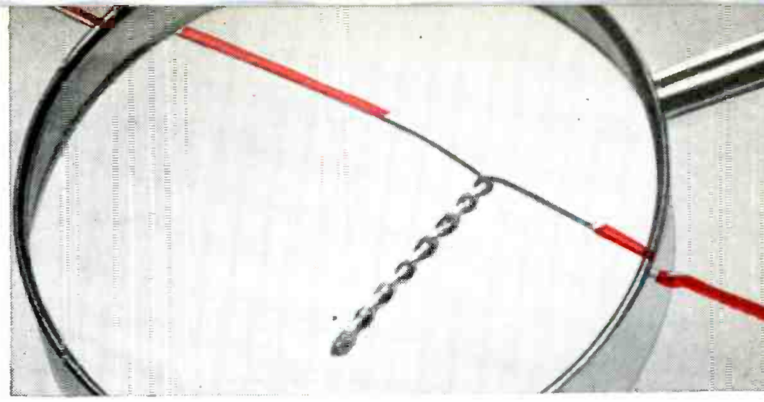
Analac is available in an exceptionally large range of sizes. The Man from Anaconda will be glad to give you more information and help with a production run in your plant. See "Anaconda" in your phone book—in most principal cities—or write: Anaconda Wire & Cable Company, Magnet Wire Headquarters, Muskegon, Michigan.

*Reg. U. S. Pat. Off. 57398

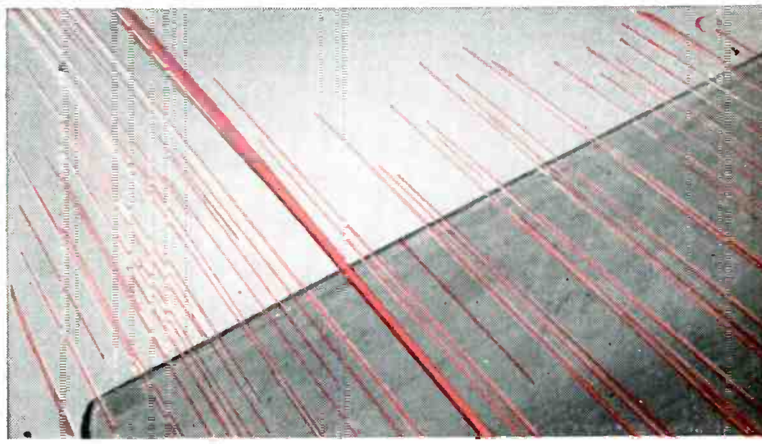


JOINT IS COMPLETED WITHOUT STRIPPING WIRE with Analac wire dipped in a 50-50 tin-lead solder at 360°C (680°F). The insulation is removed at the temperature of molten solder.

solderable magnet wire



1. STRONG JOINTS—as strong as the same joints made in bare copper wire—are produced. Here in laboratory test, joint holds under high stress.



2. EXCELLENT ABRASION RESISTANCE of Analac is shown in this test. It has the same high windability normally associated with Formvar, Plain Enamel.

3. MOLDED-PLASTIC CASES — designed and developed by Anaconda—protect spools of Analac from damage during shipping. Result: no breaks due to bent spools.

See the Man from ANACONDA®
for ready-to-solder Analac magnet wire

NEW CATALOG ON ANALAC
Yours for the asking.
Mail coupon
for your copy.

ANACONDA WIRE & CABLE COMPANY
Magnet Wire Headquarters,
Muskegon, Michigan.
Please send me catalog C-95A on Analac ready-to-solder magnet wire.

NAME & TITLE..

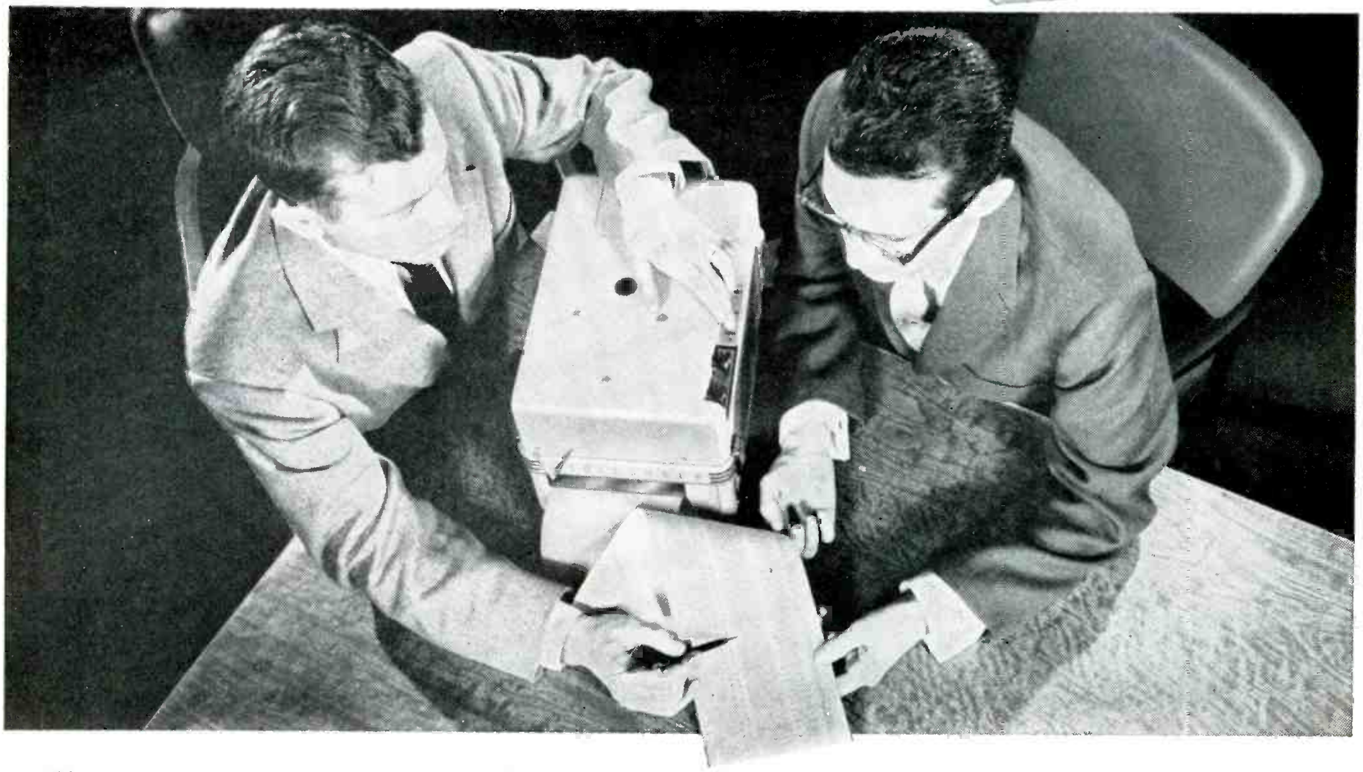
COMPANY..

ADDRESS..

CITY, ZONE, STATE..

phone now!

for a prove-it-yourself demonstration of the Honeywell VISICORDER®



We're sure, once you've seen the fabulous new Visicorder demonstrated, that you'll be as enthusiastic as the thousands of others who have watched the Visicorder in operation.

That's why we're inviting *you* to be the judge . . . to call your nearest Honeywell Industrial Sales Engineer.* He will set up a Visicorder demonstration in your office, plant, or laboratory . . . at your convenience.

The Visicorder, in the short months since its introduction has become the most wanted oscillograph in America. Why? Because the Visicorder records at frequencies from DC to 2000 CPS, with sensitivities that compare to photographic oscillographs. Because the stable, direct-reading Visicorder records are reproducible, and permanent under ordinary usage. Because the Visicorder bridges the gap between mechanical direct-writing oscillographs and photographic-type instruments.

So accept this invitation: Call your nearest Honeywell Industrial Sales Engineer today. He will arrange for you to operate the Visicorder yourself so that you can see for yourself how the Visicorder fits your most complex recording application.

MINNEAPOLIS
Honeywell H HONEYWELL
HEILAND DIVISION
5200 E. EVANS AVENUE · DENVER 22, COLORADO

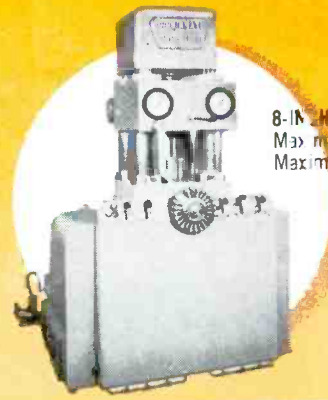
also ANNOUNCING . . .

The high-frequency Visicorder galvanometers have been redesigned to provide sensitivity improvements as great as 4 times, and a new 1000-cycle galvanometer has been added. All high-frequency galvanometers shipped after March 15 are to the new specifications.

*Visicorder demonstrators are now based in these Honeywell Industrial Sales Offices: Albuquerque • Atlanta • Baltimore • Boston • Buffalo • Cleveland • Dallas • Dayton Denver • Detroit • El Paso • Hammond, Ind. • Hartford • Long Island City • Los Angeles • Omaha • Pittsburgh • Philadelphia • Richmond • San Diego • San Francisco Seattle • St. Louis • Syracuse • Toronto, Ont. • Union, N. J. • Washington D. C. • Amsterdam, Netherlands • and more on the way.

Now... a battery of Hydroforms at

kaupp



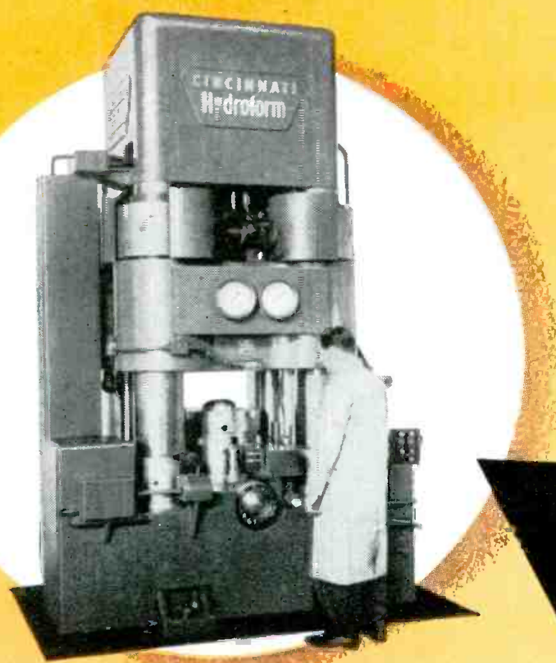
8-INCH HYDROFORM
Maximum Blank — 8" Diameter
Maximum Draw Depth — 5"

— to reduce your development time and costs on every pre-production run!

Kaupp hydroformed prototypes and pre-production parts are accurately formed and drawn in less time, at lower cost. Hydroforming produces short run, and in some cases production pieces, quicker and more economically than tool and die methods. New equipment installed by Kaupp assures faster service. For complete information on Kaupp metal forming facilities, call or write today!

- FEWER DRAWING OPERATIONS
- SIMPLER TOOLING
- FASTER SET-UP
- IMPROVED QUALITY

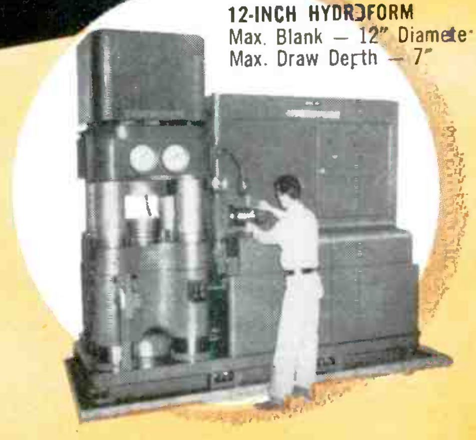
Expanded Kaupp facilities include deep drawing by conventional methods for volume production runs and a completely equipped metal spinning department



19-INCH HYDROFORM
Maximum Blank
19" Diameter
Maximum Draw
Depth — 8"

C. B. KAUPP & SONS
NEWARK WAY • MAPLEWOOD
NEW JERSEY

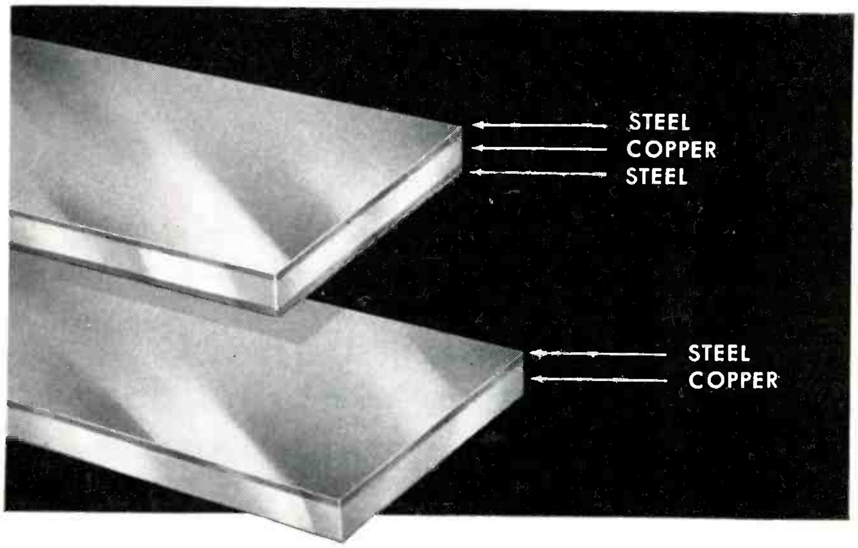
Specify
KAUPP...
for Accurate Forming and Drawing of Stainless Steel, Inconel, Cold Rolled Steel, Aluminum, Copper, Brass and Other Alloys



12-INCH HYDROFORM
Max. Blank — 12" Diameter
Max. Draw Depth — 7"

General Plate's

Stainless Clad Copper Combines Desirable Properties of Copper and Stainless To Offer New Advantages



When two or more metals are clad into sheet, desirable properties of each are combined to produce a material having new and useful characteristics not present in either metal separately.

Thus General Plate's Stainless Clad Copper offers the superior thermal and electrical conductivity of pure copper in combination with the high temperature corrosion resistance of stainless steel.

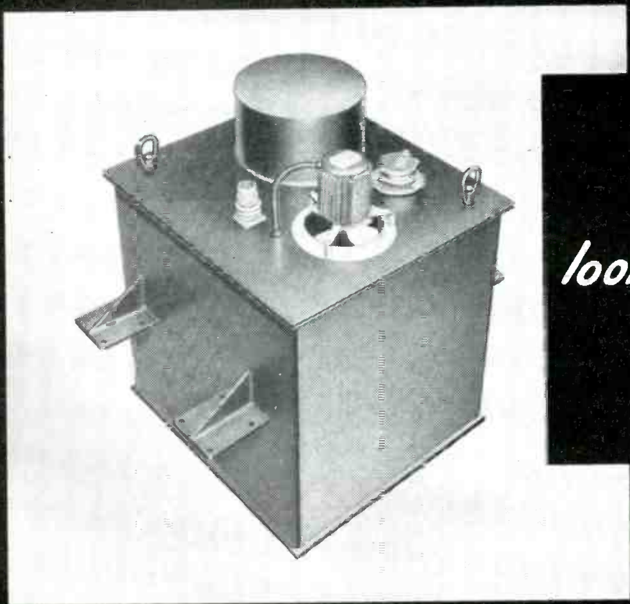
For example, in finned heat exchangers designed to work in gas temperatures up to 2600°F, the high thermal conductivity of the copper core in General Plate Stainless Clad Copper reduces fin tip temperatures by 20% to 30% compared to solid fin materials. There is a corresponding increase in fin efficiency, and at the same time the austenitic stainless steel cladding gives the fins substantially greater oxidation resistance, greatly increasing their life.

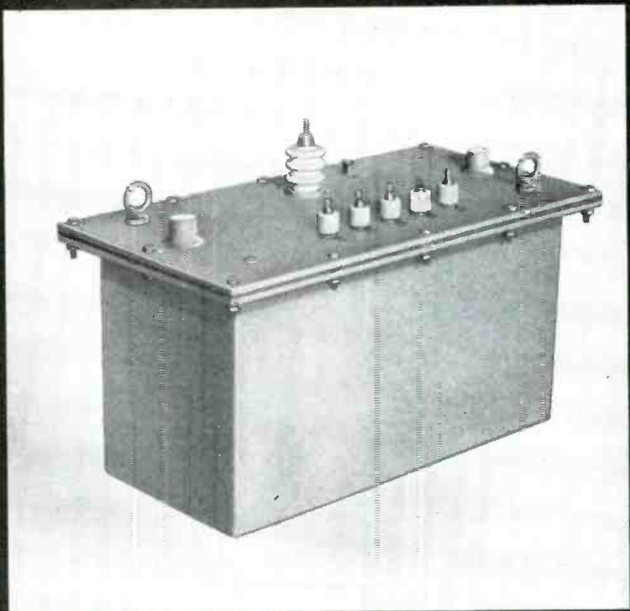
General Plate Stainless Clad Copper is available in widths up to 13″ and thicknesses up to 1/16″, single or double clad, in long lengths. It can be blanked, drawn, spun, formed, brazed, and spot or seam welded.

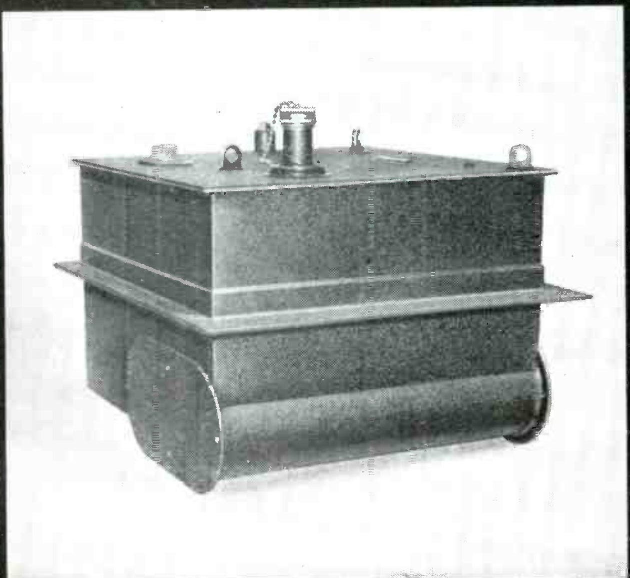
Typical products made from General Plate Stainless Clad Copper

Let us send you complete information on General Plate Stainless Clad Copper . . . it may be just what you have been looking for. Write today for Catalog Sheet 727C — no obligation.

METALS & CONTROLS CORPORATION
General Plate Division
1307 Forest Street, Attleboro, Mass.







look to MOLONEY ELECTRIC for...

UNIT RECTIFIERS

(using semi-conductors)

And Get These Inherent Advantages!

Long Life • Rugged • Lightweight

No tubes to replace

Completely Packaged Unit

Now available—a Moloney power transformer, filter reactor and capacitor, where required, and either silicon, selenium, or germanium semi-conductors combined in a neat, compact unit to give single phase or three phase rectification at any frequency. These units are manufactured in all types from a minimum rating of five kilowatts.

Save *your* Engineering man hours! Just give us input and output characteristics, service, and applicable specifications. Then let Moloney simplify your Engineering and Procurement with a coordinated job—from A. C. to D. C.

Moloney know-how and experience can be applied to your particular power supply problems to produce a better unit tailored to your needs. Check with your Moloney representative today!

Write for Catalog SR 207 "HyperCores for Magnetic Components" and Catalog ST 3506 "Magnetic Components for Electronic Applications"

ME57-14

MOLONEY ELECTRIC CO.

Plate and Filament Transformers • Chokes • Unit Rectifiers • Modulation Transformers and Reactors • Pulse Transformers and Charging Chokes • HyperCores for Magnetic Components • Developmental Magnetic Components Power and Distribution Transformers

FACTORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

Want more information? Use post card on last page.

What's YOUR Electronic

Solderability?...

Temperature?...

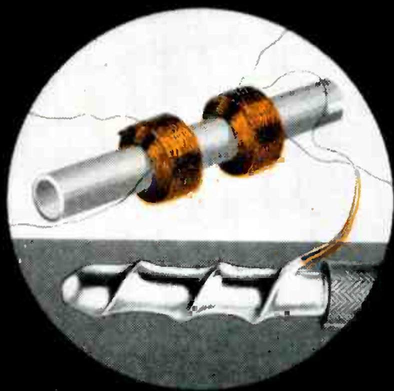
Unusual Shapes?...

Space?...

Here are five proven solutions to

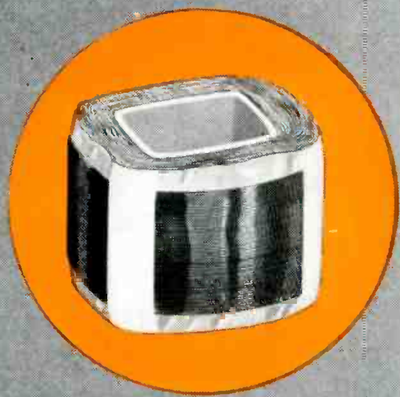
THERMALEZE

A Class "B" 130 C epoxide-polyester film wire for higher temperature windings.



SODEREZE

A polyurethane-coated wire—solders at low temperature—without stripping!



ENAMEL

Modern black enamel with uniform O.D., high tensile for layer-wound coils.

First for Lasting Quality—from Mine to Market!

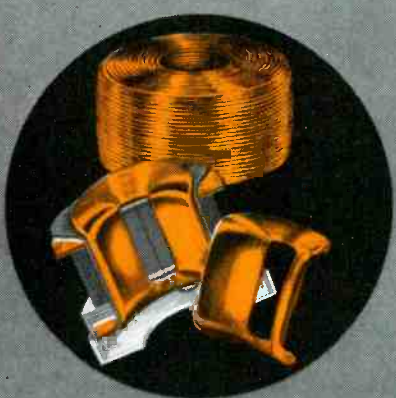
Want more information? Use post card on last page.

Coil Problem?...

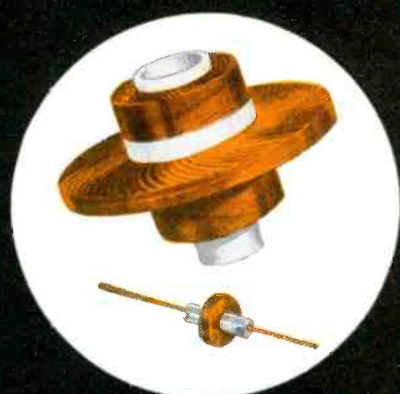
Phelps Dodge can supply the right answer to your particular magnet wire problem from its complete, up-to-date line. The products shown here have varied electronic applications. These magnet wires are the result of Phelps Dodge research and development of new materials, combined with practical experience in application engineering.

The complete line of Phelps Dodge magnet wire includes:
Enamel • Formvar • Sodereze® • Bondeze® • Thermaleze® • Grip-eze® • Silicone Enamel
Daglas® • Daglas® Silicone • Paper • Cotton • Multiple Combinations

lower-cost electronic coils



BONDEZE
Self-bonding wire for turn-to-turn bonding in unusual shaped coils, bobbinless coils, yoke coils, etc.



GRIP-EZE
Controlled friction solderable film wire for winding universal lattice-wound coils, fly-back coils, choke coils, etc.

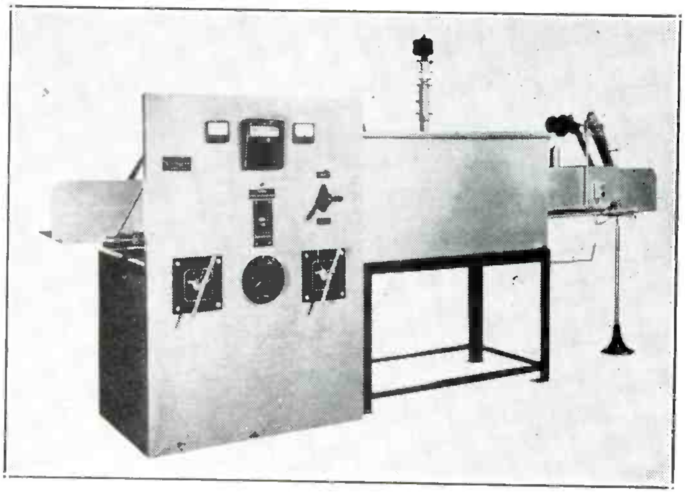
Wire packaged in Phelps Dodge special "Pakeze" containers if required.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

PHELPS DODGE COPPER PRODUCTS
CORPORATION

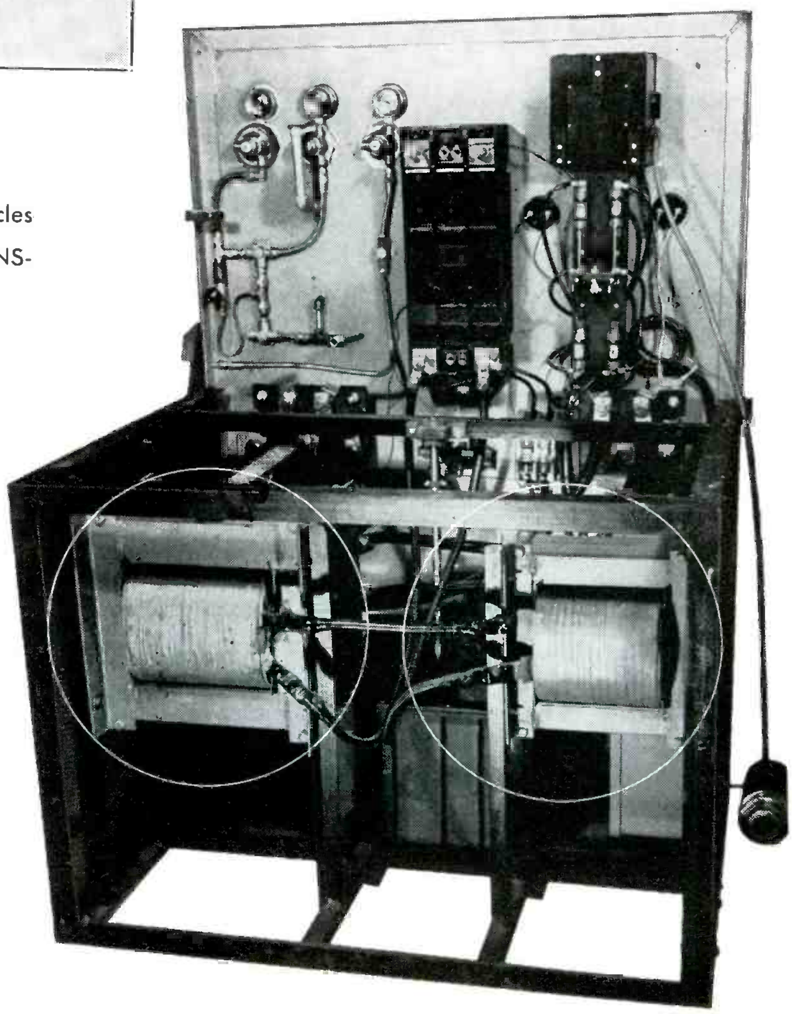
INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

ANOTHER *Nothelfer* CUSTOM BUILT TRANSFORMER INSTALLATION



At left—front view of C. M. Manufacturing & Machine Co.'s high temperature hydrogen atmosphere furnace for metallizing ceramics, containing two NOTHELFER TRANSFORMERS.

At right—rear view of furnace. White circles show where NOTHELFER 50 KVA TRANSFORMERS are installed.



The important features of NWL construction are vacuum pressure impregnation with high temperature synthetic varnishes, plastic and inorganic insulations. The use of grain oriented steels, carefully fabricated, annealed, and assembled and conservative design make for long life and high efficiency. Every transformer has "built-in" 36 years experience.

NWL

ESTABLISHED 1920

NEMA

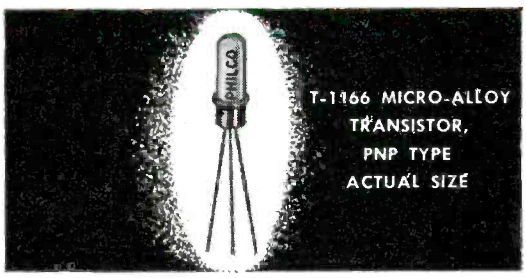
Nothelfer

WINDING LABORATORIES, INC.

P. O. Box 455, Dept. 101, TRENTON, N. J.

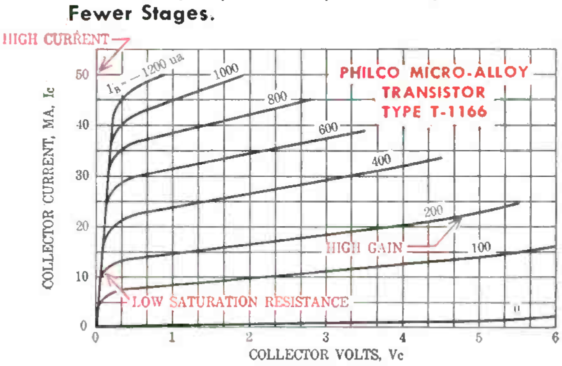
F-l-a-s-h!...from Transistor Center, U.S.A.

Announcing a new transistor class . . .
The PHILCO Micro-Alloy Transistor (MAT)*



CHECK THESE UNEQUALLED FEATURES

- Excellent High Speed Switching characteristics.
- Low Saturation Voltage (low impedance)
- Excellent high frequency amplification.
- Excellent low-level amplifier over entire frequency range from D.C. to Megacycles.
- Exceptionally Long Life (hermetically sealed)
- Permits high speed computer design with Fewer Stages.



...world's first production transistor with exceptionally high frequency and high gain . . . plus low saturation resistance!

This newest development from Philco Transistor Center features the characteristic high frequency response obtainable with extremely precise base width control. Designed for low voltage operation, the new MAT transistor is especially well suited for high speed applications where low saturation resistance (reduced power consumption) is necessary.

To combine high gain at high currents with high frequency response, the new MAT transistor employs a gallium doped alloy junction for the emitter electrode.

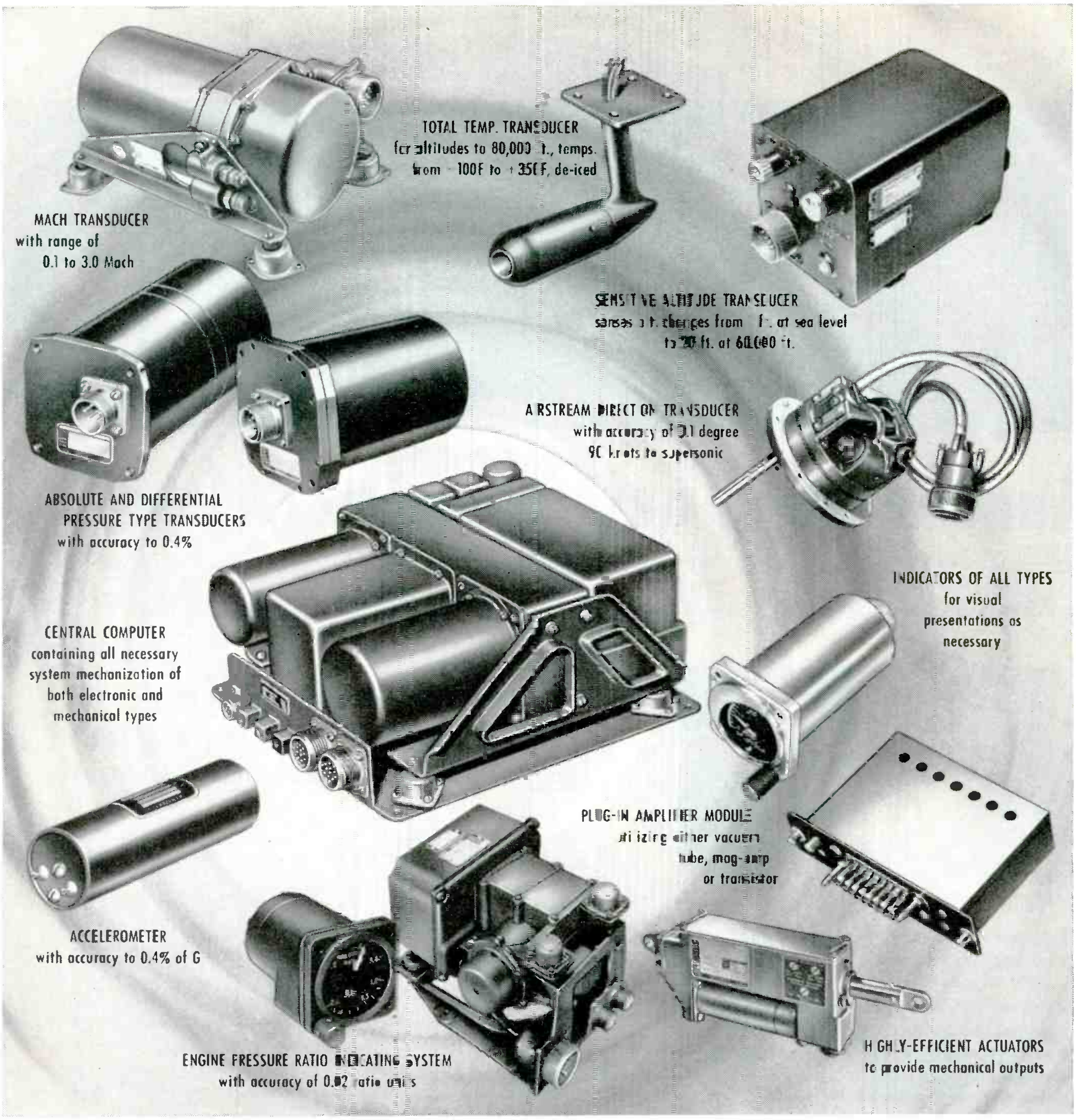
A special short-alloying cycle, combined with precise electro-chemical production techniques (pioneered and developed at Philco Transistor Center for production of SBT), results in the micro-alloy contact for exceptionally high injection efficiency. This new process assures higher gain, and permits operation at higher current. Beta linearity is excellent over the entire range of operating currents . . . up to 50 milliamperes.

• **Write for complete information** *and specifications. Make Philco your prime source of information for high frequency transistor applications.*

**Patent Applied For*

Visit The Unique Philco Transistor Display at WESCON Show, San Francisco Cow Palace, August 20-23, Booth #2217-2218.

PHILCO CORPORATION
LANSDALE TUBE COMPANY DIVISION
LANSDALE, PENNSYLVANIA



Finer components mean better air data systems

AiResearch makes transducers, computers and indicators of superior sensitivity and accuracy in *all* required parameters. These can be combined into systems that provide the air data you require and convert it into any desired type of information or impulse. The products shown in the above illustration indicate some of the areas in which we are thoroughly experienced. If desired, we will take complete system responsibility. We invite inquiries to meet the most rigid specifications.

Qualified engineers are needed now. Write for information.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Designers and manufacturers of aircraft systems and components: REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS • CABIN AIR COMPRESSORS • TURBINE MOTORS • GAS TURBINE ENGINES • CABIN PRESSURE CONTROLS • HEAT TRANSFER EQUIPMENT • ELECTRO-MECHANICAL EQUIPMENT • ELECTRONIC COMPUTERS AND CONTROLS

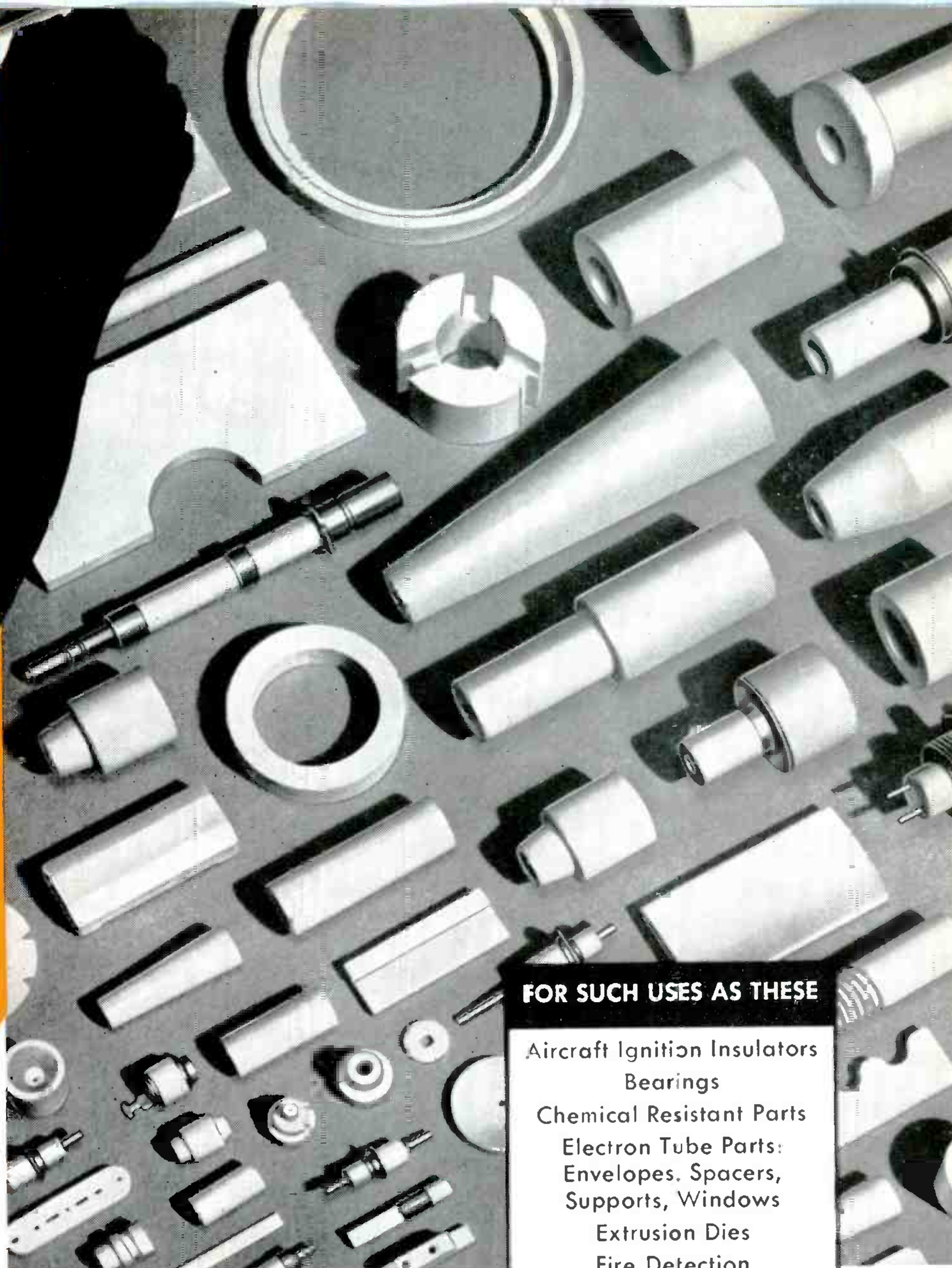
Want more information? Use post card on last page.

The Design Engineer's STRONG RIGHT ARM!

AlSiMag®

HIGH TEMPERATURE ALUMINA CERAMICS

No. 576 and No. 614



Parts shown approximately ½ size.

FOR SUCH USES AS THESE

Aircraft Ignition Insulators
Bearings
Chemical Resistant Parts
Electron Tube Parts: Envelopes, Spacers, Supports, Windows
Extrusion Dies
Fire Detection
Apparatus Parts
Hermetic Terminals
Instrument Parts
High Heat Resistant Parts for Jet Engines, Rockets, etc.
Mounting Plates
Pump Liners
Pump Plungers
Refractory Plates and Supports
Thermocouple Tubes
Wear Plates and Guides
Work Holding Devices

Industry endorsed. For demanding mechanical and electrical applications: AlSiMag 576 is strong, versatile, economical; AlSiMag 614 offers even greater strength plus valuable low loss factors. Many more special purpose AlSiMag Aluminas available.

Important physical advantages: Sapphire hard (9 on Mohs' scale). Permanently rigid. Abrasion resistant. Chemically inert. Vacuum tight. High compressive, flexural, tensile strengths. Uniform. Resist chipping and spalling. Held to precision tolerances.

Important performance values: Superior dielectric properties. Great hot-cold and mechanical shock resistance. Stable, withstand radiation bombardment without producing contaminants.

Metal-ceramic combinations: Large-scale metalizing facilities . . . high or low temperature. Custom and standard designs in any volume. Advanced techniques. Permanent bonding.

Prototype Service available: Test your designs under actual operating conditions . . . without investing in production tooling!

Prompt shipment in any quantity! For complete information on AlSiMag parts in the Alumina material best suited for your application, send blueprint or sketch with details of operation.

A Subsidiary of Minnesota Mining and Manufacturing Company

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENN.
56TH YEAR OF CERAMIC LEADERSHIP

For service, contact Minnesota Mining & Manufacturing Co. Offices in these cities (see your local telephone directory): Atlanta, Ga. • Boston: Newton Center, Mass • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, O. • Cleveland, O. • Dallas, Texas • Detroit, Mich. • High Point, N. C. • Los Angeles, Calif. • New York: Ridgefield, N. J. • Philadelphia, Pa. • Pittsburgh, Pa. • St. Louis, Mo. • St. Paul, Minn. • So. San Francisco, Calif. • Seattle, Wash. Canada: Minnesota Mining & Manufacturing of Canada, Ltd., P. O. Box 757, London, Ont. **All other export:** Minnesota Mining & Manufacturing Co., International Division, 99 Park Ave., New York, N. Y.

Use high-quality, dependable

BROWN COMPONENTS

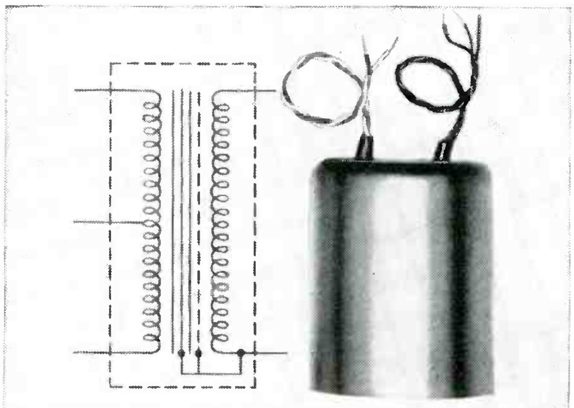
in your measuring circuits and servo loops

CONVERTERS—Handle d-c signals as small as 10^{-8} volt. SPDT switching action. Sensitive, stable performance. Ideal for computers, servomechanisms, balancing circuits. Available with special features such as fungus proofing, grounded housing, mica-filled base, various contact percentages. Weight: 10 ounces.

Driving coils in 60, 40 and 25 cycle converters are energized by 6.3 volt a-c. 400 cycle uses 18 volts. Other coil ratings as follows:

Converter Type	Impedance	D-C Resistance	Power Consumption	Current Drain
60 cycle	125 ohm	110 ohm	.3 watts	.05 amps
25 and 40 cycle types	65 ohm	55 ohm	.60 watts	.10 amps
400 cycle	191 ohm	110 ohm	1.7 watts	.094 amps

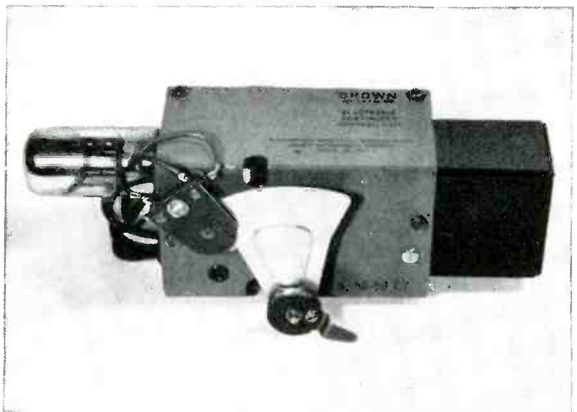
Write for Specification S900-2.



INPUT TRANSFORMERS—Handle low-frequency a-c, or chopper-modulated d-c signals from .005 to 200 millivolts, such as generated by thermocouples or other transducers. Designed with highly efficient shielding. Measure 1⅝" in diameter, 2³⁄₃₂" high.

Choose from three models		355567-1	356326	35567-2
Primary (center-tapped)	turns (½ primary)	600	1,094	3,400
	Resistance (approx.)	30 ohms	450 ohms	750 ohms
	60 cps impedance	1,300 ohms	7,500 ohms	30,000 ohms
	Impedance, full pri.	5,200 ohms	30,000 ohms	120,000 ohms
Secondary	turns	9,600	17,500	12,000
	Resistance (approx.)	2,500 ohms	5,800 ohms	3,400 ohms
	Capacity to tune to 60 cycles	.015 mfd.	.001 mfd.	.003 mfd.
Weight		5.7 oz.	7.1 oz.	6 oz.

Write for Specification S900-1.



***ELECTR-O-VANE* CONTROL UNIT**—A torque of 2 gram-inches or less actuates this precision switch. Use it as a limit switch to operate valves, lights or hopper openings, in response to motion of weighing beams or other members. Use it to sense other mechanical movements—to operate protective devices when a diaphragm is bulged or near rupture, for example.

SPECIFICATIONS

Torque to move vane . 2 gram-inches max.
Vane motion for snap action . . 0.003 in.
Precision. . . . . within 0.002 in.
Switch action . SPDT, when vane centerline approx. 41° left of vertical
Load relay rating . 115 volts, 6 amp. a-c, non-inductive load
Operating power . 115 volts, 50-60 cycles; also 230 volt model
Write for Specification S800-1.

For additional details, call your nearby Honeywell sales engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

Honeywell

H HONEYWELL *First in Controls*

21 YEARS

21 YEARS

FEDERAL TELEPHONE & RADIO FTR
14 YEARS

RCA
21 YEARS

Over 200 years experience
by 14 leading companies
demonstrates KOVAR® Alloy dependability

WESTINGHOUSE W
21 YEARS

Western Electric
19 YEARS

VARIAN associates
8 YEARS

MACHLETT
18 YEARS

10 YEARS

RAYTHEON
21 YEARS

Bomac
9 YEARS

AMPEREX
15 YEARS

Eimac TUBES
16 YEARS

SPERRY
16 YEARS

Outstanding application results . . . year-after-year!

These leading companies have learned to depend on Kovar alloy for long-term, uniform, quality performance.

Here are the advantages that make Kovar the ideal alloy for glass sealing: *it matches* thermal expansion characteristics of hard glass over the entire working temperature range . . . *it fuses* into the glass in a permanent, chemically-bonded, vacuum-tight seal . . . *it provides* superior service because of Stupakoff's precision manufacturing controls.

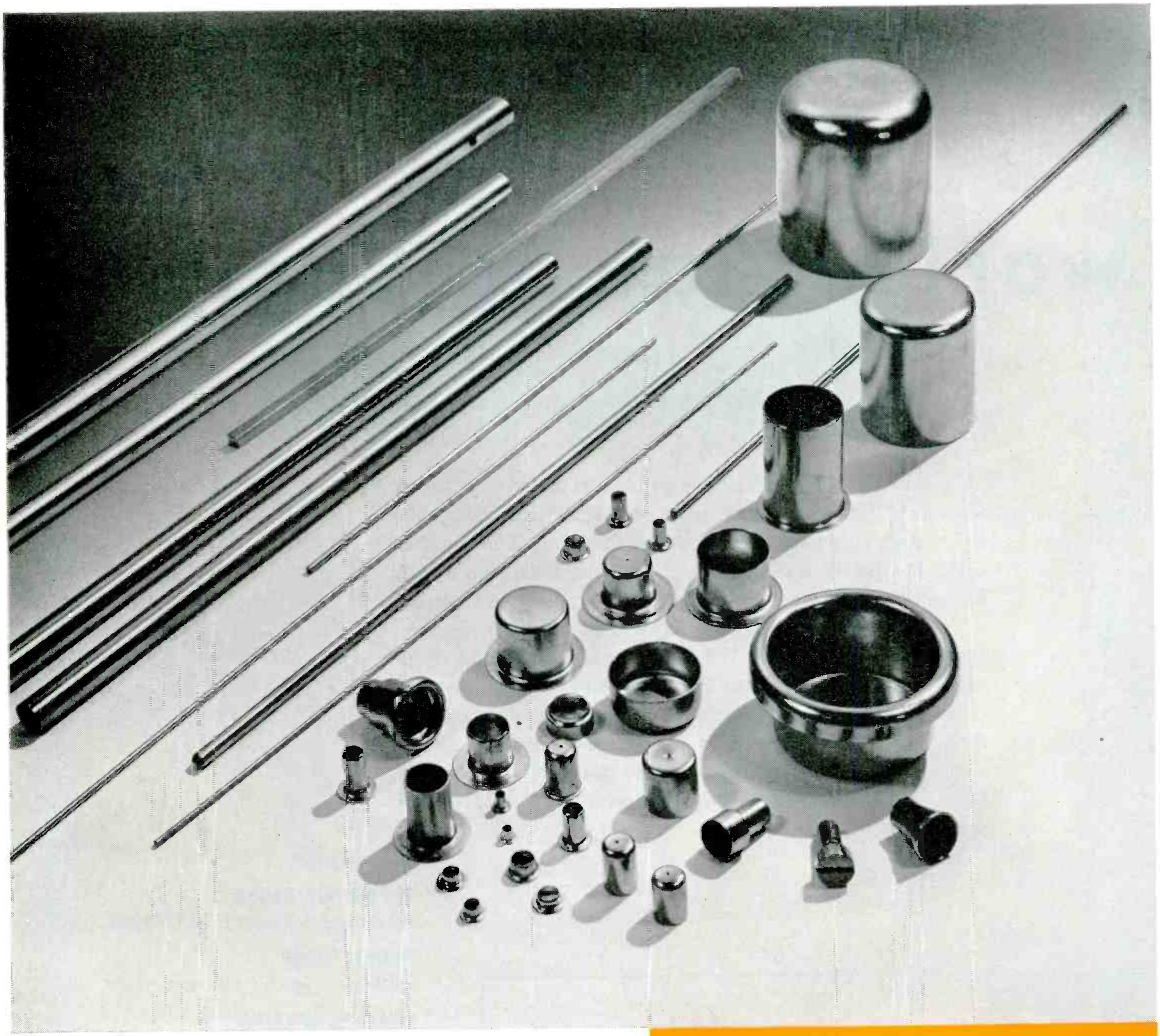
Kovar alloy is available as rod, wire, tube, sheet, strip, and foil . . . in fabricated shapes such as cups, eyelets, leads . . . and, it can be welded, soldered and brazed to other metals readily. What's more, technical service available from Stupakoff Engineers insures the most suitable design to achieve best application results.

Write us about your specific requirements.

STUPAKOFF DIVISION OF
The CARBORUNDUM Company

WRITE DEPT. E LATROBE, PENNSYLVANIA

® Westinghouse trade mark No. 337,962

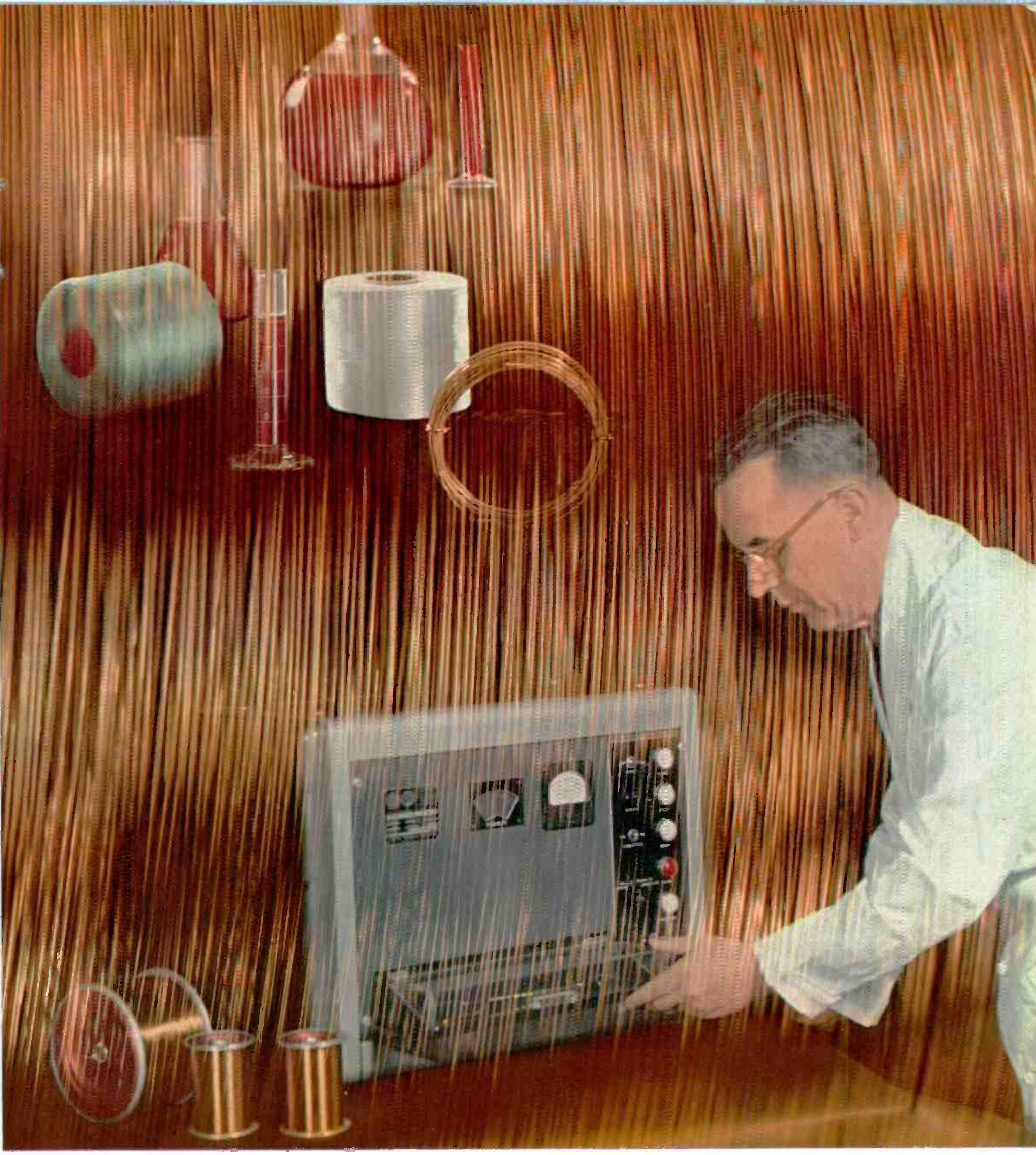


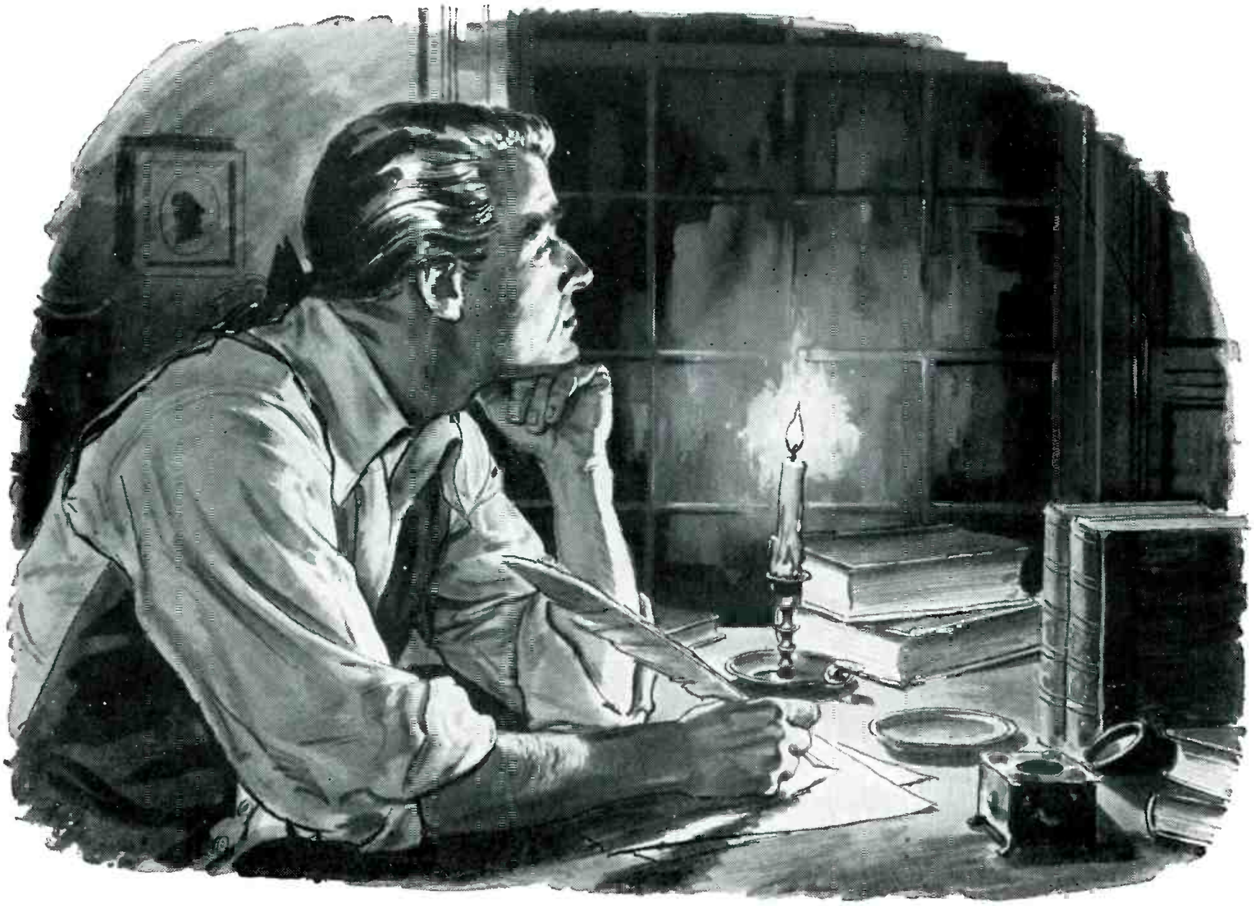
Stupakoff
KOVAR

glass-sealing alloy

for:
perfect matching
permanent bonding
long-term reliability

Want more information? Use post card on last page.





Where Do Great Ideas Come From?

From its beginnings this nation has been guided by great ideas.

The men who hammered out the Constitution and the Bill of Rights were thinkers—men of vision—the best educated men of their day. And every major advance in our civilization since that time has come from minds *equipped by education* to create great ideas and put them into action.

So, at the very core of our progress is the college classroom. It is there that the imagination of young men and women gains the intellectual discipline that turns it to useful thinking. It is there that the great ideas of the future will be born.

That is why the present tasks of our colleges and universities are of vital concern to *every* American. These institutions are doing their utmost to raise their teaching standards, to meet the steadily rising pressure for enrollment, and provide the healthy educational climate in which great ideas may flourish.

They need the help of all who love freedom, all who hope for continued progress in science, in statesmanship, in the better things of life. And they need it *now!*

If you want to know what the college crisis means to you, write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, N.Y.

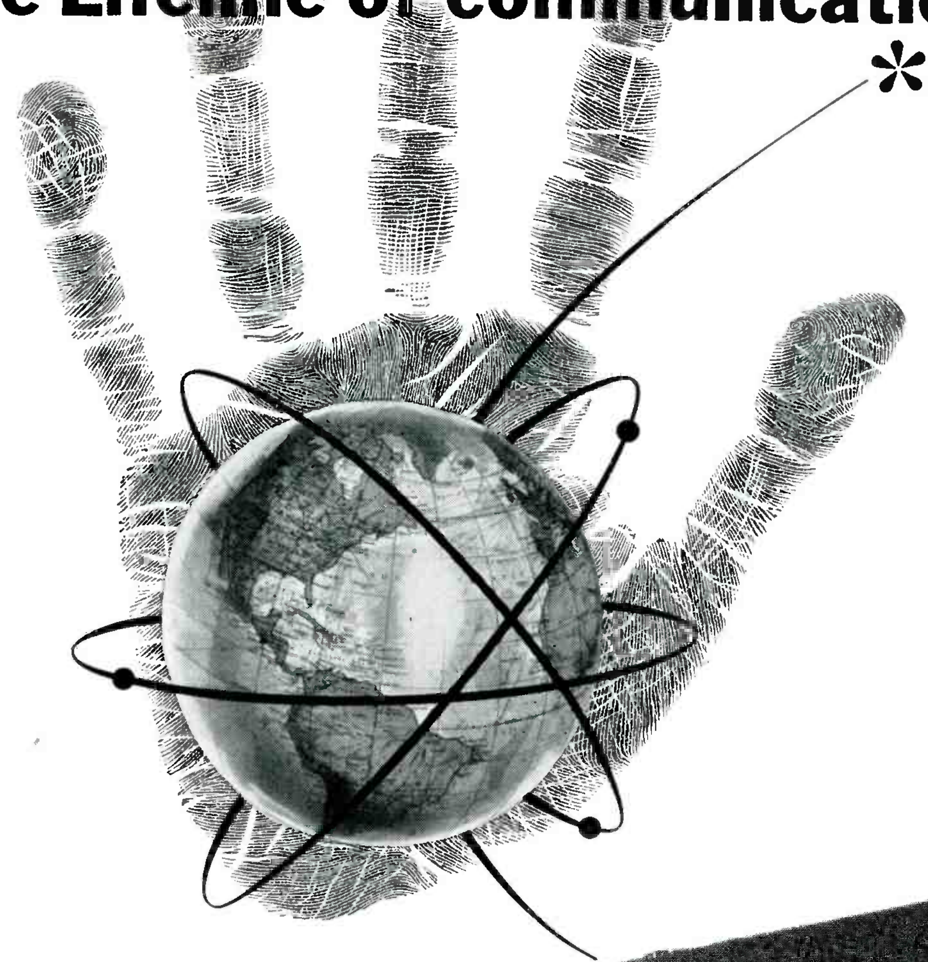
HIGHER EDUCATION
KEEP IT BRIGHT

PUBLIC SERVICE
ADVERTISING COUNCIL

Sponsored as a public service, in cooperation with the Council for Financial Aid to Education

Want more information? Use post card on last page.

The Lifeline of communication . . . *



More than eighty countries use Marconi telecommunications equipment. The total telephone channel miles of Marconi radio multi-channel systems would go 15 times round the world.

Marconi's have supplied broadcasting or television equipment to eighty countries. Most of the equipment used by the British Broadcasting Corporation and the British Independent Television Authority and its programme contractors is Marconi's. Marconi's demonstrated 'compatible' colour television in 1954.

Thirty-two airforces rely on Marconi radio, radio navigational aids and radar. For the past two years Marconi's have been in quantity production with Doppler Navigators for British and Commonwealth governments. Many of the world's major airports use Marconi radio communications, beacons and radar.

All the radio beacons round the coasts of the British Isles and Eire and many in other major seaways have been supplied by Marconi's.

These few statements give some idea of the manufacturing achievement of Marconi's, who also maintain larger research facilities devoted to radio electronics than any other European company. Moreover Marconi College was the world's first school for wireless engineers. Courses there are the coveted privilege of the world's most promising radio engineers.

MARCONI

**SYSTEM PLANNERS,
ELECTRONIC ENGINEERS,
DESIGNERS AND MANUFACTURERS
OF AERONAUTICAL, BROADCASTING,
COMMUNICATION AND MARITIME
RADIO EQUIPMENT,
TELEVISION EQUIPMENT,
RADAR AND NAVIGATIONAL AIDS**

The inquiries of radio and electronic engineers who wish to keep themselves posted about the latest Marconi equipment and activities are most welcome. Write to:
J. S. V. WALTON, MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED,
23-25 Beaver Street, New York City 4.

MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, CHELMSFORD, ESSEX, ENGLAND

LG 20

Want more information? Use post card on last page.

COMPONENTS TO SYSTEMS FROM

Mack

A DYNAMIC COMBINATION —

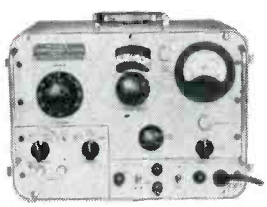
- MACK TRUCKS' MANUFACTURING FACILITIES
- MACK ELECTRONICS' SKILL AND EXPERIENCE

This closely coordinated team of research and mass production is a vital force in today's electronic industry. Mack's diversified electronic products are a result of imaginative, creative engineering coupled with unsurpassed research and manufacturing facilities.

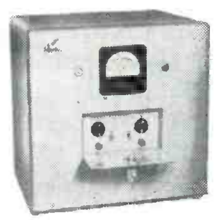
Leaders in the industrial, military, medical and commercial markets turn to Mack Electronics to solve their problems in:

• COMMUNICATIONS • RADAR • COMPUTER COMPONENTS AND SYSTEMS
• CONTROLS • ULTRASONICS
• PRECISION TEST EQUIPMENT • INSTRUMENTATION
• RADIATION DETECTION EQUIPMENT • AUTOMATION

COMPUTER COMPONENTS

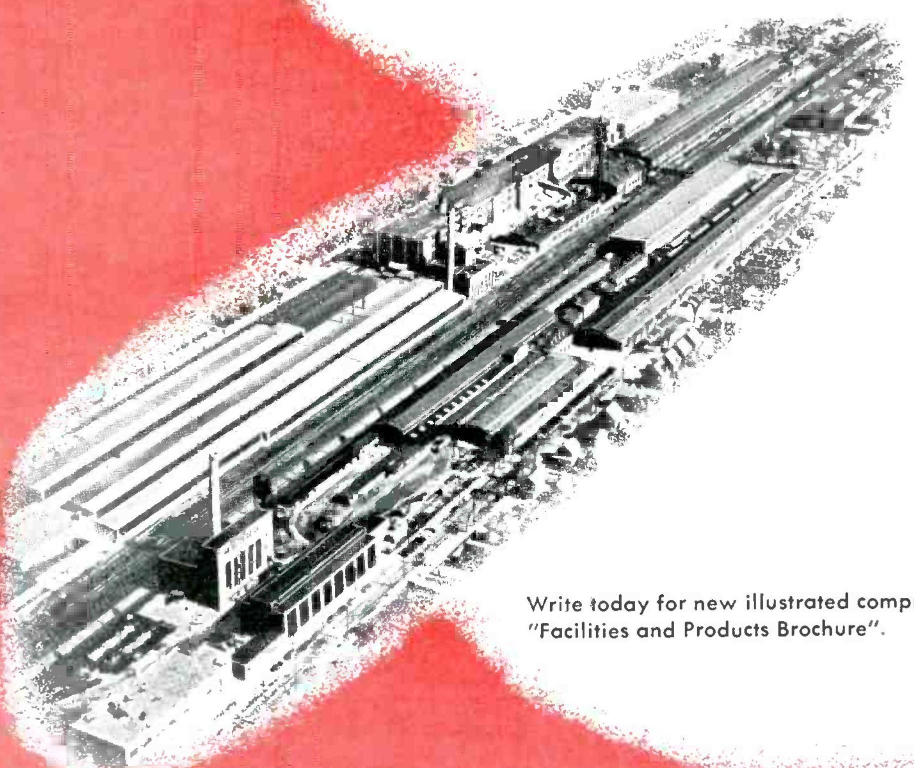


CARRIER FREQUENCY VOLTMETER (WAVE ANALYZER)



ULTRASONIC GENERATOR

AIRPORT TRAFFIC CONTROL MONITOR



Write today for new illustrated comprehensive "Facilities and Products Brochure".

Mack ELECTRONICS

MACK ELECTRONICS DIVISION INC.

A WHOLLY OWNED SUBSIDIARY OF MACK TRUCKS INC.

plainfield new jersey

Want more information? Use post card on last page.

LOW VALUE CAPACITORS

Simplest, most economical fixed composition types yet produced. Color-coded values from 0.10 to 10.0 μμf. Bulletin GA.

New! CERAMIC PERMANENT MAGNETS

The permanent magnets that are really permanent! Made from non-critical, low-cost ceramic powders. Write for new Stackpole Ceramagnet® Bulletin RC-10A.

CERAMAG® FERRO-MAGNETIC CORES

Characteristics of Stackpole Ceramag Cores are maintained with remarkable uniformity regardless of size or shape. Standard deflection yoke, "U," cup and threaded screw types. Complete facilities for special types. Ask for Bulletin RC-9A.

MOLDED COIL FORMS

Molded of high-resistance powdered iron with firmly-anchored, easy-to-solder wire leads. Bulletin RC-10C.

FIXED COMPOSITION RESISTORS

½-, 1- and 2-watt composition types in all standard RETMA ranges. Low noise level . . . unsurpassed humidity protection . . . easily-soldered, firmly-anchored leads.

VARIABLE COMPOSITION RESISTORS (Controls)

One of the largest most dependable lines including single, concentric shaft duals, midgets and types for transistorized equipment. Stackpole Bulletin RC-10B.

LINE SWITCHES

Types to provide practically any desired switching arrangement for Stackpole Variable Resistors. Ask for Bulletin RC-10B.

SLIDE SWITCHES

½ to 3 amp. UL approved types for maximum switching versatility and convenience in appliances, TV and radio sets, instruments, toys, etc. Bulletin RC-10D.

POWDERED IRON CORES

Insert, cup, sleeve, threaded, choke coil, sidemolded and plain core types. Also Stackpole preferred type "EE" Cores for maximum economy. Bulletin RC-10C.

A MAJOR COMPONENT SOURCE...for MAJOR

Bulletin RC-10B
Variable Resistors and Line Switches

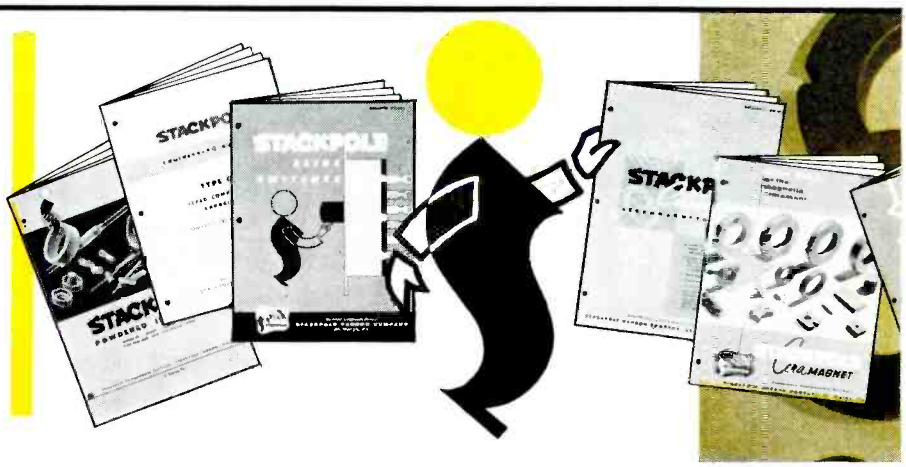
Bulletin RC-10C
Powdered Iron Cores and Coil Forms

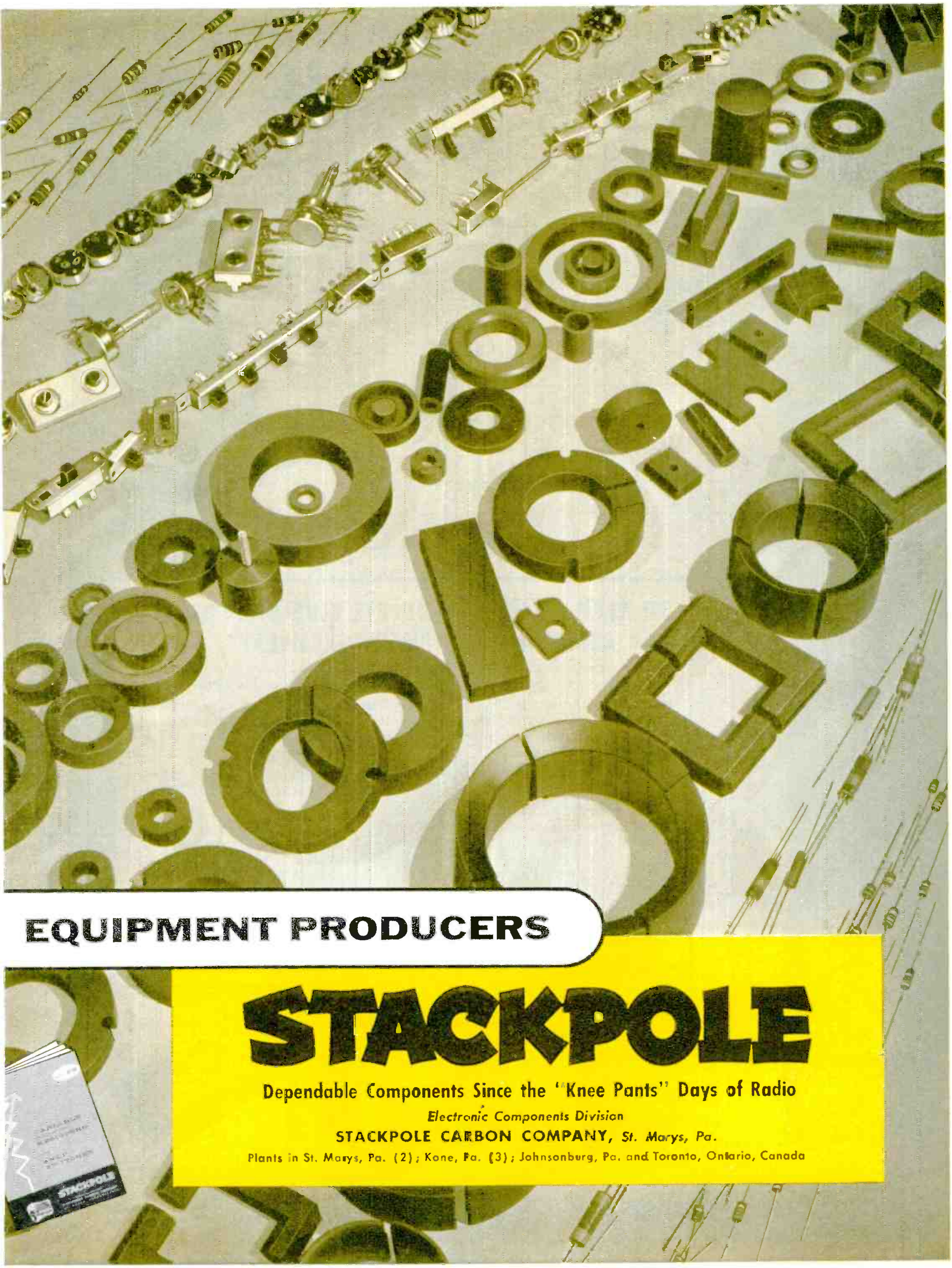
Bulletin RC-9A
Ceramag® Ferromagnetic Cores

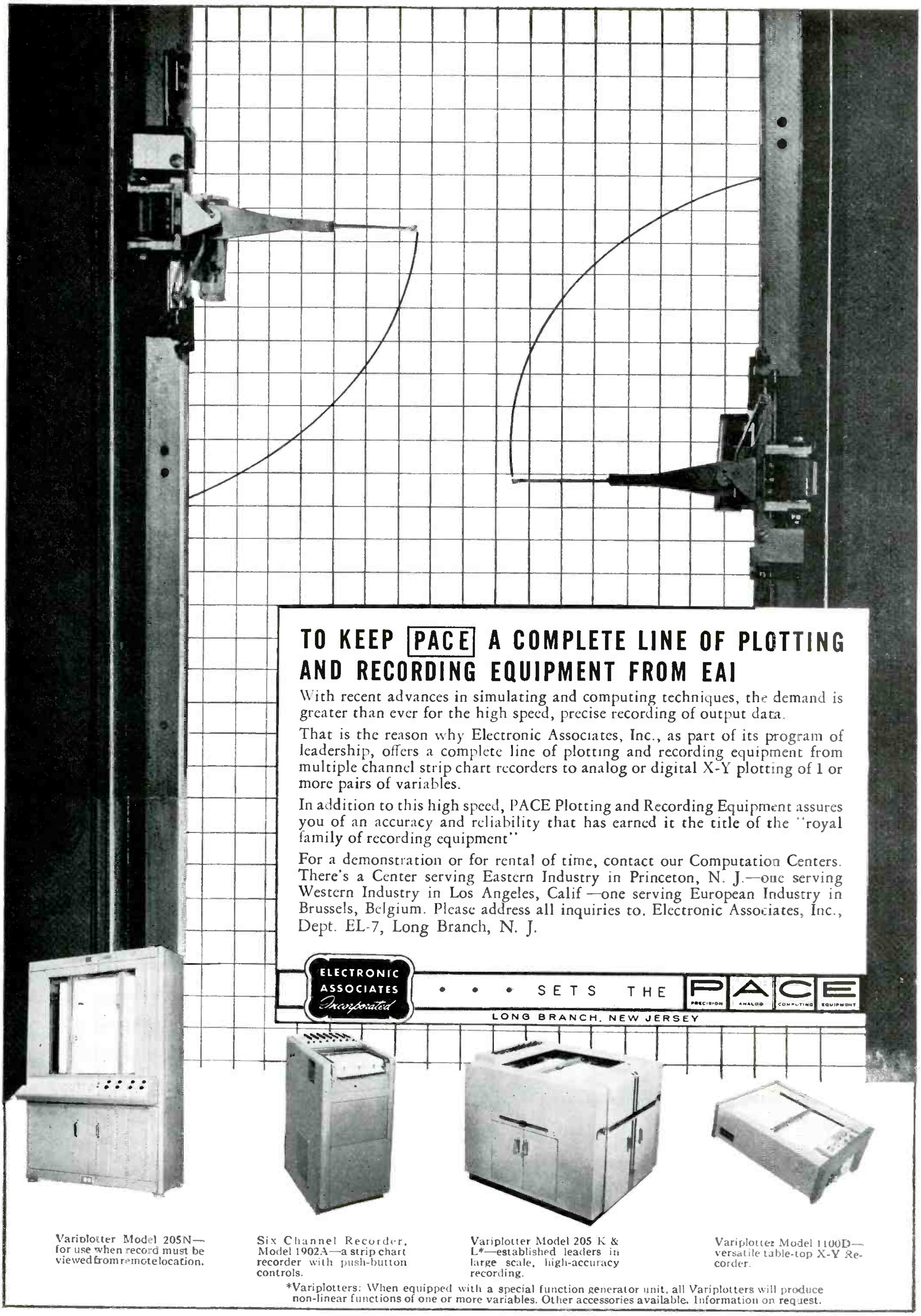
Bulletin RC-10D
Slide Switches

Bulletin RC-10A
Ceramagnet® Permanent Magnets

Bulletin GA
Low-Value Capacitors




EQUIPMENT PRODUCERS
STACKPOLE
Dependable Components Since the "Knee Pants" Days of Radio
Electronic Components Division
STACKPOLE CARBON COMPANY, St. Marys, Pa.
Plants in St. Marys, Pa. (2); Kane, Pa. (3); Johnsonburg, Pa. and Toronto, Ontario, Canada


TO KEEP PACE A COMPLETE LINE OF PLOTTING AND RECORDING EQUIPMENT FROM EAI
With recent advances in simulating and computing techniques, the demand is greater than ever for the high speed, precise recording of output data.
That is the reason why Electronic Associates, Inc., as part of its program of leadership, offers a complete line of plotting and recording equipment from multiple channel strip chart recorders to analog or digital X-Y plotting of 1 or more pairs of variables.
In addition to this high speed, PACE Plotting and Recording Equipment assures you of an accuracy and reliability that has earned it the title of the "royal family of recording equipment"
For a demonstration or for rental of time, contact our Computation Centers. There's a Center serving Eastern Industry in Princeton, N. J.—one serving Western Industry in Los Angeles, Calif.—one serving European Industry in Brussels, Belgium. Please address all inquiries to. Electronic Associates, Inc., Dept. EL-7, Long Branch, N. J.
ELECTRONIC ASSOCIATES Incorporated
• • • SETS THE PACE
PRECISION ANALOG COMPUTING EQUIPMENT
LONG BRANCH, NEW JERSEY
Variplotter Model 205N—for use when record must be viewed from remote location.
Six Channel Recorder, Model 1902A—a strip chart recorder with push-button controls.
Variplotter Model 205 K & L*—established leaders in large scale, high-accuracy recording.
Variplotter Model 1100D—versatile table-top X-Y Recorder.
*Variplotters: When equipped with a special function generator unit, all Variplotters will produce non-linear functions of one or more variables. Other accessories available. Information on request.

MIL-AC Custom Air Conditioning

Condition:
Unusual Configuration

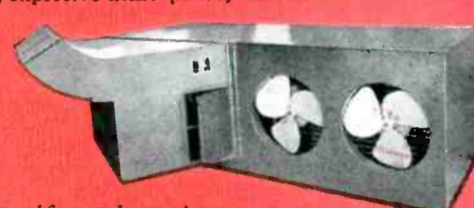
Air conditioning today's electronic systems often calls for specialized equipment that saves space, fits into unusual configurations and still meets the most difficult environmental conditions (MIL-E-5272*).

Custom air-conditioning is our business at Ellis and Watts. For example, our MIL-AC air conditioning units can be square, oblong, L-shaped, T-shaped, curved, pyramid—virtually any shape your conditions require. They can be designed for integral mounting in electronic consoles or computer racks; or for use as adjacent or remote equipment to air condition entire systems.

MIL-AC units are self-contained, compact, lightweight, readily air-transportable. They can be designed to cool, heat, humidify, dehumidify, filter, and can incorporate air-cooled or water-cooled condensers. Units are manually or automatically controlled. We are staffed with specialists who will analyze your requirements, submit a proposal, complete your installation promptly and to your complete satisfaction.

Write for helpful load calculating Nomograph and other technical data for use in making time-saving preliminary calculations.

*Military specification dealing with the following climatic and environmental conditions: Temperature, humidity, altitude, salt spray, vibration, fungus, sunshine, rain, sand and dust, explosive atmosphere, acceleration and shock



Typical MIL-AC Unit. MIL-AC configurations, features and functions to suit your specific requirements.

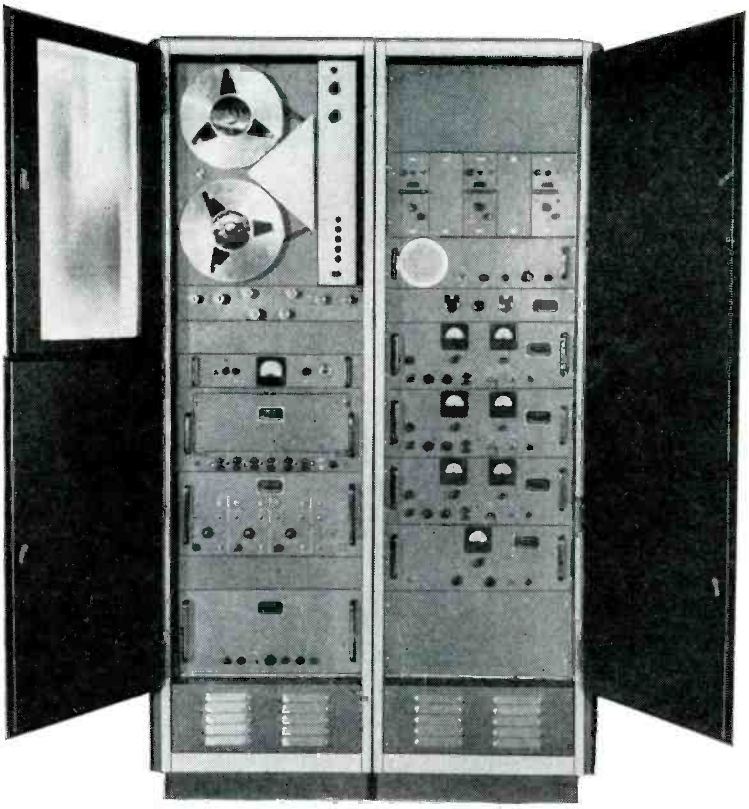
ELLIS AND WATTS PRODUCTS, INC.

P.O. Box 33, Cincinnati 36, Ohio.

Ellis and Watts also design and build custom air conditioners, liquid coolers and heaters, dehumidifiers, wave guide dehumidifiers, laboratory temperature and humidity control units.

Want more information? Use post card on last page.

NEW UNIVERSAL SYSTEMS



meet 90% of magnetic tape data recording needs

You get all the precision and accuracy of a custom design *and* the off-the-shelf availability and dollar savings of a "package" design in Davies new Universal Tape Systems.

Every component has been designed to provide maximum flexibility consistent with overall system accuracy. Interchangeable electronics match the system to *your individual requirements* . . . now and for years to come. Specify a Universal System that satisfies your *immediate* requirements . . . adding tracks of data capacity as requirements grow.

Any one of the maximum of fifteen tracks provided can carry data recorded by any one of the three major techniques. Interchangeable Direct, FM, and PWM electronics assure you a *vital* data recording system . . . able to handle each new job as it arises. Standard options are also available to meet the special needs of telemetering and multiplexed data.

Among the features of a Davies Universal Tape System never before available in "package" equipment are six tape speeds at the flip of a switch . . . automatic switching discriminators that match tape speed at the transport . . . precise phase coincidence of data among all tracks . . . and facilities for electronic flutter-and-wow compensation. Every item has been proved through years of service in jets, missiles, and on the ground.

Here's a brief rundown of the options available to you when specifying a Davies Universal Tape System that will grow with your recording requirements:

Transport: Standard transport offers up to six speeds, selectable at the flip of a switch. Precision 10½" or 14" reels available for 1" or 1½" tape. Three-speed transport optional for PWM systems.

Heads: In-line multitrack heads permit up to 15 tracks on 1½" tape, assure precise time and phase coincidence of data among all tracks. Separate record and playback heads provided. Interleaved head stacks permitting up to 30 tracks on 1½" tape, optional for telemetering, other applications not requiring data coincidence.

Direct Recording electronics record and playback data from 100 to 100,000 cps. Ideal for high frequency data, also for recording complex wave forms made up of many frequency multiplexed signal channels. Bandpass type discriminators provided for recovering multiplexed data.

FM electronics frequency modulate a stable carrier with the data, to provide extremely accurate data reproduction, independent of tape variations.

Pulse Width Modulation (PWM) electronics permit up to 90 channels of quasi-static data on each tape track. All PWM electronics are compatible with standard keyers and decoding equipment.

Flutter-And-Wow Compensation electronically eliminates the effects of tape speed variation. Included as standard equipment whenever discriminators are used for data recovery, they can be accommodated by every Universal Tape System. Compensation permits FM channels of a Universal Tape System to preserve a high signal-to-noise ratio—better than 50 db at 30 ips, for example.

COMPLETE INFORMATION *on Davies new Universal Tape Systems, and how they can satisfy your magnetic tape data recording needs is provided in Bulletin 2701. Write for your copy to Minneapolis-Honeywell Regulator Co., Davies Laboratories Division, 10721 Hanna Street, Beltsville, Maryland. Or call Webster 5-2700.*

MINNEAPOLIS
Honeywell
DAVIES LABORATORIES DIV.

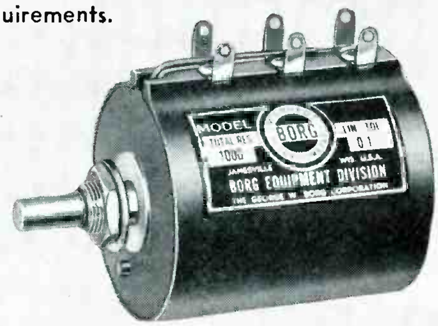
Obtain your Scotch Brand recording tape for all instrumentation recording needs at your nearest Honeywell Industrial Sales Office.

Want more information? Use post card on last page.

PRECISION IS OUR BUSINESS

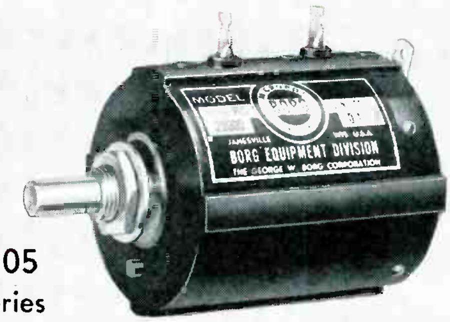
900 series

The new standard of high-precision potentiometers. Advantages include greater accuracy, finer resolution, lower torque, longer life and better performance under adverse environmental conditions. 48 standard models meet most special design requirements.



1100 series

Precision potentiometers that offer your products a price advantage in today's competitive markets. Engineered for easy installation with readily accessible terminals. Accurate, dependable, long lived.



205 series

Long a favorite for both military and commercial purposes. Has proved itself exceptionally rugged and dependable in years of use on many mobile and stationary applications.

BORG MICROPOTS

precision potentiometers with

UNLIMITED DESIGN APPLICATIONS...
MORE PROFITABLE PRODUCTION POSSIBILITIES

Your job is made easier when you use Borg Micropots. They're versatile . . . they're flexible. Standard models can be readily adapted to meet the special requirements of a wide variety of applications. What is more they have many exclusive advantages: — — absolute linearity, permanent accuracy, long life, and dependability. You can rely on them to meet your most rigid commercial and/or military specifications. They're readily available too. Production has been stepped up to assure prompt delivery of any model in any quantity. We invite consultation with your Borg "Tech-Rep". His helpful advice can often save you time and money. Write us today for his name and address. It will pay you to know him.

BORG EQUIPMENT DIVISION
The George W. Borg Corporation
Janesville, Wisconsin

ELECTRONIC – MECHANICAL BORG EQUIPMENT

Built by Borg

Want more information? Use post card on last page.

TECHNIQUES and DEVELOPMENTS in oscillographic recording

FROM **SANBORN**

DESIGN PRINCIPLES AND SOME APPLICATIONS OF A PREAMPLIFIER FOR LOGARITHMIC MEASUREMENTS

THE Model 150-1400 Log Audio Preamplifier (Figure 1), one of eleven plug-in "front ends" now available for 150 Series systems, permits measurements involving logarithmic or exponential functions. The "Log Diode" circuit (shaded portion of circuit block diagram in Fig. 2) is the heart of this instrument, and is based on the logarithmic relationship between the voltage across a thermionic diode and the current through it. If R is large, the current through the diode i_1 becomes proportional to the voltage e_1, and the logarithmic relationship of e_2 and i_1 is transformed into a logarithmic relationship between e_2 and e_1. Circuit constants for this Preamp were chosen to provide an accurately logarithmic relationship between e_2 and e_1, over the range of 200 to .63 volts for e_1. This is a 50 db spread, and the gain of the DC output amplifier (fed by e_2) is arranged so that a 50 db variation in e_1 produces a 50 mm stylus deflection.


Fig. 1

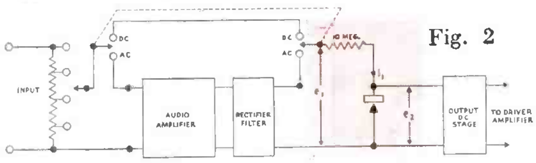


Fig. 2

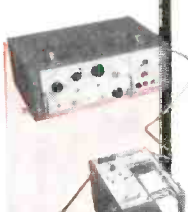
In audio or AC measurements, e_1 is derived from a peak reading type rectifier-filter circuit, which follows a high quality 20 cycle — 20 KC audio amplifier. With an input of 100 mv RMS, this amplifier will produce a 200 volt output from the rectifier. The 50 db chart, therefore, corresponds to a variation in AC input voltage of 0.316 to 100 mv.

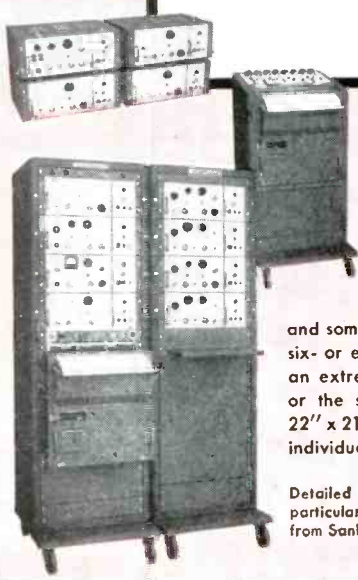
In DC measurements, the audio amplifier is bypassed and the input applied to the diode circuit. Since the diode itself is a rectifier, used in the forward direction with its cathode near ground, the DC input must be polarized with the high side positive.

One broad area of application for the Log Audio preamplifier is audio level recording. For example, room reverberation time can be measured by recording sound level decay after the sound source is suddenly turned off, the reverberation time considered the period required for a 60 db decay to occur. Another example of audio signal recording is the plotting of frequency response curves of audio equipment such as microphones, filters, loudspeakers, etc. A multi-channel recording system with appropriate filters also makes possible audio spectrum analysis.

A second major type of application of this Preamp is the recording of DC voltages on a db basis. If the signals are small, a chopper can be used to convert DC to AC, thus taking advantage of the Preamplifier's audio amplifier. With an impedance matching transformer added to such an arrangement, the system becomes a logarithmic DC millivoltmeter or logarithmic DC microammeter of extreme sensitivity. Such a device could be used for plotting the volt-ampere characteristic of a germanium diode, which might be very helpful in selecting matched pairs of diodes. Another possibility is plotting the output of a fixed gain radio receiver and linear detector to a db scale, to rapidly record antenna performance data.

A comprehensive discussion of the design and these applications of the Log Audio Preamplifier is contained in an article by Dr. Arthur Miller, Chief Electrical Engineer of Sanborn Company, published in the Sanborn RIGHT ANGLE. Copies are available on request.





Which Oscillographic Recording "PACKAGE" fits your needs?

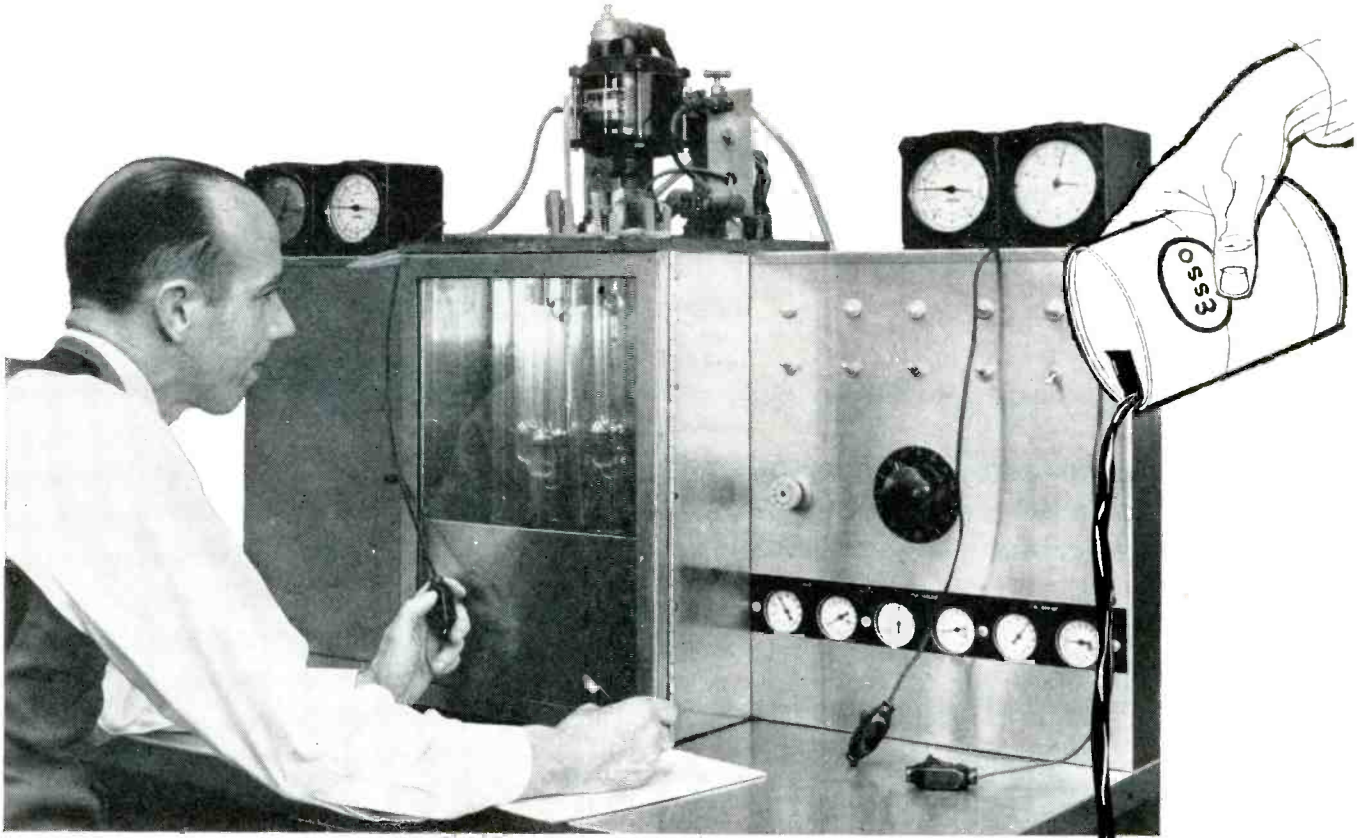
SANBORN "150's" are housed, basically, in either of two ways: a vertical mobile cabinet, or separate portable cases for amplifier and recorder units. This in itself provides a number of "packaging" possibilities, but the number is greatly increased by various other alternate, and sometimes special, housings. For example, an entire six- or eight-channel recording assembly is available in an extremely compact, mobile cabinet only 45" high; or the same recorder can be portably housed in a 22" x 21" x 23" case. If field use of "150's" is planned, individual units in cases fitted with removable covers and carrying handles, connected by patch cords, may be the best answer. Occasionally only a "special" adaption will meet a specific need.

But *whatever* the "150" oscillographic recording "package" you use, you're assured of basic Sanborn "150" advantages: *inkless* recordings in *true* rectangular coordinates; *1% linearity*, resulting from high torque galvanometers and current-feedback driver amplifiers; *numerous chart speeds*, from 0.25 to 100 mm/sec.; choice of *single to 8-channel* systems, readily adapted to new requirements by plug-in Preamplifiers selected from *11* presently available types.

Detailed information, and assistance with your particular recording problem, is always available from Sanborn engineers.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 WYMAN ST., WALTHAM 54, MASS.

Want more information? Use post card on last page.



Helping determine the viscosity index of hydraulic oils and jet engine fuels for Esso Standard Oil.

Where Split Seconds Count . . .

ESSO

There you will find rugged, reliable Standard Electric Precision Timers playing an important part in laboratory and development research, in production and final inspection.

The Esso Standard Oil Company, General Electric, Bell Telephone, American Brass — among other giants of industry — depend on Standard Precision Timers for accurate measurement of elapsed time in split seconds.

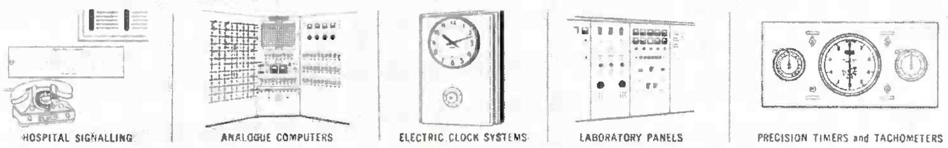
Measure time as close as 0.001 of a second

THE STANDARD ELECTRIC TIME COMPANY

TRADEMARK

97 Logan St., Springfield 2, Massachusetts

Send today for Bulletin No. 198



Transitron

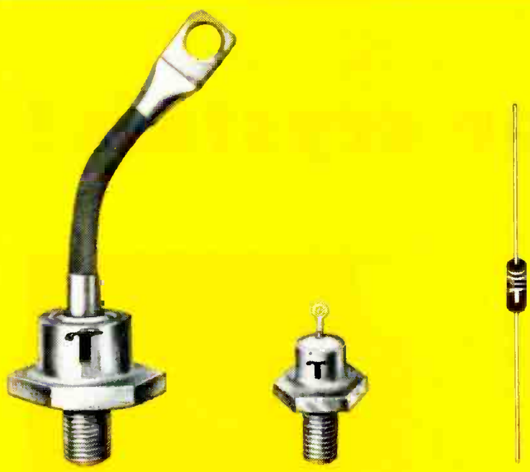
SILICON RECTIFIERS

Now at substantially REDUCED PRICES!

Major price reductions have recently been made in nearly all of Transitron's wide range of silicon rectifier types. These reductions are the result of economies in mass production and expanded usage.

The technical superiority of Transitron's silicon rectifiers has become a well established fact over the past four years. Now, the technical advantages of silicon can be had at a cost oftentimes *below* that of other rectifiers including germanium and selenium.

If you are currently using rectifiers of any type, it will pay you to check with Transitron to find out how silicon can do the job *better* . . . and quite likely at a *lower* cost.



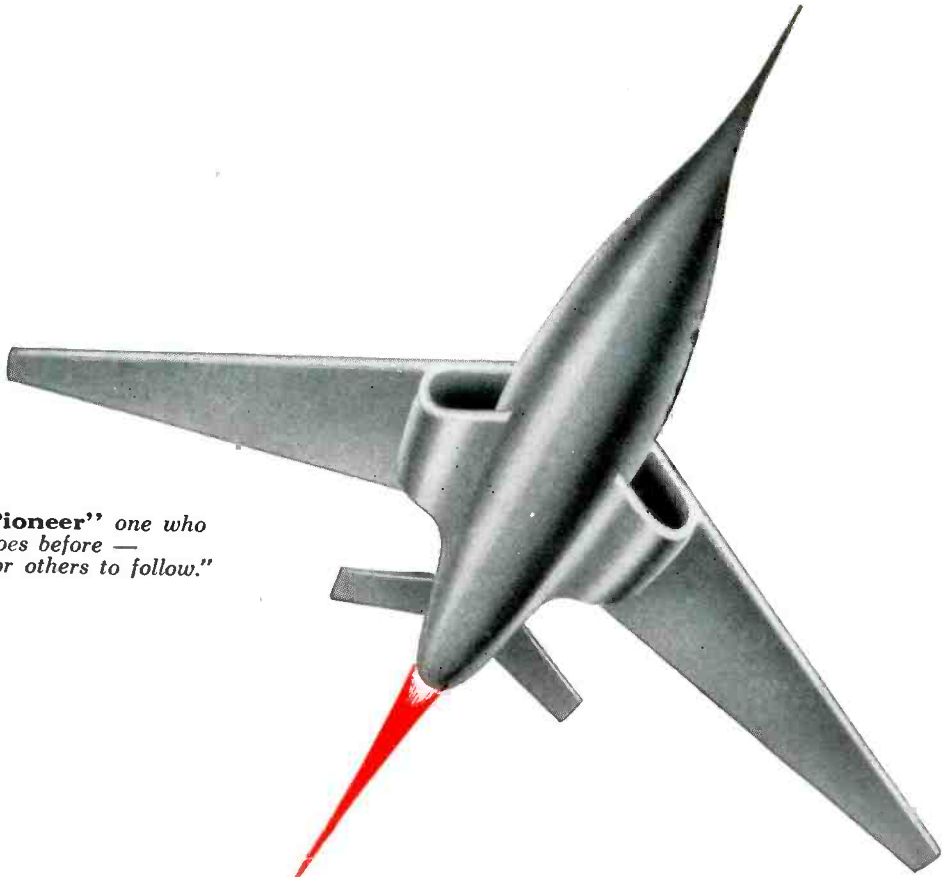
Type	Peak Recurrent Inverse Voltage (Volts)	Average Rectified Current Per Cell (Amps)	Type	Peak Recurrent Inverse Voltage (Volts)	Average Rectified Current Per Cell (Amps)	Type	Peak Recurrent Inverse Voltage (Volts)	Average Rectified Current Per Cell (Amps)	Type	Peak Recurrent Inverse Voltage (Volts)	Average Rectified Current Per Cell (ma)
1N412A	100	35	1N249A	100	20	TM27	200	3	1N483A	70	50
1N413A	200	35	1N250A	200	20	TM47	400	3	1N484A	130	50
TH302	300	35	TR302	300	20	TM24	200	1	1N486A	225	50
TH402	400	35	TR402	400	20	TM44	400	1	1N488A	380	50

MAXIMUM RATINGS AT 150°C

AVAILABLE JAN TYPES: 1N253, 1N254, 1N255, 1N256, 1N457, 1N458, 1N459

Transitron electronic corporation • wakefield, massachusetts

Germanium Diodes · Transistors · Silicon Diodes · Silicon Rectifiers

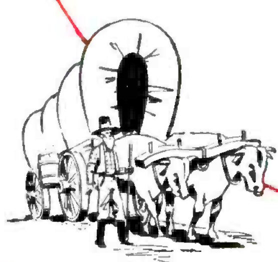


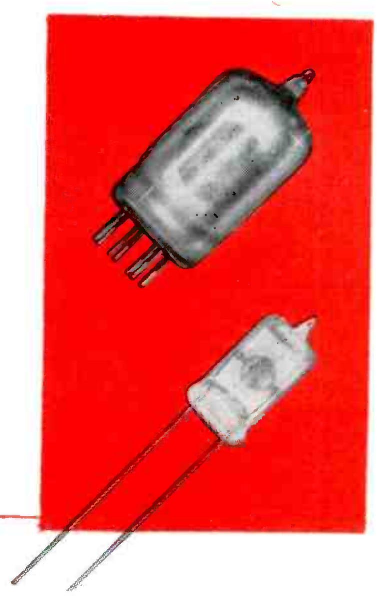
***"Pioneer"** one who goes before — for others to follow."*

IF WEBSTER IS RIGHT —
Then Midland Has Done It Again, this time with

glass holders for crystals!

Absolute and permanent vacuum attainable *only* with glass, isolates the crystal from all factors detrimental to dependable performance. Truly, here are crystals designed with the future in mind — future requirements of application and design as well as the long life of the unit far into the future.





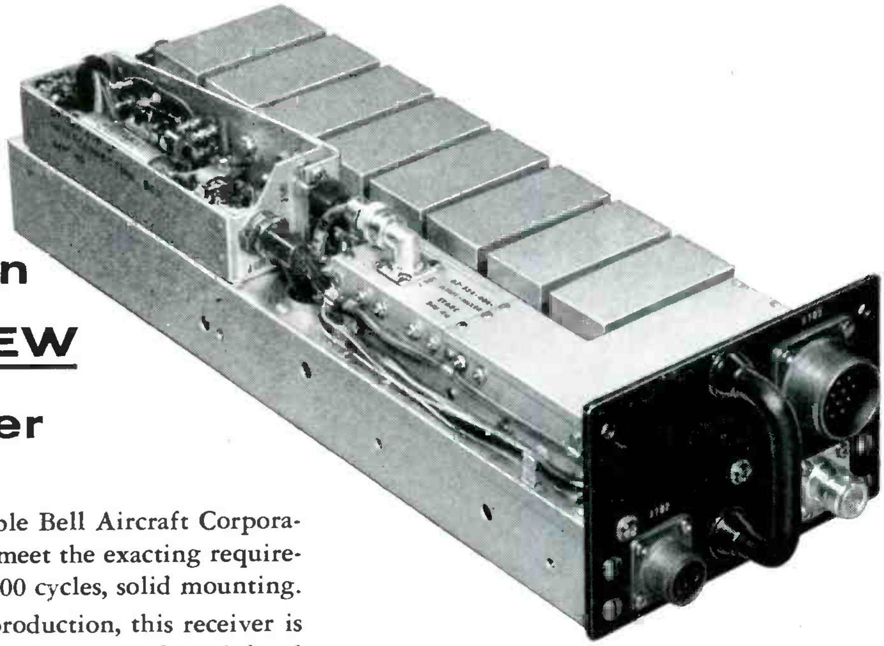
Midland MANUFACTURING COMPANY, INC.

3155 Fiberglas Road • Kansas City 15, Kansas

World's Largest Producer of Quartz Crystals

15 g's
15 g's
15g's

15 g's VIBRATION



. . . no problem in Bell Aircraft's NEW 400 mc Receiver

Modular packaging techniques enable Bell Aircraft Corporation's new 400 megacycle receiver to meet the exacting requirement of 15 g's vibration from 5 to 2000 cycles, solid mounting.

Now thoroughly proven and in production, this receiver is available immediately for any application where demodulated control signals are needed for the activation of command systems requiring a high signal-to-noise ratio, high sensitivity and stability, and a wide audio bandwidth with low harmonic and phase distortion. It is equally at home in guided missiles — as a range safety instrument — or as a ground monitor receiver.

The new 400 mc receiver is only one of many examples of the ability of Bell Aircraft's new *Avionics Division* to design, develop and produce avionic systems, units and components for any needs, however complex. If you have design or production problems in this field, write, wire or phone: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, New York.

THIS NEW BOOK telling of many new and unusual developments in the field of Avionics is yours for the asking. Send request on your letterhead to: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, N. Y.

ELECTRICAL SPECIFICATIONS

TYPE: FM 300 KC Deviation
TUNING RANGE: 406 to 420 megacycles
Plug-in assemblies to extend range to 500 mcs available
OSCILLATOR: Crystal controlled
SENSITIVITY: 5 microvolts or better for 10 db quieting
INPUT IMPEDANCE: 50 ohms
BANDWIDTH: 1.15 mcs ± .1 at 3 db
IMAGE AND SPURIOUS RESPONSE: Better than 60 db
OUTPUT: ± 0.5 db 40 cps to 40 kc 3 db at 100 kc
3.5 volts RMS 500 ohms closed circuit
SQUELCH: Adjustable squelch relay from 10 to 100 microvolts input
POWER INPUT: Less than 50 watts. Power supplies available for 115V - 400 cps or 28VDC

MECHANICAL SPECIFICATIONS

DIMENSION: 3.6 x 5.5 x 15.25 inches.
VOLUME: 300 cubic inches
WEIGHT: 10 pounds
MOUNTING: Solid — 9 mounting screws
OPERATING ENVIRONMENTS: 15 g's
5 to 2000 cycles -55° to +72°C

BELL
Aircraft CORP.
Avionics Division
BUFFALO, N. Y.

Want more information? Use post card on last page.

IMMEDIATE DELIVERY

Two Versatile Instruments for Microwave Testing

*Microline** 539 VSWR Test Set for fast check of X-band radars

This direct-reading test set accurately measures the voltage standing-wave ratio of X-band radars during installation, maintenance and repair. Compact and portable, it consists of a klystron oscillator, high-directivity directional coupler, detector, amplifier and indicator, power supply and modulator. Meter gives continuous indication, making the Microline* 539 valuable for adjusting standing-wave ratio. As the AN/UPM-12, the Microline 539 meets all requirements of Specification MIL-T-945A.

MICROLINE 539 SPECIFICATIONS

VSWR Ranges	1.05–1.3±5% 1.3–2.0±5% 2.0–3.0±10% 3.0–10.0 uncalibrated
Freq. Range	8.5–9.6 kmc
Waveguide Connection	RG52/U (1 x ½ waveguide) or RG51/U (1¼ x ⅝ waveguide) through accessory adapter
Dimensions	Length 19¾ in. Width 12 in. Height 10¼ in.
Weight	35 lbs.
Power Requirements	105–125 volts 50–1000 cycles 75 watts

*Microline** 555 Klystron Signal Source operates klystrons up to 3600 volts

A universal power supply and modulator for klystrons requiring up to 3600 volts, the Microline 555 also operates traveling wave tubes. It is used as a microwave source for measurements and testing experimental equipment. Main features include precise voltage regulation (0.025% max. variation), internal modulator which supplies sawtooth, sinewave or squarewave modulation to tube, convenient controls and repeatable settings.

*T.M. REG. U.S. PAT. OFF.

MICROLINE 555 SPECIFICATIONS

	ANDOE	REFLECTOR	GRID
Voltage Range:	–250 to –3600v	0 to –1000v	0 to –300
Max. Variation:	0.025%	0.02%	0.02%
Max. Ripple Voltage:	10mv	5mv	50mv
Current Range:	0–120ma (250 to 1250v) 0–15ma (1250 to 3600v)		
Power Requirements:	115v ± 10%, 50-60cps, 500w		
Dimensions:	19¼"W x 21½"H x 15"D		
Weight:	151 lbs.		

For prices and further details, phone or write our Microwave Electronics Division.

MICROWAVE ELECTRONICS DIVISION

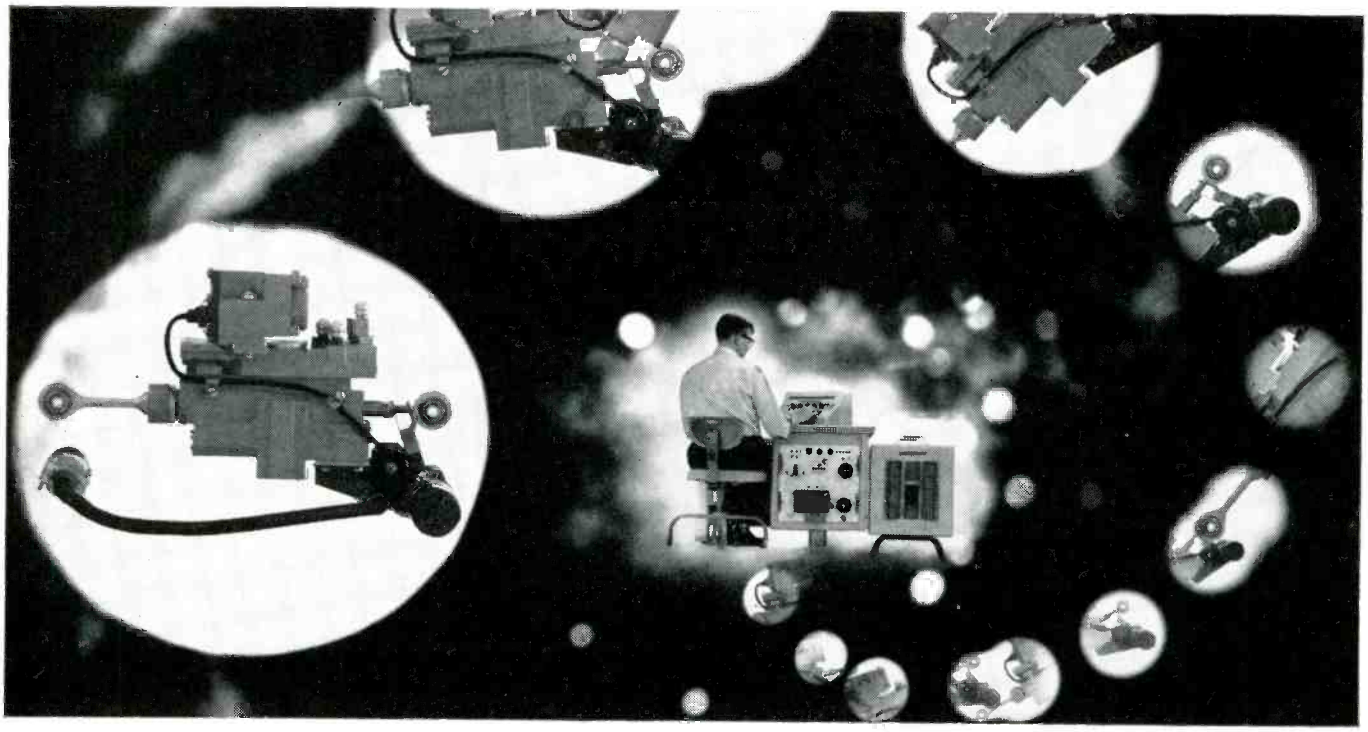
SPERRY GYROSCOPE COMPANY

Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

CLEVELAND • NEW ORLEANS • BROOKLYN • LOS ANGELES • SAN FRANCISCO • SEATTLE • IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LTD., MONTREAL, QUEBEC.

Want more information? Use post card on last page.



Let the engineers who are doing it tell you

What it's like to work in a nerve center of the new industrial era

Dr. John Bower, former associate professor of electrical engineering at Yale, has been with Autonetics 7 years . . . 5 years in charge of automatic machine tool controls development. Last April he was promoted to automatic industrial controls section chief.

Dr. John L. Bower, Chief of our Automatic Industrial Controls Section, put it this way:

"Automatic electro-mechanical control systems are the eyes, ears, and brains of the second industrial revolution. At Autonetics, we've been in the relatively young field of electro-mechanics for 11 years... making breakthroughs on many major fronts. The time was never riper for creative engineers to get in on this work."

Today you can build your career on this solid base of accomplishment, and grow forward with us as we tackle new and ever more challenging assignments.

For instance, if you are strong on servo, transistor, or digital techniques—you may qualify for a special position in the development of automatic machine tool controls, computers, automatic checkout equipment, bombing navigation systems, or advanced inertial navigation systems.

Two of our new developments in these fields are: *Numill*—a completely transistorized, numerical tape-directed control system for machine tools... and *Recomp*—a 200 pound portable computer that has giant-computer capacity.

Whatever field of engineering you enter at AUTONETICS, you'll work in an engineering-management atmosphere that is conducive to your professional advancement. You'll enjoy research, development, and test facilities as advanced as the project on which you're working.

Our engineering brochure tells the story in more detail. It's easy to get one; just send the coupon below.

Leo Noe, MSEE-Yale, joined Autonetics in 1951 as research engineer in autopilots. In '53 he was promoted to supervisor. Leo's responsibilities included development of aircraft yaw and pitch dampers. In '56 he made group leader in automatic checkout.

Autonetics
A Division of North American Aviation, Inc.

AUTOMATIC CONTROLS MAN HAS NEVER BUILT BEFORE

Mr. A. N. Benning, AUTONETICS, Dept. 358, EL-7, 9150 E. Imperial Hwy., Downey, California

Dear Mr. Benning: Please send me AUTONETICS' engineering brochure. I am interested in the following fields. (check one or more)

Guidance ☐ Fire Control ☐ Computers ☐ Flight Control ☐ Automated Machine Control ☐ Systems Analysis ☐ Test Equipment ☐

Name ____________ Home Address ____________

Degree (s) ____________ Home Phone ____________

Experience ____________

Want more information? Use post card on last page.

New trends and developments in designing electrical products . . .

- First radially heat-treated magnets ever mass-produced
- G-E thermistor makes new temperature controls more sensitive

G-E Magnet Engineers turn idea into reality

The physicist at Roanwell Corp., Brooklyn, New York, had the idea – but it took a revolutionary development in magnet manufacture to make it come true.

Roanwell was working on a new receiver for military headsets sensitive enough to distinguish sounds clearly, even under combat conditions.

A new, dynamic receiver design solved the sensitivity problem. But then the weight and height of the unit had to be reduced to make it less bulky in the aviator's helmet.

Original specifications called for an assembly of several magnets which was smaller than the plug-type magnet normally used. But the Roanwell physicist's idea was to use a *single* radially heat-treated Alnico 5 magnet to reduce the size still further, and eliminate extra fabrication steps.

No one had ever mass-produced a radially heat-treated magnet like this before (Fig. 1). And no one knew if it could be done. So Magnet Engineers from General Electric were called in to try.

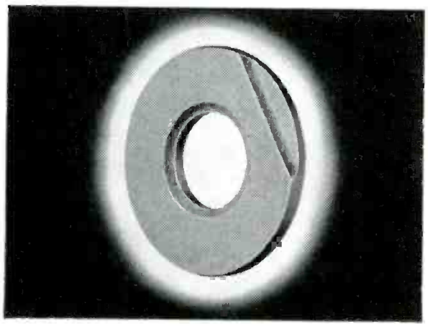


Figure 1

They solved the problem all right. But here's what they had to go through to do it:

First, they came up with special directionalizing equipment to orient the magnetic domains so the magnet could be magnetized radially.

Next, with engineers in G.E.'s unique Quality Standards Laboratory, they worked out the processing technology for mass production.

This meant starting from scratch to determine the initial heating temperature, rate of coiling, best field shape. It meant calculating axes of the directionalizing coil, computing proper aging time and temperature. And finally, it meant thorough testing and careful control of production.

The result: Roanwell is now using the first commercially produced radially heat-treated magnets (Fig. 2). The magnet produces the same flux density, but it requires less height (in fact, about half the height of a plug magnet).

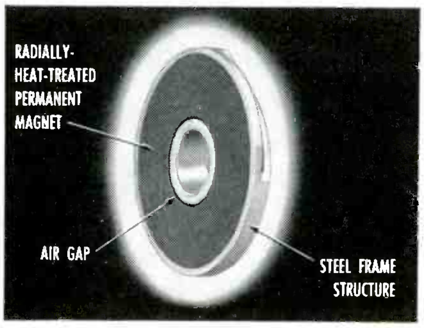


Figure 2

Because a single magnet is used, the unit is stronger, more reliable . . . and has the needed sensitivity. Equally important, the magnet can be machined accurately. This is critical because the circular air gap for the vibrating coil (see Fig. 2) is only a few thousandths wide, and magnet tolerances must be held as tightly as possible.

For Roanwell, G-E Magnet Engineers came up with this new method for mass-producing radially heat-treated magnets. For other manufacturers, they have handled jobs ranging from the design of complete magnetic circuits to development of new magnetizing and testing procedures.

Whatever the problem, G-E Magnet Engineers have the experience, skills, and the facilities behind them to solve it.

To get their expert design assistance, or your copy of the new G-E Magnet Design Manual, all you have to do is write: *Magnetic Materials Section, General Electric Company, 7806 N. Neff Road, Edmore, Mich.*

G-E thermistor gives new temperature control sensitivity to 0.075° F.

Furnace heat maintained at given levels, and alarms sounded when temperatures exceed specified limits – both can be controlled by a new device called the "Simplytrol."

The Simplytrol is made by Assembly Products, Inc., Chesterland, Ohio. It responds to changes as small as 0.075° F. because it uses a G-E thermistor as the sensing device.

The thermistor is one leg of a bridge in circuit with a D'Arsonval meter relay. (Fig. 3).

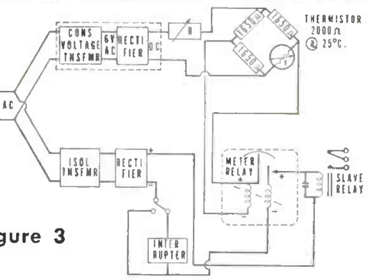


Figure 3

Because the thermistor has a large *negative* temperature coefficient of resistance, even minute changes unbalance the bridge to let the current actuate the relay.

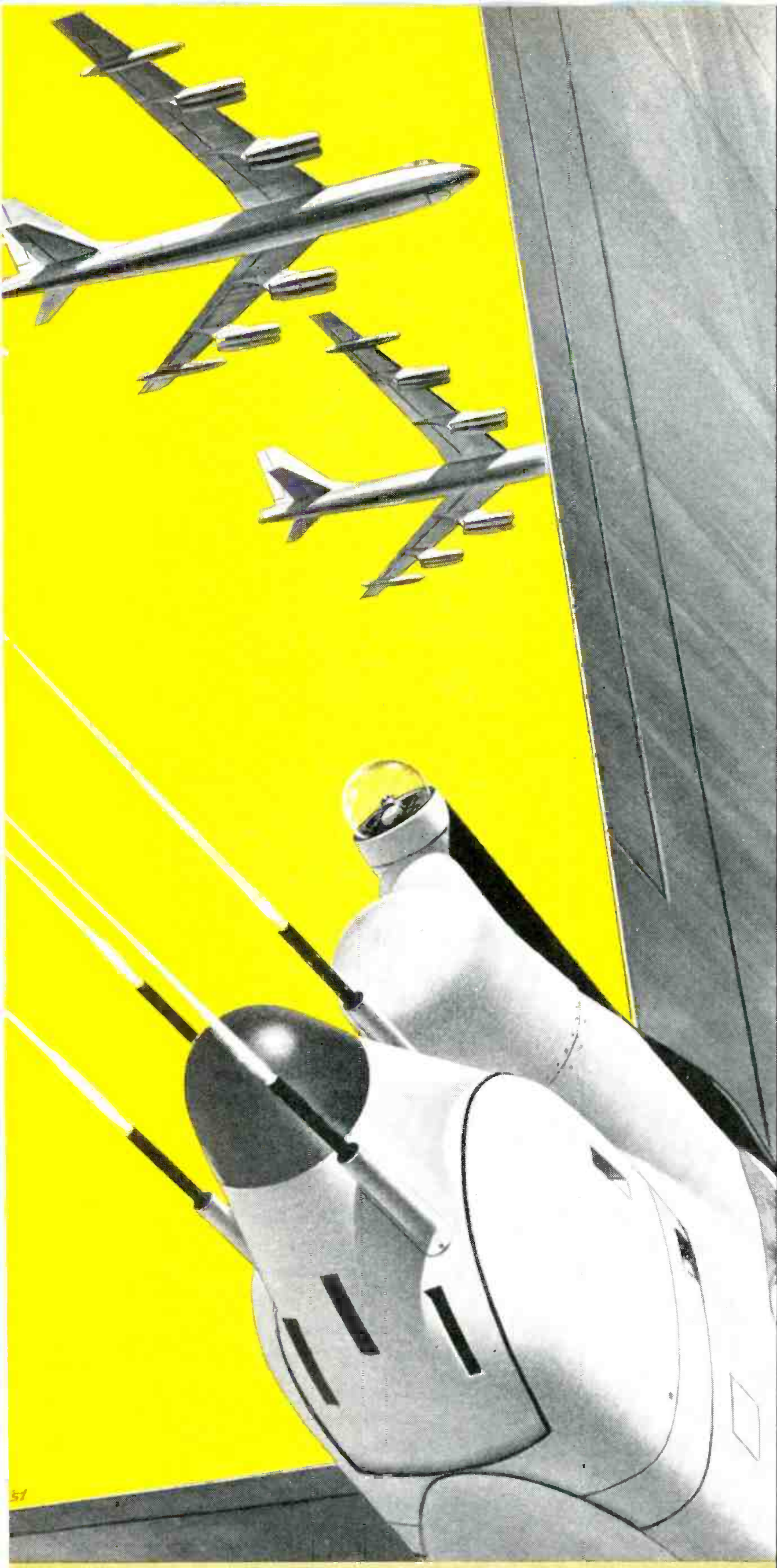
The thermistor is more sensitive than other types of sensing elements. And in the Simplytrol, it can be wired up to 200 feet from the control without affecting accuracy.

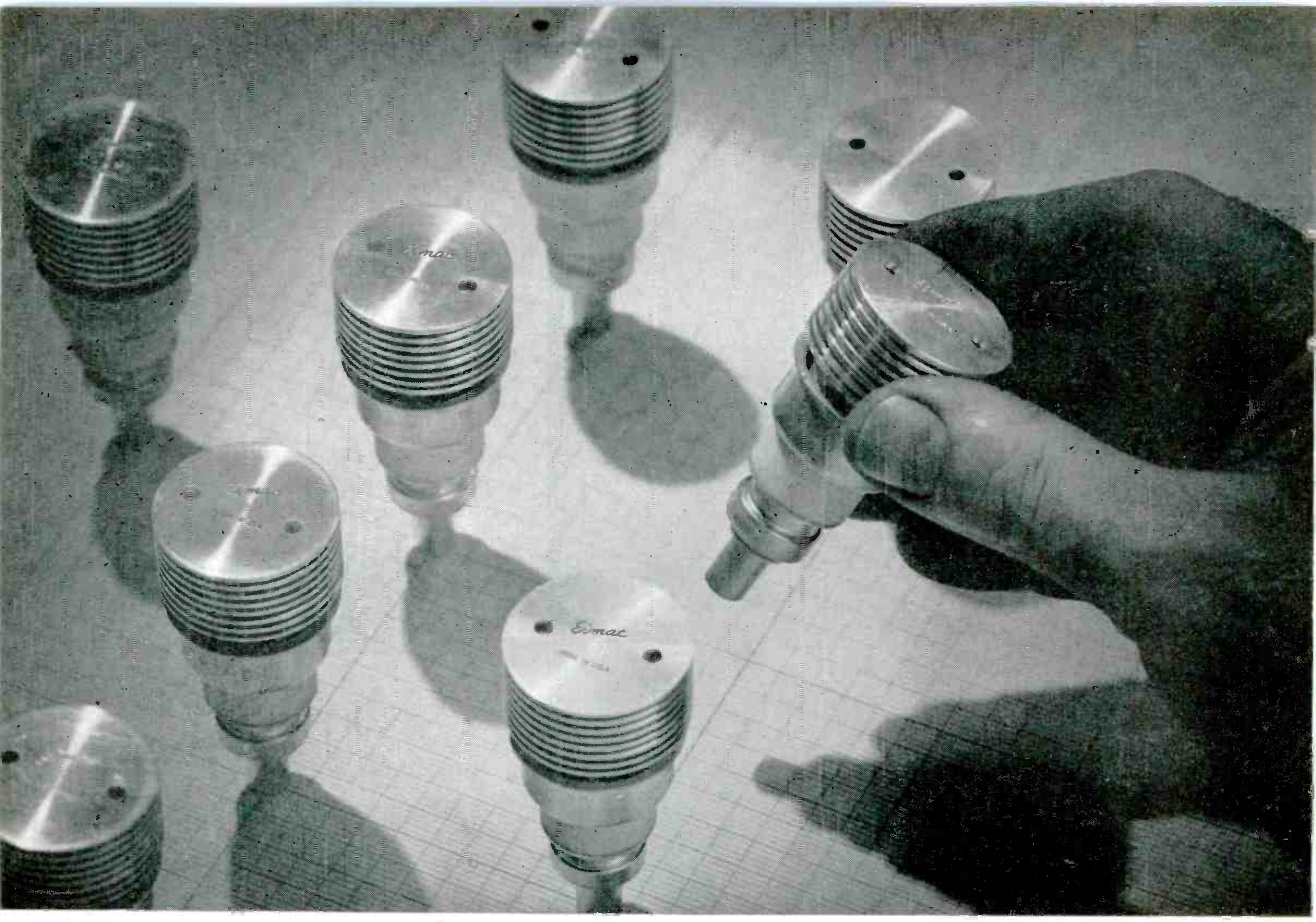
In these and similar devices, the thermistor senses changes in ambient temperature. However, when it is heated by the current of the circuit, a whole new range of applications is opened: voltage regulators, time delays, sequence switching devices.

If you have problems in these application areas, experiment in your plant with G-E Thermistor Kits – they're only $12.50 each. To find out which is best suited to your needs, write: *Magnetic Materials Section, General Electric Company, 7806 N. Neff Road, Edmore, Michigan.*

Progress Is Our Most Important Product

GENERAL ELECTRIC




Eimac

Model GLH

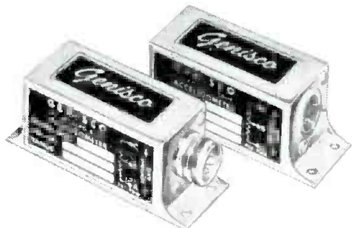
A rugged magnetically damped instrument with low natural frequencies for low range. High-quantity production assures good price and delivery schedules. Available in ranges from ±1 G to ±30 G.

Model DDL

Magnetically damped low-range instrument available in ranges from ±1 G to ±30 G. Ultra-sensitive models supplied as low as ±0.1 G. Certified to MIL-E-5400 and MIL-E-5272A. Especially good in severe shock and vibration applications. An acceleration-sensitive switch version of the DDL is designated as the Model DDS.

Model GAL

Incorporates a variable transformer a-c output with the magnetically damped sensory mechanism of the proven Models DDL and GLH. Superior reliability, life, resolution, and sensitivity. Available in ranges from ±1 G to ±30 G. Range as low as ±0.1 G also obtainable.

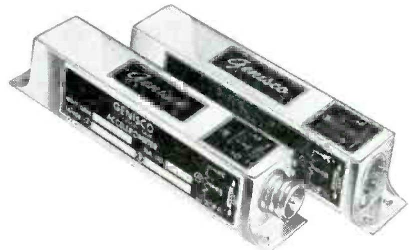


Model GMO

A rugged, miniature, viscous-damped instrument with ranges from ±2 G to ±30 G. Unbalanced-range instruments also available. Medium high natural frequencies.

Model GMT

Basically a Model GMO with internal thermostat-operated heater, assuring maximum environmental stability within the instrument. Damping remains constant with change in ambient temperature.



Model GDM

Miniature double-potentiometer instrument capable of sensing lateral acceleration in two mutually perpendicular planes (e.g., pitch and yaw). Ideally suited for missile and high-speed aircraft flight control systems.

NEW! GENISCO ACCELEROMETERS NOW GOLD PLATED FOR GREATER RELIABILITY

CASES GOLD PLATED INSIDE AND OUT—This new trend in instrument plating has two important advantages over tin plating or fusing. Being the least active metal, gold prevents the formation of crystalline "whiskers" inside the case which could reduce performance and even cause malfunction. Gold plating also assures positive protection against corrosion to the exterior of the case and, because of its excellent solderability, makes possible a more reliable hermetic seal. The new gold plating is available on *all* models at *no extra cost.*

Descriptive data sheets available on all models.
Please send request on company letterhead.

Genisco INCORPORATED

2233 Federal Avenue
Los Angeles 64, California

Now...

One Integrated Source

for High Temperature • Vacuum-Tight
Mass-Spectrometer Tested

Ceramic-to-Metal Seals

NOW AVAILABLE—A standard line of Alite high voltage bushings. Sizes 2" or 2¾" diameters; 2 to 8 flutes; 1, 2 or 3 terminal studs; optional stud lengths and thread sizes.

With the addition of complete facilities for high temperature metalizing and bonding, our Alite Division offers engineers and designers a single dependable source for ceramic-metal assemblies. Now you can plan for superior quality and highest precision in electronic insulating components employing ALITE—the sintered aluminum oxide especially formulated for critical electronic applications.

Alite possesses a unique combination of properties which makes it ideal for use as the insulating body in ruggedized, high performance hermetic seals and bushings. It has exceptionally high mechanical strength and thermal shock resistance, permitting operation over wide extremes of temperature, pressure, humidity and vibration. Alite maintains its high dielectric strength and excellent low-loss characteristics at micro-wave frequencies and elevated temperatures.

Alite seals are operative at extremely high temperatures, being limited only by the melting point of the bond metal used. When Alite is metalized and bonded, using high temperature brazing metals such as pure silver, copper, gold, or their alloys, the result is a vacuum-tight Alite-to-metal seal that meets the most exacting requirements.

Get in touch with us if you have component problems involving ceramic-to-metal seals.

Our technical service is ready to handle your toughest assignments.

A Few Outstanding Properties of ALITE

Tensile Strength	26,500 psi
Compressive Strength	285,000 psi
Dielectric Constant @ 10,000 mc	8.4
Dielectric Strength (volts per mil)	250
Power Factor @ 10,000 mc	0.0008
Loss Factor @ 10,000 mc	0.0067

Write for Bulletins A-35, A-20 and A-7R

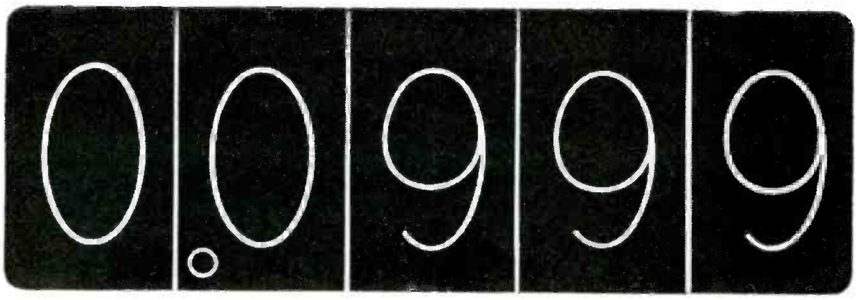
ALITE DIVISION **U. S. STONEWARE**

AKRON 9, OHIO

NEW YORK OFFICE: 60 EAST 42nd ST.

480-E

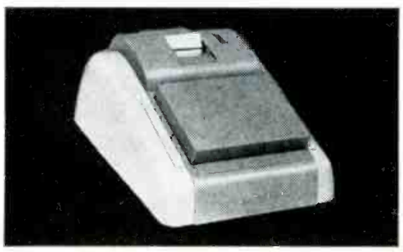
Want more information? Use post card on last page.



EITHER WAY OR BOTH

...in a clear numerical form or a printed record NLS gives you rapid, accurate electrical measurements.

The vital accuracy in electrical measurement instruments that today's exacting sciences demand is provided by Non-Linear Systems, Inc. Not only are NLS digital instruments unsurpassed in speed, dependability and long life, but their visual readout performance may be supplemented by printed data recorders. Thus, visual reading may be done by unskilled personnel while printed or punched paper data is also recorded for future study. Complete, pre-engineered automatic test systems can be established by adding input scanners to NLS digital instruments, permitting sampling of up to one thousand stations. Oil immersed stepping switches – an exclusive NLS feature – assure constant accuracy and trouble-free long life of both NLS digital voltmeters and ohmmeters. The NLS line of digital instruments covers a wide range of engineering and scientific electrical measurement applications. Whatever your needs in this field, NLS can meet your most exacting requirements in instruments and systems. Your inquiry will be welcomed.



Clary Printers (both 8 column and 11 column) are supplied by NLS to be used in connection with DC digital voltmeters, 4 digit and 5 digit AC/DC voltmeters or ohmmeters.

Input scanners used with NLS digital voltmeters or digital ohmmeters provide for automatic scanning of many inputs and when used with data recorders provide complete automatic systems.

Flexowriter equipment for typewriting of data and simultaneous paper tape punching may be used with NLS digital voltmeters and ohmmeters. NLS Flexowriter converters are provided for this purpose.

Originators of the Digital Voltmeter

non-linear systems, inc.

San Diego County Airport, Del Mar, California, Dept. D757
Sales Engineering Offices in Los Angeles and Cleveland

Digital Ohmmeters • AC-DC Converters • Data Reduction Systems • Digital Readouts
Peak Reader Systems • Binary Decimal Converters • Digital Recording Systems

Telephone Relays

Midget Relays

Keying Relays

Rotary Relays

Sealed Relays

Sensitive Relays

Latching Relays

Stepping Relays

Delay Relays

Timers

Contactors

Motor Starting Relays

Differential Relays

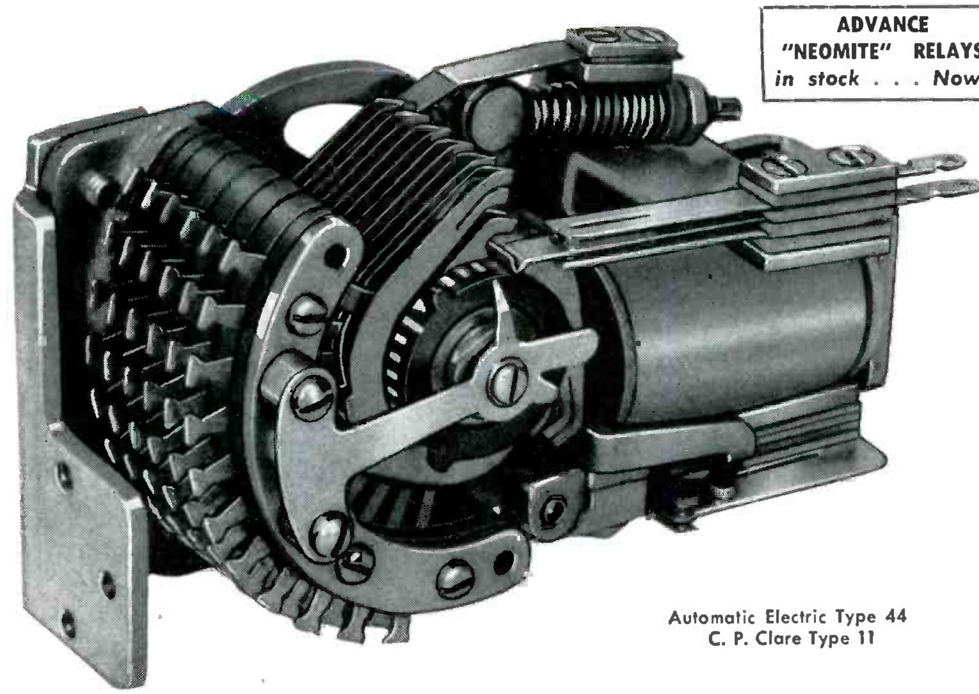
Polarized Relays

AN Approved Relays

RELAYS

QUICKLY supplied from stock!

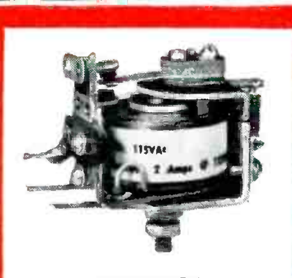
ADVANCE "NEOMITE" RELAYS *in stock . . . Now!*



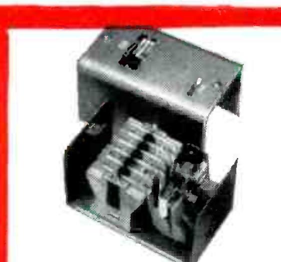
Automatic Electric Type 44
C. P. Clare Type 11

Substantial Quantities of Every Type On Hand

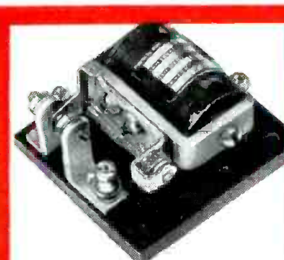
Large or small orders for relays of any type are filled immediately from our comprehensive stock. We save you weeks and months of delivery time. You are relieved of inventory problems and production delays. Call us.



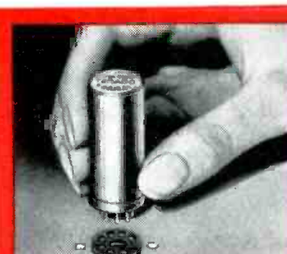
ADVANCE



SCHRACK CONTROLS



STRUTHERS-DUNN



TERADO

Write for new 24 page catalog C-7

Authorized Distributors for Major Relay Manufacturers. All relays are new, inspected and guaranteed. Phone us for same day shipment.

Phone **West Chicago 1100**

Write for new 24 page catalog C-7

RELAY SALES, INC.

P. O. BOX 186-A • WEST CHICAGO, ILL.

NOW! A REVOLUTIONARY NEW CONCEPT IN PRECISION DIGITAL MEASUREMENTS OF AC, DC, Ohms and RATIOS

New E-I transistorized plug-in modules give maximum flexibility for custom applications with standard off-the-shelf modules.

This latest E-I development provides the maximum versatility in digital instrumentation. From a few basic modules a host of instruments can be constructed. Basic modules never become obsolete. To do new jobs, simply add new modules. Equipment can be easily kept current at minimum cost and engineering.

But versatility is only part of the story. These new modules also boast dramatically new engineering specifications, fully transistorized circuits and numerous other features which were incorporated as the result of our experience with more than 1,000 digital instruments in the field.

Your E-I representative has complete information on this latest E-I development. Ask him about it... today!

Any precision instrument for measuring DC, AC-DC, Ohms, DC and AC ratios can be constructed from these five basic units!

whether it be a DC digital voltmeter...

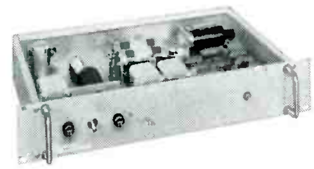
Model DVA-500

an AC-DC digital voltmeter...

Model DVA-510

or a complete check-out system.

BASIC MODULES



Universal Power Module
Supplies all power and reference voltages for other E-I modules. Power and reference supplies and stepper drive amplifier are transistorized. Powers one or more modules. Automatic calibration; stability of 0.01% from 40° to 125° F.; input power: 115 volts, 50 to 400 cycles.

DC Switch Modules, 4 or 5 digits
Visual in-line read-out of digits, polarity, decimal point. All contacts accessible at rear panel connector. Front and rear panel input connectors. Power supplied by Universal Power Module.

DC Pre-Amp Module
Input: 1 range scale, gain of 10.
Output: 0.001 to .9999 volts.
Linearity: 0.01%.
Gain Multiplication Accuracy: 0.01%.
Input Power: 115 volt, 50 to 400 cycles.
Drift: 10 microvolts per hour.

AC — DC Converter Module
A fully transistorized AC — DC converter.
Accuracy: 0.1% of reading, or 2 mv.
Frequency Response: 30 to 10,000 cycles.
Range: .0001 to 999.9 volts.
Zin, AC: 1 meg. on the 1 volt scale, 10 megs. on other scales; 20 mmf.
Ranging: Automatic
Reading Time: 3 seconds, average.

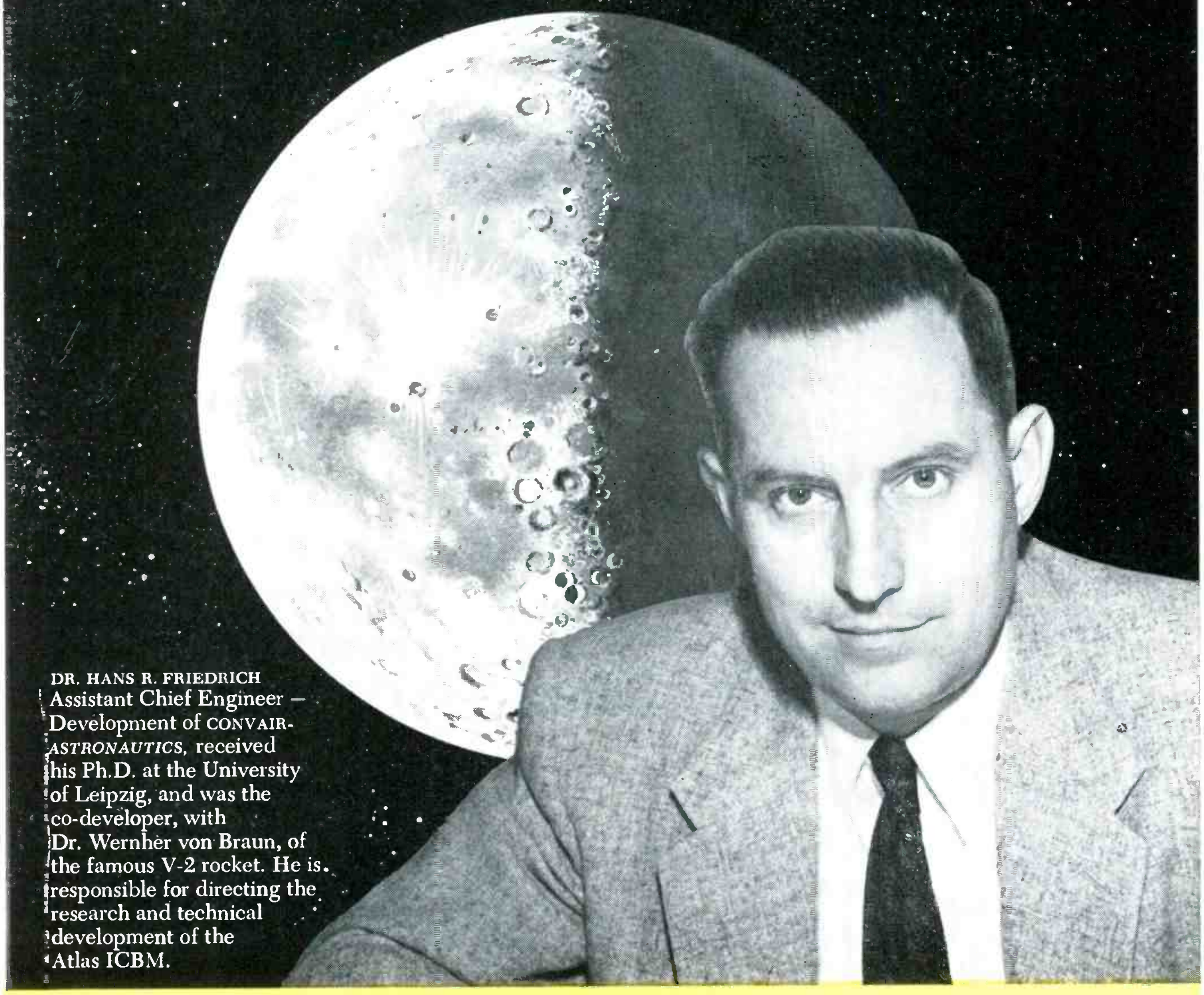
Resistance Switch Modules, 4 or 5 digits
Contains balance circuit, bridge ratio arms. Provides visual in-line read-out digits, range. All contacts accessible at rear panel connector. Power supplied by Universal Power Module.

New short form catalog now available. Write for yours today!

ELECTRO INSTRUMENTS INC.
3794 ROSECRANS, SAN DIEGO, CALIFORNIA

ENGINEERS • SCIENTISTS

"We're developing the Atlas ICBM ...giant step toward Outer Space!"



DR. HANS R. FRIEDRICH
Assistant Chief Engineer — Development of CONVAIR-*ASTRONAUTICS*, received his Ph.D. at the University of Leipzig, and was the co-developer, with Dr. Wernher von Braun, of the famous V-2 rocket. He is responsible for directing the research and technical development of the Atlas ICBM.

"The Atlas Intercontinental Ballistic Missile, now being designed and developed by CONVAIR-*ASTRONAUTICS*, will be, for a time during its flight, a true space vehicle. At hypersonic speeds, it will travel hundreds of miles beyond the earth's atmosphere.

"That's why our top theoretical scientists here at CONVAIR-*ASTRONAUTICS* are exploring every implication of flight into space. Even now these men are thinking in terms of multi-stage rocketry, re-entry, solar propulsion and cosmic dust bombardment. Other teams of our engineers and technicians are engaged in the practical application of this new science, Astronautics.

"Our first job here at CONVAIR-*ASTRONAUTICS*, of course, is to make the Atlas ICBM operative, for we are aware that this is a top priority weapon. You — as an engineer — can appreciate the stimulating atmosphere generated by a project so vital to America's defense.

"As a graduate engineer or scientist with an aptitude for creative thinking, your future is with CONVAIR-*ASTRONAUTICS*. Here you will associate with the leaders in this advanced field — work in our new $40,000,000 facility. You will see and feel the kind of achievement that means personal progress. And you will enjoy living at its best in beautiful, smog-free San Diego.

"For your future's sake, write today to: Mr. G. N. McMillan, Engineering Personnel, Dept. 77-G."

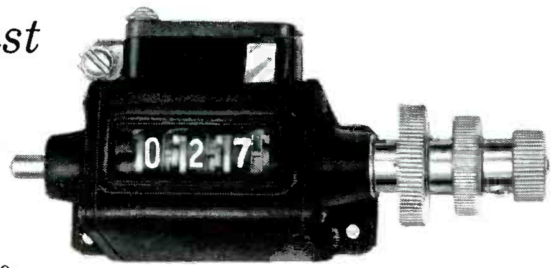
CONVAIR
ASTRONAUTICS

3302 Pacific Highway, San Diego, California

CONVAIR IS A DIVISION OF GENERAL DYNAMICS CORPORATION

Here's why it pays to CALL FOR HELP

...first thing instead of last



If you want to do anything "by the numbers," first thing to do is call the No. 1 man . . . your Veeder-Root District Engineer. Because he's an *original thinker* like yourself when it comes to designing or building *Count*rol into any type of product or process.

He knows his book on the most complete line of standard electrical, mechanical and manual counters made anywhere in the world. And from this line he can very likely adapt or modify a standard counter to your special needs. This saves cost and time in engineering, purchasing, assembly.

And you get a lot of new user-benefits to merchandise . . . direct readings, rather than dials and scales . . . remote indication from plant to office if needed . . . production figures that serve as a fair base for wage and incentive payments, production and stock *Count*rol, tax computation . . . and as proof of your own performance guarantee. So call the V-R man in, *when you begin* . . . look him up in your local phone book, or write direct to:

VEEDER-ROOT INC., Hartford 2, Connecticut

Added Evidence that

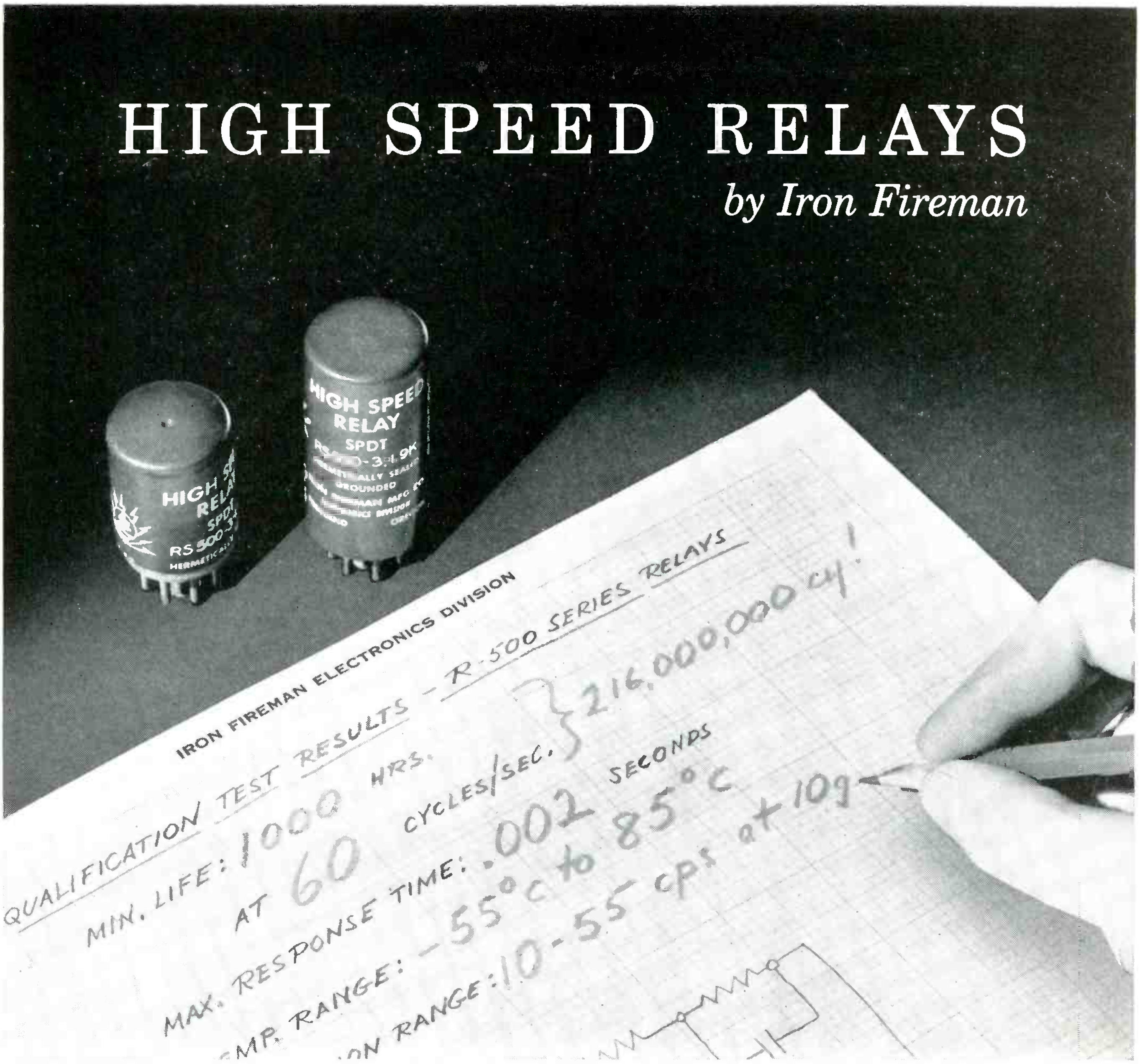
Everyone Can Count on

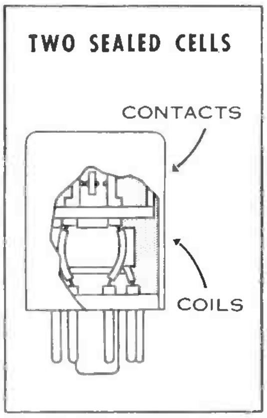
VEEDER-ROOT

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

HIGH SPEED RELAYS

by Iron Fireman





A brand new design

This Iron Fireman high speed relay is a completely new design. It features improved performance and reliability.

The contacts are enclosed in a separate hermetically-sealed compartment within the outer case—which is also hermetically sealed. This double sealing in inert gas eliminates any possibility of contact contamination. Not even volatile emanations from warm coils or wires can affect the contacts.

This is but one of the factors contributing to exceptional service life. Complete performance data available on request. Write to the address below for information on high speed or sensitive relays.

IRON FIREMAN® *Electronics* DIVISION

2838 S. E. NINTH AVENUE, PORTLAND 2, OREGON

Want more information? Use post card on last page.

A Touch here does so much

LIGHT UP . . . SPUTTER OUT . . .

A touch of 'aquadag' between the lead-in wires to the electrode shell and the screen grid of the patented Grid-Lite lamp manufactured by the Ideal Lighting Company eliminates sputter, increases lamp life and improves luminosity by eliminating blackening of the end of the tube caused by metal deposits.

'Aquadag' acts as a "printed" resistor, lowering screen-grid potentials so that electrons are repelled and the narrowed beam focused in the electrode shell. The electric arc occurs in the heel of the electrode shell, dispersing its heat throughout the length of the shell. 'Aquadag', a colloidal dispersion of graphite in water, replaces silver and platinum, which not only are more expensive, but so conductive that they soon burn out. 'Aquadag' can be painted on, a faster and more economical method than the soldering of wire.

'dag'® dispersions of colloidal graphite also have good electrical conductivity, are low in photo-electric sensitivity and resistant to electron bombardment.

An Acheson Service Engineer will gladly discuss the many uses for 'dag' colloidal dispersions in electrical and electronic applications. Write for Bulletin No. 433 "Electronic and Electrical Applications." Address Dept. E-7.

dag®

ACHESON COLLOIDS COMPANY

Port Huron, Michigan...also Acheson Colloids, Ltd., London, England

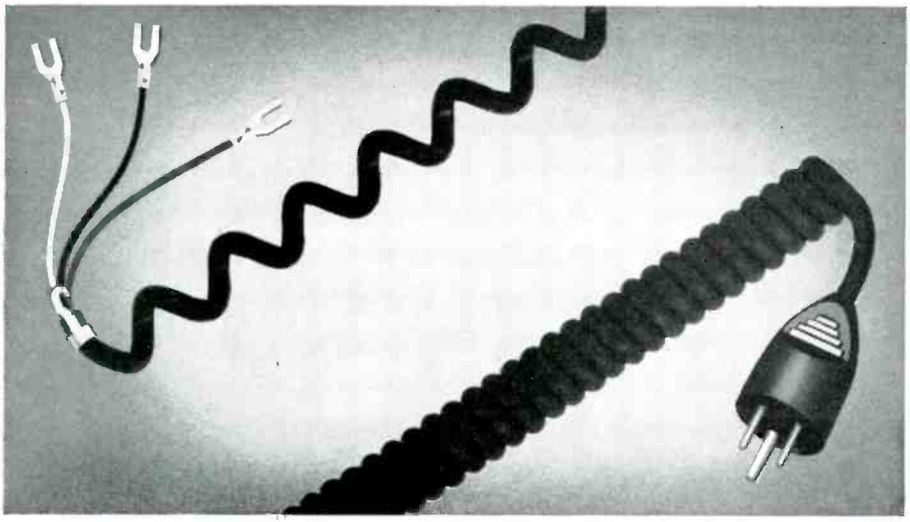
ACHESON COLLOIDAL DISPERSIONS:
Graphite · Molybdenum Disulfide · Zinc Oxide · Mica and other solids

Offices in: Boston · Chicago · Cleveland · Dayton · Detroit · Los Angeles
Milwaukee · Philadelphia · New York · Pittsburgh · Rochester · St. Louis · Toronto

Want more information? Use post card on last page.

Specify CL COILED CORDS

...add important convenience and safety features to your equipment!



Cords Limited COILED CORDS are engineered for specific application!

Coiled Cords, first choice in the communications industry, find numerous important applications in other fields! In addition to user convenience, Cords Ltd. Coiled Cords provide a safety factor preventing costly industrial accidents. Maintenance-wise, Coiled Cords give much longer service than straight cords by eliminating common abuses that shorten serviceability.

Product Data: A leader in the development of Coiled Cords, Cords Limited is a major supplier of this product to the telephone and communication industries. Coiled Cords are engineered for specific applications. Special oil, acid and moisture resistant properties of the jackets protect the product under unusual conditions. The most modern molding facilities for plug and conductor termination are available at Cords Limited to serve your needs quickly and economically!

***WRITE TODAY** for complete details . . . your quotation requests will receive immediate attention!*

CORDS LIMITED DIVISION

ESSEX WIRE CORPORATION

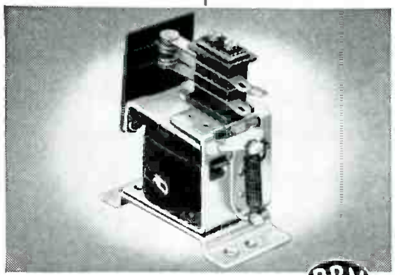
DeKalb, Illinois

*EE

other outstanding

***ESSEX ENGINEERED**

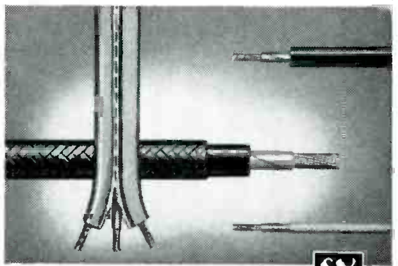
production proven products



GENERAL PURPOSE RELAYS RBM®

A.C. or D.C. General Purpose Multipole relays. For circuit switching of electrical interlocking remote control devices. Features special cross-bar contacts for low-voltage, low current circuits or button type contacts for power switching circuits. Request Bulletin No. 1060.

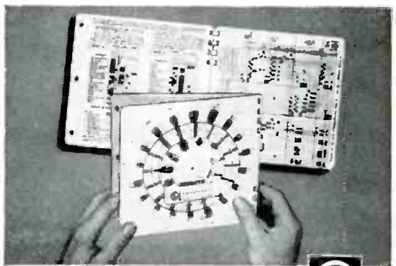
R-B-M "Control" Division
Logansport, Indiana



WIRE AND CABLE SX®

A full "Extra Test®" line of lead, appliance, automotive and refrigeration wires, plus submersible pump cable and 200° C. Sil-X® insulations are examples of the versatility of "Essex Engineering".

Wire and Cable Division
Fort Wayne, Indiana

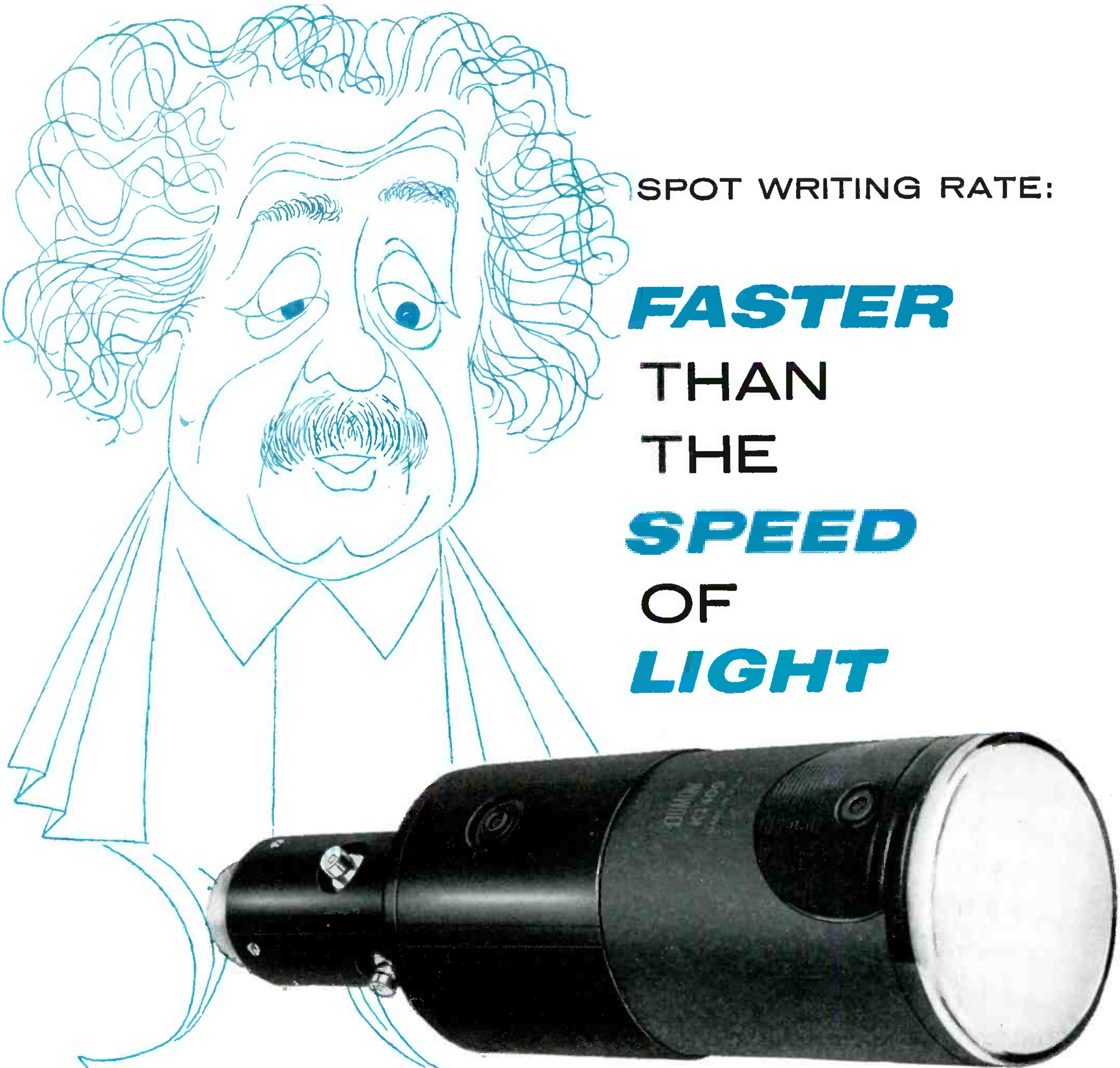


CORD SET DESIGN AID ®

The CORDINATOR®, a time-saving engineering tool, features simplified charts showing approved wire by product types. Dial side permits visual fabrication of cord sets and power supply cords. All components standard approved . . . minimizing cost . . . assuring scheduled delivery. Write for your free CORDINATOR.

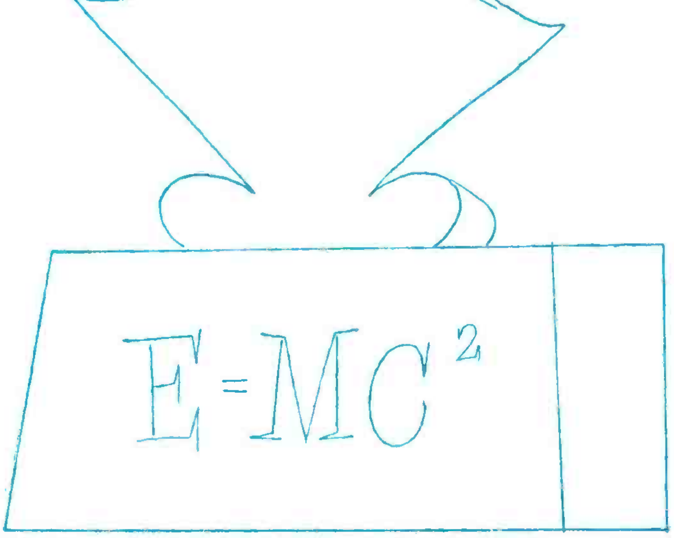
Cords Limited Division
DeKalb, Illinois

SX® **ESSEX** WIRE CORPORATION



SPOT WRITING RATE:

FASTER THAN THE SPEED OF LIGHT



Developed to meet the precise needs of nuclear research and investigation, the Du Mont Type K1409 cathode-ray tube develops a spot writing rate exceeding the speed of light.

This is another example of the "can do" spirit and ability of the Du Mont Tube Research Laboratory.

For cathode-ray tubes, or multiplier phototubes of unusual abilities, call on Du Mont's "can do" . . .

DU MONT®

INDUSTRIAL TUBE SALES,
ALLEN B. DU MONT LABORATORIES, INC.
2 MAIN AVE., PASSAIC, N. J.

Want more information? Use post card on last page.

NEW General Electric M-2 Leak Detector Offers You

UNSURPASSED LEAK SENSITIVITY

Expensive rejects of sealed electronic products can be reduced by leak testing housings before assembly with the new General Electric mass spectrometer leak detector. It offers:

EXTREME SENSITIVITY—detects leaks of 1 X 10^{-10} standard cubic centimeters of air per second (9 X 10^{-6} micron cubic feet per hour).

FAST RESPONSE—as low as 2 seconds for small, hermetically sealed electronic components.

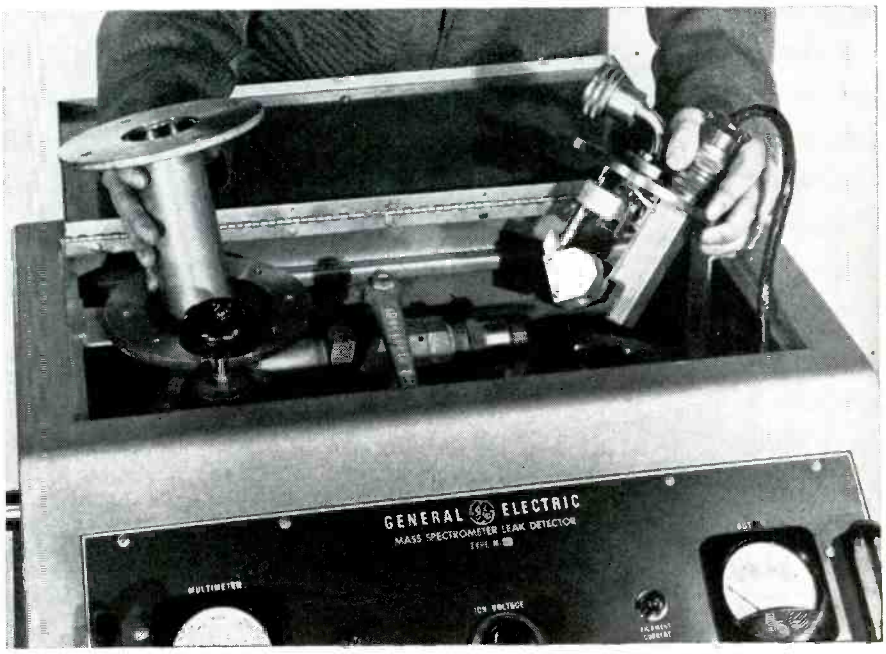
HIGH RESOLUTION which helps eliminate the possibility of response to elements other than the tracer gas.

THESE EASY MAINTENANCE FEATURES HELP REDUCE DOWN-TIME

SIMPLIFIED DESIGN of the vacuum system and use of plug-in components gives excellent accessibility and saves maintenance time. The easily removed spectrometer tube greatly reduces down-time when the tube needs cleaning or filament replacement.

NO SPECIAL TRAINING is needed to operate the General Electric M-2 leak detector. After starting, the M-2 is operated simply by opening and closing one valve. The leak will show up on the leak rate indicator of the operator's panel. An audible alarm is also available.

FOR FURTHER INFORMATION, contact your nearest General Electric Apparatus Sales Office or write for descriptive bulletin, GEC-336, to Section 585-63, General Electric Co., Schenectady 5, N. Y.



DOWN-TIME IS REDUCED through easy access and removal of the spectrometer tube (right) and by a simplified vacuum system design.

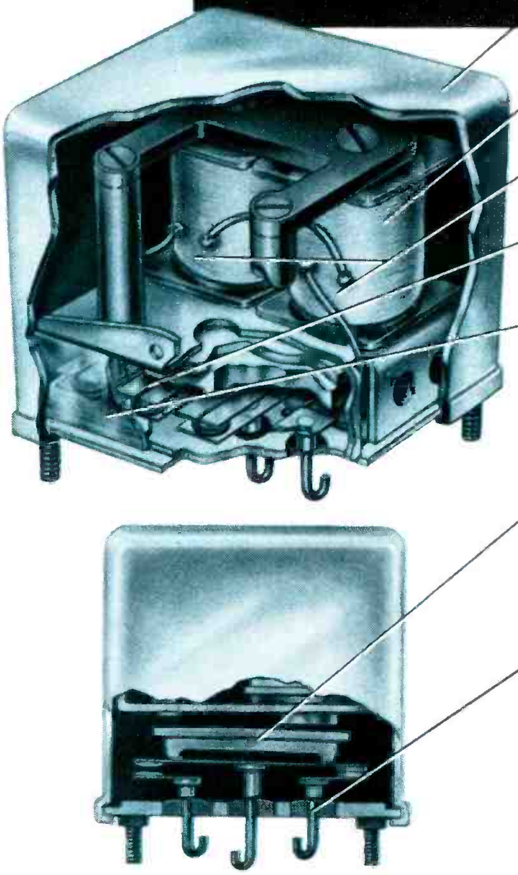
GENERAL ELECTRIC

Want more information? Use post card on last page.

Get unprecedented performance—

See for yourself why the new LEACH BALANCED-ARMATURE RELAYS outperform all other types in resistance to shock, acceleration and vibration

AIRCRAFT AND MISSILE DESIGNERS, PLEASE NOTE



ONE-PIECE DIE CAST ALUMINUM HOUSING for maximum strength and vibration resistance with minimum weight.

MAGNET COIL wound with Teflon insulated magnet wire on one-piece Kel F bobbin assures reliability at elevated ambients.

DUAL COIL construction is the most efficient magnetic circuit for minimum height and maximum resistance to vibration and shock.

BIFURCATED CONTACTS assure high reliability in contact making circuits. Overtravel and high contact pressures produced by the pivoted armature result in immunity to shock and vibration.

ARC BARRIER of Kel F molded construction provides long arc path for use on 3 phase ac circuits, prevents phase-to-phase flashover.

BALANCED-ARMATURE DESIGN. In a *Balanced-Armature* construction, shock and vibration forces cannot cause the relay armature to move. This eliminates faulty operation of contacts due to vibration and shock forces.

HEADER AND CONTACT ASSEMBLY features simplified construction which eliminates internal wiring, lowers lead resistance, provides maximum resistance to vibration. Contacts and working parts are readily accessible throughout assembly, so that Leach is able to measure contact gap, contact pressure and overtravel, prior to sealing, on 100 per cent of production. Customers are assured of maximum performance from every production relay. Patent Pending.

MEETS ALL REQUIREMENTS OF THE MOST EXACTING OPERATING ENVIRONMENTS

The Leach Balanced-Armature Relays meet or exceed requirements of MIL-R-5757, MIL-R-6106, MIL-E-5272. Typical ratings include: vibration, 20 G's to 500 cps (higher ratings available); shock and acceleration, more than 50 G's; temperature, −50° to +125°C; life, 50,000 continuous operations minimum at rated load; coils, any resistance to 10,000 ohms—also available for 115 vac, 400 cps operation.

Write today for your copy of the Leach Balanced-Armature Relay Catalog.

LEACH CORPORATION | LEACH RELAY DIVISION

5915 AVALON BOULEVARD, LOS ANGELES 3, CALIFORNIA

DISTRICT OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES OF U. S. AND CANADA

DESIGNER'S FAVORITE SENSITIVE, VERY RESPONSIVE

Thermoswitch® Is Rugged, Adaptable, Heat Controller

ASHLAND, MASS. — Word emanating from here is that Fenwal Incorporated's THERMOSWITCH units are usually the best solution for a design engineer with temperature-control problems.

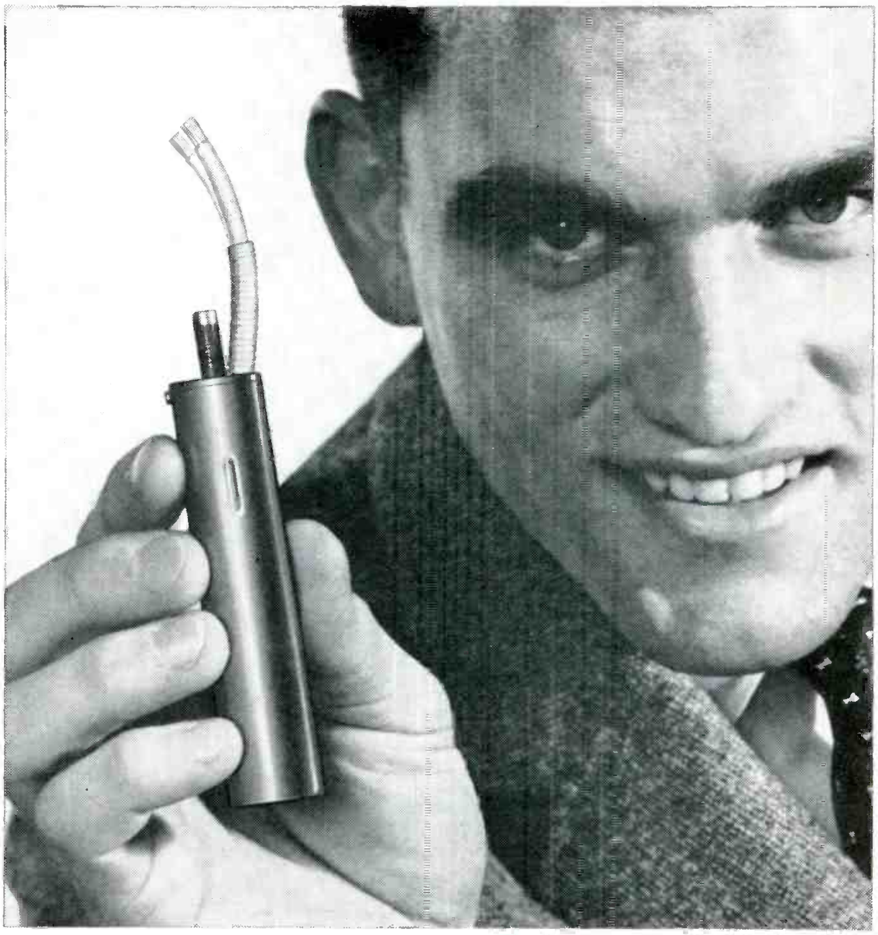
THERMOSWITCH thermal controls are adaptable, sensitive, responsive, small, tough, and accurate — and their price is right. They frequently replace controllers costing much more, and do a better job.

Their principle of operation is unique — and highly competitive in terms of every quality most design engineers would require. The unique principle is this: *the activating control element is a single-metal shell that expands or contracts instantaneously with temperature changes, making or breaking the totally-enclosed electrical contacts.*

Design engineers have put THERMOSWITCH units to work everywhere that temperature control is vital — in planes . . . factories . . . ships . . . hospitals . . . food-processing plants . . . homes . . . laboratories. The list of THERMOSWITCH applications is virtually endless. So is the list of physical ordeals the units have survived and the high performance standards they've met.

When tested alongside bulb-type and enclosed bi-metallic thermostats under identical conditions, THERMOSWITCH units have overwhelmed both with performances like these:

- reaction speed, four to nine times as fast;
- heat-responsive area, three to six times as large;
- heat-transfer path, only one-third to one-sixth as long;
- temperature differential, only one-tenth to one-nineteenth as great;
- vibration-sensitivity, only one-twelfth to one-eighteenth as great;
- shock-sensitivity, only one-tenth to one-eighteenth as great;



FENWAL THERMOSWITCH UNITS may solve your temperature control problems, too. Sensitive, tough, and accurate — they have been put to work by designers wherever temperature control is vital. Over 25,000 variations of the THERMOSWITCH unit are available. Write for THERMOSWITCH folder.

Added to these points of superiority are such demonstrable features as uniformity of sensitivity throughout the operating range, built-in temperature anticipation, enclosed tamper-proof assembly, direct radiant heat reception, and an operating range from −100°F. to 600°F.

Other ranges are available, too. The point at which a unit makes or breaks a circuit is determined by a set screw easily adjusted in the field.

There's a Fenwal sales engineer ready to help you apply THERMOSWITCH units to your particular heat control problems — ready with over 25,000 variations. Write Fenwal for his name and for complete specifications. **Fenwal Incorporated, 207 Pleasant Street, Ashland, Mass.**

Fenwal

CONTROLS TEMPERATURE
. . . PRECISELY

NEW ELECTRONIC GALVANOMETER

dc null detector

micro-microammeter

microvolt level dc amplifier

microvoltmeter

Sensitive - Rugged - Versatile

Functionally equivalent to suspension galvanometers, but with far greater versatility, the Model 204A is the ultimate for DC null detection in low level bridge and potentiometer circuits. KIN TEL's chopper stabilized, all transistor design provides extreme sensitivity and rugged durability superior to conventional moving coil or electronic galvanometers.

Immune to overload and shock, the current sensitivity of the Model 204A is 20 times greater than the sensitivity of high quality, mechanical current galvanometers. As a voltage galvanometer, the extremely high power sensitivity of the Model 204A makes it superior to low impedance moving coil instruments. This reliable, general purpose unit is ideal for use as a direct reading indicator for strain gage, thermocouple and other current or voltage measurements in industry or laboratory. The 204A's simplicity of operation makes it the key to efficient production line testing. Its unequalled stability makes it ideal for low level DC amplification to extend the range of recording and other measurement instruments.

Representatives in all major cities.

A dozen good reasons why KIN TEL's Electro-Galvo solves your low-level dc measurement problems

1 20 Micro Microamps Per Division Sensitivity

2 ± 10 Microvolts to 10 Volts or ± 0.001 Microamp to 1 Milliamp Full Scale Sensitivity

3 Withstands Extreme Overload with No Zero Offset

4 Transistorized — Rugged — Insensitive to Shock, Microphonics, Position

5 Floating Input

6 7 Voltage or Current Ranges

7 10,000 Ohm Input Resistance

8 10^{-14} Watts Full Scale Power Sensitivity

9 Equivalent Built-in Ayrton Shunt — No Accessories to Buy

10 Use as Stable DC Amplifier with 1 Volt at 1 ma Output

11 Less than 2 Microvolts Drift

12 Less than 1 Microvolt P-P Noise

Model 204A Price $325.00

KIN TEL (KAY LAB)
5725 KEARNY VILLA ROAD • SAN DIEGO 11
CALIFORNIA • BROWNING 7-6700

Want more information? Use post card on last page.

Long Life and Reliability

for Telephone and Computer Service

- **Capacitors conforming in appearance and construction with current telephone standards.**
- **Capacitors of telephone grade performance, but of other physical designs . . . designed for low leakage and high stability in computer circuits.**

Whenever and wherever circuit parameters call for the maximum reliability and life potential, Mallory capacitors are right for the job. Life expectancy of this line of capacitors is over 15 years, when properly applied to critical circuits.

Behind this design are Mallory's 18 years of building this type of high quality component. Their experience in selecting proper materials and maintaining the purity of these materials through careful handling and specialized manufacturing techniques, gives to industry this top quality line of special capacitors for such critical services as telephone and computer circuitry.

In keeping with the Mallory policy of continuous development and product improvement, a new, positive venting system has now been incorporated in this series of capacitors. This exclusive venting device gives positive protection in the event of abuse or misapplication.

Mallory capacitor specialists are always available to consult with you on the application of this special line, or any of the broad range of commercial and JAN grade capacitors, for your special circuit requirements.

Serving Industry with These Products:

Electromechanical — Resistors • Switches • Tuning Devices • Vibrators
Electrochemical — Capacitors • Mercury and Zinc-Carbon Batteries
Metallurgical — Contacts • Special Metals • Welding Materials

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

Expect more . . . get more from

P. R. MALLORY & CO. Inc.
MALLORY

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

CROSS TALK

►**SCATTERSHOT SELLING** . . . Some time ago we commented that repair service is becoming increasingly hard to get from people who sell equipment. This might be attributed to lush times in which many feel it unnecessary to get their hands dirty.

The same thing may be true of selling itself. There seems to be increasing emphasis upon methods of unearthing new prospects and decreasing effort to turn those who do respond into customers. This is the scattershot approach; ammunition is sprayed in the general direction of a market in the hope that some of the pellets will hit a target.

Learn about some new product that interests you, then seek specific information. More often than not back will come a canned answer that tells everything except what you really need to know. Or, in some instances, the very information . . . no more, no less . . . that caused you to ask in the first place.

All this is fine so long as the market keeps expanding which, fortunately, is what it is doing. But it will be a very expensive approach should there be even a momentary lull. And we can't help thinking that more follow-through in the conversion of prospects into customers would be good business right now.

►**LOOKING AHEAD** . . . Enthused last month about Science Fairs. Now, from the national competition in Los Angeles, comes this interesting statistical information:

There were 233 participating high-school students. Of these, 65 plan careers in some branch of engineering, 28 looking toward electronics. Eighteen student-fathers are engineers, but 110 did not go to college.

►**OBSOLESCENCE** . . . An increasing number of manufacturers whose electronic components or end products have for a long time enjoyed widespread customer acceptance are finding that changing customer needs are threatening their established product lines.

Such a situation can easily be aggravated when conservative management chooses to plow all of its research dollars into refining existing products rather than into developing new ones. The only insurance against product obsolescence is an imaginative, forward-looking research program.

When management asks how much should be put into research in a day of fundamental technological changes, one answer is how much should a man put into explosion insurance when his house is perched on a powder keg.

►**SOPHISTICATED CONTROL** . . . Great strides have been made in the development of automatic production equipment since the beginning of the machine age. And great strides have been made in recent years in the development of controls which monitor the operation of such equipment.

But the next great stride will not be made, many men peering into the future think, until more systems designers . . . and particularly those working with computers . . . realize that truly sophisticated control requires some substitution of machines for man's mind as well as for his muscles.

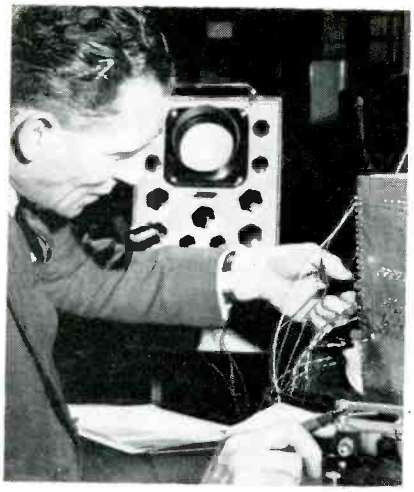
►**OUTSIDE OPINION** . . . Whether you agree or not, it is useful to know what others think of your abilities. Said a management consultant summarizing a paper scheduled to be presented to an engineering audience recently:

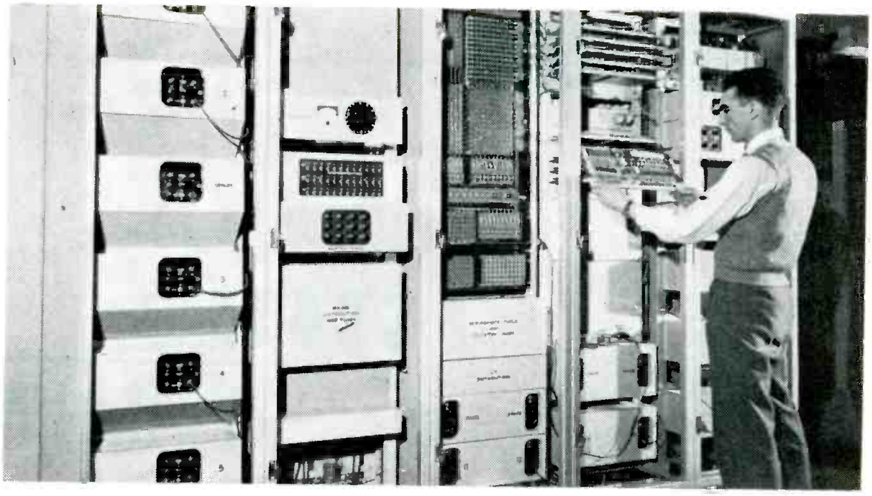
"Engineers, even when they rise to management, are prone to be thing-centered rather than people-centered in their thinking. It is tempting to the engineer-executive to take over and do the job for the person working for him."

►**QUOTES** . . . *"Perpetual Motion Development:* A disease wherein new requirements and new techniques develop into a superregenerative complex that produces committee activity and possibly prototypes, but an absence of application."

"Reliability: Early failures correspond to infant mortality, later failures to old age."

"Transistor: Wickless wonder."





Printed wire panel of master control is tested at left. Overall view of right shows hand-wired redundancy able in center

COMPUTER Selects

SUMMARY —— Premium savings bond plan operating in England requires that over 10,000 prize-winning numbers be randomly selected monthly from over 100 million bond numbers. Computer ERNIE, (Electronic Random Number Indicating Equipment) uses noise generators combined with counters and storage systems to provide a printed list of purely random bond numbers. Circuits use transistors, ferrite-core binaries and printed wiring techniques

LOTTERIES in England were discontinued in 1826. Current introduction of a state lottery would be opposed by considerable public opinion. However, the plan of using Premium Savings Bonds is not a lottery in that the purchasers' capital investment is not at stake. An element of chance is introduced in the distribution of interest earned by the investment.

The chance of being a prize winner works out at about 1 in 2,000 for the first draw and at better than 1 in 12,000 in each subsequent monthly draw.

Bonds are issued in 23 denominations from 1 to 500 units and participants can enter the plan at any time, increase their stake or withdraw all or part of it at any time. A 50-unit bond has 50 chances of winning just as do 50 1-unit bonds. Winners are not withdrawn from subsequent draws.

Number Selection

Owing to these conditions and also to the very large numbers involved (nearly 50 million units were sold in Nov. 1956), it was decided that the draws could be best carried out by an electronic computer, supplemented by manual operations thereafter.

For each denomination of bonds there is a potential numbering range of 100 million; the total numbers for the plan is therefore 2,300 million, approximately equal to the world population. For the Nov. sales, the numbered bonds ranged up to 30 million for one denomination. Accordingly ERNIE is adjusted to generate 23 × 30 = 690 million numbers.

A typical bond number is 2 AZ 987654, a coded form for bond number 20,987,654 of £1 denomination. Multiple units have consecutive numbers and bear the first and last number concerned. The selection of prize winners must, therefore, be made from 690 million 9-digit numbers. Of these digits the first is in a scale of 3(the second 23, the remainder in a scale of 10.

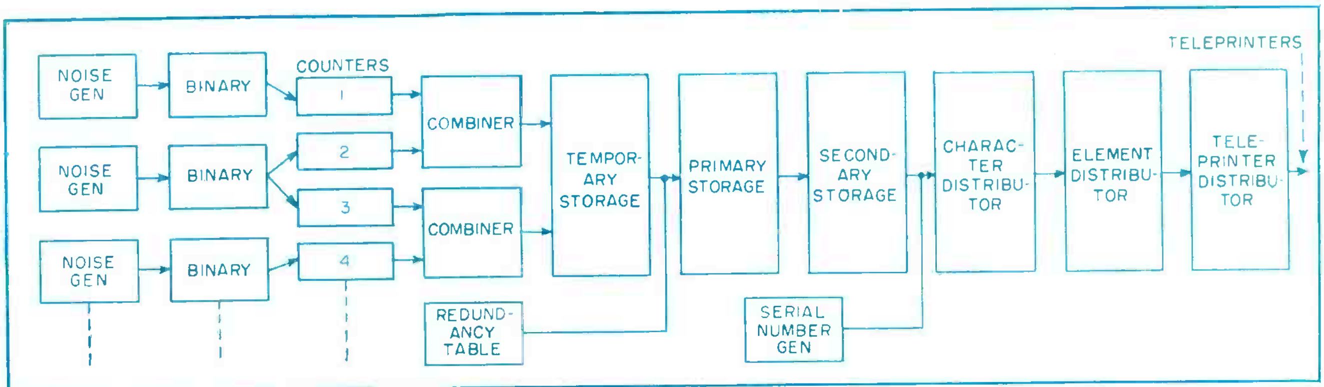


FIG. 1—Block diagram of ERNIE. Ten noise generators are used rather than nine to ensure that the machine operates when one generator fails.

By R. K. HAYWARD, E. L. BUBB and H. W. FENSOM

Research Engineers, Research Branch
Post Office Engineering Department
London, England

Premium Bond Winners

For the first draw nearly 60,000 numbers must be printed, but of these only some 23,000 will be eligible. This discrepancy arises because the bonds are sold at thousands of offices, and at any one time many bonds are in stock awaiting sale. Consequently the numbering ranges of eligible bonds are broken. The computer rejects blocks of unsold bonds when these amount to 100,000 or more, but it is uneconomical for it to deal with smaller blocks.

Generation of Random Numbers

Each of the 9 digits of the bond number is generated from a separate noise source that consists of a neon diode passing a steady current. This noise is amplified and applied to a bottom clipper. Its output triggers a monostable multivibrator which generates pulses of standard amplitude and width with a minimum time separation between pulses.

These standard pulses, randomly spaced in time, drive a single-stage binary. Its two outputs in turn drive a counter.

The counters are in scales of 6, 24 or 10 since counters must be even in scale. The scale of six is converted later to a scale of three and then used for the first digit. One digit from the scale of 24 is suppressed, leaving a scale of 23 for the demonstration digit.

The rate of pulse generation is sufficient to cause the counters to make several complete revolutions in one-sixth of a second. At the end of this period the noise generator output is suppressed and the counters are read.

Fault conditions leading to a cyclic component in a noise generator and amplifier may lead to a nonrandom result not readily detected. This event is made much less likely by separately generating each digit or letter from two random noise generators each driving an independent counter. When the counters are stopped the outputs of each pair are combined by subtracting one number from the other and the result is still random.

Noise generators are shared between counters as shown in the block diagram of Fig. 1 so each combiner works from two different noise generators. It is useful to provide 10 rather than the minimum of 9 noise generators, because if one out of nine failed, it would prevent the satisfactory operation or the machine.

Redundant Number Suppression

Redundancy arises in two ways: intermediate and terminal. The intermediate redundancy, arising from unsold bonds in the selling offices, has already been described. Terminal redundancy is the more important and refers to those bonds which have never been issued to a selling office. The sales of each denomination vary widely but the machine generates 30 million numbers for each. If only 15.3 million have been issued, then there is a terminal redundancy of 14.7 million for this denomination.

The terminal redundancy is dealt with to the next complete multiple of 100,000 greater than the highest eligible number issued in a bond denomination. Thus the first four digits of a generated number require examination.

The number of combinations offered to the suppression device, called the redundancy table, is 300

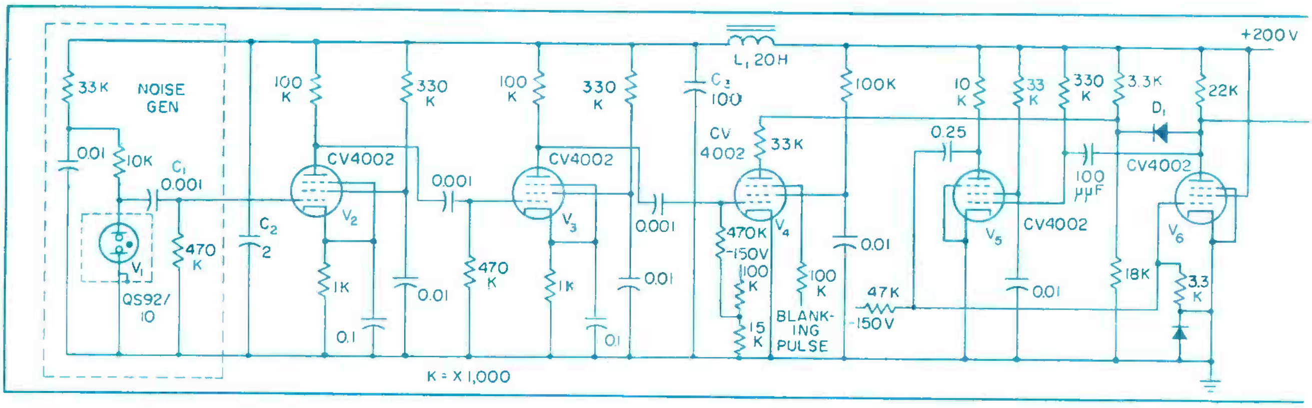


FIG. 2—Circuit of noise generator and transistor-ferrite-core binary. Series of pulses from noise generator causes negative of the two transistors. The resistor between base and emitter provides rapid transistor cutoff. The blanking pulses switch off the

$\times$ 23 = 6,900. Advantage is taken of the fact that the bonds are issued in numerical order to avoid the provision of 6,900 crosspoints.

The digits of a bond number are examined simultaneously by a series of transistor matrices. In the preceding example the highest bond number is 15.3 million. Assuming the denomination is D, a transistor matrix of 23 by 3, called the first matrix, compares the denomination digit with the 10 million digit. The matrix is wired so that D0 is approved for printing, D2 is suppressed and D1 is referred to the second matrix.

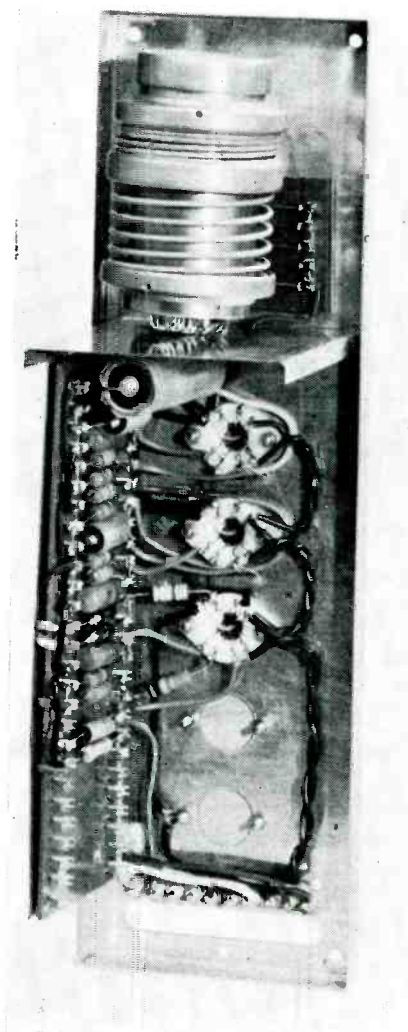
For each denomination there is only one coordinate of the matrix that must be referred to the second matrix, which is of size 23 by 10. Denomination D1 is then compared with the millions digit. In this case D10 to D14 are approved, D16 to D19 are suppressed while D15 is referred to the next matrix. These two matrices together have made numbers 16 to 30 million redundant, numbers 0 to 14 million printable and left numbers in the 15 million block to be checked in a third table, which is simpler than the preceding two because the result either is or is not a definite redundancy.

The same table is adapted to deal with intermediate redundancy

Number Storage

A number rejected by the redundancy table is erased from primary storage and the next number issued from the counter combiner is likewise examined by the redundancy table. When a printable number has been found it remains in primary storage awaiting printing, which will take place from secondary storage.

On completion of the printing of the previous message, the new number is transferred to secondary storage and printing commences. At the same time a search is restarted for a fresh number. If no printable number has been found the printer waits, but this occurs only about once in 25 times.



View of noise generator chassis shows suspension system provided for neon tube to minimize injection of external noise frequencies resulting from vibration

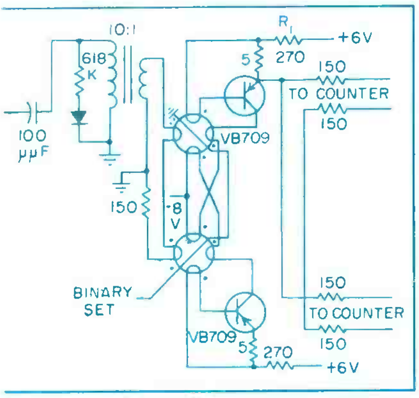
Printing Operation

On transfer to secondary storage an examination is made of the digit relating to the denomination of the bond and the pair of teleprinters appropriate to that denomination is switched to receive the message. The message, which consists of the bond number followed by the serial number, is read off character by character, converted into teleprinter code and sent out to the two selected teleprinters. In addition all messages are printed on a master copy at the control desk.

Noise Generators and Counters

Current from a constant voltage source is fed through double decoupling to a cold-cathode gas diode connected in series with a resistance load as in Fig. 2. The noise component of voltage across the diode is coupled by capacitor C_1 to a two-stage amplifier consisting of V_2 and V_3.

Tube V_1, mounted in a metal container to shield it and to give extra mass, is suspended by a spiral spring. This arrangement provides a low natural frequency of oscillation to avoid introducing extraneous microphonic noise. Amplifiers V_2 and V_3, which are ruggedized wired-in types, are also shielded, and both noise source and amplifier are decoupled by C_3 and L_1.



pulses to appear alternately at emitters counting circuit during readout

Amplified noise signals thus appear on the grid of V_4, the control-grid bias of which is adjusted by fixed resistors to some −20 volts. Only voltage peaks which equal or exceed the bias can cause V_4 to conduct. The mean rate (over a period of several minutes) of the output pulses is made about 3,000 a second by adjusting the bias.

Pulses from V_4 are applied through a diode gate to a monostable multivibrator formed by V_5 and V_6. Tube V_6 is normally nonconducting and V_5 and diode D_1 conducting. A negative input pulse from the amplifier is transmitted through D_1 to the anode of V_6 and through a capacitor to the grid of V_5, triggering V_6 into conduction. Diode D_1 is now reverse biased and remains so for the 20-μsec restoring time. Diode D_1 prevents any input signal from triggering until the anode of V_6 is substantially back to its normal voltage.

The binary circuit has two transistors and two rectangular hysteresis loop ferrite cores. The output pulse from V_6 is differentiated and applied via a 10 to 1 step-down transformer to a multiturn winding on each of the two cores. Initially the two cores have been set to opposite states by current passed through the binary-set wire. The incoming pulse therefore resets one of the cores, and the resulting large change of flux from one remnant condition to the other induces a voltage on each of the windings on the core.

One winding, connected between base and emitter of the associated transistor, causes it to conduct. Collector current flows through a feedback winding on the core to assist the switching action. At the same time current flows through a winding on the second core to set it. Emitter current flowing through a resistor provides a 12-volt negative-going pulse for 5 μsec to one phase lead (ϕ_1) of the following counters. The other transistor produces no output as it is already cut off.

The result of this operation is that the state of the two cores has been transposed and an output pulse produced. Since the circuit is symmetrical a second input pulse will return both cores to their original state and provide a pulse from the other transistor on the second phase lead (ϕ_2). A series of pulses from the noise generator will thus cause negative pulses to appear alternately at the emitters of the two transistors. Switching off a transistor is made more rapid by the voltage developed by the emitter current flowing through the resistor connected between base and emitter.

The noise generators are switched off at intervals of 160 millisec by blanking pulses of 4 millisec duration applied to the suppressor grid of V_4. During the latter period the random signals cannot affect the counters, thus allowing reading of their count. The mean count per interval is about 500. The statistical distribution of the source is adequate to ensure that any final position of a single stage decimal or 24-way counter is equally likely, assuming also that a random starting position is used. This latter condition is ensured by starting the counter from its previous stopping position.

Provision is made for injecting a predetermined number of pulses into the monostable multivibrator at the grid of V_6. These pulses are used during the blanking period to operate the counter combiner.

Counters and Combiner

The circuit of the two counters and the combiner used in generating the first digit is shown in Fig. 3. Cores X_1 to X_6 with their associated transistors Q_1 to Q_6 form counter *A*. The pulses to be counted are applied alternately to transistors Q_{14} and Q_{15}, switching these and resulting in current pulses through the series-connected ϕ_1 windings on cores X_1, X_3 and X_5 and the ϕ_2 windings on cores X_2, X_4 and X_6 alternately.

The counter is initially set up with one core in the set condition and all others reset. If core X_2 is set, then the first pulse on the ϕ_2 lead will reset this core. The voltage induced in winding N_1 exceeds the positive bias of 0.75v and carries the base of transistor Q_2 negative with respect to its emitter, causing the transistor to switch rapidly to the highly conducting condition. The resulting collector current, defined by R_1 and the supply voltage and flowing in winding N_2 of core X_3, sets this core and so completes the transfer of the condition originally stored on X_2.

Each successive pulse causes a

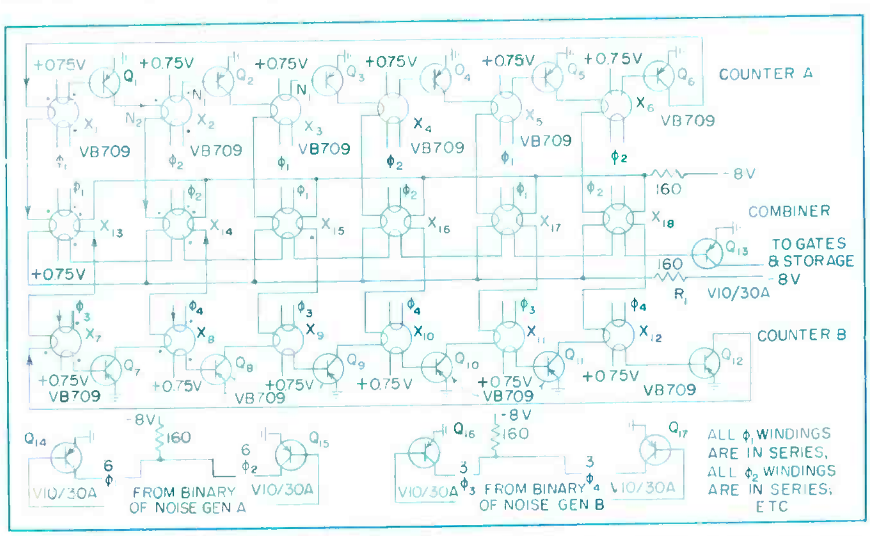


FIG. 3—Transistors and ferrite cores make up all counter and combiner circuits. Transistor coupling reduces pulse power required by deriving current from another source

further transfer in the same manner. During the resetting of X_2 a voltage is induced in winding N_2, but since this winding is connected in series with Q_1 which is in the nonconducting condition, no current flows in the circuit. The only power required from the drive pulse is that required to reset the core plus that required to bottom the transistor. The time required for the core to reset is longer than that required to switch an unloaded core due to the load imposed by the transistor base circuit.

The change of flux when core X_3 is set induces voltages in the transistor base winding N_1 and the ϕ_1 drive winding. These are in the opposite sense to those induced during resetting, hence the transistor base is driven further positive with respect to its emitter. The resulting current in the N_1 winding is therefore negligible. The drive circuit transistor is nonconducting so no current can flow in this circuit either. The core is effectively unloaded and this ensures that it is set more rapidly than the loaded core X_2 can be reset.

Transistor Coupling

Use of a transistor as a coupling between the two cores has two advantages. It ensures that currents flow only where required to perform a useful function and, by deriving the transfer current from a separate source, greatly reduces the pulse power required. No power is used between counts. Since each transistor conducts only when transferring information from one stage to the next and this occurs once per revolution of the counter, the mean dissipation of the transistors may be kept to a low value. When used as a counter the circuit described may use one collector resistor common to all stages. If separate resistors are used for each stage the circuit may be used as a two-core-per-bit register.

Cores X_7 to X_{12} with transistors Q_7 to Q_{12} form counter *B*, operating in an exactly similar manner from pulses delivered by the second noise source. Cores X_{13} to X_{18} form the combiner, giving an output pulse to switch transistor Q_{13} at a time characteristic of the combined counts.

Resetting

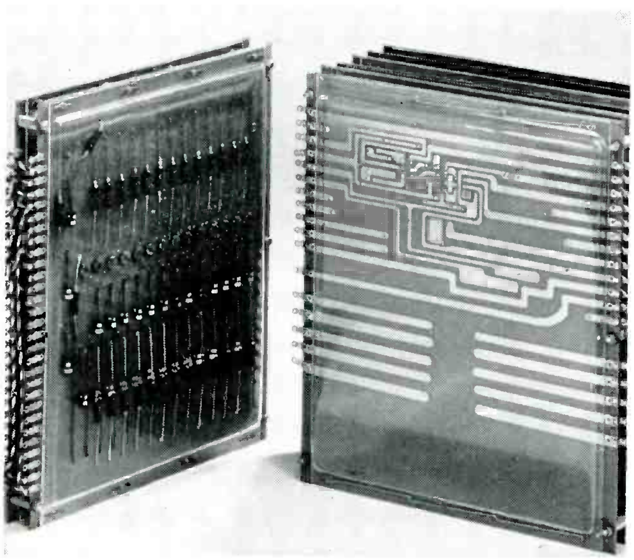
The lead from Q_1 which sets the following core X_2 is extended through a winding on X_{14} and sets this core at the same time as X_2. The resetting pulse ϕ_2, connected to X_2, is also connected to a resetting winding on X_{14}. The other combiner cores are associated in a similar manner with corresponding counter *A* cores. In the absence of any other signals to X_{13} to X_{18} this ensures that these cores are set and reset in synchronism with the corresponding cores in counter *A*.

A further resetting winding on each combiner core is connected in series with the setting winding of the associated core in counter *B* and thus each transfer of counter *B* results in an attempt to reset one of the combiner cores. Output windings on each core are series-connected between a positive bias potential and the base of transistor Q_{13} so that during the resetting of each combiner core this transistor is switched to the conducting condition.

Combining Action

Every 160 milliseconds the noise generators are blanked off and the recorded *A* and *B* counts have to be combined. One combiner core will be in a set condition unless counter *B* has overtaken counter *A* immediately prior to the blanking pulse, in which case all combiner cores will be reset. A single pulse is first applied by the master control to counter *A*. The resulting transfer ensures that one of the combiner cores is set. A train of pulses is then applied to counter *B*, the number of pulses being sufficient to cause this to complete at least one complete cycle.

As one of the transfers of this counter takes place the set combiner core will be reset. The resulting output pulse will switch transistor Q_{13}. This occurs after a number of pulses equal to one plus the difference between the recorded *B* and *A* counts. For example, assume counter *A* records 4 and counter *B* 2, so that cores X_4 and X_8 are set. The single *A* pulse causes



Printed circuit sandwiches show how ferrite cores and transistors are mounted. Molded plastic covers protect both sides of board

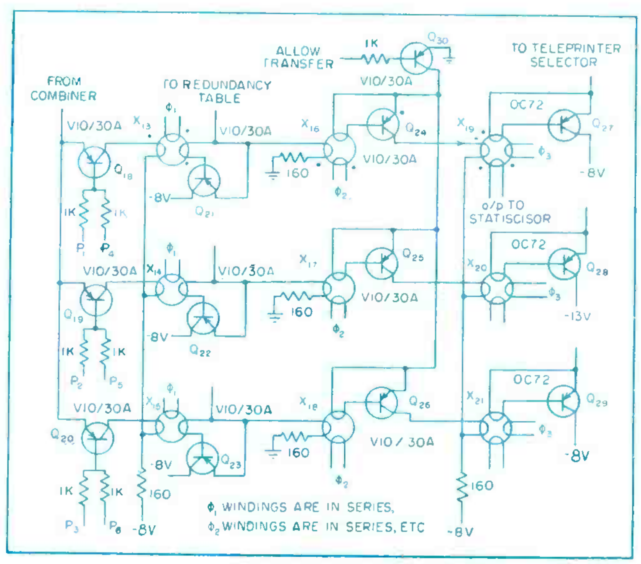
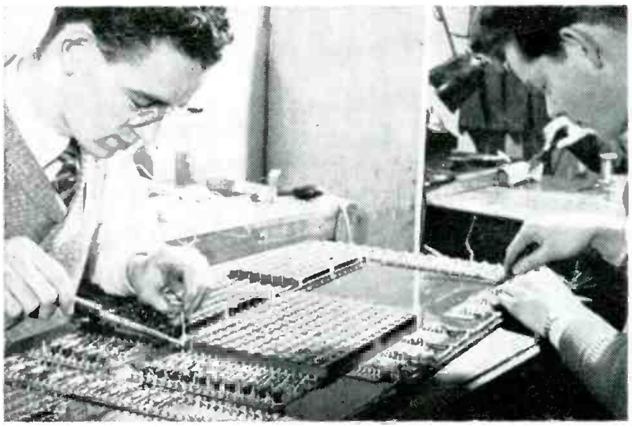
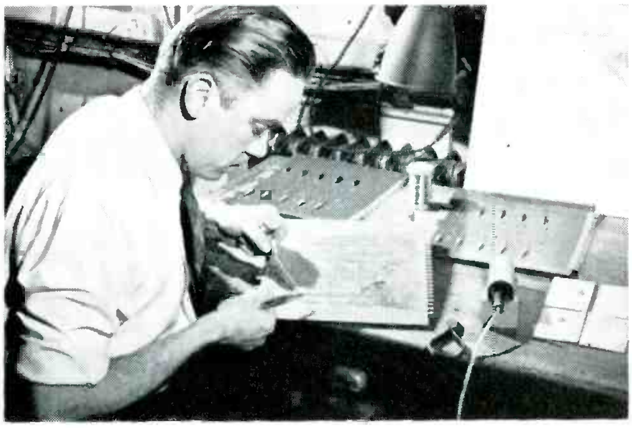


FIG. 4—Storage circuits associated with first digit of bond number. Basically, storage circuits linked with other digits are similar



Several connections on redundancy table must be changed for each draw to include bond numbers issued since previous draw



Printed wiring boards are equipped by hand. Terminals at end permit rewiring to provide other counter and storage facilities

X_5 and X_{17} 17 to be set and X_{17} will be reset by the third B pulse: $4 - 2 + 1 = 3$.

Storage Circuits

The number of pulses required to obtain the output pulse from the combiner is counted and recorded in temporary storage, examined in conjunction with other digits in the redundancy table, and if not indicated as redundant, is finally transferred to storage for printing by the appropriate teleprinters.

The storage circuits associated with the first digit are shown in Fig 4. Transistors Q_{18} to Q_{20} operate as gates. When made conducting by negative pulses applied to their bases, they connect the setting windings of temporary storage cores X_{13} to X_{15} to the output from Q_{13} of the combiner.

The pulses are applied sequentially in synchronism with the pulses of the counter B train and thus result in the setting of the core corresponding to the combination of the two counters. Two pulses are applied to each gate and the scale of six employed in the counters and combiners is stored in a scale of three as required for the first digit of the bond numbers.

After the counter B pulse train is complete, all temporary storage cores are reset by a pulse from the master control and the marked core gives a pulse which switches its associated coupling transistor Q_{21}, Q_{22} or Q_{23}. Each transistor has its collector connected to the negative supply, with the setting winding of the corresponding primary storage core X_{16} to X_{18} in series with a resistor between emitter and ground. When the temporary storage cores are reset, the corresponding primary storage core is set and an 8-volt negative pulse from the emitter of the coupling transistor is sent to the redundancy table.

The transfer from temporary to primary storage occurs simultaneously for all digits, in contrast with the transfers from combiners to temporary storage which occur at times determined by the combinations. Thus simultaneously pulses indicating the first four digits are sent to the table for comparison with the stored pattern.

If the table indicates that the number being offered is redundant then the primary storage cores of all digits are reset immediately. The base of transistor Q_{30} is held at a positive potential so, although one of the coupling transistors Q_{24} to Q_{26} will be switched, its collector current will be negligible and the code will be erased.

If no redundancy is signaled to the master control, resetting of the primary storage cores is delayed until printing of the previous message has been completed. The secondary storage cores X_{19} to X_{21} are then known to be reset, and resetting of the primary storage cores accompanied by a negative allow-transfer pulse to the base of Q_{30} transfers the code to the appropriate secondary storage core. From here it is transferred digit by digit, interleaved with letter and figure shift signals, to a staticisor employing cold-cathode triodes, translated to teleprinter code and transmitted to the printers.

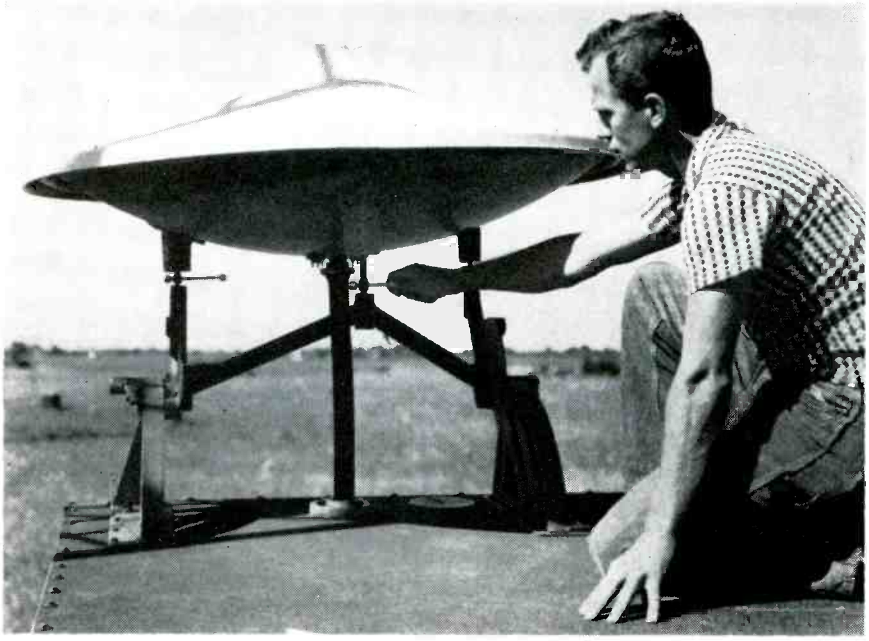
While a printable number is held in the primary storage waiting for the printing of the previous message to be completed the periodic blanking of the noise generators continues. To prevent further numbers being passed to the occupied storage, the gating pulses and the pulses to the A and B binary units are inhibited by the master control.

To arrange for the teleprinter switching, transistors Q_{27} to Q_{29} are switched by the voltage generated as the associated core is set. The emitter current causes a relay to operate and connect the required teleprinters to the line. To avoid undue slowing of the setting of secondary storage cores, transistors Q_{27} to Q_{29} and their drive windings are chosen to reflect the minimum possible load to the drive circuit.

Basically the storage circuits associated with all other digits are similar. For all digits but the first, the storage scale is the same as that in the counters and only one pulse is applied.

The redundancy table circuit requires a positive pulse from the second digit. To obtain this the loads are connected in the collector circuits instead of in the emitter circuits of the transistors coupling temporary storage to primary storage. Finally, the selection of the teleprinters depends on the first two digits only so transistors Q_{27} to Q_{29} are omitted from the circuits generating other digits.

Thanks are due the engineer-in-chief of the General Post Office for permission to make use of the information contained in this article.



Electronic equipment at various repeaters is housed in transportable shelters on which are mounted microwave antennas such as that being adjusted here

By E. K. PETERSON,
Chief Engineer

H. R. ULANDER,
Dept. Head

R. N. HARGIS
Project Engineer

Communications and Industrial Electronics Division Motorola, Inc. Chicago, Illinois

and

E. HAJIC
Motorola Research Laboratories Riverside, Calif.

Microwave Remotes Aid

SUMMARY — Long-range surveillance radar information as well as that of short-range, GCA and height-finding equipments is transmitted by microwave relay system spanning over 250 miles. Signals for control of vital radar functions and composite video and marks information are transmitted using multiplexing techniques in conjunction with encoding and decoding

RADAR STATIONS in Indiana and Ohio will soon allow the Civil Aeronautics Administration to gather air traffic information and remote it to Indianapolis by microwave radar relay systems. The program's purpose is to aid the airways operation evaluation center, a laboratory of the CAA's technical development center, in the development and evaluation of techniques and procedures for improving air traffic control.

System Details

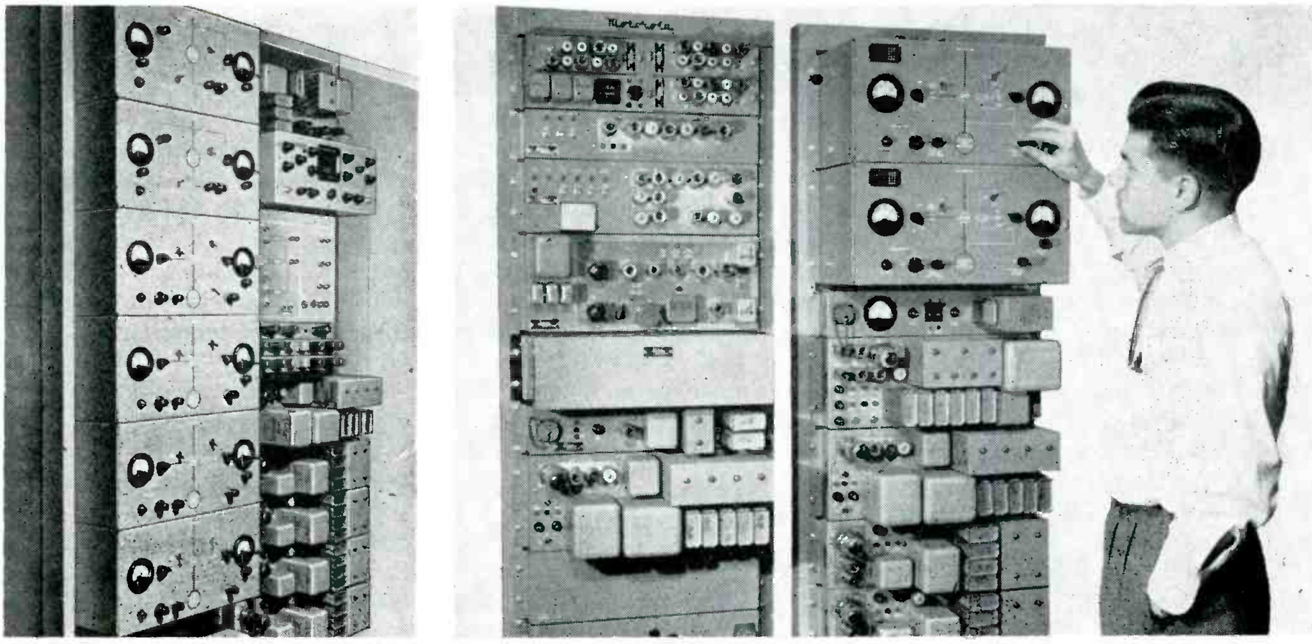
The Jamestown-Wright-Patterson AFB relay link, known as radar data transfer system, AN/TRQ-12, uses six microwave channels for remote operation of one search radar, one height-finder radar and iff equipment. There are also 18 two-way voice communication channels. Five microwave channels transmit information from the radar site to the control center; one channel is used for communications and control from the center to the radar site.

Controls

The following controls are provided: for height-finder radar, elevation control (fast scan, slow scan, scan stop) and azimuth control (manual, slewing); for iff equipment, mode selection and challenge and for search radar, none.

The Dayton-Indianapolis link also uses six microwave channels, each having a bandwidth of 5.5 mc. Five channels transmit information to the control center at Indianapolis while one channel is used for communications and control from the center.

The following information is carried on the six channels: channel 1 carries the systems trigger, composite video and azimuth information from the search radar at Jamestown; channel 2 carries the beacon video and beacon trigger from iff equipment at Jamestown and narrow-band radar data from three different radar installations—transmitted to the terminal by uhf; channel 3 carries the systems trigger, composite video and azimuth information from future radar installation at West Enon Terminal; Channel 4 carries the height finder video, angle



Rack-mounted r-f and auxiliary equipments provide microwave carriers in the 7-125 to 8,000-mc range (left). Engineer (right) adjusts klystron tuning of receiver, part of two-channel radar relay terminal. Auxiliary equipment provides rapid maintenance facilities

Air Traffic Control

mark and elevation data from radar at Jamestown; Channel 5 carries 24 voice channels with up to 18 control functions per voice channel for relaying vhf/uhf air-to-ground communication; channel 6 carries 24 voice channels with up to 18 control functions per voice channel for ground-to-air communications and remote control of vhf/uhf communications equipment.

A frequency-division f-m system is used for voice communications. The multiplexing frequency band, 400-kc to 800-kc, is subdivided to provide up to 24 individual voice channels with 16-kc separation. The resulting double f-m signal-to-noise ratio on any channel exceeds 45 db in the system.

Microwave R-F System

To accommodate a variety of channels control requirements, 18 voice-frequency carriers spaced 150 cps apart in the 500 to 3,100 cps spectrum, are used. Center frequencies of these channels range from 525 to 3,075 cps.

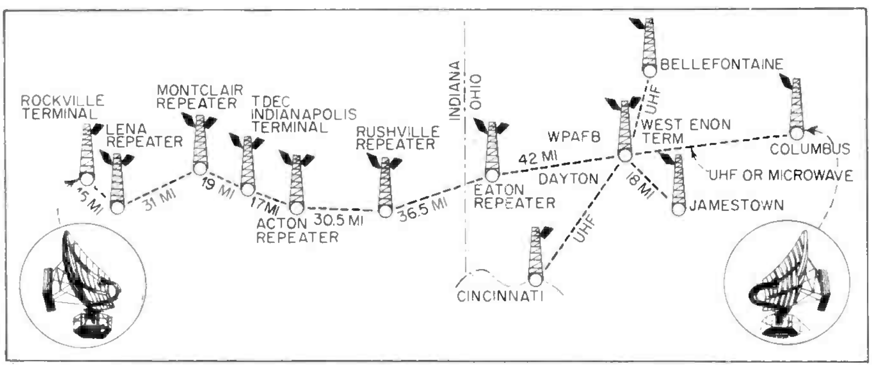


FIG. 1—Map of entire radar data collection system planned by CAA and designed for expansion to include selection of data from Bellefontaine, Columbus and Cincinnati

The system uses six basic channels, 160 mc apart, plus six auxiliary channels offset 40 mc from the basic channels. Operating frequencies range from 7,135 to 8,000 mc. Basic Group A channels are used for the odd-numbered spans in a system and the 40-mc-offset Group B channels are used for the even-numbered spans. Group B channels can also be employed when more than six outgoing or incoming channels are required at a terminal point using two antennas.

A microwave multiplexing technique using band-pass filters and band-reject filters was developed and incorporated into transmitter and receiver waveguide assemblies so that each unit is independent of all other units in the system and no critical waveguide spacings are involved.

Hi-Lo Plumbing

To cover the frequency range of 7,135 mc to 8,000 mc, a low-band and high-band system is used. The low-band plumbing covers 7,135 mc to 7,655 mc and can be used in systems having up to four channels. The high-band plumbing covers 7,655 mc to 7,975 mc, and is used for the top two channels.

Transmitter Plumbing

The transmitter plumbing assembly consists of the main leg, a multiplexing filter, a reject filter, a power monitor arm with coupler and a frequency monitor arm and coupler. The main leg links adjacent transmitter and/or receiver units and carries all signals to and from the antenna feed. The multiplexing filter is coupled to the main leg by a right-angle *H*-plane junction with the filter output iris located flush with the inner wall of the main leg.

The admittance presented by the filter at the output iris to other channel frequencies is a short circuit. To direct all of the transmitter energy toward the antenna and to prevent transmission in the opposite direction, a band-reject filter is used in the main leg at the proper distance from the *H*-junction so the transmitter signal leaving the multiplexing filter will see an open circuit in that direction and will be coupled only in the direction of the antenna.

The attenuation characteristic of the reject filter is flat-topped in the reject band and steep-sided so that signals at the other channel frequencies will pass through with negligible attenuation.

The two waveguide sections containing the power monitor and frequency monitor are mounted on the transmitter arm and are coupled by 25-db crossguide directional couplers. The signal coupled into the power monitor arm is fed directly to a crystal rectifier that supplies d-c to the power monitor meter proportional to the transmitter power. The signal in the frequency monitor arm passes through a monitor cavity tuned to the channel frequency before reaching the crystal detector. The frequency monitor meter therefore, gives an indication only when the transmitter klystron is tuned close to the proper channel frequency and a maximum reading indicates proper tuning.

Ferrite Isolator

A ferrite isolator is located between the transmitter klystron and the transmitter assembly input flange. It is used to isolate the klystron from reflections. Since the isolator is a unilateral device the transmitted signal passes through to the antenna with little loss. However, any signals reflected from the antenna or waveguide system are highly attenuated and prevented from reaching the tube. Thus the tube operates into a load having negligible susceptance change during the frequency modulation excursions and maintains its linear modulation characteristic.

Receiver Waveguide

The receiver waveguide assembly consists of a main leg, preselector filter, reject filter, crystal mixer assembly and local oscillator arm assembly. The main leg is the common waveguide which links the adjacent receiver and/or transmitter units and carries all signals to and from the antenna. The five-cavity preselector filter is coupled to the main leg by an *H*-plane junction with the filter input iris located flush with the inner wall of the main leg. The signal from the antenna is coupled through the input iris into the preselector and on through to the crystal mixer. Other frequencies in the main leg are short circuited by the effective input admittance.

The reject filter is located in the main leg below the *H*-plane junction and presents an open-circuit condition at the junction so no incoming energy at the receiver channel frequency will be coupled through the reject filter.

The local oscillator arm is mounted parallel to the preselector arm and couples the local oscillator through a directional coupler into the preselector arm where it is mixed with the incoming signal. The local oscillator arm contains a variable attenuator to control injection, a monitor cavity for setting the proper frequency and a fixed pad in front of the monitor cavity to provide a resistive load for the oscillator. The oscillator operates 75 mc below the signal to produce the 75-mc i-f signal.

The radar system trigger is a 1 to 6 microsecond pulse occuring at a repetition rate of 200 to 400 cps. This trigger must be remoted since it starts the sweep in the remote indicator.

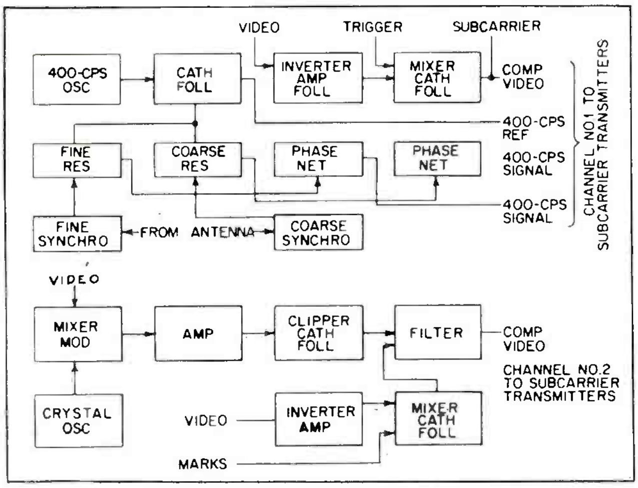


FIG. 2—Block diagram shows method used in encoding video, marks and antenna position information at transmitting site

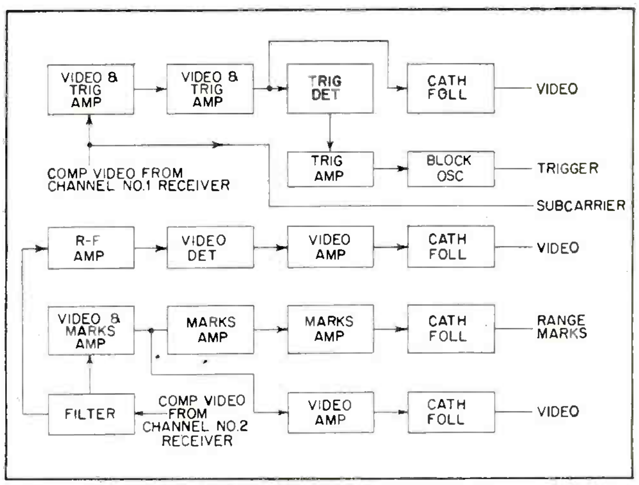
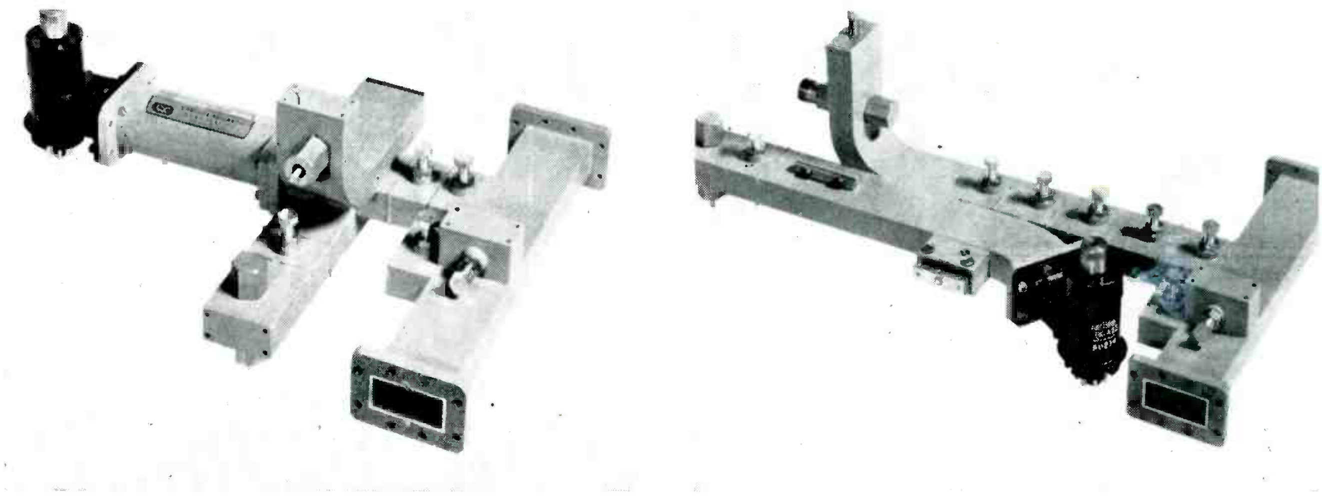


FIG. 3—Decoding at receiving stations is done as indicated in block diagram. The 400-cps demodulators are not shown



Microwave transmitting plumbing (left) and receiving plumbing (right) showing band-pass and band-reject filters used as part of multiplexing technique. Klystron used for both transmitter and local oscillator is a 100-mw tube modulated ± 3 mc

To maintain the characteristics of video signals including mti and iff, a minimum bandwidth of 2 mc is required through the microwave system. For economic reasons, several videos are combined in a composite video before being fed to the microwave transmitter.

Radar Video Multiplexing

To remote a search radar, a minimum of two microwave channels are required for transmission of the systems trigger, range marks, azimuth information and three video signals for target display as shown in Fig. 2. One channel remotes the systems trigger, one video signal and the azimuth information; the other channel remotes the remaining two videos plus the range marks.

The trigger and video on channel one and the range marks and video on channel two are combined in a similar manner to a bipolar signal occupying the 0 to 2.5-mc range of the 5-mc system bandwidth. All pulse information from the radar is of positive polarity. The trigger and range marks are fed through cathode-followers maintaining the positive polarity. The video is inverted and added to the trigger or range marks hence at this point the composite signal consists of positive trigger or range mark pulses and negative video pulses. The second video on channel two is added to a 5-mc carrier and then fed through a biased amplifier whose output consists of a low-amplitude 5-mc signal when there is no video pulse present and a large-amplitude 5-mc signal for the duration of a radar video pulse. This signal is then fed through a high-pass filter where the 0 to 2.5-mc content is removed.

Azimuth information is normally two-speed 60-cps synchro voltages.

In the terminal equipment, these synchro voltages drive synchro receivers. Coupled directly to their shafts are two resolvers whose rotor windings are excited by a 400-cps oscillator. For maximum accuracy, this oscillator must have a high degree of frequency stability and low distortion in addition to low output impedance. The amplitude of the voltages induced in these windings corresponds to the sine and cosine of the angle between the rotor winding and one of the stator windings. These voltages are each shifted 45 degrees and added to form a voltage of fixed amplitude whose phase with respect to the oscillator or reference voltage varies with the resolver rotor position. These three 400-cps voltages modulate three f-m subcarriers which occupy the upper 2.5-mc range of channel one.

Demultiplexing

At the receiving terminal the composite signal is unscrambled restored to its original form as shown in Fig. 3. Polarity sensitive amplifiers do this for the systems trigger and video on channel one and for the range marks and one video on channel two. The second video on channel two is restored by a detector and the residual 5-mc carrier is attenuated by a trap.

The three subcarriers on channel one are demodulated by three subcarrier receivers whose outputs consist of the three 400-cps voltages. To restore this information to the original 60-cps synchro voltages requires a servo amplifier, a gear train and a coarse and fine error detector. Resolvers are used as error detectors. The stator windings are excited by the reference voltages which have been split into two voltages 90 degrees apart. The resolver rotor's two windings are physically 90 degrees apart. The error voltage from the subcarrier receiver is added to the voltage induced in the rotor windings, thus the output of the error detector consists of two voltages whose amplitudes are determined by the phase of the error voltage with respect to the reference voltage and also by the resolver rotor position.

The gear train couples the resolvers through proper ratios to the servo motor. Unbalance of the resolver voltages produces torque in the servo motor in a direction which will minimize the unbalance, thus the gear train tracks the radar antenna. Coupled to the same shafts as the resolvers are two synchro generators whose output consists of the same 60-cps synchro voltages as from the radar antenna pedestal.

ANTENNA-MULTIPLEX

By H. K. SCHLEGELMILCH, O. K. NILSSEN and W. Y. PAN
Radio Corporation of America
Camden, N. J.

SUMMARY —— Distribution network gives average of 25 db isolation between television receivers connected to a single antenna. Signal strength is down only 12 db at each outlet, which gives 10-millivolt receiver input signal level for most apartment locations. Basic network uses nine 68-ohm resistors and six balun coils to give four outputs from one input. System includes provisions for inserting locally generated television signal

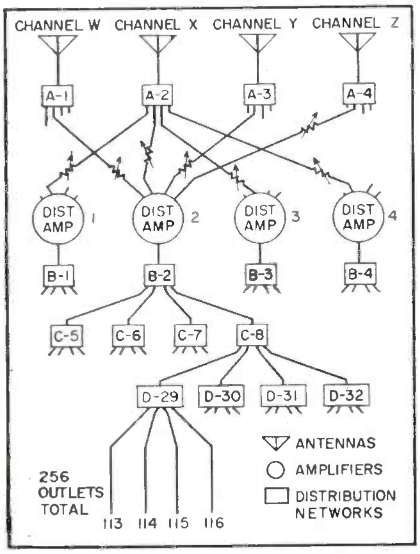


FIG. 1—Example of 256-outlet antenna-multiplex system providing choice of four tv channels

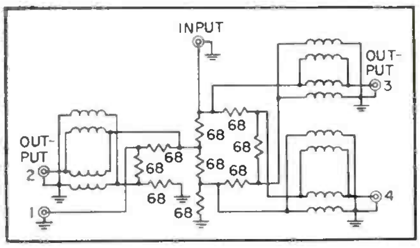


FIG. 2—Four-output distribution network

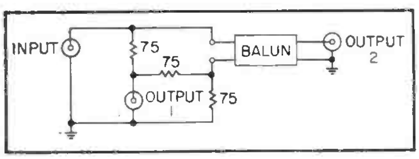


FIG. 3—Simple two-output network

A TELEVISION antenna-multiplex system distributes the desired signals to a number of usable outlets so that many television receivers can be operated from a single antenna. The requirements for a satisfactory antenna-multiplex system are more stringent with the advent of color television transmission, thus necessitating special design considerations.

Interaction Between Outlets

The input circuits of most television receivers may be matched only to the channel at which they are tuned, and may vary from an open-circuit to a short-circuit at the frequencies of the other television channels. Therefore, a high degree of isolation between outlets is stipulated to minimize interaction between receivers. Experimental results show that with a minimum isolation of 20 db, interaction between outlets is negligible.

A conventional method of obtaining isolation is by resistive pads, but such isolation is achieved at the expense of signal level by exactly the same amount. A new distribution network has been developed with theoretically infinite isolation between outlets, but practical limitations of components give an average value of 25 db of isolation for a one-input, four-output configuration. For this configuration the signal strength at each output is down only 12 db, of which 6 db is due to the theoretical insertion loss and the remaining 6 db to the expected distribution-reduction factor.

Signal Level

The signal level at the outlets must be of sufficient strength to override any interfering signal picked up by the system. An interfering signal 40 db below the level of the desired signal is considered satisfactory in television receivers.

In an antenna-multiplex system, stray pickups can take place in the long cables between the antenna and the outlets and in the lead-in line between the television tuner and the receiver input terminals. Measurements have indicated a combined stray pickup in the order of 100 microvolts at locations about 10 miles from high-power stations. Due to the phase differences, such stray pickups of tele-

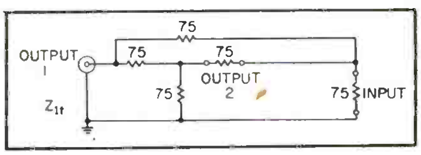


FIG. 4—Equivalent circuit of Fig. 3 when output 2 is terminated with 75 ohms

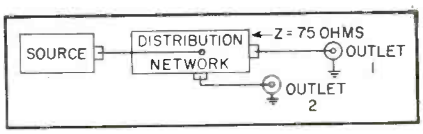
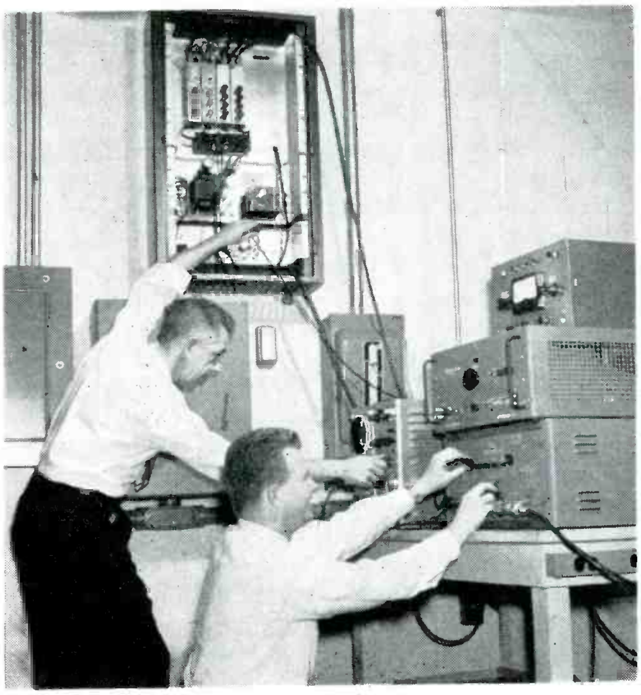
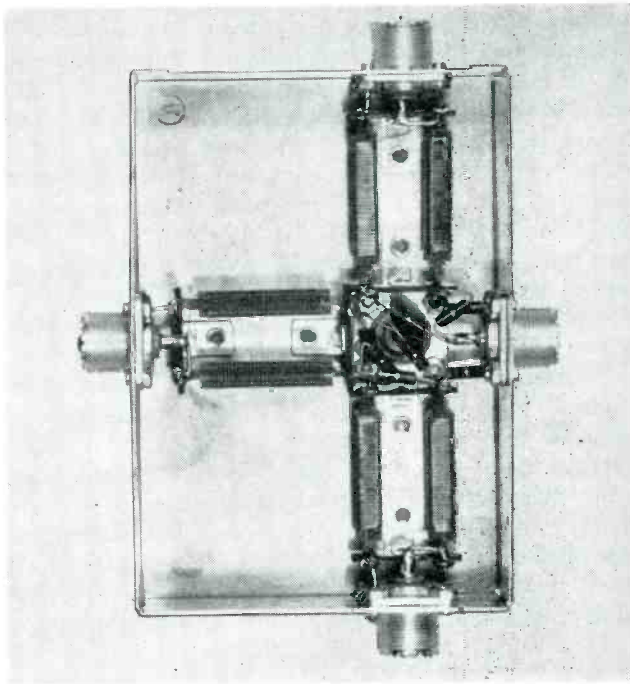


FIG. 5—Matched load presented by new distribution network

SYSTEM DESIGN



Making amplifier adjustments in typical installation



Example of basic four-output distribution network

vision signals usually degrade the picture quality received through the complete antenna-multiplex system. For this reason, such pickups are classified under interfering or undesired signals which must be kept 40 db below the desired signal. Therefore, the desired signal at the outlets must be in the order of 10 millivolts.

Voltage Variation

Another important consideration for an antenna-multiplex system, especially so for a laboratory system, is the voltage variation or tilt across the passband of any given channel. Excessive tilts may give rise to serious consequences. For instance, a peak at the sound carrier increases the cross-modulation percentage in the receiver, which may result in visible sound bars in the picture. This tilt can cause peaking of the video highs, which results in pictures with white outlines. Similarly, a peak at the picture carrier causes peaking of the video lows, which results in a smeared picture.

Voltage maxima and minima within a passband usually aggravate conditions, especially in a color transmission if such abrupt variations occur in the vicinity of the color subcarrier. Color distortion is thereby introduced due to the nonlinear phase characteristic of a sharp amplitude change. Most experienced observers have agreed that the maximum allowable voltage variation across a passband is approximately ± 1.5 db.

Cross-modulation in a typical antenna-multiplex system is primarily caused by the third-order component of the amplifier characteristic. This third-order component increases when the signal (desired or undesired) is driven further into the nonlinear region. Therefore, the signal, particularly the signal input to the last amplifier stage, must be maintained at such a level as to prevent excessive cross-modulation. A cross-modulation component of 1 percent represents an interference level down 40 db with respect to the desired signal level.

Harmonics, like cross-modulation, are caused by operation of amplifiers in the nonlinear region of the amplifier characteristic. These harmonics are also classified as interfering signals which must be 40 db down with respect to the desired signal. The result is that any harmonic present in the output of any amplifier at any channel must be less than 1 percent of the desired signal to which that particular harmonic forms an interference signal.

Interference

Obstructions or buildings near the antennas may cause reflected waves of the desired signals, thus resulting in possible ghosts in the received picture. Ghosts may also be attributable to reflections in the system resulting from improper terminations or source impedances. In addition, transmissions from other services such as amateur, aeronautical, medical and industrial are potential interfering signals to television reception. For these reasons, highly directive and selective antennas such as the Yagi are preferred in the antenna-multiplex installations.

All necessary components of a working antenna-multiplex system are indicated in Fig. 1, which may be regarded as a hypothetical illustration. The system must fulfill all the foregoing requirements. It receives four channels and provides 256 outlets.

Four Yagi antennas are used, designed and oriented for channels W, X, Y and Z respectively. A 300-ohm balanced to 75-ohm unbalanced device is incorporated in each antenna. The signal from each antenna is fed to four distribution amplifiers with RG-11U cables through a newly developed distribution network. The exact input signal to each amplifier from each antenna can be equalized by pads.

Four distribution amplifiers are needed to overcome the losses through the four branches of the system so a signal of about 10 millivolts at any channel is available at the outlets. Each distribution amplifier has a high-gain, low-level preamplifier followed by a low-gain, high-level power amplifier.

To provide a total of 256 outlets, each of the four amplifiers has to supply 64 outlets. Every outlet receives the signal from the amplifier through three distribution networks (networks B, C and D) as shown in Fig. 1. Since the total signal reduction of each distribution network having one input and four outputs is 12 db, a signal level of approximately 1 volt is needed at the output of the distribution amplifiers to maintain a signal level of 10 millivolts at the outlets if a cable loss of 4 db is allowed.

Distribution Networks

Each distribution network splits the signal from one input to four outputs, as shown in Fig. 2. The components required are nine 68-ohm ½-watt resistors, six 150-ohm balun coils (or, if available, three 75-ohm balun coils) and five connectors.

Operating Principle

The principle of operation can be explained by a simpler network shown by Fig. 3 which has one input and two outputs. When output 2 is terminated with a 75-ohm load, the impedance Z_{11} (impedance of output 1 with output 2 terminated) looking across output 1 into the network is shown in Fig. 4.

The network looking back from output 1 is a bridge circuit with output 2 appearing in the galvanometer or bridge arm. Therefore, if the source impedance is also 75 ohms, the bridge is balanced and no current will flow through output 2 as a result of any changes at output 1. The opposite condition is also true. Since the bridge is balanced, output 2 can be left open, short-circuited or terminated in any impedance and there will be no effect at output 1. Under these conditions, if all components are properly selected and arranged, the interaction between the outputs is theoretically zero.

Reflections resulting from mismatch at the distribution network or at the outlets, causing a time-delayed signal appearing as ghosts in a received picture, are virtually eliminated by the distribution network, provided the source impedance is matched to the line. This interesting property is illustrated in Fig. 5 where a 75-ohm source is connected to a simplified distribution network. Any reflected signal caused by a mismatch at outlet 1 going back along the line will be absorbed by the matched load at the distribution network; thus no time-delayed signal occurs at the outlet.

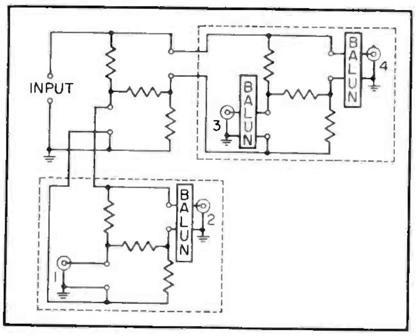


FIG. 6—Experimental distribution network giving four outputs

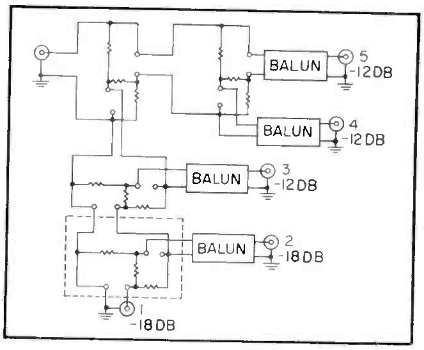


FIG. 7—Method of adding basic network to give five outputs

Experimental Data

Four typical production samples of the distribution network were tested at 80 mc to simulate the lower vhf channels and at 200 mc to simulate the upper vhf channels. Losses ranged from 11.7 db to 13.5 db, for an average of approximately 12 db.

Isolation between the outputs for an average distribution network ranged from 21.8 db to 32.6 db both at 80 mc and at 200 mc. The isolation was determined in the following manner. A signal generator was connected to the input of the network, three outputs were terminated and a 75-ohm detector connected to the fourth output. The output of the signal generator was then increased until a certain reading was obtained on a meter at the detector and the output power of the signal generator recorded.

The input was then terminated and the signal generator connected to one of the three previously terminated outputs, leaving the detector at the fourth output. The output of the generator was increased until the same reading was obtained at the detector meter as when the generator was connected to the input. The isolation is the ratio of the output power of the generator when connected to an output to that when connected to the input.

When measured input impedance is normalized to 75 ohms, the reactive component is small under all conditions and at all frequencies. With the outputs properly terminated, the input resistance is 75 ohms across the vhf television band. With the outputs open-circuited and short-circuited, the resistance is somewhat dependent on frequency, probably because of the inconsistent characteristics of the balun coils, although the maximum deviation from 75 ohms corresponds to a vswr of 1.4 to 1.

Other Network Configurations

The basic circuit in Fig. 3 is used as a building block for other configurations to split a single input to any practical number of outputs.

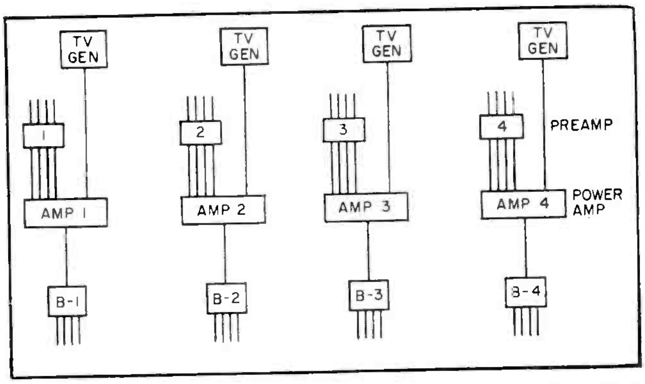


FIG. 8—Method of injecting locally generated signal by using separate generator for each amplifier branch

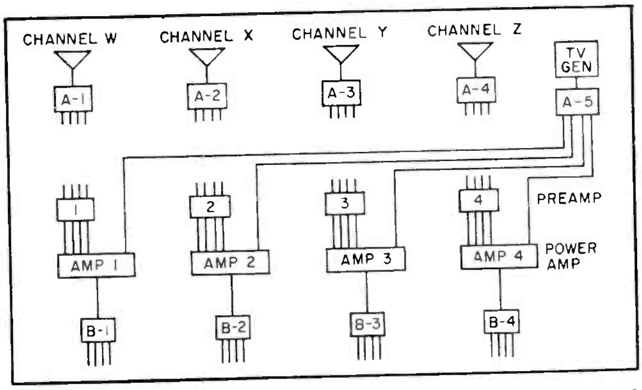


FIG. 9—Use of one generator for injecting locally generated signal for test purposes or for laboratory experiments

The experimental distribution network of Fig. 2 can be redrawn as in Fig. 6 to show this basic circuit more clearly. Other configurations are made possible by the addition or deletion of the basic circuit in the same manner as the experimental distribution network. Figure 7 shows how an additional basic circuit is added.

Cables and Amplifiers

The transmission cable for an antenna-multiplex system must be carefully selected. The cable must be checked before installation for voltage standing wave ratio across the television band with a termination that is equal to the characteristic impedance of the cable and is not a function of frequency. It must not exhibit sharp changes in standing wave ratio which, if present, can cause maxima and minima responses within the passband of a single channel.

Long runs of transmission cable having a vswr greater than unity in the antenna-multiplex system can also cause maxima and minima responses. If the average run for the transmission cable exceeds approximately 50 feet, the maximum tolerable vswr of the cable is 1.5 to 1 in order that the maximum voltage variation across the passband of any vhf channel does not exceed ± 1.5 db. If the average run is less than 50 feet, however, the requirement can be less stringent such that a vswr of 2 to 1 can be tolerated.

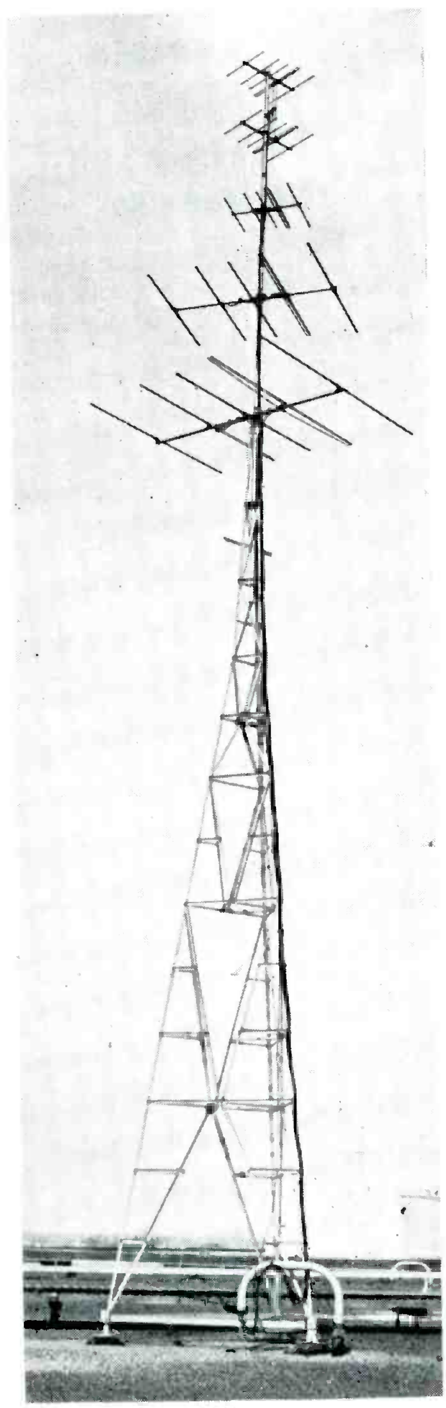
High-quality connectors must be used. They must not introduce excessive discontinuities or loading effects when connected in the system.

There are many commercially available amplifiers that, in most cases, will perform adequately for antenna-multiplex applications. The gain required for a particular application automatically narrows the selection, with the final selection contingent on the amplifier satisfying the cross-modulation and harmonic requirements.

Local Signal Injection

A locally generated television signal such as a test pattern or slide picture of known quality and controllable signal levels may be introduced in every amplifier branch as in Fig. 8 for laboratory experiments.

Figure 9 shows another arrangement for the insertion of the locally generated signal to the working system. There is only one generator needed in this case, with a distribution network used to split the signal four ways to provide an input for each amplifier branch. Other combinations are also possible, since a distribution network can be designed for any number of outputs from a single input. For example, two generators can be used in such a manner that each supplies two amplifier branches, or one generator feeds three branches and the other only one branch of the system.



Example of receiving antenna installation using new distribution network to get desired 25-db isolation between up to 256 television receivers connected to each antenna. High-quality connectors are essential in transmission lines to maintain required uniformity of response in each vhf television channel

THYRATRONS STABILIZE

SUMMARY —— High-power oscillators used to heat electron-tube elements during automatic exhaust are held within two percent between no-load and full-load by closed-loop regulator. Manual key in oscillator grid circuit is replaced by high-mu triode whose conductance varies with error signals derived from r-f output, thus varying switching rate and oscillator output

By H. J. FRASER
Dept. of Technical Education
New South Wales
Sydney, Australia

and

E. G. HOPKINS
School of Electrical Engineering
University of Technology
New South Wales
Sydney, Australia

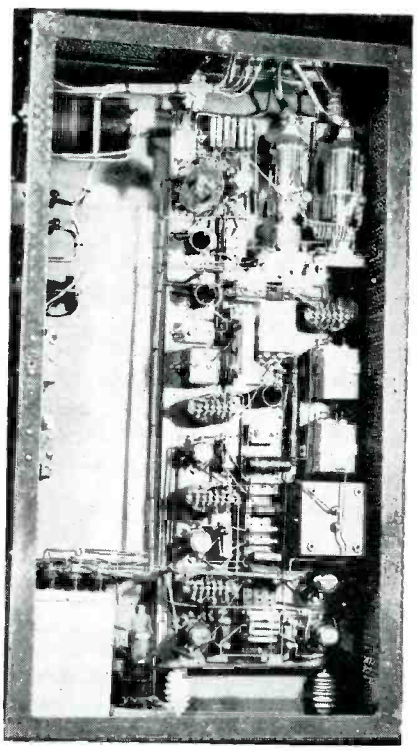
DEVELOPED TO IMPROVE the consistency of the induction heating of receiving tube electrodes during automatic exhaust, the closed-loop regulator to be described[1] has the following performance features which were regarded as desirable in this application: a response time small compared with the process time of 5 to 10 seconds, regulation of better than 2 percent between the unloaded and fully loaded oscillator conditions, ability to control any one of a number of existing oscillators of varying design with a minimum of circuit alterations and freedom from interference by nearby unshielded induction heating oscillators.

Output Control

It has been a common practice[2] for many years to key induction heating oscillators by opening the d-c path of the grid circuit by a mechanical switch as shown in Fig. 1A. This causes the oscillator to block by charging the grid capacitor to a potential beyond the cutoff grid voltage of the tube. In this regulator, the switch and portion of the oscillator grid resistor are replaced by a high-μ power triode, Fig. 1B, which is cut off for a variable portion of each half-cycle of supply voltage by a negative grid signal, thus providing smooth control of the rms output current of the oscillator.

The switching tube and the oscillator tube function as cascaded amplifiers in amplifying the power of the switching signal but require no additional power supplies so that the regulator unit need have no components of heavy power rating and need provide only a low powered signal at the grid of the switching triode.

The regulator circuit is shown in Fig. 2. The switching action is performed by the two parallel 810 triodes V_2 and V_3 that replace 5,000 ohms of oscillator grid resistor. Rectifier V_1 supplies a negative voltage developed across R_1 of divider R_1 and R_2 to the grids of the switching triodes through resistor R_3. Resistor R_3 is also in the cathode circuit of the 2050 thyratrons V_4 and V_5.



Internal view of regulator shows parts layout and shielding arrangement

At some point in each half-cycle one thyratron fires, cancels the negative voltage at the grids of the switching triodes and permits the oscillator tube to oscillate for the remainder of the half-cycle. At the end of the half-cycle the thyratron ceases conduction and the switching tubes are again cut off, causing the oscillator to block. The firing angle of the thyratrons is controlled by the phase of a sinoidal error signal derived from the measuring circuit.

Measuring Circuits

The measuring circuit consists of a tungsten-lamp bridge that produces a phase-modulated supply-frequency error signal and a tuned limiting amplifier that converts the signal into a constant amplitude sine wave of 70 volts rms. The bridge has three fixed and equal resistive arms, the fourth being the tungsten lamp connected through an *L-C* low-pass filter. The lamp is fed with a high-frequency current by a variable-coupling air-core transformer T_{RF} whose primary winding is connected between two taps on the high-frequency bus bar. Capacitor C_1 isolates the transformer from the 50-cps bridge circuit.

Because the bus-bar and transformer reactances are much greater

INDUCTION HEATERS

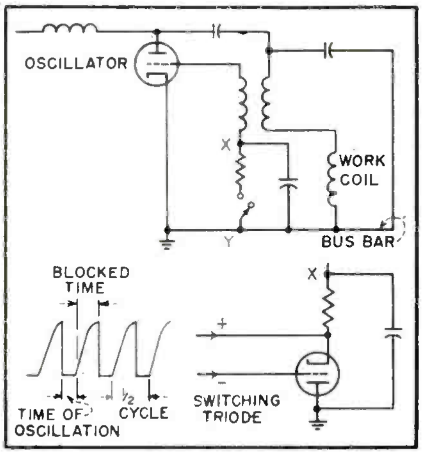


FIG. 1—Manual system of controlling oscillator output (A) compared with automatic system that replaces switch with triode (B) in oscillator grid circuit

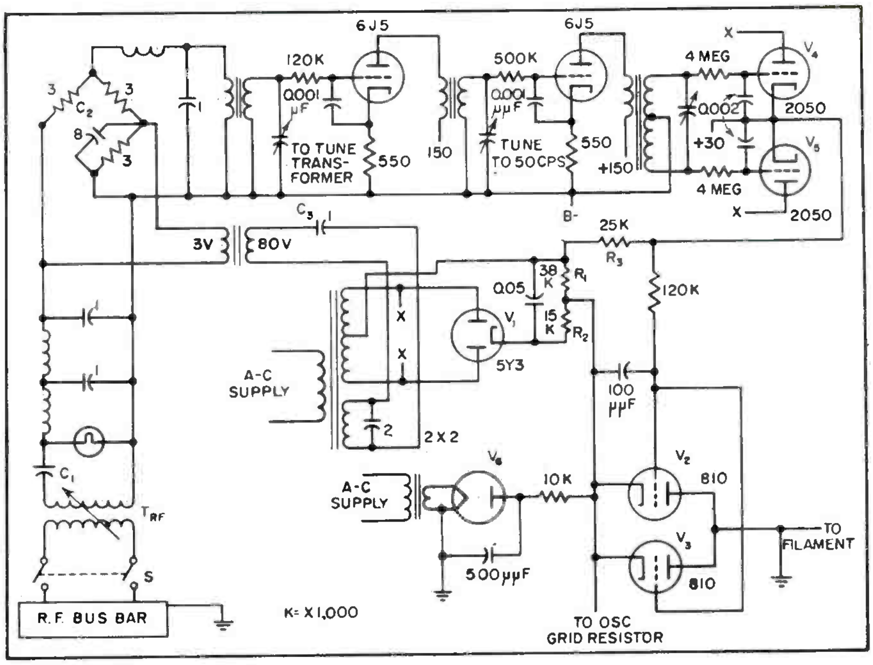


FIG. 2—Complete regulator circuit. Triodes V_2 and V_3 driven from thyratrons V_4 and V_5 replace 5,000-ohm oscillator grid resistor

than their own resistances or the resistance of the lamp, the high-frequency current in the lamp is proportional to bus-bar current irrespective of fluctuations in oscillator frequency. The supply-frequency current flowing in the lamp is 20 percent of the high-frequency current and contributes only 2 percent of the total rms current. Consequently, the bridge may be assumed to balance at some particular value of bus-bar current for each setting of the variable transformer independently of fluctuations in supply voltage.

Capacitor C_2 adds a small, fixed quadrature voltage to the bridge output causing it to vary in phase as well as amplitude. The phase of the bridge input voltage is advanced 20 degrees relative to the thyratron anode voltage by the action of capacitor C_3 so that the sensitive linear portion of the measuring circuit characteristic may be made to coincide with the most useful portion of the regulator characteristic.

The tungsten lamp has a filament 17 cm in length made from 0.008-in. diameter wire, a gauge that provides a thermal time constant slightly greater than the minimum necessary for regulator stability.

The Type 2X2 diode V_6 provides a path for negative grid current as a precaution against positive grid blocking of the oscillator as a result of secondary emission from its grid.

Construction

A photograph shows the unit after removal of the outer cover and the shield which covers the amplifier and thyratron sections. When the regulator is removed from an oscillator, another plug inserted into the socket on the oscillator completes the grid circuit through a 5,000-ohm resistor. This arrangement allows the oscillator to be returned rapidly to its original uncontrolled condition in the event of failure of the regulator unit.

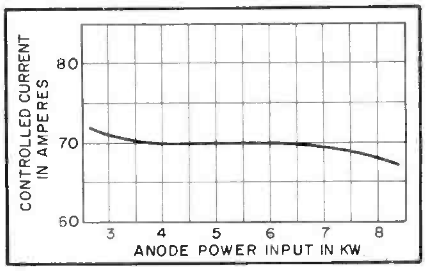


FIG. 3—Curve shows regulating characteristics under varying oscillator load

Performance

When using the regulator with tube exhausting machines, switch S is first opened and the oscillator is set by its manual control to give an unregulated unloaded bus-bar current of 30 percent above the required value. The regulator is then switched in and the variable transformer is adjusted to give the required bus-bar current.

This procedure ensures that the regulator operates near its region of maximum sensitivity. Figure 3 shows the measured regulated current of a single-phase oscillator as a function of anode input power with varying load. The response time of the oscillator to such changes is about 0.3 sec.

The authors are indebted to the Amalgamated Wireless Valve Company Pty. Ltd., of Sydney, Australia, for permission to publish this article.

REFERENCES

(1) E. G. Hopkins and H. J. Frazer, An Automatic Output Regulator for Power Oscillators, *AIEE Trans*, Applications and Industry, March 1956.
(2) E. E. Spitzer, Induction Heating in Radio Electron-Tube Manufacture, *Proc IRE*, 34, p 110, March 1946.

MORSE-TO-TELEPRINTER

By WILLIAM REID SMITH-VANIZ and ELTON T. BARRETT
Vice-President President
CGS Laboratories, Inc., Stamford, Connecticut

SUMMARY — International Morse code signals arriving at constant or variable speeds are converted into standard five-digit teleprinter code by combination analog-digital computer using 92 tubes, 62 static magnetic memory units and conversion matrix having 448 neon tubes. Special signals needed for operating teleprinter carriage shift and return are automatically generated, so messages are printed at up to 100 words per minute

Conversion of International Morse code into standard teleprinter code requires both analog and digital computer techniques. The identification of dots, dashes and spaces is analog and the translations are digital.

Standard teleprinter circuits are operated by five-digit code groups, each group requiring the same time for transmission. The positions of the mark and space pulses within each group determine the letter or number printed. Special code groups control the teleprinter for carriage shift, line feed and carriage return.

Morse code characters vary in transmission time because they range from a single dot up to as many as six dots and dashes. Moreover, the Morse code has no characters for controlling the carriage of a teleprinter. For successful conversion it is therefore necessary to provide storage circuits to take care of the difference in transmission time of the Morse characters, so that teleprinter signals are fed out at a constant rate and the required new control signals are generated. The teleprinter keyboard diagram in Fig. 1 shows the equivalent signals in the two codes.

Proper identification and translation of Morse code depends upon ability to recognize the pulse and pause pattern of each character as well as recognize the longer pauses between characters and words. This must be done despite short-term or long-term variations in transmitting speed.

Converter Operation

The main units of the Trak automatic code converter are shown in Fig. 2. The incoming Morse signal from the radio receiver or tape perforator is first fed into a pulse squarer. This sharpens the pulses and converts all to equal amplitude to overcome the effects of fading and distortion. The resultant output signal S, of negative polarity, is fed through a cathode follower to a 1-millisecond delay circuit.

The squarer also generates signal S', of positive polarity, used later for advancing the positions of stored dots and dashes in the Morse storage register.

The delay circuit gives a delayed output signal Z and generates two pairs of control pulses, P and Q; these are each about 1 millisecond in duration, and serve to control bidirectional switches in the mark and space recognition sections. Pulses P occur at the beginning of each space in the received signal (at the end of a dot or dash) and pulses Q occur at the beginning of each mark (dot or dash).

Recognition of Marks

To recognize whether each incoming mark in the Morse message is a dot or a dash, independently of code speed, the delay output signal Z is fed through a cathode-coupled amplifier into the mark recognition section. This section measures the length of each mark by generating a saw-tooth signal that lasts as long as the mark.

To tell dashes from dots, the saw-tooth voltage at the end of each mark is compared with a

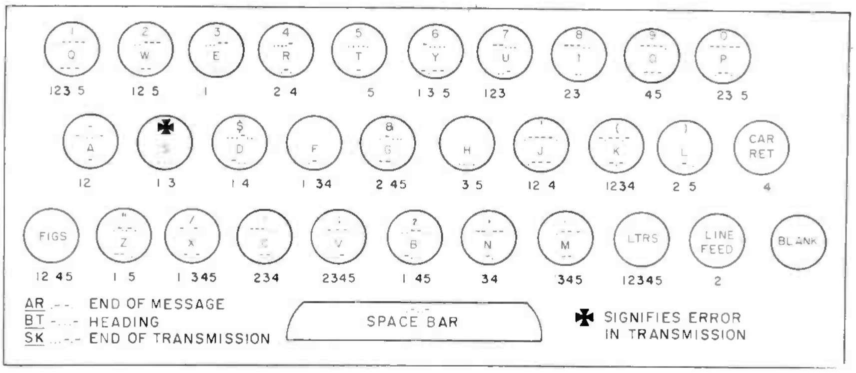


FIG. 1—Teleprinter keyboard, with equivalent Morse code signals on keys. Numbers below keys give positions of marking pulses in corresponding 5-digit teleprinter code; thus, letter F has pulses in 1st, 3rd and 4th spaces

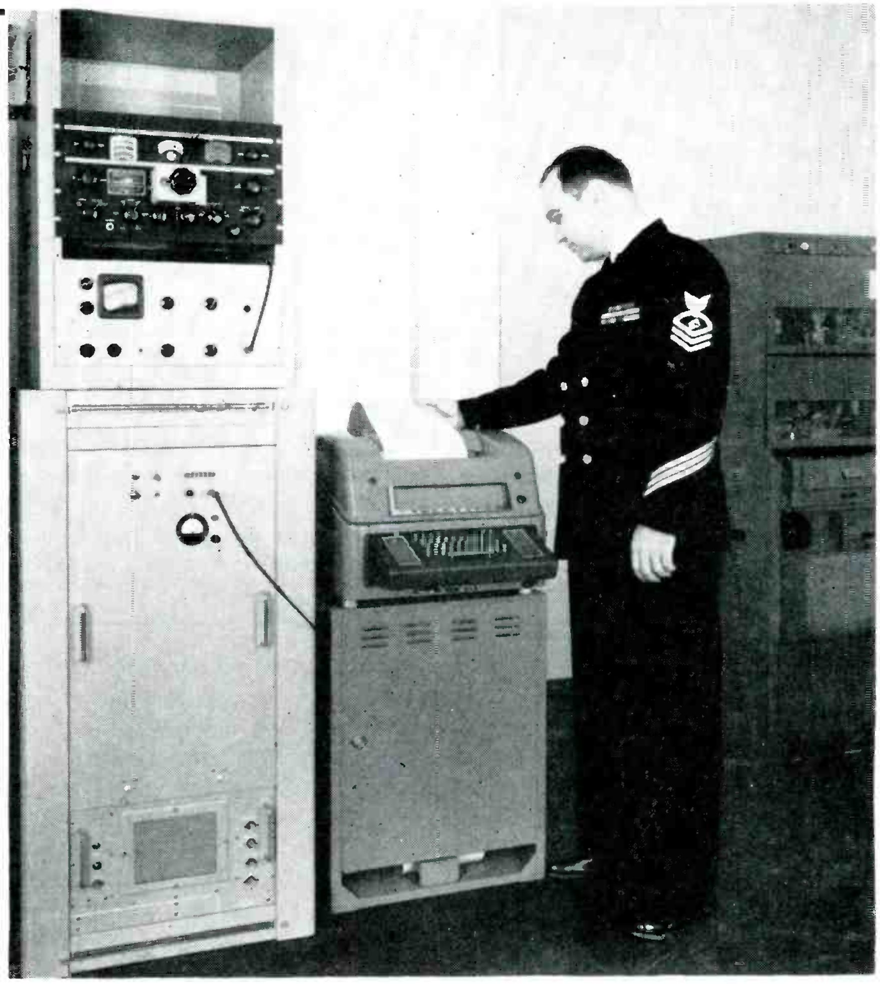
CODE CONVERTER

stored reference voltage derived from previously received marks. The successive saw-tooth voltages are also used to modify the reference voltage in accordance with changes in the speed of the message.

When a mark is long enough so the saw-tooth voltage rises to the value of this reference voltage, it is recognized as a dash. Shorter marks are recognized as dots.

When a mark is recognized as a dash, pulses D are supplied from trigger 1 in the output of the mark recognition section. These dash-decision pulses are initiated at the instant the saw-tooth voltage rises above the reference voltage and last until the end of the dash. In the absence of pulses D when a mark is being received, the mark is recognized as a dot.

The saw-tooth voltage of the mark saw-tooth generator is divided by a voltage divider into three paths. Bidirectional switch 1 is closed when the incoming mark is a dot, so the full saw-tooth voltage is applied to the mark-reference storage capacitor to establish the reference voltage. When the incoming mark is recognized as a dash, bidirectional switch 2 is closed so $\frac{1}{3}$ of the saw-tooth voltage is fed to the capacitor (a dash is normally three times as long as a dot). Pulses P from the delay actuate the proper bidirectional switch through switch control 1. The reference voltage on the mark reference capacitor is compared with the voltage on the lead marked $1\sqrt{3}$ to classify the incoming mark as a dot or a dash.



Trak model CMP-15 Morse-to-teleprinter code converter (lower left) installed for evaluation at U. S. Navy Radio Station, Cheltenham, Md., with station WWL being copied by interconnected Teletype machine at 100 words per minute. Radio receiver and static rejector are in rack above converter.—Official photograph, U. S. Navy

Space Recognition

The space recognition section in Fig. 2 distinguishes three kinds of spaces: (1) an element space; (2) the longer letter space; (3) the still longer word space. The space saw-tooth generator is triggered during space intervals by signal Z and the resulting voltage on the space reference storage capacitor is compared with a reference voltage just as for mark recognition.

When a space has been distinguished as occurring at the end of a complete Morse character, trigger 2 produces a pair of pulses L indicating that a letter decision has been made. Trigger 3 produces a negative word-decision pulse W when the space is too long to be a letter space. The absence of both the letter-decision and word-decision pulses determines that the space occurs between the elements of a single Morse character.

Because relatively long periods of time may elapse between successive words, the reference voltage on the space storage capacitor is not affected by the word spaces.

Morse Storage Register

A seven-digit binary register interconnected with seven shift-control stages stores the dots and dashes of each Morse character. A dot is stored as a binary 0 and makes one output lead $(a' - g')$ have a higher positive voltage than the other lead $(a - g)$. A dash is represented by the 1 condition in which the relative voltages at these pairs of output leads are reversed.

At the end of each letter-decision

pulse L, a pulse is fed through the reset control line into all of the storage stages to reset them back to zero, except for storage B, which is reset to 1 to insure recognition of characters having a dot as the first mark.

The regenerated signal S' from the Morse input circuit goes into an advance pulse amplifier. At the beginning of each mark this amplifier feeds a sharp negative pulse to each storage stage except the first. This advances the 0's or 1's in each storage into the next successive storage. At the same time the advance pulse amplifier feeds a negative pulse into a reset circuit, which resets storage A to 0.

Because of the 1-millisecond delay, the end of letter-decision pulse L occurs after the first advance pulse has energized the advance control line. Thus, the first advance pulse derived from the first mark of each new Morse character does not have any permanent effect upon Morse characters being stored in the register. Storage B, which is always reset to 1, indicates the front of the new Morse character being fed into the register.

If the first mark is recognized as a dash, a dash-decision pulse D is fed into a rectifier and pulse-former that generates a pulse and sets storage A to 1. If the first mark is a dot, storage A remains in its 0 condition. At the beginning of the next mark the reset circuit resets storage A back to 0 and advances all stored marks to the next succeeding circuits.

Conversion Matrix

The $f'\,g'$ product generator generates a pulse whenever storage F and G are in the 0 condition. This simplifies the design of the Morse-to-teleprinter conversion matrix, formed of special neon lamps connected at selected crossovers of a grid of wires.

Before the Morse storage register is reset by letter-decision pulse L, the conversion from Morse to teleprinter code is made in the matrix. The matrix output is fed through the memory input control (lower right in Fig. 2) to the magnetic memory.

The outputs from the seven shift controls are fed simultaneously into the conversion matrix. This converts the seven-digit binary code from the Morse register into a simultaneous five-digit teleprinter code on leads $T_1 - T_5$.

Output T_6 from the matrix indicates whether the teleprinter character is to be lower or upper case. This output controls the carriage shift through the case read-out amplifier, case storage transformer and figures (or letters) pulse ampli-

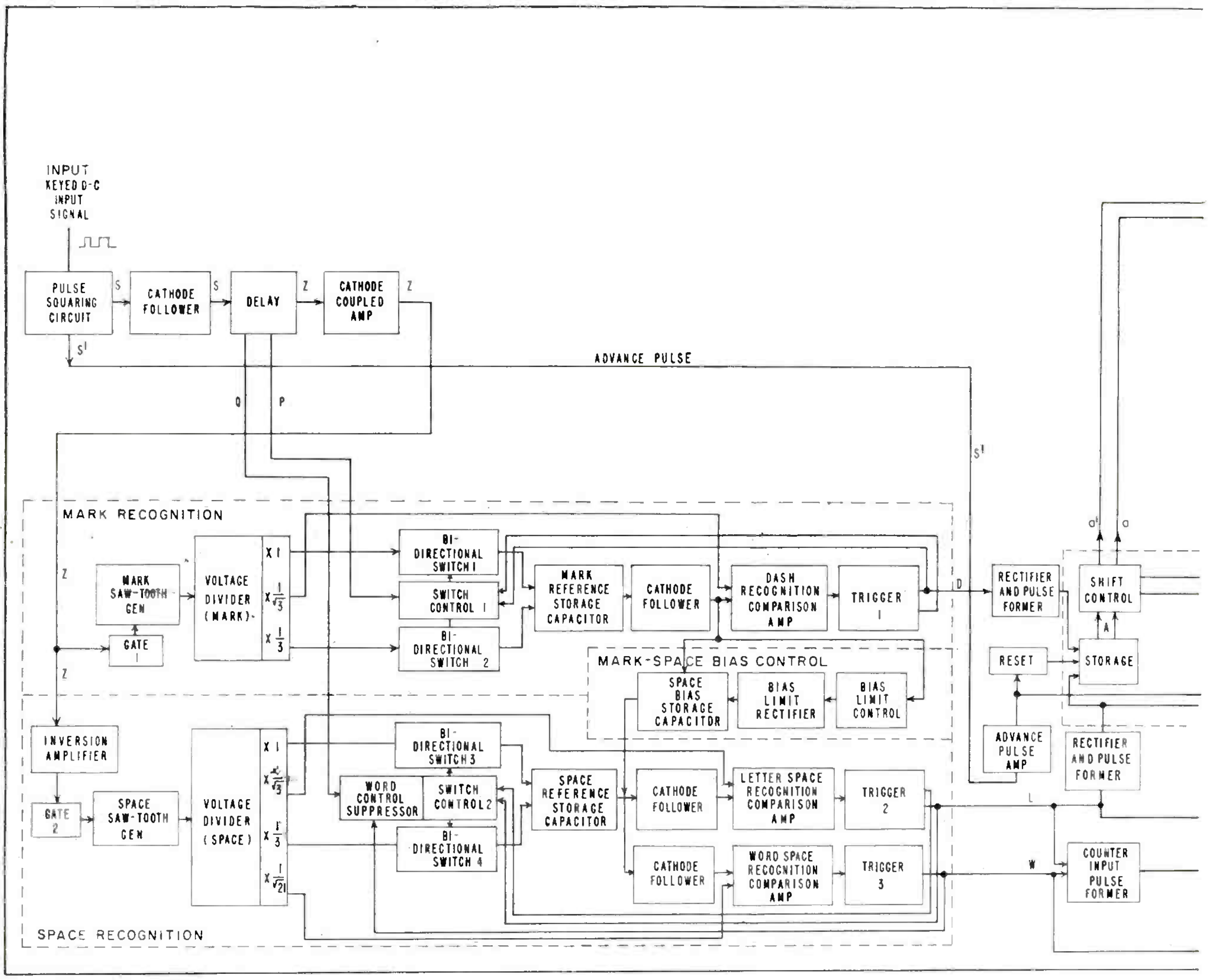


FIG. 2—Automatic Morse-to-teleprinter converter arrangement. Input Morse signal may be keyed audio tone from radio receiver or

fier. The case storage transformer has high hysteresis and remains magnetized in either direction until forced to change, to eliminate unnecessary shifts when several figures (or letters) are sent in succession.

Output T_7 indicates reception of special Morse characters such as AR, BT and SK, meaning end of message, heading and end of transmission respectively. This T_7 output signal acts through the gated read-out amplifier to trigger the carriage return and line feed generator. Simultaneously the external full-set combining network is actuated to initiate cycling that empties the magnetic memory until the special character reaches the last row. Normal cycling is then resumed for the next paragraph or message.

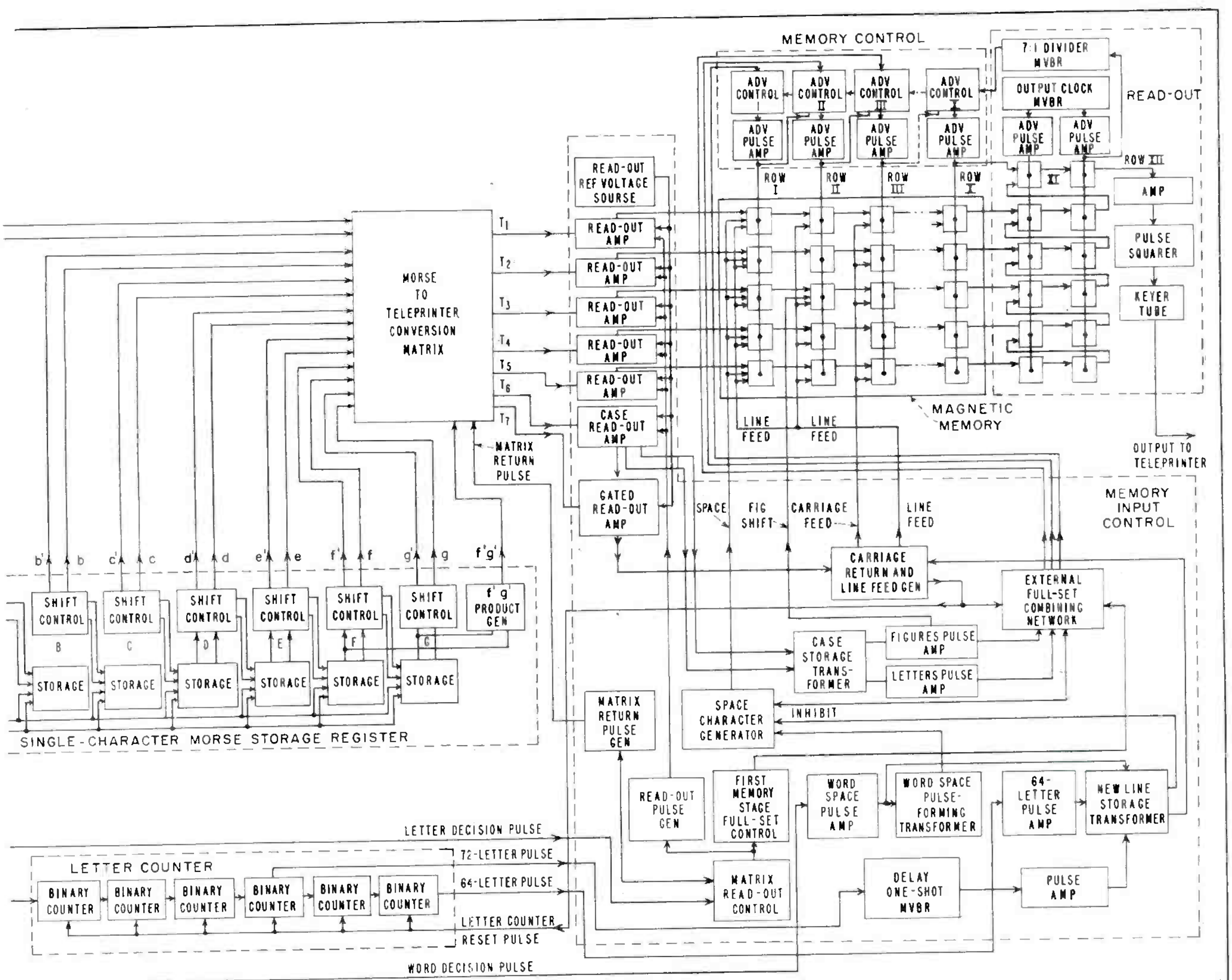
Because the Morse code message does not indicate when the teleprinter carriage should be returned, a binary letter-counter is used. To count each letter and the spaces between words, letter-decision pulses L and word decision pulses W are fed through an input pulse former to the counter. The last binary counter delivers a control pulse when 64 letters and word spaces have been received, thereby setting the memory input control to return the carriage at the end of the word then being received.

Magnetic Memory Circuits

The teleprinter has a capacity of 72 character spaces per line so the carriage must be returned after this count is reached, regardless of whether the end of a word has occurred. When the count reaches 72, the letter-counter circuit initiates carriage return and resets the letter-counter to zero.

To take up the slack between the variations in speed of the Morse message and the constant speed of the teleprinter and to allow insertion of special teleprinter characters, magnetic memory is used. In effect, this operates like a ten-position hopper, with each new teleprinter character being dumped into the front end in row one. Stored characters are removed in sequence from the tenth row at the other end of the hopper at proper intervals as required for transmission in teleprinter code. Special carriage control characters are inserted into the appropriate first three rows of the memory and are removed from the tenth row in sequence.

Letter-decision pulses L are fed into a matrix read-out control that delivers a pair of short control pulses in sequence, each about 500 microseconds in duration. Both pulses are fed to a common return



tone line, keyed d-c voltage produced by hand or automatic keying, or keyed direct current produced by photoelectric scanner from the conversion matrix. The combined negative pulse lasts for about 1,000 microseconds and places the matrix in condition to deliver its output. The second of these 500-microsecond pulses is also fed to a read-out pulse generator, which delivers a read-out pulse to each of six matrix read-out amplifiers. These amplifiers compare the voltages on leads $T_1 - T_6$ with a read-out reference voltage source and deliver code pulses to the magnetic memory when the voltages on certain of these leads exceed the reference voltage.

Whenever the incoming Morse code is garbled or includes a character not having a corresponding teleprinter equivalent, the output on matrix leads $T_1 - T_5$ is such as to print an error-warning character and sound a warning bell.

Word Space Storage

To cause the teleprinter to leave spaces between words, each word-decision pulse W also goes to a word-space pulse amplifier. This amplifier causes a word-space pulse-forming transformer to feed a pulse to a space-character generator. This generator then stores a teleprinter space character in the appropriate memory units of the first row of the magnetic memory. In addition, the space character generator feeds a control pulse to the external full-set combining network. This combining network then feeds control voltage to the memory control circuits to advance all stored characters one row.

Constant Output Speed

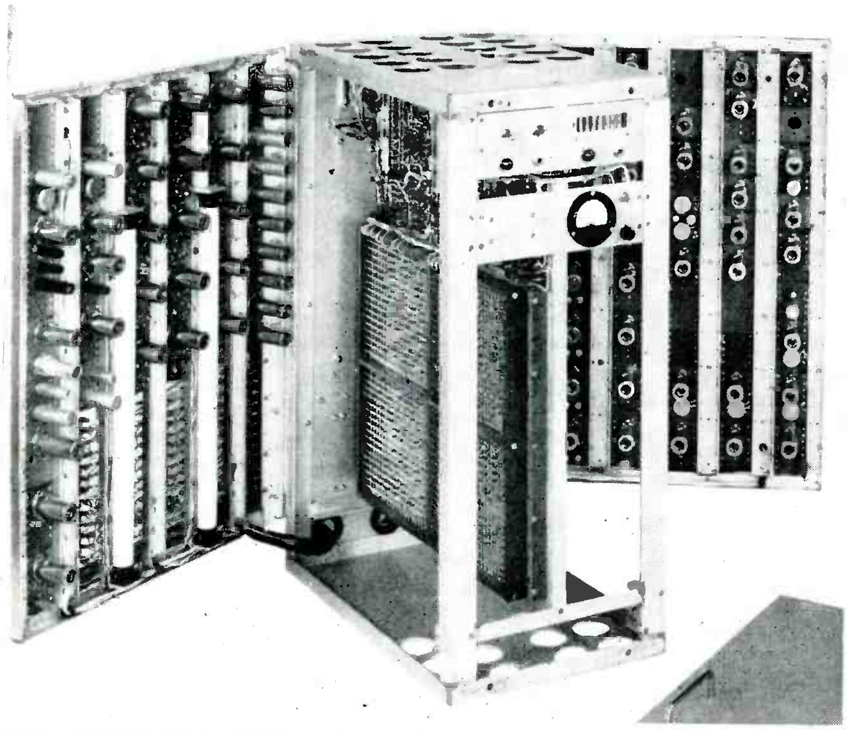
The rate at which the characters are removed from the tenth row of the memory is controlled by a 7-to-1 divider multivibrator that delivers pulses at the maximum teleprinter rate, generally 60 words per minute. For this the divider multivibrator frequency is about 6.5 cps and is controlled by an output-clock multivibrator having a frequency of about 45 cps. The multivibrators act on the magnetic memory stages through advance pulse amplifiers and advance control units.

Pairs of advance pulses are fed to the eleventh and twelfth rows of the magnetic memory in a steady sequence under the control of the clock multivibrator, so they repeat every 22 milliseconds. The first pair sends out the start space. The next five pairs of advance pulses send out the five elements of the teleprinter character. The seventh pair of advance pulses finds all six of the memory units in both rows empty and so there is a 0 output for the standby condition between characters.

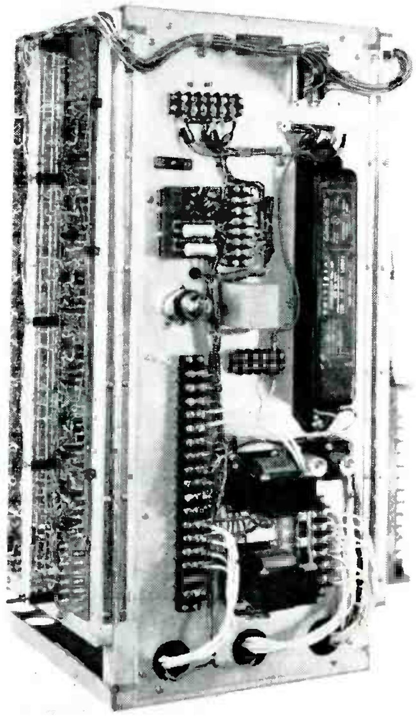
The 7-to-1 divider multivibrator is triggered by the last advance pulse of the seventh pair. The characters are thus removed from the memory and fed into the teleprinter line at a constant rate that is under the control of the output-clock multivibrator and can be set to any optimum rate desired.

Slow-Speed Operation

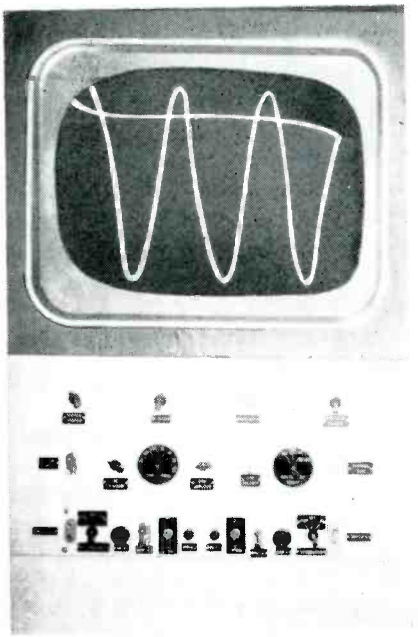
When the Morse code message is slower than 60 words a minute, the read-out periodically finds that the tenth row of the memory has not been filled. Then the output to the output amplifier is all 0's. No start pulse is generated, because the tenth advance control is already empty, hence the 7-to-1 divider multivibrator cannot actuate this advance control. The teleprinter thus remains in standby condition until the next character has filled the tenth row of the memory.



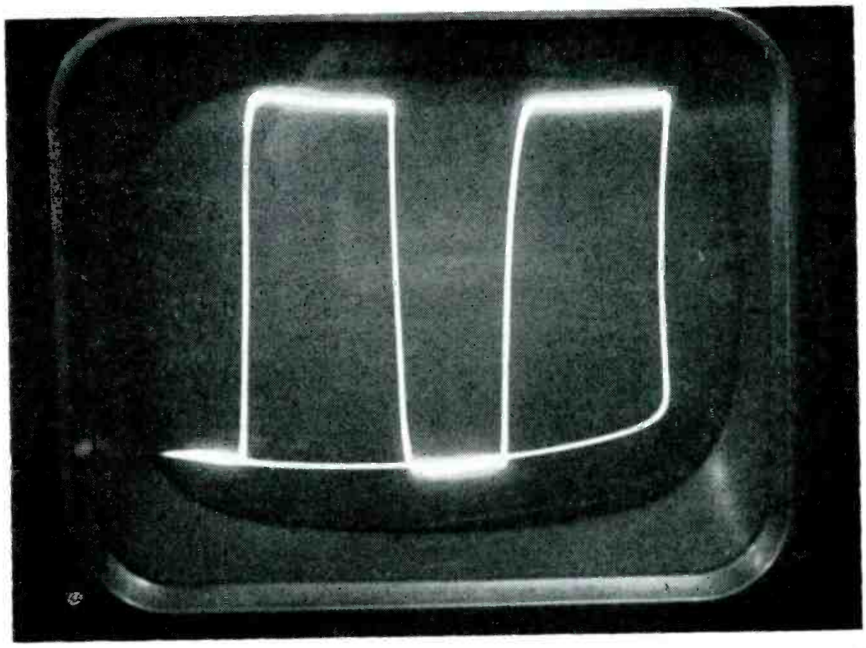
When converter unit is pulled out from rack on roller suspension, hinged side chassis units swing out to give access to tubes and to neon-tube matrix on center section. Fluorescent lamps mounted between vertical rows of tubes on left chassis insure consistent operation of neon tubes in matrix



Rear view of converter unit, showing fluorescent lamp ballast mounted on panel and starters directly below. Side panels are supported by piano hinges



Picture tube, in separate cabinet atop amplifier, shows 1,000-cps sine wave



Appearance of 2,000-cps square wave signal on 21-inch screen. Display is approximately 12 inches high. Pattern is essentially identical to input signal

Magnetically Deflected 21-Inch Oscilloscope

By HAROLD E. O'KELLEY and WAITE H. TODD

Assoc. Prof. of Electrical Engineering, Alabama Polytechnic Institute, Auburn, Alabama

Electronic Scientist, Research Laboratories, Redstone Arsenal, Huntsville, Alabama

SUMMARY —— Large-screen display unit for classrooms, technical lectures and demonstrations can be built economically from ordinary television receiver components and tubes. Push-pull vertical and horizontal amplifier stages permit use of feedback to make deflection coil current waveforms proportional to input signal voltages. Full deflection of 10 inches is achieved up to 18,500 cps; deflection drops gradually to 4 inches at 50,000 cps

ELECTROSTATICALLY DEFLECTED tubes with screens greater than 7 inches are not generally available. Therefore, the construction of a large-screen oscilloscope ordinarily would proceed on the basis of employing magnetic deflection. Since the function of an oscilloscope dictates it, and because magnetic deflection is used, it is necessary that there be a linear relationship between input voltage and deflection coil current waveforms. Therein lies the problem peculiar to a large-screen oscilloscope—to produce a current in a reactive circuit which is a linear function of an arbitrary voltage waveform. This problem was successfully solved for a 21-inch oscilloscope by using current feedback in the horizontal and vertical amplifiers.

The oscilloscope amplifier circuit in Fig. 2 uses essentially identical vertical and horizontal amplifiers, push-pull throughout, with degenerative feedback applied across all but the first stage. Each amplifier has two pairs of input terminals so that they will accept balanced, unbalanced or separate signals.

The net input to the amplifier is the algebraic difference of the voltages at both inputs. As an example, consider the vertical amplifier. If an unbalanced input signal is to be observed, it may be applied at either input, though No. 1 is preferred because of the greater range available in its step attenuator. A balanced signal is applied between the ungrounded terminals on input No. 1 and input No. 2. A display of the difference of two input waveforms can be had by applying them separately to the two pairs of input terminals.

Push-Pull Amplifier

The push-pull arrangement reduces amplitude distortion and permits use of the feedback signal to improve the precision of the current waveform in each side of the center-tapped deflection coil. If the driving amplifier were unbalanced the current in only half the deflection coil could be used to generate a feedback signal.

A cathode follower input is employed so that a high input impedance is obtained and the signal is combined from a low-impedance source with the feedback voltage. The 12AT7 double triode was selected for the input stage because of its ability to operate with several volts bias at small values of plate current. A bias voltage of 2 volts or greater is desired to prevent plate current cutoff by negative-going signal voltages, while a low plate current lessens the demand on the power supply.

Direct-Coupled Amplifier

The second stage of amplification consists of a 12AX7 which was selected for its high amplification factor. This stage is direct-coupled to the following stage, making it difficult to use a pentode because of the screen grid supply problem. Slight changes in screen grid voltage cause plate voltage shifts which are intolerable in a direct-coupled amplifier.

In the second stage, phase inversion is accomplished by the use of a common cathode resistance. This action is enhanced by returning the common cathode resistor to a negative voltage which allows the use of a large resistance. The phase inversion obtained is not complete since for this arrangement the output plate voltages differ by approximately 5 percent. The common cathode resistance of the following stage serves to improve the phase-inverting quality so that the magnitudes of the output voltages at the plates of V_{3A} and V_{3B} differ by less than 1 percent.

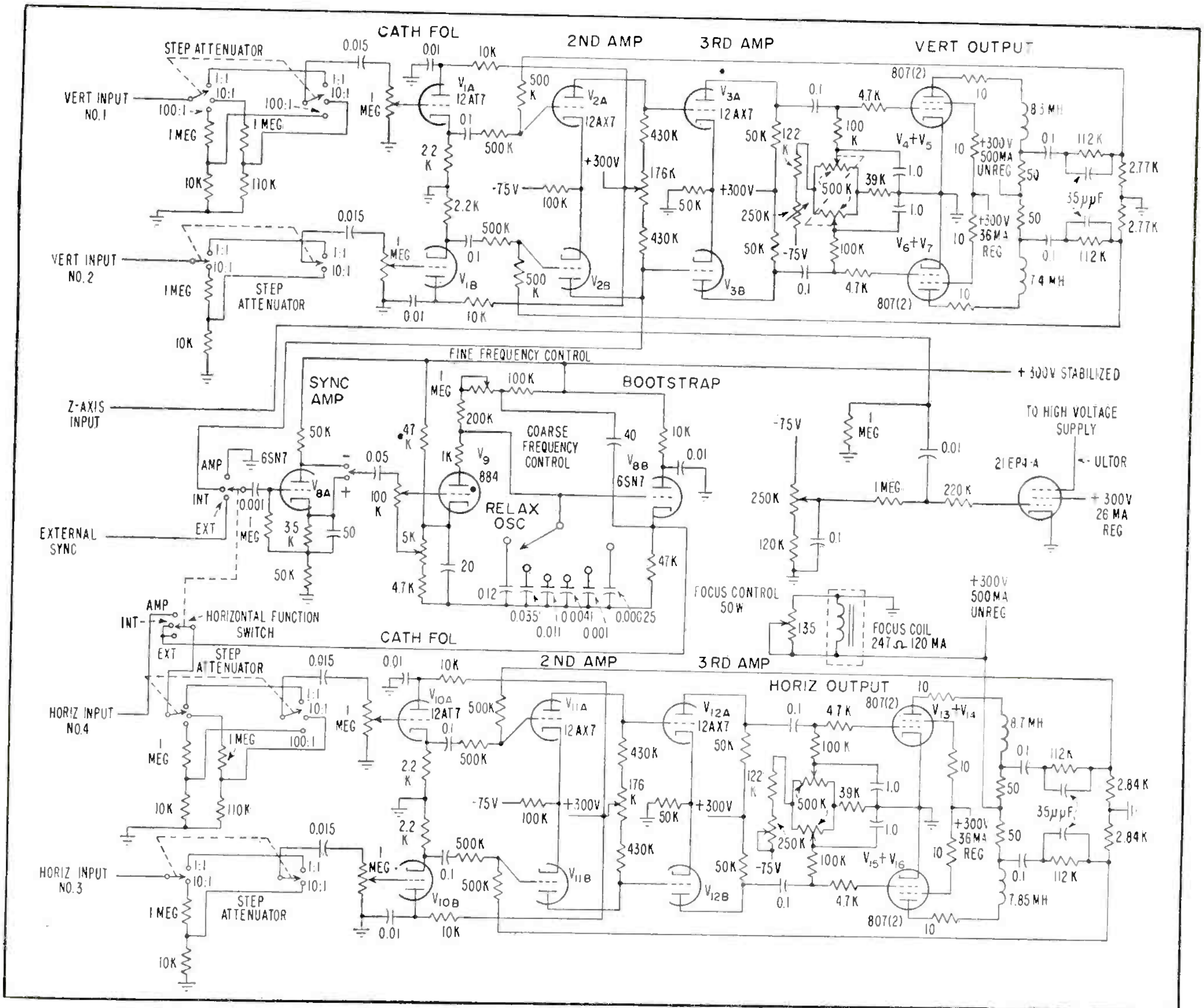


FIG. 1—Deflection amplifier circuits for 21-inch oscilloscope using television receiver picture tube. Power supply circuits (not shown) are conventional

Two half-megohm resistors in the grid circuit of the second stage act as a resistive adder for combining the input signal with the feedback voltage. Since the resistors are of equal value, the signal appearing at the tube grid is half the sum of the incoming and fed-back voltages.

Third Stage

The third stage is also a 12AX7, with somewhat less gain because it is working into an impedance of 100,000 ohms. This is the recommended maximum grid resistance for a class A 807 with fixed bias.

The output stage consists of four 807 tubes in a parallel push-pull arrangement. The deflection yoke used requires a 240-ma change in each vertical winding (210 ma horizontal) to produce a 12½-inch deflection. The quiescent plate current is fixed at 62.5 ma per tube, thus allowing, for two tubes, swing of 120 ma about the operating point.

Distortion

The distortion produced by operating over a large portion of the tube characteristic is largely even harmonic in nature and its effects are cancelled by the push-pull arrangement. Any remaining distortion is reduced by approximately 17 times by the use of negative feedback. A dual linear potentiometer in the grid circuit permits balancing of tube currents and positioning of the pattern on the face of the cathode-ray tube. A single potentiometer allows adjustment of the total tube current for long-term drift or after output tube replacement. Parasitic suppressors in the form of 10-ohm resistors are connected in series with the control grid, screen grid and plate leads as close to the tube as possible.

Feedback

Feedback voltage is developed across a 50-ohm resistor placed between the plate voltage supply and the yoke coil. Several schemes for locating the yoke coils and feedback resistor were considered but placing them in the plate circuit proved best. Terminals for Z-axis input are provided, though no amplification is provided.

The 884 thyratron operates as a relaxation oscillator, providing the internally generated horizontal sawtooth waveform. Triode section V_{8B} is used with the thyratron as a bootstrap circuit, thereby yielding a greater output voltage with good linearity. The other half of this 6SN7 operates as a sync amplifier where either internal or external synchronizing signals can be applied to its input terminals.

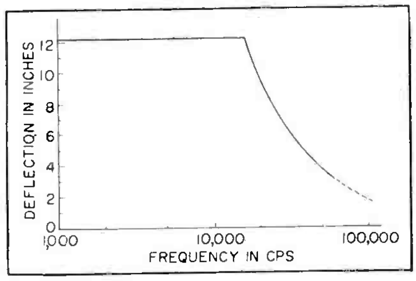


FIG. 2—Maximum vertical deflection as a function of frequency

Power Supplies

For best spot brightness and focusing characteristics, the 21EP4-A cathode-ray tube requires an ultor voltage of 12 to 15 kv at approximately 100 microamperes. The deflection yoke manufacturer recommends 12 kv accelerating potential for this cathode-ray tube and the Y-16FF6-P deflection yoke. A conventional television receiver flyback power supply is used for developing this voltage. A ½ 6SN7 blocking oscillator supplies gating pulses to a ½ 6SN7 discharge tube which drives a 6BG6-G beam-power tetrode. The RCA 232TI autotransformer in the plate circuit of the tetrode develops a high voltage which is rectified by a 1B3-GT and filtered. A 6W4 damping rectifier is used to provide a boosted B supply voltage for the beam-power tetrode. Adjustment of the ultor voltage is made with the drive control.

For economy, two identical low-voltage supplies are paralleled. Each uses 5U4-G's in a full-wave circuit with capacitance-input filter to give a rated 340 ma. From the common output is obtained 325 v at 50 ma unregulated for the high-voltage power supply, 300 v at 500 ma unregulated for the output tubes and focus coil, 300 v at 36 ma regulated by two VR150's for the screens of the output tubes and 300 v at 26 ma regulated by two other VR150's for the horizontal and vertical amplifier stages.

Two filament transformers back to back give an isolated 115 v a-c for a selenium rectifier supply which provides minus 75 v regulated by a VR75 for bias on the 807's and the cathode-ray tube. A relay operating from this supply opens power transformer center-tap connections in event of bias failure.

When the two low-voltage supplies are connected in parallel and operated at near their rated load, their currents do not differ by more than 5 ma. The supplies are individually fused.

The 807 output tubes obtain their screen grid voltages from one stabilized output. The horizontal and vertical amplifiers, excluding the output stages, are supplied from a second stabilized output. The focus coil current of 120 ma is obtained and adjusted by a network in series with the 807 plate current supply.

Performance

The oscilloscope is capable of displaying a sine wave at full deflection of 10 inches up to a frequency of 18,500 cps and will display higher frequencies at reduced deflections. At low operating frequencies the load presented to the output tube is largely resistive and the limits of deflection are set by the maximum current available at the output stage. At some higher frequency, due to the induced voltage in the deflection coil and the voltage drop in the feedback resistance, excessive plate voltage excursions carry the plate potential below the knee of the plate characteristic curve and excessive distortion occurs. A large screen grid current is drawn at low plate voltage which could cause damage. To find the useful large-display frequency range of the oscilloscope, the deflection amplitude and frequency were found which would cause the plate voltage of the output amplifier to drop to within 60 volts of ground potential. The results are shown in Fig. 2. Full deflection could be had at higher frequencies if a higher plate potential were used and the current capacity of the output stage were increased.

ULTRASONICS BUBBLES

By ARTHUR S. DAVIS
Mack Electronics Division, Inc.
Mack Trucks, Inc.
Plainfield, New Jersey

SUMMARY — Magnetostriction transducer driven by ultrasonic generator vibrates filled beer bottles during packaging process to cause foaming that drives unwanted air out of bottle just before it is sealed. Generator delivers 250 watts to transducer and consists of a Wien-bridge oscillator feeding phase inverters that drive the push-pull final

To meet increased demand for packaged beer, breweries have been required to expand their facilities and in particular to pay more attention to the problems of bottling and canning. In this area ultrasonics has been found to be a useful production tool.

Packaging Problems

Beer and ale are basically food products and shelf life is an important factor in packaging the product. Whereas with kegged beer and ale the product is consumed in a relatively short time, in bottles or cans the product may not be consumed for months.

Exposure to either air or accluded air shortens the shelf life considerably. Oxygen in air oxidizes or denatures some of the protein groups dissolved in beer. This oxidation tends to make the protein less soluble, hence come out of solution. The result is that the product becomes hazy and acquires a fruity or estery taste.

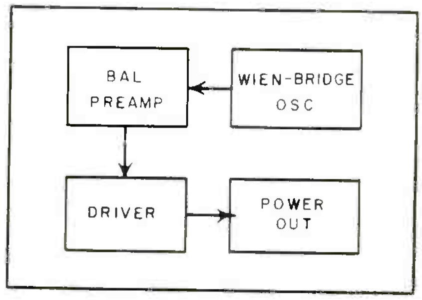


Fig. 1—Block diagram of ultrasonic beer foam generator shows signal-flow path

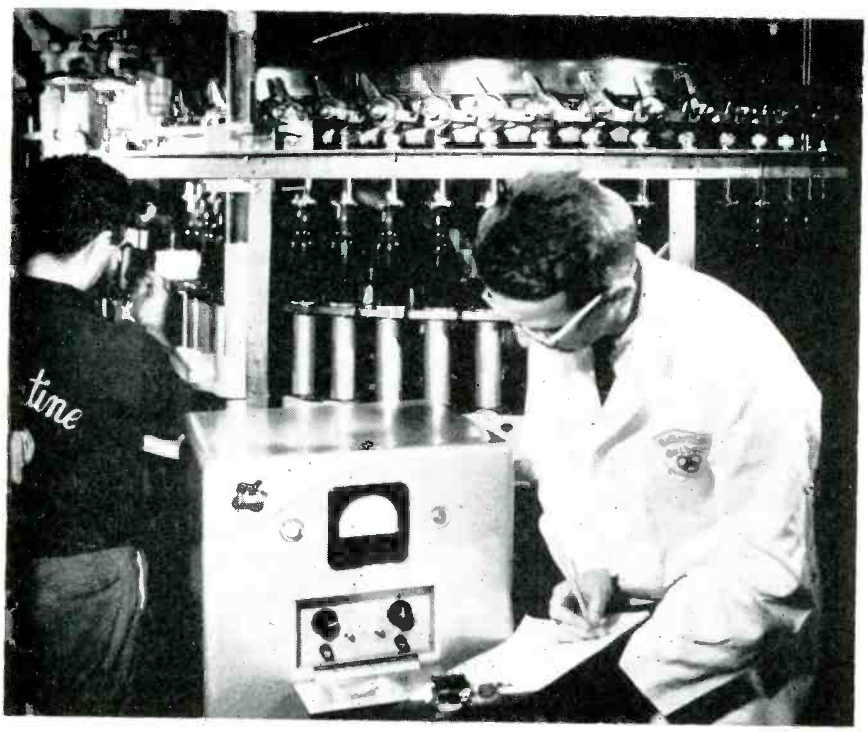
It has been found that an acceptable unit for air in beer is about 1 cc of air for every 5 oz of beer or ale, although some breweries keep well below this limit. It is also true that pasteurization prolongs the life of the packaged product. In pasteurization however, excessive air content will give the product a cooked or syrupy flavor.

Bottling and Air Elimination

The bottling method almost universally adopted in American breweries is to feed cleaned, empty bottles into a circular rotating filling machine. As the bottle enters the machine, it is automatically gripped by the neck and connected to a traveling pressurizer and feeder. The bottle is immediately subjected to about 10 to 12 pounds pressure and the beer is gravity fed through a tube extending about one-quarter way into the bottle.

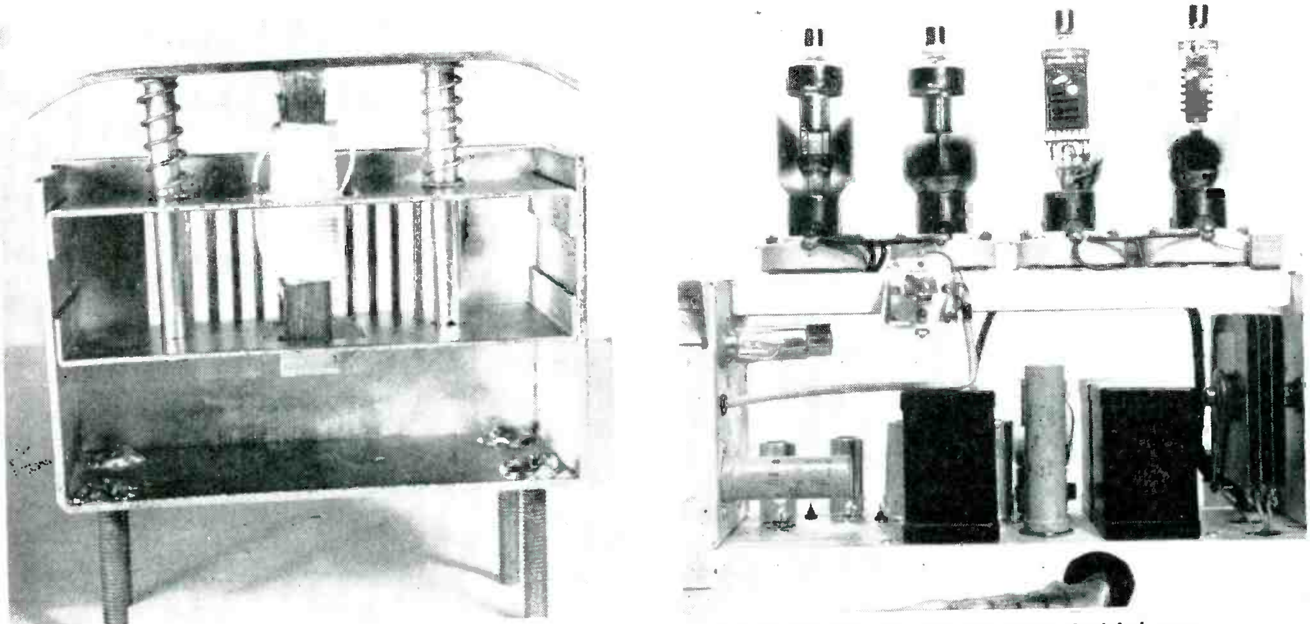
The feeding continues until the bottle is full, whereupon the bottle is agitated and the filling tube is extracted. The agitation tends to make the beer foam when the tube

THE FRONT COVER



Operator checks dial settings during routine maintenance on beer bubbler at plant

BEER IN BREWERY



Magnetostriction transducer (left), driven by output of ultrasonic generator (right), has a laminated oxidized nickel core

is extracted. The foaming process drives off most of the air which displaced the tube by substitution with CO_2. After the beer is foamed it is immediately capped and the bottling operation is complete.

The agitation process is where ultrasonics is being successfully used. Three methods of foaming beer are currently in use, jetting, knocking and ultrasonic agitation. The process of jetting consists of squirting either pressurized CO_2 or beer into the uncapped filled container. This agitation provides enough foaming but is usually used on cans since bottles have too narrow a neck for effective application.

Knocking has been the method used up until now. The bottle is struck with a pair of steel rods just before the filler tube is removed. This agitation foams the beer or ale. However, these knocks are responsible for a great deal of bottle breakage. On high speed filling machines the bottle must be struck harder so that sufficient foaming can take place before capping. The bottle cannot be struck earlier in the filling process since it is under pressure and premature agitation will increase gas pressure causing a partial fill.

The harder strike is rougher on the bottles and increases breakage. Besides the loss of bottle and brew, production usually must be halted to clear away the borken glass. Further, broken glass can cause other bottles to be thrown off center and break and the glass can cause serious harm to the filling machine as well as be hazardous to the operator.

The ultrasonic device, from observation, produces finer bubbling and foaming in terms of size of the bubbles. This tends to be advantageous, especially in operations where knocking has left a relatively high amount of air. A further advantage of ultrasonic agitation is that high-speed machines do not require the modifications required when additional knockers are used.

Ultrasonic Foamer

The ultrasonic beer foamer consists of a 250-watt generator and

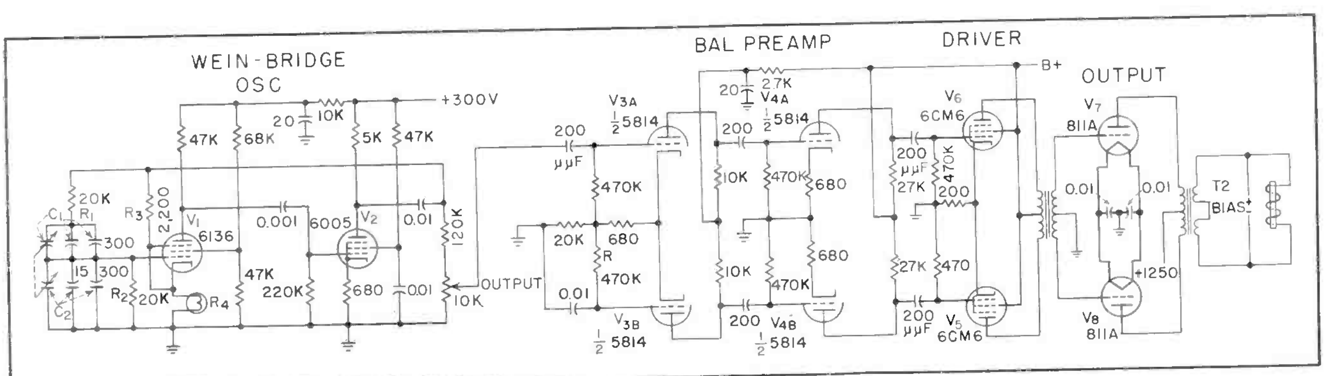


FIG. 2—Complete schematic shows how relatively standard circuits can be adapted to solve an industrial packaging problem

bias supply connected to a magnetostriction transducer. A shoe is mounted on the end of the transducer to accomodate the bottles on the filling machine. A control unit is also available for remote operation.

The ultrasonic generator is basically a tunable 22-kc oscillator and power amplifier with an output of 250 watts. The block diagram is shown in Fig. 1 and a schematic diagram shown in Fig. 2.

Frequency Stability

A Wien-bridge oscillator is used because of its excellent frequency stability. The Wien bridge consists of R_1 and C_1 in series, R_2 and C_2 in parallel and R_3 and R_4 (a lamp) which forms the third and fourth arm of the bridge. The fixed capacitors, together with the associated resistors, set the oscillator frequency near the transducer resonance point. The variable capacitors allow the oscillator to be tuned within the narrow range needed.

The lamp keeps oscillator amplitude stable because of its variation of resistance with current. The output of V_1 is amplified by V_2 and fed to output potentiometer R_5. A portion of the output of V_2 is regeneratively fed back to V_1 to sustain oscillations.

From potentiometer R_5, the signal is fed through a coaxial cable and applied to the grid of V_3 through a blocking capacitor. Tube V_{3B} is cathode coupled to V_{3A} to obtain push-pull output from the stage. Thus, the plate circuits of V_3 and V_4 are 180 deg out of phase.

The push-pull signal at the plates of V_3 and V_4 is coupled through blocking capacitors to the grids of V_5 and V_6. These tubes, act as straightforward R-C push-pull amplifiers. The push-pull output of V_5 and V_6 is fed to cathode biased push-pull drivers V_7 and V_8. Their output is transformer coupled to power output tubes V_9 and V_{10}.

An output transformer matches the output tubes to the transducer impedance of approximately 25 ohms.

The power supply is a full-wave, choke-input 300-v low-voltage supply. A thermal time delay relay is used to allow filament warm-up before applying plate voltage.

Transducer

The transducer is of the magnetostrictive type using a laminated oxidized nickel core stack with winding around the long arms as shown in a photograph. A permanent magnet supplies a biasing magnetic flux to the transducer.

The equipment, without biasing magnetic flux would operate at twice the transducer resonant frequency since the absolute magnetic condition rather than the direction of the magnetic condition of the nickel determines the change-over in length of bar.

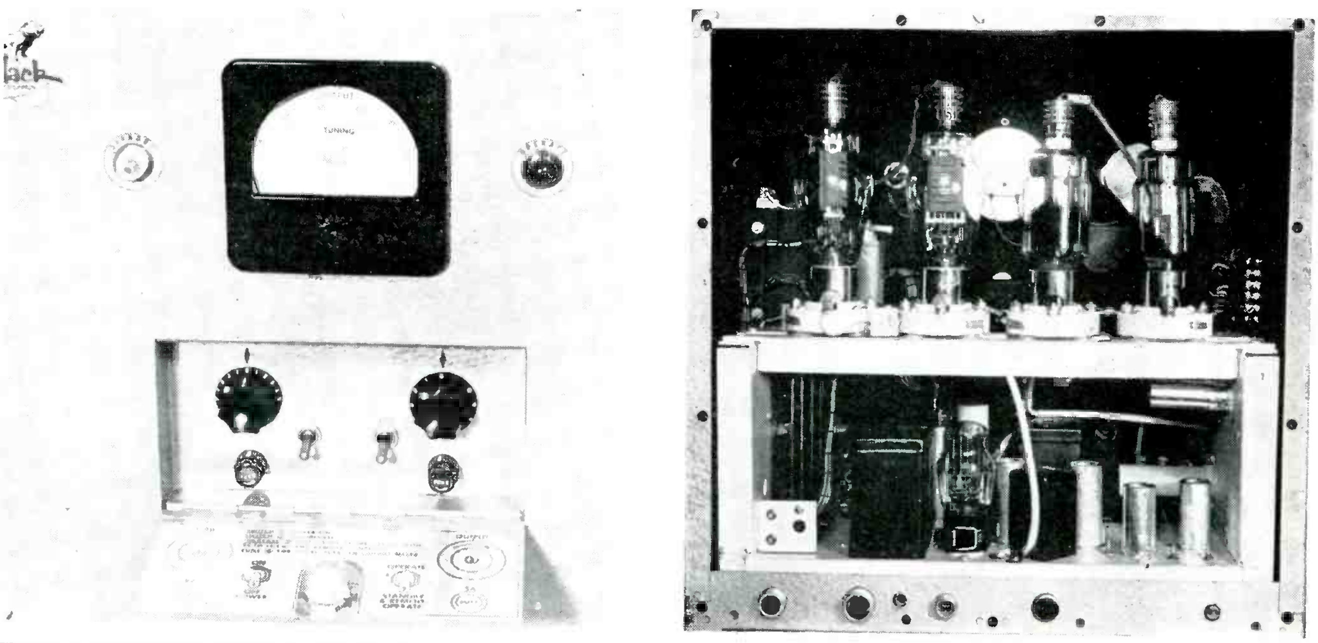
Laminations are used in the nickel to reduce eddy-current loss. The stack is attached by an epoxy resin to a shoe 8 by 3 in. wide. The shoe is held in place on the machine by two spring-loaded rods mounted at the acoustical null points. Thus the shoe makes positive contact with the bottles.

Construction

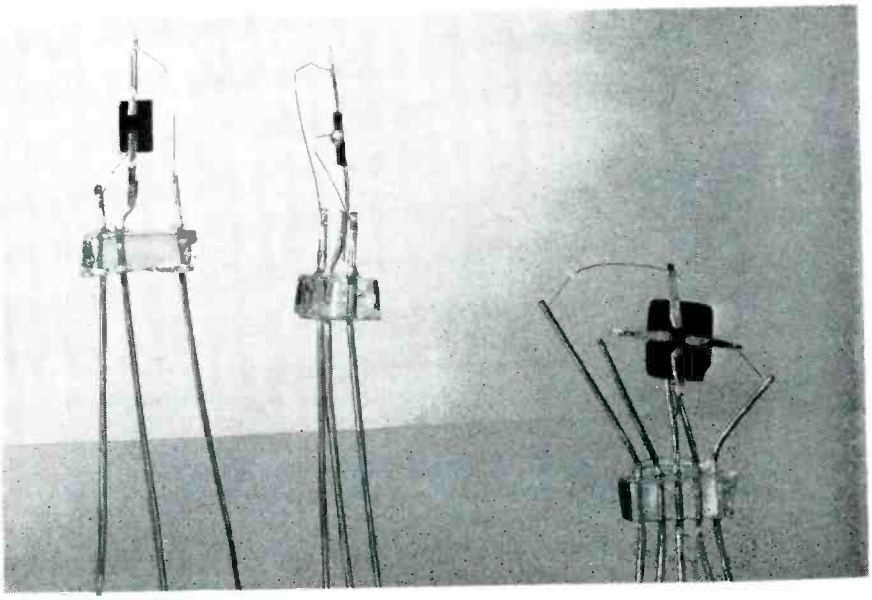
Environmental conditions in a brewery usually are quite damp and the conditions are very amenable to the growth of bacteria on equipment. Further, usual brewery practice is to hose down all equipment before shutting down for the day. Hence the construction of the generator requires that it be both drip and splash proof with emersion-resistant components.

The transducer and shoe are made of stainless steel components, with the exception of the nickel stack, and teflon insulated wire is used in the transducer. The whole equipment weighs under 100 lbs.

Other applications include medical units for treatment of calculus deposits of various types in the body, cleaning of small parts and accelerated aging of wine.



Close-up of generator front panel (left) and internal view of compact housing (right) that is drip and splash proof



Front and side views of developmental single-direction photocell with multi-contact two-direction cell at right

PHOTOCELL MEASURES LIGHT DIRECTION

By J. T. WALLMARK
RCA Laboratories
David Sarnoff Research Center
Radio Corporation of America
Princeton, N. J.

SUMMARY — Output from semiconductor photocell varies in relation to angle of light source from photocell axis. Varying bias on base contacts gives scanning action similar to turning photocell mechanically. Applications include gun-fire locator, computer function generator and vibration detector

LIGHT incident on a semiconductor close to a *pn* junction produces hole-electron pairs that will be separated by the junction, creating a voltage across the junction. In the photocell to be described, with a small spot of light and a large junction, a voltage is created not only across the junction, but also parallel to the junction in a lateral direction. This is illustrated in Fig. 1A.

Voltmeter V_1 connected between the *n* and *p* region will read the photovoltaic voltage. Voltmeter V_2 connected between any two points along the surface of the *n* region will read a lateral voltage. The potential is lowest at the light spot and rises towards the sides linearly with distance.

Lateral Photocell

The construction of the lateral-photoeffect photocell is shown in Fig. 1B. The cell consists of a germanium wafer, of 1 to 2 ohm per cm resistivity, approximately 0.005 in. thick and ¼ in. square. An indium dot 0.045 in in diameter is alloyed on the wafer to a depth of 0.002 in. Two base contacts are applied symmetrically.

If a light spot hits the cell at point *A* as indicated in Fig. 2, a voltmeter connected between the two base contacts as shown will measure the difference between two lateral voltages, one between the light spot and the left end of the photocell, and the other and larger one between the light spot and the right end of the cell. The output voltage will be, for example, 1.5 mv as indicated by the curve.

If the light spot is moved to the center of the cell as at point *B*, the voltmeter will measure the difference between two equal and opposite voltages. This corresponds to the crossover point of the characteristic. When the light spot is moved to point *C*, the left-hand lateral voltage will be larger than the right-hand one and the output voltage will be negative. The resulting curve is a straight line ex-

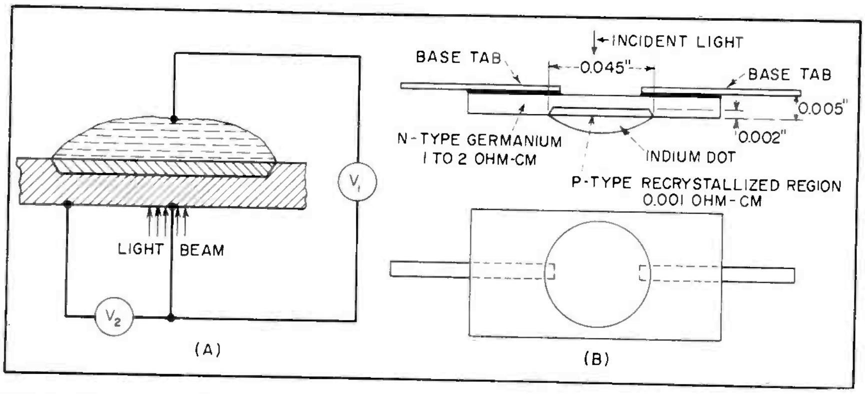


FIG. 1—Basic operation of lateral-effect photocell (A) and its construction (B)

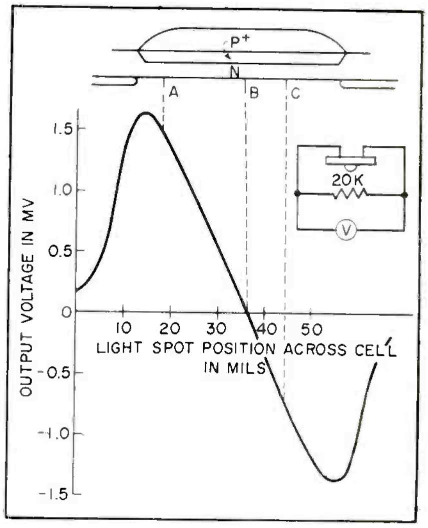


FIG. 2—Photocell output in relation to light spot position on cell surface as measured with voltmeter across 20,000-ohm resistor as shown in diagram at right

cept at the ends, where stray effects cause a fall-off.

With four base contacts on the photocell as shown to the right in the photograph, the output voltage from one pair is proportional to the light spot position in a horizontal direction, and the output voltage from the other pair is proportional to vertical light spot position.

The most obvious application of such a photocell is to measure the direction to a light source, as indicated in Fig. 3A. Here the light from a distant source is focused by a lens onto the photocell. If the light falls on the center of the cell, no output voltage will be read by a voltmeter between the two base contacts. If the light is to one side of the symmetry axis, a positive voltage will result. This voltage is larger the further away the light is from the symmetry axis. If the light is on the other side of the symmetry axis, a negative voltage will be shown by the voltmeter. This means that the direction to a light can be found by turning the photocell until the output voltage is a minimum, indicating that the cell is pointed directly towards the light. The accuracy of this direction-finding is better than 0.1 second of arc, which is considerably better than can be done with even a good optical range finder. This high accuracy means that the light spot on the photocell can be located to better than 100 A. Using a four-base photocell, the direction can be measured in two coordinates simultaneously.

In many cases it would be desirable to be able to find the direction to a light of short duration, say a few milliseconds, such as the light flash from a gun. Turning the cell in that short time would be difficult. However, as indicated in Fig. 3B, the turning can be simulated if the axis of the characteristic curve is shifted. Then a light off the symmetry axis could be located by shifting the characteristic until the output voltage is zero. The amount of shift would be a measurement of the direction to the light. This can be accomplished with the lateral photocell by sending a bias current between the base contacts as shown in Fig. 4A.

The foregoing solution has one drawback. The sweeping current is applied between the base contacts, where the output is also measured. Use of mechanical light chopping would permit conversion of the desired signal to a-c for filtering out from the applied sweeping current. But this returns to the speed limitations of mechanical devices. However, it is possible to make an electronic equivalent of light chopping.

Electronic Chopping

To accomplish the electronic chopping of the light signal the alloyed dot is used. If a forward current is sent through the junction and returned through a balanced arrangement as shown in Fig. 4B, this current does not contribute to the output signal. However, the voltage drop caused by the current hinders the holes from reaching the *p*-type region and therefore reduces the sensitivity of the photocell. In other words, the higher the forward current through the junction, the lower the slope of the characteristic as shown in Fig. 4B.

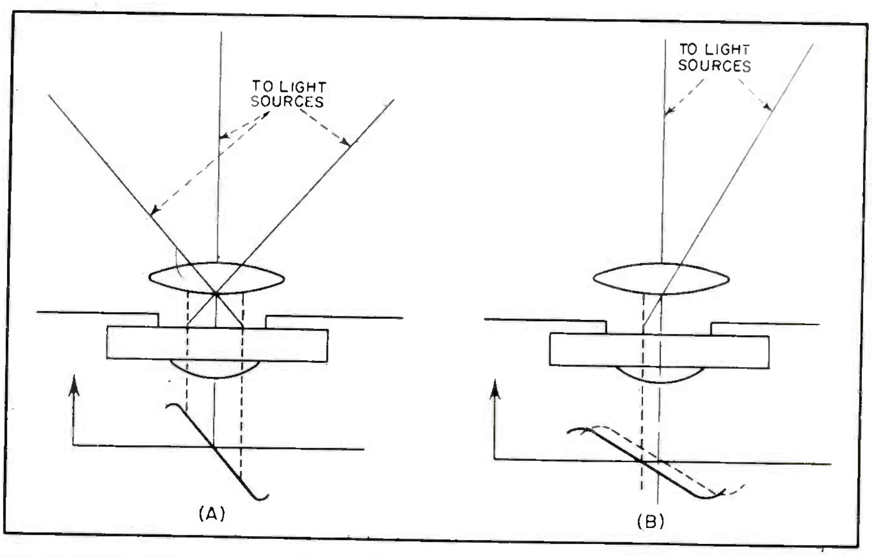


FIG. 3—Light source can be indicated by variation of cell output (A) or by electronically shifting axis of characteristic to obtain null (B)

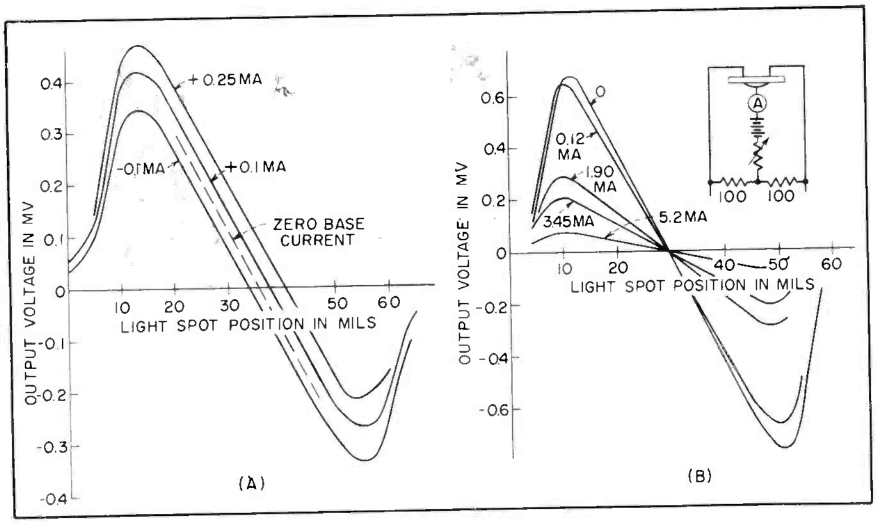


FIG. 4—Axis shift with bias current provides a scanning action (A) and electronic chopping is obtained by applying various values of forward current through dot (B)

This means that if a square wave is applied to the dot so that during part of the wave the dot is biased in the forward direction, and during part of the wave unbiased or in the backward direction, the sensitivity of the cell and the output signal will vary with the square wave. As a consequence, the output signal can be filtered out and separated from the sweep signal.

A light locator is shown in Fig. 5A. It consists of two lateral photocells with sweeping and chopping circuits. Assume a sudden flash of light at a distance, such as gun-fire. Then both photocells give signals of the chopping frequency, which are amplified in a pulse amplifier with d-c level retained.

The output is fed to a diode pair. When the pulses are positive one of the diodes will be conducting and the other cut off during each pulse. When the pulses are negative, the opposite is true. Therefore a bias voltage will be fed from one of the diode load resistors to the proper shift circuit to accomplish negative feedback. The sweeping current generated by the shift circuit will make the output signal from the photocell approach zero.

The bias voltage is also fed to a meter which gives a direct indication of the direction to the light. The two meters, one for each photocell, define two lines intersecting at the point of light. With a sufficiently thin base region, the speed of response of the photocell should be good to approximately 1 mc.

Enough time is therefore available during the duration of the flash, some milliseconds, to accurately measure the directions. As the photocell is sensitive out to approximately 1.9 micron, infrared light can also be detected.

Vibration Detector

A vibration detector for investigation of microphonics in electron tubes, for example, is shown in Fig. 5B. A small spot of light is used as a probe and is focused on tube elements while the photocell is used to detect vibration

The output from the photocell may be viewed on an oscilloscope and directly compared with the output from the tube under test. The photocell can indicate the tube element that is vibrating and also the direction of vibration.

Function Generator

A function generator for analog computers is shown in Fig. 5C. The desired function is drawn on paper, a photographic negative is made and the negative is mounted inside a transparent cylinder which rotates around a filamentary lamp. A slit transmits one point of the curve at a time onto the photocell. The output current then represents the desired function.

In an application of this type, linearity is the main concern. The linearity has been tested by connecting two experimental cells in opposition, measuring only the difference between the two. The maximum deviation of a straight line was found to be less than 1.5 percent of the maximum signal in spite of the primitive experimental cells used.

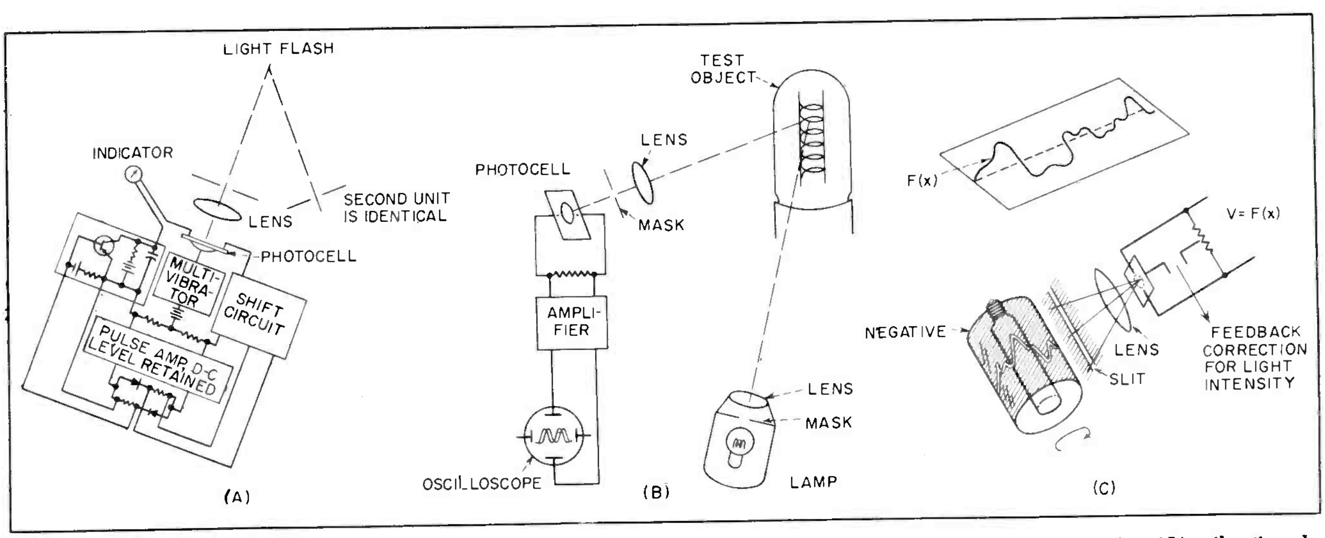
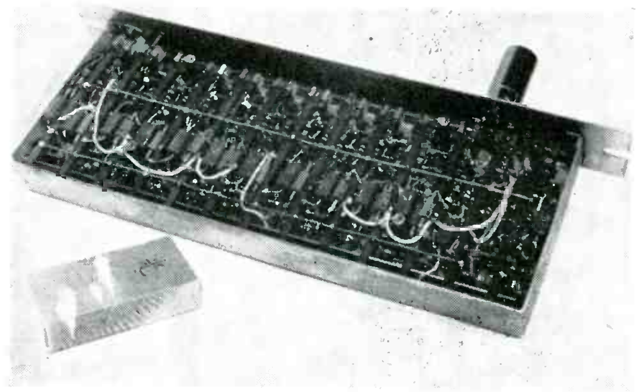


FIG. 5—Typical applications for lateral-effect photocell include light flash locator for determining source of gunfire (A), vibration detector for testing for microphonic electron tubes (B) and computer function generator (C)

Portable tv camera-transmitter in use for over 4,000 hours (left) uses compact modular constructed sync generator (right)

Transistors Synchronize

—By KOJIRO KINOSHITA, YASUSHI, FUJIMURA, YOSHIO KIHARA and NOBUO MII—

TV Research Section
NHK Technical Research Laboratories
Tokyo, Japan

SUMMARY —— Japanese portable tv camera-transmitter uses sync generator comprising ten transistor flip-flop circuits with two feedback amplifiers to form a counter unit that divides twice the horizontal frequency by 525 to produce the field frequency. Unit uses modular design

SYNC GENERATORS for portable telecasting equipment must be light and compact. This article describes a transistorized sync generator now in use by NHK, the Broadcasting Corp. of Japan.

Housed in a 12 by 3.75 by 1.75-inch chassis, the unit has a total power consumption of about 500 miliwatts which is just under the power required to heat the filament of one 12AU7. Alloy-junction transistors are used throughout.

Generator

Figure 1 shows a block diagram of the complete sync generator. All 26 transistors are used in the common-emitter configuration. The unit is made up of 13 two-transistor modules. There are ten counter modules, a master oscillator and 2H output amplifier module, a 2H clipper and feedback amplifier module and a feedback and field frequency amplifier module.

The horizontal frequency is internally derived from a crystal controlled oscillator. A lockup signal picked up from the base station also may be used to provide the 2H frequency.

Circuits

The master oscillator output is clipped and fed to the counter chain. This is the main portion of the sync generator and consists of a total of ten counters employing two separate feedback loops. One counter chain and feedback loop divides the master frequency by 25 while the other divides by 21 resulting in a total division by 525 to give the field frequency. The 60-cps field frequency obtained from the tenth counter stage is amplified and fed to the camera-transmitter system.

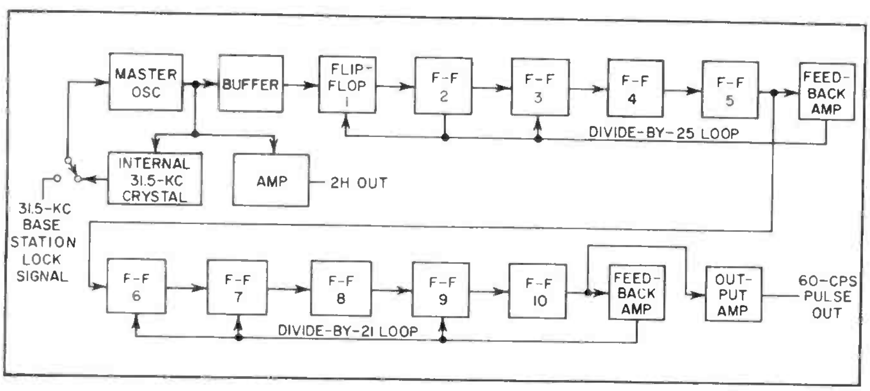


FIG. 1—Block of system shows feedback technique that produces count down from 31.5 kc, or twice the line frequency, to a field frequency of 60 cps

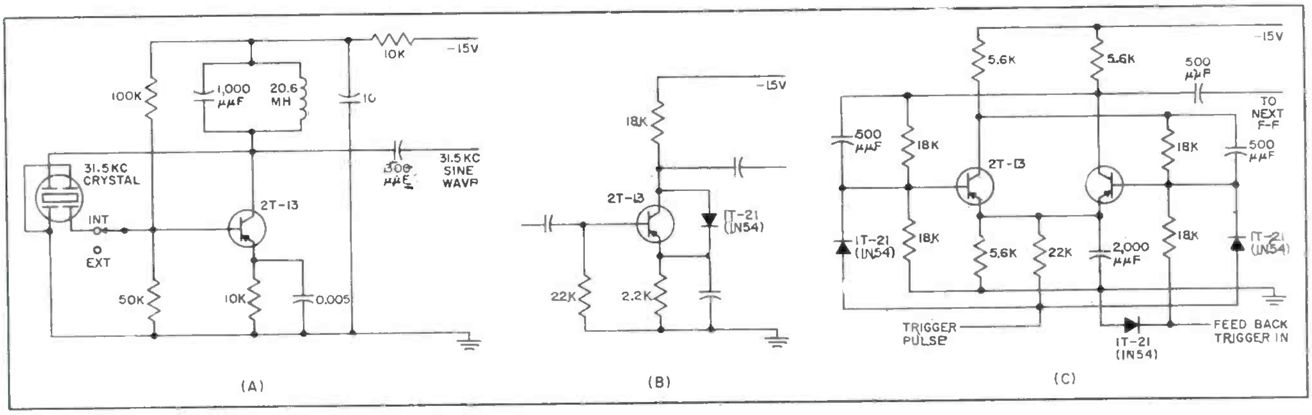


FIG. 2—Basic circuits. Output of crystal-controlled master oscillator (A) is clipped at (B) and triggers flip-flop counters as in (C)

Portable TV Camera

The master oscillator shown in Fig. 2A uses a special miniature-type 31.5-kc crystal, utilizing the flexure mode of oscillation. It acts as the frequency controlling element in the feedback path between the transistor collector and base when S_1 is in the internal position. When S_1 is on external, the circuit works as a tuned amplifier.

The circuit shown in Fig. 2B uses a diode between the emitter and collector to minimize hole-storage effects and to clip the master oscillator signal to provide a trigger for the succeeding counter stages.

Each counter consists of a two-transistor flip-flop stage as shown in Fig. 2C. A feedback pulse is fed to selected counters which have the base return resistor of one transistor in series with a germanium diode. The trigger is inserted at the junction of the other diode-resistor combination which also acts as a buffer.

The pulse rise time at the collector is about 3 μsec while the delay time per stage is approximately 0.5 μsec. The ratio of minimum trigger pulse amplitude to output trigger pulse amplitude is approximately two.

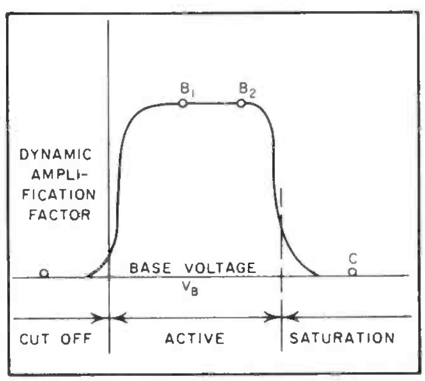


FIG. 3—Typical dynamic characteristic curve for junction transistor swicthing circuit showing possible operating prints

Major effort in the design of this sync generator was expended on the flip-flop circuits. Selection of the proper operating point on the dynamic characteristic curve associated with junction transistor switching circuits was of prime importance here. Such a curve is shown in Fig. 3.

If the operating point is chosen at C, minority storage effects will cause appreciable delay and insensitivity. To avoid this, the circuit elements were selected to provide an operating point in the active region. Choice here is based on the relation between circuit time constants and input pulse.

If an operating point is set at B_1, an appreciable overshoot occurs at the leading edge of the collector waveshape as shown in Fig. 4A; this overshoot will increase at each successive stage until a point is reached where one counter will be switched off and on again destroying the count down process.

By adjusting the circuit elements for operation at point B_2, the overshoot is minimzed as shown in Fig. 4B and good count down results.

The authors thank T. Nomura, and T. Shiromi for their advice and assistance and K. Iwama for his helpful discussions.

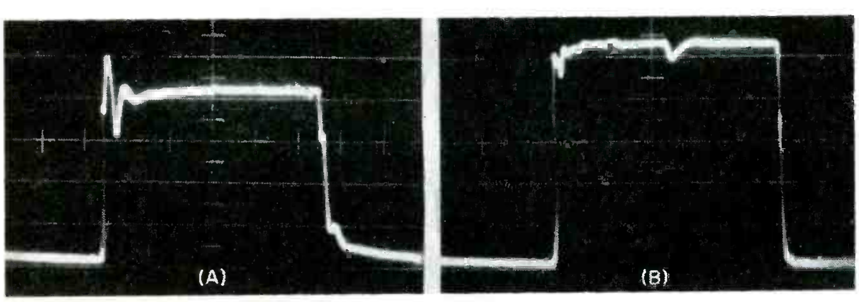


FIG. 4—Collector waveshapes show overshoot (A) caused by operation at B_1 in Fig. 3 and flat top (B) caused by operating at B_2 on the same dynamic characteristic curve

FLUID-COOLING AN

By JAMES B. HUMFELD

Member of Technical Staff
Hughes Weapon Systems Development Laboratories
Hughes Aircraft Co.
Culver City, California

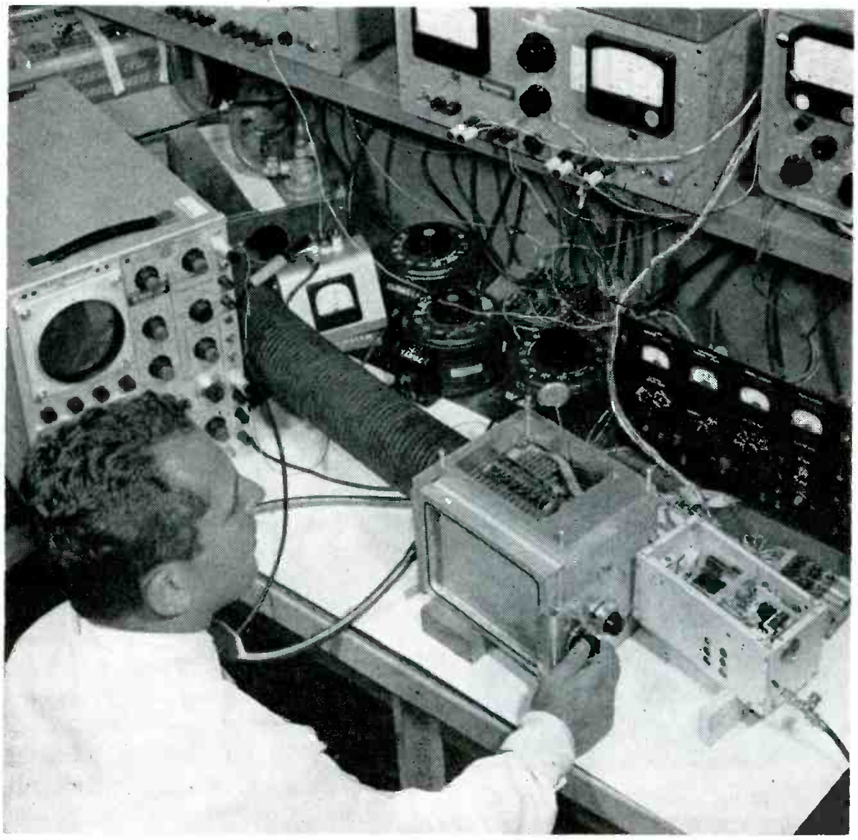
SUMMARY —— Design of compact high-power amplifier for high-performance aircraft employs six paralleled output tubes in self-rectifying six-phase circuit that eliminates need for separate power supply. Cooling is by immersion in silicone fluid. Total volume of assembly is 500 cubic inches

AT PRESENT, airborne h-f radio transmitters are limited to about 100-watts maximum carrier power output, mainly because of excessive size and weight of higher power output transmitters.

In supersonic aircraft, h-f antennas are becoming physically shorter, with tail-cap or wing-cap antennas replacing long wires. At lower frequencies, these antennas have low radiation resistances and high reactance as seen at their input terminals. At medium and high frequencies in the h-f band, from say 10 to 30 mc, the radiation resistance of these antennas is comparable to 50 ohms, and the reactance is usually not very great. However, from 4 to 10 mc, the reactance is quite large and a high voltage is developed at the base of a short antenna for a 1-kw average power input. It was determined that the increase in power to the kilowatt level would be useful in the medium- and high-frequency ranges. As better antennas are developed more of the available kilowatt of power can be used on the lower frequency ranges.

A miniature power amplifier, covering 4 to 30 mc, has been developed, employing self-rectification and silicone oil immersion cooling to achieve a volume of but one-third cu ft. Total heat dissipation is 1,275 watts while delivering nearly 1 kw of useful power.

Using the approximation that the power amplifier will have an overall efficiency of 50 percent, roughly



Complete r-f amplifier under bench-test before filling with silicone fluid. Expansion chamber for fluid is at side of amplifier housing facing technician

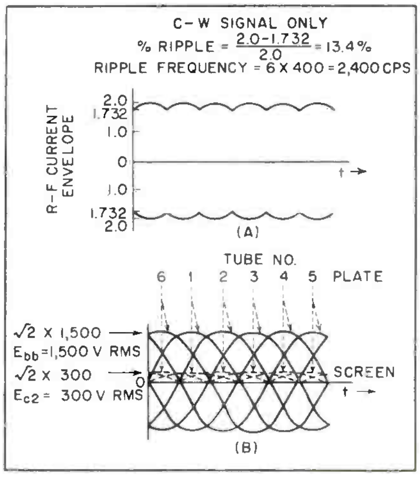
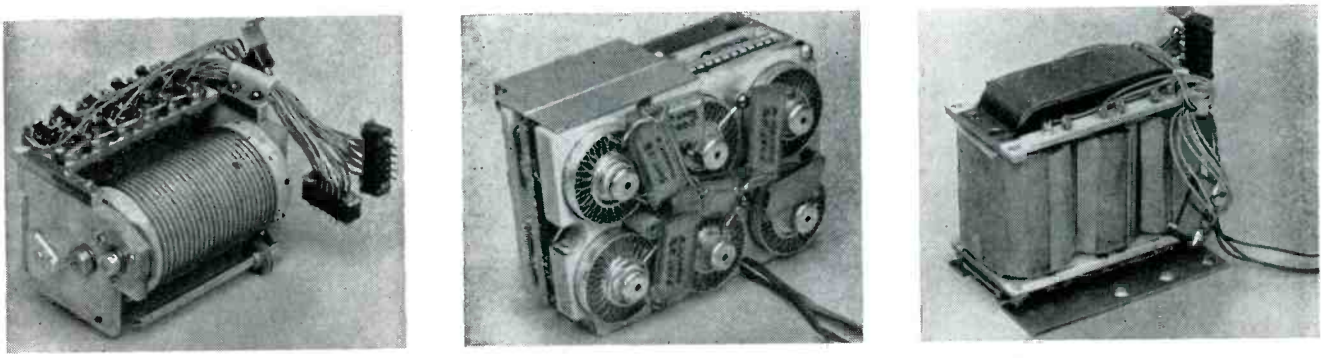


FIG. 1—Ripple frequency (A) and plate and screen voltages (B) for six-tube radio-frequency power amplifier for aircraft

AIRBORNE TRANSMITTER



Variable inductor assembly (left), six-phase transformer (center) and power tube assembly (right) for 1-kw power amplifier

1 kw of heat will be dissipated in the power-amplifier enclosure. The cooling problem is made more difficult by the fact that the temperature of entering cooling air may be no less than 250 F.

If air cooling is used, a serious arc-over problem will occur because of the combination of high voltages (several thousand volts) and the low-pressure air encountered in high-altitude operation. Certain silicone fluids exhibit excellent voltage insulation, dielectric constants and relatively low loss along with extremely low vapor pressures.

These physical and electrical properties made it possible to design a power amplifier completely immersed in silicone fluid. This fluid immersion provides the voltage insulation and high heat conduction from the heat-dissipating elements to the walls of the enclosure and also avoids altitude pressurization.

The disadvantages of this fluid immersion operation are an increase in stray capacitances on the order of 2½ times that in air, change of dielectric constant with temperature, accessibility and servicing difficulties, expansion of fluid with rising temperature and necessity for complete immersion of heat-dissipating elements even when the unit is in an inverted position.

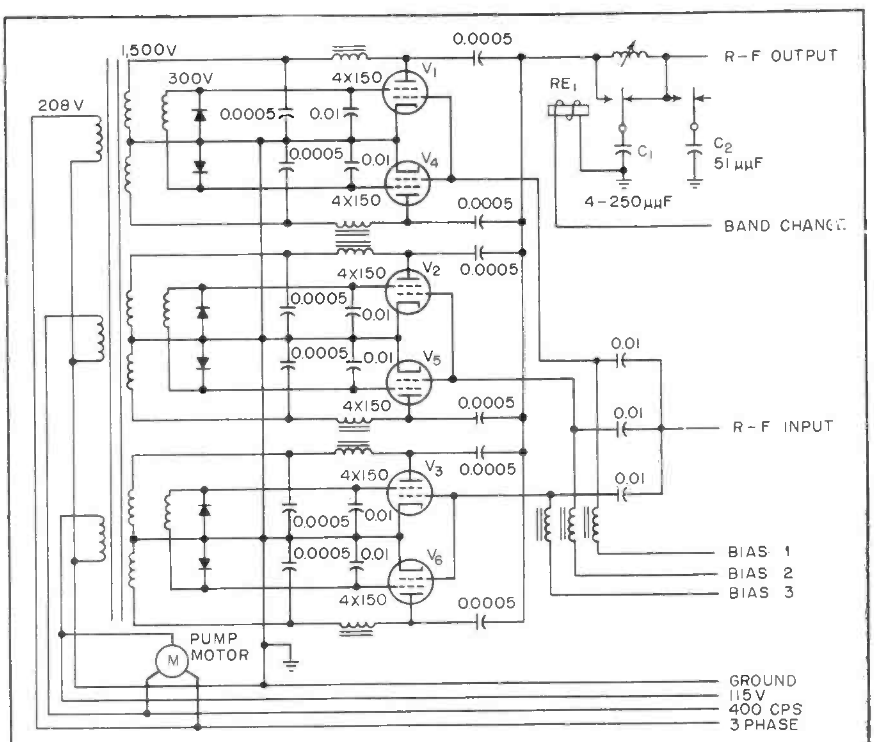
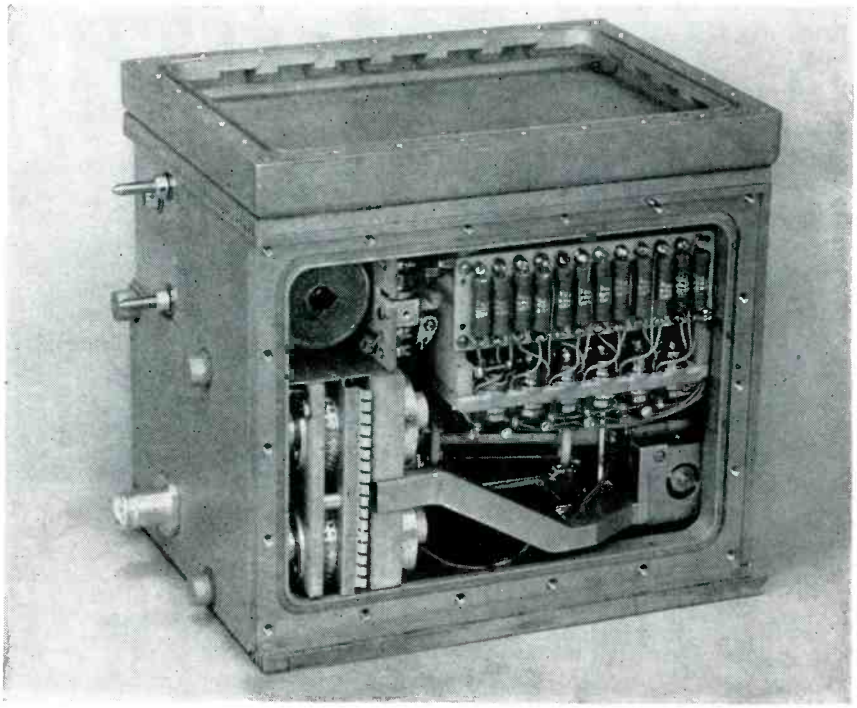


FIG. 2—Six-phase self-rectifying radio-frequency power amplifier provides 1-kw output using six 4X50 tubes immersed in silicone cooling liquid

Power Supply Design

Assuming a plate circuit efficiency of 60 percent and 1,200 watts of r-f output power, there will be 2,000 watts of input power required and 800 watts of total plate dissipation. A vacuum-tube rectifier-type d-c supply would occupy more than half of the available 500 cubic inches. Since high-temperature silicon power diodes were not available at the time of this initial design and since ripple could be tolerated for the intended applications, it was decided to transform the three-phase 400-cycle primary power of the aircraft to six-phase plate and screen voltages and to apply them directly to the electrodes of six 4X150 power-amplifier tubes.

The choice of six 4X150's in place of a single large tube was dictated also by the fact that no single tube in the 1-kw power output region could be found that would not only be rugged enough for an airborne environment but would also be small enough for this application. The entire power supply in the six-phase self-rectifying type of operation would consist of a 2-kw three phase to six-phase power transformer estimated to occupy 35 cu



Complete amplifier in housing. Fluid expansion chamber is at top, output tubes at lower left with fluid circulating pump and ducting across bottom

in. The power-supply ripple is 13.4 percent and six times the power supply frequency, as shown in Fig. 1A.

R-F Circuit Design

Figure 2 is the circuit of the six-phase self-rectifying type of power amplifier. It is a single-ended amplifier with a π network for plate tuning and impedance matching to a 50-ohm transmission line. Only two variable controls are used to simplify the tuning mechanism. Six separate blocking capacitors and r-f plate chokes allow the six-phase voltage to be impressed on the plates of the six 4X150's. The screen grids are fed directly from the power transformer and are in phase with their respective plates, as is shown in Fig. 1B. Screen voltage is not allowed to go negative because the tubes have a tendency to become gassy when operated at high temperatures with a-c on the screen grids.

The π network used for plate tuning has two variable elements, a capacitor and an inductor. Relay RE_1, places the vacuum variable capacitor C_1 in the input shunt arm of the π for frequencies below 10 mc; for frequencies above 10 mc, C_1 is placed in the output arm and fixed capacitor C_2 is removed from the network. The series arm is a continuously variable inductor, as shown in a photograph, which consists of a 24-turn coil, two inches in diameter, utilizing a rolling tap to give a range of 0.5 to 16 μh. This particular inductor, when operated in silicone fluid, gives a Q of 100 or more over its entire inductance range. Consequently, the losses in the inductor remain relatively low over the entire frequency range and thus do not contribute heavily to the serious cooling problem.

Six separate r-f chokes are necessary because each tube anode is at a different potential with respect to the 400-cycle plate supply voltages. However, the anodes are essentially at the same r-f potential since the reactance of the 500-$\mu\mu$f blocking capacitors is quite low in the 4 to 30 mc r-f range. The six plate chokes are operating in parallel in the r-f range and net impedance is one-sixth that of each individual choke coil. The net impedance is shown as a function of frequency in Fig. 3. These plate chokes can easily withstand the 1,000-volts rms potential to isolate the power transformer from the plate circuit and yet operate without a decrease in performance at temperatures as high as 350 F.

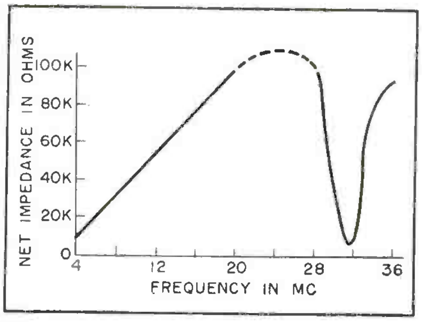


FIG. 3—Net impedance of six parallel r-f chokes as compared to frequency

The power transformer is shown in one of the photographs. Its dimensions are $4\frac{5}{8}$ by $3\frac{3}{4}$ by $2\frac{1}{4}$ inches. It weighs $5\frac{1}{2}$ pounds. High-temperature insulation is used throughout.

The six 4X150 power tubes are grouped in a subassembly installed on its side in the lower left-hand corner of the power amplifier enclosure so that the control grid lead from the r-f input receptacle may be as short as possible. A pump forces the silicone fluid through ducting to the tube assembly.

Mechanical Design

The amplifier is housed in an aluminum box, with removable side, end, and top cover plates. The sides are made of extruded aluminum, incorporating fins to increase the heat-dissipating area. Since the silicone fluid expands nearly 25 percent over the operating temperature range, an expansion space had to be provided. The expansion chamber is the top portion of the box and is connected by a small tubing between the top of the box and bottom center of the chamber.

When first operated, the amplifier had serious parasitic high-frequency oscillations in the 160- to 250-mc region. Parasitic suppressors were added in the grid and plate circuits. Due to the amplifier being immersed in silicone fluid and assembled inside of a box, circuit modifications were time-consuming but not difficult because the tubes, variable inductor, transformer and other subassemblies are removable and are interconnected entirely by plugs and receptacles. The oil immersion increased stray capacitance considerably and necessitated a rework of the π output matching network to match the power tubes to the load over the entire frequency range.

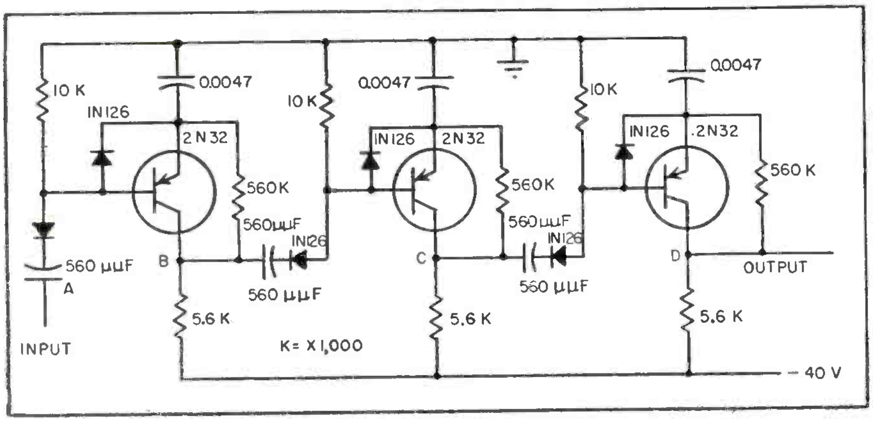
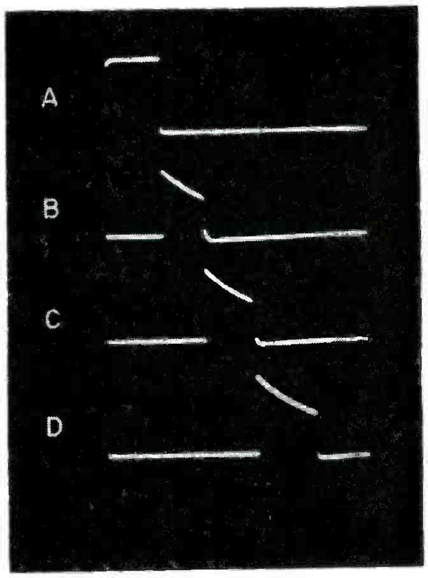


FIG. 1—Transistor delay line for airborne digital computer has delays of 40 microseconds per section for total delay of 120 microseconds

Input pulse *A* and outputs *B, C, D* at various points marked on Fig. 1 are shown in the illustration at right



Computer Delay Unit Uses Semiconductors

By WILLIAM A. SCISM
San Diego, California

SUMMARY — Three point-contact-transistor one-shot multivibrators are cascaded to provide delay of 40 microseconds per stage. Delay line permits sequential read-in to parallel-form input of digital computer adding register. Rise times are better than 0.1 microsecond per stage

IN an airborne digital computer, it was desired to read data into the register sequentially although the data was presented in parallel form. A delay line was used to allow the carries to propagate before the next bit was read in.

Three conditions were necessary to close the and gates—voltage from the data leads, voltage from a time-sharing circuit and a pulse. The voltage from the data leads were read-in parallel to all gates simultaneously, applied to a block of gates for a time longer than that necessary for the pulses to traverse the delay line and pulses were applied to each gate sequentially from taps on the delay line. In this manner parallel data was read into the register sequentially. Use of this delay line saved circuitry and weight that would have been necessary had other storage means been used.

Circuit

The delay line consists of three cascaded point-contact one-shot multivibrators as shown in Fig. 1. A negative current pulse through the base emitter circuit of the first stage initiates one-shot operation. The positive pulse from the first stage is ignored by the second stage because of the diode in the coupling circuit.

The trailing negative-going edge of the first stage output passes through the diode triggering the second stage. Hence a positive-going pulse appears at the output of the second stage later than at the first stage by a time determined by the on time of the first stage. The same action is carried through the third stage.

If diodes with a higher back-resistance than the 1N126 are used, a return should be provided for the coupling capacitors.

This circuit provides delays of about 40 microseconds per stage with rise times of 0.1 microsecond. The differentiated output pulse was used to trigger the computer adding register.

SUMMARY — Radio receiver, connected to any electric clock, is triggered by time-signal tone broadcast by National Bureau of Standards station WWV. Operator sets clock to verbal announcement of time and relay connected to diode-triode starts clock the instant the tone is broadcast. Setting error, owing to electro-mechanical lag, is within 0.06 second. Simplicity and low-cost make time-setter highly desirable for small broadcaster or temporary station wishing to reduce setting error

Time-Signal Broadcast

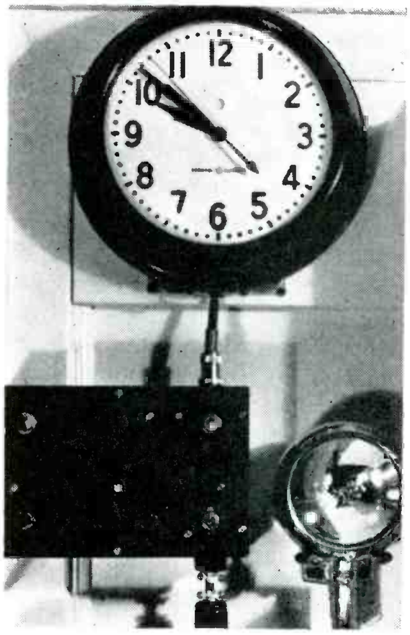
By RONALD L. IVES
Palo Alto, California

WHEN an electric clock is compared to WWV time and is found to be off time, the clock is stopped, by interrupting the current, as soon as the second hand reaches zero. The minute and hour hands are set manually to the next announced time interval and the current is turned on again as soon as the WWV tone resumes. After resetting, the stop alarm, supplied on most clocks to indicate current failure must be reset. Thereafter, the time indicated by the clock is WWV time, minus transmission and set-time lags, so long as the line frequency remains 60 cycles per second.

A small compact receiver attachment used with a modified commercial electric clock reduces the error owing to operator reaction lag and simplifies the setting procedure.

Clock Modification

Most standard electric clocks incorporate a current-failure indi-



When clock is off-time, lower right switch on panel is turned on. Ready button, left of switch, stops second hand at zero. Clock is set to time announcement and switch is turned off

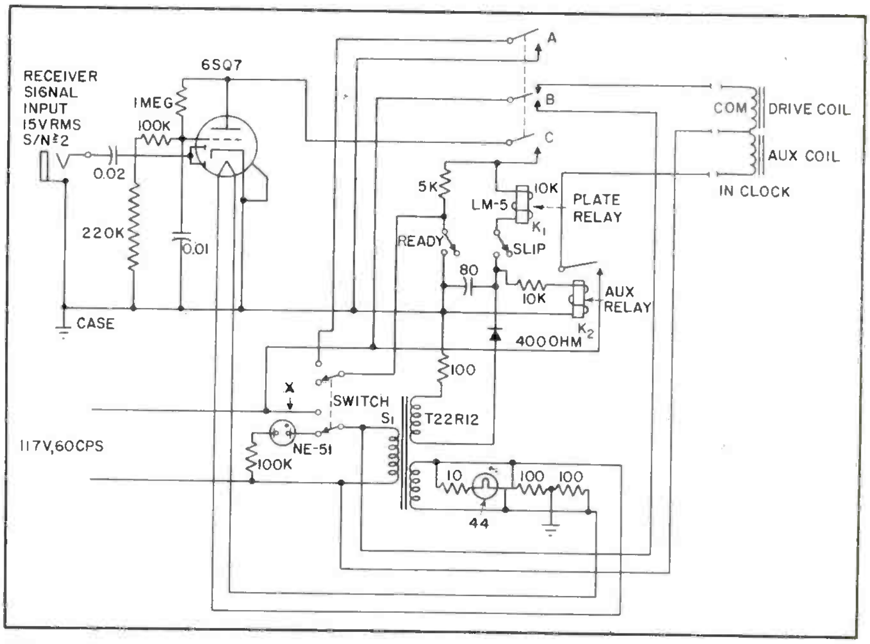
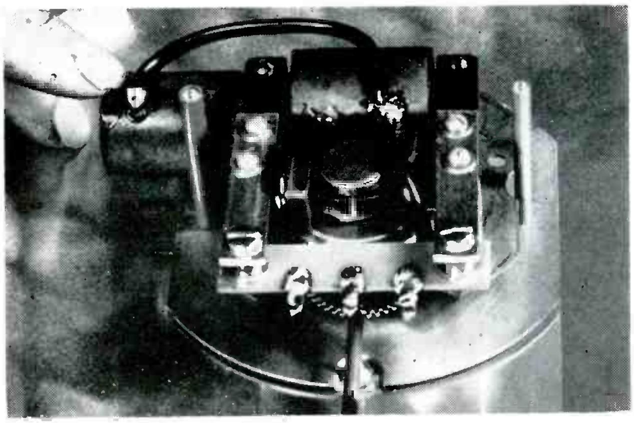
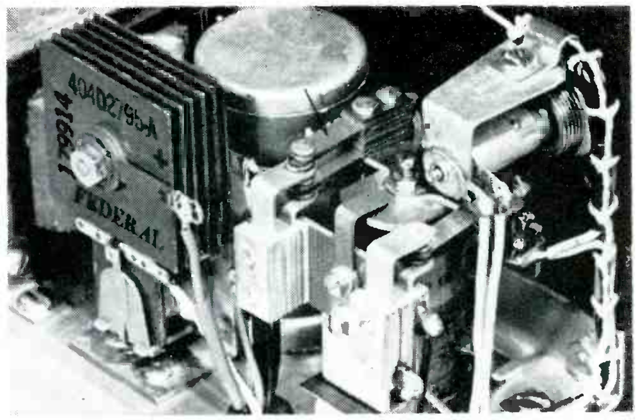


FIG. 1—Electronic time-setter is turned on at S_1. Relay K_2 energizes the auxiliary coil in clock. Ready button activates relay K_1, which shorts the switch and stops the clock. After clock is set manually to time of next verbal announcement, S_1 is turned off and relay K_2 is held only by plate current of the tube. Tone signal from WWV releases relay, starts the clock at the exact time and de-energizes the auxiliary coil



Clock modification incorporates an auxiliary coil shown here at left of main coil. This auxiliary is connected across the a-c line and disables the clock current-failure indicator



Small relay for control of auxiliary coil is bolted to same bracket that supports the selenium rectifier. Relay frame is insulated from bracket by insulating washers around the mounting screws

Sets Electric Clock

cator, that shows a red dot on the clock face when current fails. This alarm is a small magnetic vane, held at white position by the clock motor leakage field. If this field fails, the vane falls by gravity to red position.

Auxiliary Coil

To keep this indicator in place only when the clock is stopped intentionally, an auxiliary coil is mounted at the side of the main coil. This coil, connected across the a-c line, provides the requisite leakage field and the current failure indicator remains in the white position, regardless of current, in the main coil.

This leakage field also takes up slack in the main clock gear train when the current is off in the motor coil, preventing backlash and flop of the sweep second hand. This auxiliary coil can be taken from an inoperative electric clock of the same manufacture and is held in place by the left motor mounting bolt of the clock. Hum is prevented by cementing the coil firmly to the core. Direct current should not be used as it will permanently magnetize adjacent clock parts.

When the auxiliary coil is de-energized, the clock operates normally, with the current interruption alarm falling to red position whenever the current is interrupted. When the auxiliary coil is energized, the current-failure alarm is inoperative at all times.

Circuit Operation

The electronic timer shown in Fig. 1 consists of a diode-triode vacuum tube, two relays, two push-buttons, one switch and a small power supply.

Operation of the circuit consists of a simple sequence of switchings, each cued by the WWV announcements.

When a WWV signal has been tuned in and the clock is to be reset, the receiver is turned on at switch, S_1. This energizes the power supply and lights the power pilot. Relay K_2 functions, along with its series resistor, as the power supply bleeder to energize the auxiliary coil in the clock, so the circuit interruption alarm will be inoperative during setting. The input signal should have an rms voltage of about 15, with a signal-to-noise ratio of two or better.

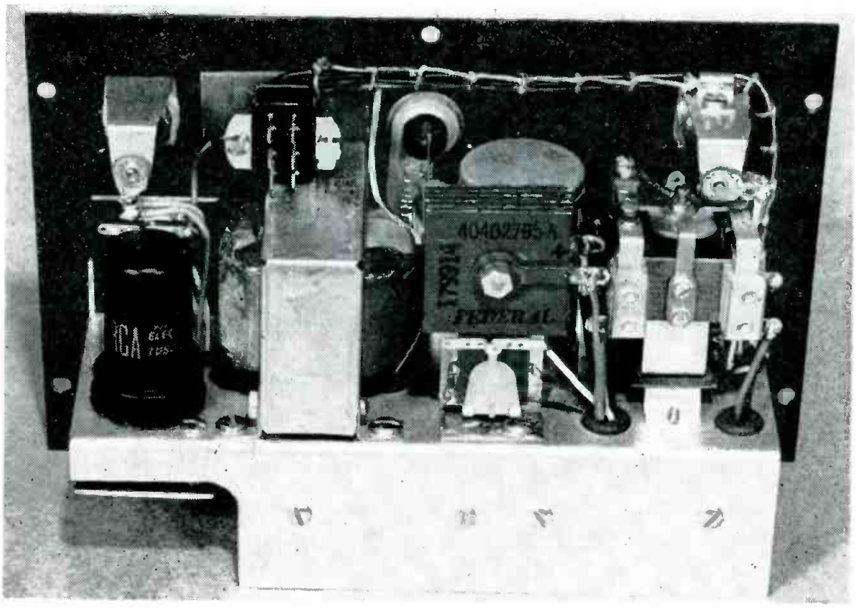
When the sweep second hand of the clock reaches zero position, straight up, pressing the ready button locks relay K_1 through contact *A*. At the same time, power is removed from the clock drive coil, stopping the clock and contact *B* is shorted. Direct current is applied to the plate of the triode through contact *C*.

The minute and hour hands of the clock are now set manually to the time of the next verbal announcement over WWV. When the correct time is announced for the second time the switch is turned off. The relay is now held down only by the plate current of the 6SQ7 triode.

When the WWV tone resumes, the tube ceases to draw plate current and the relay is released: starting the clock, shutting off the setter and de-energizing the current failure alarm disabler (auxiliary coil in clock). The clock is now controlled by line frequency until another setting operation begins.

Rectification

Action within the tube circuit is as follows. When the signal commences, rectification takes place in the diode-cathode circuit, negatively charging the 0.01-μf grid capacitor and offsetting the slightly positive grid bias produced by the voltage divider from plate to grid to diode plate to ground. The tube is cut off after approximately 15 cycles at a 15 volt rms input. This



Rear chassis of clock-setter shows six-terminal plug above transformer which engages the mating socket, bolted to the top of the case

connection, even though it produces a short fixed delay, is preferred to straight grid rectification because it is noise-immune and cannot be triggered by an ordinary switching transient or static burst.

When the ready button is pressed, plate relay C is held down by both the tube current and the current through the 5,000-ohm resistor, so relay performance is not influenced by spurious signals or verbal announcements. when the switch is in off position, the tube circuit acts on the first sustained signal received and the neon pilot indicates ready.

Auxiliary Relay

Relay K_2, which controls the auxiliary coil, acts as soon as the setter is turned on and does not go out of action until many milliseconds after the clock has been set. This delay reduces system sensitivity to most transients.

If the clock is stopped at the wrong point, pressing the slip button starts it again.

Modification of the plate relay consists in adding a third pole. This is accomplished by reversing the left upper contact, a button of silver alloy and adding an insulated arm taken from another relay of the some manufacture. This change is desirable because three-pole plate type relays are usually unavailable.

The small relay for control of the auxiliary coil is bolted to the same bracket that supports the selenium rectifier. Relay frame is insulated from the bracket by means of fiber insulating washers around the mounting screws. This is a radiosonde relay, requiring about 10 ma for operation.

Adjustment

After assembly and checking, the only adjustment required is that of the plate relay. This is done with a vtvm across the signal input. The relay tension screw is adjusted until the relay will just hold down when the signal input is 7.5 volts rms. When this adjustment is correctly performed, the relay will release when the signal voltage rises to approximately 9; and the release will be rapid when the voltage reaches or exceeds 15.

Switching sequence for making this adjustment follows: Turn switch on, press relay armature down, turn switch off, wait until filament is thoroughly warm, then apply test signal. This is repeated, during adjustments, until the desired sensitivity is found.

Maintenance

Experience with similar equipment suggests a probable service life, between major overhauls, of more than 10,000 operations. Annual cleaning of the relay contacts is recommended, at which time the tube should be tested for failing emission.

Tamper-proofing of this clock setter is obtained by inserting a lock-type switch at point X in Fig. 1.

Operation

Operation of the completed device, in conjunction with an electric clock modified as outlined and a radio receiver tuned to a WWV time signal, is accomplished as follows:

(1) Check clock time against WWV time. If clock is off, turn on switch.

(2) When sweep second hand of clock reaches zero position, press the ready button. If the clock does not stop at exactly zero, press slip button and try again.

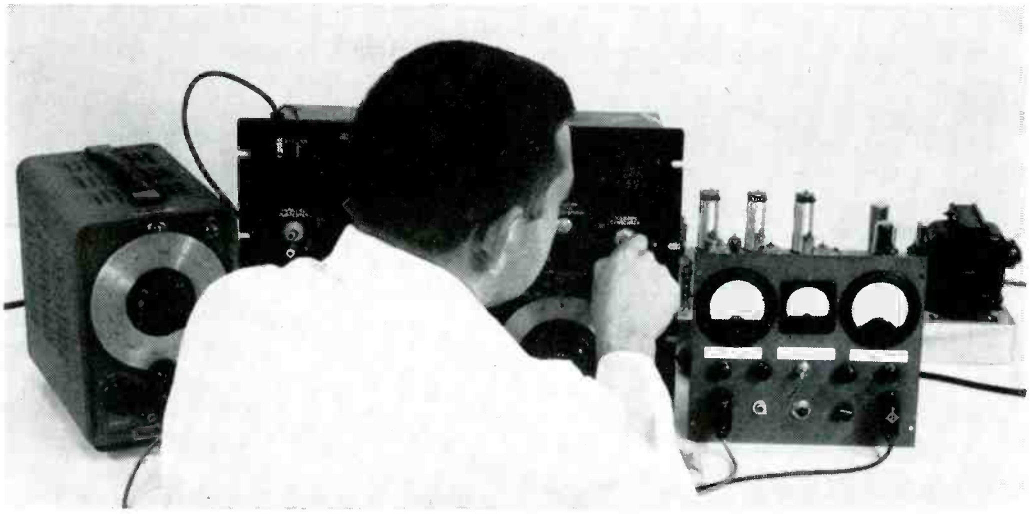
(3) Set minute and hour hands of the clock to the time next to be announced by WWV. This is done with the setting mechanism supplied with the clock.

(4) Wait for the voice announcement of the time from WWV. When this is given the second time, turn the switch to off position. Resumption of the WWV tone will start the clock and de-energize the setter automatically.

Accuracy

Attainable accuracy with WWV signals, having an amplitude of 15 volts rms and a signal-to-noise ratio of two or better, is high. Measured electromechanical lag is 0.05 second, plus or minus about 0.01 second. Lag using a skilled human operator is usually 0.2 second, plus or minus 0.05 second and also subject to many false starts and misses from interruptions.

Thus, by using this electronic setter, WWV setting error is quartered and reduced to a value that is entirely negligible for most applications. At the same time, variability of setting lag is divided by five and aborted settings, caused by operator distractions, are minimized. Several other sources of possible error, such as slop and slack in the clock gear train, are virtually eliminated by the auxiliary coil, which holds the clock train in position while the driving coil is de-energized.



Differential voltmeter unit (foreground) with relay control unit at rear are used with Schering bridge to sort capacitors with a high degree of accuracy in developmental setup

Bridge Sorts Capacitors To Tolerance

By SAM D. BRESKEND, J. I. COOPERMAN and P. J. FRANKLIN

Diamond Ordnance Fuze Laboratories
Washington, D. C.

SUMMARY —— Automatic two-channel system uses Schering bridge to measure dissipation factor and capacitance variation from standard value. Thyratron controlled relays route tested capacitors to over, under and acceptable bins in 5, 10 and 20 percent ranges. System accuracy is better than 1 percent in sorting 1,000-$\mu\mu$f capacitors

DESIGNED for production testing and sorting of capacitors a system consisting of a Schering bridge and phase-sensitive voltmeter indicates variation of capacitance and dissipation factor independently on individual meters. An additional thyratron control circuit sorts capacitors automatically when used in conjunction with appropriate mechanical gates. The system has been used to sort 1,000-$\mu\mu$f capacitors to better than 1 percent.

Advantages of using a system such as this are that the bridge contains its own standard and does not require external standard capacitors for adjustment, complex bridge manipulations are not required for individual measurements and it is an easy-to-operate direct-reading instrument. The system is shown in block form in Fig. 1.

The output of an off-balance Schering bridge contains both in-phase and quadrature components that are separable. For a bridge setting of C_N equal to the nominal capacitance and a dissipation-factor setting of zero percent, there is effectively no voltage output at the null. When there is an unbalance condition due to a reactive component of the unit under test, the output voltage is in phase with the bridge input and varies in amplitude with the degree of unbalance.

When an unbalance condition is caused by a resistive component of the unit under test, the output voltage will be displaced in phase by 90 deg relative to the bridge input. The relative amplitude of this quadrature component will be determined by the amount of off-balance.

There are also conditions of off-balance in which both the resistive and the reactive components of the unit under test are not balanced out in the bridge. In this case, the voltage at the detector terminals will be of a complex nature; it will contain components that are in phase and components that are 90-deg out of phase with the excitation voltage. Many methods of separating these components have been described. Phase shift

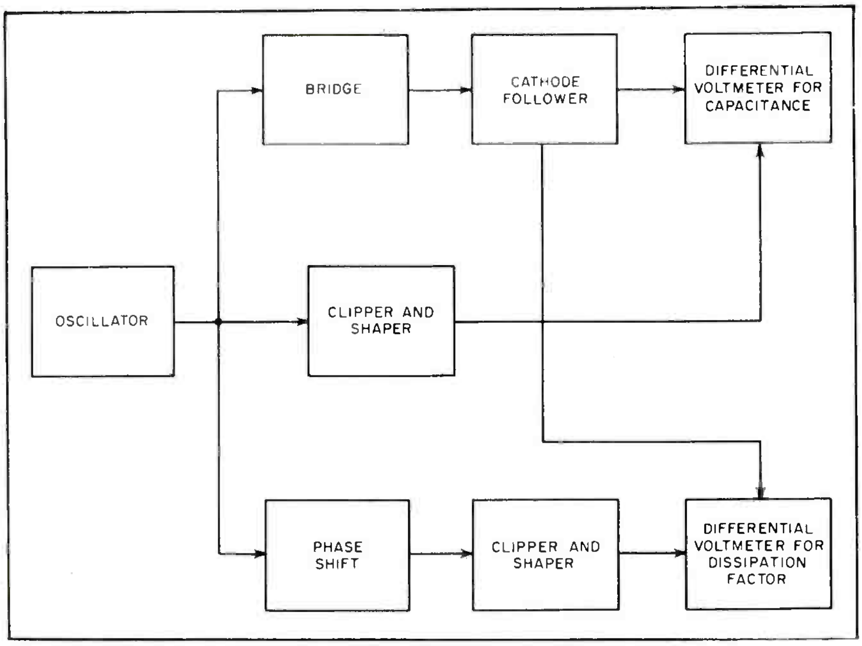


FIG. 1—Two-channel system for sorting capacitors for dissipation factor and capacitance value uses Schering type bridge to obtain in-phase and quadrature signals

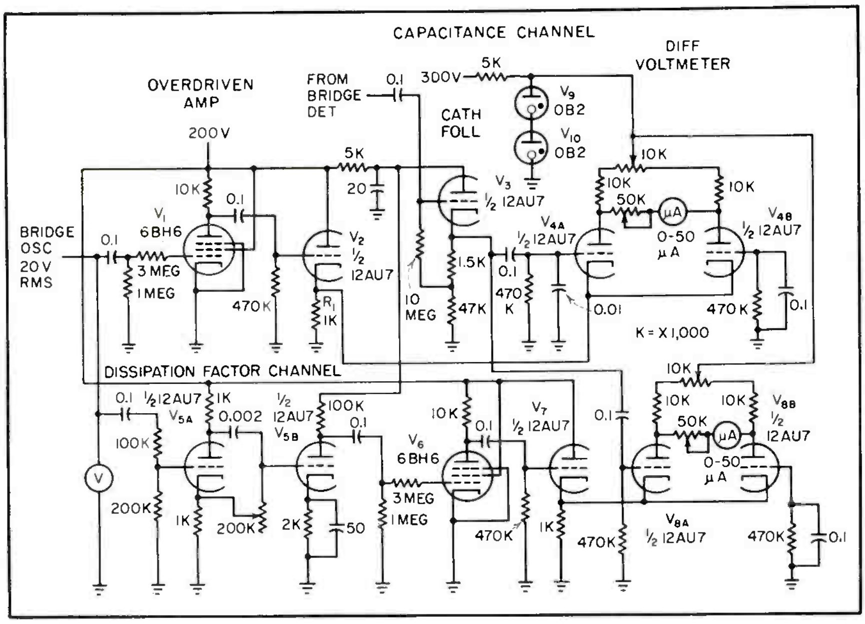


FIG. 2—Capacitance and dissipation factor channels for automatic capacitor sorting system use similar circuits for differential voltmeter

methods using an oscilloscope have been used and various types of balanced modulators have also shown promise. This article deals with the latter method of accomplishing this task.

Capacitance Channel

The channel for indicating variations in capacitance consists of a cathode follower that drives a gated differential voltmeter and is shown schematically in Fig. 2. It is essentially a cathode-coupled phase inverter, where resistor R_1 is the coupling impedance. The gating voltage is derived from the oscillator that drives the bridge by suitable clipping and shaping circuits and is in phase with the oscillator voltage. When the bridge is at balance and there is no voltage output at the detector terminals, the grids of both V_{4A} and V_{4B} are at signal ground potential. Although the plate voltages are varying as a result of the gating voltage applied to the cathodes, they do this simultaneously. There is no potential difference between them hence no indication on the meter.

If the off-balance condition results only from a reactive component of the unit being tested, the signal voltage at the grid of V_{4A} will be in phase, or 180 deg out of phase with the gating voltage and the signal at the plates of V_{4A} and V_{4B} will appear as in Fig. 3A.

If the off-balance condition results only from a resistive component of the unit being tested, the signal voltage at the grid of V_{4A} will be in quadrature with the gating voltage and the signal at the plates of V_{4A} and V_{4B} will appear as in Fig. 3B. During conduction the plates of V_{4A} and V_{4B} swing alternately more positive and also less positive in the same ½ cycle of the gating voltage. The integrated difference voltage is, therefore, zero and hence has no effect on the direct-current meter reading.

If the off-balance condition results from a combination of both reactive and resistive components of the unit being tested, only that portion of the complex signal voltage which is in phase, or 180-deg out of phase, with the oscillator voltage will cause a deflection on the meter.

Signal voltage at the plate of V_{4B} is actually smaller than that at the plate of V_{4A} although indicated in the waveforms as being equal in amplitude. The reason is that the coupling resistor, R_1, is smaller than the optimum value required for adequate phase inversion. Nevertheless, it does help to increase the sensitivity of the complete instrument by causing push-pull action, and is a convenient method of injecting the gating voltage to V_{4A} and V_{4B}.

Dissipation Factor

The channel for indicating changes in dissipation factor is identical to the first channel with the exception of a phase-shifting network and an extra stage of amplification before the overdriven amplifier. By adding the phase shift here, the same effect is achieved as that of shifting the quadrature component 90 deg. This permits an indication on the meter of off-balance conditions of the bridge resulting from a resistive component. The off-balance of the

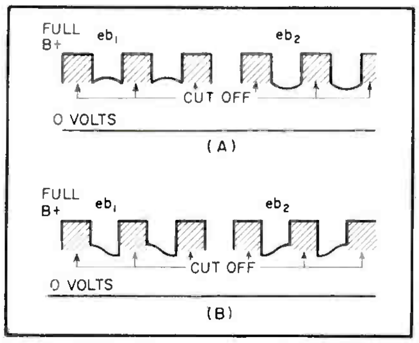


FIG. 3—Differential voltmeter waveforms with in-phase (A) and out-of-phase conditions (B)

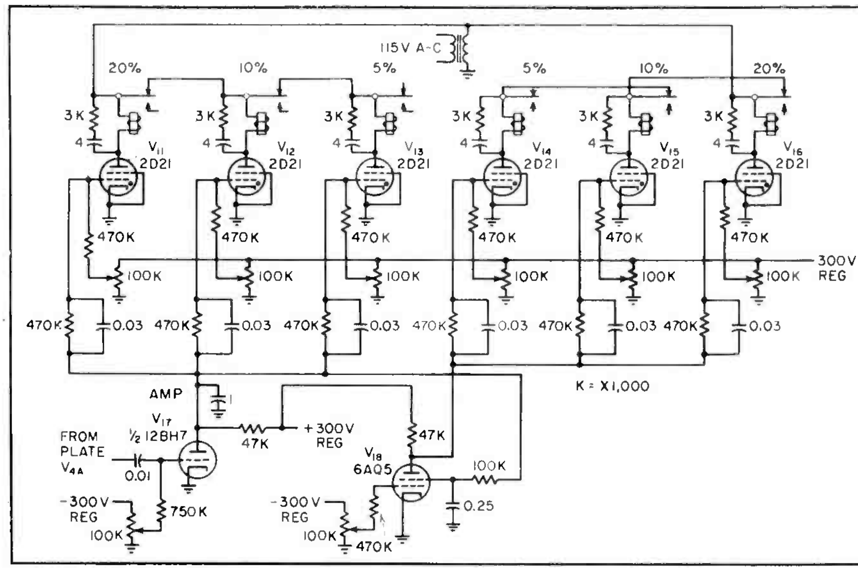


FIG. 4—Control circuit used with differential voltmeter for sorting capacitors according to variations from standard

bridge because of a reactive component appears as a quadrature voltage in reference to the gated differential voltmeter which indicates dissipation factor and, therefore, has no effect on the meter indication.

When this unit is used in conjunction with the automatic sorting equipment, Fig. 4, a control voltage is extracted from the plate of V_{4A}. The waveforms of Fig. 5 show the character of this voltage with varying degrees of capacitance unbalance of the bridge. Capacitor coupling from the plate of V_{4A} removes the d-c level and provides a signal whose positive peak value is related to the amount of bridge unbalance. Tube V_{17} is a biased amplifier stage which conducts only during the positive half cycles of its grid signal. The pulsating plate voltage is integrated and the resulting d-c level is used to control the ignition of the three thyratrons, V_{11}, V_{12} and V_{13}. Tube V_{18} is a phase inverter and its plate potential controls the firing of the remaining three thyratrons, V_{14}, V_{15} and V_{16}, for bridge unbalances in the opposite direction. This scheme permits a symmetrical order of operation for the thyratrons and a dead zone where capacitors within tolerance will not operate any relays.

The plate of V_{17} is coupled directly to the screen grid of V_{18}. In this manner the large voltage swings of the plate of V_{17} can be inverted without using a high power supply potential. Plate voltage for the thyratrons is interconnected through the relay contacts; thus, only one relay can be energized at any one time.

Use and Calibration

Operation of the phase sensitive voltmeter in conjunction with a Schering bridge involves setting the dissipation-factor arm to zero and the precision variable bridge capacitor to the desired value. The

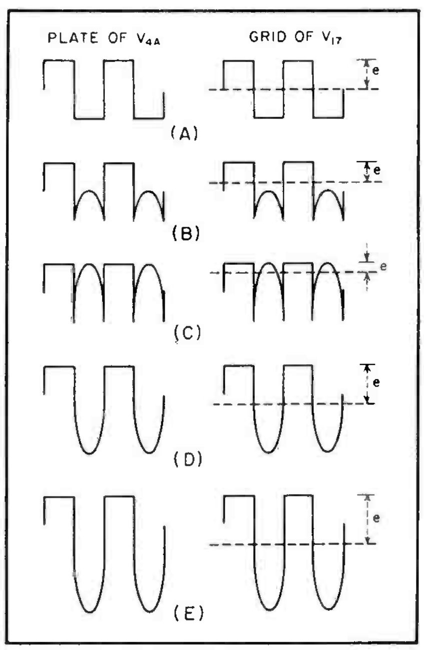


FIG. 5—Plate and grid waveforms for balanced bridge (A), small positive capacitance unbalance (B), large positive capacitance unbalance (C), small negative capacitance unbalance (D) and large negative capacitance unbalance

instrument will then display on its indicators the percentage deviation of a test capacitor from the value originally set on the bridge. The device is calibrated by varying the meter-multiplier resistor to give a desired amount of meter deflection for a particular deviation. Since the equipment is sensitive to amplitude variations, the oscillator voltage should be held constant and the equipment recalibrated for different values of capacitance balance.

The dissipation factor channel is adjusted in a similar manner except that, in addition, the phase-shift network is adjusted for zero indication on the meter when the bridge is at dissipation factor balance. If only capacitance indications are desired, the dissipation factor indicating channel may be omitted.

The sorting device is adjusted by unbalancing the bridge by specific amounts and varying the grid bias potentiometers for tubes V_{11} through V_{16} so that the proper relay operates for its particular deviation.

Performance

The phase-sensitive voltmeter was designed to indicate variations of capacitance and dissipation factor and seems to be stable and linear. When used for automatic sorting, with the relay-control chassis, sorting to within 10 $\mu\mu$f can be expected for 1,000-$\mu\mu$f capacitors.

MUSCLES CONTROL

By L. H. MONTGOMERY
Department of Anatomy
School of Medicine
Vanderbilt University
Nashville, Tennessee

SUMMARY — Potentials picked up from muscles as paralyzed patient attempts to breathe triggers control circuit for artificial respirator allowing patient's body needs to control rate of breathing. Circuit failure switches control to conventional iron-lung operation

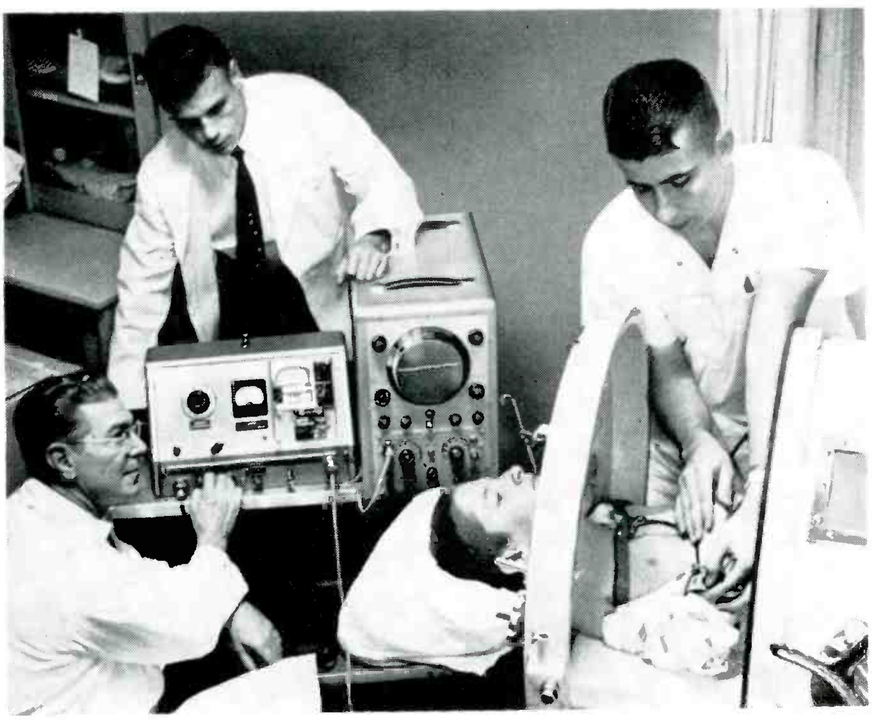
IDEALLY, the operation of a respiratory aid should be under the control of the patient's own biochemical needs. This can best be done by utilization of respiratory nerve or muscle action potentials as the activating force.

The control system should provide the patient with a wide and variable range of respiratory rates and inspiratory volume. Its operation should not require voluntary effort by the patient. It must be dependable with the least possible supervision and should be simple and safe. Special equipment should be kept to a minimum, especially those requiring periodic replacement, such as vacuum tubes.

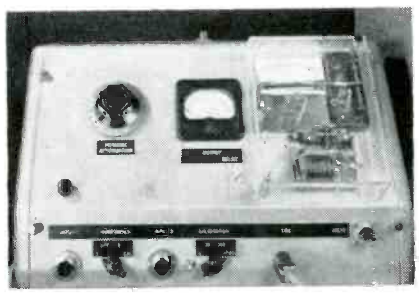
Pulse Pickup

Complete respiratory paralysis following poliomyelitis is rarely if ever encountered so that for practical purposes such action potentials are present and detectable in all patients even though the remaining muscle action is inadequate for normal breathing. These potentials are complex pulse potentials of 10 to 1,000 microvolts with duration of 0.01 second to approximately 1 millisecond when recorded from the surface. The individual fiber discharge is about 1 millisecond in duration. However, these pulse potentials overlap in the muscle bundle to produce lower frequencies. These pulses are picked up by nickel-silver disk electrodes, each about the size of a quarter. Placement of the electrodes depends on the muscle location.

The greatest problem encountered in utilization of small muscle potentials is that of artifacts from 60-cps stray power fields and from interference caused by potentials from the heart. This is not too serious since the individual muscle



Iron-lung setup (left) with respiration control unit and monitor oscilloscope. Skin electrodes are being attached to patient's chest to pick up activating impulses that will trigger iron-lung valve



Front panel of respiration monitor with control relays mounted under plastic cover at upper right. System is fail-safe, switching to automatic operation if patient does not trigger breathing cycle

IRON-LUNG OPERATION

potentials of interest have a duration of a few milliseconds whereas the major components of the heart and other artifacts are principally below one one-hundredth of a second.

The respiration-rate control unit shown in Fig. 1 uses an amplifier with a low-frequency cut-off near 100 cycles. The input stage is push-pull and has a high value of common cathode resistance to cause degeneration of in-phase voltages. Interstage coupling transformers are tuned to pass 100 to 1,000 cps. The tuning of the third-stage input transformer is made variable by using a tap switch and fixed capacitors which range from 0.0001 to 0.025 μf. A slight amount of positive feedback is used to increase its apparent Q.

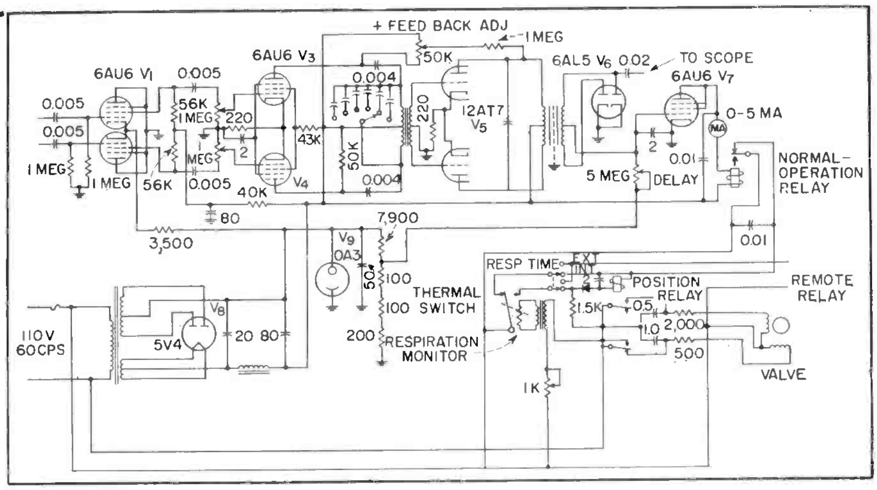


FIG. 1—Respiration monitor in iron-lung control system switches operation to automatic if patient does not start inspiration cycle after set time

Operating Cycle

Under normal conditions, after passing through the selective amplifier, the muscle potentials are integrated with respect to time so that random spikes and artifacts such as switching transients will not trip the apparatus. It will, however, trip on inspiration after the first few muscle potentials and hold until the muscle relaxes. Expiration is then permitted. The equipment returns to its resting state where it remains until the patient makes an inspiratory effort.

When the patient makes an effort to breathe, the muscle potentials which are integrated appear in the form of a d-c voltage which is used to control the normal-operation relay. This, in turn, controls the position relay which operates a motor-driven valve. This valve controls the flow of air to the respirator. The latter relay may also be operated by the respiration monitor.

If the patient does not breathe again within a predetermined length of time the emergency monitor will take over the operation of the respirator and continue to operate it until the patient's muscle potentials again fall within the selected range.

The monitor consists of a thermal element, using a stepdown transformer and a No. 18 iron wire which is maintained in tension by a spring. A mechanical lever magnifies the thermal expansion of the wire. The lever carries two contacts, one representing the lower limit and the other representing the upper limit of normal respiratory rates.

Monitor Operation

Starting cold, the lower limit contact is closed. Current passing through this contact energizes the position relay which swings the valve to its inspiratory phase. It also energizes the heating circuit through the transformer.

When the force due to expansion of the wire allows the spring to exceed the pull of the duration magnet, the contact will open. This releases the position relay causing expiration and cutting off the heating power which in turn allows the wire to cool. The contraction of the wire closes the lower limit contact and thus completes the cycle.

The operation will continue until such time as the normal-operation relay closes its contact due to the presence of muscle potentials. When the normal-operation relay closes, it causes the valve to shift to inspiration and also energizes the heater.

The current through the heater is adjusted so that under normal respiration the contact lever of the monitor will float around mid-scale or half way between the range contacts which are adjusted to the patient's normal respiration requirements.

In event of muscular spasms or convulsions the monitor takes over. The upper limit contact will make causing the position relay to shift to the expire position, thereby cutting off the heating power and permitting deflation of the lung. As the wire cools it will open the contact on the arm and thus set up a new respiratory cycle. This automatic operation continues until the normal-operation relay resumes its function. At this time the monitor arm returns to its normal position midway between contacts.

The author acknowledges the help in this work of Randolph Batson, associate professor of Pediatrics and director of the Vanderbilt Polio Respiratory Center, and colleagues in the Department of Anatomy, especially David McCroskey and Larry Beisel who have been working on this project. Financial assistance from The National Foundation for Infantile Paralysis is also acknowledged.

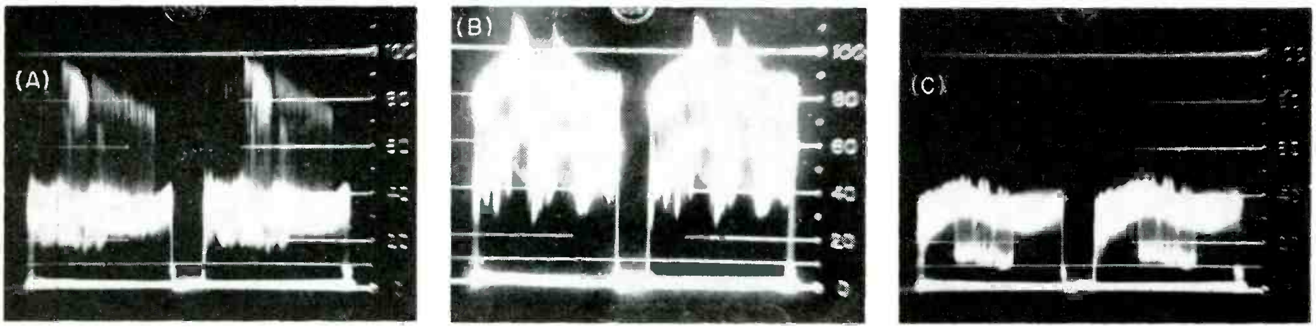


FIG. 1—Output waveform from manually controlled iconoscope chain for average (A), large white area (B) and low-contrast (C slides with no adjustment made for slide content or density

Automatic Level Control

By E. W. LAMBOURNE
Chief TV Engineer
KTVT
Salt Lake City, Utah

SUMMARY —— Simple three-tube circuit keeps peak-to-peak video-signal output from iconoscope slide chain at constant predetermined level. White peaks just reach 100-percent modulation level regardless of slide subject content or density. Circuit provides reliable operation

MODERN SLIDE PROJECTORS such as those used with iconoscope chains switch slides instantaneously and therefore any corrections in level that may be required due to different slide densities must be made after the slide comes up on the air. An operator must be present at the controls when different type slides are used and no matter how fast his reacions are, he cannot correct levels fast enough to prevent the changes from being visible on the air.

Since it is not practical to have all the slides of uniform density, an automatic level control has been devised that keeps the peak-to-peak output voltage of the iconoscope chain at a predetermined value regardless of the slide density. This technique assures a reasonably good picture on any slide, without attention of an operator.

Figure 1A shows the output of an adjusted chain, with no automatic level circuitry, for an average slide. Figure 1B shows the output for a second slide with large white areas, punched up on the projector without changing the camera controls. The whites are above the 100-percent modulation point and will produce overmodulation effects such as blooming and sound buzz in intercarrier sets due to cutting of the visual carrier during the white peaks.

Figure 1C shows the camera output with a low-contrast slide. This will produce only a dim picture on most receivers and one that may be barely visible on others, depending on the setting of the brightness controls. The last two slides could be corrected by the pedestal and gain controls, but this involves an operator and time.

In approaching this problem, it was felt that if the white peaks could be made to just reach the 100-percent point for each slide, reasonably good pictures would result, no matter what the slide content: dark, low-contrast slides would not be lost as dim pictures; high-contrast slides would not overmodulate and would have their black areas below set-up level where they belong; average slides would about fill the video envelope.

Figure 2 shows the outputs for the same slides with the automatic level control in operation. The second slide now has its pure whites at the 100-percent point, thus preventing overmodulation. The low-contrast slide has its average video level up where it will be seen on all receivers. The waveform envelope is not filled with video from the low contrast slide, but the brightness is at a level where the picture will not be lost on any receiver.

Circuitry

In an RCA TK20-D iconoscope chain, automatic level control can be accomplished with the circuit shown in Fig. 3.

A negative control voltage is obtained from the chain's output video by rectifying the output of isolation stage V_1. This control voltage regulates the gain of amplifier V_3 that feeds amplified horizontal-drive pulses into the iconoscope black-level circuit. The horizontal-drive pulses are added to the video input of the camera control to set the video level upon a pedestal of adjustable height. The peaks of the drive pulses are eventually clipped

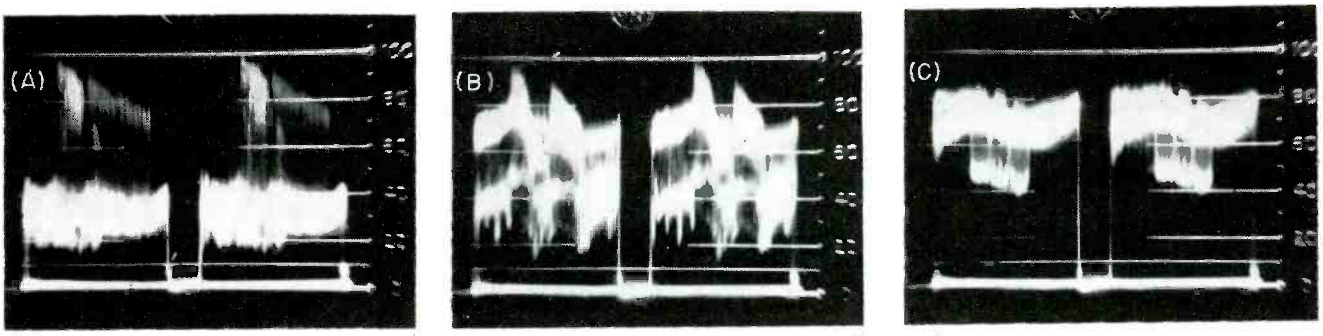


FIG. 2—Same slides as used in Fig. 1 provide essentially constant white peaks when automatic level control is employed. Large white area slide (B) has lower average video level and low-contrast slide (C) has higher average level

for TV Slide Chains

off by the blanking clipper, but their effect is to raise or lower the blanking amplitude.

Low-Density Slide

Thus, for example, should a low-density slide produce a voltage at the output of the chain that is less than normal, the negative voltage that biases V_3 would be reduced and the gain of V_3 would increase. This in turn would couple more horizontal-drive voltage into the black-level circuit and raise the pedestal level back to normal.

Conversely, a slide with large white areas that may produce an output peak-to-peak voltage that is greater than normal will come up with a greater bias for V_3. This will reduce the horizontal drive voltage into the black-level circuit and lower the pedestal. Time constant in the R-C filter can be adjusted to control the speed of the correcting action.

With the automatic level control switched off through S_1, the chain is adjusted for normal levels with an average slide. The black-level is then adjusted to reduce pedestal until all video just disappears off the waveform monitor. The automatic level control is switched on and gain is adjusted until the level is again normal. This peak level should hold for different slides.

Operation of the circuit can be readily ascertained as the circuit will oppose manual changes in the black-level control.

This circuit has been in operation for more than a year at KTVT and has been found to be a useful tool for smooth operations. It has been found to be particularly useful on slides used in conjunction with the two color color-effects system where black-and-white slides are transmitted in two colors. Maintaining the colorplexer input voltages at a constant level is of major importance in producing pure colors.

Limitations

The circuit works with film chains as well as slides, but the theory of correcting all video to a reference white level may not be desirable on some scenes. For example, on a transition between scenes where the picture fades to black and then into the next scene, the automatic control would return the chain to full white and may thus negate the mood of the transition. Likewise, on night scenes where only a small amount of video voltage is present, the automatic control may cause the background to be pulled up to a medium or light gray area.

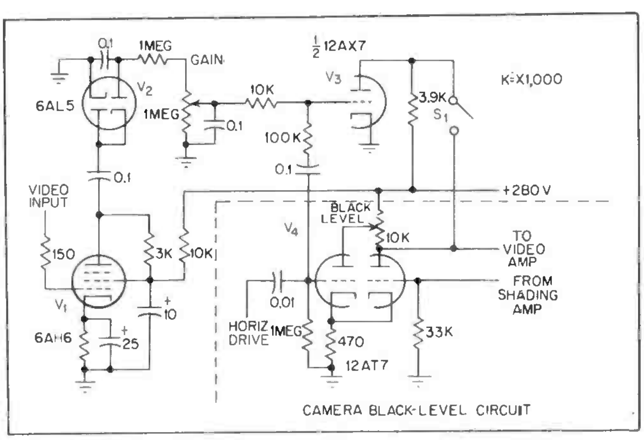


FIG. 3—Control circuit for use with RCA TK20-D iconoscope chain

Operator punches up call-letter slide on switching-mixing unit

Laboratory setup used to measure gain-temperature characteristics of silicon transistors in 1-mc grounded-emitter i-f amplifiers with feedback and thermistor compensation

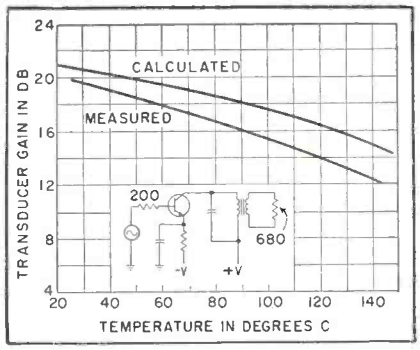


FIG. 1—Curves give calculated gain and measured gain for configuration shown

Compensating Silicon

By S. H. GORDON

Diamond Ordnance Fuze Laboratories Washington, D. C.

SUMMARY —— Results of tests on 1-mc i-f amplifiers using silicon transistors show a sensitivity to temperature that requires compensation. Effects of impedance mismatch, feedback and thermistor compensation for the grounded-emitter configuration are given for temperatures of 20 to 100 C

SILICON TRANSISTORS were thought a cure for many of the temperature problems that exist in circuits using germanium transistors. They are rated at temperatures up to 150C and, because silicon withstands high temperature better than germanium, temperature variations should have little effect on their characteristics.

In many cases these original hopes were fulfilled. However, when the silicon transistors were tried in high-frequency i-f amplifier circuits, the gain dropped considerably as temperature increased. This decrease in gain was not expected, as it had not occurred in any previous experiences with wide-band low-frequency R-C coupled amplifiers.

Temperature Compensation

Analysis of the changes in gain caused by temperature changes in an uncompensated amplifier were made. The curves of Fig. 1 show the correlation between the calculated change in gain with temperature and the measured gain. The lower measured gain is probably caused by either losses in the output transformer or errors arising out of initial assumptions in determining equations to calculate the gain. The operating frequency in both cases is 1 mc. Further analysis that includes temperature compensation techniques is certainly possible however because of the expected complexity of the resulting equations and the time consumed to analyze each temperature compensation technique it was decided to investigate experimentally.

The three general methods of temperature compensation investigated were impedance mismatching, feedback and the use of thermistors. Only the temperature range from 25C to 100C was investigated, however the techniques developed for this temperature range can be applied at the lower temperatures. An important factor here was to obtain the desired compensation with a minimum loss of gain.

Impedance Mismatch

The input impedance of a grounded-emitter 1-mc i-f amplifier at room temperature is normally about 200 ohms. Output impedance is normally about 1,500 ohms. As the transistor is heated, the input impedance will increase and the output impedance will decrease. In an attempt to compensate for the effects of these impedance changes an approximate 8-to-1 mismatch of 1,500 ohms in series with the input was tried. An output load of 120 ohms through an 8-to-5 transformer ratio was also tried. The curves obtained using these matching values are shown in Fig. 2A. Since little or no improvement was noted and because the power loss due to mismatch was large, this method of temperature compensation appeared unsatisfactory.

Two types of feedback in the grounded-emitter amplifier were

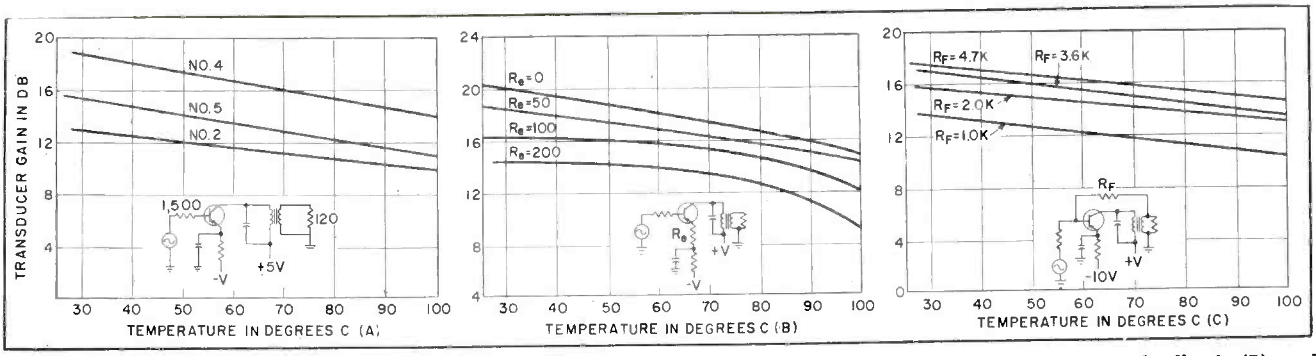


FIG. 2—Effects of compensating grounded-emitter narrow-band amplifier by mismatched impedance (A), emitter feedback (B) and negative feedback (C). Numbers identify transistors tested in circuit configuration associated with curves

Transistor Amplifiers

investigated. They were degenerative feedback in the form of an unbypassed emitter resistance and feedback from the collector to the base. The curves of the degenerative emitter feedback are shown in Fig. 2B and curves of the collector-base feedback are shown in Fig. 2C. The input and output matching resistor was changed for each different feedback condition that was used so a matched condition could be obtained at the start of each temperature run.

No significant improvements in the temperature characteristics were noted with the amounts and types of feedback shown. Analysis of why the feedback did not help as expected was not made, however some important parameters in the equations governing feedback in a transistor amplifier are the input impedance and the amplifier gain.

Since these parameters vary with temperature, the improvement expected with feedback may not be obtained.

Thermistors

Two types of temperature compensation which employ thermistors were investigated. The first method used a thermistor in series with the input circuit to attenuate the input signal more at the low temperatures than at the high temperatures and the second used a thermistor in series with the emitter to change the d-c operating point with temperature.

The results of the first type of compensation are shown in Fig. 3A. If the input thermistor-resistor network is designed so that the amplifier is matched at the higher temperature and the input signal is attenuated at the lower temperature so the output power is the same as that obtained with the higher temperature, then the temperature-gain curve should be relatively flat. The loss in gain is the difference between the high and low-temperature gains. The transducer gain shown in Fig. 3A was measured after matching at the high temperature end which results in an R_g value of 400 ohms.

Results of the second type of compensation are shown in Fig. 3B. As the emitter current is increased from low to medium the beta of the transistor increases, thus increasing the gain.

This method has an advantage in that the increasing input impedance resulting from heating the transistor is compensated by the increase in emitter current. This also tends to lower the input impedance. All types of compensation that make use of thermistors require some matching of the thermistor to the transistor. The thermistors used in Fig. 3A were the only type of compensation tried which displayed good results with only a small loss in gain.

The author thanks R. C. Carter, W. H. Schuette and E. H. Harrison Jr. for their helpful suggestions.

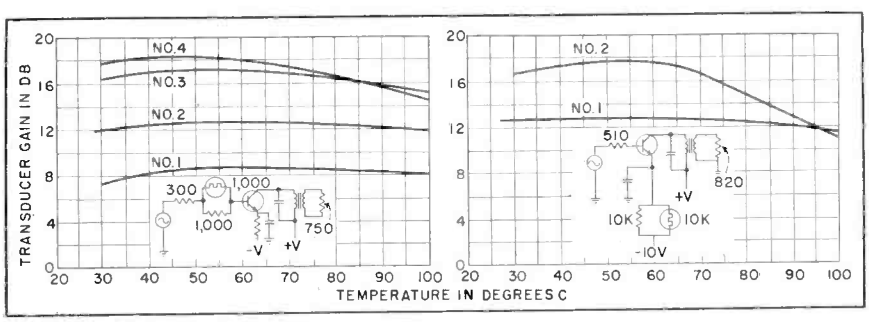
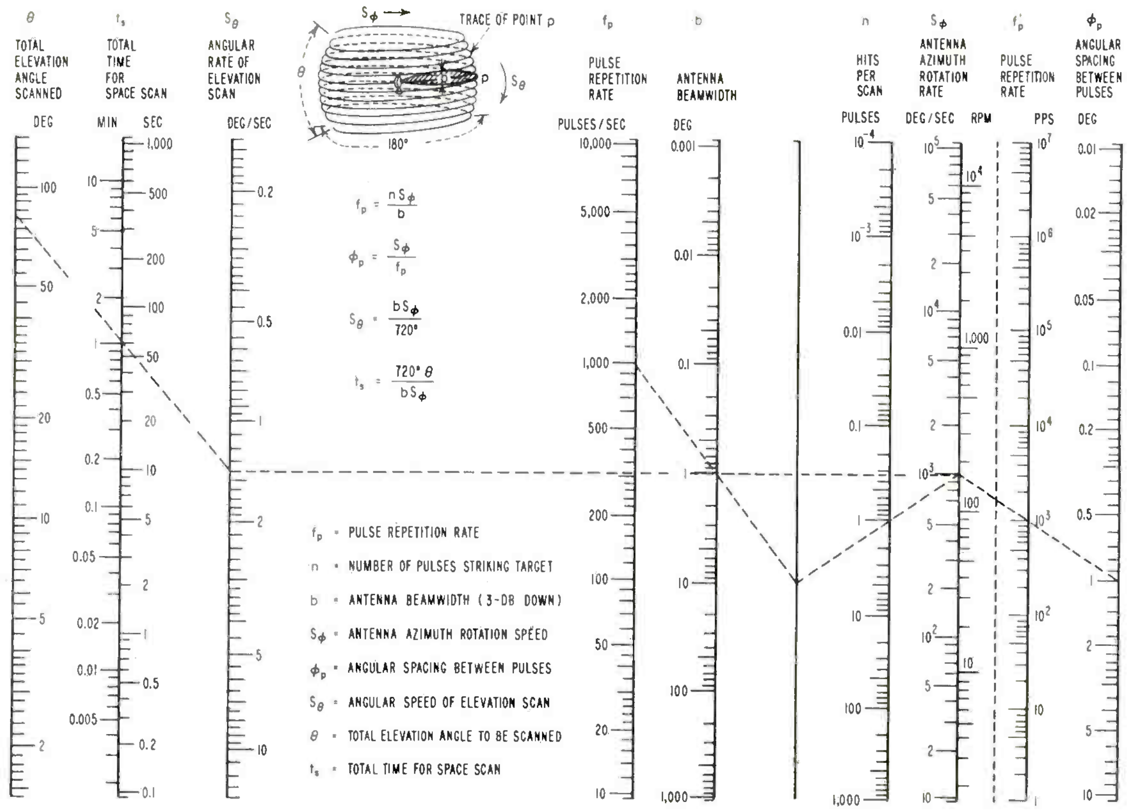


FIG. 3—Compensation resulting from thermistor in input circuit (A) and in emitter circuit (B) for silicon units of same type shows stability throughout temperature range



Helical Scan Nomograph

By CHESTER W. WOOD

Senior Research Engineer
Advanced Techniques Group
Convair, Division of
General Dynamics Corp.
Pomona, Calif.

SUMMARY — Scanning angle, rate of scan, radar prr and antenna beamwidth are related to probable hit per scan for helical scanning radars used in interceptor aircraft for searching space above and below horizon

HELICAL SCANNING radars are used by interceptor aircraft in searching the space above and below their horizon. Probability of detection is dependent upon the number of pulses striking the target. This in turn is dependent upon the rate at which the beam is traversing the sky and the pulse repetition rate.

The accompanying nomograph combines several dependent factors which the system designer must take into account in deciding what the radiation density shall be. The two scales on the far right can only be used with antenna azimuth rotation rate, scale S_ϕ.

As an example, assume that total elevation angle θ to be scanned is 85 deg, total time t_s for space scan is 1 min, antenna beamwidth b is 1 deg and pulse repetition rate f_p is 1,000 pps. The angular rate of elevation scan, antenna azimuth rotation rate and angular spacing between pulses are to be determined.

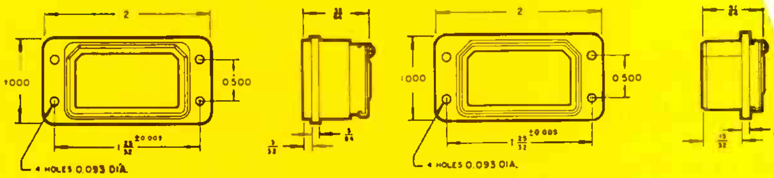
Starting on the left, draw a straight line from $\theta = 85$ deg through $t_s = 1$ min and intersect scale S_θ at 1.4 deg per second. Draw a line from $S_\theta = 1.4$ deg per sec through $b = 1$ deg and extend the line to $S_\phi = 1{,}000$ deg per sec. Draw a line from $f_p = 1{,}000$ pps through $b = 1$ deg and extend to the turning point on the uncalibrated vertical line. Connect this point with $S_\phi = 1{,}000$ deg per sec, intersecting scale n at 1 hit per scan. Draw a line from $S_\phi = 1{,}000$ deg per second through $f'_p = 1{,}000$ pps to $\phi_p = 1$ deg between pulses.

DPA 32-34P

DPA 32-33S

DPA CONNECTORS:

Shell with retaining plate. Pin and Socket Inserts.



MORE THAN THIRTY YEARS EXPERIENCE in the design and manufacture of standard electronic components insure

D SUB-MINIATURE
DPA AND DPX SERIES

☆ CANNON CONNECTORS

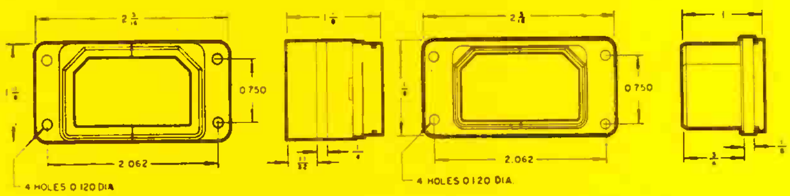
by CINCH to be of the highest quality materials, fabricated to specifications to maintain consistent quality of product; highest standards throughout all operations.

DPX 23-34P

DPX 23-33S

DPX CONNECTORS:

Split shell. Pin and Socket Inserts.



DB 25P

DB 25S

Send for illustrated Catalog No. 157 with details of "D" Sub-Miniature, "DPA" and "DPX" Series.

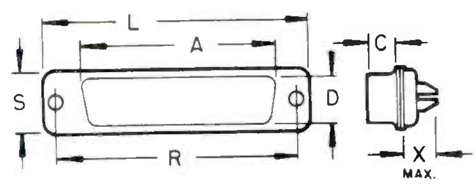
For your connector requirements — you can depend on CINCH.

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; LaPuente, California; St. Louis, Missouri.

CINCH MANUFACTURING CORPORATION
1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

D SUB-MINIATURES:

STANDARD PIN AND SOCKET INSERTS:



D SUB-MINIATURE SPECIFICATIONS:

Shell, including flange — steel or brass; Finish — Cadmium plate or Irridite. Contacts — No. 20, 5 ampere rating—Copper base alloy, gold plate finish.

Insert arrangements — 5 plus coaxials in 9, 15, 25, 37 and 50 contacts.

Insulation material — Zytel 101 or DIALL.

Polarization — Keystone cornered shell.

Operating temperature —67° to +310°F.

size	A	C	D	L	R	S	X	weight
DA-15P	1 1/64	15/64	23/64	1 17/32	1.312	31/64	5/16	.013
DA-15S	1 3/32	15/64	5/16	1 17/32	1.312	31/64	5/16	.014
DB-25P	1 9/16	15/64	23/64	2 5/64	1.852	31/64	5/16	.023
DB-25S	1 33/64	15/64	5/16	2 5/64	1.852	31/64	5/16	.031
DC-37P	2 13/64	15/64	23/64	2 23/32	2.500	31/64	5/16	.035
DC-37S	2 11/64	15/64	5/16	2 23/32	2.500	31/64	5/16	.035
DD-50P	2 7/64	15/64	15/32	2 5/8	2.406	39/64	5/16	.035
DD-50S	2 5/64	15/64	27/64	2 5/8	2.406	39/64	5/16	.040
DE-9P	45/64	15/64	23/64	1 13/64	.984	31/64	5/16	.011
DE-9S	41/64	15/64	5/16	1 13/64	.984	31/64	5/16	.012

FRACTIONS ±1/64 Tolerance   DECIMALS ±0.005 Tolerance

☆ *Manufactured by Agreement with Cannon Electric Company*

Coaxial Stub Design

By LEO YOUNG

Fellow Engineer
Westinghouse Electric Corp.
Baltimore, Maryland

SUMMARY — Design chart correlates relation between coaxial stub admittance and transformer admittance to obtain minimum vswr over specified bandwidth. Factors influencing admittance are given for stubs used as supports for coaxial inner conductors and used as right angle corners

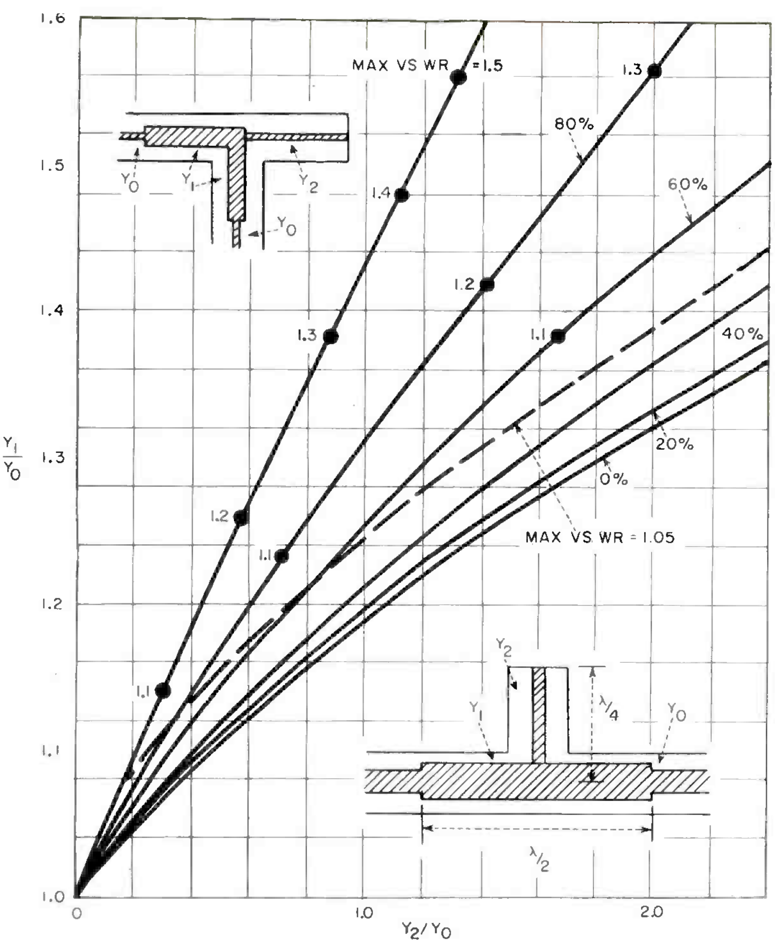
ANY ARBITRARILY selected stub admittance Y_2 has a corresponding transformer admittance Y_1 which minimizes the highest vswr over any specified bandwidth. Several factors influence the selection of Y_2 and Y_1. Making Y_2 equal to the main line admittance Y_0 economizes on the diversity of tubes required. For larger band-widths or improved electrical performance Y_2 should be reduced, thus increasing the ratio of outer to inner conductor diameters to give a compromise between electrical performance and mechanical rigidity. Optimum transformer admittance minimizes the highest vswr over any specified band. Having selected Y_2, the chart enables one to determine the optimum Y_1 for the desired bandwidth.

It can be shown that Y_2, Y_1 and Y_0 are related by

$$\frac{Y_2}{Y_0}\left[1+\left(\frac{Y_1}{Y_0}\right)^2\tan^2\left(\frac{\pi\,\Delta f}{4 f_0}\right)\right] - 2\frac{Y_1}{Y_0}\left[\left(\frac{Y_1}{Y_0}\right)^2 - 1\right] = 0$$

where Δf is the bandwidth and f_0 is the arithmetic mean frequency.

The highest vswr corresponding to V_{max} for several cases is marked on some of the curves. The broken line joins all the points having a vswr of 1.05. To design for a vswr better than 1.05 over the band, Y_1 and Y_2 must correspond to points below this line.

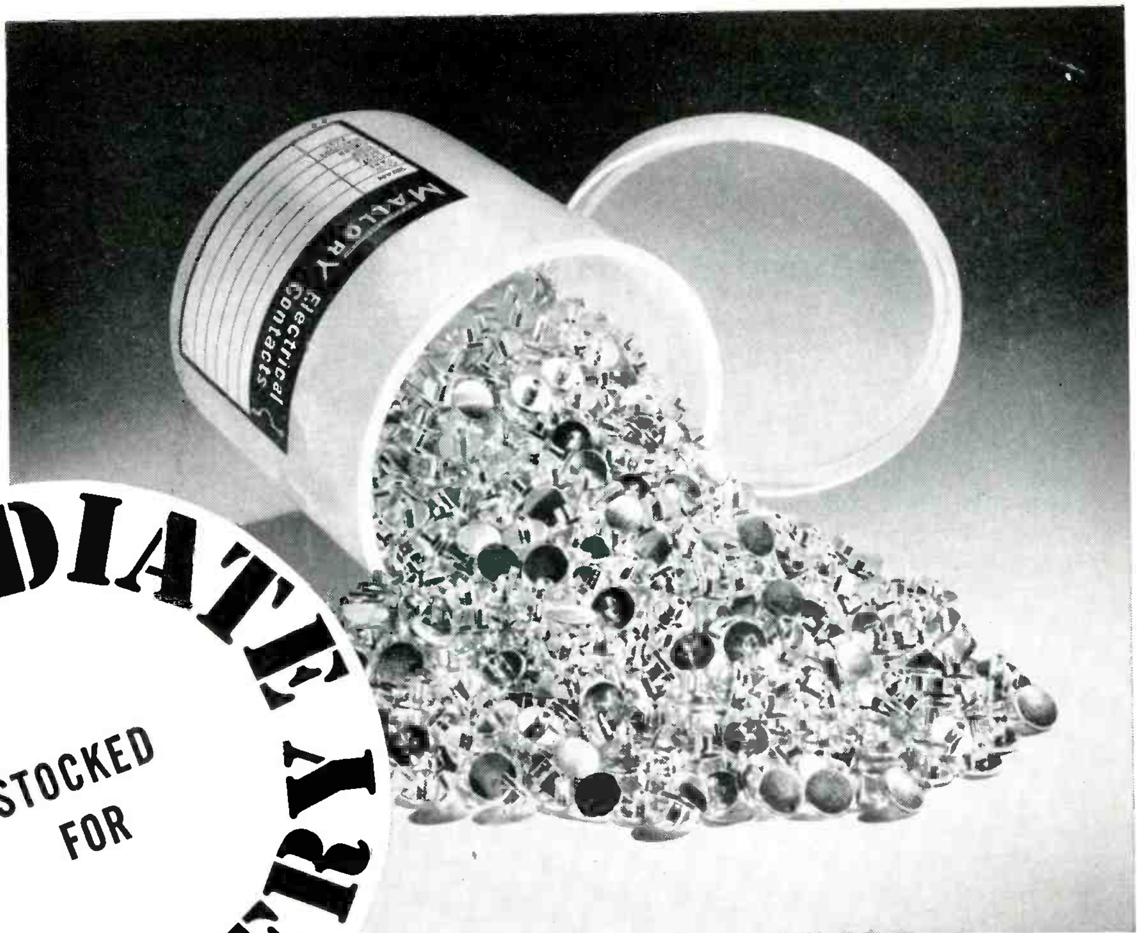


Curves show admittance relationship between 0 and 100-percent bandwidth

Example

As an example, if the vswr over a 60-percent band is not to exceed 1.05, what is the largest permissible Y_2? The 60 percent curve and the maximum vswr = 1.05 dashed curve intersect at $Y_2 = 0.84\ Y_0$. Therefore Y_2 must be less than $0.84\ Y_0$ if the vswr is not to exceed 1.05. If Y_2 is made equal to $0.84\ Y_0$, the corresponding Y_1 is $1.22\ Y_0$.

The exact length of the stub and the transformer will have to be determined experimentally. At high frequencies, or with large diameter lines, the shunt junction assumption is no longer as valid and bandwidth cannot be computed as accurately.



IMMEDIATE DELIVERY

STOCKED FOR

"Stocked for Immediate Delivery"—can be music to the ears of your production design engineers or purchasing agent.

Out of thousands of styles and sizes of fine-silver headed rivets as specified in customer orders came a list of 70 standard size contacts most frequently used. All 70 *standards* are "Stocked for Immediate Delivery" at Mallory.

For your new designs . . . check the Mallory "preferred list" for a size to fit your job. A Mallory standard can save engineering time . . . assure economical cost and prompt delivery when you go into production.

For your existing production lines . . . check the Mallory "preferred list" for a size closely matching the contacts you may now be purchasing on special order. A change to a Mallory standard may enable an appreciable cost savings on current and future production runs.

Write . . . or ask the Mallory representative for your copy of the Mallory Contact Division brochure 3-15A. It contains a complete stock list, dimensions, and pricing information.

Serving Industry with These Products:

Electromechanical — Resistors • Switches • Tuning Devices • Vibrators
Electrochemical — Capacitors • Mercury and Zinc-Carbon Batteries
Metallurgical — Contacts • Special Metals • Welding Materials

P.R. MALLORY & CO. Inc.
MALLORY

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

Want more information? Use post card on last page.

Electrons At Work

Edited by DAVID A. FINDLAY

Airborne Infrared Warning System Measures Range

By W. E. OSBORNE
Chief, Guided Missile Division
Nevada Air Products Co.
Reno, Nevada

AN INFRARED proximity warning system has been developed in experimental form for minimizing airplane collisions. Total weight is 30 lb., range at flight level 10 miles under good conditions, plus 800-foot warning for above-or-below. The latter range is fixed by Air Transport Association specifications, as aircraft are allowed a 1,000-foot elevation difference.

The pictorial representation in Fig. 1 shows relative placement of the infrared scanners. The drawing exaggerates unit size, since the housings or irdomes are only eight inches in diameter. Each

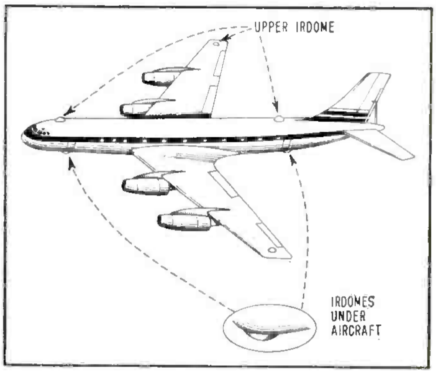


FIG. 1—Typical placement of infrared detectors on plane. Size of irdomes relative to plane is exaggerated

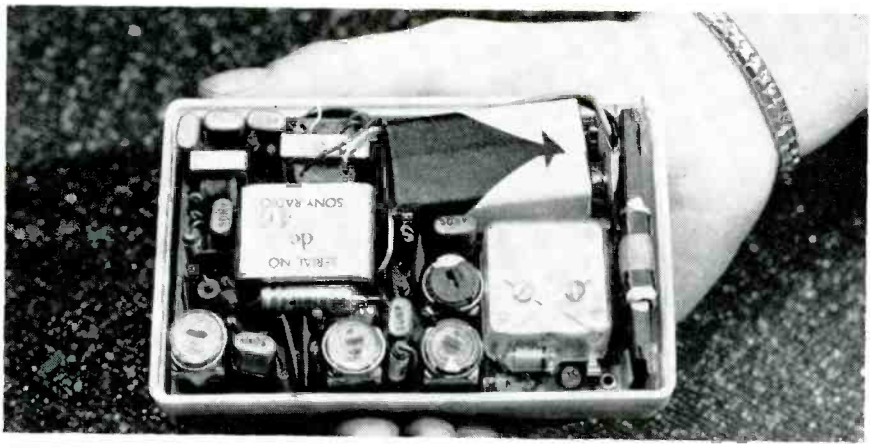
irdome cover is constructed of an infrared - transparent material partly related to Teflon. It is sturdy, nonbrittle and possesses a fairly uniform transmission characteristic from 0.9 micron to 8 microns.

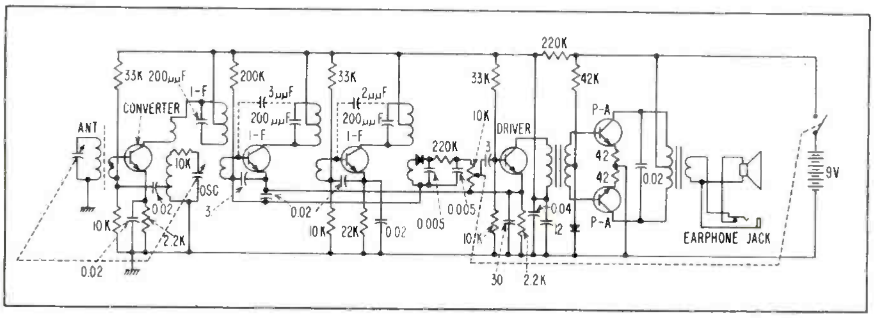
The system shown in Fig. 2A employs a narrow-band (5-cps) tuned amplifier for noise reduction, while that in Fig. 2B uses the equivalent of a synchronous-rectifier arrangement. Both systems incorporate several rings of uncooled PbS cells, on a single dome-shaped envelope inside each irdome. The number of cells in each ring determines the azimuthal accuracy of the system, as each cell looks out over a narrow cone of vision, preferably not be more than ten degrees. These rings are then sequentially switched into the circuit to preserve their angular identity. The terms lower, middle, and upper refer to the number of rings, not individual cells, and therefore to the elevation angle viewed. For better resolution of elevation angle the number of rings should be increased.

In Fig. 2A each cell is equipped with a subminiature transistor preamplifier of cathode-follower type. The outputs are then sequentially switched and chopped as shown, with special precautions taken to eliminate switching and chopping spikes by opposing pulses supplied by an R-C oscillator. The output of each cell in turn is passed through the main amplifier to a computer section consisting of eleven transistors and four subminiature vacuum tubes. The final stages are controlled by a time-base sweep which limits the ranges shown on the crt indicator. One main amplifier is used for each housing.

The system of Fig. 2B is basically similar, but here the switching tube operates directly from the PbS cells. This tube is a Dekatron type that has been specially developed for low-noise characteristics. The main amplifier is a conventional square-wave type, completely transistorized, and triggers an out-

Push-Pull Output Transistor Radio





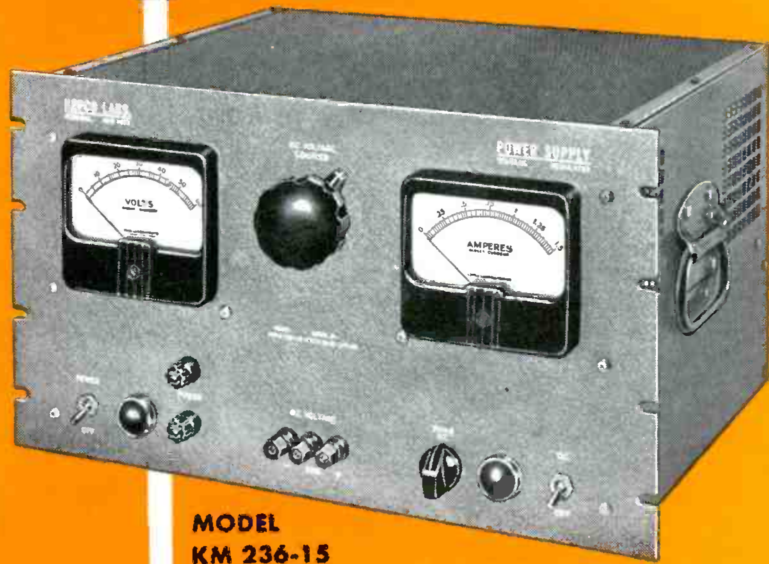
Latest in a line of compact Japanese broadcast receivers is the Sony TR-63 that employs six transistors and a varistor to avoid damage in case the battery is reversed. The varistor also compensates for temperature effects. Sensitiviy of the receiver is a millivolt and it has a maximum undistorted output of 20 mw. Selectivity is approximately 15 db 10 kc off. Set is made by Tokyo Tsushin Kogyo, Ltd., Western Electric Transistor licensees first in Performance Reliability and Quality

Kepco

introduces the first in a series of

NEW MAGNETIC TUBELESS

VOLTAGE REGULATED POWER SUPPLIES



MODEL KM 236-15

2-36 VOLTS
15 AMPS.

featuring

- **Output voltage within 0.5% during recovery time for line transients 105-125 volts.**
- **Short circuit will not damage supply.**
- **Full current may be drawn at any voltage from 2-36 volts.**

OUTPUT VOLTAGE DC: 2-36 volts continuously variable.

OUTPUT CURRENT DC: 0-15 amperes continuous duty.

REGULATION: In the range 2-36 volts the output voltage variation is less than 0.5% for line fluctuation from 105-125 volts, and less than 0.5% or 25 millivolts, whichever is greater, for load variations from minimum to maximum current.

RIPPLE VOLTAGE: Less than 0.5% or 25 millivolts RMS, whichever is greater.

FUSE PROTECTION: Input fuses on front panel.

OVERLOAD PROTECTION: An automatic current limiting device allows direct shorting of the output terminals without damage to the supply.

POWER REQUIREMENTS: 105-125 volts, 57-63 cycles.

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 chassis. 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 connecting the power supply to the load.

METERS: Ammeter: 0-15 amperes, 4" rectangular
Voltmeter: 0-15 volts, 4" rectangular

CONTROLS: Power on-off switch, DC on-off switch, remote error signal on-off switch, coarse and fine voltage controls.

PHYSICAL SPECIFICATIONS: Rack panel construction. Panel height 12¼", width 19", depth 17". Color Kepco standard gray hammertone. This unit is designed for relay rack mounting or bench use. Carry handles are provided.

OPERATIONAL CHARACTERISTICS: This regulated unit consists of a ferro-resonant line regulator followed by a magnetic amplifier regulator. The ferro-resonant line regulator furnishes well regulated transient free AC power. The high gain magnetic amplifier is used to regulate the DC output voltage to compensate for voltage changes in the power unit for varying load currents. The response time for pulse loads is less than 0.2 seconds.

WRITE FOR SPECIFICATIONS ON 30 AND 50 AMP. MAGNETIC SUPPLIES.

RESEARCH • MANUFACTURING

KEPCO LABORATORIES, INC.

131-38 SANFORD AVENUE • FLUSHING 55, N. Y. • INDEPENDENCE 1-7000

VISIT BOOTHS #808-809 . . . . WESCON SHOW . . . . AUG. 20-23

Want more information? Use post card on last page.

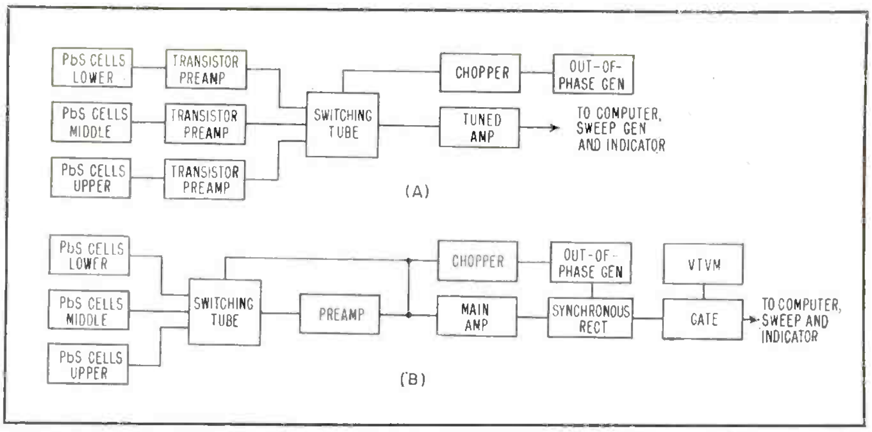


FIG. 2—Two infrared aircraft proximity warning systems in block form

put gate. This results in the rejection of all noise pulses which a continuous system would be compelled to accept.

The gate is synchronized in frequency with the chopper, and the computer and output stages are the same as before. Elevation and bearing components are separately modulated and demodulated (pm and fm, respectively) to facilitate presentation. Range is obtained by triangulation, assuming a minimum distance of fifty feet between each pair of scanners. The noise figures are 2.1 microvolts (including cell) before switching, and 10 microvolts immediately afterwards. This latter figure determines sensitivity of the system, apart from optics.

Errors

Some error factors are introduced by the flexibility of the wings of the aircraft, in addition to pitching, yawing, etc. On a small company airplane, in actual tests, this averages almost four percent, but it is quite conceivable that if the scanners were installed near the wing-tips of a DC-7, for example, this error could increase to 10 percent or greater. While a 10-percent tolerance places the system outside the limits of a high-accuracy collision avoidance system, it still is highly desirable as a proximity warning indicator, particularly as no cooperative units are required on other aircraft. While a large number of PbS sections (72) is desirable for higher accuracy, a compromise is necessary owing to the time constant of the lead-sulphide cell. This should not be shorter than 250 microseconds for a high signal-to-noise ratio.

An electromechanical system is also under development in which the scanner utilizes a mechanical chopper consisting of a slotted shield which rotates around the multi-cell envelope. The rest of the system is basically similar to the electronic unit.

Electrostatic Generator Has High Stability

By Dominique Gignoux
U. S. Representative of SAMES
New York, N. Y.

Combination of electrostatics and electronics has brought about high voltage power supplies having a relatively high power and an extremely stable voltage. Developed initially for projected television systems, this generator has found applications in electron microscopes, image converters and d-c overpotential testing.

Figure 1 shows the basic construction of the electrostatic generator. The charge conveyor is a rotor of insulating material. Along the rotor, commutation takes place at poles, each consisting of one inductor or conductive body with rounded edges and one ionizer or blade pointing towards the conveyor. The deposition of charges on the conveyor and their collection therefrom take place in the ionized atmosphere along the edges of the ionizers.

Ionization is maintained by the potential differences E_1 and E_2 as shown in Fig. 1. The electric field between the ionizer and the inductor becomes very intense along the edge of the ionizer and dissociates the gas.

It can be shown that the current flow through the generator is determined by the algebraic sum $E_1 + E_2$. The output potential is a function of this current and of the resistance of the load circuit.

Operation of the generator requires mechanical energy to drive the rotor, and sources of potential to maintain the potential differences E_1 and E_2. Such a system is similar to an electron tube in which bias potentials and no electric energy are used to control the flow of current through the tube.

Regulation

The generator uses a regulation and stabilization system as shown in Fig. 2. In this system potential E_1 is relatively high and potential $E_2 = 0$. The ionization is maintained along the edge of the output ionizer by the difference of potential between the charges on the conveyor and the output ionizer.

The basic circuits consist essentially of a feedback loop. A voltage divider provides a low voltage proportional to the high voltage; this low-voltage signal is then com-

Electrostatic generator supplying 150 kv at 2.5 ma has electronic regulation

Want more information? Use post card on last page.

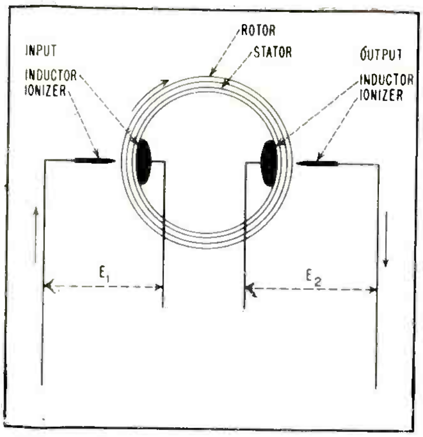


FIG. 1—Basic operation of electrostatic high-voltage generator

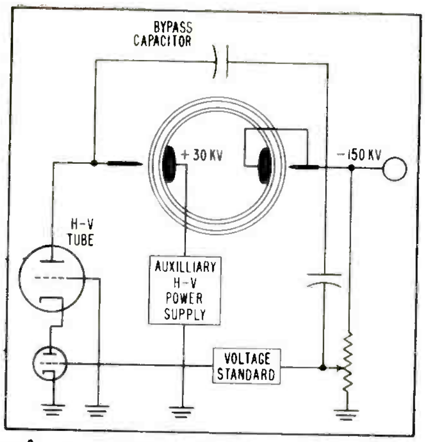


FIG. 2—Regulation system for stabilized electrostatic generator

pared to a voltage standard, amplified and used to control a high voltage triode. The variations of the conductivity through the triode result in variations of the positive potential of the input ionizer. The voltage E_1 is in this case the difference between the fixed potential of the auxiliary high voltage power supply and the variable potential of the input ionizer. The response time of the generator itself is of the order of 1/100 sec since the charges have to be transported on the rotor from the input to the output pole. The bypass capacitor will maintain the voltage at a constant value during this time.

This capacitor is also controlled by the high voltage triode. Due to the amplification, a drop in the negative high voltage of 100 volts may result in a drop in the positive voltage of the anode of the triode of approximately 5,000 volts. Therefore a substantial energy can be provided by the capacitor with a negligible change in the output voltage. The voltage divider is shunted by a capacitor to increase the amplification of fast fluctuations.

The complete generator is shown in a photograph. Output voltage is variable between 5 and 160 kilovolts, maximum current 2.5 ma, with regulation of 500 volts per milliampere. Variations of ±10 percent in line voltage result in variations of the high voltage of less than ±20 volts. The internal capacitance is 0.005 μf.

The generator is driven by an electric motor and the dielectric used is compressed hydrogen. Although not the best dielectric fluid, this gas is completely noncorrosive.

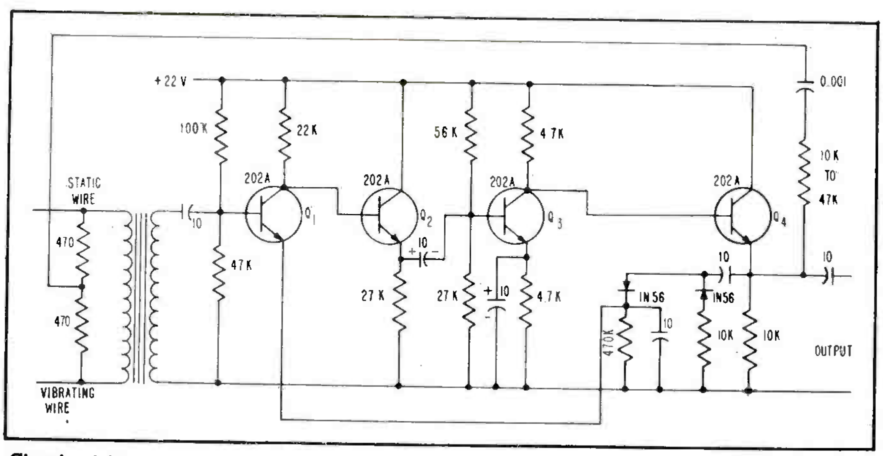
Artificial Ionosphere

APPARENT success in March 1956, when radar signals indicated the temporary creation of an ionospheric layer by rocket-release of 18 pounds of nitric oxide gas, will spur further ionosphere experiments.

It is expected that the Air Force will fire several ionization-producing rockets each year beginning July 1957. Projected into the E-layer region at about 70 miles, the ionizing material can be expected to spread out and thin so as to support communications at several different frequencies over a period of time.

Frequencies between 14 and 148 mc will probably be propagated within a 1,400-mile circle centered at Alamogordo, New Mexico. Such a circle would span the distance from Los Angeles to Houston and from the tip of Lower California to the northeast corner of South Dakota.

Details of the operation can be obtained from Oswald G. Villard, Jr., Radio Propagation Laboratory, Stanford University, Stanford, Calif.



Circuit of improved version of amplifier used in bathythermometer

Bathythermometer Amplifier

BY J. H. CAWLEY
Research Engineer
General Atomic
Division of General Dynamics Corporation
San Diego, California

IN THE article "Bathythermometer Telemeters Ocean Data" (ELECTRONICS, May 1, 1957, p 142) a vibrating wire transducer and transistor amplifier are described as part of the pressure measuring system.

In an effort to adapt the amplifier to more recent transistors, a new circuit using 4 close-tolerance 202-A transistors was developed. This circuit, shown here, differs from the previous circuits principally in the addition of transistor Q_2. It has been added to more nearly match the output impedance of Q_1 to the input impedance of Q_3. Transistor Q_2 is a simple direct-coupled common-collector amplifier which improves the voltage

Want more information? Use post card on last page.

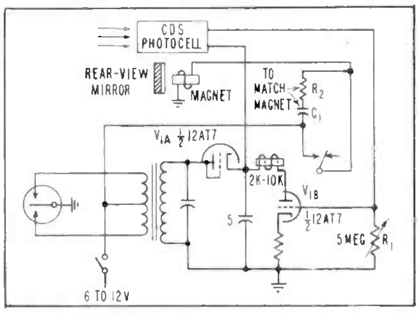
gain of the first stage by almost 6 db.

This not only improves the waveform at the output but has the added advantage of making the entire amplifier less dependent on h_{fb} of the individual units as well as more independent of temperature variations.

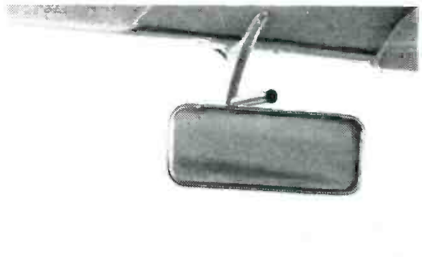
Of 12 transistors selected at random from stock, 11 performed interchangeably with no observed variation. Changing the amplifier input voltage from −4 to +10 db (0 db = 1.4 mv) caused an output amplitude variation of 0.5 db or less.

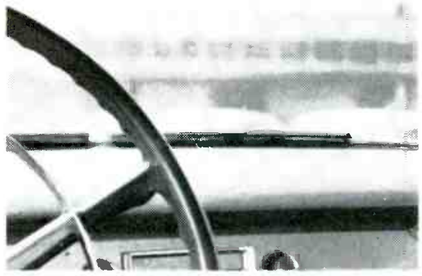
Distortion in the output is negligible over this range. This constant amplitude output is important in the operation of the vibrating wire transducer as the frequency is dependent on a constant amplitude drive.

Self-Deflecting Automobile Rear-View Mirror



Single 12AT7 serves as rectifier and relay control tube in mirror system





Small tube over rear-view mirror houses cadmium-sulfide photocell that controls mirror position with glare

A PHOTOCELL mounted over an automobile rear-view mirror as shown in the photograph controls a magnet to deflect the mirror when headlight glare from following cars is too bright.

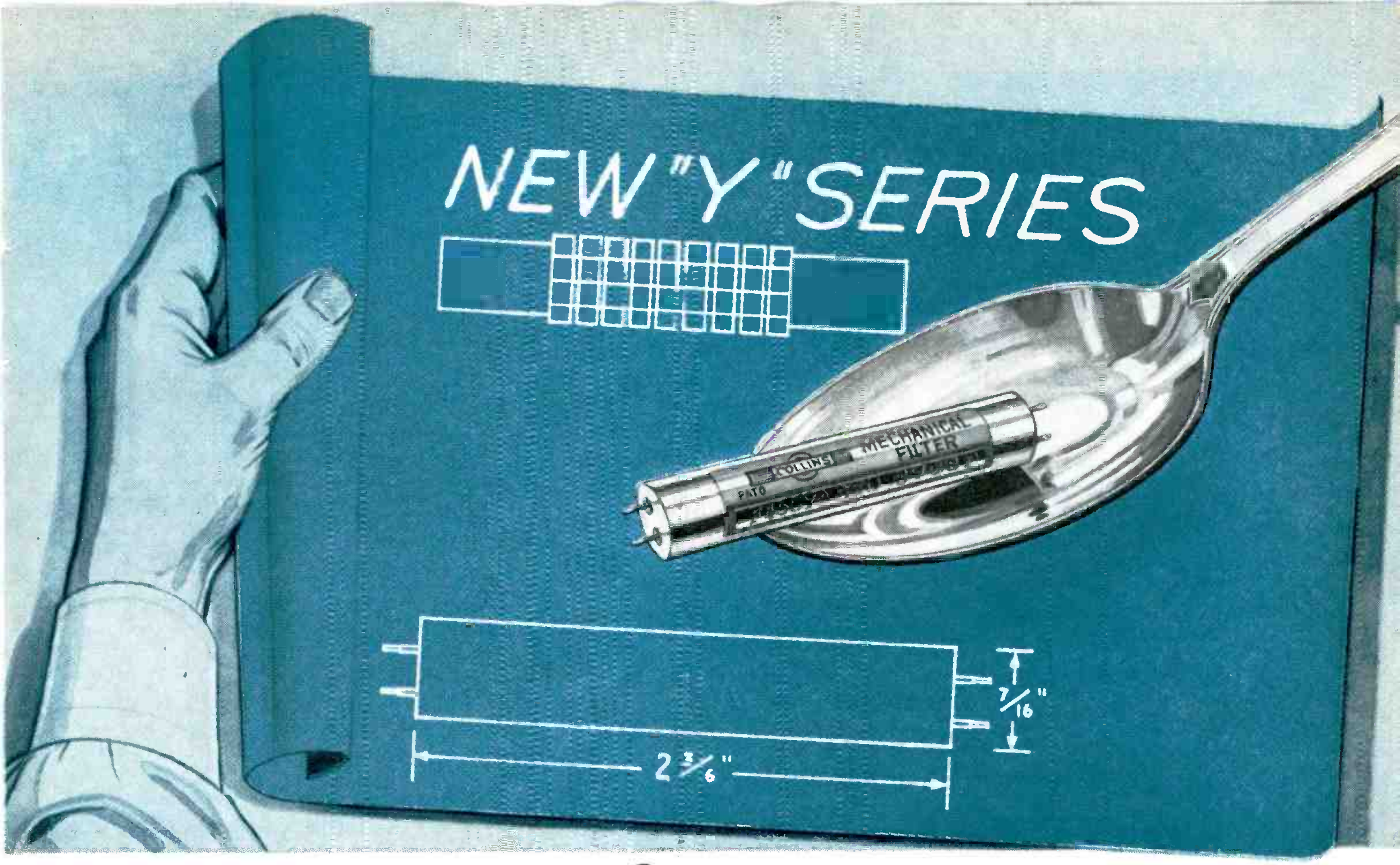
As shown in the schematic diagram, the photocell and level-setting potentiometer R_1 act as a voltage divider with the grid of V_{1B} connected to the center tap. In the absence of light, the resistance of the photocell is on the order of 1,000 megohms. When light strikes the cell the resistance drops to about 50,000 ohms and allows the grid to go positive. This increases the plate current closing the relay and actuating the magnet to move the metal-backed mirror deflecting the glare from the driver's eyes.

Arc-suppression network R_2-C_1 is selected to have a time constant equal to that of the magnet winding. Power is obtained from a vibrator-transformer combination using one-half of the 12AT7 as a rectifier. The information given here was supplied by the Instrument Research Co. Brighton, Mass.

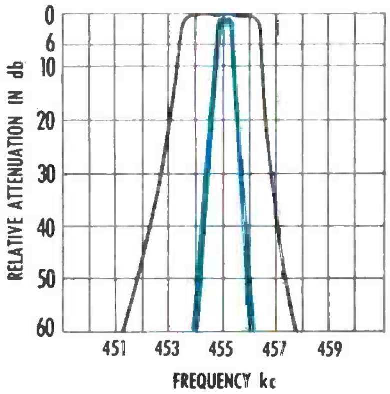
Transistor Phase Detector

THE transistor demodulator described here provides considerable amplification in addition to operation as phase-sensitive rectifier. The half-wave circuit is shown in the diagram. Carrier reference voltage turns the emitter currents on and off in alternate half periods of the carrier waveform. If the input signal from Q_1 is zero, the emitter-to-base voltages applied to Q_1 and Q_2 would be equal and there would be no output.

If a signal is fed from T_1 in such



Collins MECHANICAL FILTER MINIATURIZED



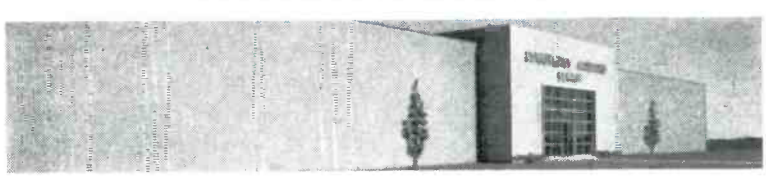
Sample orders:
Quantities of 1 to 4,
through F455Y-60—$30.00 ea.

Receiver design engineers—are you having a feeding problem with your *"new baby"?* You no longer have to *spoon-feed* your I. F. problems. Use the just-announced Collins "Y" series filter. Its response characteristics are identical to the previous styles of Collins mechanical filters (the older models are still available from stock, of course, in series "A"—"Z"—"F"—"H"—"J" and "K").

Note the "Y" series advantages . . .

1. Smaller size!
2. Standard performance!
3. Lowest priced mechanical filters yet!
4. Ideal for transistorized printed circuit applications!
5. From stock! Center frequencies of 455kc and 6db bandwidths of 2.1kc (F455Y-21), 3.1kc (F455Y-31), 4.0kc (F455Y-40), 6.0kc (F455Y-60), 8.0kc (F455Y-80), 12.0kc (F455Y-120), 16.0kc (F455Y-160), and 35.0kc (F455Y-350). Other bandwidths available soon.
6. Tooled for quantity production!

Technical data sheets are available.



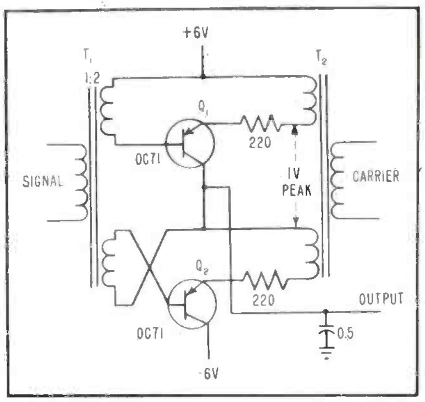
C-A-C ®

World's Largest Exclusive Producer of Toroidal Windings C-121

COMMUNICATION ACCESSORIES COMPANY
Lee's Summit, Missouri • Phone Kansas City BRoadway 1-1700
A Subsidiary of Collins Radio Company

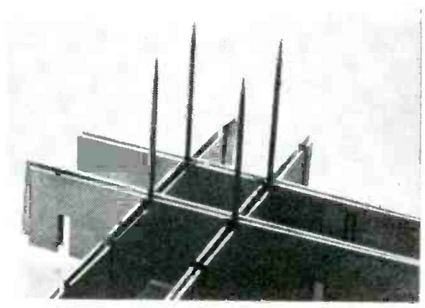
a sense that a negative voltage appears at the base of Q_1 and a positive voltage on the base of Q_2, the emitter-to-base voltage of Q_1 will be greater than that of Q_2 and a positive output will be produced.

A full-wave demodulator would employ two circuits of the type shown with additional secondary windings on the transformers. This information has been abstracted from the article "A Transistor Demodulator" by H. Sutcliffe appearing in *Electronic Engineering*, Mar. 1957, p 140.



Half-wave demodulator for 2-kc carrier using two transistors. Full-wave version would use two-circuits of this type and additional transformer windings

Applications of Corona Effects



By D. M. Tombs
Hoover Limited
Perivale, Middlesex
England

E. J. Chatterton and K. Galpin
Imperial College
London, England

When the voltage between a sharp and blunt conductor in air is raised sufficiently, there will be, prior to arcover, an electrical discharge from the sharp point, measurable as a small electric current and visible as a faint blue glow between the electrodes. It is caused by ionization of the air.

For a particular application, it was desired to turn off corona discharge without switching the main voltage. Since strong corona phenomena depend upon a nonuniform field distribution, the corona can be affected by altering electrode geometry. For example, it can be stoppped by enlarging the point.

A more practical way is to surround the needle with a ring and apply a small voltage between needle and ring, diverting sufficient of the lines of force from needle tip to the ring to inhibit corona. Such a device constitutes a corona triode and has the properties of a thermionic tube, but does not require a heater.

▶ **Equipment** — Apparatus shown in Fig. 1 comprises a needle fixed in a collet chuck to allow interchange. The hemispherical knob electrode of 10-cm diameter is so mounted that the distance from the needle can be altered and the changes measured directly on a built-in micrometer. Covering the needle and insulated from it is a conducting electrode with smooth exposed blunt surface. This part is made with several different throat diameters and forms the grid. Location of the grid relative to the fixed needle tip can be accurately determined.

Figure 2 shows a conventional triode circuit and the corresponding corona triode circuit. Measured gains of 3 have been observed but there has been no attempt to develop a cascade amplifier using corona triodes. The fact that positive and negative corona can be employed gives the designer greater freedom than with conventional amplifiers.

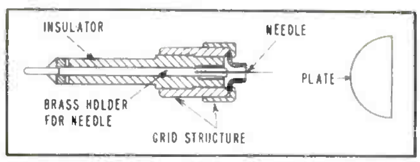
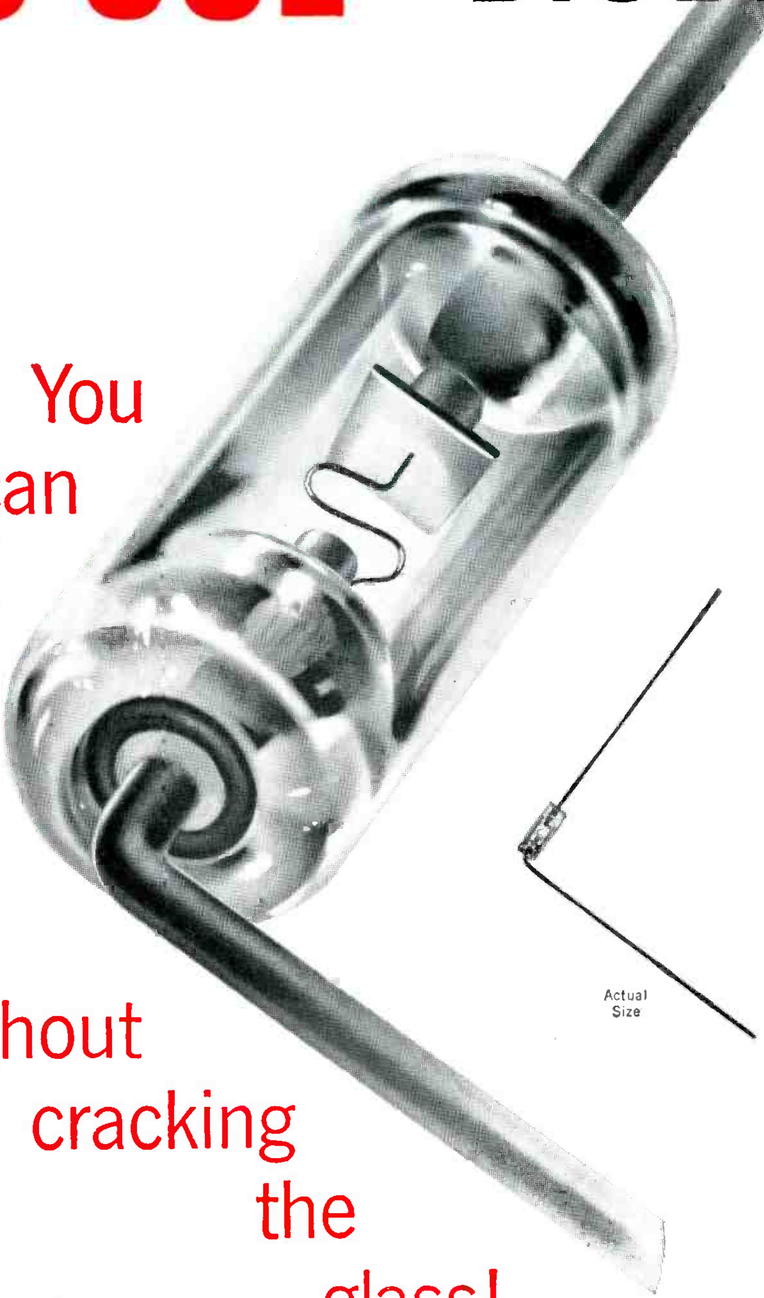


FIG. 1—Corona wind triode assembly

▶ **Corona Wind**—When a source of

TUNG-SOL GOLD BONDED GERMANIUM COMPUTER DIODES



You can bend the leads like this, without cracking the glass!

Actual Size

Here's the answer to the problem of how to make computer diodes so the lead wires can be sharply bent close to the glass body without cracking the end seal. It's the "ring seal" design, an exclusive Tung-Sol construction feature embodying a metal collar fused into the end-seal. The collar absorbs the strain of lead wire bends, thereby preventing damage to the diode enclosure.

During its more than fifty years of lamp, electron tube and semiconductor manufacturing experience, Tung-Sol has had to overcome countless problems in glass to metal bonding. Almost every new product development and design improvement thru the years has presented new technological challenges. The resulting stockpile of experience in sealing glass to metal is one of the reasons for the high quality standards enjoyed by Tung-Sol tubes and semiconductor products.

Tung-Sol Diodes with "ring seal" construction will be supplied in the standard RETMA or JAN types. The Tung-Sol junction-forming technique features an electronically-controlled bonding cycle. The result is a consistently accurate bond which assures maximum uniformity of electrical characteristics.

IT'S THE EXCLUSIVE TUNG-SOL "RING SEAL" CONSTRUCTION!

TYPICAL DIODE CHARACTERISTICS:

Peak Inverse Voltage 75 volts
Forward Current At 1.0 volt 75MA
Reverse Currents At −50.0 volts 50 Microamperes
Recovery Time Less Than 1.0 Microsecond

ADDRESS INQUIRIES TO:

SEMICONDUCTOR DIVISION, Tung-Sol Electric Inc., 95 Eighth Avenue, Newark 4, New Jersey.

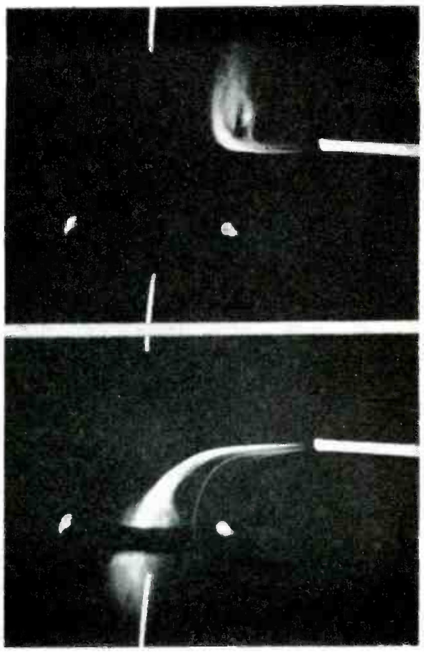
SALES OFFICES:

Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N.J.; Melrose Park, Ill.; Newark, N.J.; Seattle, Wash.

SPECIAL INFORMATION SERVICE:

Your name will be added to our Special Mailing List to automatically receive new data as it becomes available.

Want more information? Use post card on last page.



Effect of varying grid potential. With low voltage (top) high voltage (bottom)

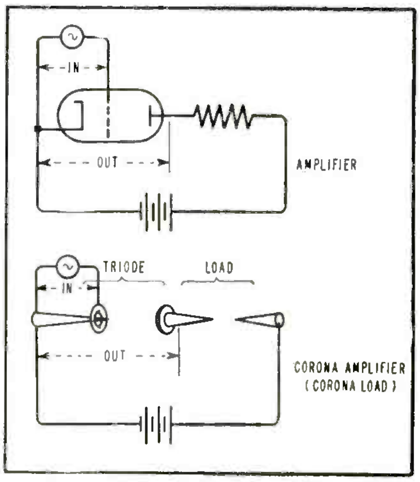


FIG. 2—Comparison of conventional triode and corona triode amplifier circuits

smoke is interposed between electrodes, the direction of flow is determined by grid potential. The photographs show that corona wind blows the smoke upwards (towards the negative electrode) when the grid potential is low. The device has been set up vertically in this experiment. At a high grid value, the wind drives the smoke downwards. An alternating potential applied to the grid causes an alternating air movement. Even with a single pair audible output can be observed for high frequencies.

▶ **Loudspeaker**—To provide a sufficient radiating area, a stack of corona triodes is arranged on a half-inch matrix. Method of assembling the needles is shown in the photograph. The grid comprises 16 gage wire soldered in a mesh of half-inch squares. The two needle stacks are separated by about 2 cm and aligned so the line joining opposite needle tips passes through the middle of the grid rectangle.

Surrounding the grid and needle assembly is a baffle to ensure better matching of the speaker to the acoustic load at low frequencies. Experimental versions of the loudspeaker show limitations in linearity. A push-pull version gives decided improvement.

Measured acoustic power under conditions of minimum distortion is about 0.1 milliwatt per sq cm. Electrical power is about 50 mw per sq cm at 12 kv d-c.

Broadcast Modulation Monitor

By MARTIN M. MITCHUM
Radio Engineering Consultant
Rolla, Missouri

WITH the advent of remote control of many broadcast transmitters, modulation monitors were moved to studio locations leaving no modulation monitor at the transmitter location.

This situation poses a problem for the transmitter engineer when he wants to make tests on the audio performance of the transmitting equipment. Either he must remove the modulation monitor from the studio location and transport it to the transmitter for after sign-off testing and then return it, or he must rely on a second person at the studios to transmit information to him via telephone.

The second method is objectionable because the true characteristics of the transmitter are de-

-*hp*- 150A

HIGH FREQUENCY OSCILLOSCOPE

New reliability • New convenience
DC to 10 MC. Plug-in preamplifiers
24 direct reading sweep times
Sweeps 0.02 μsec/cm to 15 sec/cm
"Universal" automatic triggering
New, ultra-conservative design

SPECIFICATIONS

Sweep Range: 0.02 μsec/cm to 15 sec/cm.

Calibration: 24 sweeps: 1-2-5-10 sequence, 0.1 μsec/cm to 5 sec/cm. 3% accuracy.

Triggering: Internal, line voltage or external 0.5 v or more. Pos. or neg. slope, +30 to −30 v trigger range.

Preset Trigger: Optimum setting for automatic stable triggering.

Horizontal Amplifier: Sweep magnification 5, 10, 50, 100 times. Vernier position control selects any 10 cm part of sweep. External input pass band dc to over 500 KC. Sensitivity 200 mv/cm to 15 v/cm.

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

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

Prices: -*hp*- 150A High Frequency Oscilloscope, $1,100.00
-*hp*- 151A High Gain Amplifier, $200.00
-*hp*- 152A Dual Channel Amplifier, $250.00

New Model 150A is not a "warmed-over" imitation of previous oscilloscopes. Instead it is a totally new kind of instrument whose radical design approach obsoletes old standards of oscilloscope versatility, simplicity and dependability.

Specifications given here spell out the 150A's unique usefulness. Its simplicity and reliability stem from such unique features as: *Unitized circuits,* easily isolated for testing or service, etched and mounted on translucent plastic. *Highest quality components,* operated well below ratings. *Concentric, color-coded,* functionally-grouped controls. *Direct sweep-time selection;* no mental gymnastics. *Universal automatic triggering* system wherein one preset adjustment provides optimum triggering for almost all conditions.

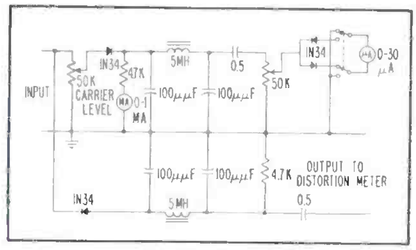
Wouldn't you prefer a *really new, convenient* oscilloscope? Call your -*hp*- representative today for the complete story. Or, write direct.

HEWLETT-PACKARD COMPANY
4053A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
CABLE "HEWPACK" • DAVENPORT 5-4451
Field engineers in all principal areas

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

also offers -*hp*- 130A Low Frequency Oscilloscope, dc to 300 KC, sweeps 1 μsec/cm to 12.5 sec/cm.

Want more information? Use post card on last page.



Circuit diagram of the modulation monitor for tone testing transmitter

graded by the performance of the r-f amplifier at the studio. It would be useless to try to make distortion measurements from the output of the studio-located modulation monitor because the band pass of the r-f amplifier would not include the higher audio harmonics.

Since all audio measurements made on the transmitter employ steady tone modulation, ballistic characteristics of the modulation meter are not important and a simple and effective modulation monitor can be made to serve for such testing.

The monitor shown in the circuit diagram operates entirely from r-f power developed in a small pick-up loop placed near the output circuit of the transmitter. Output is provided for a distortion meter. A peak switch selects either the positive or the negative audio peaks for observation on the meter. The carrier-set control allows the setting of the carrier level meter to the point at which the instrument is calibrated. The carrier level meter is also calibrated for the reading of carrier shift.

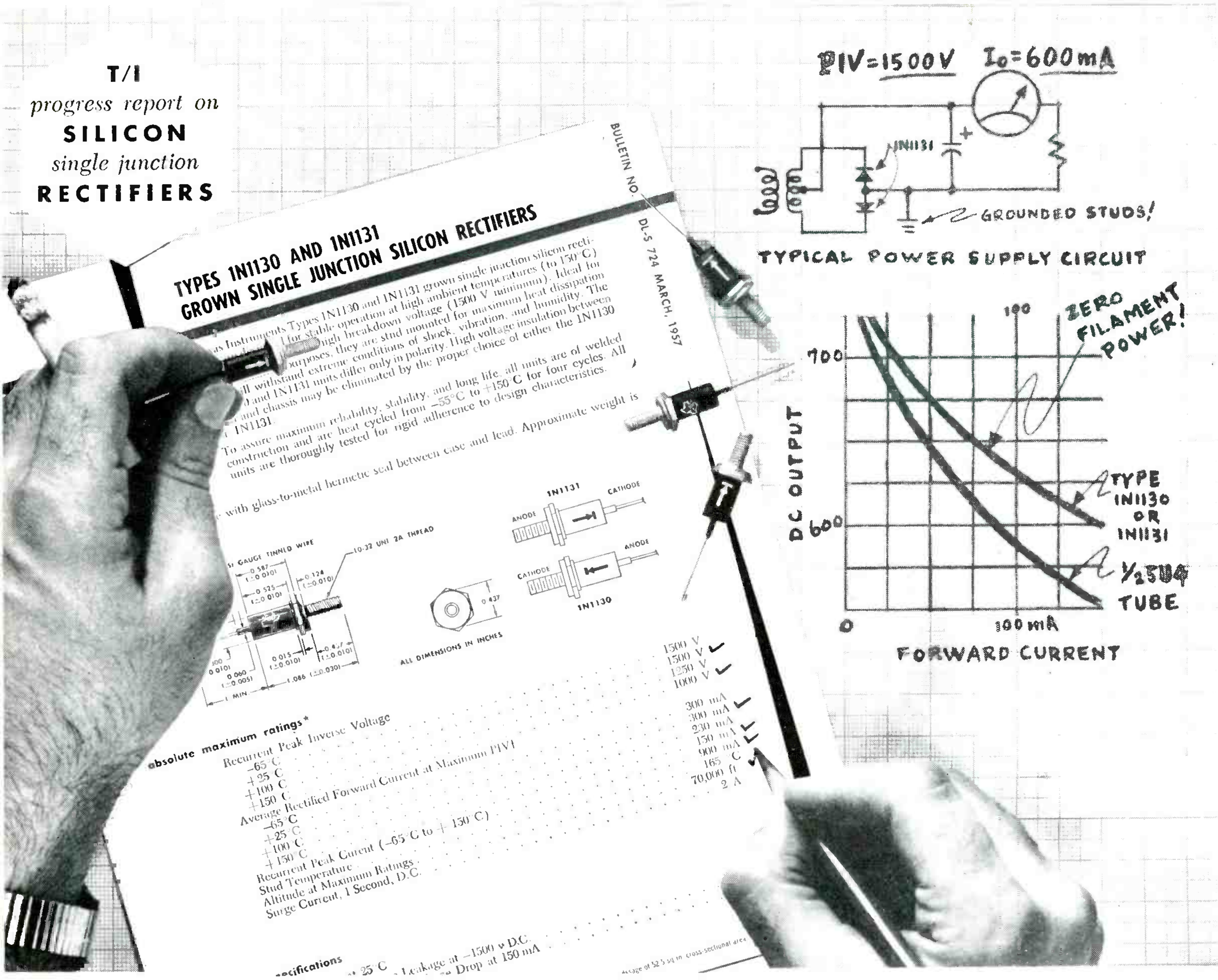
This monitor has been in use by the author for nearly two years. It is frequently checked by comparing it with a modulation monitor located at a transmitter site. It holds its calibration well and is as satisfactory for tone testing as the regular monitor.

Wide-Swing Choke

By THOMAS A. WEIL
Section Manager
Raytheon Manufacturing Co.
Wayland, Mass.

IF a choke-input supply is to work over a wide range of load current, the choke must have a high inductance to maintain choke-input action at light load and yet must also

T/I
progress report on
SILICON
single junction
RECTIFIERS



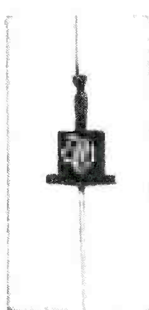
new design freedom for your miniature high voltage power supplies with . . .

NEW TI 1500 V, 300 mA RECTIFIERS

You can replace 5R4 and 5U4 rectifiers with TI's new single junction rectifiers in many applications. In a fraction of the space, you will get instant operation at high temperatures with *zero filament power*. Here are some significant ratings of these new Texas Instruments Types 1N1130 and 1N1131 (differing only in polarity):

VALUE	AMBIENT TEMPERATURE 25°C	150°C
PIV	1500 V	1000 V
I_f (at max. PIV with heat sink)	300 mA	150 mA

Designed to meet stringent military requirements, these TI rectifiers give you the ultimate in hermetic seal protection. The standard RETMA stud is of *copper* for optimum performance and the hex base assures high-torque chassis mounting. High voltage insulation between stud and chassis can be *eliminated* by proper choice of either 1N1130 or 1N1131.



400 V, 750 mA TI TYPE 1N540
ECONOMICAL *diffused* RECTIFIER
***lower* FORWARD VOLTAGE DROP**

Reliability of your power supplies is assured by this rectifier . . . giving you cooler operation. Typically, at 150° C, they give you 0.64 V voltage drop at 250 mA and 0.20 mA reverse current at 250 V.

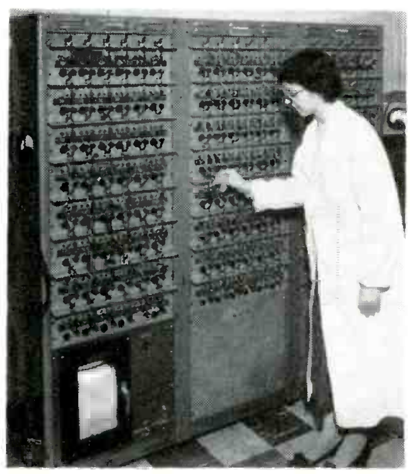
TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

be designed to carry full-load current. This requirement can be accomplished by using a swinging choke.

The most common type is a 15-henry choke that, although wound with wire rated to carry 200 ma saturates soon above 20 ma d-c. Physically, this choke is almost identical with a 1.5-henry, 200-ma choke except that a smaller gap is used. At 20 ma d-c, there is little saturation; at greater loads the choke is saturated over much of the cycle and the peak currents drawn from the rectifier tend to become as high as they would in a capacitor-input circuit. Although the desirable feature of good regulation is obtained by the use of a swinging choke, the rectifier peak and rms currents increase. Furthermore, at full load the swinging choke is saturated and does not provide much reduction in ripple as compared with a capacitor input circuit.

Much better results are obtained by using both a swinging choke and a linear choke. Since a 15-henry swinging choke is identical with the 1.5-henry, 200 ma choke except for gap, the two chokes can be combined into a single core and coil of twice the size. In the combined choke, half of the core would have a small gap and half would have a larger gap. This technique can be looked upon as a convenient method

Transistor Life Test



Sample transistors are operated in these racks from 500 to 2,000 hours at Delco Radio division of General Motors

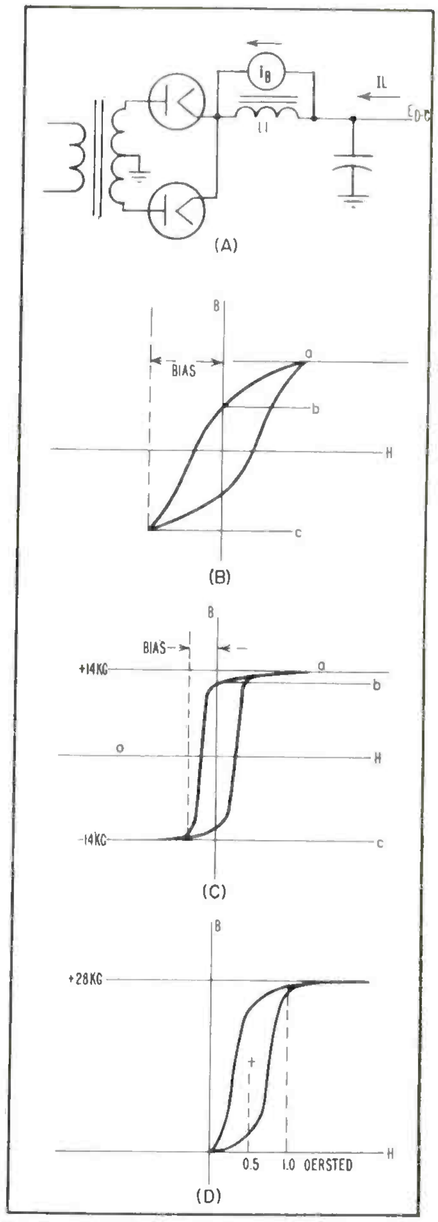


FIG. 1—Demagnetizing the core (A) flux pattern (B) and (C) and Deltamax pattern (D)

of designing a wide-range swinging choke, rated in this case 15/1.5 henries, 20/200 ma d-c.

The requirement could just as well have been for 150 henries at 2 ma and the resulting swinging choke would theoretically be the same size as the 15-henry, 20-ma swinging choke described except that now only a 2-ma bleeder would be required on the power supply instead of a 20-ma bleeder.

Actually, it is difficult to achieve even the 15 henries at 20 ma, owing to limitations in the effective mu that can be obtained from the core. The fact that the swinging

"An infinite capacity for taking pains"

The above familiar phrase is usually given as a definition of genius. We borrow it as a job description.

The lengths to which our Quality Control people go, to insure the reliability of our complex products, are truly painstaking, and are applied equally to components we make ourselves and those we purchase from outside suppliers.

For example, consider vacuum tubes, the heart of hundreds of projects in our Electronics Division. No spot check satisfies here (even if that's all our customer specifies)—but a whole series of critical tests, including such precise evaluations as these:

Inspection of tube characteristics to rigid Stromberg-Carlson specifications—performed on special equipment which can do in a half-hour what would take days on conventional testing devices.

Inspection by X-ray, looking for deeply hidden potential faults which could cause malfunction at any time after first use.

Inspection by microscope, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

You can't put a price on "taking infinite pains." You *can* place your confidence in a company where this is everyday procedure.

STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

choke must also carry a current many times larger than the current at which it is to have high inductance means that high inductance must be obtained with abnormally low values of ampere-turns in the winding. This requires a high mu and as the gap in the core is re-

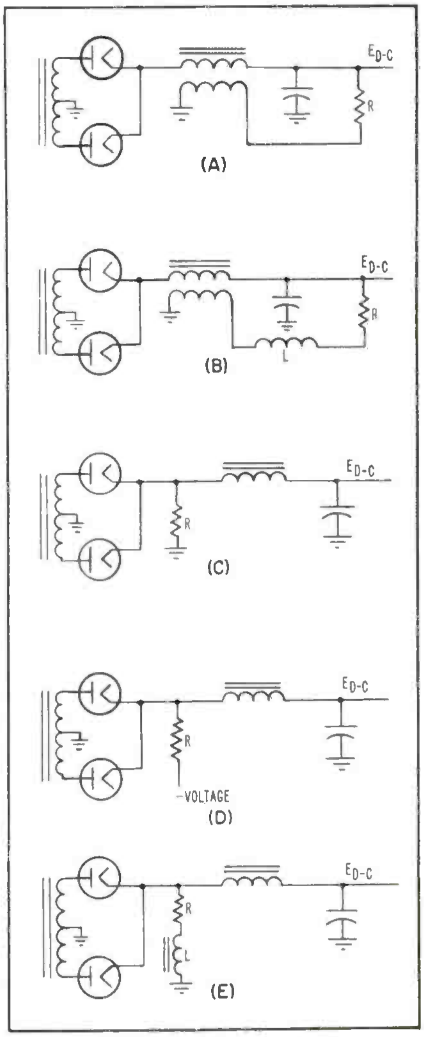


FIG. 2—Biased choke arrangements are described in the text

duced, the limiting mu obtainable is that of the iron core alone.

However, as the air gap is closed, the retentivity of the core material is no longer minimized by the demagnetizing effect of the air gap. With unidirectional excitation the usable mu and flux swing of the core material may be far less than can be obtained with a-c excitation.

This problem is severe, since high-mu materials also tend to have high retentivity. In practice, it is hard to make a swinging choke

HUBBELL

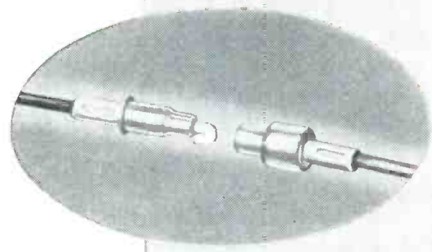
Interlock PLUGS

TRADE MARK

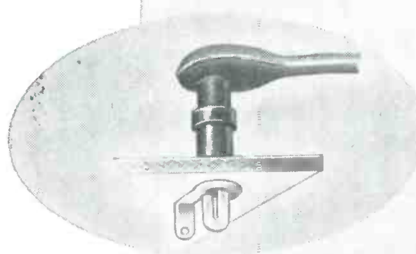
Stay Locked IN ACTION!

Won't Disconnect Accidentally . . .
Yet Disconnect Quickly When Intended

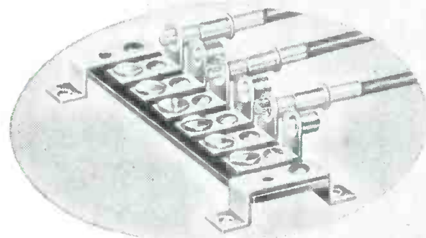
Today's engineers ask more of the connectors they use than simply that they make contact. Computers and modern, automatic machinery require *constant, positive* connections . . . aircraft wiring must be vibration proof and unaffected by temperature changes . . . printed circuits need sub-miniature connectors that will remain fixed. Hubbell *Interlock* Connectors are designed with all these features — and more! Whether they're used for connecting wire to wire, wires to panels, or wires to terminal strips, the combination of *Interlock* plugs and eyelets or plugs and jacks provides *automatic locking, quick disconnect* wiring that assures constant low contact resistance. Contact is maintained by a coil spring that adjusts for temperature and pressure changes and is part of the disconnect mechanism that permits fast rearrangement of circuitry and ease of maintenance.



Wire to Wire



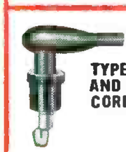
Wire to Panel



Wire to Terminal Strip

TYPE "A" PLUGS, JACKS AND EYELETS Nylon Insulated and Non-Insulated. Current Capacity: 10 amps. Wire Sizes: #14 to #18

TYPE "B" PLUGS AND JACKS Nylon Insulated and Non-Insulated. Current Capacity: 5 amps. Wire Sizes: #18 to #22



TYPE "A" ANGLE PLUGS AND DOUBLE ENDED JUMPER CORDS Current Capacity: 10 amps.

TYPE "C" SUB-MINIATURE PLUGS AND EYELETS Current Capacity: 1 amp. Wire Sizes: #20 to #22 or smaller

TYPE "S" PLUGS AND JACKS Nylon Insulated. Current Capacity: 15 amps. Wire Sizes: #14 to #18

TYPES "A" AND "B" LAMINATED TERMINAL STRIPS AND TYPE "B" FLEXIBLE TERMINAL STRIPS

IT PAYS TO HAVE GOOD CONNECTIONS — HUBBELL — REG. U.S. PAT. OFF.

HARVEY HUBBELL, Inc.

Interlock Electronic Connector Dept.,

Bridgeport 2, Conn.

SELF-LOCKING CONNECTORS

Want more information? Use post card on last page.

effective at less than 10 or 20 percent of full-load current without making it excessively large.

A convenient and effective means of demagnetizing the core is bias. The effect of biasing can be seen most clearly from Fig. 1 in which an ideal current source I_B is used to bias swinging choke L_1, which is now made without any gap at all. In the absence of bias, the available working flux range would be between a and b of Fig. 1B, whereas with bias the entire range between a and c can be utilized.

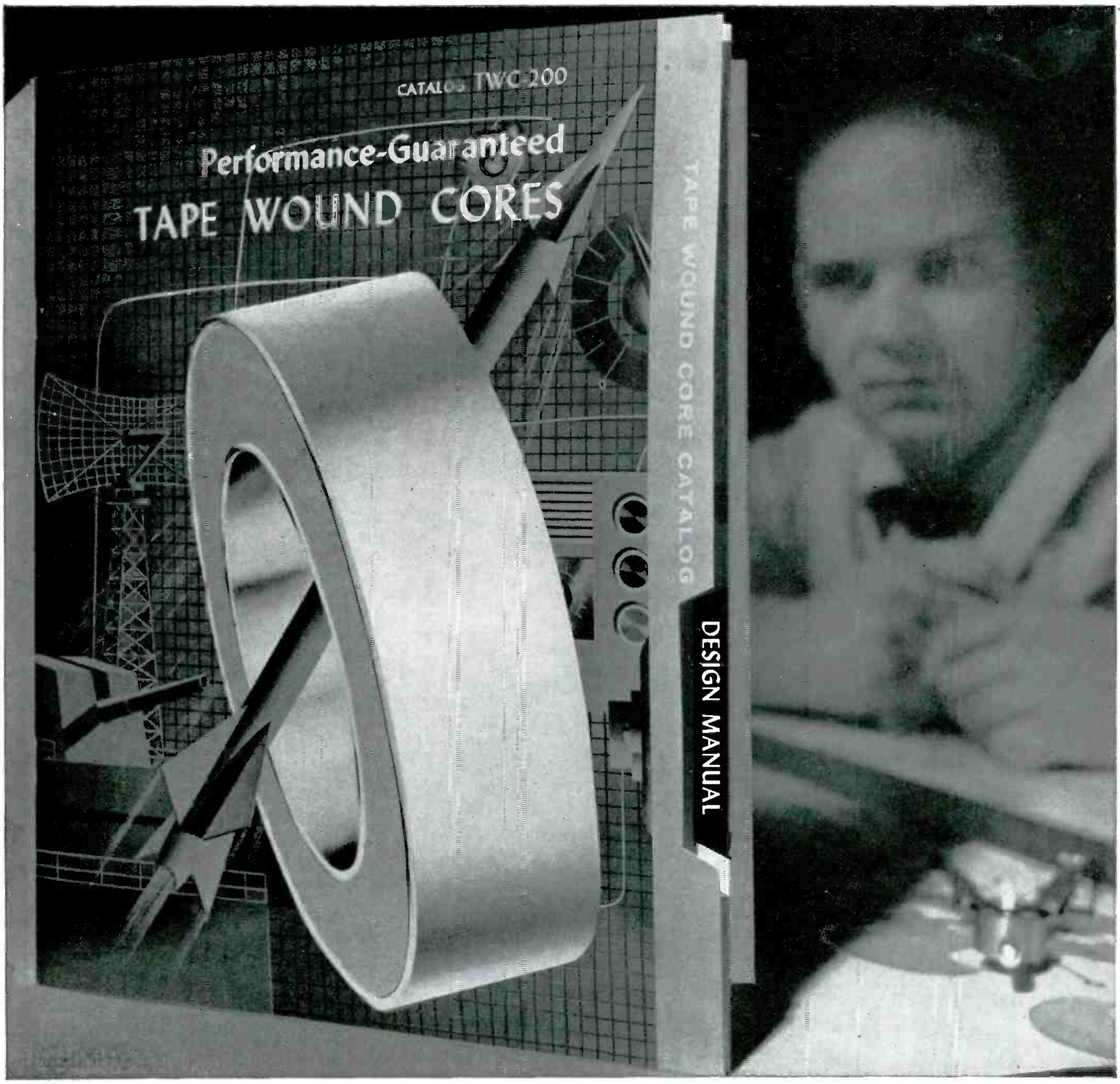
The advantage is even more pronounced when a high-mu material such as Deltamax is used, as shown in Fig. 1C. With bias as shown, a Deltamax core becomes as useful and desirable as a fictitious core material having the characteristics shown in Fig. 1D. Since this fictitious core material has no retentivity, a swinging choke made with a gapless core of this material could work down to a direct current corresponding to about 0.5 oersted in the core and this can reasonably be about 1 or 2 percent of full-load current.

Since Deltamax with bias exhibits the characteristics of Fig. 1D, a swinging choke working down to 1 or 2 percent of full load current is now practical. It should also be noted that bias provides twice as much usable flux swing as is usually available in filter choke design.

Since ideal current sources are

Plant Observed By ITV

Mounted in a protective housing, a television camera with wide-angle lens observes the area in which a propane desalting pilot unit produces a hazardous atmosphere. This safety aid using GPL equipment is installed at the Esso Research and Engineering Co., Bayside, N. J.



Here's the first design manual for your work with tape wound cores

Because engineers have expanded high permeability magnetics into a host of new uses, Magnetics, Inc. has combined its new tape wound core catalog with the industry's first design manual. If you and your staff need a working familiarity with magnetic equations, characteristics and terminology, this 28-page book will be of unusual value.

This design manual has been compiled under the direction of our laboratories. It contains basic units and conversion factors, methods of testing (dynamic, EI loop and d-c), properties and magnetic values of nickel-iron alloys, and many pages of curves showing the variation of magnetic properties with temperature and of core loss with frequency.

This fact-packed catalog and design manual also describes in detail the tape wound cores and bobbin cores which we manufacture. It will enable you to design around and specify the industry's only Performance-Guaranteed Tape Wound Cores. Should your engineering departments feel that more than one copy would be of value, please write for TWC-200 on company letterhead, giving full names and titles. *Magnetics, Inc., Dept. E-40, Butler, Pa.*

MAGNETICS inc.

Want more information? Use post card on last page.

not conveniently available, practical biasing circuits must be considered. Fortunately, it turns out that bias is easily obtainable in a variety of ways.

A separate winding can be fed from the d-c output voltage through a resistor that approximates a high-impedance current source as shown in Fig. 2A. Any independent d-c source could also be used. A separate winding may be used, fed from the d-c output voltage through a resistor and a choke which approximates a high impedance current source at a-c as shown in Fig. 2B.

A resistor can be used at the rectifier output, which during portions of the cycle when the rectifier output voltage is less than the d-c output voltage, tends to draw current back through the choke from the d-c output voltage. This is shown in Fig. 2C. Such action is slightly imperfect since the bias will not be maintained near the instant of zero-voltage output from the rectifier, but in many cases this may be adequate.

Back leakage in the rectifiers can actually serve this purpose, to an extent dependent on the amount of leakage, without any additional resistor actually appearing in the circuit. A resistor at the rectifier output can be returned to ground through a choke as in Fig. 2E. The choke performs the same function as the negative supply does in Fig. 2D.

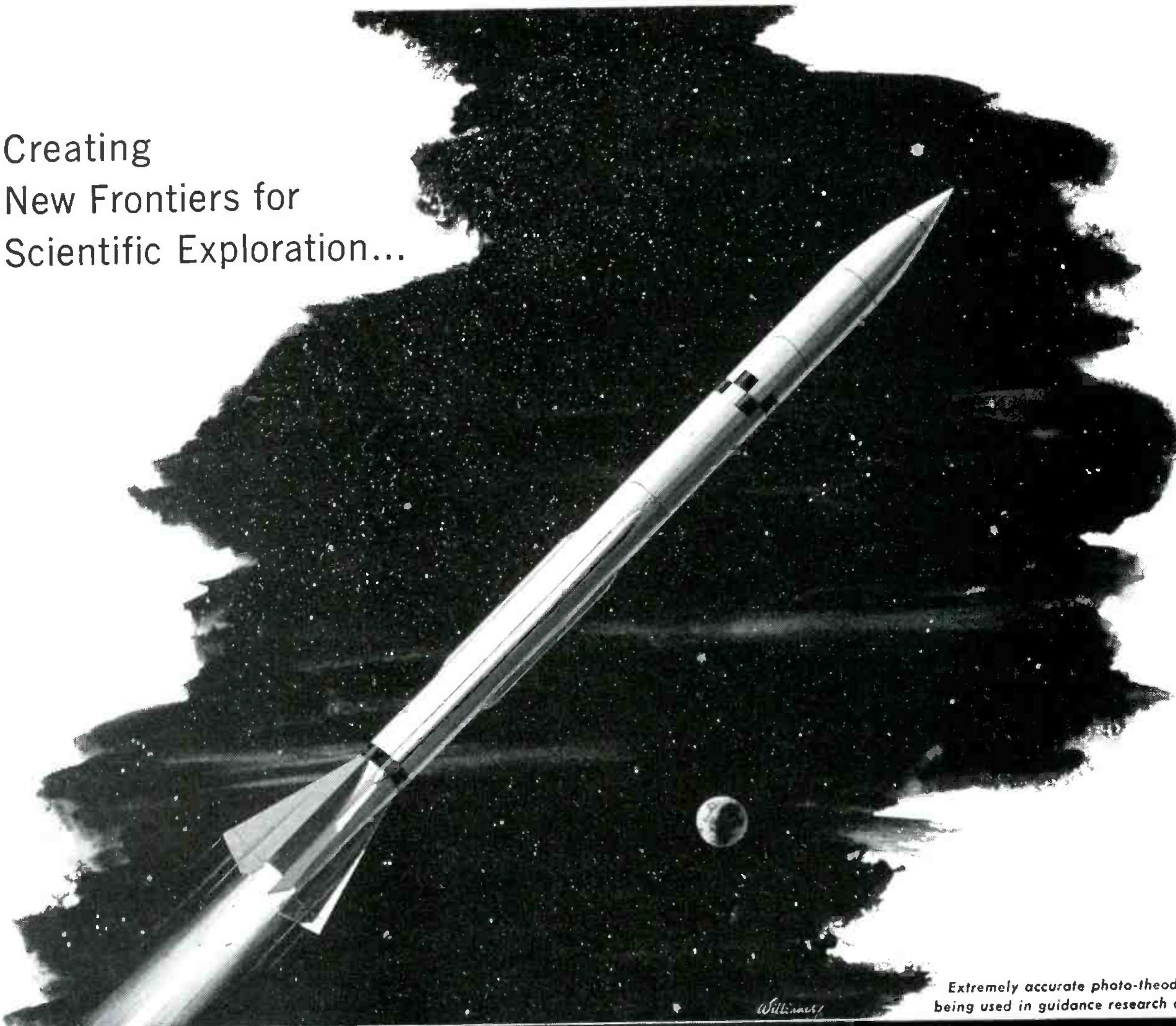
Permanent magnet bias on the core of the swinging choke might be feasible, although practical methods of doing this are not evident at this time.

The methods shown in Fig. 2A and (B) make use of the necessary bleeder current while methods shown in (C), (D), and (E) do not require any bleeder whatsoever on the d-c output, since bleeder current is effectively drawn back through the swinging choke as bias.

Torsional Wave Delay Lines

DELAY LINES having delay times per unit length as much as 25 times as great as those of conventional lines can be obtained by using the

Creating New Frontiers for Scientific Exploration...



Extremely accurate photo-theodolites being used in guidance research at JPL

JPL, pioneer in jet propulsion from its earliest stages, has drawn together engineers and scientists whose talents embrace practically all of the physical sciences.

Working in their chosen fields, supported by excellent facilities and given unusual opportunity for individual initiative, these men are now actively engaged in solving the complex scientific problems leading to the advancing new era of technological development.

The Jet Propulsion Laboratory, under U.S. Army contracts, has broad interests and maintains a constant search for new approaches to the myriad technical problems posed by the rapid advance of modern science. As a result, exceptional opportunities for those creative individuals interested in such activities are provided at the Jet Propulsion Laboratory.

Career Opportunities Now Open in These Fields

ELECTRONICS
•
PHYSICS
•
AERODYNAMICS
•
MATHEMATICS
•
MECHANICAL ENGINEERING
•
CHEMICAL ENGINEERING

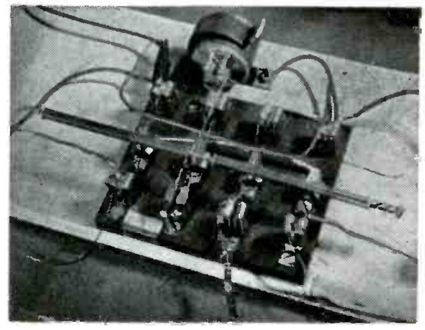
jpl

JET PROPULSION LABORATORY
California Institute of Technology
PASADENA • CALIFORNIA

Want more information? Use post card on last page.

construction shown in the photograph. Delay time is dependent on velocity of propagation of a torsional wave. This velocity can be decreased by disk loading, using a rod composed of alternate large and small diameter sections.

In this construction, developed by Bell Laboratories, the delay line consists of a series of equally spaced disks on a smaller diameter rod. Using a disk-to-rod diameter ratio of 4-to-1, delay time is 43



Experimental torsional wave delay line using disk and rod construction

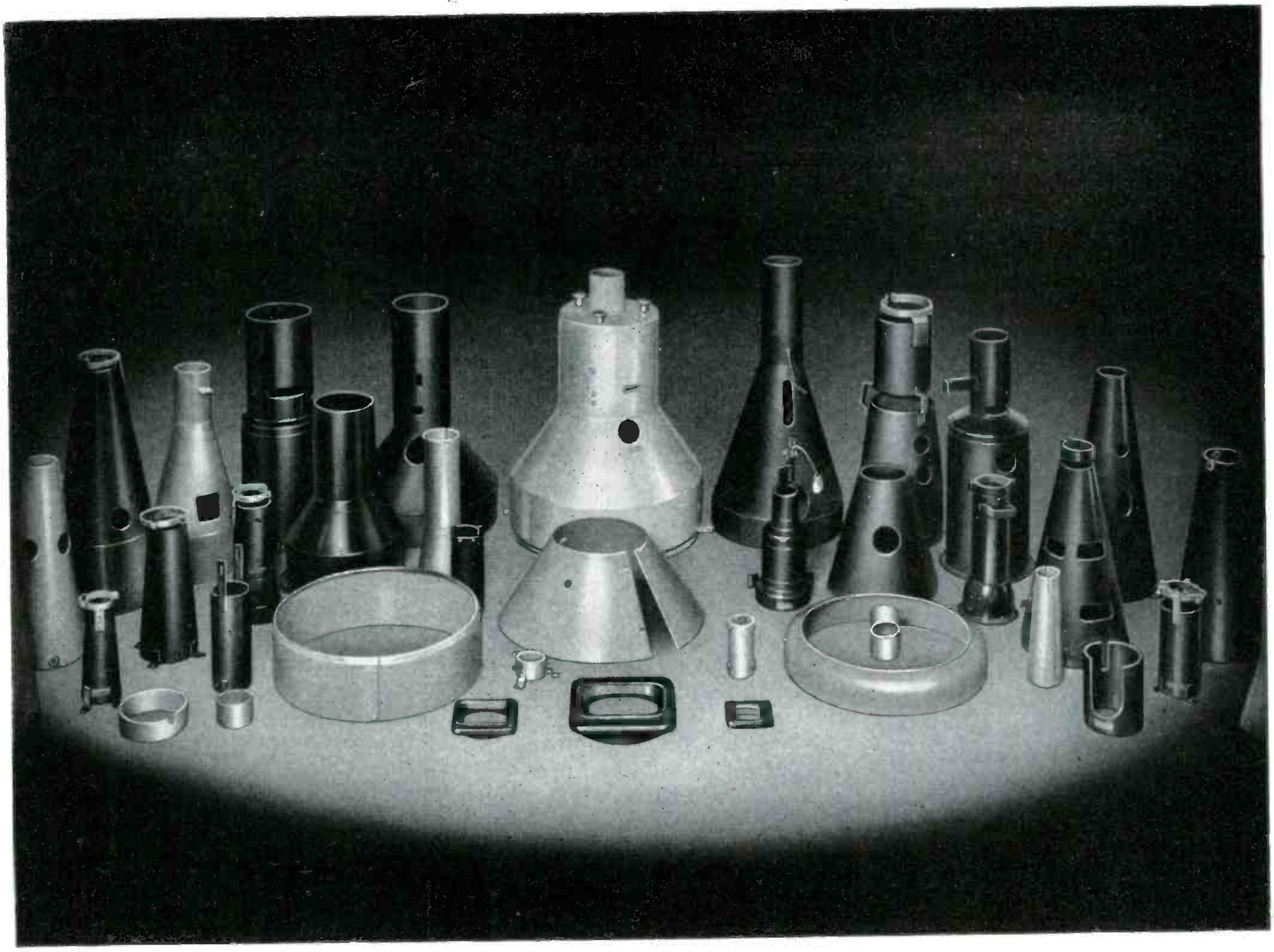
Disk and rod construction of delay line offers improvement in delay time by a factor of 25 over uniform brass rod

microseconds per cm with an insertion loss of 1.7 db for a $2\frac{1}{2}$ in. length. With a disk-to-rod diameter ratio of 5-to-1 and a total length of 3 in., delay time is 114 microseconds per cm with an insertion loss of about 1 db.

Torsional wave delay in a brass rod of uniform diameter is only 4.5 microseconds per cm.

Capacitor Insulation Resistance

INSULATION resistance of capacitors can be the limiting factor in computers and other devices where an

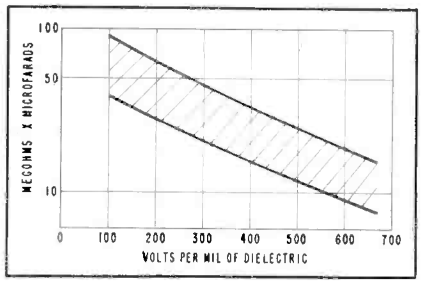


Want more information? Use post card on last page.

analog depends upon charge as a significant parameter.

Although insulation-resistance variation with room temperature has been specified in MIL-C-25A, little has been published about variation on insulation resistance with voltage stress. This variation is considerable between 100 and 500 volts d-c.

Experiments have recently been performed at five different voltages



Megohms times microfarads vs voltage stress for mineral-oil impregnated capacitors at 125 C

on paper dielectric capacitors. An ambient temperature of 125 C was selected. Insulation resistance was measured after units had been in an oven for an hour. Electrification time was one minute and readings were made first at the low potential.

Representative curves are shown for mineral-oil filled capacitors. This information has been furnished by General Electric Co.

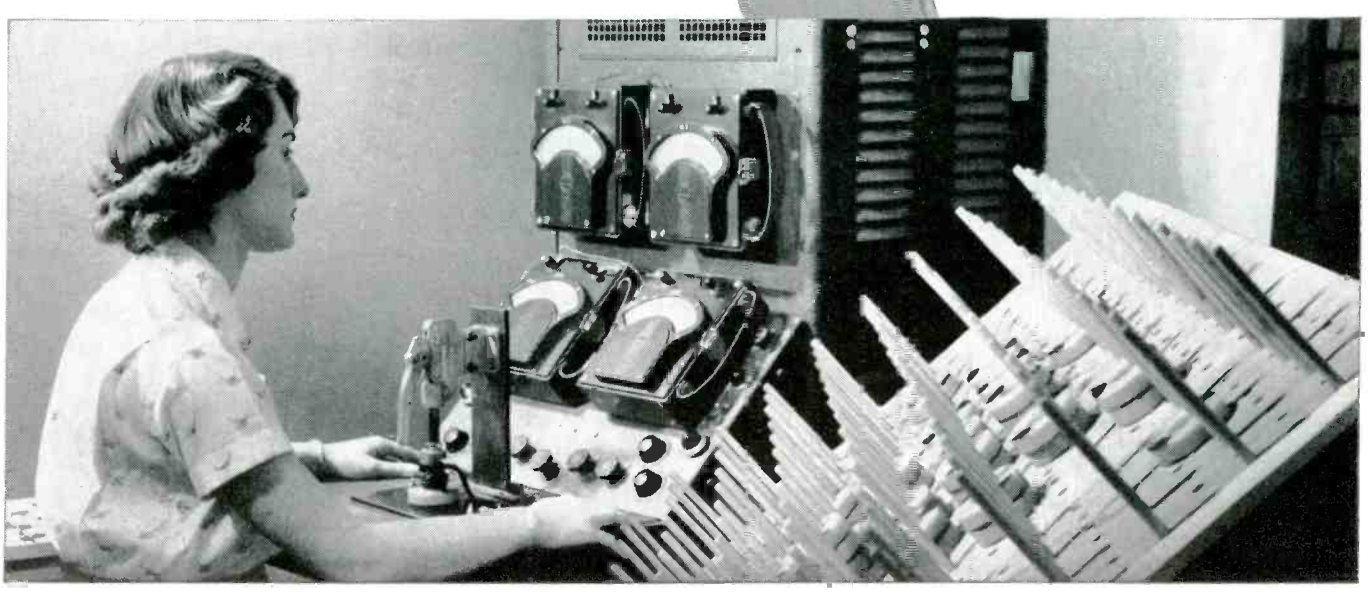
PERTINENT PATENTS

By Norman L. Chalfin
Hughes Aircraft Co.
Culver City, Calif.

INVENTIONS reviewed this month include those having to do with television, a photographic printing process and elimination of tire thump.

Image Indicator

In recent patent 2,757,293 issued to M. C. Teves and T. Tol of Eindhoven, Netherlands, a Luminoscope is described. This patent is assigned to the Hartford National Bank and Trust Company, Hart-



Want more information? Use post card on last page.

ford, Conn., as trustee.

The patent discloses a new bright-image indicator for x-ray or infrared images. As shown in Fig. 1, the Luminoscope has a transparent surface through which images of x-rays or infrared are impressed on a thin aluminum screen. The other surface of the screen has a fluorescent coating

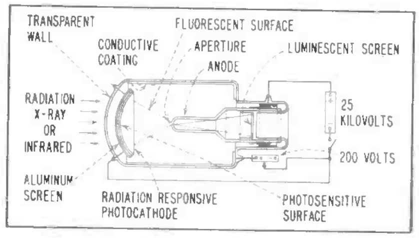


FIG. 1—Luminoscope construction

and a photosensitive cathode surface.

The image causes the fluorescent surface to glow and excite the photosensitive surface. The photosensitive cathode surface emits electrons in a bundle of streams corresponding to the fluorescent image and its light and dark areas. A central thimble-shaped anode with a small aperture has a high potential applied to it. Opposite the aperture inside the anode there is a luminescent screen.

For every point on the photocathode an electron beam is drawn through the anode aperture and impinges on the anode luminescent screen. At the proper focus all beams cross over at the anode aperture. There is thereby produced on the luminescent screen a bright luminescent display of the image projected onto the aluminum screen side of the photocathode.

Xerography

One of the newer applications of static electricity is the photographic process known as xerography. A recent patent 2,756,676 has been issued to F. A. Steinhilper for a method of production of xerographic prints. The patent is assigned to The Holoid Corp.

First step in the process is sensitization of a surface. This involves the electrostatic charging of the surface. An image is formed by the partial discharge of the surface

New IRC® Metal Film Resistors

Type MEF

Type MEC

FEATURES

• Available in 1/2 and 1 watt ratings • Metallic resistive film accurately controlled and applied to special high quality ceramic cores • Designed to surpass characteristic A of specification MIL-R-10509B • Low noise level independent of range • Voltage coefficient can be disregarded

Here are molded metal film resistors that set new standards of performance—units that will withstand full load at 125° C. ambient to zero at 175° C. In addition to high initial accuracy, these new MIL type units combine a stability on load and a low, controlled temperature coefficient never before available in film resistors. They also provide low inductance and shunt capacitance plus excellent high frequency characteristics.

Small in size and weight, IRC precision metal film resistors can replace precision wire wound resistors in many applications. They are available in five temperature coefficient spans for maintaining or controlling resistance over wide temperature ranges. They can be used where high stability must be obtained under difficult load and humidity conditions. You'll also want to investigate them for high frequency applications. Send for complete details.

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

Wherever the Circuit Says — IRC

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

SEND TODAY FOR COMPLETE DETAILS

INTERNATIONAL RESISTANCE CO. Dept. 236, 401 N. Broad St., Philadelphia 8, Pa.; *In Canada:* International Resistance Co., Ltd., Toronto, Licensee

Want more information? Use post card on last page.

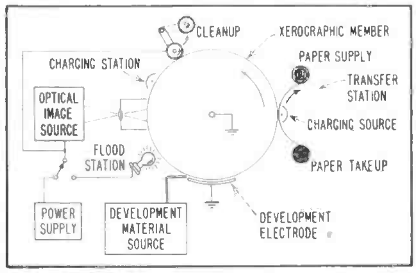


FIG. 2—Cycle in making prints

through exposure to radiation in which the image character appears. The development of the image is accomplished by the deposition on the changed image surface of an electroscopic substance in the form of a colored powder or mist.

The electroscopic substance has a charge opposite to that of the charged surface so as to be attracted to it. A powdered image surface is thereby built up. This image is transferred to moistened paper on contact. A number of reproductions are thereby possible.

In Fig. 2 a mechanical system for the operation of such an image charging and transfer process is shown. A drum having a xerographic surface member is rotated to pass through a cycle involving (1) sensitization charging, (2) image formation discharge, (3) powder or mist application and (4) printing.

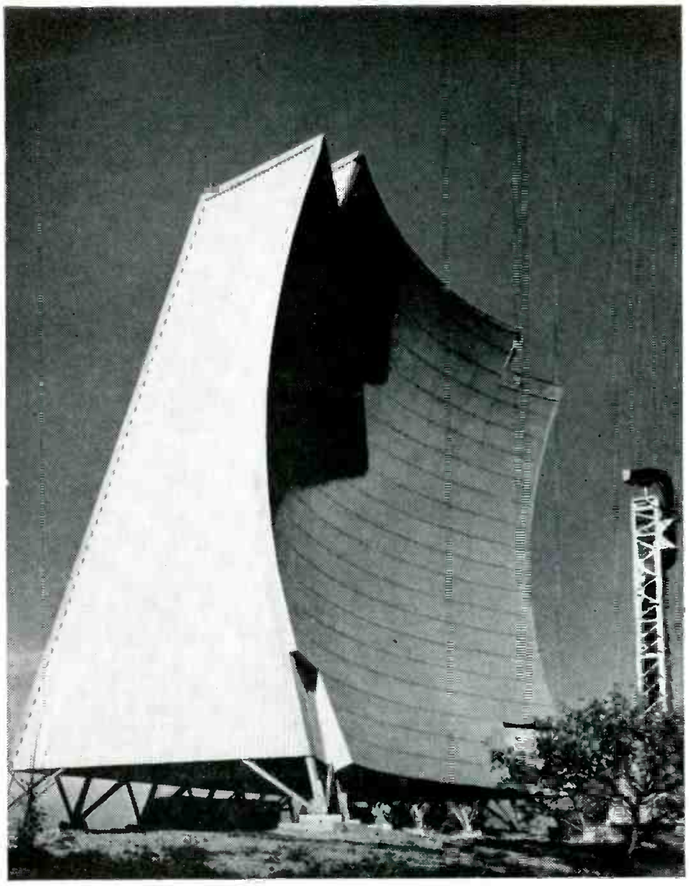
To reset the equipment for a subsequent different image, cleanup brushes (5) for the mist or powder are put in action and the charged area flooded (6) with a radiation source to discharge completely any latent image. The reproduction cycle is then repeated for a new image.

Thump Measurement

When driving an automobile on a perfectly smooth road a tire thump is heard, owing to the beating of higher-order harmonics of other vibrations related to the rotational speed of the wheels.

An apparatus invented by David C. Apps of General Motors for measurement of this tire thump condition was awarded patent 2,735,292. With the ultimate aim of eliminating this source of annoyance the inventor has devised the system shown in block diagram

How UHF radio got seven-league boots



Giant over-the-horizon antenna designed by Bell Telephone Laboratories for "White Alice," Air Force Alaskan defense communications network.

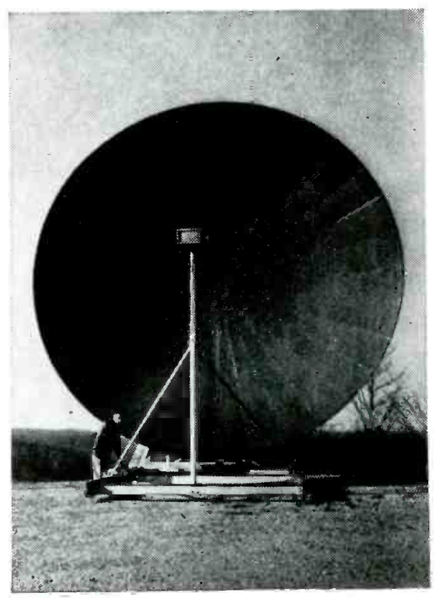
THE huge antenna systems which project ultra-high frequency radio communications beyond the horizon began when a Bell Telephone Laboratories engineer became intrigued with a strange phenomenon. Although these radio waves were supposed to be useful only over line-of-sight distances, the waves displayed a mysterious tendency to take off in a giant stride to antennas beyond the horizon.

This phenomenon had been studied both here and abroad, but no practical use was seen until the engineer became interested and thoroughly sifted the experimental data. He came up with the stimulating conclusion that over-the-horizon transmission is far stronger and much more dependable than was generally supposed. Further he predicted that it could be utilized to supply dependable broadband communications. He and his associates at Bell Laboratories confirmed the prediction experimentally, then drew up requirements for the first over-the-horizon UHF transmission system.

This pioneer work at Bell Telephone Laboratories has greatly increased the usefulness of UHF communications. For example, over-the-horizon transmission now provides critically important communications between remote military outposts in the Arctic and in the far north.

For the Bell System it can provide important new links for telephone conversations and television.

Kenneth Bullington, B.S.E.E., University of New Mexico; M.S., Massachusetts Institute of Technology; recipient of the 1956 Morris Liebmann Memorial Prize and the 1956 Stuart Ballantine Medal for his contributions in the field of over-the-horizon ultra-high frequency radio transmission.



Experimental antenna used in early over-the-horizon UHF radio transmission research. Research extended transmission from 30 miles line-of-sight to 200 miles.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT form in Fig. 3, along with the waveforms to be observed in each of these equipment blocks.

The range of frequencies in which the thump is observed is in the order of 0 to 10 cps.

If a car is moving at 30 mph the 7th and 8th harmonic tones of wheel speed may be strongly generated. On a typical tire size the rotational speed is near 6 a second so that harmonics of 42 and 48 cycles a second are present.

These tones may excite acoustic or structural resonances in the car, which by reason of slight differences in the frequency of the generated tones result in slight cyclic variations in a 6 cps difference tone envelope produced by a beating of the mechanically excited 42 and 48 cycle tones. While the car cannot detect the 6 cps wave it can detect the amplitude peaks of the slow rise and fall of these beat waves.

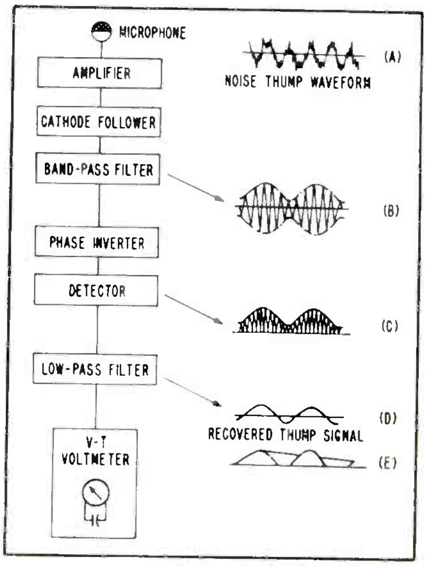


FIG. 3—Block diagram of thump detector

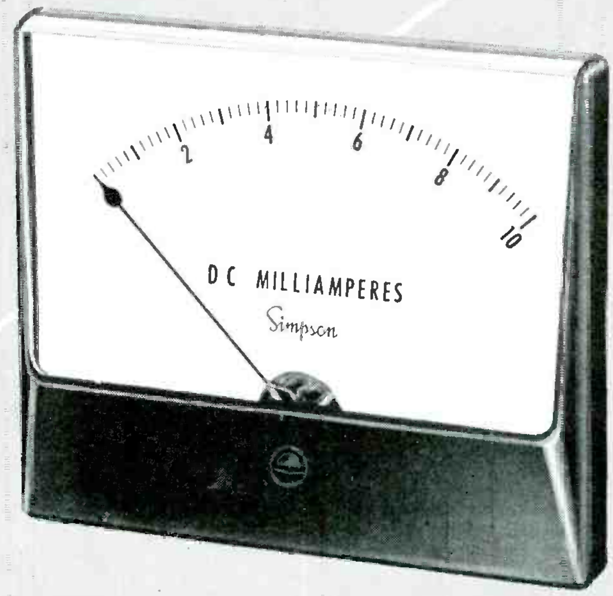
The vibrational sounds are picked up by a microphone. After amplification and transmission through a band-pass filter a modulated envelope as at waveform (B) is developed. This waveform is demodulated to recover the tire thump signal shown at waveform (D).

The capacitor across the vtvm results in the measurement of the amplitude of the thump. By appropriate adjustment of structural portions of the automobile the thump can be reduced or eliminated.

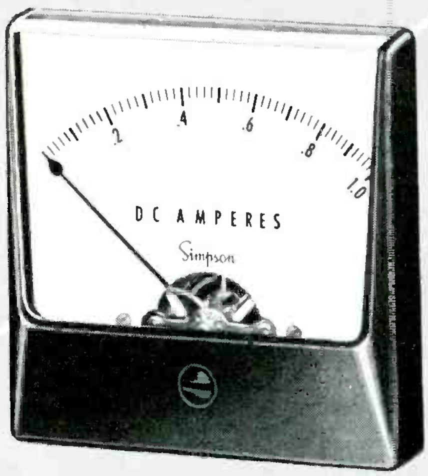
NEW Simpson

WIDE-VUE

panel instruments



4½″



3½″

2½″

a new concept

in styling and visibility

The clean, graceful lines of these "Wide-Vue" panel instruments add two plus values to your equipment. First, style—ultramodern beauty that blends with the advanced design of today's panels. Second, functionalism—longer scales together with wide-angle readability. The 2½″ size, for example, has the same scale length as a conventional 3½″ panel instrument. The durable, plastic cover is formed in one piece, and can be supplied with black or color finishes. Custom-built in 2½″, 3½″, and 4½″ sizes. External magnet type movement or *self shielded* core magnet meter movement.

Simpson
ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois
Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd., London, Ontario

INSTRUMENTS THAT STAY ACCURATE

Edited by JOHN MARKUS

Portable Self-Feeding Power Screwdriver Uses Cartridge Loads

A COMPLETELY AUTOMATIC power screwdriver, developed for mass assembly operations by the Shakeproof Division of Illinois Tool Works, drives screws automatically at any angle as fast as the operator can pull the trigger. Weight is only 6½ lb.

Each screw is automatically fed into the driving jaws and held tightly in place until started into the work piece.

The screw supply is always visible and is quickly replenished by replacing the screw cartridge. An accessory electric hopper reloads cartridges automatically. The cartridge holds sixty No. 8 screws and slightly less of No. 10 in lengths from 7/16 to 1½ inches and practically all types of heads. Driving bits can be changed in seconds without tools. Drive torque is equally easy to adjust.

One light-weight air hose provides driving power for new Semspak self-feeding screwdriver, being used here to anchor decorative trim on panel of console

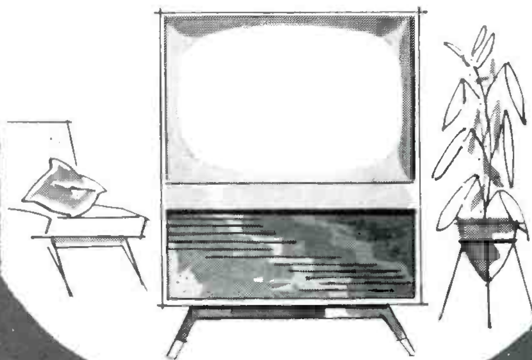
Card-Programmed Transformer Winding Resistance Tester

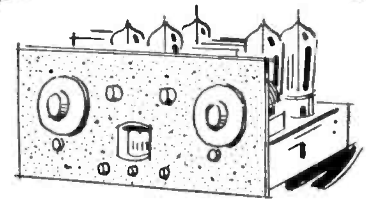
IRON-CORE TRANSFORMERS are automatically tested for d-c resistance of windings with a new test set developed by the Air Arm Division of Westinghouse in Baltimore. The resistance range may be 0.001 ohm to 10,000 ohms.

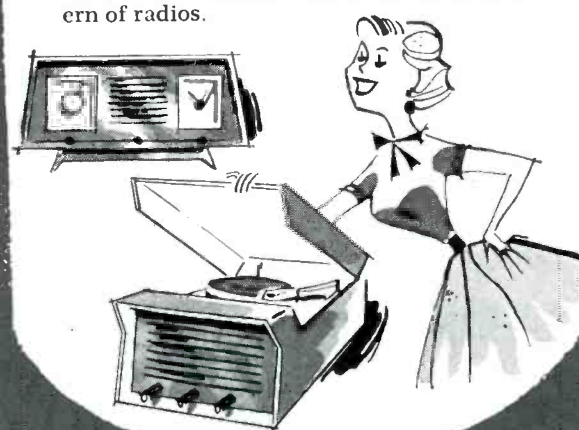
The system employs a d-c resistance bridge and a card-controlled programmer with a three-digit read out. Once testing is initiated by the operator, the system will automatically step ahead, recording on the test indicator whether the unit passes or fails according to the limits programmed into the punched card.

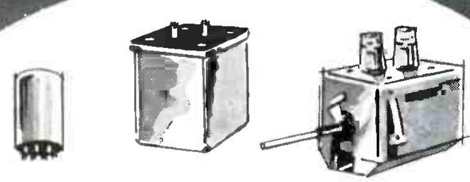
▶ **Calibration** — Included in this test set is an automatic calibration unit. This unit requires that every time the system changes its resistance range, it must pass an internal calibration prior to any

Inserting punched card which controls programming for measuring d-c resistance values of windings in up to 24 transformers. Hooks on ends of test leads speed connecting









Want more information? Use post card on last page.

transformer testing. This unique feature eliminates any possibility of passing bad units. Test accuracy is 1.5 percent.

The calibration quickly points up operator errors. If the machine shows 100-percent reject, the operator knows there is something wrong in the hookup. However, if the system failed calibration, the machine would stop operating.

▶ **Indicators**—To simplify maintenance, the passive indicator unit and the passive control panel have been added.

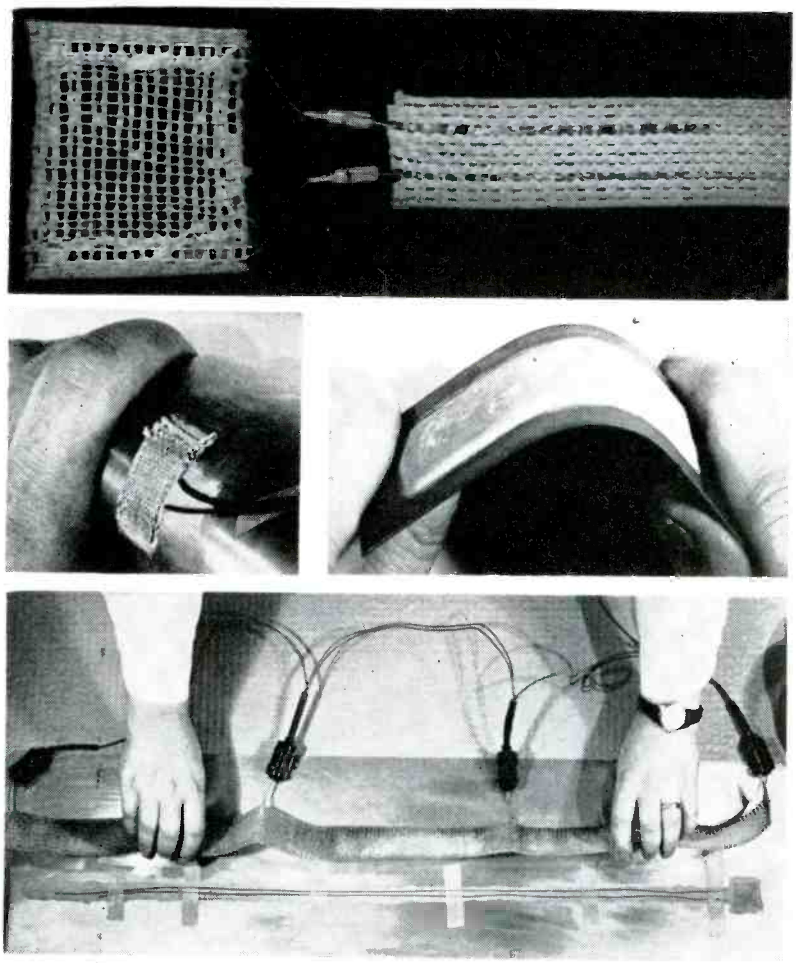
The passive indicator unit gives a visual presentation of the internal sequencing operation. This enables the technician to localize the trouble while watching the visual display rather than attempting to determine the system error through manual circuit check and symptom analysis.

The passive control panel, which is normally closed to the operator, gives the technician full independent control over the separate units. This enables him to override and control the sequencing process to facilitate sequence and system evaluation of trouble.

Also included are failure interlocks. If failure or malfunction of the sequencing system should occur, the system automatically shuts down and cannot be reactivated by the tester.

Twenty-four transformers, checking three separate windings per hookup, can be tested by this automatic unit. It takes 2 seconds to test one unit, approximately 10 times faster and more reliably than in manual testing.

Design of the Month: TRANSDUCER

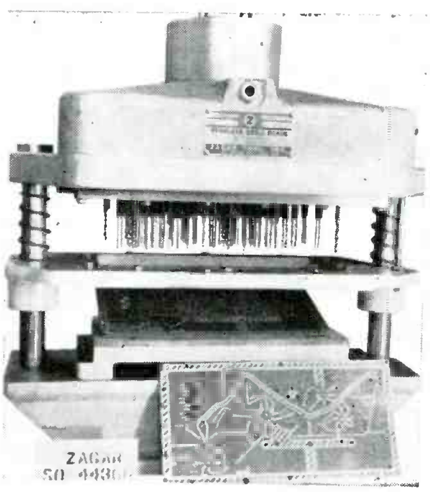


New surface-temperature transducer about size of postage stamp, designed originally for skins of guided missiles, uses woven grid of fine platinum wire to give high accuracy and fast response from —320 F to 950 F. Unit can be attached easily to any flat or curved surface with new dielectric cement which withstands up to 1,500 F after curing yet has permanent consistency of old chewing gum. Metal strip with cemented-on transducer can be bent almost double without cracking or crazing of cement. Matching lead tape consists of fine silver strands woven into porous glass, to provide mechanical interlock for the CA-9 refractory cement. Where oven curing is inconvenient, special electrical heating tape shown in lower view can be placed over cemented transducer and leads for curing. All are developments of Charles Engelhard, Inc., East Newark, N. J.

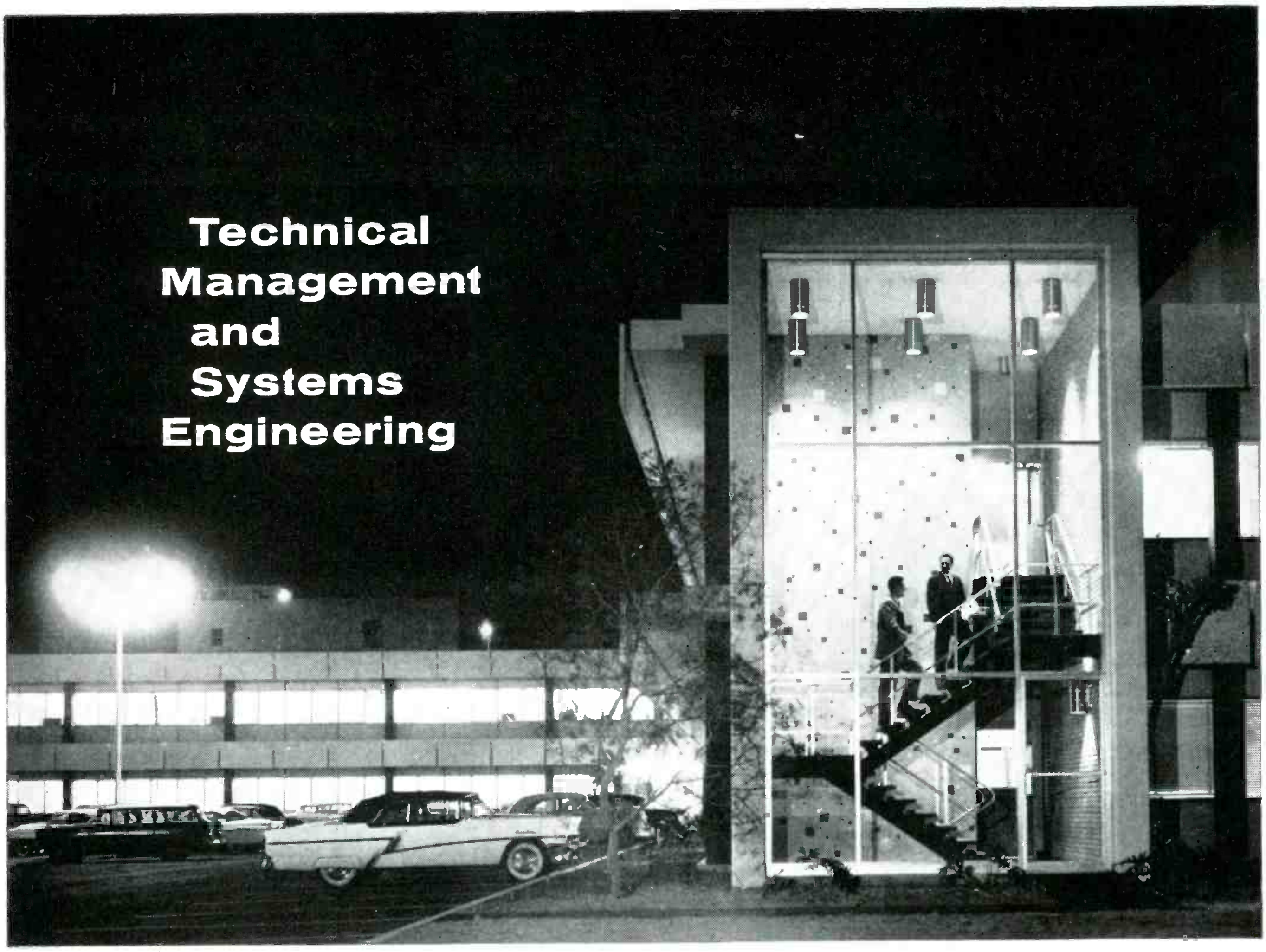
Quick-Change Drills for Printed-Circuit Boards

A NEW QUICK-CHANGE multiple-spindle drill head utilizes a special bottom plate and oscillator insert made of Formica. This material serves as bearings as well as for its primary purpose, permitting centers as close as 0.156 inch. Life expectancy of the inserts is approximately 10,000 passes, giving 10,000 drilled boards.

The quick-change feature is especially attractive where a great variety of boards of limited production are required. The insert assembly for each circuit is drilled or jig-bored to the proper pattern. By this means it is possible to have one basic drill head with which



Multiple-spindle drill uses an easily-changed basic drill head, for short-run production of a variety of printed circuit boards. In foreground is example of drilled board. Drill heads are made by Zagar Tool, Inc., Cleveland, Ohio



In systems engineering work, it is necessary to bring together a team that includes scientists and engineers of a wide range of technical specialties. In major weapons-systems projects, such teams will include hundreds of scientists and engineers.

But the assembly of a large group of scientists and engineers, no matter how capable they may be individually, does not of itself ensure good systems-engineering performance. The caliber of the project management has a major effect upon its technical accomplishment. It is not easy to coordinate the activities of large numbers of scientists and engineers so as not to stifle their creativeness on the one hand, nor to permit the various development sub-efforts to head toward mutually incompatible objectives on the other.

Of primary importance for good systems management is the philosophy underlying the selection of the supervisory personnel. The head of a technical activity should, first of all, be a competent scientist or engineer. A common mistake – nearly always fatal in systems work – is to fill such positions by nontechnical men who have been trained only in management techniques. In the highly complex activities of major systems work, what is required is *technical management*, and of the two words, the word *technical* must never be overlooked.

In the selection of scientists and engineers for technical management, it is essential that the men chosen be broad in their training and approach. Each principal department head, for example, must have a good basic understanding of the technical facts of life of the other departments. When these people get together they need to speak a common language and understand each other's fields, so that proper decisions can be made on the many interrelated problems that come up. The higher the organizational responsibility of a technical manager, the more important this factor becomes.

The Ramo-Wooldridge Corporation is engaged almost entirely in systems work. Because of this, the company has assigned to scientists and engineers more dominant roles in the management and control of the business than is customary or necessary in most industrial organizations.

Scientists and engineers who are experienced in systems engineering work, or who have specialized in certain technical fields but have a broad interest in the interactions between their own specialties and other fields, are invited to explore openings at The Ramo-Wooldridge Corporation in:

Guided Missile Research and Development
Aerodynamics and Propulsion Systems
Communications Systems
Automation and Data Processing
Digital Computers and Control Systems
Airborne Electronic and Control Systems
Basic Electronic and Aeronautical Research

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE ST. • LOS ANGELES 45, CALIF.

various insert assemblies can be used to handle a varied production.

The maximum drill size for 0.156-inch centers is ⅛ inch, though the number of spindles for maximum-size drills in any single head has to be limited.

At present, these drill heads are made in three sizes. A 10-inch-diameter head handles a 2×4-inch piece, a 14-inch-square drill head handles a 6×10-inch piece and a 14×16-inch drill head handles pieces up to 6×12 inches.

Electronic Gage Sorts Mica Automatically

INSTALLATION of a battery of six Federal electronic gaging and automatic sorting units in the Brooklyn, N. Y. plant of Victory Mica Mfg. Co. cut in half the labor costs of gaging and sorting mica, while reducing sorting error by 75 percent.

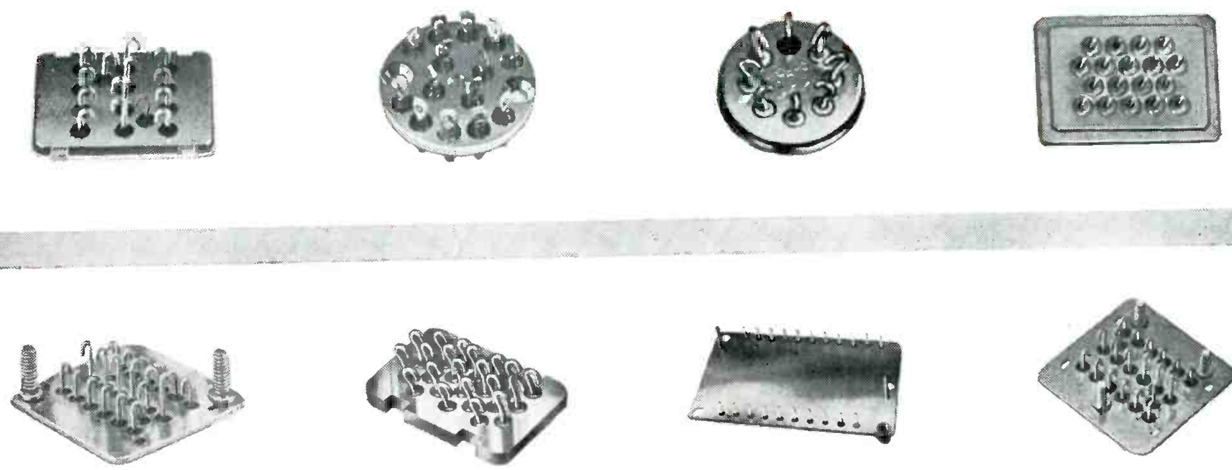
Precise measurement and sorting are important because: (1) insulating qualities of the material depend on its thickness, (2) recent automation of vacuum-tube assembly requires precisely uniform mica thicknesses, and (3) die life, an important cost factor, is lengthened considerably by stamping mica of uniform thicknesses.

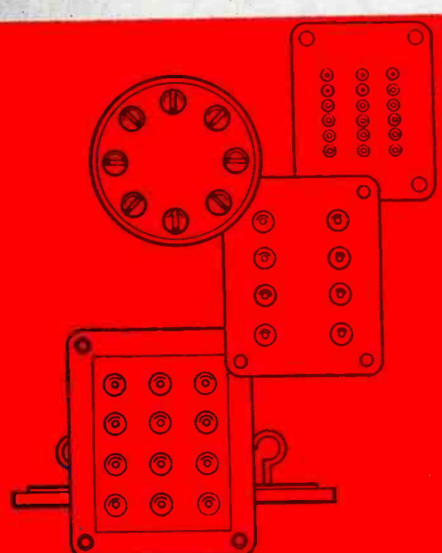
The machines sort the new mica into the same ten thickness categories used previously for manual sorting (0.005 to 0.015 inch in steps

At sorting position, operator now merely inserts mica sheets one by one between gaging contacts. Electronic gage measures thickness to thousandth of inch and drops sheet into proper receptacle below. Control equipment is in relay rack at rear

PEAK PERFORMANCE *Always*

WITH *Constantin* MULTI-HEADERS AND ALL-IN-ONE ASSEMBLIES





Even under the most extreme pressures and temperatures, vibration, and shock, electronic components will remain at peak performance and efficiency when Constantin's Multi-Headers and All-In-One Assemblies are used for all glass-to-metal sealing applications.

Constantin's units hold their seal effectively against wide ranges of temperature and pressure . . . against air, oil, corrosive compounds, high humidity, salt water immersion, spray and other substances. Constantin Multi-Headers and All-In-One Assemblies now provide full and positive protection against reliability-destroying factors in hundreds of thousands of relays, capacitors, transistors, rectifiers, diodes, transformers and many other electronic units.

These Multi-Headers and All-In-One Assemblies are superior for glass-to-metal sealing applications because, from drawing board to final inspection, the highest standards of quality, in design and precision manufacture, are built into the Constantin seal.

Multi-Headers and All-In-One Assemblies range from simple to intricate designs. When standard designs are not suitable, Constantin's experienced engineering staff will promptly meet your specifications with a custom-engineered seal. Other Constantin glass-to-metal seals are available in either kovar or mismatched seals of the compression type.

Let Constantin's precision equipment and specialized experience in glass-to-metal sealing help you design quality into your components. Send today for full technical information.

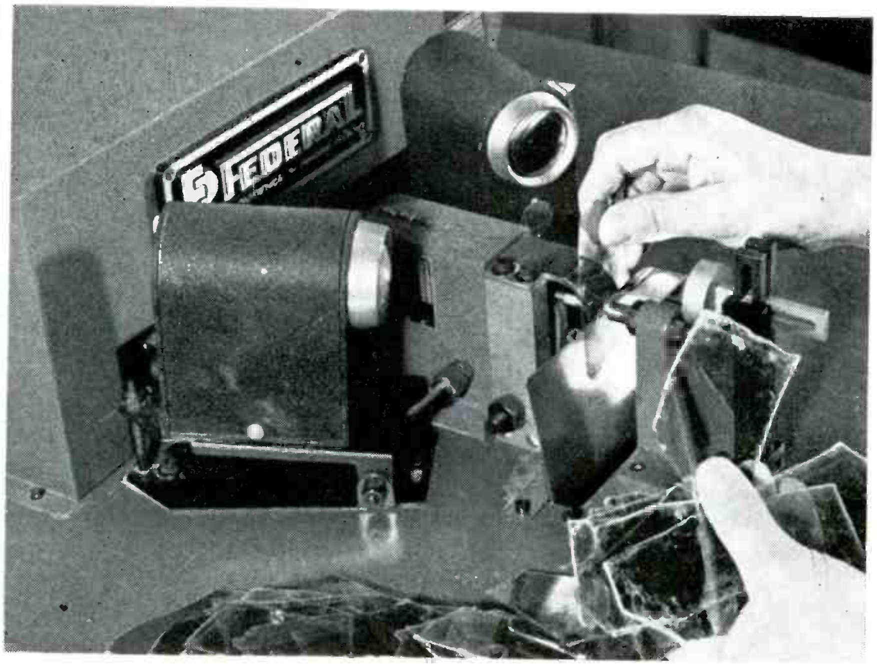
"QUALITY WITH CONFIDENCE"

L. L. Constantin & Co. MANUFACTURING ENGINEERS

Route 46, Lodi, N. J. • 187 Sargeant Ave., Clifton, N. J.

TRANSISTOR MOUNTS • SINGLE TERMINALS • COMPRESSION HEADERS • END SEALS • CRYSTAL BASES • CONNECTORS • MINIATURIZATION

Want more information? Use post card on last page.



Insertion of sheet of mica between gaging contacts breaks light beam to photocell, causing contacts to move together, grip mica and measure it for thickness. Contacts then open and sheet drops through opened trap door for that thickness

of 0.001 inch), but the number of missorted pieces is now less than 5 percent, as compared to 20 percent with the old method. At this rate, the machines should pay for themselves in about 2½ years.

▶ **Operation**—The electronic units, made by Federal Products Corp., Providence, R. I., can gage and sort mica by thickness at the rate of 120 pieces per minute. Feeding the gage by hand, the operator breaks a light beam to a photoelectric cell. This action causes the contacts of the gage to move together and grip the mica to measure it for thickness. Successive signals to an amplifier, classifier and solenoid result in the opening of the proper trap door, through which the measured piece goes to the proper receptacle. All operations after feeding are automatic, so the possibilities for human error are removed.

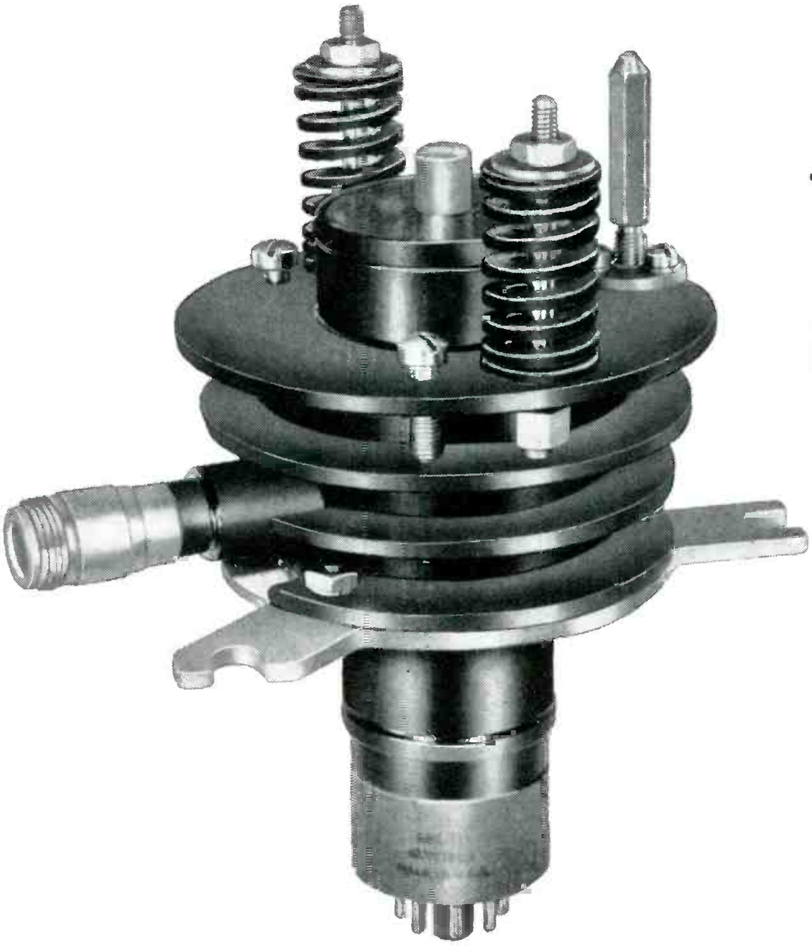
The thicknesses of classified pieces are spot-checked twice a day with hand micrometers to determine the accuracy of the gaging and sorting units. Thus far, no unit has required readjustment.

Another important advantage provided by the new gages is the relatively small amount of experience required of the operator. Girls working under the old method needed at least three months of practice to achieve the required skill; even then, there was a relatively high amount of rejects.

Automatic X-raying of 18,000 Tubes a Day

AN AUTOMATIC x-ray machine in Raytheon's Newton, Mass. plant photographs up to 18,000 special subminiature tubes per day, each from three different angles. Use of fine-grain film and special developing processes gives the image sharpness needed to show flaws in some 15 to 20 welds connecting the parts and in the glass seal. The negatives also reveal the spacing between parts and the presence of loose metallic particles. Some parts are four times finer than a strand of human hair. X-raying is the only way to tell if a true weld has been made without pulling the weld apart.

The x-ray examination is an added safeguard, in addition to the regular series of tests used by tube manufacturers. These include inspection by eye, both direct and through a microscope, electrical



Transmitter klystrons for microwave communications

10-watt SRL-7 series reflex oscillator klystrons for 1700-1930, 1850-2100, 1930-2160, 2160-2400 mc

SRL-7 SPECIFICATIONS		SRL-7F	SRL-7C	SRL-7G	SRL-7H
	Frequency Range	1700-1930 mc	1850-2100 mc	1930-2160 mc	2160-2400 mc
	Output Power	7-10 w	7-10 w	7-10 w	7-10 w
	Modulation Bandwidth	20 mc	20 mc	20 mc	20 mc
	Modulation Sensitivity	63 kc/v	70 kc/v	87 kc/v	84 kc/v

Designed primarily for telephone, teletype, telegraph and TV transmitting applications, the Sperry SRL-7 series reflex klystrons are also ideal for laboratory use in test equipment and bench oscillators. Important features include extended service life running into thousands of hours, outstanding ease of modulation, and single-screw tuning. Now in large-scale production, SRL-7 series klystrons are ready for immediate delivery. Phone or write your nearest Sperry district office for data sheets on these tubes and other Sperry klystrons for other purposes.

ELECTRONIC TUBE DIVISION

SPERRY GYROSCOPE COMPANY

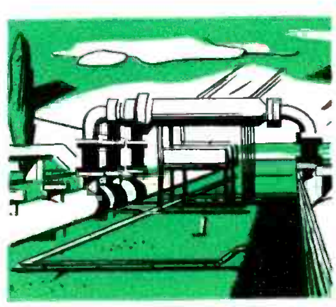
Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

CLEVELAND • NEW ORLEANS • BROOKLYN • LOS ANGELES SAN FRANCISCO • SEATTLE. IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC.

Television transmission

Microwave relay



Flow control

Battlefield communications

Want more information? Use post card on last page.

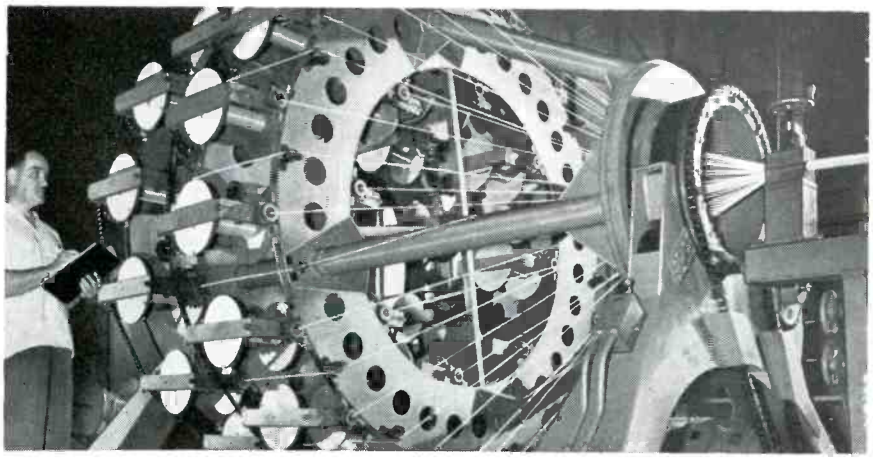
Loading tray of subminiature guided-missile and radar tubes on turntable of new automatic x-ray machine. X-ray tube is in heavy metal shield box at rear over turntable

tests under circuit loads, and mechanical tests such as shock, vibration and fatigue life.

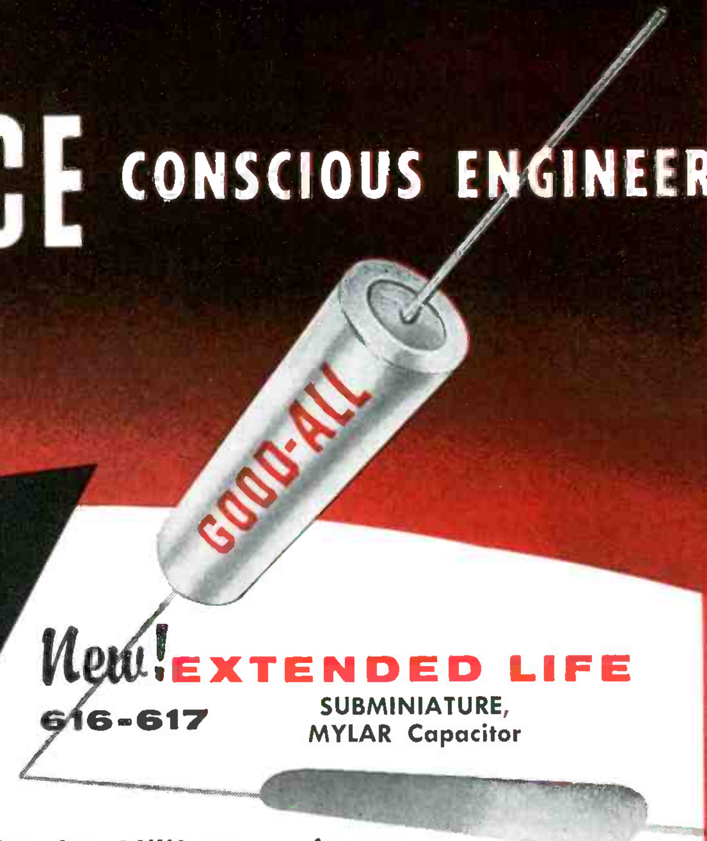
The new automatic apparatus makes it possible to x-ray tubes in mass-production quantities. Tubes are placed in concave circular trays on a huge four-quadrant turntable. This arrangement permits loading and unloading at three positions while tubes in the fourth quadrant of the turntable are being x-rayed from three different angles. Cardboard strips folded into corrugations keep the tubes uniformly spaced on the trays.

Contrahelical Planetary Cabler for Missiles

CONVENTIONAL wiring harness techniques have proved unsatisfactory for large guided missiles such as the Corporal, for a variety of reasons. Each harness differs electrically from another since wires are scrambled within whatever sheath they are placed. In one harness two incompatible leads may be in intimate contact throughout the entire length, while in another they may be completely separated, creating a serious problem in equipment calibration and setup. When the missile is in flight, acceleration and vibration can completely change



Producing complete umbilical-cord cable for guided missile on model D-100 Douglas planetary cabler. The two rings of wire reels rotate in opposite directions to give a contrahelical lay, and each reel tumbles about its own transverse axis while unreeling to remove twist from conductors for the SPACE CONSCIOUS ENGINEER



Good-All capacitors

New! **EXTENDED LIFE**

616-617 SUBMINIATURE, MYLAR Capacitor

Check list for Military engineers

- ✓ Smaller than MIL-C-25A
- ✓ Full rating to 125°C
- ✓ Metal enclosed hermetically sealed
- ✓ Excellent stability with life
- ✓ Low voltage range for transistors
- ✓ Available to close tolerances
- ✓ 500-hour accelerated life test
- ✓ Mylar* dielectric • Inherently high IR

Good-All Types 616 and 617 were developed in anticipation of the new specifications on film dielectric capacitors now being prepared by various military agencies.

SPECIFICATIONS

Insulation Resistance — See curve below for typical performance.

Life Test — 500 hours at 125°C and 125% of rated voltage

Long Term Stability — Extensive testing indicates capacitance change is less than 1% after 5000 hours operation at rated voltage and 125°C

Capacitance Change with Temp. — See curve below for typical performance

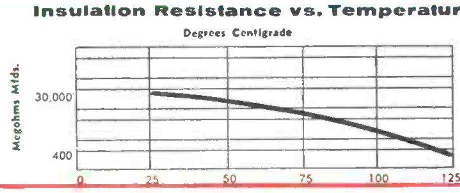
Mechanical Properties — Meet all requirements of MIL-C-25A

Temperature Immersion — Meet requirements of MIL-C-25A for 125°C (Characteristic K)

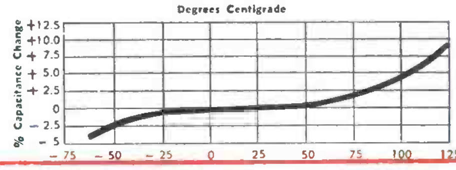
*DuPont's trademark for polyester film.

Cap. In Mfd.	616 (One Lead Grounded to Case) 50V	150V	400 V	617 (Both Leads Insulated From Case) 50V	150V	400 V
.001	.173 x 11/16	.173 x 11/16	.193 x 11/16	.173 x 3/4	.173 x 3/4	.193 x 3/4
.0047	.173 x 11/16	.193 x 11/16	.233 x 13/16	.173 x 3/4	.193 x 3/4	.233 x 7/8
.01	.193 x 11/16	.233 x 11/16	.312 x 3/4	.193 x 3/4	.233 x 3/4	.312 x 7/8
.047	.312 x 11/16	.312 x 13/16	.400 x 1 1/8	.312 x 3/4	.312 x 7/8	.400 x 1 1/4
.1	.400 x 3/4	.400 x 15/16	.562 x 1 1/8	.400 x 7/8	.400 x 1 1/16	.562 x 1 1/4

Insulation Resistance vs. Temperature



Capacitance Change vs. Temperature



GOOD-ALL ELECTRIC MFG. CO. OGALLALA, NEBRASKA

A leading manufacturer of Tubular and Ceramic Disc Capacitors

Want more information? Use post card on last page.

the relationship between conductors from instant to instant. Voids between wires also create a heat dissipation problem which can cause critical changes in the electrical characteristics of the cable itself.

▶ **Helical Lay**—The critical conductor relationship problem is largely solved by using a helical lay. Ordinary helical lays are more subject to vibration problems, however. They have an excessive minimum bending radius and are difficult to coil or handle during installation. The presence of delicate coaxial and shielded leads magnifies

Example of special missile-launcher cable harness having neoprene jacket which remains flexible down to −65 F. Five connector fittings at lower left are anchored in waterproof junction box. Flange on cable provides seal to box

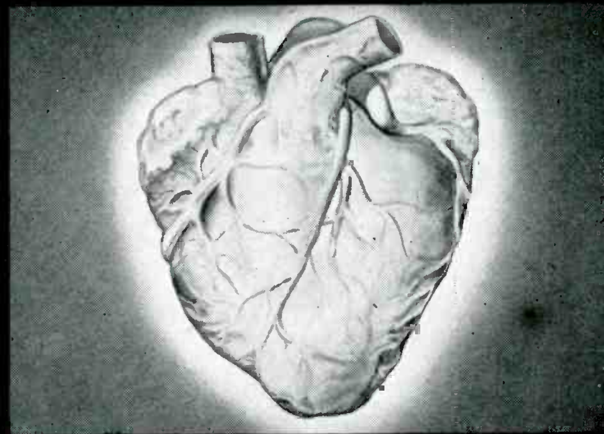
the problem of equalizing stress on the wires created by acceleration.

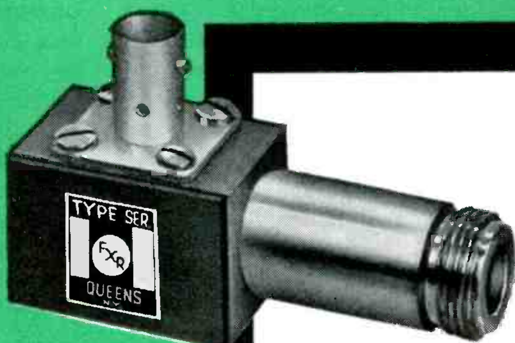
These problems were particularly solved in the Los Angeles plant of Douglas Roesch, Inc. by the use of a contrahelical lay. Here each helically reversed layer of conductors is concentric statically, dynamically balanced and so juxtaposed that electrical characteristics remain always constant.

A unique variable-pitch planetary cabler developed by the firm will fabricate an unlimited variety of conductors in almost any combination into one cable simultaneously, in either one-of-a-kind or production quantities and in any length regardless of branching. Each reel rotates about a transverse axis as it unwinds, to remove the twist in each conductor as all reels revolve

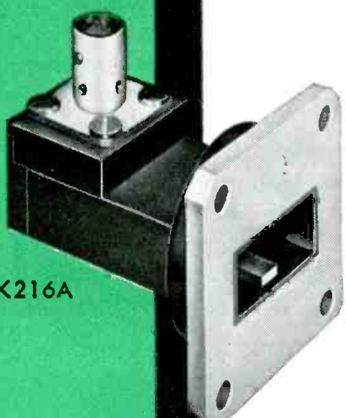
tomorrow is here today!

New doors unlocked in the study of coronary conditions. The world's most perfect pump—the heart—has long been the subject of experiments dealing with its damage or stoppage. The newest development in this field is the "ballisto-cardiograph", a remarkable instrument more sensitive than the electro-cardiograph. It is used to pick up and record the ballistic movements imparted to the body when a column of blood is ejected from the heart, useful in indicating organic heart disease. New precision instruments for cardiac catheterization accurately measure the pressures within the heart chambers and in the pulmonary arteries. All these new developments and techniques are aimed at halting the nation's No. 1 killer—heart disease.





N215A



X216A

BROADBAND THERMISTOR MOUNTS

FXR Extensive line of broadband matched thermistor mounts provides complete coverage from 500 to 40,000 Mc for the accurate measurement of CW or modulated power. The glass encapsulated thermistor elements used are electrically stable, exceptionally rugged and will withstand large overloads without burnout.

The 216A series waveguide mounts are fixed tuned over their respective waveguide frequency ranges. In addition, two coaxial mounts are available each fixed tuned over the band from 500 to 10,500 Mc. The new N217A coaxial mount is similar to the N215A, but it is provided with temperature compensating disc thermistors.

TYPE NO.	FREQUENCY RANGE KMC	TRANSMISSION LINE	MAX. VSWR
L216A	1.12- 1.70	W.G. 6.660x3.410"	1.50
S216A	2.60- 3.95	3x1½"	1.50
H216A	3.95- 5.85	2x1"	1.50
C216A	5.40- 8.20	1½"x¾"	1.50
W216A	7.05-10.00	1¼"x⅝"	1.50
X216A	8.20-12.40	1x½"	1.50
Y216A	12.40-18.00	0.622x0.311" ID	1.75
K216A	18.00-26.00	0.420x0.170" ID	2.00
U216S	34.00-36.00*	0.280x0.140" ID	1.50
N215A	0.50-10.50	Coax-Type "N" Jack	1.50
†N217A	0.50-10.50	Coax-Type "N" Jack	1.50

1. All waveguide units require a nominal 20 mw of power for 200 ohm operation.
2. Both coax units require a nominal 34 mw of power for 200 ohm operation.
*On special order this mount can be set to other 6% bands in the range from 26.5-40.0 KMC.
†Provided with disc thermistors—to be used in temperature compensated unbalanced type bridges.

ELECTRONICS & X-RAY DIVISION
FXR
F-R MACHINE WORKS, INC.

Electronics & X-Ray Division

F-R MACHINE WORKS, Inc.

26-12 Borough Place, Woodside 77, N. Y. ASToria 8-2800

Write TODAY for new catalog of complete line of Precision Microwave Test Equipment.

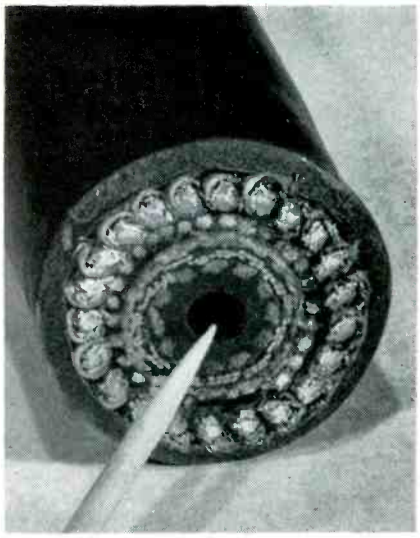
Representatives: Los Angeles: J. C. VanGroos Co.; Denver: Hytronic Measurements Inc.; Chicago: KaDell Sales Assoc.; Export: Szucs Int'l Co., N. Y.

about the cable axis. The machine can be loaded without utilizing long conductor lengths.

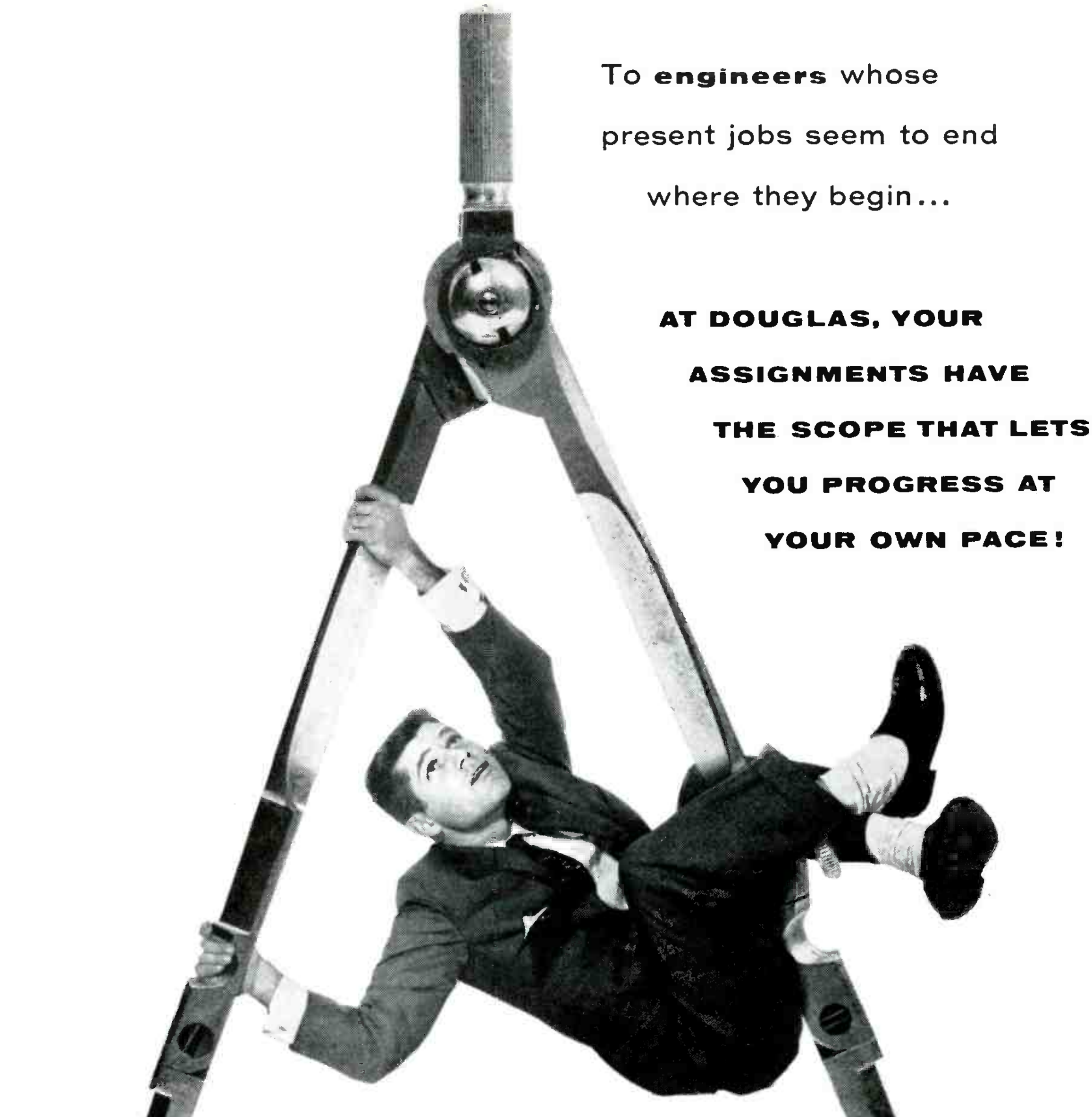
▶ **Missile-Launcher Cable**—As one example, a missile-launching cable made on the machine was composed of over 100 conductors ranging from 20-gage coaxial leads to 20-ampere power wires, plus strong plastic tubing for cushioning and a stranded steel stress cable running from connector to connector. All leads are connected to one specially designed Cannon connector. The launching receptacle was redesigned and relocated on the side of the missile and a device created to swing the cable away from the blast so that it could be reused. Tests made on the cable showed that it could withstand almost any force in any direction and could be wound on drums with a diameter of only 12 inches.

▶ **Jacketing**—To meet the requirements for missile cables, a new low-temperature neoprene compound was developed which could be molded or used as a sheath without applying heat or pressure. The jacket retains flexibility, strength and abrasion resistance qualities at temperatures as low as −65 F. The new compound will permit twists at an angle of 90 degrees at this subzero temperature.

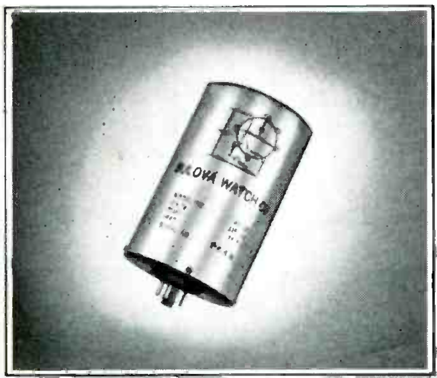
Other new cable molding and potting techniques include the manu-

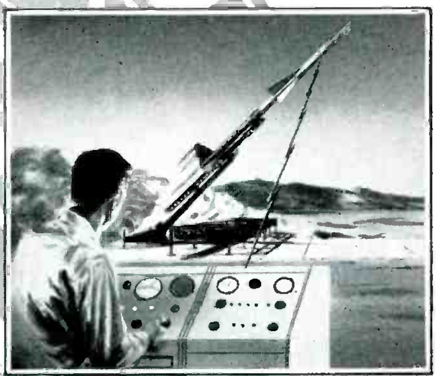


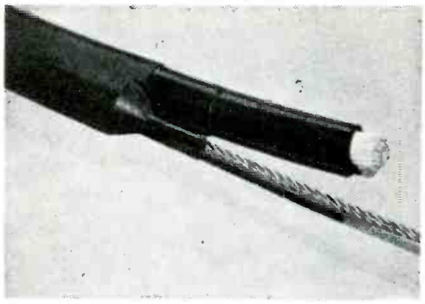
Contrahelical-wound cable having hose in center for air or hydraulic fluid used to release umbilical plug when missile is fired from launcher



www.americanradiohistory.com







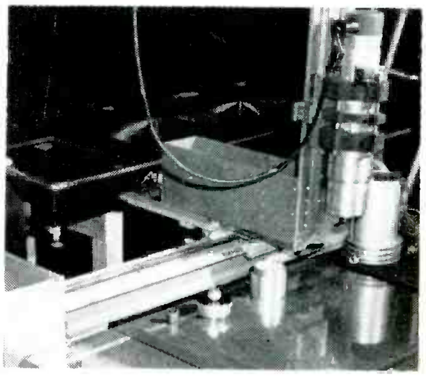
Method of molding strain relief breakout around stainless steel wire rope used to support long cable during firing of large missile

facture of rectangular or round cable incorporating completely sealed cable-connector assemblies bonded to metal plates to assure pressure-tight seals through bulkheads.

Electronic Printer for Etched Slot Antennas

By Sheldon Isaacson and Murray Hoffman
Research and Development Department
Maryland Electronic Mfg. Corp.
College Park, Maryland

A PRECISION electronic printer capable of exposing negatives for printed circuits to an accuracy of 0.0001 inch allows printed-circuit techniques to be utilized in fabrication of high-frequency antenna arrays. These are etched in copper-

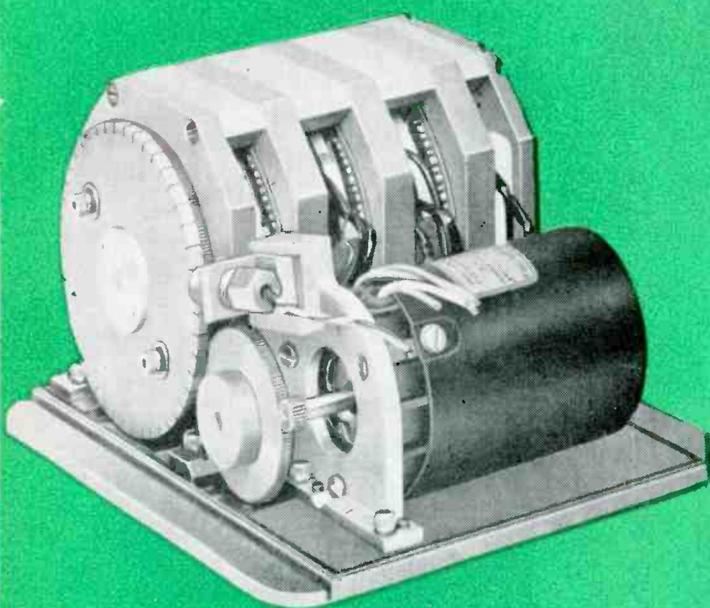


Projector of printer is mounted vertically on ways of lathe which moves over heavy surface plate on which is placed negative to be exposed. Counter wheel housing is at left end of lathe

clad laminate after exposure by the printer through a master negative.

▶ **Printer Construction**—The printing machine is built on a steel table whose mass helps to reduce inher-

DESIGN ACHIEVEMENTS WITH SUPRAMICA* ceramoplastics



MYCALEX TM Commutation Switch for Telemetering, Using Precision-molded SUPRAMICA* 555 Ceramoplastic Commutator Plates.

Precision-molded SUPRAMICA* 555 Ceramoplastic Commutator Plate, CP-340, With 360 Contacts and 2 Slip Rings. Other Standard Plates Are Available.

OVER 1000 HOURS SATISFACTORY OPERATION AT 1200 RPM

CUSTOMER EVALUATION TESTS DEMONSTRATE RELIABILITY OF MYCALEX TM TELEMETERING SWITCHES

Mycalex* TM commutation switches with SUPRAMICA ceramoplastic commutator plates have introduced a degree of accuracy and sustained dependability never before approached in telemetry. Evaluation tests show **completely satisfactory performance** for more than 5500 hours at 600 rpm, with unattended life in excess of 1000 hours. Exhaustive testing under severe conditions demonstrates consistent noise level performance as low as 0.2% peak-to-peak of signal into a 500 ohm load.

Where warpage of only .0002" of the commutator plate will distort and destroy the value of the signal, these precision switches withstand extremes of temperature, altitude, shock and vibration and deliver a clean, unvarying pulse.

Such accuracy and dependability depend on painstaking precision workmanship, and commutator plates with total dimensional stability. SUPRAMICA ceramoplastics have thermal expansion coefficients comparable to most insert metals, assuring tight bonding and permanent anchorage of contacts. High dielectric strength, radiation and arc resistance, low electrical loss, and thermal endurance as high as 500 degrees C. (932°F.) are also provided. In military and industrial applications, Mycalex TM commutation switches with SUPRAMICA ceramoplastic commutator plates are making significant contributions to the reliability and durability of electronic equipment.
Write for complete technical information.

*MYCALEX and SUPRAMICA are registered trade-marks of Mycalex Corporation of America. 555 is a trade-mark of Mycalex Corporation of America.

MYCALEX
ELECTRONICS CORPORATION

THE FIRST SUPRAMICA® CERAMOPLASTIC — THE FIRST SYNTHAMICA SYNTHETIC MICA — SINCE 1919 MYCALEX® THE INSULATOR

EXECUTIVE OFFICES:
30 ROCKEFELLER PLAZA
NEW YORK 20, NEW YORK

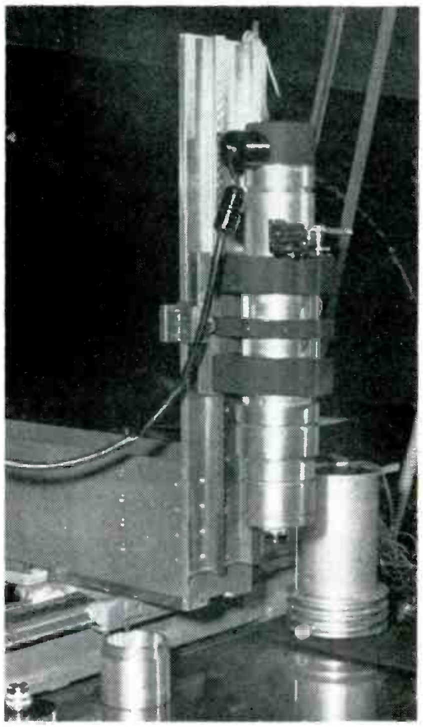
GENERAL OFFICES AND PLANT:
CLIFTON, NEW JERSEY

CHICAGO — LOS ANGELES — DAYTON
WASHINGTON — MIAMI

WORLD'S LARGEST MANUFACTURER OF GLASS-BONDED MICA AND CERAMOPLASTIC PRODUCTS ent vibration. Resting on this steel table is a carefully leveled surface plate and a lathe whose ways were leveled and tested for parallelism to the surface plate.

The cross slide of the lathe is fitted with vertical tracks and a lead screw for raising and lowering the projector assembly. The positioning of the projector parallel to the ways of the lathe is controlled by the main lead screw.

Directly geared to the main lead screw is a wheel with 125 holes

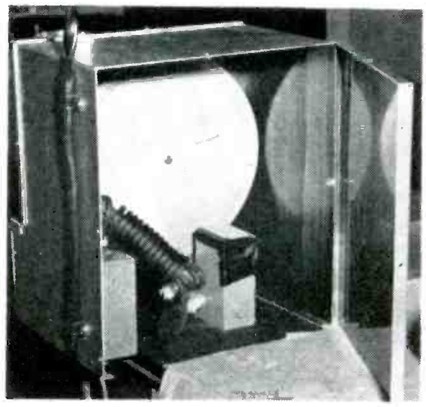


Arrangement of vertical tracks on cross slide for raising and lowering projector assembly

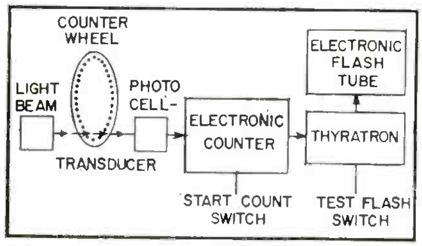
accurately indexed and drilled in its periphery. The gearing, in conjunction with the eight threads per inch on the lead screw, permits each hole in the counterwheel to correspond to one ten-thousandth of an inch. The counterwheel interrupts a light beam photocell-transducer system which emits one output pulse per interruption, thereby allowing each pulse to represent one ten-thousandth of an inch travel of the projector down the ways of the lathe as the carriage is propelled by the lead screw.

▶ **Electronic Counter** — The pulse output from the transducer is fed

Want more information? Use post card on last page.



Counter wheel and light beam system using photocell and transducer

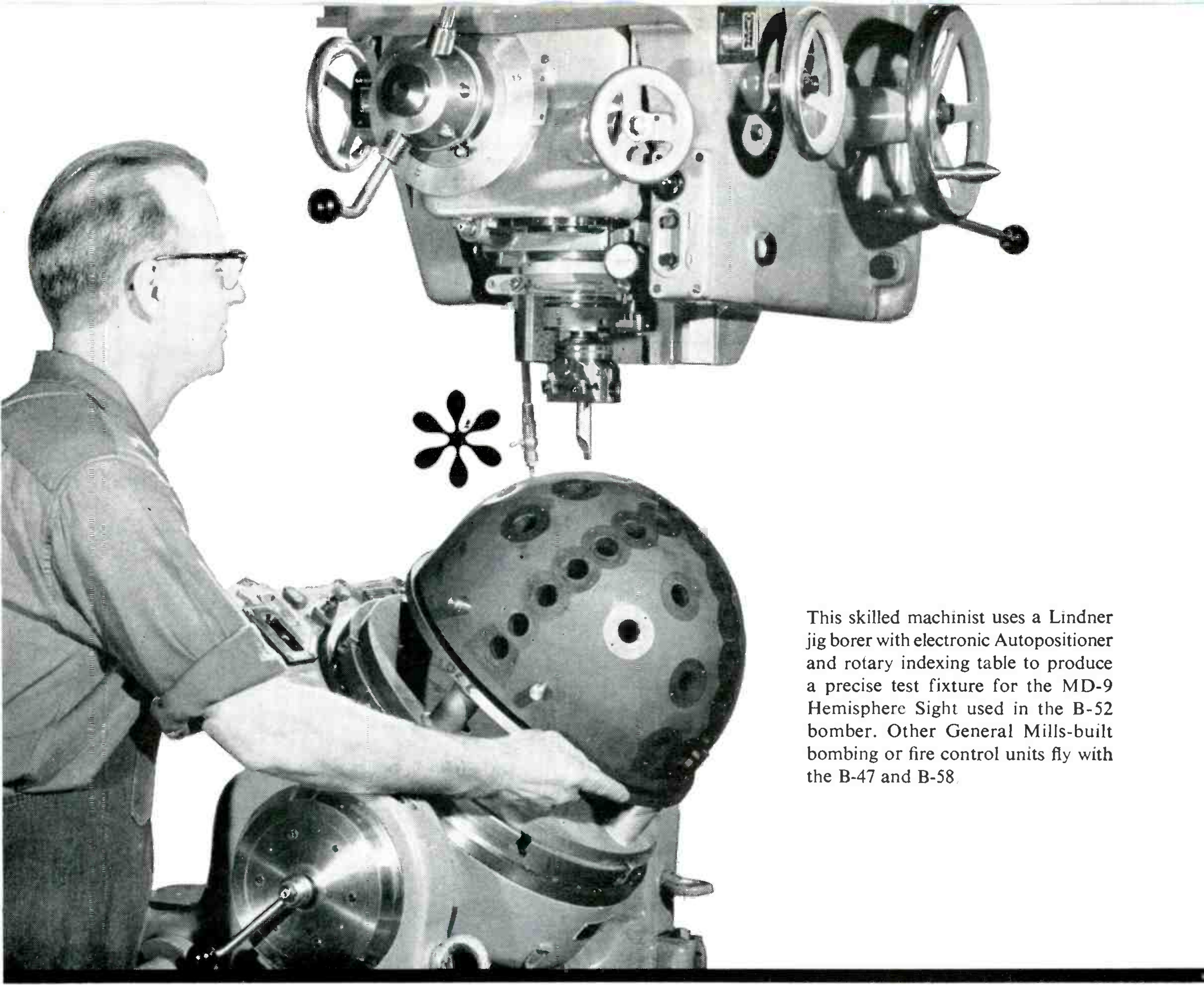


Block diagram of electronic system feeding flash tube

into a commercial pre-set counter. The pre-set feature of the electronic counter allows a specified number of pulses to be received before an output pulse from the counter is fired. The counter automatically recycles itself without losing a count, so that a pre-set count can be accurately repeated as often as desired.

The output pulse from the electronic counter is fed through a thyratron tube to an electronic flash tube, which provides the necessary light for exposing the image on the photographic plate. The elapsed time from the electronic counter output pulse to the end of the flash from the strobe tube is approximately 105 microseconds. The thyratron delay time is 5 microseconds and the time of the flash duration is 100 microseconds. The short time duration of 105 microseconds permits the use of high-speed longitudinal travel without blurring the image.

The nominal rating of the electronic strobe flash tube is 100 watt-seconds. However, energy output is $E = \frac{1}{2} CV^2$. Thus, by controlling the amount of capacitance or the voltage in the circuit, energy output can be controlled. The minimum voltage setting, determined by



This skilled machinist uses a Lindner jig borer with electronic Autopositioner and rotary indexing table to produce a precise test fixture for the MD-9 Hemisphere Sight used in the B-52 bomber. Other General Mills-built bombing or fire control units fly with the B-47 and B-58.

*B-52 gunners are better marksmen because of this General Mills craftsman

Maintaining accuracy of the MD-9 Hemisphere Sight for the tail defense system in B-52 bombers calls for unusually close tolerances. Holding these tolerances requires exacting test fixtures. We designed, engineered and built many of them.

We'd like to tell you more about how we combine creative engineering and fine precision production to serve industry and military. Our unified team can handle research, development or manufacturing—or the whole package. Send for facts, Dept. EL7

The optical device in the picture has flat, microfinished surfaces with angular accuracy within two minutes of arc surrounding lens openings. The critical flat areas and openings are located from bearing holes that are held within $+.0002''$, $-.0000''$.

Test fixture in place on MD-9 Hemisphere Sight which we build under subcontract for the Crosley Division of Avco.

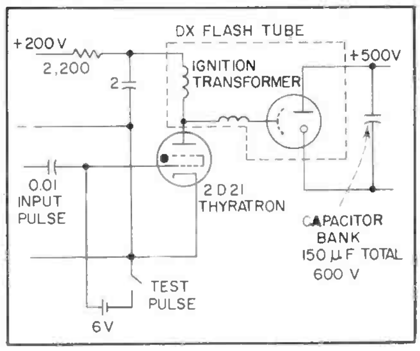
MECHANICAL DIVISION General Mills

Minneapolis 13, Minnesota

CREATIVE RESEARCH AND DEVELOPMENT • PRECISION ENGINEERING AND PRODUCTION the gas used in the flash tube, is approximately 450 volts. However, by using less capacitance, the electronic strobe flash tube can be derated to give longer life.

The necessary voltages for the operation of the thyratron and electronic flash tube are provided by conventional power supplies. An auxiliary input to the thyratron permits a test pulse to be fired for a pre-run test.

▶ **Projector** — The strobe tube mounts in the upper portion of the projector. The image to be projected is held in a rotating stage which permits the proper alignment of the image relative to the ways of the lathe. A modeling light



Triggered electronic flash circuit

replaces the electronic flash tube when initial settings are being made. The remaining parts of the projector are the light collimator, lens holder and extension tubes.

The desired magnification ratio of the image is controlled by a geared lead screw and a mechanical counter attached to the projector. The vertical positioning of the projector is controlled to one thousandth of an inch.

The projector with its extension tubes permits magnification or demagnification. The lens system is interchangeable and permits large variations for photography.

▶ **Example** — A typical antenna system using slots as radiating elements contains 3,300 slot elements. This was printed and exposed from a master negative by the precision electronic printing machine in approximately 20 minutes. While the overall length of the antenna array

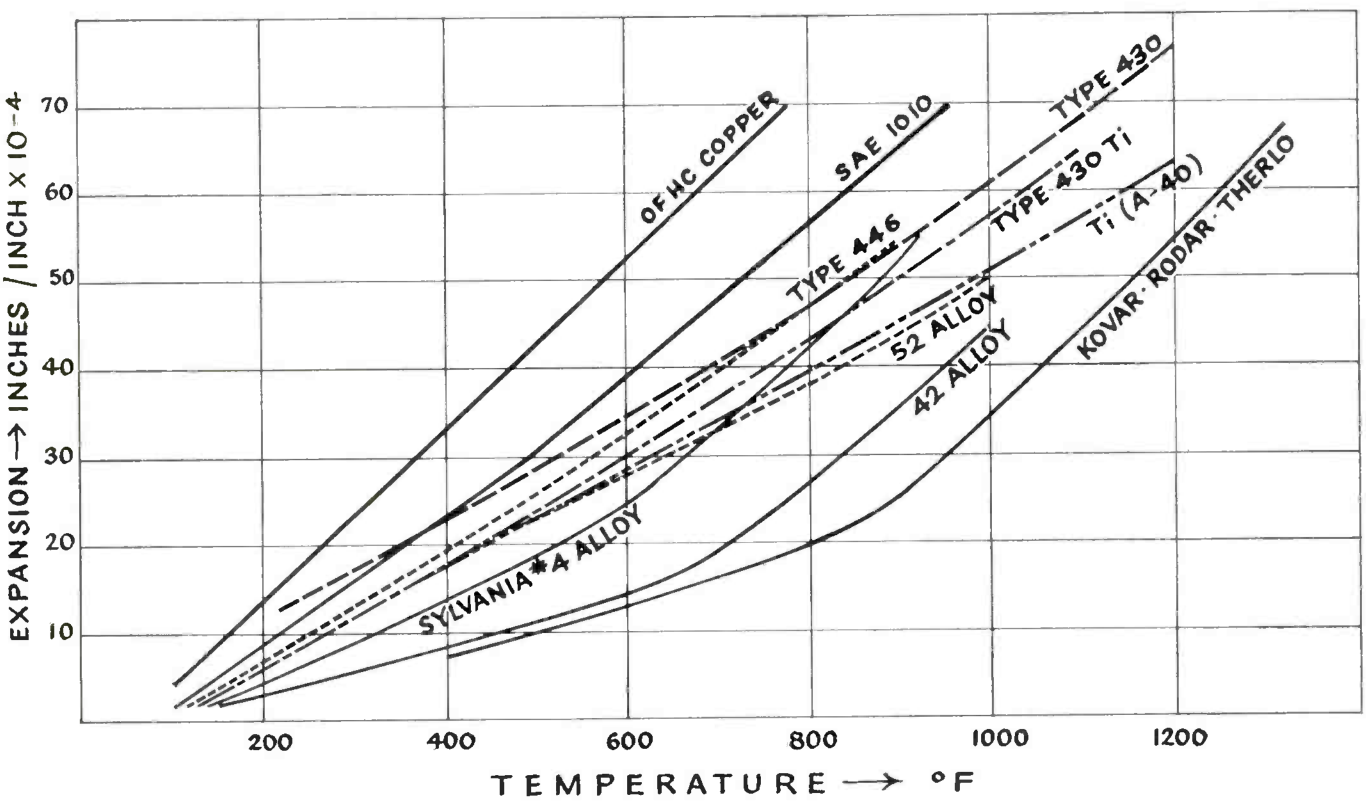
SUPERIOR TUBE ADDS

5 NEW GLASS SEALING ALLOYS

TO STANDARD LINE

KOVAR* | **RODAR†** | **#430** | **#430Ti** | **THERLO‡**

Now Superior offers glass sealing alloy tubing with expansion characteristics to meet practically any glass sealing requirement. These five new analyses are in addition to six already in the line. Superior also offers titanium tubing for ceramic-to-metal seals. All are available in quantities as small as 50 ft. and are cold drawn to close tolerances. Size limits in most cases from .012 to 1⅛ in. OD. Write or send coupon for new Data Memorandum 15 giving technical information on all these alloys and the known applications for them.



APPROXIMATE EXPANSION CURVES OF VARIOUS METALS

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.—an affiliated company making precision metal stampings and deep-drawn parts.

SUPERIOR TUBE CO.
2500 Germantown Ave., Norristown, Pa.

Send me a copy of new Data Memorandum 15, on glass sealing alloys.

Name ______________________

Company ______________________

Street ______________________

City ______________ Zone ______ State ______

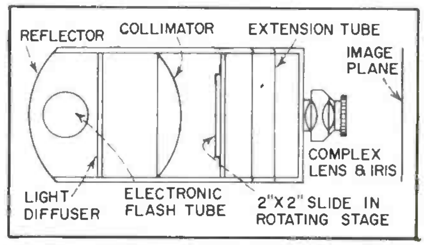
*Stocked and sold by the Stupakoff Division of the Carborundum Co., Latrobe, Pa. T.M. Reg. U.S. Pat. Off., Westinghouse Electric Corp.

†T.M. Reg. U.S. Pat. Off., Wilbur B. Driver Co.

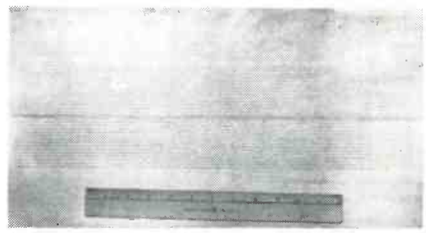
‡T.M. Reg. U.S. Pat. Off., Driver-Harris Co.

Want more information? Use post card on last page.

is about 18 inches, the machine is capable of producing work up to 36 inches long. Arrays greater than 36 inches are made in sections which are aligned in a supporting frame. Maintenance of the spacing accuracies between sections is assured by employing an accessory



Interior of projector



Typical slot antenna array produced by etching of sheet copper after exposure by precision electronic printer

to the machine, which permits inspection to accuracies of 0.00001 inch.

The method of printing includes a photographic reduction of the original (which is many times oversize) onto a 2-inch-square glass slide. Then, by employing further demagnification in the projector, the final size of the image is achieved.

This method of double reduction allows the final size of the image to be accurately controlled.

▶ **Future Plans**—The machine at the present time is fully automatic in that the operator selects his photographic pattern, sets his desired spacing on the electronic counter and turns on the printer. The machine exposes the photographic plate to an accuracy of one ten-thousandth of an inch at the pre-set intervals and shuts itself off at the end of the run. The operator merely develops and prints the image and the new antenna is fabricated.

The future antenna engineer

Lambda makes own transformers, seals them hermetically, uses military-standard moisture-control test

BUBBLE BATH
for COM-PAK® power supply transformers

NEW COM-PAK SERIES SAVES PANEL SPACE

New 1.5 amperes model (illustrated) is available in three voltage ranges, needs only 8¾" of panel height, from $550. Other space-saving models from 200 MA (5¼"), priced from $169.50.

Every Lambda Com-Pak power supply transformer gets a pre-installation soaking in hot water. A single bubble and the transformer is rejected. The unit installed in your Lambda Com-Pak power supply has passed this military test...assurance of long, trouble-free service.

This extra protection against moisture is one of a right-down-the-line set of Com-Pak quality control standards enforced by the world's largest exclusive manufacturer of power supplies. In-service satisfaction is the reason engineers who specify power supplies consistently name Lambda "first choice"...to the tune of 2½ times over the next identified manufacturer.

Lambda manufactures a complete line of regulated DC power supplies with current ranges through 1.5 amperes. Use the coupon to get the new 1957 catalog.

LAMBDA Electronics Corp.

The first name in power supplies

11-11 131st Street, College Point 56, N. Y.

INdependence 1-8500

Visit us at the Wescon Show • August 20-23 • Booth No. 2201-2

LAMBDA Electronics Corp., Dept. E-757
11-11 131st Street, College Point 56, New York

Send me literature listing complete specifications for all Lambda Power supplies.

Name__________ Title__________

Company__________

Address__________

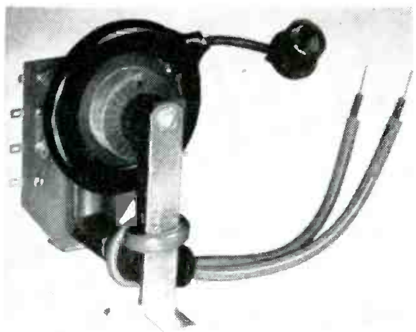
City__________ Zone___ State______

may merely select the desired antenna pattern, type a punched card, feed it into the precision electronic printer, then pick up his antenna in a few hours. Fantasy? Maybe not!!

Coil-Coating Machine Applies Butyrate Tire

FLYBACK high-frequency transformers for television receivers protect the coil from physical damage and corona discharges with a new hot-melt cellulose acetate butyrate formulation developed by Pyroxylin Products, Inc., Chicago, using an Eastman Chemical Products butyrate.

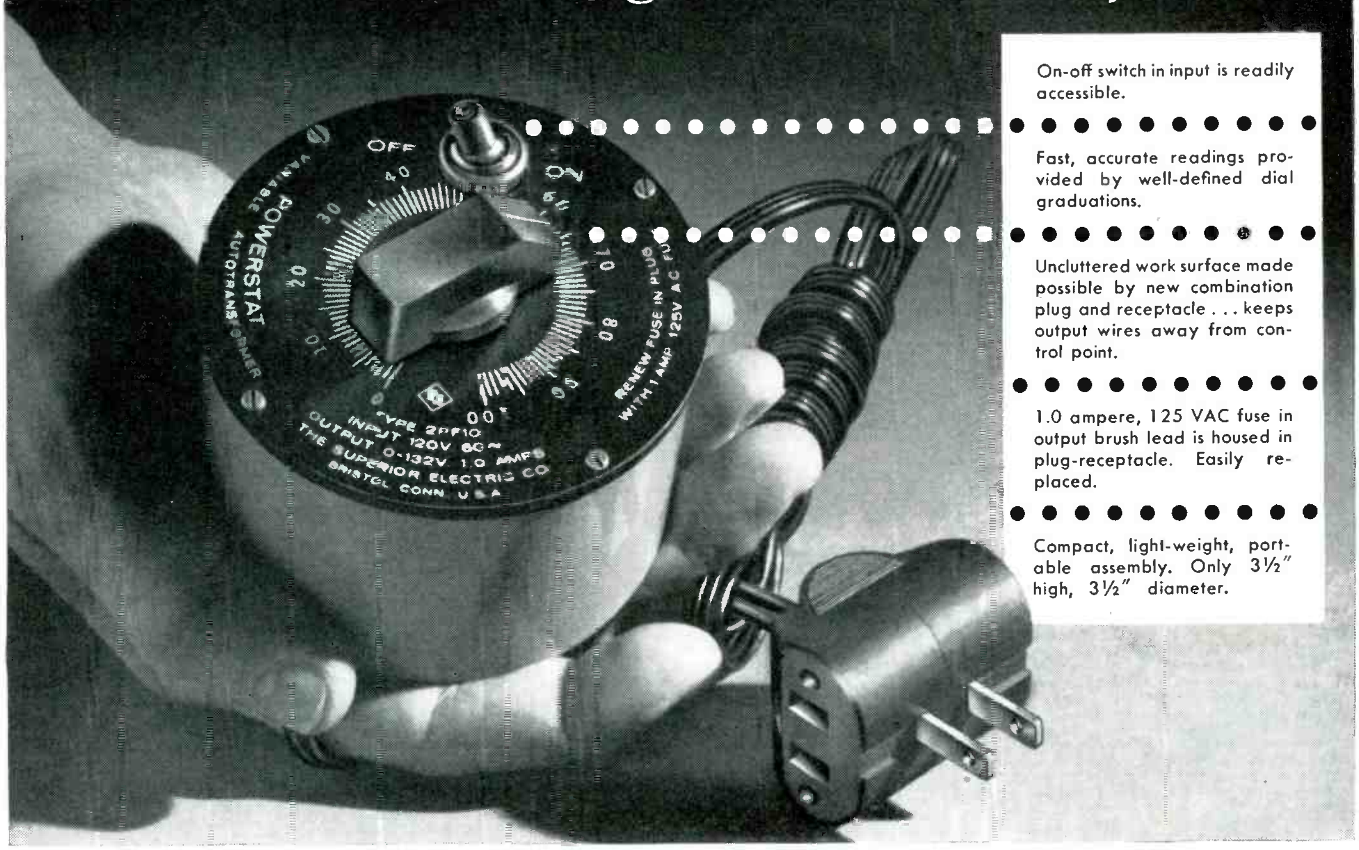
By excluding air and moisture from the outer rim of the flyback transformer, the butyrate coating effectively suppresses the development of a corona discharge at the sharp edges of the coil. This in turn helps prevent breakdowns due to transformer loading, oxidation and shorts. Wound with extremely fine wire, the transformer coil is also easily subject to physical damage which the cushioning action of the thick, tough butyrate coating reduces to a minimum.



Complete transformer using coil having new protective butyrate tire

In the plant of Admiral Corp. the new heavy butyrate coating is automatically applied. The hot-melt formulation is fed constantly to an overflow pot at 350 F to produce the correct viscosity. Coils are mounted on a chain drive spindle at the loading position and are rotated by another chain as they move horizontally across the top of the pot. The coils pick up the hot-

NOW a compact, portable, self-contained low wattage variable transformer



On-off switch in input is readily accessible.

Fast, accurate readings provided by well-defined dial graduations.

Uncluttered work surface made possible by new combination plug and receptacle . . . keeps output wires away from control point.

1.0 ampere, 125 VAC fuse in output brush lead is housed in plug-receptacle. Easily replaced.

Compact, light-weight, portable assembly. Only 3½" high, 3½" diameter.

NEW *INPUT: 120 volts, 60 cycles, single phase*
OUTPUT: 0-132 volts, 1.0 amperes, 132 VA

You'll find POWERSTAT type 2PF10 is ideal for laboratory, inspection, classroom and many other uses where low wattages of 50, 100 and 130 watts are required. Use it as the voltage control of small motors, heaters, centrifuges, mixers and test apparatus . . . as the control of light sources in optical equipment.

Like all POWERSTATS, it is a toroidal wound autotransformer with a movable brush-tap. It produces continuously-adjustable output voltage from a-c power sources with maximum efficiency. It runs cool. You only pay for the power you use. Size: 3½" high, 3½" diameter. Send coupon for more facts.

POWERSTAT®

variable transformer TYPE 2PF10

Be sure to see SUPERIOR ELECTRIC'S Mobile Display when it is in your area

Offices: Los Angeles, California • San Francisco, California • Toronto, Ontario, Canada • Miami, Florida • Chicago, Illinois Baltimore, Maryland • Detroit, Michigan New York, New York • Cleveland, Ohio Dallas, Texas • Seattle, Washington

a precision product of
THE SUPERIOR ELECTRIC COMPANY
207 Bradley Avenue, Bristol, Connecticut

Please send data sheet on POWERSTAT type 2PF10 ☐
Send POWERSTAT Bulletin showing all types ☐
Have your representative call ☐

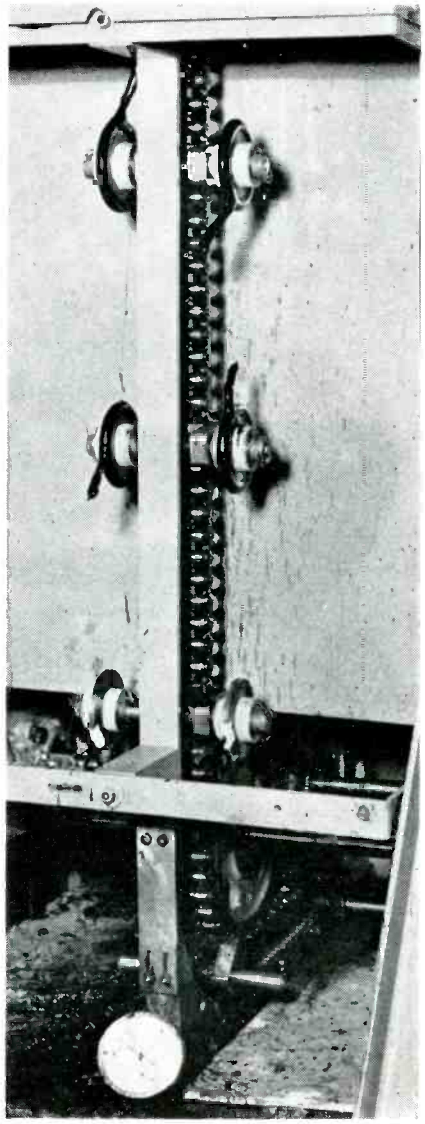
Name . . . .

Company . . . .

Street . . . .

City . . . . *Zone* . . . . *State* . . . .

Want more information? Use post card on last page.



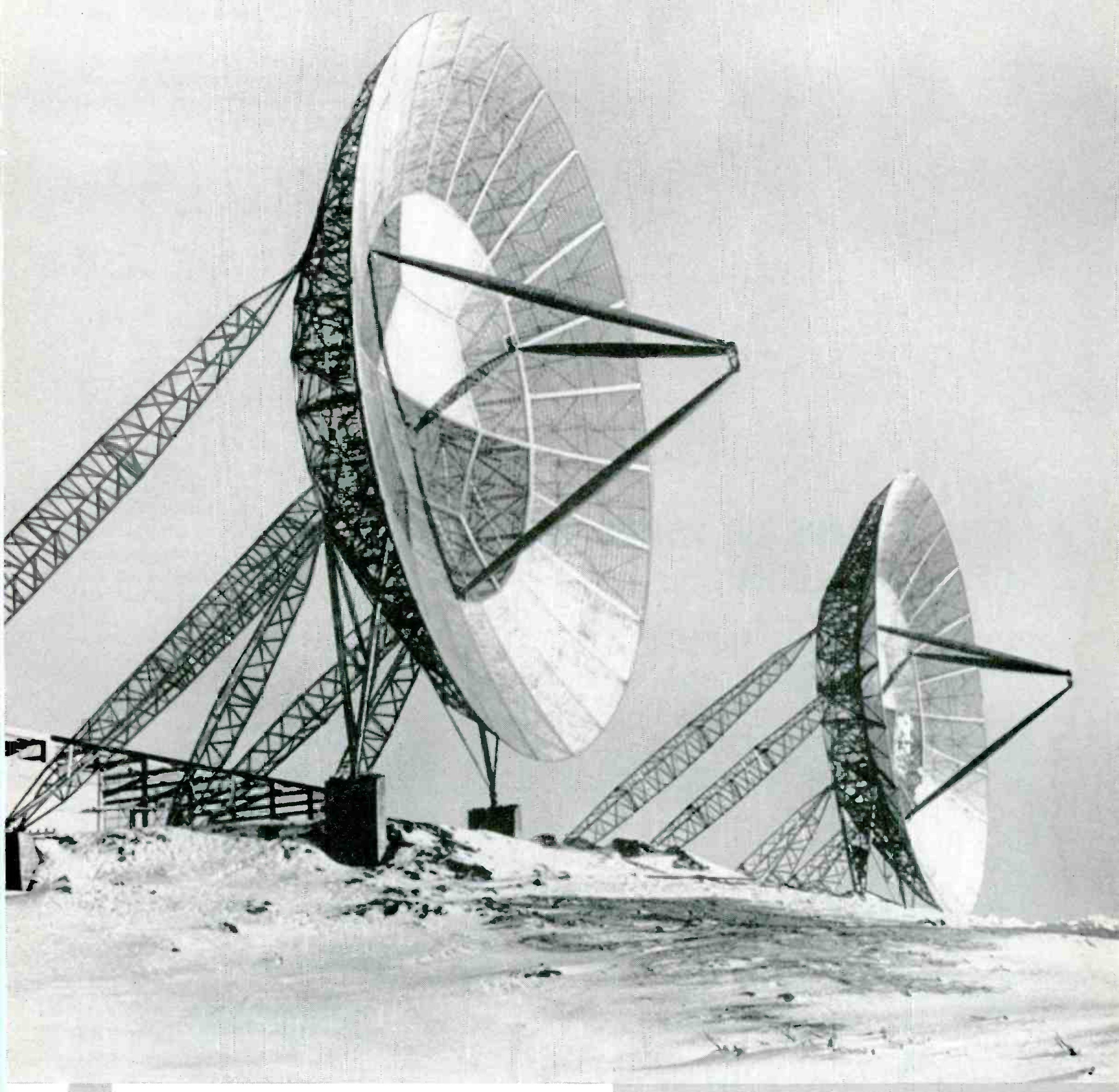
Endless chain conveyor arrangement used for applying protective hot-melt coating to flyback transformer coils. Operator unloads coated coils here as they move down, and puts on new coils for trip across top of pot

melt in the form of a tire. As the coils move away from the pot, the butyrate hardens quickly. The excess run-off at the lead wires of the coil is trimmed off by hand later on the production line.

Transparent Conductive Tube Coatings

IN ELECTRON TUBES it is often desirable to have a conducting coating on certain defined inner sections of the glass envelope to prevent electrons from charging the glass. Frequently used for this purpose are coatings of platinum,

KENNEDY ANTENNAS *...on the alert overseas*



This is a 60′ Trans-Horizon antenna designed and built by Kennedy — a big "dish" with a big job.

Standing somewhere in northern Europe, it serves as an important link in the vast chain of communications that guards the perimeter of the free world.

It was built to do its job well. By means of "Scatter Propagation", it can handle multi-channel circuits over hundreds of miles with unimpaired clarity under all weather conditions. Made of lightweight, durable aluminum, it is virtually weather-proof, and features sectionalized construction for ease of transportation and erection.

Kennedy's long experience in designing and building big "dishes" for big jobs will serve you well when you have antenna problems.

ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

COHASSET, MASS. — TEL: CO4-1200

Down-To-Earth **SOLUTIONS** *to*
Out-Of-This-World **PROBLEMS**

Tracking Antennas
Radio Telescopes
Radar Antennas
Tropospheric Scatter
Ionospheric Scatter

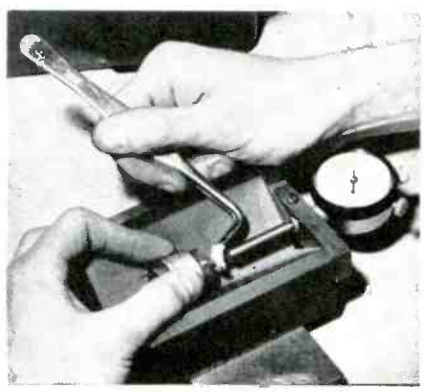
gold, silver and graphite. For many applications, however, such coatings have the disadvantage of being opaque. In addition, the application of these coatings normally requires elaborate methods, some involving vacuum exhaust.

A novel way of applying such a coating and a means of restricting it to desired areas has been developed by W. W. Campbell of Naval Research Laboratory, Washington, D. C. A solution of stannic chloride (anhydrous fuming) and isopropyl alcohol is sprayed onto the hot glass, maintained at its annealing temperature while rotating in a glass lathe. A commercial fine-spray gun, such as DeVilbiss type EGA series 502, provides the controlled spray. For masking sections to be left uncoated, a mixture of chromic oxide and glycerine is painted on the specified areas within the tube before coating. This mixture has the advantage of withstanding higher temperatures than material used previously, and it is easily removed by water and a detergent.

By using this method one can easily apply transparent conducting coatings of various sizes and shapes within glass tube envelopes. Films can be produced having any desired resistivity between 50 ohms and several megohms per square.

Checking End Play In Servo Motors

A SIMPLE V-SHAPED metal fixture, with a Starrett dial indicator gage mounted at one end, speeds checking of end play for all sizes and



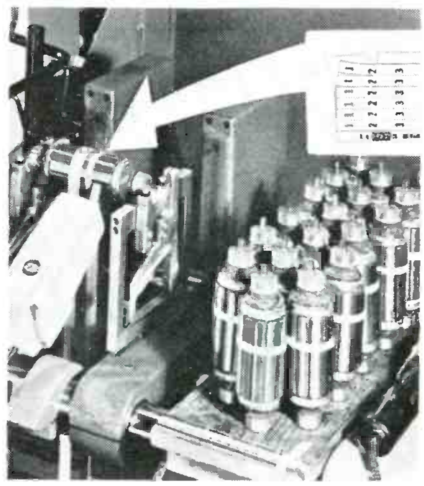
Method of using fixture for checking end play of precision servo motor

types of servo motors in the Westbury, N. Y. plant of the Mechatrol Div. of Servomechanisms, Inc.

The operator brings the projecting shaft of the motor up against the sensing shaft of the gage, then moves the shaft back and forth with tape-padded offset tweezers while watching the dial pointer. These motors are normally adjusted so that end play falls somewhere between 2 and 5 thousandths of an inch.

Tape Aids Balancing of Servo Rotors

PRINTED NUMBERS on self-sticking vinyl cloth tape are used on parts balanced with Gisholt dynamic balancers to achieve fast, accurate production. The close-tolerance printing on precision-cut tape strips manufactured by the W. H. Brady Co. of Milwaukee, Wisc. allows the unbalance to be read in



Use of indicator tapes on universal motor armatures illustrates how technique can be applied to rotors of servo motors, synchros and other rotating electronic components that require precision balancing

unit values easily understood by the operator.

The tapes are manufactured to precision lengths with uniform spacings between numerals to insure accurate stroboscopic reading of the work piece. The special adhesive adheres well to metal so no shifting occurs, even at high speeds. The tape leaves no sticky residue when removed, and may be used over again many times.

"I'M WITH UNIVAC"

"I'M WITH UNIVAC"®... your password to a new and exciting world of opportunity. A career with Univac takes you behind the scenes of important developments in national defense, scientific research, business and industry. The tremendous advances made by Univac in automatic data processing and automation vitally affect all of these fields.

Become a member of the team that designs and builds the world-famous Univac electronic computers. Build a future for yourself in the most fascinating, fastest-growing industry of our times. Investigate the outstanding opportunities now open to you at Univac – world leader in this industry.

You'll be proud to say: "I'M WITH UNIVAC."

Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION

Check the following openings at any of these three locations

PHILADELPHIA, PA.

Electronic Engineers, Logical Designers, Physicists, Programmers, Mathematicians. Send complete resumé to Mr. James Drumm, Dept. PMy-2, 1900 W. Allegheny Ave., Philadelphia, Pa.

SO. NORWALK, CONN.

Mechanical Engineers (graduates BS and MS levels), Design Engineers, with or without formal degree, if qualified. Send complete resumé to Mr. Robert Martin, Dept. NMy-2, Wilson Ave., South Norwalk, Conn.

ST. PAUL, MINN.

Electronics Engineers, Mechanical Engineers, Electronic Design Engineers, Engineering Writers, Physicists, Mathematicians. Send complete resumé to Mr. R. K. Patterson, Dept. SMy-2, Univac Park, St. Paul 16, Minn.

® Registered in U. S. Patent Office.

New Products

Edited by WILLIAM P. O'BRIEN

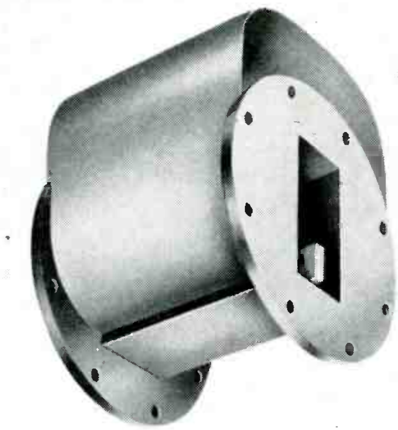
82 New Products and 45 Manufacturers' Bulletins Are Reviewed . . . Control, Testing and Measuring Equipment Described and Illustrated . . . Recent Tubes and Components Are Covered

FERRITE ISOLATOR

for the 2,700-2,900 mc range

AIRTRON, INC., 1101 West Elizabeth Ave., Linden, N. J., has announced a new S-band miniature ferrite isolator to furnish unidirectional magnetron to load isolation for high power radar systems.

The 400-kw resonant absorption isolator furnishes sufficient isolation between the magnetron and r-f energy reflected from line mismatches to insure optimum magnetron spectrum and power output with consequent good afc performance. Since the ferrite is mounted directly on the wave-



guide wall, heat conduction away from the ferrite is quite rapid, allowing operation at high power levels without forced air cooling.

The isolator was designed as a compact unit with optimum electrical characteristics. It operates over a frequency range of 2,700 to 2,900 mc, with an isolation of 15 db minimum, an insertion loss of 0.5 db and an input vswr of 1.10 with matched loads. It has a wide application in all radar designs whether airborne, missile, fire control or ground radar systems. The isolator has no movable or adjustable parts. **Circle P1 inside back cover.**

FLOATED RATE GYRO

meets rugged missile conditions

NORDEN-KETAY CORP., Commerce Road, Stamford, Conn. Model 55,-000 floated rate gyro was designed expressly to meet the rugged environmental conditions encountered in missiles. Accuracy better

than ± ½ percent full scale can be obtained. The gyro can be supplied in a variety of maximum rate ranges from 1 deg per sec to 1,000 deg per sec. It incorporates an inductive signal pickoff, which provides a higher power signal output than has previously been available in this size rate gyro. The power signal output enables the use of minimum gimbal displacement, consequently yielding high natural frequency.

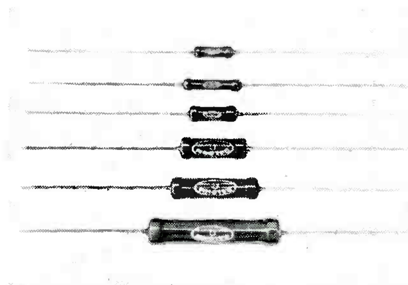
The gyro is completely filled with flotation fluid. This insulates the gimbal bearings from shock and vibration, and also provides damping.

Damping ratio is maintained without a heater by a novel arrangement, which provides for varying the gap between the gyro rotor float chamber and an adjacent member. The damping ratio can be established to suit customer requirements and maintained within 0.1 over the temperature range of −55 C to +85 C. **Circle P2 inside back cover.**

PRECISION RESISTORS

are noninductive wirewound

DALE PRODUCTS, INC., Box 136, Columbus, Nebraska. The Dalohm NS type are noninductive, wirewound, power resistors of miniature size. Silicone sealed, they offer protection from salt laden air and humidity. Their special



It takes a lot of doing to produce the exact same thing over and over again hundreds of thousands of times—without slipping up on a thousandth of an inch, watt, or milligram. This insistence on *uniformity* has helped build our reputation as the world's most Consistently Dependable producer of CAPACITORS. Continuously uniform production is a science —one that we've painstakingly pursued since 1910.

Typical of the "countless" C-D electrolytics used by major equipment manufacturers the world over are:

"EC" MINIATURIZED CERAMIC CASED TUBULARS For cramped-space applications in hearing aids, transistorized devices, and remote control assemblies. Less than ¼" D., only ¾" L.

"NL" ULTRA-SMALL Hermetically sealed aluminum cased electrolytics, built for compactness, ruggedness, low leakage, long shelf and in-use life.

TANTALUM 3 tubular types, all with low power-factor, moisture-impervious hermetic seal, long service and especially long shelf life. "TX" with sintered anode; "TAN" miniature foil type; sub-miniature, low-voltage wire anode type "NT".

TYPE "UP" Made in the smallest tubular aluminum cans possible for any given capacity and voltage combination. In single, dual, triple and quadruple capacity combinations.

Write for catalog to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

CONSISTENT HI-DEPENDABILITY
CORNELL-DUBILIER CAPACITORS

SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER & CAMBRIDGE, MASS.; PROVIDENCE & HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD, FUQUAY SPRINGS & VARINA, N. C.; VENICE, CALIF.; & SUB.: THE RADIART CORP., CLEVELAND, OHIO; CORNELL-DUBILIER ELECTRIC INTERNATIONAL, N. Y.

Want more information? Use post card on last page.

protective coating also provides maximum resistance to abrasion and high dielectric strength.

Complete welded construction from terminal to terminal provides exceptional unit strength. Careful design and precision manufacturing of NS resistors create maximum stability and reliability.

Available in five wattages—2, 3, 5, 7 and 10 w—and six physical sizes, the NS resistors can meet the most demanding requirements. Maximum continuous operating temperature is 275 C.

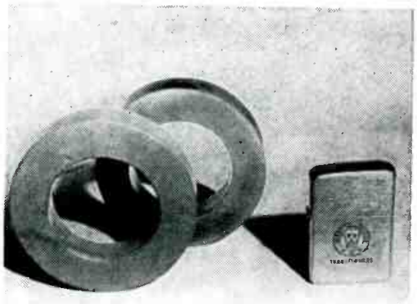
Resistance range is 1 ohm to 37,000 ohms, depending on size and tolerance. Temperature coefficient is 0.00002 per deg C. They are available in tolerances of 0.05, 0.1, 0.25, 0.5, 1 and 3 percent.

Bulletin R-34 gives complete information. **Circle P3 inside back cover.**

RESIN-INSULATED CORES

ring-type devices

WESTINGHOUSE ELECTRIC CORP., P.O. Box 2099, Pittsburgh 30, Pa. A new resin-insulated ring-type core made from grain oriented Hipersil steel in all gages from 1 to 12 mils thick is available. It is used for toroidal core designs ranging in size from small blocking-oscillator pulse transformers through large power units.

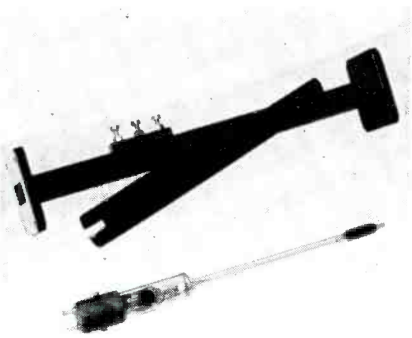


Windings can be placed directly on the core, eliminating the need either to tape the core or to encase it in a plastic or aluminum box.

The resin coating is continuous and smooth. Corners are rounded to eliminate any possibility of shorting wire to core. The coating does not impair magnetic properties of the core and withstands a voltage to ground of 2,500 v. **Circle P4 inside back cover.**

X-BAND NOISE TUBE

features small size and weight



FERRANTI ELECTRIC INC., 30 Rockefeller Plaza, New York 20, N. Y. Type TE10 noise tube provides a stable noise source of small size and weight which can be built into X-band systems to provide a regular check on receiver performance, and is also useful for production and general test purposes.

The wave guide mount is fitted with a three-screw matching section which is normally set for operation at 9,375 mc with a vswr of 1.01. Under these conditions the vswr with the tube in operation is less than 1.25 over the range 8,900-9,800 mc, with a noise output of 15.5 db and a nonoperating insertion loss of less than 0.2 db. The matching section can be tuned to a center frequency anywhere in the band 8,500–10,500 mc.

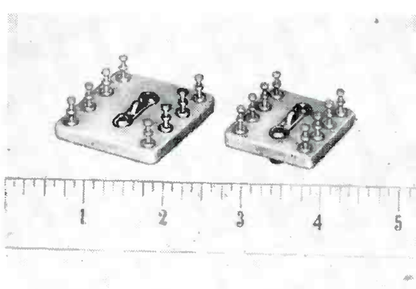
A simple resonant circuit provides for striking and operating the tube from a 150 v 35 ma d-c supply. **Circle P5 inside back cover.**

TERMINAL BOARDS

designed for high temperature uses

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass. Types X2036 and X2030 ceramic terminal boards are ideal for applications in equipment that will be subjected to high temperature.

Standards for the board are in accustomed CTC practice. Terminals, type X2034-C are silver-plated brass and the ground straps are silver-plated copper. The insulation material is Grade L-5 ceramic, silicone impregnated. Mounting studs are 4-40 internal thread.



The X2036 is 1 17/32 in. long by 1 3/8 in. wide. The X2030 is 1 1/4 in. long by 1 3/16 in. wide. Both units stand approximately 5/8 in. high overall when mounted. **Circle P6 inside back cover.**

ENVIRONMENTAL CABINET

built to specifications

ATMOSPHERE CONTROL CO., INC., 5315 Chester Ave., Philadelphia 43, Pa., announces an environmental cabinet that is custom-

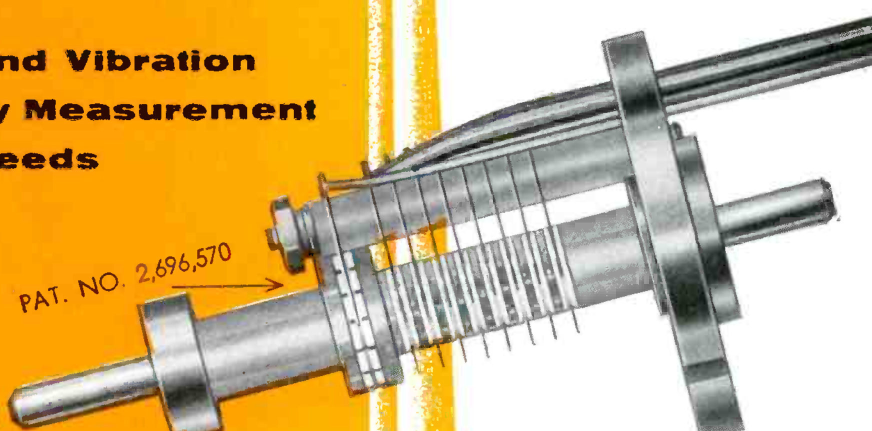
For ACCURATE HIGH SPEED SWITCHING...

Specify

ELECTRO TEC miniature ultra low torque Precision Selector Switch

- Withstands Shock and Vibration
- Offers High Accuracy Measurement
- Operates at High Speeds

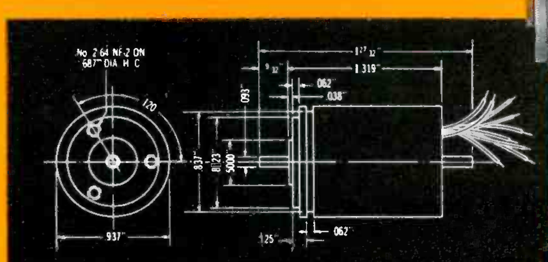
This new Electro Tec Precision Selector Switch is ideal where miniature size, low friction torque, high accuracy, and low electrical noise at high speeds are requirements. Simplified circuits and long service life recommend it for a wide variety of uses including sampling, pulse generation for precision measurement, telemetering and strain gage applications, in aircraft, missiles, servos, computors, etc. Switch design incorporates many exclusive features that have gained industry-wide acclaim for Electro Tec precision slip rings, commutators and brush blocks.



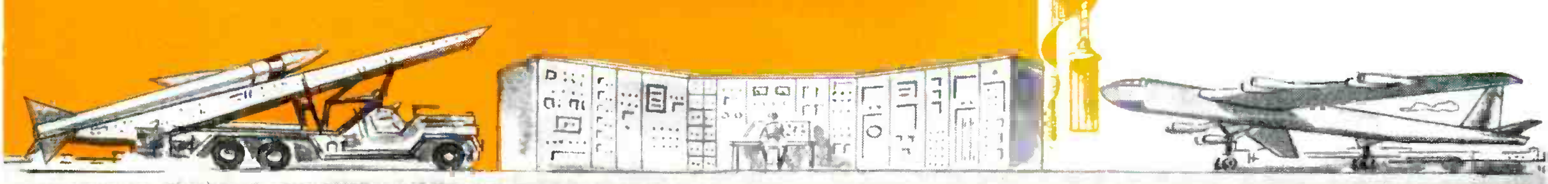
CALL OR WRITE FOR ILLUSTRATED BROCHURE

8 or 10 position switches in standard size 10 synchro housings are available for immediate delivery; other circuit combinations supplied to specifications.

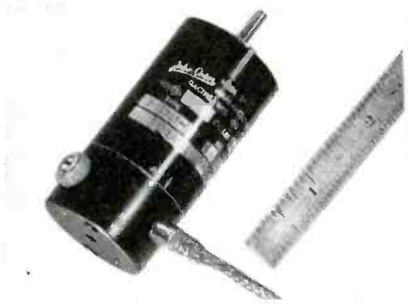
ACTUAL SIZE



Electro Tec Corp.
SO. HACKENSACK
NEW JERSEY
Tel.: HUbbard 7-4940



built to the customer's specifications of temperature, humidity, altitude, vacuum and pressure. The complete control system is of the electronic program type made by Minneapolis-Honeywell, or other, according to customer's preference. The cabinet can be used either with altitude or without and can be used simply as a temperature and humidity test chamber when desired. Customers can have 3 to 5 feet of testing space in these cabinets, according to their needs. **Circle P7 inside back cover.**



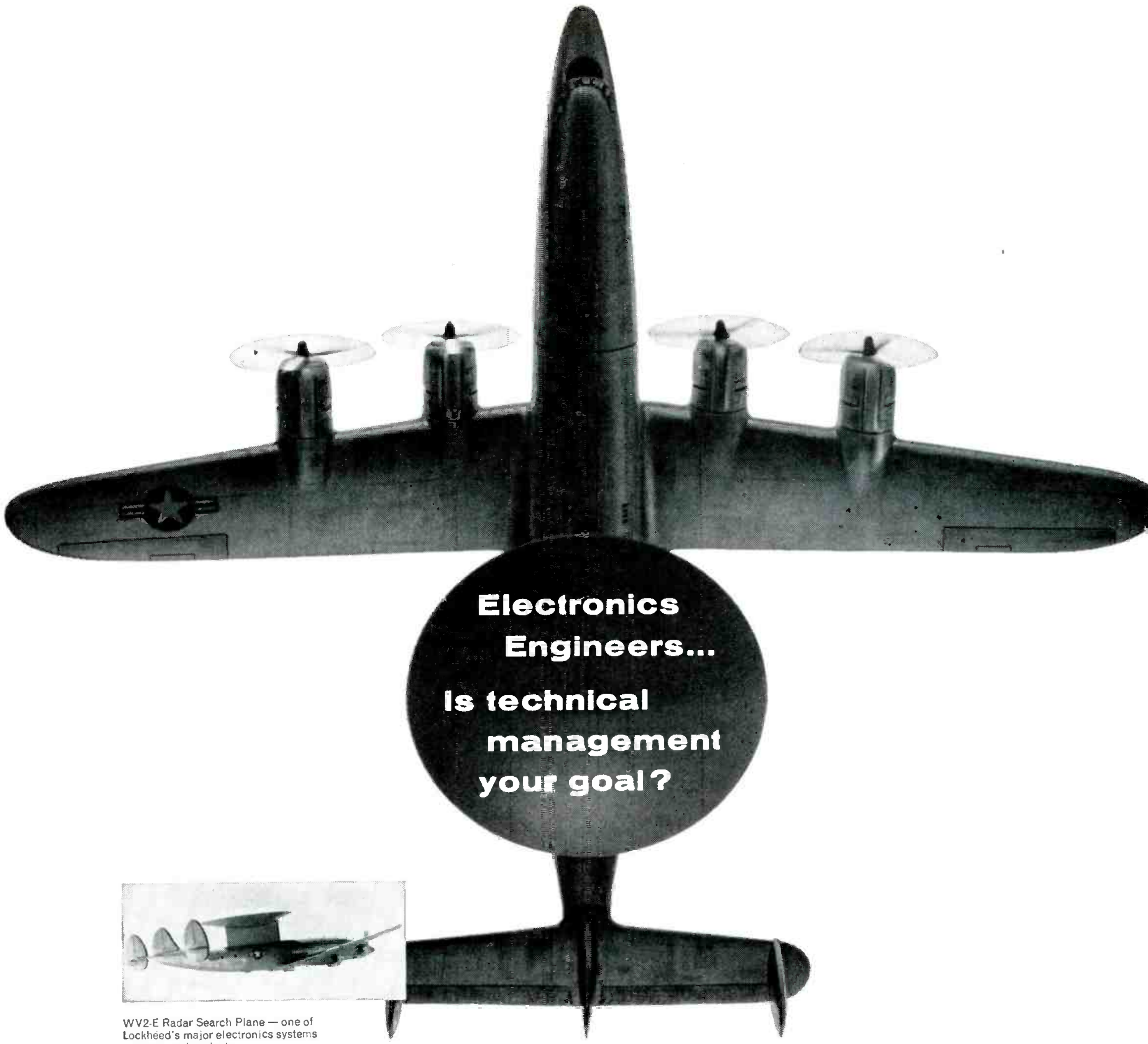
D-C GENERATOR
features high output

JOHN OSTER MFG. CO., Avionic Division, 1 Main St., Racine, Wisc., has developed a permanent magnet d-c generator with a new high output for its size and weight. Type 13-PG-6901-01 has a 10-w output at 10 v minimum d-c at 8,000-rpm continuous duty with 1,000-hr life and 25 C maximum temperature rise.

Diameter is 1.25 in., length 2.6 in. and weight 7 oz. It can be made to meet MIL-E-5272A. The device has 3 oz-in. input torque and is face mounted. It is designed for any d-c generator application requiring exceptionally high d-c output. **Circle P8 inside back cover.**

INSULATED TERMINALS
for stand-offs, feed-throughs

SEALECTRO CORP., 610 Fayette Ave., Mamaroneck, N. Y. Dispensing with threads, nuts, washers, lockwashers and seals, by taking full advantage of Teflon insulation and press-fitted installation, these tiny insulated terminals were designed



WV2-E Radar Search Plane — one of Lockheed's major electronics systems management projects

Technical management of electronics systems is the primary responsibility of Lockheed's Electronics and Armament Systems Division.

Engineers in the division supervise and participate in conceiving advanced systems and then performing research, development and evaluation up to production stages on all Lockheed aircraft—radar search planes, high-speed fighters, propjet cargo and passenger transports, small turbojet transports, bombers, jet trainers and other significant classified projects.

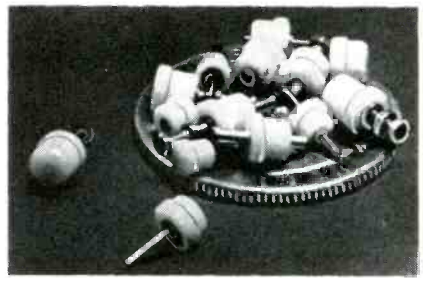
Technical management positions are open in fields of:

Fire control, radar, countermeasures, inertial systems, weapons, communications, infrared, optics, sonics, magnetics, antennas and microwaves.

Inquiries are invited from Electronics Engineers and Physicists possessing experience or keen interest in technical management. Address E. W. Des Lauriers, Technical Management.

California Division **LOCKHEED**

AIRCRAFT CORPORATION • BURBANK, CALIFORNIA



for the company's Press-Fit stand-offs and feed-throughs.

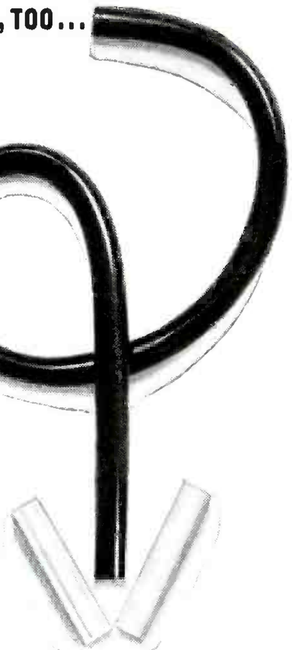
Sealectro Press-Fit subminiature terminals range from 0.093 in. in diameter and from 0.250 in. to 0.5 in. overall height depending on whether they are stand-offs or feed-throughs. Such terminals simply press-fit into chassis holes with a simple insertion tool and drill-press equipment.

Despite diminutive size, permitting use in the most compact equipment and tightest spots, these terminals withstand the severest service requirements such as in guided missiles, radar, communications equipment and electronic computers where breakdowns and any loosening cannot be tolerated. **Circle P9 inside back cover.**

GALVANOMETER
a combination instrument

KIN TEL (Kay Lab), 5725 Kearny Villa Rd., San Diego, Calif. Model 204A electronic galvanometer is a combination d-c null detector, linear deflection indicator, micro-voltmeter, micro-microammeter, and low-level d-c amplifier. The chopper stabilized, all transistor circuit provides many added features over conventional moving

Want more information? Use post card on last page.



coil and electronic galvanometers.

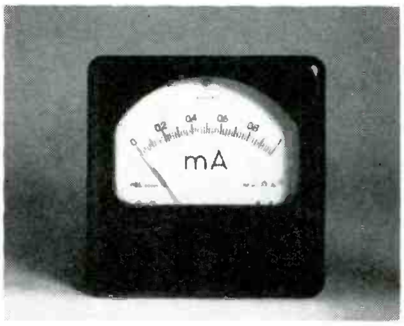
The instrument is insensitive to vibration, shock, microphonics, earth's magnetic field and stray pickup. It can withstand severe overloading with no offset on return to zero and has rapid response. Seven decaded ranges cover d-c voltages from 10 μv to 10 v full scale or currents from 0.001 μa to 1 ma full scale. The sensitivity control functions as an attenuator and is calibrated in attenuation. Input resistance is a constant 10,000 ohms.

Further information on the unit is available from the company. **Circle P10 inside back cover.**

TV CAMERA TUBES
two new types

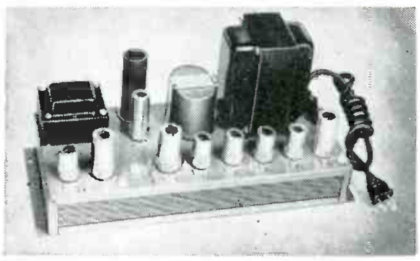
GENERAL ELECTRODYNAMICS CORP., Garland, Texas, has announced production and immediate availability of two new types of Vidicon tv camera tubes. These are the GEC 6198-A (illustrated) intended primarily for industrial use, and the 6326-A, a studio-quality tube for film-scanning and live broadcast purposes.

New design features which have been incorporated in these 1-in. camera tubes are the elimination of the side tip which characterized earlier models, and the inclusion of a special particle shield to keep any loose particles of cathode and getter material from falling on the light-sensitive surface. This makes it possible for these GEC Vidicons to be operated in the face-down position, previously not recommended. **Circle P11 inside back cover.**



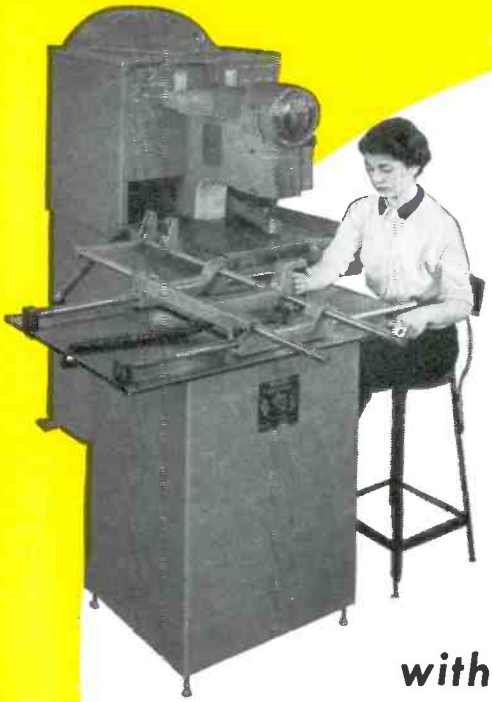
METERS
made to specifications

PHYSICS RESEARCH LABORATORIES, INC., P. O. Box 555, Hempstead, N. Y., announces a new line of 0.5-percent d-c moving ammeters, milliammeters, microammeters, voltmeters and millivoltmeters made in Switzerland to PRL specifications. The voltmeters have an internal resistance of 1,000 ohms per v. The ammeters are rated at 150 mv. All instruments come with mirror scales and knife-edge blade-type pointers. **Circle P12 inside back cover.**



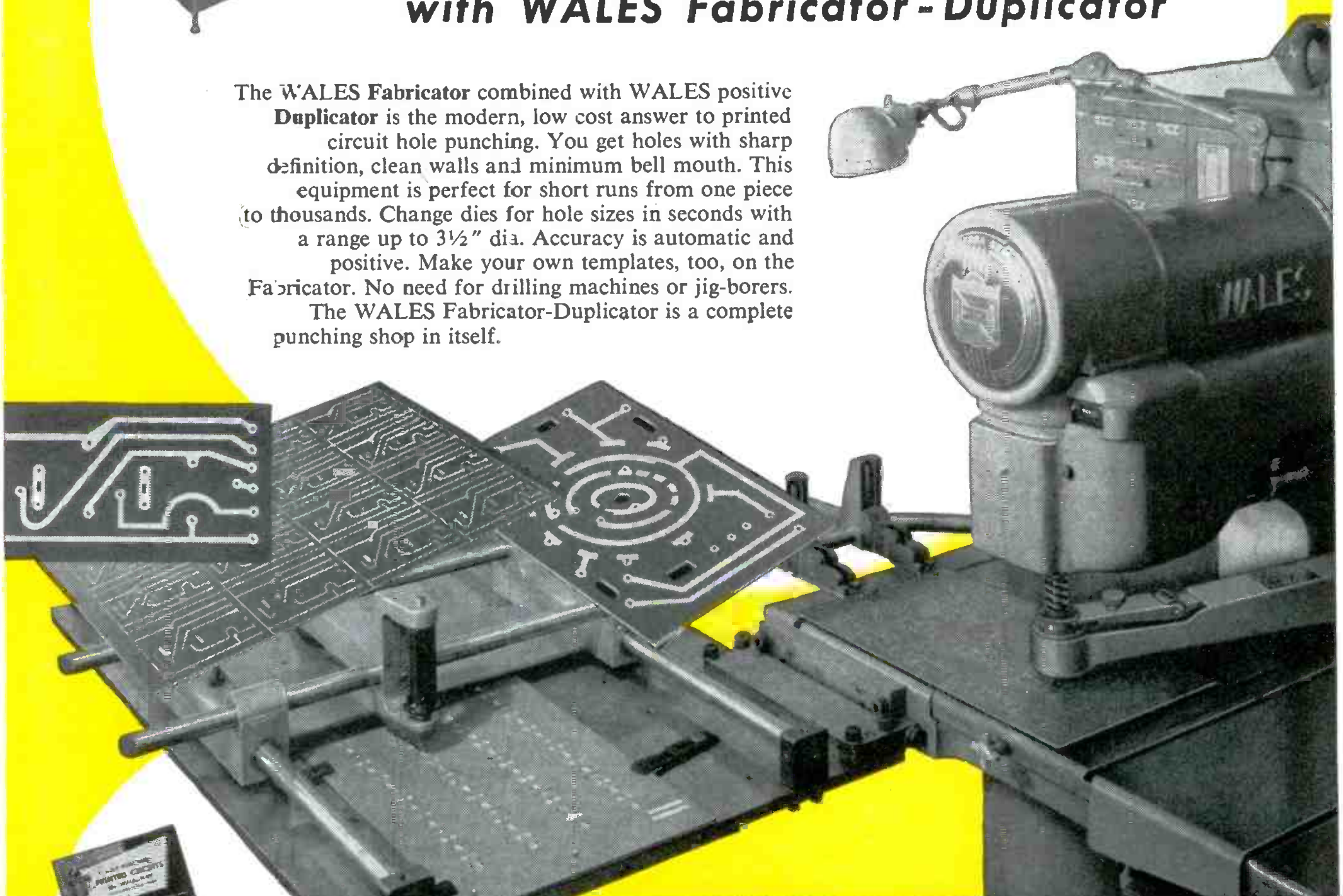
R-F AMPLIFIER
for 54-88 mc use

WESTBURY ELECTRONICS, INC., 300 Shames Drive, Westbury, N. Y. Model ABB-1 broad band r-f amplifier has been developed for industrial tv use for channels 2 through 6 (54-88 mc). It is designed for continuous commercial service and features a simplified tilt control system which permits equalization of cable characteristics over the entire pass band. High signal-to-noise ratio is pro-



Punch
PRINTED CIRCUITS
Cold...
with WALES Fabricator-Duplicator

The WALES **Fabricator** combined with WALES positive **Duplicator** is the modern, low cost answer to printed circuit hole punching. You get holes with sharp definition, clean walls and minimum bell mouth. This equipment is perfect for short runs from one piece to thousands. Change dies for hole sizes in seconds with a range up to 3½" dia. Accuracy is automatic and positive. Make your own templates, too, on the Fabricator. No need for drilling machines or jig-borers. The WALES Fabricator-Duplicator is a complete punching shop in itself.



SEND FOR BULLETIN NO. 13F

Complete specifications and capacities are yours for the asking.

WALES Strippit COMPANY

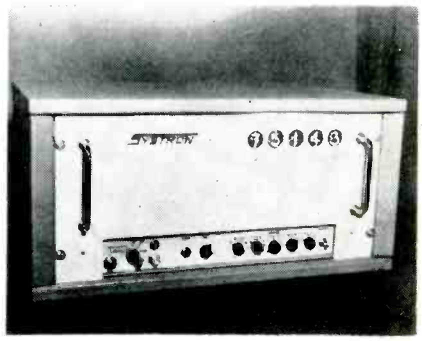
"...the Wales-Way is the PLUS-PROFIT way"

AKRON, NEW YORK

WALES-STRIPPIT OF CANADA LTD., HAMILTON, ONT.

vided by a cascode input circuit matched to 75 ohms for no reflections. Gain is 45 db at midband with a factory aligned 8-db slope. A matched 75-ohm output conservatively provides 0.3 v per channel or 2-v composite undistorted output.

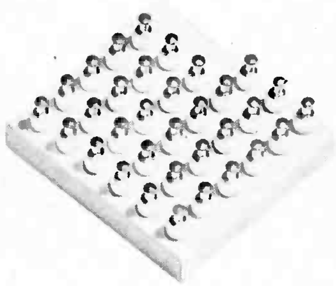
The output signal level is held to 1.5 db for a 10-db input swing by an agc circuit. The output level control permits adjustment of gain while maintaining slope linearity to ±0.5 db over the pass band. A constant voltage power transformer provides filament and plate regulation to 2 percent. Noncritical circuits insure complete stability. **Circle P13 inside back cover.**



DIGIT-SET COUNTER
is extremely flexible

SYSTRON CORP., 2055 Concord Blvd., Concord, Calif. Model 1040 digit-set universal counter is a truly industrial frequency counter designed for reliable measurement of flow, speed, pressure, temperature and other analog quantities that can be converted into frequencies. Exclusive features include the Nixie in-line readout and the use of the magnetron beam switching tubes. It also provides time base selection from 1 millisec to 100 sec in 1 millisec increments, nonoverloading amplifiers from 5 mv to 100 v from 5 cps to 100 kc, and printed readout facility.

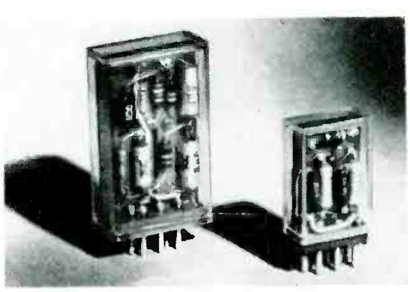
High reliability is obtained by use of 50,000 hr magnetron beam switching tubes in the counting and dividing circuits. This plus a self-checking feature and recessed tamperproof panel make the unit well suited for industrial applications and a wide variety of data processing systems. On the other hand, its extreme flexibility as a frequency counter, pulse interval generator, and frequency ratio make the model 1040 also useful as a laboratory instrument. **Circle P14 inside back cover.**



SUBMINIATURE TERMINALS

no need to solder in headers

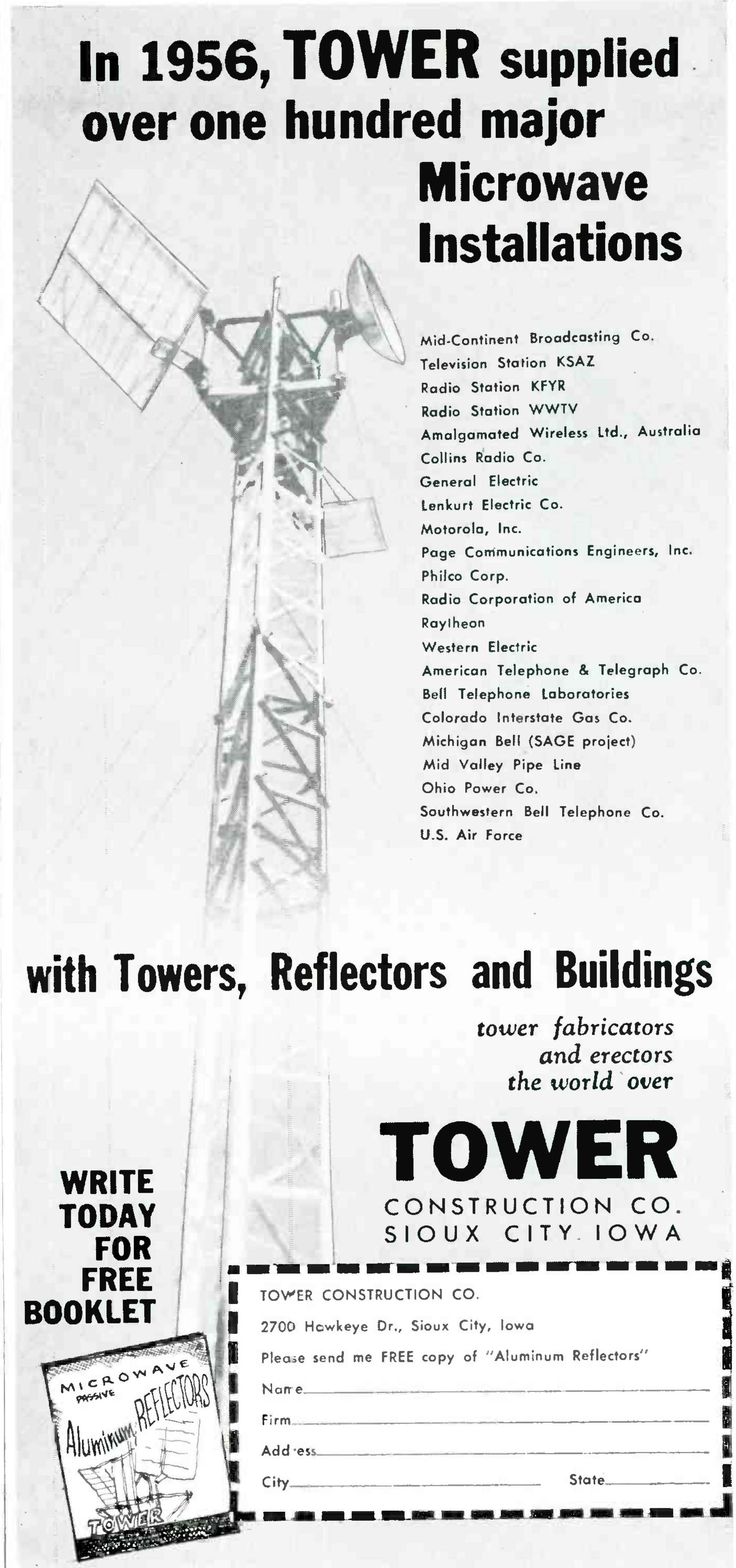
THE SPHERE CO., INC., 25 Amity St., Little Falls, N. J., announces the availability of a line of subminiature terminals designed to keep pace with the demand for miniaturization of components. The terminals, measuring only 0.170 in. in diameter by ¼ in. outside height by 1/16 in. inside height, feature a teflon coated outer insulator, and are available in either feed-through or turret head styles. A particularly important feature is that they can be assembled directly to the panel, thereby allowing unlimited patterns and eliminating the necessity of soldering in headers. **Circle P15 inside back cover.**



LITTLE AMPLIFIERS

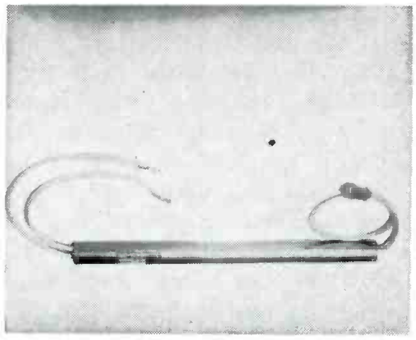
use transistors

VENNER ELECTRONICS LTD., Kingston By-Pass, New Malden, England, has produced two types of transistorized amplifier. The first is intended for frequencies in the



audio range and has a response flat within 3 db from 120 cps to 10 kc. The second is intended for industrial applications and has a response within 3 db from 15 cps to 125 kc. Voltage gains of the amplifiers are similar, between 900 and 1,000. Each consists of two stages which may be used separately or in cascade, the individual stage gains being of the order of 60. The amplifiers are assembled in plastic cases and are mounted on small 8-pin bases. The pin connections are identical.

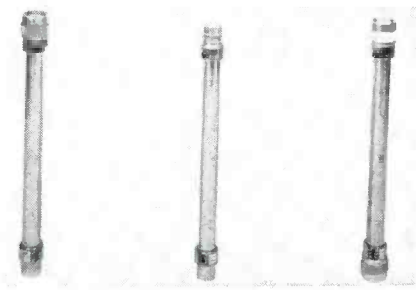
The units are small and lightweight. Both amplifiers are R-C coupled and employ temperature compensation circuits to give satisfactory working from −10 C to + 50 C. The amplifiers are designed to work from a nominal 10-v supply but will function with supplies from 1.5 v d-c to 12 v d-c. With a 10-v supply the maximum undistorted output is 2 v rms. **Circle P16 inside back cover.**



TWT AMPLIFIER
low-noise, L-band type

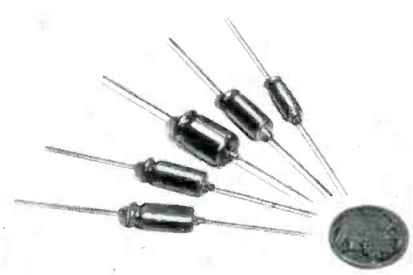
HUGGINS LABORATORIES, INC., 711 Hamilton Ave., Menlo Park, Calif. The HA-14 broadband t-w amplifier operates from 1.0 to 2.0 kmc without the necessity of any electrical or mechanical operating adjustments. The tube is a high gain, low noise broadband device suitable as the first stage of a receiver in many microwave applications. Noise figure reduction is accomplished by multi-anode techniques in gun construction, with all electrode potentials less than 200 v.

Specifications include: noise figure, 10 db maximum; small signal gain, 30 db minimum; saturation gain, 25 db; magnetic field, 1,000 gauss; capsule length, 15½ in.; capsule diameter, 1.0 in.; net weight, 1 lb. **Circle P17 inside back cover.**



COAXIAL ATTENUATORS
cover 1,000 to 10,000 mc

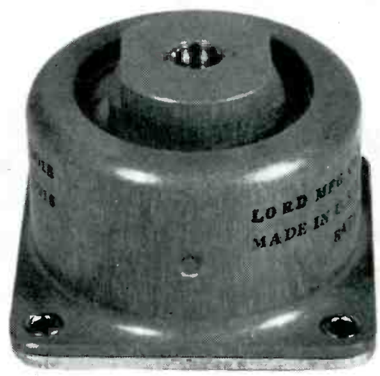
WEINSCHEL ENGINEERING, 10503 Metropolitan Ave., Kensington, Md., announces models 520, 521 and 522 broad-band coaxial attenuators having type C connectors covering the frequency range of 1,000 to 10,000 mc. Units in these series are available in 1-db steps from 1 to 10 db. Typical properties of a 3-db unit (model 520–3) are: 5-w average, 10-kw peak power input; accuracy at 4 kmc—3 ±0.1 db; maximum frequency sensitivity from 1,000 to 10,000 mc—0.4 db. **Circle P18 inside back cover.**



ELECTROLYTICS
aluminum cased

P. R. MALLORY & CO., INC., 3029 E. Washington St., Indianapolis 6, Ind., has announced a line of low-cost subminiature aluminum-cased electrolytic capacitors. These TT line capacitors are ideal for new circuit designs requiring dependable components and miniaturization. They are especially suited to transistor and battery-operated equipment.

The TT line is available in over 30 capacity and voltage ratings, from 1 to 110 μf, and from 1 to 50 v working. The smallest unit of the line is only $\frac{3}{16}$ in. diameter by $\frac{1}{2}$ in. long. The aluminum case uses silicone-rubber hermetic seals. The No. 22 wire leads are $1\frac{3}{4}$ in. long and can be had with insulating sleeves if desired. The TT line features an operating temperature range of from −20 to 65 C. **Circle P19 inside back cover.**



HEAVY-DUTY MOUNTING
compact in size

LORD MFG. CO., 1635 West 12th St., Erie, Pa., announces a new series of heavy duty Temproof mountings for use on heavy electronic equipment. This new mounting features (1) load capacities above 60 lb, (2) temperature resistance from −80 to +250 F, (3) superior vibration isolation performance in severe operating conditions.

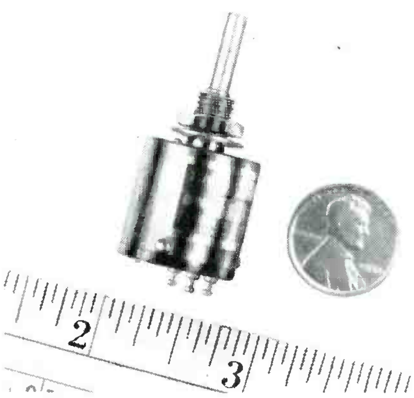
Compact in size, the new Temproof mounting is designed to meet the specification requirements of MIL-C-172B and is self-damping in its resonant range. The mountings support loads in either the upward or downward direction. **Circle P20 inside back cover.**

TWIN TRIODE
for computer applications

RADIO CORP. OF AMERICA, Harrison, N. J. A medium-mu twin triode (RCA-6350) of the nine-pin miniature type, designed for use in a wide variety of applications in high-speed digital electronic computers and other on-off control equipment, has been introduced.

In such service the 6350 maintains its emission capabilities even after long periods of operation under cutoff conditions, thereby providing good consistency of plate current during its "on" cycles. Balance of cutoff bias between the two units of the tube is closely controlled during manufacture. Production controls carried out under typical electronic computer operating conditions and rigorous tests for interelectrode leakage, high resistance, intermittent shorts and cathode interface, insure long dependable performance from the 6350.

The 6350 has separate terminals for each cathode to facilitate flexibility of circuit arrangement and a mid-tapped heater to permit operation from either a 6.3-v or a 12.6-v supply. **Circle P21 inside back cover.**

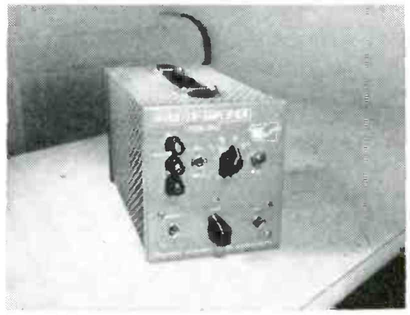


PRECISION POT
miniaturized, low cost

MAUREY INSTRUMENT CORP., 7924 S. Exchange Ave., Chicago 17, Ill. A $\frac{3}{4}$ in. diameter by $\frac{3}{4}$ in. long, 2-w, precision wirewound potentiometer has been developed to meet the needs of a wide variety of commercial and military applications. A one-piece anodized aluminum housing secures a low loss phenolic terminal board and winding assembly. Special design attention has been given to maintain the shaft torque to a minimum; 0.05 oz-in. is standard, 0.02 oz-in. is available on special request.

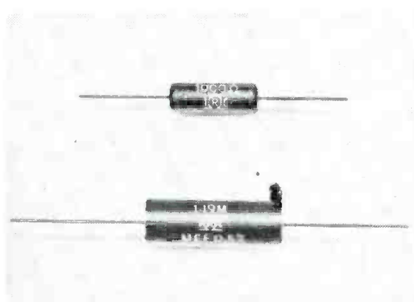
An independent linearity of 1 percent is standard; better linearity can be provided. The Maureypot precision potentiometer is available in a servo mounting (75-M27), or threaded bushing

(75-M7), with a wide selection of shaft lengths. Standard resistance values range from 25 ohms to 50 K. **Circle P22 inside back cover.**



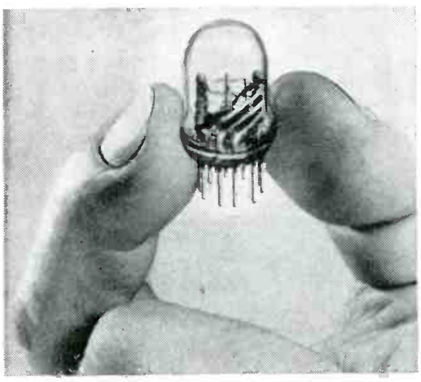
D-C AMPLIFIER
for pen-motor recorders

ALLEGANY INSTRUMENT CO., 1091 Wills Mountain, Cumberland, Md. Model 405 is a trouble-free d-c pen-motor amplifier featuring low drift, voltage gain of 30,000 and a unique amplification technique which results in high stability without sacrificing its long-life characteristics. The power supply is self-contained. The 405 can be used with wire strain gages, load and pressure cells, acceleration transducers and thermocouples; an incorporated attenuator permits inputs as high as 500 mv without overloading the instrument. **Circle P23 inside back cover.**



METAL FILM RESISTOR
two new types

INTERNATIONAL RESISTANCE CO., 401 North Broad St., Philadelphia 8, Pa., has added types MEC and MEF metal film precision resistors to its line. Available in two molded sizes, ½ and 1 watt, these close tolerance units are manufactured to exacting quality standards and have a metallic resistive film firmly bonded to a specially compounded ceramic core. Designed to combine high accuracy and stability with low and controllable temperature coefficients, types MEC and MEF resistors also provide low noise and negligible voltage coefficient and have low capacitance and inductance which permits their use in high-frequency applications. Units for special requirements can be supplied. **Circle P24 inside back cover.**

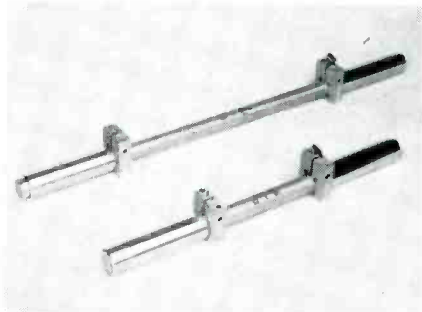


READ-OUT TUBE
all-electronic device

Burroughs Corp., Electronic Tube Division, Plainfield, N. J., has announced a miniature, all-electronic device which converts electronic signals directly to readable characters—the miniature Nixie. It is a gas-filled, cold cathode, 10-digit numerical indicator tube having a common anode. It is intended for use as a direct, in-line, read-out device.

Four times smaller than the standard Nixie, the miniature is 6/10 in. in diameter, ¾ in. high, and clearly visible at 10 ft. The miniature tube utilizes 100 v and operates at ⅛ w. Other features include rugged construction, simple plug-in stem, perfectly formed figures precisely aligned, and controllable brilliance. It is not affected by environmental conditions.

Designed for miniaturized instrumentation, the miniature Nixie has applications wherever readout is required; for example: aircraft instrument panels, computers, industrial control, counters, military electronic indicators, digital voltmeters, fiuid meters, elevators and channel indicators. Circle **P25 inside back cover.**

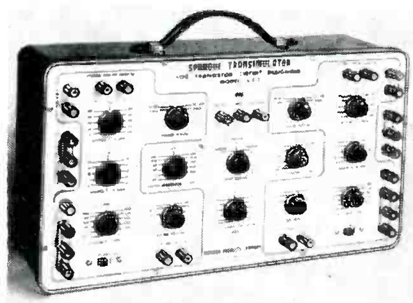


FIXED DELAY LINES
magnetostrictive type

DELTIME, INC., 608 Fayette Ave., Mamaroneck, N. Y., has announced fixed delay lines in a wide range of different sizes and ratings. These model 104 units are available in fixed delays from 2 to 200 μsec or more. Electrical characteristics may be specified by the user. Intermediate outputs may be incorporated.

These tubular units are suitable for incorporation in computer equipment and other commercial assemblies. They are resistant to shock and vibration. Terminal blocks measure only 1½ by 1¼ in., while the tubular casing, dependent upon the delay factor, can be up to several feet long.

Literature on model 104 Deltime units, as well as other models of delay lines, will be sent on request. **Circle P26 inside back cover.**



TRANSISTOR CIRCUIT SIMULATOR
eliminates breadboard layout

SPRAGUE PRODUCTS CO., 35 Marshall St., North Adams, Mass., has introduced an instrument that eliminates breadboard layout by simulating complete transistorized amplifier stages. Named the LF-1 Transimulator, the unit is priced at $79.50 net, less batteries.

Any a-c or direct-coupled amplifier stage, except high power audio output stages, can be simulated with the LF-1, as can multivibrator, switching, phasing, push-pull, class A and B circuits, and others by using cross-coupled Transimulators. Common or grounded emitter, base or collector circuits may be simulated using *pnp*, *npn* or surface-barrier transistors. A separate Transimulator can be used for each stage to permit simultaneous multistage operation or circuits can be simulated stage-by-stage for cascade operation. **Circle P27 inside back cover.**

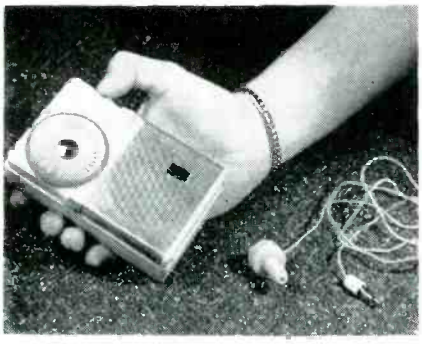
BROAD-BAND VOLTMETER
is all transistorized

KAY ELECTRIC CO., 14 Maple Ave., Pine Brook, N. J. The Transvolter model Video, all transistorized broad-band audio-video voltmeter, has been announced. It provides all the advantages inherent in an instrument designed with transistors in place of vacuum tubes—small size, light weight, portability, long life, low power consumption and high conversion efficiency.

A wide-band high-frequency, low-level transistorized voltmeter, the Transvolter incorporates a negative feedback amplifier which insures long, stable operation and permits the replacement of transistors without impairing the stability of the instrument.

Frequency range is 10 cps to

10 mc; direct reading in volts and db. Literature and prices are available. **Circle P28 inside back cover.**



POCKET-SIZE RADIO
uses six transistors

TOKYO TSUSHIN KOGYO, LTD., 351 Kitashinagawa-6, Shinagawa, Tokyo, Japan, has in production the TR-63 six-transistor pocket-sized superheterodyne radio with a built-in dynamic speaker. A varistor avoids damage to the transistors even if one reverses the polarity of battery by mistake. Also, it helps in not affecting the sensitivity and sound quality due to change of temperature.

Frequency range is 535 to 1,605 kc. Maximum undistorted output is approximately 20 mw. Selectivity is approximately −15 db, 10 kc off. The radio uses a built-in a p-m dynamic speaker and a 9-v battery. Size is 4.4 by 2.8 by 1.3 in. Weight is approximately 0.6 lb. Accessories are an earphone and a leather cover. **Circle P29 inside back cover.**

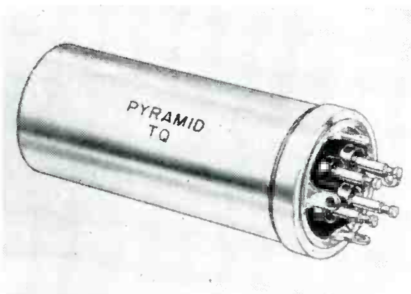
SILVER ALLOY
in wire and sheet form

THE VENTURE CORP., 30 Fulton St., Newark, N. J., has introduced a new silver alloy, Ventureloy II, which has found wide acceptance as electrical contact material. In the form of wire, it is finding acceptance in certain uhf and vhf applications. The alloy is also available in sheet form.

The electrical conductivity of Ventureloy II is upward of 75 percent IACS. Its tensile strength and hardness is greater than that of coin or sterling silver. As electrical contact material it has performed better than silver-cadmium oxide and some other refractory contacts. It can take greater current loads, higher frequencies of operation and greater contact forces. **Circle P30 inside back cover.**

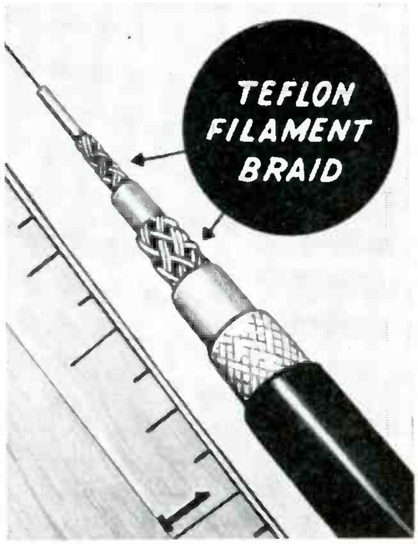
ELECTROSTATIC GENERATOR
for use as a test instrument

DOMINIQUE GIGNOUX, 50 Broadway, New York 4, N. Y. A highly stabilized power supply has been developed by Societe Anonyme De Machines Electrostatiques for use as a test instrument for the supply of electron microscopes and projection tv systems. Rated at 150 kv 2.5 ma, this power supply has a stability of 0.1 percent and consists essentially of a Felici type electrostatic generator. **Circle P31 inside back cover.**



ELECTROLYTICS
for high reliability

PYRAMID ELECTRIC CO., North Bergen, N. J., has announced a new electrolytic capacitor designed for applications with high-reliability electronic equipment. Designated as type TQ, it is manufactured under quality controlled processes with special attention to vibration, container seal and life test. It is capable of long life, trouble free performance. **Circle P32 inside back cover.**



DIELECTRIC CABLE
high temperature, low capacitance

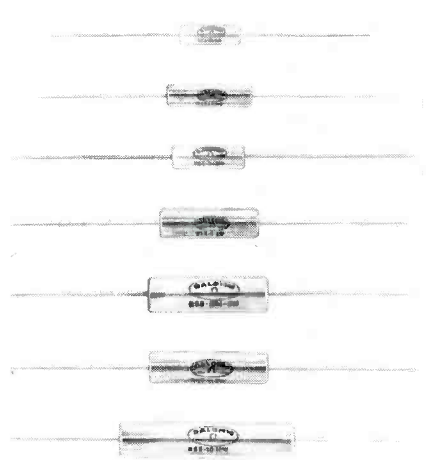
TENSOLITE INSULATED WIRE CO., INC., 198 Main St., Tarrytown, N. Y., has developed a Teflon-air dielectric miniature coaxial cable. The recently developed cable has a nominal overall diameter of 0.220 in. The conductor is No. 30 Awg, 7/38 silver plated copperweld.

The low attenuation of the 10-$\mu\mu$f cable makes it particularly useful for high-frequency, low-level applications and as low-capacitance probe cable. Capacitance values of less than 10 $\mu\mu$f, with somewhat larger overall diameters, are also available on request. **Circle P33 inside back cover.**

BEAM POWER TUBE
for tv and radio receivers

RADIO CORP. OF AMERICA, Harrison, N. J., has introduced a new beam power tube of the seven-pin miniature type designed for use as a class A amplifier in the audio output stage of tv and radio receivers.

The RCA-6DS5, when used in cathode-bias circuits, can deliver a maximum-signal power output of approximately 3.6 w with a peak a-f grid No. 1 voltage of only 9.2 v. Cool operation of grid No. 1, made possible by structural design, minimizes grid emission. Because of this feature, the 6DS5 can be used with cathode bias and a relatively large value of grid-No. 1 circuit resistance. This feature is particularly significant in tv receivers where the audio output tube is driven directly by the f-m detector tube. **Circle P34 inside back cover.**

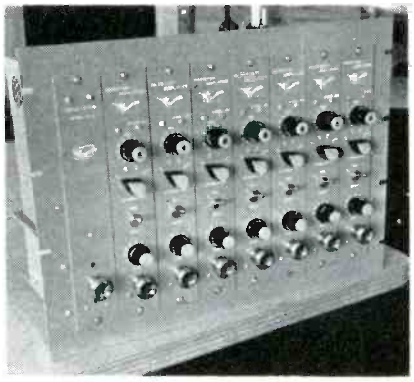


POWER RESISTOR
has 5 wattages in 7 sizes

DALE PRODUCTS INC., Box 136, Columbus, Nebraska. Dalohm RSE type resistors now include five wattage ratings from 2 to 10 w, in seven sizes, with resistance ranges of 0.5 ohm to 175,000 ohms, depending on size and tolerance. Precision tolerances of the RSE resistors are 0.05 percent, 0.1 percent, 0.25 percent, 0.5 percent, 1 percent and 3 percent.

The resistor discussed is a wirewound precision resistor inserted into a nickel plated brass tube. The resistor element is surrounded by a resilient material as it is inserted into the protective brass tubing. The whole assembly provides trouble-free operation under the most demanding environmental conditions.

Maximum continuous operating temperature is 275 C. Substantial increases in power dissipation (up to 50 percent) may be obtained when RSE resistors are clip-mounted to chassis. **Circle P35 inside back cover.**



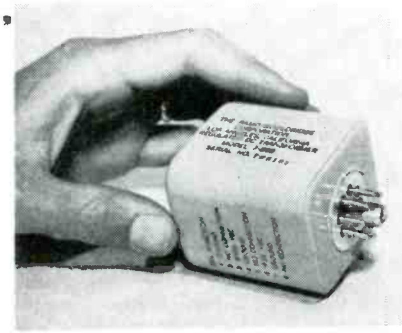
AMPLIFIER PACKAGE
for cro's and tape recorders

ALLEGANY INSTRUMENT CO., INC., 1091 Wills Mountain, Cumberland, Md. For those who employ c-r oscillographs and tape recorders, Alinco offers a new seven-channel d-c amplifier package for use with wire strain gages, load and pressure transducers, accelerometers and thermocouples.

Employing a unique amplification technique which features built-in power supply, the model 210's system insures that the signal from the phenomenon under study is not disturbed in the band-pass frequency. This seven-channel package, supplied for 19-in. rack mounting, features high gain, low drift, frequency response of d-c to 10 kc, balanced input and high output impedance. There is no operational delay when these instruments are overloaded. Literature is available from the company. **Circle P36 inside back cover.**

D-C TRANSFORMER
used in extreme environments

ELECTRONIC INSTRUMENTATION DIVISION, The Ramo-Wooldridge Corp., P.O. Box 8405, Denver 10, Colo. Designed for use in high-performance aircraft, missile systems and other applications in extreme environmental conditions, this 900-v regulated d-c current transformer is potted in epoxy resin and sealed. It operates over an ambient temperature range of −55 to 71 C and is unaffected by



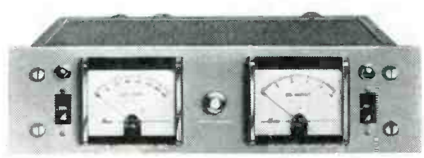
extremes of shock and vibration.

The new power package operates on 24 to 32-v d-c input and delivers 900-v d-c at 30 μa, regulated within 3 percent. Output ripple is regulated within 3 v peak-to-peak. The entire unit—transistorized switching circuit, transformer, rectifier and regulator—is integrated in a 2 by $2\frac{1}{4}$ by $2\frac{3}{4}$ in. package. **Circle P37 inside back cover.**

CAPACITOR TERMINALS
hermetic seal units

SPHERE CO., INC., Eagle Rock Bldg., 25 Amity St., Little Falls, N. J., has available a new line of hermetic seal terminals developed specifically for sealed capacitors. The terminals feature silicone insulation; twist-free construction, eliminating the annoyance and danger of terminals turning; and extremely low, space saving inside height.

They are available in both type B feed-through styles and type E post styles. **Circle P38 inside back cover.**

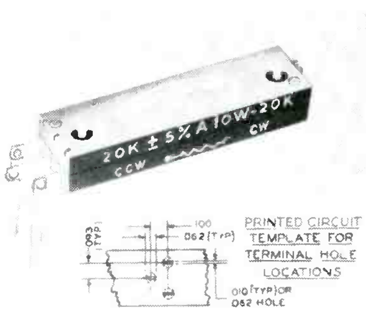


POWER SUPPLY
highly regulated unit

HARRISON LABORATORIES, INC., Berkeley Heights, N. J., announces a new (1.5 ampere) highly regulated, continuously variable power supply. Model 700-A features less than 500 μv ripple, less than 0.01

output voltage variation from no load to full load, and uses only 5¼ in. of rack height.

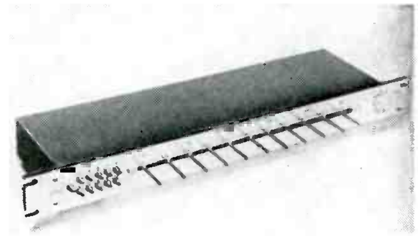
Another advantage is that the voltage across the series tubes is kept constant by a secondary feedback loop, while the primary feedback loop controls the output voltage. Varying the line voltage, changing the load, or manually varying the output voltage does not affect the average series tube dissipation. In this way the series tubes always have the proper operating voltage, and the regulator never loses regulation even with a full 1.0-ampere step change in load. **Circle P39 inside back cover.**



TRIMMER TERMINALS
for printed circuit assembly

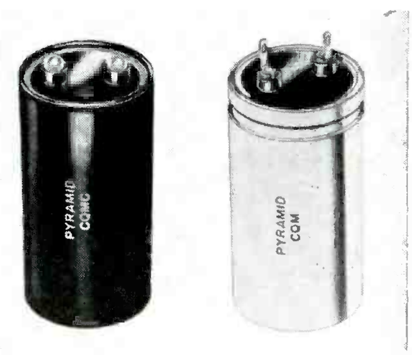
Dale Products Inc., Box 136, Columbus, Nebraska. Newly modified terminals with 90-deg arms establish a new model Dalohm A10-W trimmer which provides easy insertion in printed circuit assembly. Coupling this assembly ease with secure mounting, either by the terminals themselves or in conjunction with mounting holes, these trimmers assure ideal, trouble-free printed circuit application.

A10-W trimmers are powered at 0.8 w, derating to 0 at 175 C. Fully adjustable throughout a 25-turn range, they offer ruggedized characteristics, are humidity proof and perform well under high temperature conditions. The Mil-E-Trized trimmers surpass MIL-E-5272A and MIL-R-12934 requirements. Precision winding gives excellent linearity with 5-percent maximum deviation; resolution, 0.07 percent to 1 percent depending on value. The precision resistance unit is completely sealed in a high-temperature plastic case, 0.220 by 0.312 by 1.250 in., providing a truly miniaturized pot that operates in a temperature range of -55 C to 200 C; insulation resistance of 500 v d-c at room temperature—1,000 megohm minimum. **Circle P40 inside back cover.**



DELAY LINES
magnetostrictive type

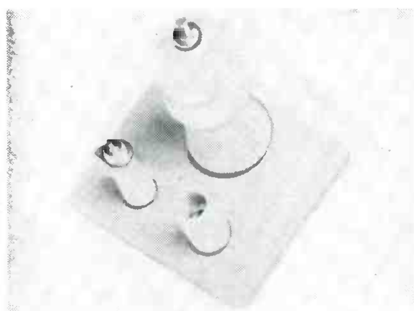
DELTIME, INC., 608 Fayette Ave., Mamaroneck, N. Y. For convenient incorporation in rack-type equipment, the new model 103-10R delay line unit is announced. The metal-cased unit's polished aluminum front panel mounts the coaxial-lead terminals and the locking thumb-screws for the pickup coils, sliding in the calibrated positioning slot. The unit provides for 50 μsec delay with 10 fully adjustable outputs. The closest pickup separation is 0.75 μsec, and the minimum pulse transmitted, 0.05 μsec. With a 1-μsec input pulse, attenuation is 45 db. The unit measures 1¾ in. high, by 19 in. wide, by 4¼ in. deep back of panel. **Circle P41 inside back cover.**



CAPACITOR
for computer use

PYRAMID ELECTRIC CO., North Bergen, N. J., has introduced a new computer-quality electrolytic capacitor known as type CQM. Since computer designs require a high degree of quality capacitor to insure long life operation, Pyramid has employed the highest quality aluminum foil. Hermetically sealed in an aluminum can, it is available with a cardboard cover or a vinyl sleeve.

Also available is type CQP which is similar in construction and design to the CQM but the unit is sealed in a plastic mold. **Circle P42 inside back cover.**



CUSTOM TERMINALS
in the 15 to 50-kv range

The Sphere Co., Inc., 25 Amity St., Little Falls, N. J. High-voltage terminals in the 15-kv to 50-kv range have been developed. In addition to the standard items available, complete facilities to build special custom terminals are in operation. The terminals are all twist-free, gasket type, and feature a special oil-filled design providing superior insulating qualities. Special emphasis has been placed on raising the corona threshold thereby allowing the use of a smaller terminal for corona free operation. **Circle P43 inside back cover.**

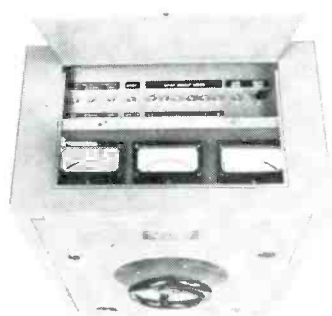
D-C AMPLIFIER
uses transistors throughout

Video Instruments Co., Inc., 2340 Sawtelle Blvd., Los Angeles 64, Calif. Model 71 differential d-c amplifier utilizes transistors throughout and features extreme stability and low noise. Maximum drift, after warmup, is only 3 μv. Response is from d-c to 50 kc. Input impedance is 0.5 megohm and output is either differential or single-ended at low impedance without

 For additional information on all items on this page, use post card on last page.

superimposed d-c level. Gain is adjustable in four steps up to 500 times and linearity is better than ±2 percent. Transient response is ideal because of essentially gaussian fall-out permitting reproduction of square waves without overshoot or ringing.

The unit, only 3½ in. wide by 6 in. high and 12 in. deep, weighs only 10 lb. Model 71 may be operated from 105-125 v a-c or from mercury batteries. The units are also available for rack mounting and can be arranged for mounting five amplifiers in 7 in. of rack space. **Circle P44 inside back cover.**



A-C POWER SUPPLIES
adjustable voltage type

DAYTON ELECTRIC MFG. CO., 114 S. Oakley Blvd., Chicago 12, Ill. A new series of five standard models of adjustable voltage metered power supplies for laboratory testing, production line and maintenance use has been announced. These test sets provide a self-contained, compact source of adjustable a-c voltage combined with laboratory quality instrumentation. Now available are 60 cycle, 120 and/or 240 v models. Eight current ranges from 0.5 to 100 amperes are provided; with corresponding power ranges up to 12,000 w.

The ultimate in convenient voltage adjustment is provided by the direct and vernier circuits. Important on production line installations, provision for remote location of meters and key controls is included as standard equipment. Meter losses are eliminated or compensated for by special means.

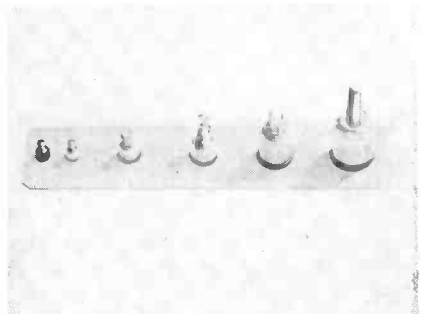
The test set is 30½ high by 23 wide, by 18 in. deep and weighs 184 lb. Prices start at $1,890. **Circle P45 inside back cover.**

EXTERNAL ANODE TUBE
for airborne instrumentation

UNITED ELECTRONICS CO., 42 Spring St., Newark, N. J. Engineers engaged in the design of military and civilian electronic equipment will find this miniaturized and ruggedized thermionic power diode an interesting component for modern airborne instrumentation, especially missile guidance equipment. Designed for air or liquid immersed operation, the 545 will provide long reliable service under the most severe environmental conditions.

As a rectifier, this external anode tube provides an average plate current of 50 ma d-c. Weighing less than 0.7 oz, the tube is 2 in. long, ⅞ in. wide and has a

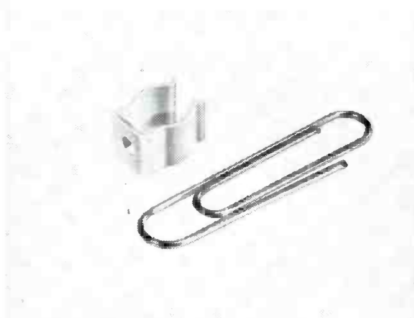
shock rating of 300 g. Maximum bulb temperature is 265 C. **Circle P46 inside back cover.**



SEALED TERMINALS

use silicone rubber

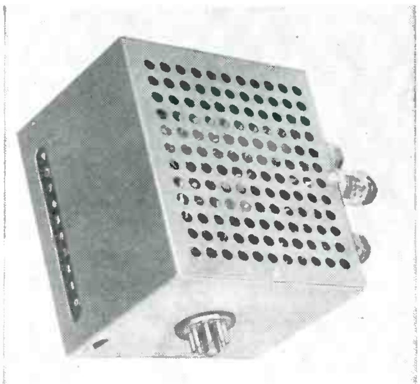
THE SPHERE CO., INC., 25 Amity St., Little Falls, N. J. The newly developed standard line of hermetic seal terminals range from 3,500 v rms to 14,000 v rms flashover ratings. The terminals feature specially compounded silicone rubber as the sealing and insulating agent which assures unusually high electrical insulating qualities and mechanical stability heretofore unavailable in gasket type terminals. The entire line is twist-free and will meet all MIL-T-27A specifications. They are available in a wide variety of sizes and styles. **Circle P47 inside back cover.**



TRANSISTOR CLIP

available in many sizes

THE BIRTCHER CORP., 4371 Valley Blvd., Los Angeles 32, Calif. A new transistor clip designed to retain all popularly used transistors under conditions of severe acceleration, deceleration, shock and vibration has been announced. Made from tempered beryllium copper, the transistor clips perform a dual function of retention and heat dissipation. Offered in a choice of cadmium, black ebanol or silver plate, the clips are available in many sizes and modifications. Circle P48 **inside back cover.**



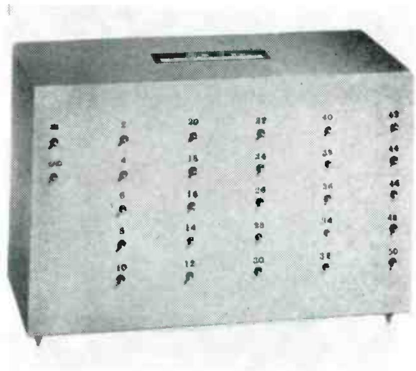
DECADE SCALER
with improved design

LABORATORY FOR ELECTRONICS, INC., 75 Pitts St., Boston 14, Mass. A new and improved version of a 10-mc decade scaler especially designed to improve the reliability factor has been announced. The new design eliminates the source of most potential failures. These decade scalers are plug-in devices capable of counting electrical pulses and recurrent events up to a rate of 10 million per sec. They are usable as drives for slower counting scalers to build up a bank of counters. The display is a scale of numbers lighted by neon bulbs. **Circle P49 inside back cover.**

DELAY LINE
with a total of 50 taps

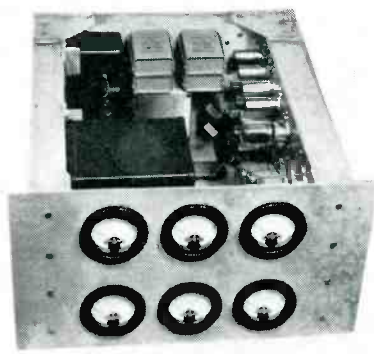
CONTROL ELECTRONICS CO., INC., 1925 New York Ave., Huntington Station, N. Y. Model F-186 delay line has a delay of 100 μsec and is tapped every 2 μsec. Although originally designed for the Vanguard program, this delay line should find many uses in the laboratory and elsewhere.

This unit features long delay with low attenuation. At the full delay of 100 μsec, risetime is 5.5 μsec and attenuation is 1.4 db. Characteristic impedance is 2,000 ohms. The unit comes in a hermetically sealed box with di-



mensions of 10½ in. long by 4 in. wide and 6¾ in. high. Twenty-five tap terminals are brought out on each of the length and height sides, for a total of 50 taps.

The unit can be cascaded with additional such units to provide longer delays. For example, four such units will provide a delay of 400 μsec with a rise time of 17 μsec and an attenuation of 6 db. The unit is provided with studs for mounting. **Circle P50 inside back cover.**



D-C POWER SUPPLY
three simultaneous outputs

DAVENPORT MFG. CO., 1713 N. Ashland Ave., Chicago 22, Ill., has announced a new airborne d-c power supply with three simultaneous outputs. Outputs are rated at +300 v d-c at 300 ma; +150 v d-c at 200 ma; and −150 v d-c at 200 ma. The unit operates on 208-v, 400-cycle current and provides regulation against input and load better than 0.01 percent. Long time stability is also rated at better than 0.01 percent (24 hr).

The supply is designed to meet MIL-E-5400 specification for operation from −50 C to +50 C at altitudes up to 50,000 ft. It is constructed to withstand shocks of 10 g to 1,000 cps. The unit weighs 68 lb and measures $10\frac{1}{2}$ in. high, 17 in. wide and $17\frac{1}{2}$ in. deep. **Circle P51 inside back cover.**

POT, MV SOURCE
in one instrument

ALLEGANY INSTRUMENT CO., INC., 1091 Wills Mountain, Cumberland, Md. Model P-55 is a small, lightweight potentiometer and millivolt source in one instrument. It measures $4\frac{1}{8}$ in. by $4\frac{1}{2}$ in. my $7\frac{1}{2}$ in. and weighs only $3\frac{1}{2}$ lb. Designed for conditions encountered in field and laboratory, it can be used with any thermocouple, or to measure any potential in the 0 to 55-mv range. In addition, the instrument will accurately supply the same millivolt potential for checkout of recorders and other instruments.

The P-55's dual input provides two sets of 55-way binding posts for convenience in checking two thermocouples, or one thermocouple against a standard. A thermometer is shockmounted in the lid. Accuracy of the P-55 is guaranteed to be 0.1 percent of full scale. **Circle P52 inside back cover.**

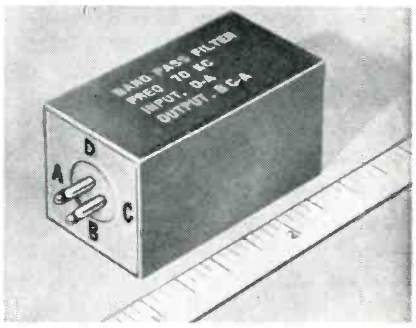
KILOWATT AMPLIFIER
uses ceramic power tubes

THE HALLICRAFTERS CO., 4401 W. Fifth Ave., Chicago 24, Ill. The HT-33 linear kilowatt amplifer employs ceramic power tubes which assure higher performance as well as provide extra safety under overload conditions.

The grid circuit of the HT-33 is designed for 52 ohms output and

is capacitor tuned. Band switching is by single knob which simultaneously selects the proper grid coil and plate tank inductance. The output circuit is a pi-network for fixed 52-ohm output impedance. High voltage for plates and screens is obtained from two 866A rectifiers while screen voltage is regulated by two OB2 and one OA2 tubes.

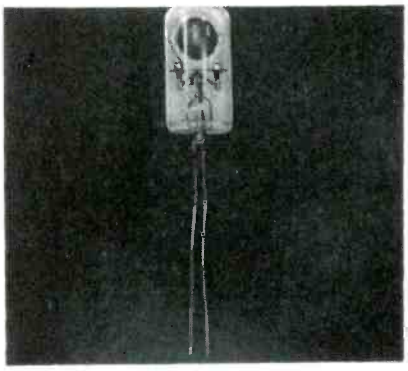
Additional features of the HT-33 include full metering of important circuits, coverage of the 80, 40, 20, 15, 11-10 meter amateur bands, a built-in power supply, and filtering of all control leads. **Circle P53 inside back cover.**



TELEMETERING FILTERS
subminiature, lightweight

AEROVOX CORP., Pacific Coast Div., 2724 Peck Road, Monrovia, Calif., has announced a new line of subminiature, lightweight telemetering filters for missile applications. Size of the filters is 2 cu in. or less per unit. Telemetering filters for channels 1 through 6 are only 1.562 in. high by 0.75 in. by 1.187 in.; weight is 71 grams. Channels 7 through 18 are only 1.375 in. high by 0.75 in. by 0.75 in., weight is 36 grams.

Completely cast in an epoxy-filled resin, all units are hermetically sealed and will meet all applicable MIL specifications for immersion shock and enviromental tests. All channels will pass 20 g's at 2,000 cycles for 2 hours. Temperature range is −55 C to +85 C. All units are made to plug into standard 4-pin Winchester sockets. Standard input impedance is 20 K and output impedance is 100 K. **Circle P54 inside back cover.**



QUARTZ CRYSTAL
one part/billion stability

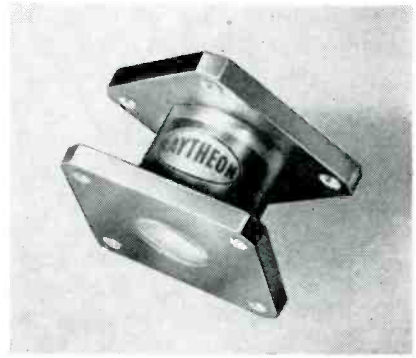
BLILEY ELECTRIC CO., Union Station Bldg., Erie, Pa. This glass-mounted optically polished, gold-plated quartz crystal operates on the 3rd overtone mode at 5 mc. Known as type BG61A-5, the temperature coefficient of the unit is less than 0.1 ppm over a 1 deg C range at the preferred operating temperature (75 C or 85 C). When used with temperature control adequate to maintain ±0.01 C, the resultant crystal stability is 1 part per billion at 5 mc. **Circle P55 inside back cover.**

MICROWAVE ISOLATORS
with improved performance

RAYTHEON MFG. CO., Special Microwave Device Group, Seyon Bldg., Waltham 54, Mass., has available microwave isolators featuring improved performance and compactness in standard and custom designs.

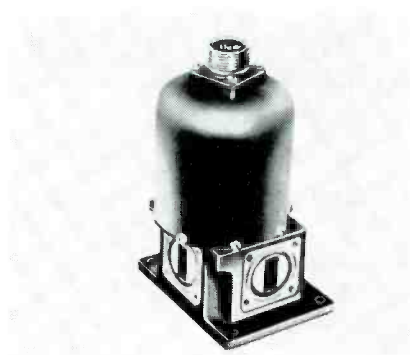
Model IXL1, the new X-band type, has a frequency of 8.5 to 9.6 kmc and provides greater than 18 db isolator, yet it weighs only 6 oz and is only 1⅛ in. long.

Model IK$_E$L1, another standard



type, covers a range of 13.2 to 13.7 kmc in the K_E band with greater than 20 db isolation; it weighs 7.5 oz and is less than 1½ in. long.

Modified standard units with flanges rotated to any desired twist angle are available on special order. **Circle P56 inside back cover.**



WAVEGUIDE SWITCH
miniature type

AIRTRON, INC., Linden, N. J., has announced a new miniature waveguide switch for use on applications requiring minimum size and weight. The switch provides rapid switching of signals from any one of three positions to either of the remaining two and will not change to another position upon failure of its power supply.

The electrical characteristics of the 1.00 in. by 0.500 in. o-d size switch (pictured) include a frequency range of 8,500 to 9,600 mc with a maximum vswr of 1.10 and a minimum isolation of 40 db. The maximum switching time is 0.25 sec for 240-deg operation and 0.15 sec for 120-deg operation. The universal switch operates at 3.0 amperes maximum at 28 v d-c nominal and employs r-f and pressurized fittings built into the switch, giving up to 20 lb of pressurization throughout.

Available in X_s and X_L band series, the switches are of the rotary channel type using a circular bend in the rotor and a broadband internal choke design. Precision casting insures a low vswr and top electrical performance. **Circle P57 inside back cover.**

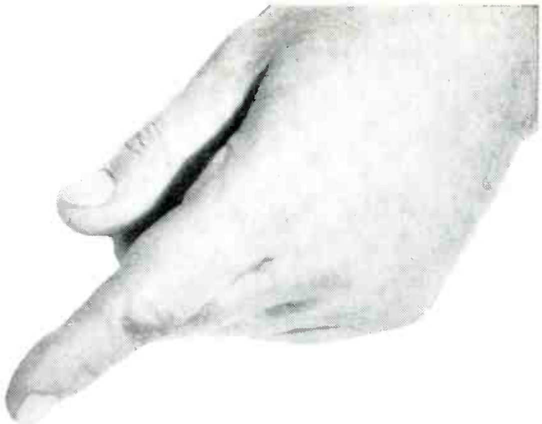
PLASTIC SHEET
for electronic applications

REINFORCED PLASTICS DIV., Hays Mfg. Co., Erie, Pa. An extra flexible grade of reinforced plastic sheet $\frac{1}{32}$ in. thick, with characteristics which make it suitable for such application as transformer layer insulation, is in production. Known as grade EEF, this insulating material has uses in other electrical and electronic components. Bulletin No. 101 containing product characteristics is available. **Circle P58 inside back cover.**

DIODE CLIPS
are spring-loaded

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge, Mass., has announced two new spring-loaded diode clips. They hold securely fragile diode pig-tail leads, and bring the number of such clips offered by CTC to three. The three can handle pig-tail leads ranging in size from 0.005 in. and 0.085 in. in diameter.

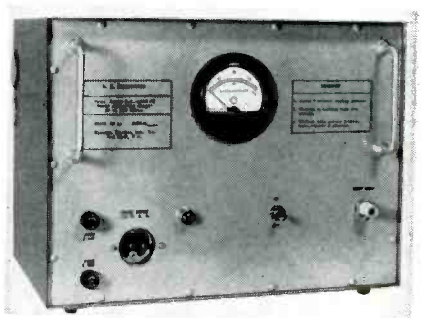
The smallest size clip has been designated as X2146 when furnished with a screw stud and X-2147 when furnished with a rivet mounting. The middle size clip has been designated as 2329 with a screw stud and 2330 with a rivet



mount; the large diode clip is 2339 with a screw stud and 2340 with a rivet mount. Each of the three CTC rivet mounted clips is available with five different shank lengths. **Circle P59 inside back cover.**

UTILITY OSCILLATOR
compact and portable

KAY ELECTRIC CO., 14 Maple Ave., Pine Brook, N. J., announces availability of its new Utilator, a compact, portable utility oscillator for the 4.5 to 220 mc range. Incorporating self-contained attenuators, power supply and output meter, the Utilator provides a high level r-f output agc'd for flatness over the entire range, plus a direct-reading frequency dial accurate to ±1 percent. Flatness is ±0.5 db over the range. Dimensions of the unit are 11 in. wide, 6½ in. deep and 8½ in. high. Weight is 19 lb. **Circle P60 inside back cover.**



R-F CALORIMETER
direct-reading unit

ELECTRO IMPULSE LABORATORY, 208 River St., Red Bank, N. J. This new direct-reading r-f calorimeter, with frequency range of d-c to 4,000 mc and power measuring range of 10 to 150 w, is of the constant flow type. It does not use flow meters or thermometers and does not require any flow adjustment. The only control is the on and off switch for the constant flow system.

Flip it on, connect the r-f power, and the meter needle climbs to the correct value for approximately one minute. Power is read directly on the meter. Accuracy is 5 percent. Power supply: 105-120 v, 60 cps, 60 w. **Circle P61 inside back cover.**

LOAD ISOLATOR
operates from 8.2 to 12.4 kmc

CASCADE RESEARCH CORP., 53 Victory Lane, Los Gatos, Calif., announces model X-121, a new broadband Uniline load isolator which operates within a frequency range of 8.2 to 12.4 kmc. Forward attenuation is 1.4 db maximum. Reverse attenuation at band edges is 20 db minimum. Vswr is 1.25 maximum. Power handling capability is 200 w average, 200 kw peak.

The unit is 9½ in. long overall, weighs 5 lb. Input and output flanges are UG-39/U. This load isolator is currently available from stock. Price is \$300. **Circle P62 inside back cover.**

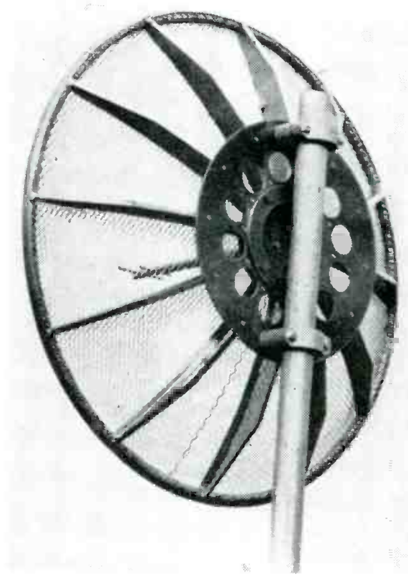
TRANSISTOR TESTER
for laboratory use

DURSON CO., 10416 National Blvd., Los Angeles 34, Calif. The Transistometer 201, laboratory transistor tester, measures small signal beta of *pnp* and *npn* low power junction transistors in three ranges—0 to 50, 0 to 250, and 0

 For additional information on all items on this page, use post card on last page.

to 500. The circuit employs 1-percent calibrating and attenuating resistors and a 2-percent meter movement. The instrument features etched circuitry, interlocking selector switch wiring, and a test socket which accommodates linear or triangular pin configurations. The power supply consists of mercury cell batteries with an operational life of 1,000 hours.

Dimensions are 10 by 7 by 5, and price, $190. **Circle P63 inside back cover.**



DISH ANTENNA
with simplified mounting

TECHNICAL APPLIANCE CORP., Sherburne, N. Y., has announced a one-piece, four-ft dish antenna designed for tubular mast mounting. The new antenna represents many new design developments resulting in a more rigid structure.

Two heavy-duty clamps secure the antenna to 4-in. IPS tubular masting. The clamps are designed to produce an even, tight connection assuring positive orientation under extreme wind loads.

This model is constructed on a ring principle. The basic ring is a circular heavy-weight aluminum disk supporting cantilever aluminum arms, which extend to the perimeter. The parabolic surface is covered with expanded aluminum mesh, inert arc-welded to the supporting arms.

The antenna is designed to operate in the range of 1,000 through 4,000 mc. Standard drivers are of the dipole and horn type. Other drivers for specific requirements are available. **Circle P64 inside back cover.**

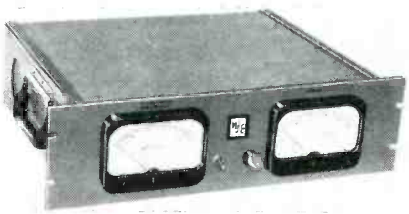


PLATE POWER SUPPLIES
fully transistorized

THE NJE CORP., 345 Carnegie Ave., Kenilworth, N. J., has available three new fully transistorized high-power plate power supplies. The model SS-1503 (illustrated) supplies 100 to 150 v at 0 to 1.5 amperes, regulated to better than 0.1 percent against either line or load changes, with less than 1.0 mv of ripple, and occupies only 5¼ in. panel height. It dissipates less than 50 w to deliver its full rating of 225 w to the load, thus eliminating the need for expensive, bulky blowers and air filters. Comparable vacuum-tube supplies dissipate as much as 625 w to deliver the same power.

Model SS-1003 delivers 50 to 100 v at 0 to 1.5 amperes, and the SS-1603 delivers 20 to 160 v at 0 to 1.5 amperes. **Circle P65 inside back cover.**

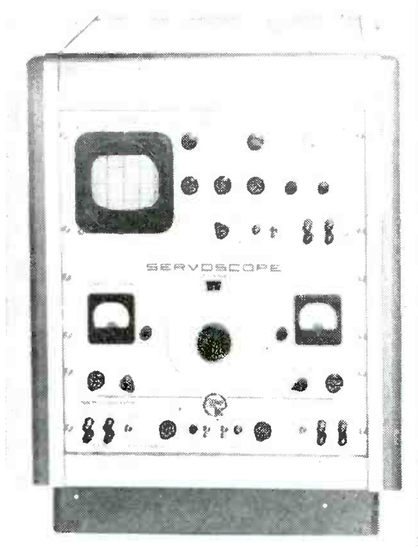
X-Y RECORDER
priced at $520

MANDREL INDUSTRIES, Instrument Division, 5134 Glenmount Drive, Houston, Texas. Typical uses of the new x-y recorder include: computer readout, hysteresis curves, semiconductor and tube

characteristics, filter characteristics, stress/strain and temperature/pressure.

The recorder draws curves in Cartesian coordinates. The pen moves on the x and y axes in accordance with voltage signals applied at the input terminals. The unit has a sensitivity of 10 mv per in., input resistance of 10,000 ohms and operates on 115 v, 60 cps.

Standard $8\frac{1}{2}$ by 11-in. graph paper is used, with full chart visibility at all times. Writing speed is 7.5 ips. Price is $520. **Circle P66 inside back cover.**



SERVO ANALYZER
used in lab and production

SERVO CORP. OF AMERICA, 20-20 Jericho Turnpike, New Hyde Park, N. Y. The new model F Servoscope servo analyzer provides sine, modulated-sine and square-wave signals as well as linear sweep on four ranges from 0.005 to 100 cps.

For less exacting requirements the company offers four other models. All five models will accept carrier frequencies of 50 to 5,000 cps from the same source used for the system under test.

Measuring phase and gain change throughout the frequency range, these servo analyzers are used in the lab for the design and test of servo systems and componets. They are also used in production for inspection and quality control of systems and components. **Circle P67 inside back cover.**

MEASURING BRIDGES
portable type

NEW ENGLAND SCIENTIFIC INSTRUMENTS Co., Box 408, Cambridge 39, Mass. A series of portable measuring bridges are available for the following applications: a Wheatstone bridge for the measurement of ohmic and polarizable resistances in the range between 0.08 and 120,000 ohms with 0.5-percent accuracy; a capacitance bridge with a range between 10^{-11} and 10^{-5} farad with 1-percent accuracy and a d-c compensating bridge for the measurement of emf between 0 and 60 mv with an accuracy of 0.5 percent. These instruments offer extreme reliability, high accuracy and rapidity of measurement at a moderate price. **Circle P68 inside back cover.**

RESISTANCE NETWORK
for computer power supplies

GENERAL RESISTANCE, INC., 577 E. 156th St., New York 55, N. Y. A

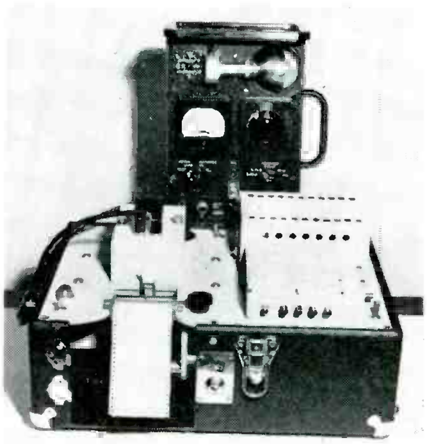
newly designed precision resistance network splits 600 volts into two parts within 0.01 percent over the temperature range of 0 deg to 100 C and under adverse environmental conditions. The network is completely encapsulated and hermetically sealed. It is capable of taking surges of double rated voltage.

This precision resistance network has specific application on computer power supplies and is representative of a line designed to meet specific needs. **Circle P69 inside back cover.**

UHF TWIN TETRODE
delivers 5.5 w useful power

AMPEREX ELECTRONIC CORP., 230 Duffy Ave., Hicksville, L. I., N. Y. Type 6939 twin tetrode is a unique noval-base miniature tube designed for low-power vhf transmitter applications. With a seated height of only 2 $\frac{9}{32}$ in., it delivers 5.5 w of useful power (ICAS rating) at any frequency up to 500 mc.

The outstanding performance of the 6939 is due mainly to the Frame-Grid construction, which insures extreme accuracy of interelectrode spacing. The tube's special characteristics frequently permit the elimination of entire stages in original equipment design, resulting in lowered manufacturing cost. Detailed data sheets and applications engineering information are available. **Circle P70 inside back cover.**



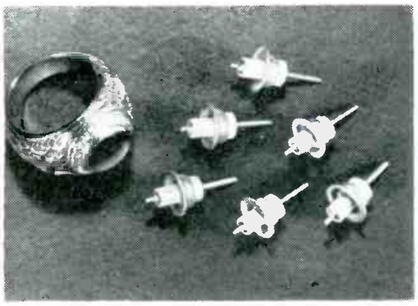
SOUND LEVEL RECORDER
dynamic, high speed unit

SOUND APPARATUS CO., Stirling, N. J., has improved its dynamic high-speed sound-level recorder SL-2 with special emphasis to sound, noise and vibration measurements. Design features include adjustable writing speed by a patented electronic feedback system and push-button selection of chart speed. Scale functions in linear, decibel or loudness are available.

The photograph shows model SL-2b connected to the G.R. sound level meter. With this simple setup the most complicated acoustical measurements can be recorded rapidly and accurately. The unit is priced at $885. **Circle P71 inside back cover.**

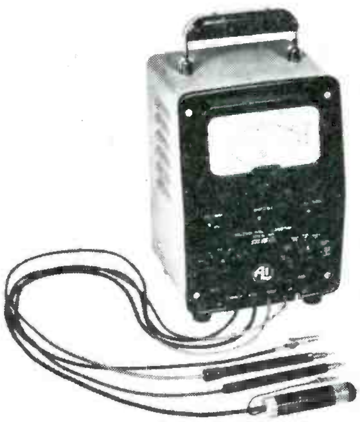
ALUMINA TERMINAL
for h-v airborne uses

RAYTHEON MFG. CO., Foundry Ave., Waltham 54, Mass. The PC-52 alumina terminal is a miniature



component designed for reliable operation at high voltages and temperatures. Only $\frac{3}{8}$ in. in diameter, the new terminal employs high-alumina ceramic to achieve a voltage rating of 3,500 v (sea level), an extra high temperature rating, ruggedness and reliability.

The center conductor and insulating sleeve are vacuum-sealed in a metal flange which can be hermetically sealed to the mounting surface with either soft or hard solder. Various finishes are available. Applications include ultracompact airborne units for high-altitude operation. **Circle P72 inside back cover.**



VTVM
features stability, accuracy

ACTON LABORATORIES, INC., Acton, Mass. Long-time stability and accuracy are achieved in this new vtvm through the use of balanced circuits, liberal inverse feedback and precision components. The instrument measures d-c (plus or minus) from 1 to 1,000 v in seven ranges; a-c from 1 to 300 v (rms) in seven ranges and resistance up to 500 megohms using seven multipliers.

Accuracy of d-c voltage measurement is ±2 percent full scale; a-c voltage measurement, ±3 per-

Want more information? Use post card on last page.

cent full scale. Frequency response is ±1 db from 10 cps to 700 mc. Input impedance for d-c measurement is 100 megohms to minimize loading of the measured circuit. Input capacitance of the a-c probe is kept extremely low (1.2 $\mu\mu$f) to maintain high input impedance up to 700 mc. The instrument operates on 110-120 v, 60-cps. **Circle P73 inside back cover.**

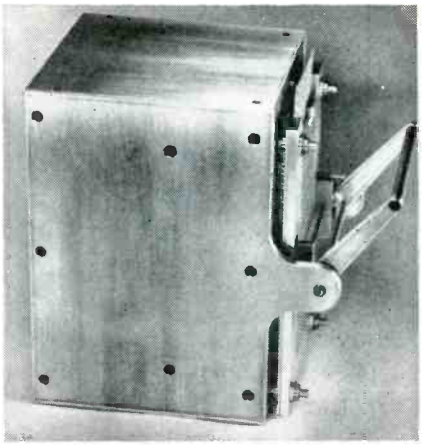
H-V GLASS TUBULARS
available in two types

DEARBORN ELECTRONIC LABORATORIES, 1421 North Wells St., Chicago 10, Ill., announces two lines of glass tubular capacitors. Type GML operates up to 85 C without derating over the range 0.002 μf-1,000 v d-c to 0.03 μf-12,500 v d-c. Type GTL operates up to 125 C without derating over the range 0.001 μf-2,000 v d-c to 0.03 μf-10,000 v d-c. These complex-dielectric, oil-filled lines introduce a new high in reliability and insulation resistance and a new concept of miniature size for the voltage range covered.

The end seals consist of tiny metal rings which are permanently bonded to the glass and metal disks soldered to the rings. The resulting rugged, leak-resistant seal offers the maximum creepage distance between terminals. **Circle P74 inside back cover.**

PUNCHED-CARD READER
available as separate unit

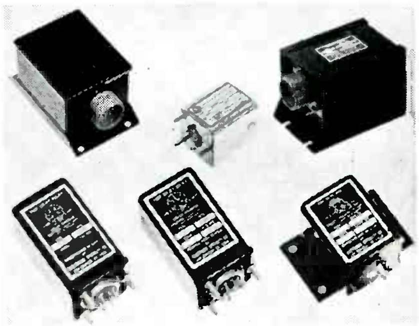
METRON CORP., 8 Coryell St., Lambertville, N. J. has announced the new model K-1 Sensor, a recent development in the field of programming devices. A static punched-card reader designed for use as a multiple switching mechanism, it is adaptable to any combination of



540 switching operations. This is the first time such a device has been made available as a separate unit.

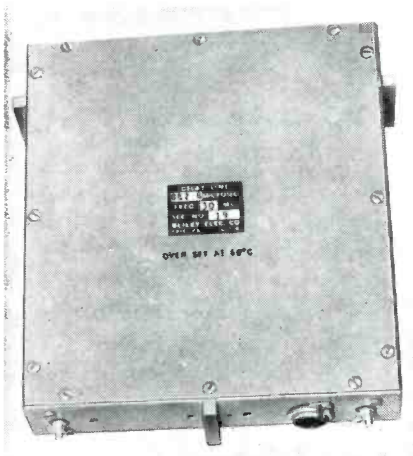
The card reader accepts a standard punched-card with 540 holes, arranged 12 wide by 45 high, which is read or sensed when the handle is closed. In each hole position is a spring-loaded Teflon pin and a corresponding spst switch. Where there is a hole in the card the pin remains static. In each position where the card is unpunched the pin moves forward and opens the corresponding switch.

It is readily connected to the user's circuitry by standard connectors. The K-1 Sensor is a compact 6¼ by 10¼ by 9 in. and weighs only 18 lb. **Circle P75 inside back cover.**



TIME DELAY RELAYS
four basic types

THE ELECTRONIC SPECIALTY CO., 5121 San Fernando Road, Los Angeles 39, Calif., is producing a comprehensive line of electronic time delay relays. Type 1 utilizes the maximum efficiency of the company's subminiature relays with slugged coils. Type 2 is used for short delay times and broad tolerance applications and contains essentially resistance capacitor networks. Type 3 uses germanium transistors where maximum temperature requirements are 165 F and silicon junction transistors are used for units rated up to 250 F. Type 4 is used in long delays and requires the use of subminiature vacuum tubes for high accuracy, stability and highest reliability. Maintenance free and hermetically sealed, these timers can be divided into three basic classifications: delayed pull-in, delayed drop-out and pulse output. **Circle P76 inside back cover.**



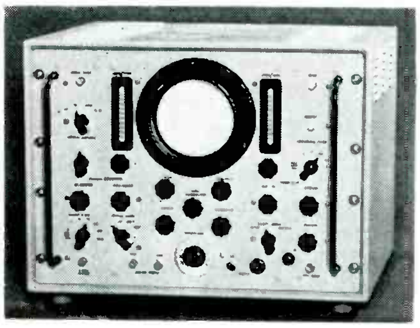
DELAY LINE
with built-in oven

BLILEY ELECTRIC Co., Union Station Building, Erie, Pa., announces a temperature-controlled delay line supplied to specifications in delay time range of 100 to 1,000 μsec with stability ± 0.01 percent from 0 deg C to +60 C. Known as type SDL-25T, it is designed for use in commercial memory channel units. Carrier frequency is 10 mc to 40 mc. Oven heater voltage is 110 v; power, 30 w. **Circle P77 inside back cover.**

MULTIPURPOSE OVEN
for temperature control

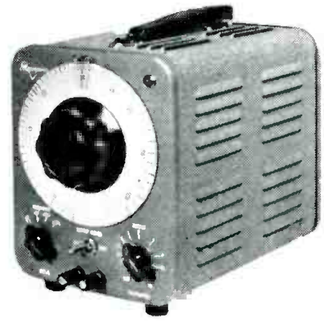
BULOVA WATCH Co., Electronic Division, Woodside 77, N. Y. The AM-100 oven is designed to yield exacting temperature control of more than just crystals. Now entire circuits, components and/or complete subassemblies can be

housed in one, low-cost unit. It features: rugged lightweight construction (less than 7½ oz); long life expectancy due to triple insulation on heater windings; high stability, ± 0.1 C; standard octal plug-in mount (stud mounting available). The unit draws 20 w on initial warm-up, with average dissipation less than 5 w after warm-up. It meets vibration tests per MIL-E-5272. Overall size is 3 in. diameter by 5 in. high; cylindrical cavity, 1¾ in. diameter by 2¾ in. high. **Circle P78 inside back cover.**



WIDE-BAND SCOPE
with dual calibration

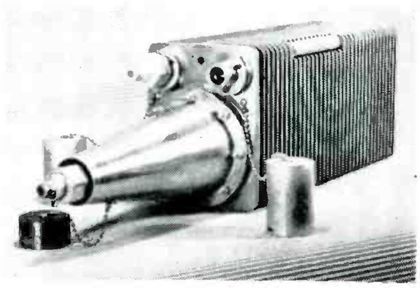
Lavoie Laboratories Inc., Morganville, N. J., has announced a high-performance oscilliscope featuring dual calibration of amplitude and time. Designated as model LA-259, the instrument is militarized, has a frequency response from d-c to 15 mc within 3 db and features direct reading calibration of both signal amplitude and duration, with verification of both. The LA-259 is designed for use both in the laboratory and for field applications. Rise time is 22 millimicroseconds. Unique construction combines ease of maintenance and ability to withstand shock and vibration of military applications. Specifications are available from the manufacturer. **Circle P79 inside back cover.**



AUDIO OSCILLATOR
covers 10 cps to 100 kc

Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y. Model 401A audio oscillator is a general purpose instrument of advanced design covering the range 10 cps to 100 kc. It delivers a full half watt into 600 ohms (20 v open circuit) with output constant to within ±½ db over the entire frequency range. Distortion is below ¼ percent at any power of frequency setting for loads of 600 ohms or more

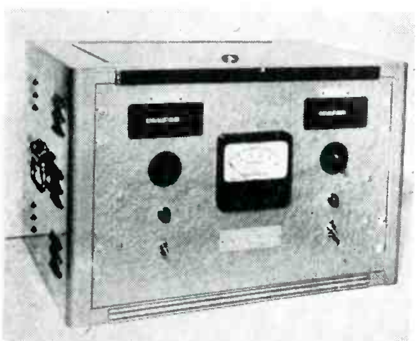
The new oscillator circuit used virtually eliminates switching and tuning transients Weight is 121 lb. Price is $125. **Circle P80 inside back cover.**



COAXIAL DUMMY LOAD
d-c through 5,000-mc range

Wac Line, Inc., 35 So. St. Clair St., Dayton 2, Ohio. The DS-58 (military designation AN/URM-58) coaxial dummy load is a 50-ohm termination with a single input used for transmitter outputs of 500 w over the continuous range of d-c through 5,000 mc. It connects directly to type LC cable fittings; adapters are furnished to provide for connection to type N and LN cable fittings. Low voltage standing wave ratios are featured with a maximum of 1.2 without adapters and a maximum of 1.3 with adapters.

The unit is compact, rugged, readily carried and requires no separate transit case. Large radiator fins, cast integrally with the housing, provide a large interior surface as well as a large exterior surface area to adequately dissipate the 500 w without a blower. **Circle P81 inside back cover.**



INSULATION TESTER
a combination instrument

PESCHEL ELECTRONICS INC., 15 Garden St., New Rochelle, N. Y. The P-3 insulation tester combines a sensitive Hipot tester with a fault indicator and counter for continuous production use in the manufacture of insulated wire or other material. This dual unit allows the testing of two distinct types of insulation faults: pinholes and substandard insulation.

Having two separately variable power supplies it becomes possible to discriminate between the two types of faults which are voltage sensitive. By energizing the forward electrode with a suitably low potential (100 v) and the following electrode with high voltage (up to 20,000 v) separate counts are obtained for both pinholes and substandard insulation—thin spots, contaminated insulating material or lack of centering of a wire within plastic insulation. **Circle P82 inside back cover.**

New Literature

Silicon in Electronics. Aries Laboratories, Inc., 41 East 42nd St., New York 17, N. Y. The use of silicon, which makes possible better transistors, rectifiers, computers and instruments, will increase from 10,000 lb in 1956 to an estimated 100,000 lb in five years, according to a 20-page nomograph recently issued. The bulletin describes the characteristics of silicon in rectifiers, solar batteries and transistors, and the methods of device fabrication. **Circle L1 inside back cover.**

Copper-Clad Micarta. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa. Booklet B-6577 deals with the company's copper-clad Micarta plastic laminate for printed circuits. The booklet, illustrated with photographs and diagrams, discusses what printed circuits are, the advantages to be gained from their use and the construction and properties of Micarta plastic laminate. A complete data sheet for all the copper-clad Micarta plastic laminate types is included. **Circle L2 inside back cover.**

Soldering Efficiency Poster. Multicore Sales Corp., 80 Shore Road, Port Washington, N. Y., has available an attractive, colorful 18 by 24-in. sheet addressed to assembly line operators. It illustrates dramatically how to do a more effective soldering job, eliminating costly rejects and adding to production efficiency. Manufacturers of electronic equipment may have copies free of charge by writing on company letterhead to Dept. K-23 at the above address.

Photoelectric Developments. Autotron, Inc., Box 722-H, Danville, Ill. A recent catalog supplement includes new plug-in mounted photoelectric controls and light sources; new miniature phototube and light source heads with installation diagrams; new one-package photoelectric controls, impact actuated electronic controls, current surge actuated electronic controls, and combined photoelectric and timing controls. **Circle L3 inside back cover.**

H-F Variable Transformers. The Superior Electric Co., 83 Laurel St., Bristol, Conn. Bulletin P257H, a concise, illustrated 28-page bulletin offers features, ratings and complete data on a new standard line of Powerstat variable transformers for h-f applications. Of particular interest to the aircraft, marine, missile and industrial fields, the bulletin serves as a valuable engineering reference of variable transformers which deliver a continuously-adjustable voltage from 400/800 cycle a-c power lines. Full information is given on 35 types of miniaturized manual and motor-driven Powerstat variable transformers for 28, 120, 240 and 480 v, single and three-phase service in ratings from 56 va to 8.7 kva. **Circle L4 inside back cover.**

TV Products Catalog. Blonder-Tongue Laboratories, Inc., 9-25 Alling St., Newark 2, N. J., has issued a new catalog of its complete line of tv products. Among the new items are crystal controlled vhf and uhf converters and a series of all-channel indoor cable tapoffs. Illustrations, descriptions and trade prices are included for each B-T Model.

Copies of the catalog, as well as technical bulletins on the converters and tapoffs, are available on request. **Circle L5 inside back cover.**

Flush Mounting Panel Meters. International Instruments Inc., P. O. Box 2954, New Haven 15, Conn. Form 268 is a data sheet describing the new 1½ in. flush mounting panel meter. Specifically designed for use on edge-lighted panels, model 155 meter described is provided with an external shroud that permits mounting from the front with minimum projection from the panel surface.

The data sheet contains full engineering information, including specifications, electrical characteristics and standard ranges in addition to generally descriptive matter. It is expected to find wide readership among specifying and design engineers and others who are looking for a small, light, high-sensitivity meter for portable, airborne and other similar applications where light weight and small size are essential or where edge-lighting of the panel is required. **Circle L6 inside back cover.**

Electronic Counters. Laboratory For Electronics, Inc., 75 Pitts St., Boston 14, Mass. A new four-page brochure covers a line of electronic counters. Described in the leaflet is a decade scaler with a counting speed of 20 mc. Other decade scalers discussed have counting speeds of 20 kc, 40 kc, 100 kc and 1 mc. Also described are three preset scalers of 20 kc, 40 kc and 100 kc counting speeds. **Circle L7 inside back cover.**

Welding Controls. The Taylor-Winfield Corp., Warren, Ohio. Bulletin SP-19 describes precise welding controls using Dekatron tubes in counting circuits that control welding time. The new controls discussed improve the consistency of weld time longer than 15 cycles. Block and schematic diagrams illustrate the purpose and operational principles of the new controls. **Circle L8 inside back cover.**

Capacitor Reference Chart. Erie Resistor Corp., Erie, Pa., has produced a convenient reference chart giving data on capacitors in quickly available form. The plastic card is $7\frac{5}{8}$ in. by $4\frac{1}{8}$ in. It shows dielectric qualities and temperature coefficients of Erie tubular and Disk-Ceramicons, as well as maximum available nominal capacitances in $\mu\mu$f. **Circle L9 inside back cover.**

Thermistor Catalog. Gulton Industries, Inc., Metuchen, N. J., has announced a new 10-page bulletin on Glennite thermistors.

Listing typical applications and circuitry, the catalog gives specifications and characteristics of wafer, rod and bead thermistors. Each type of thermistor is illustrated with diagrams and charts indicating models and their cor-

For additional information on all items on this page, use post card on last page.

responding characteristics and size.

Included is a table showing the resistance ratio versus temperature to compute thermistor resistance at specified temperatures. Special ordering information for standard Glennite thermistors as well as custom and special engineering application units is also given in bulletin No. T-100. **Circle L10 inside back cover.**

Microminiature Tantalytic Capacitors. General Electric Co., Schenectady, N. Y. The four-page bulletin, GEA-6065C, describes micro-miniature capacitors for low-voltage, direct-current applications where large capacitance values are required in a small space. The publication includes ratings and dimensions. **Circle L11 inside back cover.**

Accelerometers. Genisco, Inc., 2233 Federal Ave., Los Angeles 64, Calif. Illustrations, specifications, and special design features for a variety of the company's accelerometers are presented in a new catalog. An instrument application guide is included. A detailed performance breakdown for each instrument is given. The catalog also contains information on such optional configurations as dual-output instruments, switch-contact instruments, digital-output instruments, special damping features and very-low and very-high G-range accelerometers. Technical data, illustrations and possible applications of a new a-c output instrument are given. **Circle L12 inside back cover.**

Rack Mounting Oscillographs. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio, has published a new eight-page folder, illustrating and describing five models of its multichannel rack mounting oscillographs.

The instruments discussed permit simultaneous recording of up to eight phenomena in clearly legible chart form. When used with Brush amplifiers, recordings may be made over a frequency range extending from d-c to 100 cps.

The free literature details many of the instruments' features and covers engineering and operating information. One section is devoted to accessories which may be used with the oscillographs where added flexibility is desired. **Circle L13 inside back cover.**

Transistor Wall Chart. General Transistor Corp., 91–27 138th Place, Jamaica 35, N. Y., has announced a new wall chart showing, at a glance, applications and maximum ratings and typical characteristics at 25 deg C of 56 types of germanium junction alloyed transistors. The chart also contains a handy interchangeability table, outlines of five different transistor cases, diagrams of various circuits and standard IRE symbols and definitions. **Circle L14 inside back cover.**

Ceramic Capacitors. Skottie Electronics, Inc., Peckville, Pa., a subsidiary of Astron Corp., East Newark, N. J. A six-page catalog describes the company's complete line of ceramic capacitors.

Disk, tubular and plate types of ceramic capacitors are illustrated with charts and diagrams. Each application for temperature compensating, stable capacitance, high voltage, printed circuitry is discussed, with complete specifications and properties of the ceramics listed. Special customized applications are mentioned.

Also described are the particular manufacturing and inspection procedures of the company. **Circle L15 inside back cover.**

Instrumentation Tape. Reeves Soundcraft Corp., 10 E. 52nd St., New York, N. Y., has published a new booklet describing Soundcraft type B instrumentation tape designed specifically for telemetering. The multicolor booklet completely describes operating characteristics of the type B tape for carrier-type recording, including specifications and magnetic properties. The booklet covers use of the tape for f-m/f-m or f-m/p-m, pdm/f-m, or pdm/p-m. **Circle L16 inside back cover.**

Klystron Facts. Eitel-McCullough, Inc., San Bruno, Calif. A 24-page, 2-color brochure entitled "Klystron Facts Case No. 4" has been published. Summarizing recent Eimac developments in the field of klystron design, it includes useful facts on super-power klystrons, beam switch tubes, beam rectifier tubes, as well as information on depressed collector operation, use of klystrons in high power uhf ssb service, shaped pulse applications and other Eimac klystron developments. **Circle L17 inside back cover.**

Multiheaders and Plugs. Hermetic Seal Corp., 29 S. Sixth St., Newark 7, N. J. Catalog 657-C on hermetic seal vacuum-tight compression multiheaders and plugs, is just off the press. The catalog is a condensation of the most widely used hermetic seals selected from over 10,000 different types manufactured by the company.

Parts are carefully grouped to provide essential information, part numbers are simplified and dimensioning standardized for quick, easy reference. **Circle L18 inside back cover.**

Residual Noise in Chopper Circuitry. James Vibrapowr Co., 4050 N. Rockwell St., Chicago 18, Ill., has available a four-page technical paper covering the theoretical as well as the practical evaluation of residual noise in a wide variety of chopper circuitry. Included are graphs and other information helpful to the design engineer. **Circle L19 inside back cover.**

Tape Wound Core. Magnetics, Inc., Butler, Pa. Catalog TWC-200 has been prepared with a separate section which serves as a design manual for engineers and scientists. The literature supplies engineers with basic information on magnetic terminology, design equations, material characteristics and testing data. **Circle L20 inside back cover.**

Panel-Mounting Instruments. Trio Laboratories, Inc., 4025 Merrick Road, Seaford, N. Y., announces a new 36-page catalog and designer's guide with photos, outline drawings, description, theory of operation, mounting details and complete specifications on their entire line of miniature, panel-mounting electronic instruments.

The catalog, sectioned for ease of reference, includes a-c vtvm's, d-c vtvm's power supplies and special instruments such as multi-channel vtvm's, phase meters and null meters.

The designer's guide gives aids in the selection and application of vtvm's to measurement or monitoring problems and discusses the "how-to" phase of building electronic instruments into system equipment. **Circle L21 inside back cover.**

Transistor Booklet. Radio Corp. of America, Harrison, N. J. A new 24-page booklet, titled "RCA Transistors and Semiconductor Diodes", has been published. It contains a general explanation of transistor theory and operation, with a special section devoted to the drift type transistor. Complete characteristic data on the 18 RCA types of transistors and four semiconductor diodes are supplemented by equivalent circuits and dimensional outlines.

Another feature of the booklet is an interchangeability directory. The listings contain more than 500 type designations including junction and point contact types.

The booklet concludes with eight pages of circuit diagrams which illustrate 20 of the more interesting applications of RCA transistors and diodes. Copies of the booklet are 25 cents each. **Circle L22 inside back cover.**

Electronic Equipment Rack. Craig Systems Inc., Danvers, Mass. Bulletin 100-RA-3M-257, a four-page brochure, covers a general-purpose rack for electronic equipment with a high-strength, low-weight ratio. Constructed of aluminum and designed to accommodate standard 19-in. wide RETMA panels, the rack discussed is available in four standard sizes. **Circle L23 inside back cover.**

Mass Spectrometer. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif. Three catalog sheets illustrate and describe the type 21-611 mass spectrometer. Included are applications, principle of mass spectrometry, accessories, specifications and flow diagrams. **Circle L24 inside back cover.**

Microminiature Cable and Connector. Microdot Inc., 220 Pasadena Ave., South Pasadena, Calif., has available a new 32-page 1957 catalog completely describing the unique line of microminiature coaxial cables and connectors that the company has pioneered. **Circle L25 inside back cover.**

Heavy Duty Relays. The Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford 6, Conn. An 8-page illustrated booklet giving complete information about the new line of type IMP (interchangeable multiple pole) and FMP (fixed multiple pole) heavy duty relays has been published.

Diagrams and dimensional drawings, as well as photographs, are used in this booklet to illustrate the extreme versatility of these new relays which make it possible to meet almost any relay requirement with a minimum stocking of replacement parts. Parts are standardized and interchangeable throughout the entire line.

Included among the many advantages claimed for these relays by the manufacturer in the new booklet are their adaptability for use with a unique plug-in receptacle and an exclusive latching attachment. The plug-in receptacle makes it possible to rapidly examine or replace the basic relay without disturbing the wiring. It is pointed out that this is of special importance where relays are in use on mass production assembly lines since it reduces costly down-time due to repair or replacement to a minimum. **Circle L26 inside back cover.**

Capacitors. Industrial Condenser Corp., 3243 No. California Ave., Chicago 18, Ill., has available literature on its miniaturized Stabelex D capacitors which are now available in voltage ratings up to 25 v and in capacitances from 1 to 50 μf. The capacitors described, if allowed to stand charged, will lose only 0.1 percent of their initial charging voltage after 600 hours. **Circle L27 inside back cover.**

Precision Wire Wound Resistors. International Resistance Co., 401 North Broad St., Philadelphia 8, Pa. Catalog data bulletin D-lb contains comprehensive data on construction, types, winding technique, winding forms, impregnation, terminals, and characteristics for a line of precision wire wound resistors. Detailed charts and graphs are included in the four pages. **Circle L28 inside back cover.**

Bimetal Thermostats. Stevens Mfg. Co., Inc., Lexington, Ohio. Bulletin 6000 deals with Stemco snap-acting type M bimetal thermostats. Covering both hermetically sealed and semienclosed types for use in tv relay stations and communications equipment, the bulletin contains principles of operation, construction features and ratings. It is illustrated with photos showing different types of available terminal arrangements and enclosures. **Circle L29 inside back cover.**

Universal Relay Tester. The Magnavox Co., Fort Wayne 4, Ind. Detailed specifications, including electrical and special characteristics, for a new universal relay tester are presented in a four-page brochure. Methods-Time Measurement (MTM) production data, developed for production and industrial engineers, and an outlined dimensional drawing are also included. **Circle L30 inside back cover.**

Cooling Equipment. Rotron Mfg. Co., Schoolmaker Lane, Woodstock, N. Y., offers an eight-page, colored brochure containing pictures and brief descriptions of representative models from the company's line of cooling equipment for electronic applications. At a glance this brochure, entitled "What We Make", shows the scope of Rotron's products and engineering services. **Circle L31 inside back cover.**

Pulse Height Analyzer. Pacific Electro-Nuclear Co., 11818 Teale

St., Culver City, Calif. A four-page folder describes the new model PA-4 100-channel pulse height analyzer. The most important advancement achieved in the instrument discussed is the great increase in speed of pulse analysis with a corresponding reduction of counting losses. Other features mentioned include an individual channel storage of better than one million counts when needed, a precise and stable calibrating pulser, provision for automatically normalizing data, and maximum versatility in choice and control of readouts. Complete specifications are included. **Circle L32 inside back cover.**

Technical Journal. Beckman/Berkeley Div., 2200 Wright Ave., Richmond 3, Calif. First issue of a new technical journal, *"Berkeley Engineering,"* has been announced.

Drawing upon the accumulated technical knowledge of the company's engineering staff, each issue will contain a feature article plus announcements concerning new products, applications literature and service notes.

To be issued every three months, the publication is intended to contribute to the general interchange of ideas and information essential to the growth of the entire electronics industry. **Circle L33 inside back cover.**

Two-Way Radio Interchangeability. General Electric Co., Syracuse, N. Y. Maximum versatility of two-way radio units is stressed in bulletin ECR-458 which covers Progress Line communication equipment. It describes building-block design of two-way radio, explaining how components may be interchanged between station and mobile combinations to assure flexibility. In its eight pages, the bulletin also covers adaptability of the building-block design in adding optional equipment, such as selective-signalling, selective-calling or simultaneous monitoring. **Circle L34 inside back cover.**

Vacuum Tube Quality Test. Eitel-McCullough, Inc., San Bruno, Calif. A 16-page, two-color technical brochure deals with a new quality test for use in the production of power vacuum tubes. Existing test techniques and their limitations are discussed and the new method is described with sample data included. **Circle L35 inside back cover.**

Microwave Products. Microwave Associates, Inc., 22 Cummington St., Boston 15, Mass., has available a four-page short-form catalog (57-BG) describing all of the products manufactured by the company. Listed in the brochure are: pulsed and CW magnetrons, TR and ATR duplexing tubes, microwave silicon diodes, silicon power rectifiers, flange-mounted and solderable waveguide pressure windows, waveguide components and test equipment.

Operating characteristics are tabulated for a majority of the products. **Circle L36 inside back cover.**

Antenna Systems. Andrew Corp., 363 E. 75th St., Chicago 19, Ill., has published a 32-page new product supplement. It covers products recently developed by the company and information on engineering improvements to their existing antenna systems equipment.

Such items as their new 9-in. uhf transmission line, 3⅛-in. uhf coaxial switch and the expanded and improved line of microwave and communication antennas, are completely described in this well-illustrated supplement. **Circle L37 inside back cover.**

Miniature Electrical Connectors. The Deutsch Co., 7000 Avalon Blvd., Los Angeles 3, Calif. has available a new 24-page, 3 color catalog describing its full line of miniature electrical connectors. The catalog includes drawings of each connector and clocking chart that shows contacts and alternate insert positions.

Charts supply significant dimensions, including weights, for the complete line of miniatures. Mating combinations, special numbering and mounting dimensions are also given.

For flexibility, the publication follows a quick-reference data sheet format. Catalog sheets may be added as new connectors and modifications are introduced, and old sheets can be replaced as they become obsolete. **Circle L38 inside back cover.**

Magnetic Properties of Ferrite Materials. General Ceramics Corp., Keasbey, N. J., has available catalog sheets describing the magnetic properties of three types of Ferrite materials produced by the firm. Designated Ferramic "O-2", Ferramic "Q" and Ferramic "H", the Ferrites discussed are used as component parts in radio and tv sets, computers, automatic controls and related electronic equipment. Pertinent information is contained in tables and graphs. Photographs are included. **Circle L39 inside back cover.**

Microwave and UHF Test Equipment. The Narda Corp., 160 Herricks Road, Mineola, N. Y., has published a new 48-page edition of its catalog covering a complete line of waveguide test equipment, radar test equipment, bolometers and thermistors and coaxial and uhf equipment, which runs to more than 300 products.

The new edition includes all the recent additions to the Narda line, such as uhf meter detectors, coaxial detectors, broadband disk bolometers and thermistors, coaxial turret attenuators, coaxial pads and wave and power meters. **Circle L40 inside back cover.**

Multichannel Oscilloscopes. Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa., has issued a new 28-page catalog describing its complete line of standard 2 and 4-channel oscilloscopes, Strainalyzers and related d-c amplifiers. A number of new items are featured including a two-channel scope with a vertical frequency range from d-c to 15 mc and a versatile four-channel recording oscilloscope and master Strainalyzer with which input information may be either differential or single-ended.

A portion of the catalog is devoted to explaining the advantages of multichannel oscillography in which nonrecurring events may be triggered and the resulting operational phenomena recorded simultaneously from different points. **Circle L41 inside back cover.**

Magnetically Regulated Power Supplies. Engineered Magnetics Division, Gulton Industries, 212 Durham Ave., Metuchen, N. J. Glennite magnetically regulated power supplies are described in a new catalog. The four-page folder describes and illustrates filament power supplies, telemetering and strain gage power supplies, computer power supplies and miniature magnetic amplifier power supplies.

Also discussed is the EM transistorized line including d-c voltage regulators and d-c inverters. **Circle L42 inside back cover.**

G-Type Oil Capacitors. Industrial Condenser Corp., 3243-65 N. California Ave., Chicago 18, Ill., has available catalog 1134 covering their high reliability "G" type oil impregnated capacitors. The capacitors described, featuring a threaded molded mounting neck, are specifically designed for applications where limited space and mounting ease are major problems. **Circle L43 inside back cover.**

Automatic Control. Autron Engineering, Inc., 1254 W. Sixth St., Los Angeles 17, Calif. Literature covering an entire range of automatic control equipment has been offered. Information on latest-type Autron control components, devices and systems is included.

The brochure furnishes details on such Autron control units as standard control switching units, process control units, subminiature and standard size light beam projectors, photoelectric detectors and sensor units including temperature thermistors, proximity detectors and special transducers for pressure, acceleration, displacement and temperature.

A special data section also covers the newly-introduced Autron Neuron high-speed electromechanical digital counter. **Circle L44 inside back cover.**

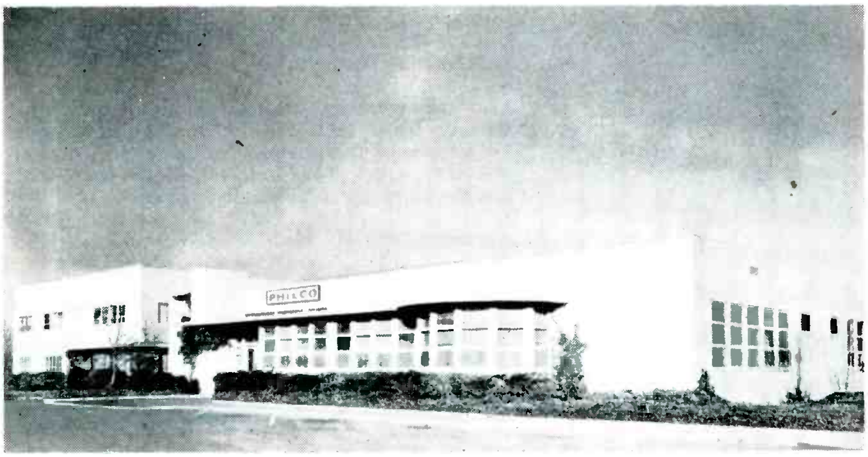
 For additional information on all items on this page, use post card on last page.

Plants and People

Edited by WILLIAM P. O'BRIEN

Electronics manufacturers expand plants and facilities by acquisition, leases or new construction. Top engineers and executives in the industry are promoted and move to new responsibilities. West Coast Firm Receives $860,000 AEC Contract

New Philco Development Laboratories Opened



Philco's new Western Development Laboratories at Redwood City, Calif.

Oscar T. Simpson

THE GOVERNMENT and Industrial Division of Philco Corp. has established new Western Development Laboratories at Redwood City, Calif., it was recently announced by Henry F. Argento, vice-president and general manager of that Division.

Acquisition of the new laboratories is the first step forward in a major expansion program that will increase the Division's facilities to handle its rapidly growing West-Coast business.

Staffed by an executive technical group, the new Philco laboratories will be programmed in the areas of advanced research and development in electronics and related fields.

The executive group will be headed by Oscar T. Simpson, general manager, who has had administrative supervision of engineering groups engaged in the design and development of airborne radar, tv systems and weapons systems including missiles and fuzing. Prior to 1954, he had many years experience as a project and research engineer and supervised the design of low-noise radar and new X and K band radar systems. He also has had broad experience in the fields of microwave, radar and missile design.

Circuits Authority Joins Texas Instruments

ROBERT L. TRENT, a recognized authority on electronic circuits development, has joined Texas Instruments Inc. to direct a newly-formed engineering branch for applications and test equipment in the Semiconductor-Components Division. His title will be Head, Circuit Development Branch.

The scope of activities of the new engineering branch will include basic circuit research, studies of nonlinear switching circuits, characteristics of power output devices, and high frequency applications.

Trent was a member of the technical staff of Bell Laboratories, Inc., at Murray Hill, N. J., for sixteen years. In this capacity, he had broad experience in device, systems and circuit design and worked on transistors and transistor applications since 1950. He has received numerous patents for various types of transistor switching circuits and feedback amplifiers and is the author of many published papers in this field. He was a co-recipient of the 1957 W. R. G. Baker Award from the IRE.

Servomechanisms Builds New Plant

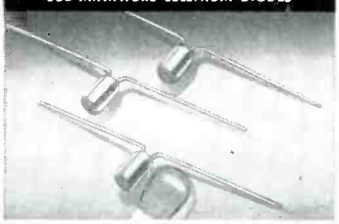
SCHEDULED for completion this year is the new Westbury, N. Y., plant of Servomechanisms, Inc., producers of electronic and electromechanical subsystems, computers and components. The new factory will

International Rectifiers

For all DC needs from microwatts to megawatts!

SELENIUM

SUB-MINIATURE SELENIUM DIODES

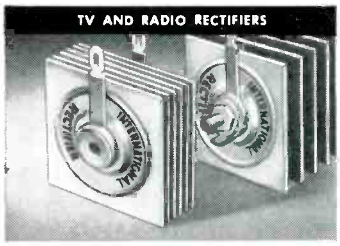


Developed for use in limited space at ambient temperatures ranging from −50°C to +100°C. Encapsulated to resist adverse environmental conditions. Output voltages from 20 to 160 volts; output currents of 100 microamperes to 11 MA. **Bulletin SD-1B**

HIGH VOLTAGE CARTRIDGE RECTIFIERS

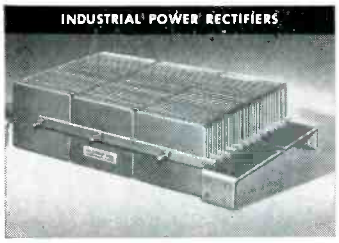
Designed for long life and reliability in Half-Wave, Voltage Doubler, Bridge, Center-Tap Circuits, and 3-Phase Circuit Types. Phenolic Cartridge and Hermetically Sealed types available. Operating temperature range: −65°C to +100°C. Specify **Bulletin H-2**

TV AND RADIO RECTIFIERS



The widest range in the industry! Designed for Radio, Television, TV booster, UHF converter and experimental applications. Input ratings from 25 to 156 volts AC and up. DC output current 50 to 1,200 MA. Write for application information. **Bulletin ER-178-A**

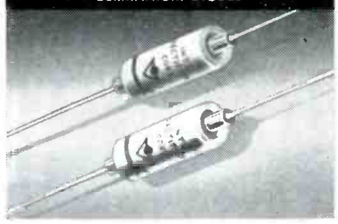
INDUSTRIAL POWER RECTIFIERS



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

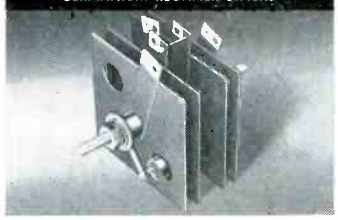
GERMANIUM

GERMANIUM DIODES



This series of general purpose, high quality point contact diodes provide excellent rectification efficiency for very high frequency applications. Special "RED DOT" series available for ambient temperatures from −55° C to +100° C. **Bulletin SR-140.**

GERMANIUM RECTIFIER STACKS



Extremely low reverse leakage values make this series ideal for magnetic amplifier applications. These units utilize 10 amp junctions—26 to 66 AC input volts rms—are available in a wide range of circuit types and DC current ratings. **Bulletin SR-148.**

AIR-COOLED GERMANIUM JUNCTIONS

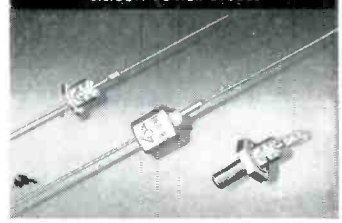
Engineered for heavy power applications, these highly efficient forced air cooled units feature moisture and corrosion resistant housings. A complete series in each of 3 current ratings: 150, 330 and 500 Amperes @ 26 to 66 volts rms. Request **Bulletin GPR-2.**

LIQUID COOLED GERMANIUM JUNCTIONS

Liquid cooled for maximum power in minimum space. Junction rating: 670 amps at 26 to 66 volts rms. Housed in high-conductivity copper cast around special steel coils. Water, oil or other accepted coolants may be used. For complete data. **Bulletin GPR-2.**

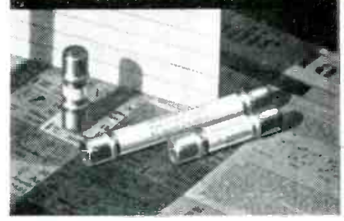
SILICON

SILICON POWER DIODES



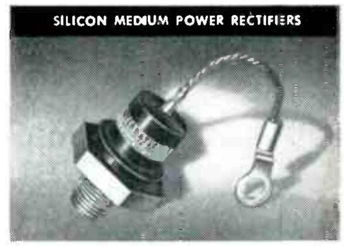
Hundreds of types in three basic styles, for operating temperatures from −55°C to +150°C. Up to 800ma DC output current per junction over a voltage range of 50 to 1,000 PIV. Hermetically sealed. For complete information on all types. **Bulletin SR-A.**

SILICON CARTRIDGE RECTIFIERS



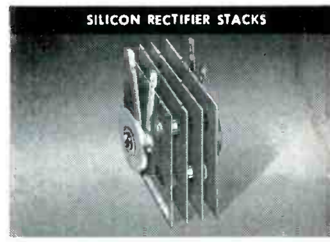
The answer to tough miniaturization problems! Ratings for high temperature applications: from 1000 volts PIV at 100ma half-wave DC output to 16,000 volts PIV at 45ma. Hermetically sealed, metallized ceramic housing. Request **Bulletin SR-139B.**

SILICON MEDIUM POWER RECTIFIERS



Specifically engineered for industrial applications—the most conservatively rated silicon rectifiers in the industry! Rugged all-welded construction and hermetic sealing mean greater reliability—longer life. Types available in 3 series. Request **Bulletin SR-143B.**

SILICON RECTIFIER STACKS



These units consist of hermetically sealed junction diodes mounted on copper cooling fins, stacked to include the interconnections required for specific circuits. Junction ratings: 1.25 amps. DC output; 70 to 350 AC input volts rms. Request **Bulletin SR-137A.**

A WORLD OF DIFFERENCE • THROUGH RESEARCH •

International Rectifier
C O R P O R A T I O N

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA • PHONE OREGON 8-6281

NEW YORK: 132 E. 70TH ST., TRAFALGAR 9-3330 · CHICAGO: 205 W. WACKER DR., FRANKLIN 2-3888

CAMBRIDGE, MASS., 17 DUNSTER ST. UNIVERSITY 4-6520 · IN CANADA: ATLAS RADIO CORP., LTD., 50 WINGOLD AVE. W., TORONTO, ONTARIO, RU 1-6174

THE WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS

Want more information? Use post card on last page.

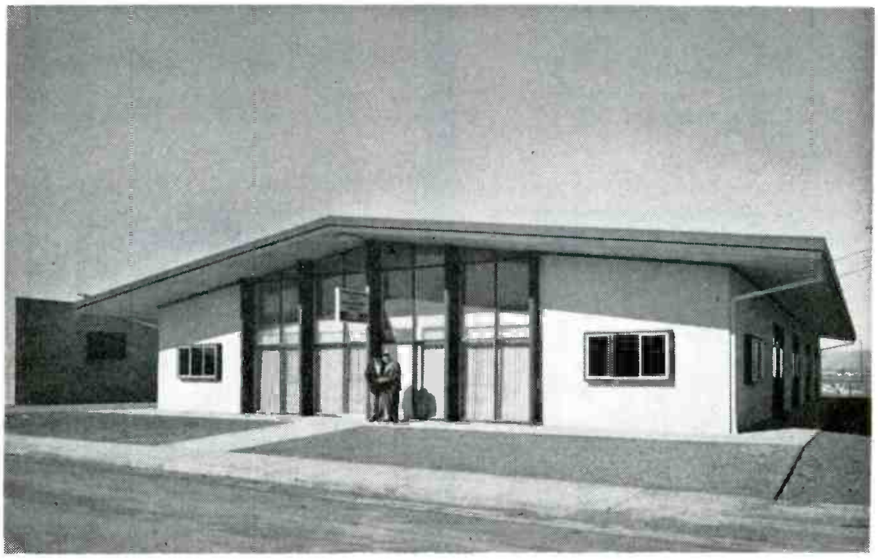
occupy 55,000 sq ft of floor space on 10½ acres of land. It will be utilized for the design, development and manufacture of complex electronic control equipment, primarily for the aircraft and missile fields.

Servomechanisms, Inc., also operates other plants in Westbury, Long Island, and Hawthorne, Calif. It recently leased additional space in Garden City, Long Island. It has two wholly owned subsidiaries, Servomechanisms (Canada) Ltd., in Toronto, Ontario, and Industrial Electronics of Canada, Ltd.

FTL Moves to New Quarters in Palo Alto

FEDERAL TELECOMMUNICATION LABORATORIES, the Palo Alto branch of the Nutley, N. J., subsidiary of IT&T has just completed a move into a new 6,000-sq ft research and development headquarters at 937 Commercial St., Palo Alto, Calif.

The building provides facilities for an ultimate capacity of 50 individuals working on projects related to communication and carrier-telephone equipment and accessories for manufacture of other members of the IT&T family. The new FTL building provides space for an expanded engineering department, laboratory and model shop, machine shop, drafting and reproduction section, and administration.



Federal Telecommunication Laboratories' new research and development headquarters

Scatter Specializing Subsidiary Announced by Tripac

FORMATION of a new subsidiary firm specializing in the engineering, design and installation of Scatter radio communications systems has been announced by Tripac Engineering Corp. of Bethesda, Md. The new subsidiary, Tripac Scatter Communications, Inc. shares office space with its parent concern at 4932 St. Elmo Ave.

All members of the new firm were formerly associated with Page Communications Engineers where they were responsible for the engineering and supervision of installation for the Air Force of the world's largest Scatter system, or are members of the parent firm which is engaged in the design, development and production of radar, communications and computing equipment.

Key personnel of the new concern include Samuel A. Jordan,

Samuel A. Jordan

Clifton F. Foss

William E. Yost, Jr.

How to keep informed [illegible] the "with what" part of y[illegible] business

At your finger tips, issue after issue, [illegible] ur richest veins of job information – advertising. You m[illegible] the "with what" type – which dovetails [illegible] of the editorial pages. Easy to read, talking your language, ge[illegible] ically to the betterment of your business, this is the kind of prac[illegible] a which may well help you do a job quicker, better – s[illegible]ve your company money.

Each advertiser is obviously doing his level best to give you helpful information. By showing, through the advertising pages, how his product or service can benefit *you* and *your* company, he is taking *his* most efficient way toward a sale.

Add up all the advertisers and you've got a gold mine of current, on-the-job information. Yours for the reading are a wealth of data and facts on the very latest in products, services, tools . . . product developments, materials, processes, methods.

You, too, have a big stake in the advertising pages. Read them regularly, carefully to keep job-informed on the "with what" part of your business.

McGRAW-HILL PUBLICATIONS

president, vice-president in charge of research and development for the parent firm; Clifton F. Foss, executive vice-president, formerly project manager with Page on the world's largest Scatter program; William E. Yost, Jr., vice-president in charge of engineering, formerly senior project engineer for Page on the Air Force Scatter project.

Bendix Missile Fills Key Positions

J. M. Miller

E. F. Lapham

J. M. MILLER AND E. F. LAPHAM have been appointed to key engineering positions in the Missile Section of the Products Division of Bendix Aviation Corp. The appointments resulted from continued expansion of engineering operations.

Miller will be responsible for all design activity on equipment for the Talos missile, for which Bendix is the prime contractor. Previously, he was works manager of the tv and broadcast receiver division. He is a pioneer in the development of various types of radar and missile guidance equipment.

Lapham, promoted to chief electronics engineer, will be responsible for the design of all electronic systems of the Talos missile. Formerly he supervised design activities on the guidance system of the Talos. He also was on the staff of the Research Laboratories division of the company.

RCL Advances Two Engineers

RADIATION COUNTER LABORATORIES, INC., Skokie, Ill., recently promoted two of its scientific personnel.

Robert W. Schumann, formerly chief development engineer at RCL, has been named vice-president-research. Prior to joining RCL, Schumann was an associate electronic engineer at Argonne National Laboratories. He designed the 256-channel analyzer, the 1024-channel neutron time of flight analyzer, and other nuclear data processing equipment.

Vernon L. Brown, Jr., replaces Schumann as chief development engineer. He was formerly senior engineer at RCL.

Weihe Heads GPL Avionic Systems Planning

VERNON I. WEIHE has joined the Avionic Division of General Precision Laboratory Inc. He will direct GPL's Avionic Systems

Vernon I. Weihe

Planning activities from Washington, D. C.

Weihe was formerly technical assistant to the vice-president in charge of engineering at Melpar, Inc.

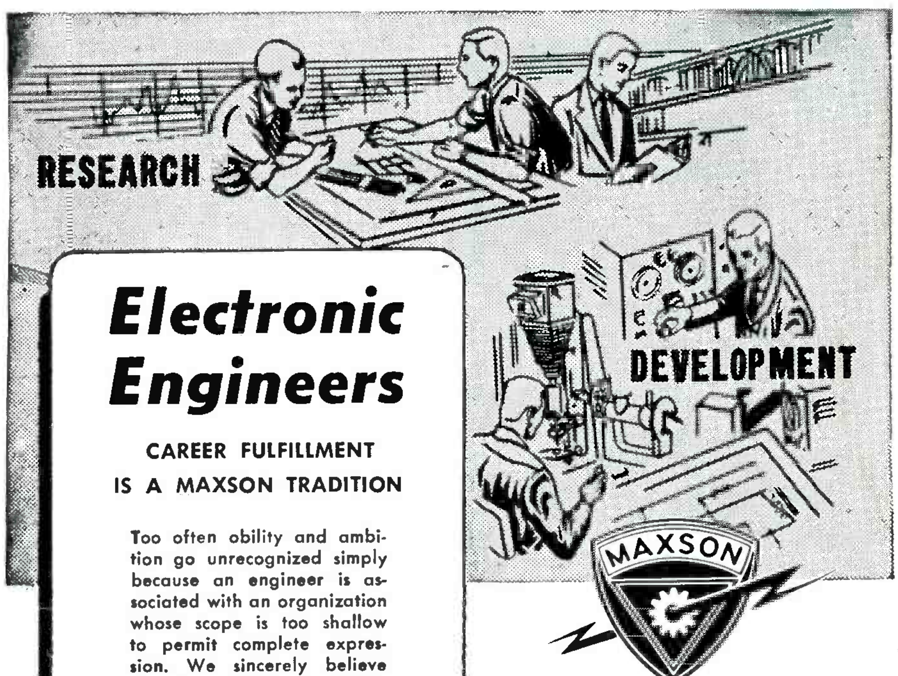
Alberhill Takes Over Dynamics Instrumentation

ACQUISITION of Dynamics Instrumentation Co., designers and manufacturers of electronic instrumentation systems, is announced by Charles J. Biddle, president of Alberhill Corp. The new venture will be conducted as Dynamics Instrumentation Co., Divsion of Alberhill Corp. It will be active in the fields of automatic process control, special regulator systems, magnetic, vacuum-tube and transistor amplifiers, recording systems of a mechanical, magnetic, optical and digital nature, analog computers and acoustical devices.

The address is 1118 Mission St., South Pasadena, Calif.

SRI Selects Lab Manager

DR. SEYMOUR B. COHN has been appointed manager of Stanford Research Institute's Antenna Systems Laboratory. He formerly headed the microwave group, and has been with the Institute since 1953. A specialist in microwave research, he has published numerous technical papers in the field. From 1948 until he joined the staff of SRI, Cohn was a research engineer with



Sperry Gyroscope Co., Great Neck, N. Y.

The Institute's Antenna Systems Laboratory is engaged in research and development of antennas and antenna systems in all ranges from very low to millimeter-wavelength frequencies, and in research and development of microwave systems, circuits and components.

Bristol Opens L.A. Branch Factory

Bristol's new Los Angeles branch factory and repair laboratory

As PART of a general expansion program, The Bristol Co. of Waterbury, Conn., recently opened a new branch factory and repair laboratory in Los Angeles, Calif. Located at 6800 E. Acco St., Los Angeles, the new facility will enable the company to step up delivery schedules to instrument and electronic components customers on the West Coast, as well as providing rapid repairs and service for users.

With the recently announced new branch factory at Houston, Bristol now operates four such facilities, including others at Chicago and San Francisco, in addition to the main factory at Waterbury, Conn.

Engineered Magnetics Expands

ENGINEERED MAGNETICS division of Gulton Industries, Inc., has announced expansion plans for its plant that will triple production capacity when completed early in 1957. The division has moved its manufacturing facilities to 13030 Cerise Ave., Hawthorne, Calif. It is presently engaged in the manufacture of magnetically regulated power supplies for airborne, computer and other applications. The parent company is located in Metuchen, N. J.

In making the announcement, Dr. L. K. Gulton, president, also stated that Bert McComb has joined the division as chief engineer. Formerly associated with the Ramo-Wooldridge Corp., McComb is an authority and early pioneer in the field of magnetic amplifiers and related equipment.

Research Director Named At Osborne

FRANK C. BRAUGH has been appointed director of research for Osborne Electronics Corp., Portland, Oregon. Braugh was formerly chief engineer for the Spectrol Div. of Carrier Corp. He will direct and coordinate the techni-

Frank C. Braugh

cal research and product development programs for Osborne Electronic Corp. Initially he will spearhead the technical advances planned for Osborne Electronic's Precision Potentiometer Division.

Frank Braugh has a diversified production background including service as chief engineer for Helipot Corp., production engineer and general foreman for the A-C Sparkplug Div. of General Motors, and assistant to the manager of the Manufacturing Development Dept. of Hughes Aircraft Co.

Dearborn Electronics Appoints Two

Two new appointments have been announced at Dearborn Electronics Industries, Inc., of Chicago, Ill.

Joseph T. Heller has been named chief engineer. He was formerly associated with the Gudeman Co., Chicago.

Robert Lockhart is the new director of development for the company. Prior to his joining Dearborn, he had five years of service with the Sprague Electric Co.

Johnson Moves Up at Beckman

BECKMAN INSTRUMENTS, INC., through its Scientific Instruments Division, announces the appointment of Bruce Johnson as chief manufacturing engineer for data

Want more information? Use post card on last page.

and control systems at the new plant in Anaheim. He will be in charge of quality control and inspection at the Beckman unit which currently employs 200 persons in the manufacture of electronic data systems for industrial process control and performance testing of advanced jet engines, aircraft and guided missiles.

Levinthal Appoints Plotkin

Sheldon Plotkin

SHELDON PLOTKIN has been appointed a senior project engineer at Levinthal Electronic Products, Inc., Palo Alto, Calif., manufacturer of microwave systems and electronic medical instruments. Plotkin was formerly a project engineer at the Cosmic Ray Laboratory of the U. of Calif.; had been formerly a member of that faculty; an electronic engineer at the U. S. Naval Missile Test Center, Pt. Mugu, Calif.; and an electronic engineer at the Los Alamos Scientific Laboratory, Los Alamos, New Mexico.

Eimac Receives AEC Contract

EITEL-MCCULLOUGH, San Bruno, Calif., manufacturer of transmitting tubes, has received an Atomic Energy Commission contract that marks its entry into the nucleonics field. The $860,000 contract covers research and development. Nothing about the project has been revealed, except that it is in the nucleonics field. Eimac expects the work, which will take two years to perform, to lead to a production contract.

Good-All Promotes Lyons

W. E. Lyons

W. E. LYONS has been named general manager of the Capacitor Division, Good-All Electric Mfg. Co., Ogallala, Nebraska. He joined the company in January 1956 as a project engineer, responsible for the introduction of several new lines of Mylar capacitors, and since August 1956 has served as an acting general manager for the Capacitor Division.

New Company Announced

FORMATION of a new company called Technical Products Inc., at 38 South Shelbey St., Indianapolis, Ind., has been announced. It is primarily an engineering electronics firm available for research, design and development, and production. A brochure showing complete services is available.

Electro Data Names Section Manager

ROY M. SKEIRIK has been appointed manager of the Production Department's Mechanical Assembly Section at Electro Data Division of Burroughs Corp., Pasadena, Calif. Before joining Electro Data in January, Skeirik served as staff engineer on various computer projects with International Telemeter Corp. From 1934 to 1941 he served in supervisory positions with IBM Corp.

GTC Appoints Engineering V-P

Martin Braude

APPOINTMENT of Martin Braude as vice-president in charge of engineering for General Transistor Western Corp., Los Angeles, Calif., has been announced. Braude has been engaged in the electronics field for the past 12 years, the latter four years in the design and manufacture of magnetic recording heads in both the computer and audio fields. His past experience includes employment with North American Aviation, Magnavox Research Labs, U. S. Naval Air Missile Test Center and Auricon Camera Co.

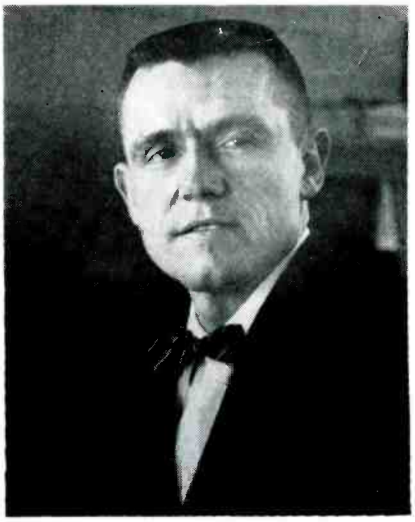
Assembly Engineers Moves to New Plant

ASSEMBLY ENGINEERS, INC., of 8921 West Pico Blvd., Los Angeles, Calif., has opened its new 10,000 sq ft plant at 5970 W. Jefferson Blvd., Los Angeles, Calif.

The new plant will allow them to

more than double their operations as specialists in the manufacture of precision machined parts for the electronic and aircraft field. They also engineer the complete planning, fabrication and assembly of hydraulic, electric, and optical mechanical assemblies.

Daystrom Systems Div. Hires Chief Engineer



Bill Waddell

BILL WADDELL, formerly technical assistant to the general manager of G. M. Giannini & Co., has joined the Systems Division of Daystrom, Inc., as chief engineer, new products.

While at Giannini, Waddell's special assignments included wind tunnel data systems and digital peak recorders. At Northrop Aircraft he headed a computation to analysis project and as senior engineer for Electronic Associates he developed a digital coefficient potentiometer and a digiplotter. At Librascope his design responsibilities included digital to analog shaft conversion, shipboard data recording devices, and data logging equipment.

Erie Opens New Plant In California

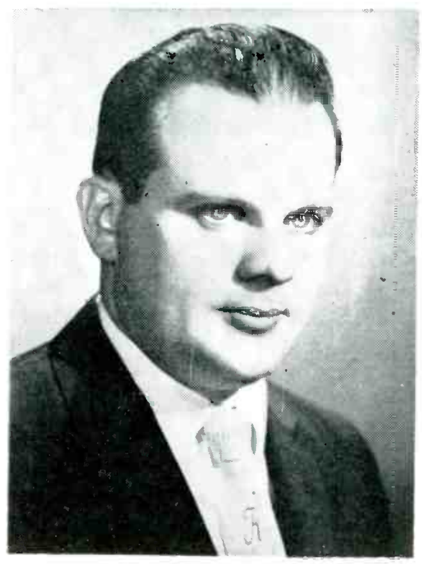
ERIE RESISTOR CORP. of Erie, Pa. is opening a new 9,000 sq ft plant on the west coast for its electro-mechanical division. James H. Foster is general manager of the division. The new plant will be located in

Hawthorne, Calif. Manufacturing is scheduled to begin in October. The plant will make electronic and mechanical assemblies for electronic equipment.

George Osborn, district manager of sales in Los Angeles, has been named manager of the Erie-Pacific works. In addition to his new duties he will also be in charge of all sales activities for the electro-mechanical division on the west coast.

Joseph Martin, plant manager of Elgin labs., Waterford, Pa. for the past year, will be superintendent in charge of manufacturing at the new California factory. He has been with Erie for over 20 years in various manufacturing capacities. The last 8 years he has specialized in electro-mechanical assemblies.

Northport Engineering Appoints Sales Engineer



William Klingner

WILLIAM KLINGNER was recently appointed sales engineer of Northport Engineering, Inc., St. Paul, Minn. He was previously employed by U. S. Steel Corp. in their industrial Engineering Dept., Minneapolis-Honeywell Aero Div. in the manufacture of motors and electronic subassemblies; and just prior to joining Northport Engineering, was employed by Remington Rand Univac for three years as a manufacturing project engineer on a large scale military computer and then was promoted to process engineer supervisor on military computers. Klingner will cover industrial plants in the Twin City area in a sales and advisory capacity.

General Electrodynamics Names Chief Engineer

B. Whitfield Griffith, Jr.

B. WHITFIELD GRIFFITH, JR., has been appointed chief engineer for General Electrodynamics Corp., manufacturers of electronic tubes. For the past 10 years, Griffith has been research engineer for Continental Electronics Mfg. Co., and participated in the development of specialized equipment and systems for Voice of America. Prior to that, he was in charge of broadcast equipment design for E. F. Johnson Co.

The Garland, Texas, firm has just announced a new line of tv camera tubes designed for use in broadcast and industrial applications. The GEC Vidicon tubes are built to resist abusive handling and severe operating conditions.

Kuhl Adds to Plant

KUHL MFG. CO., San Leandro, Calif., which specializes in industrial sheet metal work, plans to add 6,000 sq ft to its 10,000-sq ft plant to provide for work on diversified electronic parts. Estimated investment in the expansion is $40,000.

New equipment being added will

make possible metal fabrication to tolerances with a ± 1/64 in. on drill, tapping, punching, shearing and forming.

Philips Appointed Applications Engineer

Sam Philips

SAM PHILIPS has been appointed applications engineer for J. B. Rea Co., manufacturer of general purpose and special systems and systems components, and the new Readix dual computer systems.

Philips will serve as applications engineer for the complete line of Readix dual computers and tie-in equipment.

Bendix-Scintilla Expands in Sidney, N. Y.

A $5 MILLION plant expansion and a stepped-up employment program have been announced by the Scintilla division of Bendix Aviation Corp. The building program is the largest single expansion of plant facilities in the history of the division. By 1961 it will add about 200,000 sq ft to the present 560,000-sq-ft plant.

An increase in employment of about 20 percent is expected by 1961. Scintilla now has 4,800 employees. About 400 to 500 new employees will be hired gradually, following the completion of the first phase of the construction program, about Sept. 1.

This new facility includes a 52,-

000-sq-ft addition, now under construction, to be devoted to electrical connector manufacturing, engineering and sales groups.

Transistor Man Joins Delco Radio

Ralph B. Brown

RALPH B. BROWN has joined the Delco Radio Division, General Motors Corp., Kokomo, Ind., as group leader in charge of evaluation of transistors. This was announced by Dr. Frank Jaumot, director of semiconductor research and engineering at Delco.

Brown worked with the Philco Corp. prior to joining the Delco Radio Division.

Litton Picks Salt Lake City for Eleventh Plant

SALT LAKE CITY has been chosen as the site for Litton Industries' eleventh plant location. To manufacture magnetrons, klystrons and other microwave tubes, this facility adds Utah to the list of states, including New York, Maryland, Indiana and California, in which Litton currently has plants and laboratories. A plant covering 60,000 sq ft and employing about 600 people is planned.

Litton Industries, with headquarters in Beverly Hills, Calif., is

Want more information? Use post card on last page.

active in the fields of digital computers and controls, inertial guidance, radar and countermeasures, servomechanisms, space simulation research, electronic transformers, and numerous electronic components including color display tubes for military and industrial applications.

The Salt Lake City activity will be an addition to the company's Electron Tube Division, whose principal plants are in San Carlos, Calif., near San Francisco. Dr. Norman H. Moore, Litton Industries vice-president, is the managing director of this division.

Three Join IFI Staff

Milton Halpern

INSTRUMENTS FOR INDUSTRY, INC., Mineola, N. Y., has announced three additions to its staff.

Milton Halpern, formerly associated with Allied Research, Inc., Kollsman Instruments and Sperry Gyroscope Co., is the new project engineer. He will be engaged in special development work on several projects in vhf and uhf communications systems.

Norman S. Darch has joined the staff as an electronic engineer. He will work on the development of specialized r-f circuitry. Darch was a former employee of Radio Receptor Co., Inc., where, as senior engineer, he participated in the de-

Norman S. Darch

velopment of military receiver and transmitter systems.

New staff engineer at the company is Sol Schneiderman. He will

Sol Schneiderman

be responsible for the development of Signal Corps Radio Set AN/MLQ-8 (XE-3) at I.F.I. He was formerly associated with Radio Receptor Co., Federal Mfg. and Engineering Corp., and Precision Associates.

New Hermetic Seal Manufacturer Announced

RECENT formation of Glass-Tite Industries, Inc., 1391 Atwood Ave., Johnston 9, R. I., has been an-

Want more information? Use post card on last page.

nounced. By using new scientific techniques and their own exclusively developed manufacturing equipment, the new company is able to insure rigid quality controlled seals to exacting high-reliability requirements.

MIT To Hold Summer Computer Class

A ONE-WEEK special summer program—"Analog-Digital Conversion Techniques"—will be offered Aug. 12-19 by MIT.

The program is directed towards systems and design engineers with a background in electrical engineering, but experience in digital data processing is not required.

Surveyed will be the range of engineering problems encountered in designing conversion equipment. The current state of the art in solving these problems will also be discussed.

Barlowe Television Changes Name

TO COVER more adequately its diversified activities in the electronic field, Barlowe Television has changed its name to Barlowe Electronics. The organization, located in Bethpage, N. Y., is now placing special emphasis on the development and manufacture of transistor devices, industrial electronic controls, medical electronic equipment and the maintenance of these devices in industry.

Pioneer Award Goes To Hyland

THE 1957 Pioneer Award was recently conferred upon Lawrence A. Hyland, vice-president and general manager of Hughes Aircraft Co. of Culver City, Cal., by the IRE's professional group on aeronautical and navigational electronics.

The plaque honored Hyland for his demonstration in the early 1930's that radio waves will reflect from objects, a basic radar discovery. He first observed and proved the principle of radar detection of aircraft while an associate engineer in the Naval Research Laboratory at Anacostia in 1931. In 1921 he participated in the first blind landing of a flying boat by radio.

Hoffman Sets Up New Division, Department

RECOGNIZING the growing importance of the field of solar energy, Hoffman Electronics Corp., Los Angeles, Calif., recently established its Solar Division. The new division, which will be headquartered in Evanston, Ill., will be concerned with the development and production of solar energy converters. It will operate as a part of the Hoffman Semiconductor Division, also located in Evanston.

Hoffman Laboratories, Inc., wholly-owned subsidiary in Los Angeles, has set up a new department to take over the research and development of semiconductor applications. Called the Semiconductor Equipment Design Section of Hoffman Laboratories, this unit will be concerned with developing new apparatus using all types of semiconductors, including solar energy converters, for industrial and government applications.

Cushing Joins Lenkurt Electric

FORMER radio project engineer with the North-West Telephone Co. in Vancouver, B. C., Thurb D. Cushing has joined the Product Planning Division of Lenkurt Electric Co., San Carlos, Calif. In his new position as radio communications engineer, he will do research in communications methods and in analysis of new products to serve the industry.

During his eight years with North-West, Cushing was responsible for major radio engineering projects, including the British Columbia portion of the Trans-Canada TD/2 system.

New Books

Television Receiving Equipment

BY W. T. COCKING

Philosophical Library, New York, 1957, 446 *p,* $12.00.

THIS text is the fourth edition of the subject book. Compared to the previous editions it has been for the most part completely rewritten to include development and design trends in television receivers during the past five years.

▶ **British System** — The text, in general, is confined to the British 405-line positive modulation system. However, reference is made to the three other systems, i.e., 525, 625 and 819 line, some of which use negative modulation. Pros and cons of these systems are given along with a chart tabulating in what countries each is used.

While this text is intended primarily for engineers with a background in television, the first three chapters develop in a clear and lucid manner the fundamental theory underlying our present day television system.

▶ **Deflection Circuits** — The next seven chapters are devoted to the difficult and unpredictable problems that are encountered in the design of suitable electromagnetic scanning circuits for a television receiver. These problems are discussed from a practical, rather than a theoretical, point of view. As Mr. Cocking points out, the design of such circuits is usually more empirical than mathematical.

The succeeding three chapters cover the important design phases of synchronizing circuits. Operation of modern circuits such as the phase discriminator and flywheel circuits used for horizontal sync are discussed. These three chapters are also discussed chiefly from a practical point of view.

▶ **Audio and Video** — Video and sound signal amplifying and detecting circuits are discussed in the next eight chapters. These circuits are analyzed from a mathematical point of view. However, a lot of practical ideas in the design of such circuits are highlighted.

The remaining ten chapters cover antennas, interference, sensitivity, noise, gain control, special circuits and power supplies.

While this text is written primarily from a practical point of view, formulas useful to the designer have been collected in a convenient manner in the appendices. The well-written text and many practical ideas should make it an invaluable reference work for the television design engineer.—B. AMOS, *Asst. Man., Receiver Eng. Dept., Allen B. Du Mont Lab, Inc., East Paterson, N. J.*

Progress in Semiconductors

BY A. F. GIBSON, P. AIRGRAIN, R. E. BURGESS

John Wiley & Sons, New York, 1956, 220 *p,* $8.00.

THIS is the first in a forthcoming series of annual volumes which has been stimulated by the indubitable fact that even specialists have difficulties in following the semiconductor literature if they also want to do productive work of their own. It is intended to present in each volume a number of individual and independent articles each of which covers a special problem.

▶ **Criterion for Usefulness** — To make such a book useful to many, only such topics should be selected where during the past year or two either (a) a major breakthrough has occurred, or (b) where the field has been completely worked out so that a conclusive and definite presentation can be given, or (c) where in the past such a large amount of more or less unrelated data has been obtained that it it worthwhile to pause and to order these data before going ahead. As to this present volume, one only needs to read the first paper, "Recent Advances in Silicon", to be convinced that such a series can be extremely worthwhile if only the editors succeed in getting the proper contributions. They have succeeded fairly well in this volume.

Not all the contributions are equally desirable and equally well written, nor is everything that would be desirable included. This reader would have liked to see a few of the papers replaced by more recent or more important contributions. But the overall figure of merit of the book is as good as one can reasonably expect from any review series, particularly from a first volume for which it is always more difficult to solicit contributions.

There are two objections which the reviewer anticipates but does not share. First, that the style is hetergeneous. Sure it is, but so what. Second, a man who is himself actively engaged in work on one of the topics will almost inevitably find his topic treated poorly, out of date, incomplete and what not. Never mind. The section in question was not written for him but for all the others who work on the other topics. It is for him that all the other topics are there.

▶ **Contents** — The individual contributions are: "Recent Advances in Silicon"—An excellent survey of the present methods for the preparation of silicon and of our knowledge about its properties. There are two short chapters about *on* junctions and other silican devices but they are included for completeness only. Emphasis is clearly on the silicon proper. This reader considers this desirable since the material technology and properties are probably less subject to change than the device technology. Within this limit, the article is as much up to date as is compatible with the final printing time of a book.

"The Germanium Filament in Semiconductor Research"—A summary of the standard methods to determine drift-mobilities, etc. in semiconductor filaments. Basically, this material is not new. It has probably been included in this first volume to round off the whole series.

"Theory of the Seebeck Effect in Semiconductors"—A highly mathematical and condensed, theoretical treatment of the thermoelectric forces in semiconductors. A final treatment in the sense that it is as complete as seems useful for a long time to come, even including non-spherical energy surfaces.

"The Electrical Properties of Phosphorus"—A summary of progress since 1948, including electroluminescence; the electroluminescence part is particularly good. One might wish that it had been longer, if necessary, by cutting the rest.

"The Design of Transistors to Operate at High Frequencies"—Considering the great importance of this topic, the article might easily have become the key article of the whole book had it been a little more up to date. But it was written in June 1955 just when a whole avalanche of work in this direction started. As a result the large number of very important contributions that have appeared since are not included in the report; nor are a few earlier but less easily accessible contributions. Even the part that is included has not been worked over and presented in a logical fashion, but appears more or less accidentally arranged. Partly all this could have been avoided, partly not. The whole topic should have been withheld for a year or, at least, a short note should have been added during proofreading, as had been done with the silicon paper.

"Photo-Magneto-Electric Effect in Semiconductors"—A very desirable complete treatment of an effect that has been growing rapidly in importance during the past few years.

"Field Effect in Semiconductors"—Something that is not exactly new but of which a good summarizing treatment like this one has been overdue for some time.

▶**Summary**—There is a need for a series like this and the first volume indicated that this series might fill in that need. It should be included in every library. Whether the individual engineer or scientist should own it, will have to depend on his interest in the individual articles. The above remarks may aid him in this decision. —HERBERT KROEMER, *RCA Laboratories, Princeton, N. J.*

Reference Data for Radio Engineers

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP., *New York*, 1956, 1,121 *p*, $6.00.

THE fourth edition of this handbook is enlarged and revised as compared to the previous edition. Since the third edition has had some success it seems useful to compare this new edition with it.

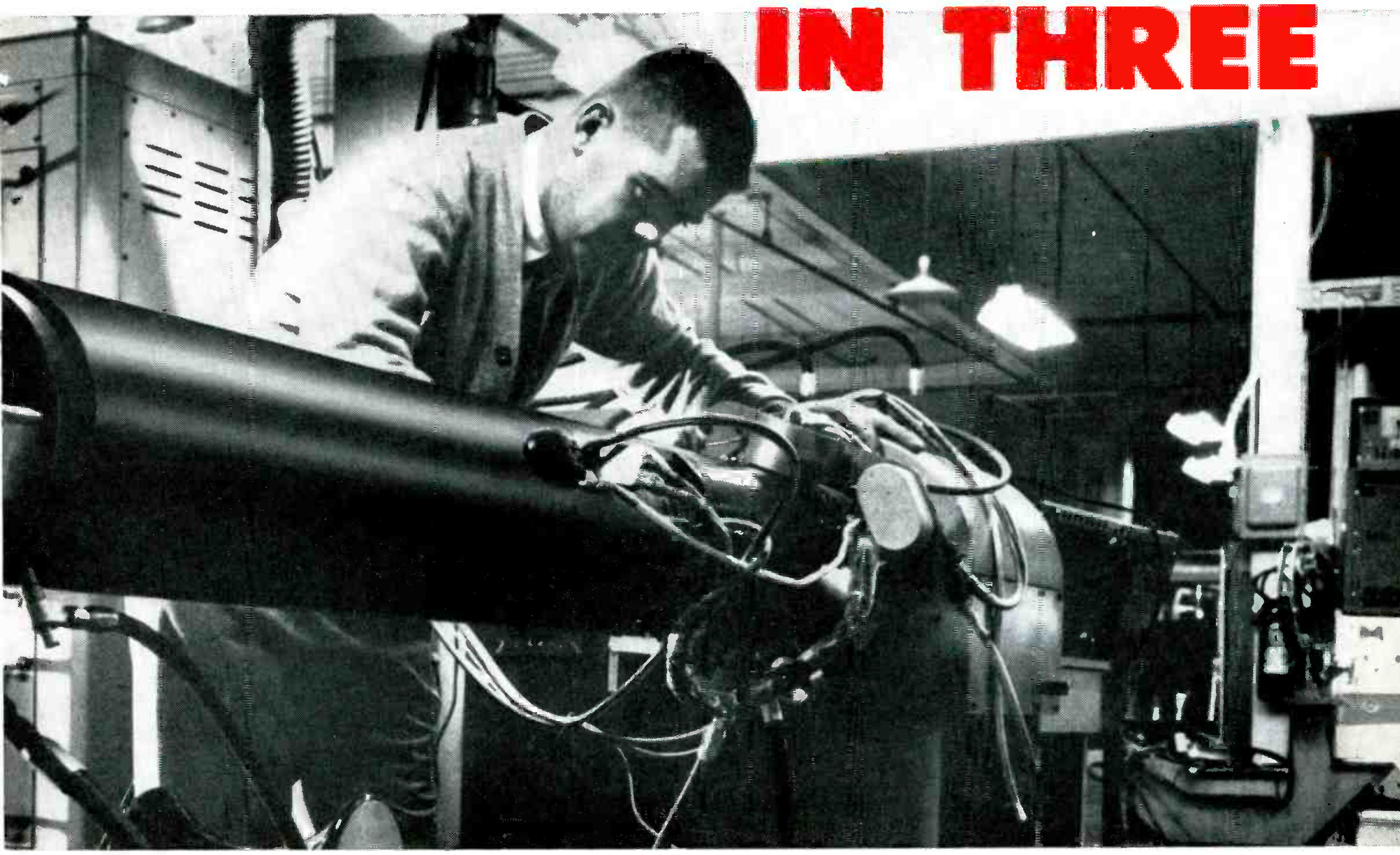
The number of chapters has been increased and material that duplicates that in the older edition has been rearranged.

▶**Frequency Data**—Chapter one is similar to that in the older text but has been expanded: the colored spectrum chart is larger and easier to read; the audio spectrum for various musical instruments has been added and data for frequency allocations for various services has been increased. Information regarding the standard-frequency broadcasts of WWV and WWVH has been brought up to date.

In chapter three a periodic chart of the work functions of the elements has been added. Tables of voltage drops in long circuits and tables that give the fusing currents of various size wires of copper, aluminum, german silver, iron, and tin, a table giving the inch-size of various millimeter and gauge number drills, and information on sheet-metal gauges and a table comparing various gauges have been included. A descriptive section on ferrites, including a table of the characteristics of 17 types, has been introduced.

▶**Components**—Chapter four has been revised and expanded. Information on fixed film resistors has been included in the section on resistors. In the section on capacitors, the old RMA standards that appeared in the third edition have been omitted as obsolete. Information has been added on metalized

TO THE ONE MAN IN THREE



HIGH CALIBER MISSILE ENGINEERING places Raytheon in a unique position among electronics companies—with prime contracts for both Navy's Sparrow III and Army's Hawk. Contracts include complete systems responsibility for these air-to-air and surface-to-air missiles.

To the one man in three who will qualify as a Raytheon engineer: quite frankly, we're not looking for the average engineer. Our unusually complex engineering assignments require men with abilities much above the average. You work in project groups small enough to insure individual recognition—with maximum opportunity for promotion and professional growth. *For details, see the following pages.*

Raytheon areas open to you include missiles, radar, countermeasures, sonar, communications, semiconductors, microwave tubes and electron tubes. For full information, please write to L. B. Landall at the address below or directly to the division of your choice, as listed on the following pages.

Are you the ONE MAN IN THREE?

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY
Waltham 54, Massachusetts

RAYTHEON

Continued ▶

✓

***PLAN TO VISIT RAYTHEON DURING YOUR NEW ENGLAND VACATION** — Contact Ed Herlin at above address or telephone TWinbrook 4-7735.*

paper, plastic film and electrolytic capacitors. A section on printed circuits augments this chapter.

Chapter 5, covering the fundamentals of networks has acquired some new topics. Curves for determining the effect of shielding on the inductance of a solenoid are introduced in this edition. General circuit parameters (sometimes called the ABCD constants) have been added; matrix methods are used in developing this topic. Tables are given for the general-circuit matrices of various two-port networks.

▶ **Filters**—Chapter 6, titled "Filters, Image-Parameter Design," is essentially the same as chapter 7 in the third edition. Chapter 7, "Filters, Modern-Network-Theory Design," is new. There is no development of the theory or the method, only the end results are presented. The method of design presented here classifies filters and accomplishes their design by the use of physically realizable attenuation characteristics for actual terminations. Data are given for the design of Chebishev and Butterworth performance with constant-K configurations.

The design of m-derived types follows the methods of Norton and Darlington. This procedure is somewhat involved and additional references would need to be consulted to be able to use the data given intelligently. A section on the use of quartz crystals in filters has been added. Stagger-tuned circuits, which were in chapter 6 in the third edition, appear in this chapter.

Chapter 12, "Rectifiers and Filters," covers the material of chapter 10 in the third edition with the addition of a section of semiconductor rectifiers and articles on surge suppression and contact protection.

▶ **Magnetic Amplifiers** — Chapter 13 is an expansion of material formerly in chapter 11. It includes a survey of the elementary theory of magnetic amplifiers, describes typical circuits—some in combination with transistors, discusses feedback in magnetic amplifiers and gives design principles.

Chapter 14 on feedback control systems is a revision of the old chapter 25. There has been a considerable expansion of the articles on stability criteria and methods of stabilization. The value of this material has been enhanced in the new edition. The details of the positioning type servomechanism that appeared in the older edition have been omitted.

▶ **Tubes**—Chapter 15 has been revised and expanded as compared to the old chapter 12. The article on noise has been increased in size while the old article on positive-grid tubes does not appear in this edition. An article on multicavity klystrons has been added and the article on traveling-wave tubes has been expanded. A section on photometry and an extensive section on photosensitive tubes appears in the new edition.

Chapter 16, "Electron-tube Circuits," includes the material of chapter 13 in the third edition. There is a new article on amplifier pairs which includes the cascode amplifier and the cathode-coupled differential amplifier. The article on resistance-capacitance coupled amplifiers has been expanded to include cascaded stages. Data on special feedback amplifiers, such as the anode follower and the Miller integrator, have been added.

▶ **Transistors** — Chapters 17 and 18, "Semiconductors and Transistors," are new in the fourth edition. They contain definitions and properties of semiconductors. A brief theoretical discussion of semiconductor devices is given and the characteristics of transistors and transistor parameters are discussed. Matrix methods are employed for combining networks. Formulae are tabulated for the various transistor connections. Information on the use of duality and the electron-tube analogy is included.

Small- and large-signal operation of transitor amplifiers and use of transistors in trigger circuits and oscillators is considered briefly. Video and intermediate-frequency amplifiers are discussed to a greater extent. Considerations of temperature compensation, pulse circuits and measurement of small-signal parameters are included.

Chapter 19, "Modulation," contains, essentially, the material of the old chapter 14. The article on pulse modulation has been reorganized and expanded, pulse-modulation spectrums having been added.

Chapter 20, Transmission lines, includes the material formerly in chapter 16. Articles of microstrip, strip transmission lines, spiral delay lines, and surface-wave transmission lines have been added.

▶ **Scattering Matrices**—Chapter 22 has no counterpart in the third edition. The method of analysis discussed here describes the performance of uniform microwave structures in terms of the power flow and the phase of the field at a cross section. The scattering matrix permits the calculation of a reflected wave at a junction or at a discontinuity in a wave guide. A transformation matrix, that permits the calculation of the effect of cascaded junctions, is also discussed. Experimental methods of measuring the matrix and geometry of reflection charts are included.

Chapter 23, "Antennas," contains material from chapter 18 in the former edition. The article on elliptical and circular polarization has been revised and expanded. Information on discone, helical and slot antennas has been added. Articles on passive and corner reflectors augment the original material.

Chapter 28, "Wire Transmission," is a revision of the former chapter 23. Charts and graphs have been added that give a comparison of the 500- and 302-type telephone sets. Information on negative-impedance and negative-admittance telephone repeaters is included. The data on carrier-telephone systems has been increased in quantity and scope. The section on telegraph facilities has been revised.

▶ **Digital Computers** — Chapter 30 did not appear in the older edition. It gives a brief, but good, summary of the principles of number systems, coding and switching circuits.

"Nuclear Physics," chapter 31, is

CONTINUED

another new topic in the fourth edition. It includes descriptions of the fundamental atomic and nuclear particles, the terminology of nuclear physics, information on high-energy particle accelerators, nuclear instrumentation, radiation safety and health physics.

Chapter 33, "Information Theory," is a new topic in this edition. It gives a survey of this subject, discussing the amount of information transmitted, units for the measurement of information, entropy, information sources, binary encoding, noiseless channels and noisy channels.

▶ **Mathematics** — Chapter 34, "Probability and Statistics," is another new topic. A fair summary of the field is given here, including definitions of terms, the characteristic function, distributions, sampling, chi-square test, Monte Carlo method and random processes.

Chapter 35, "Fourier Waveform Analysis," is a revision of chapter 15 in the former edition. Data and tables of Fourier transforms have been added and spectra of common pulse waveforms have been tabulated. The analysis of pulse trains is included with a tabulation of common forms.

Chapter 37, "Mathematical Formulas," is but slightly changed from chapter 28 of the earlier edition. There have been added articles on the Gamma function, hyperbolic trigonometry, Bessel functions and matrix algebra.

Chapter 38, "Mathematical Tables," is an expansion of chapter 29 of the former edition. There have been added tables of logarithms to the base two, powers of two, random digits, the normal probability density function, the probability of deviation from the mean in normal distribution and the cumulative normal distribution function.

The revisions and additions of the fourth edition reflect fairly well the advances and the shift in emphasis in the field of communications and electronics. The format and slightly increased size of the charts make the book easier to read.

Although it is a handbook it may

be useful to supplement text books in college courses. Many references are quoted and this reference book may well be used as an introduction and guide to a new topic. The chapter on semiconductors is somewhat incomplete and weak but it is difficult to keep any text up to date in this rapidly developing field.

In many instances the user may desire more theory or more practical data than is available, but this reference book is certainly useful to students and engineers in communications, electronics, or control systems and appears to be the most modern available in this field. —HAROLD WOLF, *Professor, Electrical Engineering, The City College, New York.*

Thumbnail Reviews

On Human Communication — A Review, A Survey, and A Criticism. By Colin Sherry, Technology Press and John Wiley & Sons, Inc., New York, 1957, 333 p, $6.75. This introduction to information theory is based on a series of lectures delivered by the author on subjects such as "the relations between diverse studies of communications, of the causes and the growth of this modern interest, together with some idea of the unification which exists".

Tape Recorders—How They Work. By Charles G. Westcott, Howard W. Sams & Co., Inc., Indianapolis, 1956, 177 p, $2.75. Tape recorder principles for service technicians, high-fidelity enthusiasts and recordists intended as a guide in selecting equipment.

Equivalent Radio Tubes Vade-Mecum (13th Edition). Edited by J. A. Gisen, P. H. Brans, Ltd., Antwerp, Belgium, 356 p, $5.00. Listing of all replacement tubes for a given type, including exact and near-equivalent types, with over 43,900 comparisons.

A Human Engineering Bibliography. By Ivan McCollom and Alphonse Chapanis, San Diego State College Foundation, San Diego, Calif., 1956, 128 p, $4.00 (paper). Prepared for the Human Engineering Guide to Equipment Design this volume lists 5,666 references covering man-machine systems, visual problems, auditory problems, speech communication, environmental effects on human performance, body measurement and movements, etc.

Continued

Backtalk

Spectrum Congestion

DEAR SIRS:

NEW amplitude modulation techniques are increased in importance lately, in view of the radio spectrum congestion.

This is forcing channel assignments for mobile, industrial, public service and commercial users to narrower bandwidths. This results in placing f-m equipment into an increasingly unfavorable mode of operation which will shortly require the re-evaluation of the entire f-m vs a-m (or some form of a-m, such as dsb, suppressed or reduced carrier; or ssb) communications picture.

I believe that ssb is not here to stay, as the universal system of the future, but rather that double-side-band systems even at present offer more results for less effort, and will eventually prevail.

RALPH H. BAER
Vice-President
Transitron, Inc.
Manchester, N. H.

Gravity Theories Welcome

DEAR SIRS:

MY COPY of ELECTRONICS is usually perused from cover to cover each month but I must have missed your item in *Looking Ahead* in the January 1956 issue. It is gratifying to know someone else may hold similar ideas on gravity.

You will probably agree that a full explanation hitting the public between the eyes at this time would incite ridicule from laymen and present-day scientists alike.

Whether my beliefs are correct or otherwise, enough interest may be aroused through your pages to prove or disprove many more corollaries to my (or our) new theory of gravity, of which I could write on and on.

For the past twenty-five years, an unusual theory of the nature of gravity has been entertained by this writer; so unusual and simple, its full explanation cannot be suddenly divulged. The item in *Looking Ahead* nearly coincides in its statement "a combination of centrifugal forces from outer space pressing upon the earth rather than as a pull from within the planet."

If this is a wild conjecture (p 500, "Gravity and Inertial Mass", ELECTRONICS, March 1956) let it not be supplanted by another conjecture just as wild and uncapable of proof either mathematically or in the laboratory. Suffice to say, it is my belief gravity is more of a push than a pull; the definition of outer space need only be modified. Gravity, then, becomes a result of the daily motion of the earth, not even remotely associated with magnetism. The terms "gravity" and "attraction" have become almost synonymous only because of the lack of a better explanation of natural law.

It is amusing to read (a) a scientific treatise on the expansion of the universe; (b) another discourse contradicting the theory of an expanding universe; (c) an article on the contracting of the earth's crust with an eventual denial; (d) the gradual slowing down of the earth's motion; (e) another on the gradual speeding up of its motion; (f) line of sight transmission of radio and television signals; (g) bending and distorting these waves in order to explain observed facts of reception of signals beyond the horizon; and many other "dictions" and contradictions too numerous to mention.

All of this because of the acceptance of a few assumed "facts" after Colombus proved the earth was not flat nearly five hundred years ago! Add to this the misapplication of simple trigonometry and the present list of "Upset Theories" (ELECTRONICS, Jan. 1956, p 121) can be enlarged a hundred-fold.

E. E. WILSON
Western Electric Co.
Curbstone physicist, sans°°
San Lorenzo, California

Credit Due

DEAR SIRS:

IN the ELECTRONICS business edition, May 20, 1957, p 40, there is an article "Pogo Stick Up-Down Meter", drawing attention to a coming paper in the June 1 technical edition.

I believe that the author, Mr. S. Logue of Convair, had published

Continued

a report about his instrument a few months ago in a trade paper without giving me any credit for my work in the same field which was published in the *Proceedings of the Institute of Radio Engineers* in June 1955. I am enclosing a reprint of my paper: "Direction Sensitive Doppler Device", and I would like to ask you to include a credit line.

In addition to my paper, I have two patents pending, the civil rights of which are my property.

HENRY P. KALMUS
Chief
Supporting Research Laboratory
Ordnance Corps
Diamond Ordnance Fuze Laboratories
Washington, D. C.

Editor's Note: Because of our printing schedule pages for feature articles close several weeks ahead of our mailing date, making it impossible to include the credit.

Vertical Separation

DEAR SIRS:

AFTER reading the *Shoptalk* section in the March 1957 issue of ELECTRONICS, I feel that there is a way that Mr. Markus could gain easier access to his periodicals with considerably less physical effort.

We stand all our journals vertically on the shelves, like ordinary books, and insert stiffeners at regular intervals, usually every six numbers. Pieces of ⅛th-inch hardboard, cut to the size of the journal, serve the purpose nicely.

KURT M. FREUND
University of Toronto
Toronto, Canada

CRT Deflection Circuit

DEAR SIRS:

I HAVE just read my article, "CRT Deflection Circuit Has High Efficiency" which appeared on p 172 of the April 1, 1957 issue of ELECTRONICS. Please note that in Fig. 3B, L_1 should be 0.25 mh and D_1 should be 1N158.

In addition, the direction of current i_2 in the small loop of the right hand circuit in Fig. 2 is shown reversed.

WALTER B. GUGGI
Television Laboratory
Stanford Research Institute
Menlo Park, California

PROFESSIONAL SERVICES

The BOSTICK LABORATORY, INC.
Pulse Transformers—Inductors
Complete Service—Consulting,
Design, Development;
Also Production Orders
Main Plant Tyngsboro, Mass. — Business Office P. O. Box 167 Chester, N. J.

CONSULT THESE SPECIALISTS:
Let them save your time by bringing their broad experience in their specialty to bear on your problems.

PICARD & BURNS, INC.
Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research Development and Production of Special Electronic Equipment
240 Highland Ave. Needham 94, Mass.

BRIGGS ASSOCIATES, INC.
Engineering Services
ELECTRONICS MECHANICAL
Development — Manufacturing — Consulting
Special Machines — Instrumentation — Automation
Electron Tube Design, Materials, Reliability
10 DeKalb St. Broadway 9-2120 Norristown, Pa.

ERCO RADIO LABORATORIES, INC.
Radio Communications Equipment
Engineering - Design - Development - Production
Our 27th Year in Air to Ground Communications and Radio Beacons
Garden City • Long Island • New York

ALBERT PREISMAN
Consulting Engineer
Television, Pulse Techniques, Video Amplifiers, Patent technical consultation.
616 St. Andrews Lane, Silver Spring, Maryland

CROSBY LABORATORIES, INC.
Murray G. Crosby & Staff
Radio - Electronics
Research Development & Manufacturing
Communications, FM & TV
Robbins Lane, Hicksville, N. Y.
WElls 1-3191

McCann Engineering Company
Consulting Mechanical Engineer
Design and Development of Test Equipment for Synchros, Potentiometers, Gyros, Etc.
Redesign of Products—Trouble Shooting
Production—Automatic Machinery.
Special Machines with Sequence, Form Recognition, Dimension Decision and Special Environment Features.
9210 So. Vermont Los Angeles 44, Calif.

TELECHROME MFG. CORP.
Electronic Design Specialists
COLOR TELEVISION EQUIPMENT
Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus, Telemetering for Guided Missiles.
J. R. Popkin-Clurman, *Pres. & Dir. of Eng.*
28 Ranick Dr. Amityville, L. I., N. Y.

DELAWARE PRODUCTS CO.
Analog Voltage to Digital Conversion
Digital Voltage Recording Systems
Design-Development-Manufacturing
300 Broadway Camden 3, N. J.

Measurements Corporation
Research & Manufacturing Engineers
HARRY W. HOUCK MARTIAL A. HONNELL
Specialists in the Design and Development of Electronic Test Instruments
Boonton, New Jersey

WHEELER LABORATORIES, INC.
Radio and Electronics
Consulting — Research — Development
R-F Circuits — Lines — Antennas
Microwave Components — Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N. Y. HUnter 2-7876

ELECTRONIC RESEARCH ASSOCIATES, INC.
"TRANSISTORIZE" YOUR PRODUCT!
Complete Service in consulting, research, development, and production on Transistor circuitry, products and instrumentation.
67 East Centre Street Nutley, N. J.
NUtley 2-5410

NIAGARA ELECTRON LABORATORIES
CONSULTATION - DESIGN - CONSTRUCTION
MFG. THE THERMOCAP RELAY
Specializing in solution of problems of electronic and electro-physical instrumentation for the research or analytical laboratory. Industrial plant problems also invited
Andover, New York Cable Address: NITRONLAB

YARDNEY LABORATORIES
Research-Design-Development
Electro-Chemical Generators of Energy
40-48 Leonard Street WOrth 6-3100
New York 13, N. Y.

MANUFACTURERS' REPRESENTATIVES
IN THE ELECTRONIC INDUSTRY

HORMAN ASSOCIATES, INC.
2017 "S" STREET, N.W.
WASHINGTON 9, D. C.
DECATUR 2-5705

SERVING
DELAWARE, MARYLAND, DISTRICT OF COLUMBIA, ARLINGTON AND FAIRFAX COUNTIES IN VIRGINIA
TELETYPE NO. WA-559

REPRESENTING —
HEWETT-PACKARD CO.
SORENSON & COMPANY INC.
VARIAN ASSOCIATES
BETA ELECTRIC CORP.
ELECTRO-MEASUREMENTS INC.
GERTSCH PRODUCTS INC.
SENSITIVE RESEARCH INST. CORP.
SANBORN COMPANY
KINTEL (formerly KAY LAB)
JOHN FLUKE MANUFACTURING CO.
BUDD STANLEY COMPANY, INC.
WEINSCHEL ENGINEERING CO.
Complete Recalibration Laboratory

•CONTACTS•
FOR THE FIELD OF ELECTRONICS

This CONTACTS Section
supplements other advertising in this issue with additional announcements of products essential to efficient and economical production and maintenance.

SAMUEL K. MACDONALD, INC.
manufacturers representatives over 25 years
1531 SPRUCE STREET, PHILA. 2, PA.
Territory: Pennsylvania • New Jersey, Delaware • Maryland, Virginia • West Virginia, District of Columbia
Other Offices: Pittsburgh, Baltimore, Washington, D.C.

160,000 prospects!
In *Electronics* magazine the advertiser talks to 46,000 paid subscribers, plus 3 or 4 interested potential customers receiving each copy for pass-along reading . . . approximately 160,000 prospects

IDENTIFICATION NAME PLATES
For controls and panels—precision engraved on bakelite or black anodized alum.—any titles—quick service by mail on large or small jobs—send for sample and prices.
ATLANTIC ENGRAVERS, INC.
52 Ocean Ave. Amityville, N. Y.

ENGINEERING and SCIENCE at RCA

STARTING SALARIES: non-managerial to $15,000 . . . managerial open

FIELDS OF ENGINEERING ACTIVITY	MANAGERS	Electrical Engineers 0-2	Electrical Engineers 2-3	Electrical Engineers 4-15	Mechanical Engineers 0-2	Mechanical Engineers 2-3	Mechanical Engineers 4-15	Physical Science 1-2	Physical Science 2-3	Physical Science 4-15	Ceramics Glass Technology Metallurgy 1-2	Ceramics Glass Technology Metallurgy 2-3	Ceramics Glass Technology Metallurgy 4-15
		TYPE OF DEGREE AND YEARS OF EXPERIENCE PREFERRED											
• SYSTEMS *(Integration of theory, equipments and environment to create and optimize major electronic concepts.)*													
AVIATION ELECTRONICS • CONTROLS		W P	W P X	W C P X	W	W P	W C P	W P	W P X	W C P X			
DIGITAL DATA HANDLING DEVICES	M C	P	M C P	M C P		C	C P		C P	C P			
MISSILE WEAPONS SYSTEMS • RADAR	M W	W	M W X C P	M W X C P	W	M W C	M W C P	W C P	M W X C P	M W X C P			
INERTIAL NAVIGATION			W C P	W C P		W C	W C P		W C P	W C P			
COMMUNICATIONS		C P	C N P	C N P T	C	C			P	C N P T			
• DESIGN • DEVELOPMENT MISSILE WEAPONS SYSTEMS—Planning and Design—Radar—Fire Control—Servomechanisms—Computers	C M	W C M X	W C M X	W C M X	W C M X	W C M X	W C M X	W C M X	W C M X	W C M X			
AVIATION ELECTRONICS — Radar — Computers — Servomechanisms —Shock and Vibration—Circuitry—Remote Control—Heat Transfer—Sub-Miniaturization—Automatic Flight—Automation—Transistorization—Infrared—Airborne TV	W C	W C X	W C X	W C X	W C X	W C X	W C X	W C X	W C X	W C X			
RADAR—Circuitry—Antenna Design—Servo Systems—Gear Trains—Intricate Mechanisms—Fire Control—Information Handling—Displays	M C	W M C X	W M C X	W M C X	W M C X	W M C X	W M C X	W M C X	W M C X	W M C X			
COMPUTERS—Systems—Advanced Development—Circuitry—Assembly Design—Mechanisms—Programming—Digital Data Handling Devices	M	C W	M C X W	M C X W	C W	M C X W	M C X W	C W	M C W	M C W			
KINESCOPES (B & W and Color), OSCILLOSCOPES—Electron Optics—Instrumental Analysis—Solid States (Phosphors, High Temperature Phenomena, Photosensitive Materials and Glass to Metal Sealing)		L	L Y	L Y	L	L Y	L Y	L	L Y	L Y	L	L Y	L Y
GAS, POWER AND PHOTO TUBES—Photosensitive Devices—Ceramic to Metal Sealing—UHF and VHF—Super Power		L	L	L	L	L	L	L	L	L	L	L	
RECEIVING TUBES—Tube Design—Test and Application Engineering—Chemical and Physical Development—Methods and Process Engineering		H	H	H		H	H		H	H		H	H
MICROWAVE TUBES—Tube Development and Manufacture (Traveling Wave—Backward Wave—Magnetron)	H	H	H	H		H	H		H	H		H	H
SEMICONDUCTORS—Materials research (surface studies—crystallography)—device design—circuitry—process engineering—automation.		V	V	V	V	V			V	V			V
COMMUNICATIONS — Specialized Systems — Microwave — Mobile —Aviation—Audio—Propagation Studies—Acoustics—Transducers		C N	C N	C N		C	C	C N	C N	C N			
BROADCAST AND TV—Monochrome and Color Studio Equipment—Cameras—Monitors—High Power Transmitters		C	C	C	C	C	C	C	C	C			
RELIABILITY & COMPONENT ENGINEERING			C	C		C	C		C	C		C	C
• SYSTEMS APPLICATION *(Evaluation and Planning—Design and Development—Modification—Specification)*													
MISSILE TEST INSTRUMENTATION (Data Acquisition and Processing) — Radar — Telemetry — Timing — Communications — Optics — Computers	F	F S	Z F S	Z F S	F S	F S	Z F S	F S	Z F S	Z F S			
RADAR—Airborne—Surface—Shipboard—Sonar—Fire Control	F	F S	Z F S	Z F S	F S	F S	Z F S	F S	Z F S	Z F S			
COMMUNICATIONS — Radio — HF — VHF — UHF — Microwave — Telephone—Teletype—Telegraph Terminal Equipment—Wave Propagation	F	F S	F S	F S	F S	F S	F S	F S	F S	F S			
• MACHINE DESIGN Mechanical and Electrical—Automatic or Semi-Automatic Machines		L H	L H	H	L	L H	H		L	L			

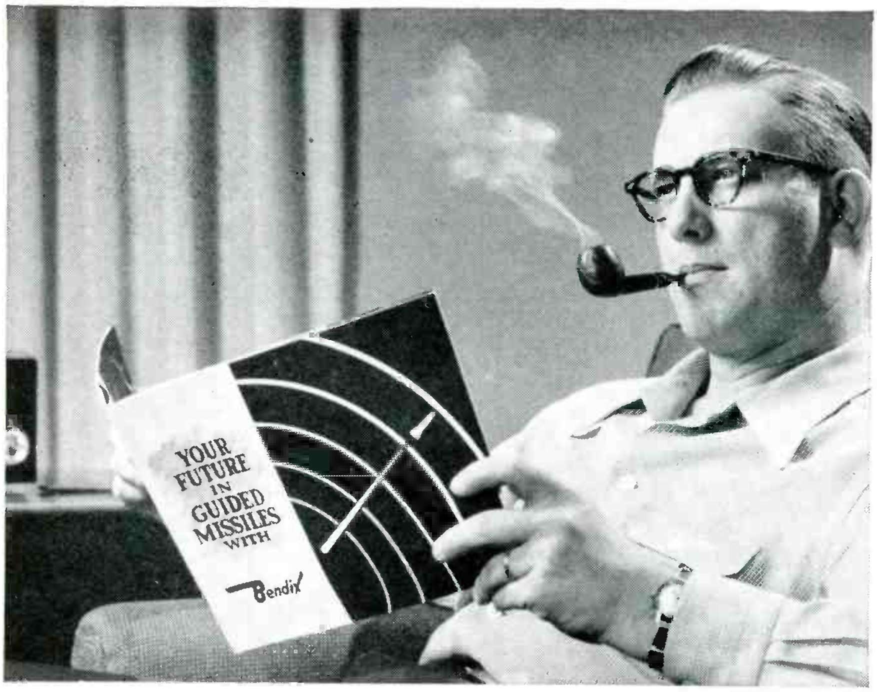
LOCATIONS: C—Camden, N. J. **F**—Cocoa Beach, Fla. **H**—Harrison, N. J. **L**—Lancaster, Pa. **M**—Moorestown, N. J. **N**—New York, N. Y. **P**—Princeton, N. J. **S**—RCA Service Company (Cherry Hill, N. J.; Alexandria, Va.; Dayton, Ohio; San Francisco, Calif.) **T**—Tucson, Ariz. **V**—Somerville, N. J. **W**—Waltham, Mass. **X**—West Los Angeles, Calif. **Y**—Marion, Ind. **Z**—White Sands, N.M.

Modern benefit program . . . interview and relocation expenses paid . . . Please send resume of education and experience, with location preferred, to:

Mr. J. C. Rankin, Employment Manager
Dept. A-16G, Radio Corporation of America
30 Rockefeller Plaza, New York 20, N. Y.

RCA

RADIO CORPORATION of AMERICA



THIS COULD BE THE MOST PROFITABLE HALF HOUR OF YOUR LIFE!

Will you invest a three-cent stamp and a half hour of your time in your future? If so, just fill out the coupon, and we will send you the most complete guide to job opportunities in the guided missile field ever published.

This booklet—"Your Future in Guided Missiles"—can help you blueprint your own future. It contains a detailed background of the functions of the various Bendix Missile engineering groups, such as systems analysis, guidance, telemetering, steering intelligence, component evaluation, missile testing, environmental testing, test equipment design, reliability, ram-jet propulsion, hydraulics, and other important engineering operations.

Here is exactly the type of information that every ambitious engineer should have if he is concerned about his future. Why not tear out the coupon and send for your copy of the booklet now? A half hour spent reading it could be the most profitable half hour of your life.

Bendix — *prime contractor for the TALOS MISSILE*

Bendix Products Division—Missiles
403 K, Bendix Drive, South Bend, Indiana
Gentlemen: I would like more information concerning opportunities in guided missiles. Please send me the booklet "Your Future In Guided Missiles".

NAME__________

ADDRESS__________

CITY__________ STATE__________

SALES ENGINEERS

Unusual opportunities with one of America's fastest growing electronic companies

An exceptional opportunity is available to electronic engineers interested in the field of component sales. Previous sales experience is not essential. The position is at our home office in Wakefield.

Our products are semi-conductor components including — transistors, rectifiers, and diodes. As one of the largest manufacturers in this young and rapidly growing field, there are unlimited opportunities for advancement.

Here is your chance to work with stimulating, congenial associates in a company atmosphere that is informal and free of red tape. You will be located in pleasant, suburban Boston, where cultural, educational and recreational advantages are found for you and your family.

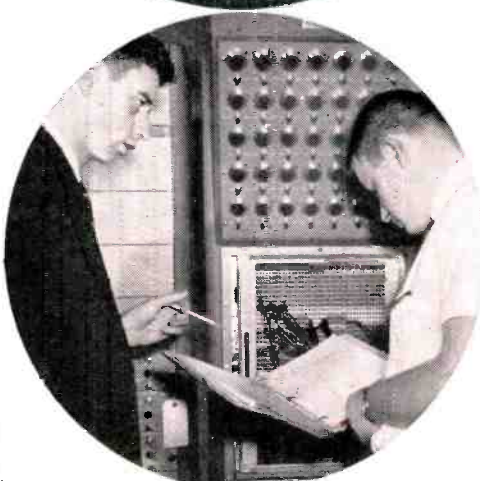
In a few short years Transitron has carved out a leading position in the field of semi-conductors. Today approximately 1500 people are employed in two plants having over 300,000 square feet.

Write or Call

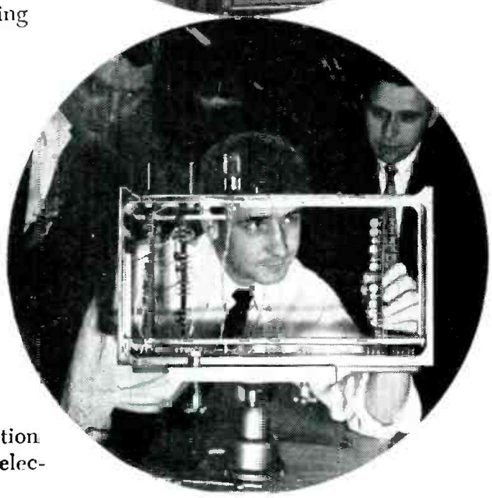
Transitron
electronic corporation
Wakefield, Mass.
CRystal 9-4500

Reliability of miniaturized components: real technical challenges are presented to maintain high reliability standards.

Computer systems tests: unusual responsibilities are available in testing various computer assemblages and unitized systems.



Test equipment: broad opportunity to develop testers capable of verifying operations of computer systems, components, sub-assemblies.



Tooling systems: finalize tool designs, order tools and mechanisms for fabrication and assembly of latest electronic components.

You'll find a new challenge and a rewarding career in Manufacturing Engineering at IBM

More than ever before, Manufacturing Engineering at IBM provides an opportunity to demonstrate your ability and versatility—with commensurate financial reward.

With a stable balance of civilian and military work, IBM offers challenging opportunities in engineering the manufacture of advanced electronic computers for industry and business...science, education, and defense.

If you are an electrical, mechanical, or industrial engineer—or have equivalent experience—you may qualify for a rewarding position at IBM—where promotions occur through personal achievement and new opportunities are created due to rapid company expansion.

For details, just write, outlining background and interests, to:

Mr. R. A. Whitehorne, Dept. 407
Mgr. of Engineering Recruitment
International Business Machines Corp.
590 Madison Ave., New York 22, N.Y.

IBM INTERNATIONAL BUSINESS MACHINES CORPORATION

DATA PROCESSING • ELECTRIC TYPEWRITERS • MILITARY PRODUCTS
SPECIAL ENGINEERING PRODUCTS • TIME EQUIPMENT

Plants and laboratories: Endicott, Kingston, Owego, Poughkeepsie, N. Y.; Lexington, Ky.; Rochester, Minn.; San Jose, Calif.

ENGINEERS & PHYSICISTS *Electronics*

Information manual about APL and its current programs now available

The Applied Physics Laboratory (APL) of The Johns Hopkins University is unique in that we are neither an industrial nor an academic organization, but rather a composite, having drawn freely from the methodologies of each.

For thirteen years APL has pioneered in guided missiles. Today we are engaged in a broad program of R & D for the Navy; in addition, we are responsible for technical direction of industrial and academic contractors in developing the Terrier, Talos and other major weapons and weapons systems. Our staff members enjoy not only the stimulus of association with their immediate colleagues at APL, but also with those in other organizations of considerable stature.

NEW 30-PAGE PUBLICATION

A few positions for senior engineers and scientists are now open. Information on our accomplishments and goals is available in a new 30-page publication, just off the press.

In it staff leaders representing each of the various disciplines and fields outline the nature of their programs. Information on our new laboratory in Howard County, Md. (equidistant between Baltimore and Washington) is also included, together with facts on the outstanding communities in which our staff members live.

Quantity is somewhat limited. May we suggest you send now to:
Professional Staff Appointments

The Johns Hopkins University Applied Physics Laboratory

8609 Georgia Avenue Silver Spring, Md.

ENGINEERS

PARTS APPLICATION
(Reliability)

ME or EE degree with design experience and/or application experience. Job will be to recommend types of parts to be used and how these parts shall be used.

Qualified men will become a vital part of a Reliability Group.

GM INERTIAL GUIDANCE SYSTEM PROGRAM

• ELECTRONICS DIV.,

Milwaukee 2, Wis.
Flint 2, Mich.

Enjoy Challenging Opportunities in the most versatile Laboratories in the country. Work with the top men in the field and with the finest test, research and development facilities. We are in the process of a Major, Permanent, Expansion Program. New Plant facilities being added in suburban Milwaukee area.

To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's Electronics Division aggressive position in the field of manufacture and GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Recent EE,ME Graduate Inquiries Also Invited

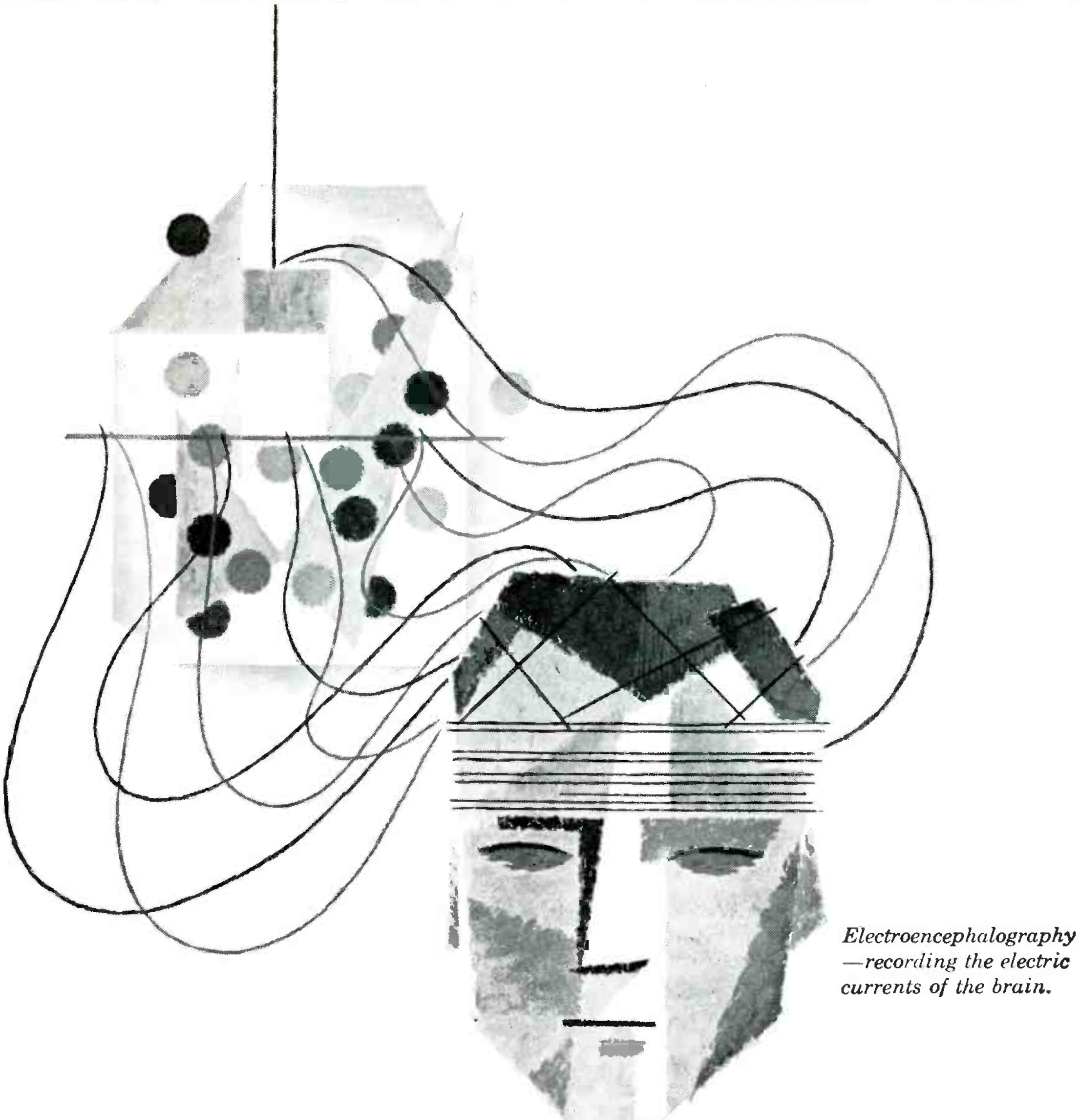
Milwaukee offers ideal family living in a progressive neighborly community in cool, southern Wisconsin where swimming, boating, big league baseball and every shopping and cultural advantage is yours for the taking.

To arrange personal, confidential interview in your locality send full facts about yourself today to

Mr. Cecil E. Sundeen
Supervisor of Technical Employment

AC

Electronics Div.
General Motors Corp.
FLINT 2, MICHIGAN
MILWAUKEE 2, WISCONSIN



Electroencephalography —recording the electric currents of the brain.

WHAT'S YOUR "WAVE LENGTH"?

Some of the most stimulating engineering problems in the world today are waiting for solutions at Honeywell, Brown Instruments Division.

Even the fine engineering staff now at work here needs help.

But the ordinary engineer won't do. Standards are too high, demands too exacting for all but those with extraordinary capacity.

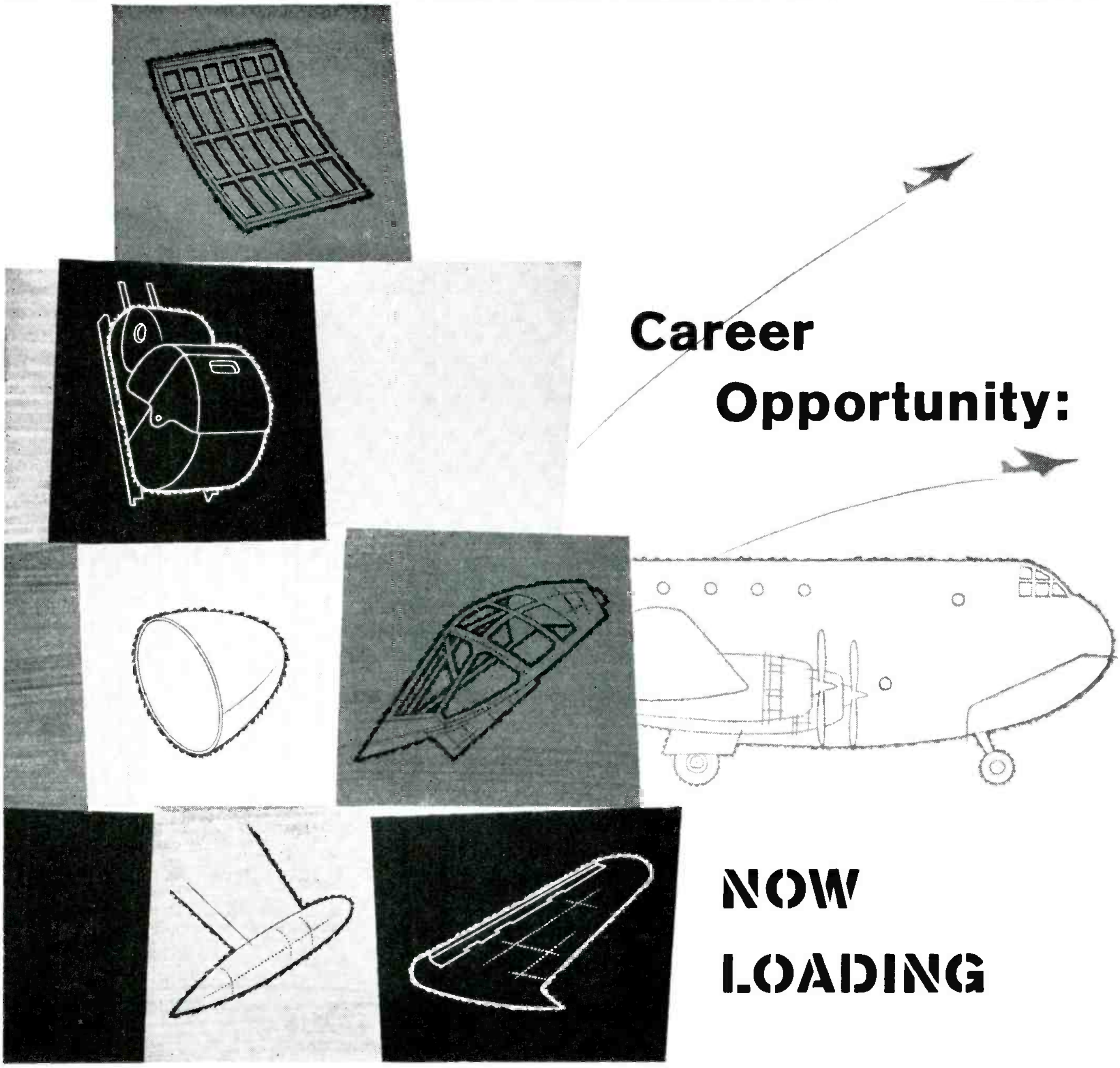
We're interested in you, *if* you think you'd "fill the bill".

Everybody knows Brown Instruments . . . the world's leading designer and producer of industrial instruments. And engineers know the company's reputation for superior treatment . . . in pay, in extras, in the factors that count with an engineer. Many come to us, few are selected, very few leave.

If you're our type of man, we think you'd be happy working here. You don't have to supply a resumé. Just send in your name, address and home telephone number . . . address Mr. Dan Garvey . . . we'll get in touch with you.

Good Company—at Brown you'll work with such men as Roger S. Hewett, B.S. in E.E., Tufts College. With Brown 18 years, Roger is Section Head of an Application Engineering Section on government and institutional instrumentations.

Honeywell BROWN INSTRUMENTS DIVISION
Wayne & Windrim Avenues • Philadelphia 44, Pa. *First in Controls*



HERE YOU SEE some of the major components now being supplied by Goodyear to major aircraft manufacturers. Goodyear engineers had a hand in virtually all of them.

Helping to outfit these winged powerhouses is just one of the exciting activities at Goodyear Aircraft these days. Important parts are being built for guided missiles – there are stimulating developments in electronics, radar structures, plastics, metals and countless other projects.

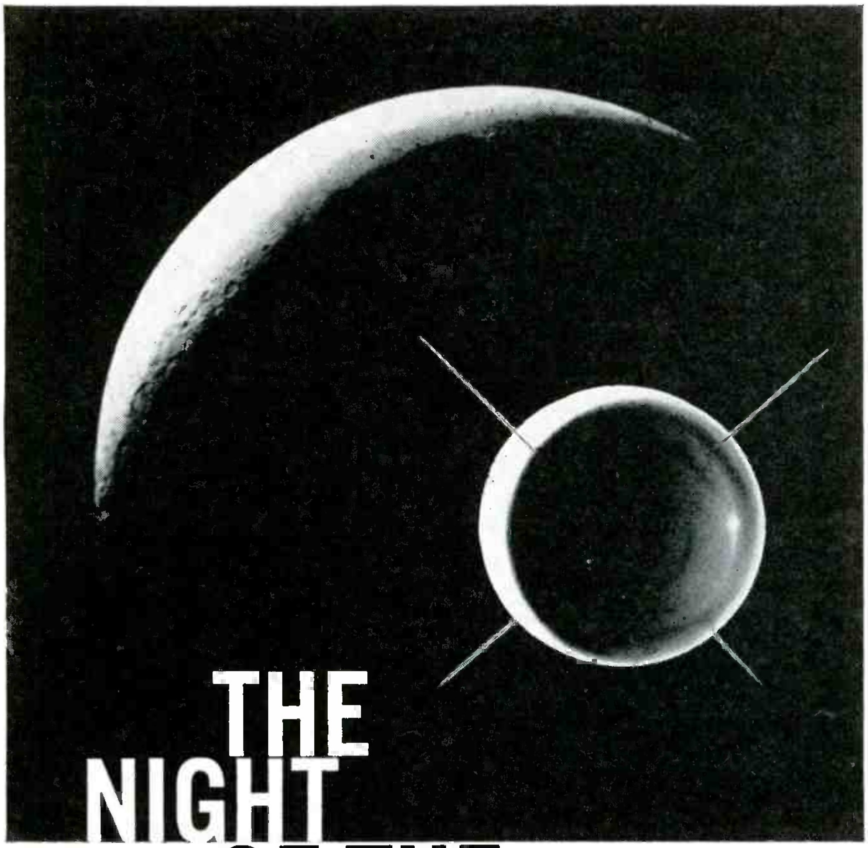
All this spells opportunity unlimited for engineers. Our continued growth and diversification have required expansion of our engineering staffs in all specialties at both Akron, Ohio, and Litchfield Park, Arizona. Available for your use are the most modern engineering and research laboratories, including a large computer laboratory.

If you have an eye to the future – and it's focused on the sky – a rewarding career can be yours at Goodyear Aircraft. Salaries and benefits are liberal, of course. And if you wish to continue your academic studies, company-paid tuition courses leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

They're doing big things at

GOODYEAR AIRCRAFT



THE NIGHT OF THE BIG FUTURE

The big count down has begun. The opening gun for the coming age of astronautics is now only months away.

Its meaning to the future of Martin engineers in the fields of electronics, servo controls and guidance systems engineering is tremendous.

Don't miss it! Contact J. J. Holley, Dept. E-7, The Martin Company, Baltimore 3, Maryland.

MARTIN

BALTIMORE

ORO ANNOUNCES Challenging Openings in OPERATIONS RESEARCH

Operations research is a fast growing and practical science attracting some of the best brains in the country. Its future is unlimited. If you want to join a group of pioneers in this exciting field, we invite you to investigate the openings on our staff.

ON OUR PART WE OFFER:

1. A record of experience in operations research, out-distanced by perhaps no other organization.

2. A scrupulously maintained professional approach and atmosphere.

3. The team approach to problem solving. On each team are representatives of varied disciplines—sometimes three, occasionally as many as a dozen.

4. Fully equipped digital and analog computing facilities.

5. ORO occupies several buildings in Chevy Chase, Maryland, one of America's most attractive suburbs. Pleasant homes and apartments in all price ranges are available. Schools are excellent. Downtown Washington, D. C., with its many cultural and recreational advantages is but a 20-minute drive.

6. Favorably competitive salaries and benefits, extensive educational programs, unexcelled leave policy.

FOR DETAILED INFORMATION, WRITE:

Dr. L. F. Hanson

OPERATIONS RESEARCH OFFICE ORO

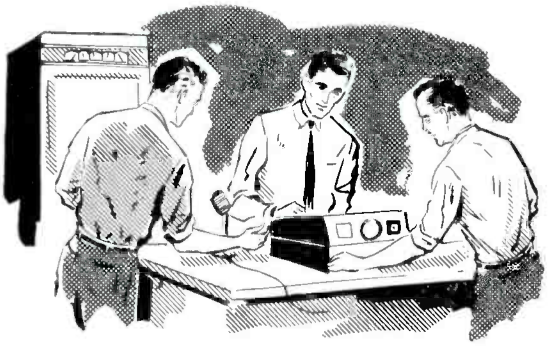
The Johns Hopkins University

7100 Connecticut Avenue
Chevy Chase, Maryland

Research and Development ENGINEERS

NEW career opportunities with MOTOROLA

- **2-WAY MOBILE COMMUNICATIONS**
- **PORTABLE COMMUNICATIONS**



Here is opportunity *unlimited* for men who like challenges and the rewards that go with accomplishment. You'll be part of the Communications and Electronic division of the world's largest manufacturer of 2-way radio—Motorola. And you'll have ample opportunity to grow right along with the dynamic, rapidly expanding uses for Handie-Talkie radiophones and mobile 2-way radio communications.

You'll enjoy working in well instrumented laboratories and benefit from association with men of the highest technical competence. There are many liberal employee benefits, including an attractive profit sharing plan.

Salary levels are open and commensurate with ability. Directly related engineering experience is *not needed*.

POSITIONS AVAILABLE IN:

2-WAY RADIO COMMUNICATIONS
• Receiver design & development • Transmitter design & development • Power supply • Systems Engineering • Selective Signaling • Transistor Applications • Crystal Engineering

PORTABLE COMMUNICATIONS
• Design of FM Communications in portable or subminiature development

For full discussion of these opportunities—Write:

Mr. L. B. Wrenn Dept. A
MOTOROLA INC.
4501 Augusta Blvd.
Chicago 51, Ill.

MOTOROLA

ELECTRONIC ENGINEERS!

HERE'S THE OPPORTUNITY OF YOUR LIFETIME!

For Just Three Cents!

That's right! The stamp on your letter asking for more information about MEMCO opens the door of opportunity . . .

- to use your creative engineering talents.
- to work on all phases of your projects.
- to be appreciated as an engineer, not as a replaceable cog in a big machine.
- to get top pay and many benefits.
- to build a sound, worthwhile future.

So, if you are tied up in red tape . . . if the scope of your work is limited . . . if you can't use your creative engineering talents . . . then MEMCO offers you a welcome escape from stagnation and monotony.

For full details please write to:
Mr. J. E. Richardson,
Personnel Director

MARYLAND ELECTRONIC
MANUFACTURING CORPORATION
5009 Calvert Road
College Park, Maryland
(A suburb of Washington, D. C.)

Openings as of July 1

WHICH OF THESE 18 CAREER POSITIONS at ARMA INTERESTS YOU MOST?

New long range projects assure not only challenging, high-level creative work, but security and job stability as well. Excellent starting salaries plus all the resort and cultural advantages of suburban Long Island living. Moving allowances arranged.

A partial listing follows. Further information on these and many more positions may be obtained by calling Robert Burchell COLLECT at Pioneer 2-0242.

TRANSDUCER DEVELOPMENT ENGINEER
Perform basic development on transducer for use in precision electronic computer field.

SYSTEM EVALUATION ENGINEER
Establish engineering requirements and investigate design approaches. Plan and direct the preparation of specifications for special in-plant test and evaluation facilities on centrifuges, scorsbys, complex wave simulators, sidereal tables and digital computers. Liaison between subcontractors and company.

DESIGN ENGINEER — GROUND EQUIPMENT
Design and development of production test and field test equipment where specific objectives and general requirements are known in the electrical and mechanical engineering fields. Must have experience on design or development of electromechanical instruments.

DATA PROCESSING AND REDUCTION ENGINEER
Responsible for establishing overall data reduction procedures. Direct the activities in specifying and procuring all components of standard automatic digital and analog data handling and processing equipment. Responsible for design or procurement of special data processing equipment.

FUNCTIONAL ENGINEERS — MISSILE SYSTEMS
Develop inertial guidance systems including gyro, accelerometers, integrators, servo systems and computers. Analyze functional problems arising during development and evaluation of said system.

ELECTRO-MECHANICAL ENGINEER
Conduct investigation on special electromagnetic and electromechanical devices including evaluation and/or design of transducers, servo systems and related devices.

GROUND EQUIPMENT ENGINEER
Plans and performs engineering studies, basic electrical and mechanical design, development and evaluation of production test and field test equipment where specific objectives and general requirements are known. Must be familiar with electromechanical instrumentation.

TRANSISTOR CIRCUIT ENGINEER
Pulse application of high speed transistors used in airborne digital computers. Circuit design applications requiring knowledge of latest transistors such as tetroids and superficial barriers.

DIGITAL COMPUTER ENGINEER
Basic research and development including logical design, dynamic analysis, component development, hardware and packaging, system and component reliability, and laboratory and field evaluation of complex computers for fire control and guidance systems.

FIELD EVALUATION ENGINEER
Perform overall planning functions for field evaluation of missile guidance systems. Direct activities in scheduling the field operations. Liaison with field test site agencies and formulating overall operating procedures at test site on missile project.

PROJECT ENGINEER — AIRBORNE EQUIPMENT
Project engineering of computers, pro and anti submarine fire control equipment, airborne navigation plotting equipment and similar equipment. Preparation and proposals on equipment of such types.

PRODUCT ENGINEER
Initiate, compile and maintain design standards on electrical, electronic and mechanical design subjects pertinent to fire control equipment and inertial guidance components. Must have considerable responsible experience on product design standards covering areas indicated in job studies.

DEVELOPMENT ENGINEER — RADAR
Research and development engineering of new radar, navigation and guidance systems. Responsibility of theoretical and laboratory phases of research and development of radio frequencies and pulse circuitry portions of such systems. Experience in modulator, intermediate frequency amplifier, indicator, synchronizer, or R.F. component design is applicable.

DYNAMICS TEST ENGINEER
To conduct vibration, shock and acceleration tests on electromechanical components and systems. Analyze results and develop equipment to conform with specification requirements.

ENVIRONMENTAL TEST ENGINEER
To plan, conduct and report on environmental tests of electromechanical and electronic components.

ENVIRONMENTAL ENGINEER
To plan, conduct and report upon development studies of finishes, materials and processes, which will be incorporated into the design of electromechanical and electronic components and systems.

OPERATIONAL ANALYSIS ENGINEER
To plan, conduct and report upon environmental tests of electromechanical and electronic systems. Must be capable of redesigning components or systems to correct any deficiencies encountered during the evaluation program in the computer, servo systems and missile field.

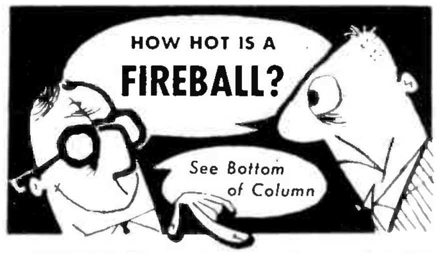
LIAISON ENGINEER — AIRBORNE PROJECTS
Technical assistance to AF in maintenance of various AF contracts. Knowledge of AF procedures and specifications desirable.

CALL COLLECT. Or, clip the job (or jobs) you're interested in and mail, with your confidential resume. No reference contact without your permission. You'll receive a prompt reply, and copies of "Your Engineering Career with Arma" and "Long Island," full of detailed information about this company and its community.

ARMA

Robert Burchell, Pioneer 2-0242
Technical Personnel Dept. E-674

Division American Bosch Arma Corp., Roosevelt Field, Garden City, L. I., N. Y.



Electronic Engineers
Mechanical Engineers

Advancement... Security ...Responsibility

Professional personnel needed at all levels to fill responsible openings at this steadily expanding Division of Bendix Aviation Corporation. It's your chance to get specific assignments at the peak of the art in ELECTRONICS and MICRO-WAVE DEVELOPMENT and DESIGN. Good salaries, all employee benefits, ideal suburban living conditions. Whether you be a Department Chief or a Junior Engineer with less than one year's experience, we have the opening and the shoes for you to fill.

Address: Chief Engineer Dept. H

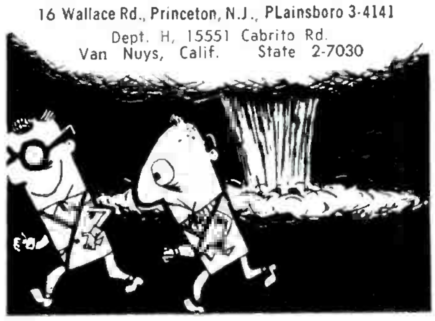
Bendix
AVIATION CORPORATION
York DIVISION

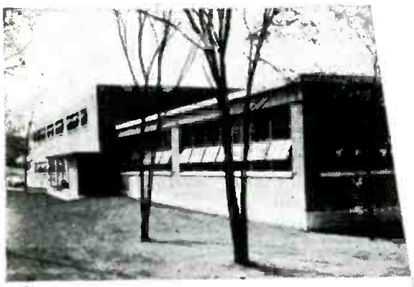
York, Penna. York 47-2611

An A-Bomb Fireball at 45 feet diameter is 300,000° centigrade. If you're a fireball in any of the fields listed below there are some hot opportunities for you at ASCOP. Contact our technical personnel manager for complete details.

ELECTRONIC ENGINEERS
Skilled In
Data Acquisition • Data Handling
RF Techniques • Circuit Design
Transistor Applications • Technical Writing

ASCOP
APPLIED SCIENCE CORP. OF PRINCETON
16 Wallace Rd., Princeton, N.J., PLainsboro 3-4141
Dept. H, 15551 Cabrito Rd.
Van Nuys, Calif. State 2-7030

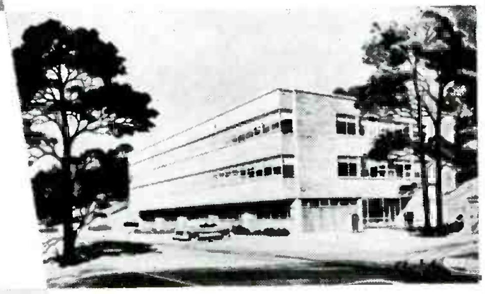


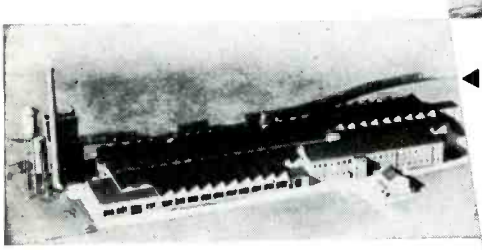


▲ Plant of Westchester manufacturing subsidiary, Pleasantville Instrument Corporation; additions are under construction.

Electronics Engineers

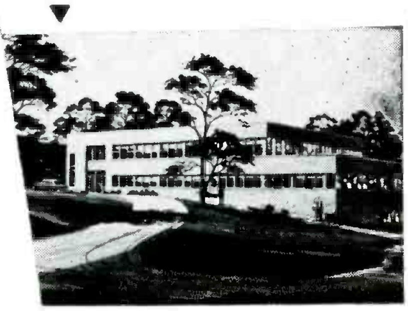
Latest GPL engineering building, for which ground was broken recently. ▶





◀ Plant of Bloomfield, N. J., manufacturing subsidiary, Simplex Equipment Corporation; added in 1957.

New GPL environmental test lab, most modern of its kind, now nearing completion. ▼



GPL keeps GROWING

...how about YOU?

You can find opportunity in many places, but you can find more of it at GPL. As a result of GPL's brilliant scientific break-through in harnessing Doppler to air navigation, scores of new development and production opportunities have been created. We need electronics engineers who can keep pace with us and, more important, help set the pace for future growth.

You can find security in many places, but here at GPL you get a double measure. You participate in the secure strength of the nationwide GPE Group. Top salaries and ideal working conditions give you the peace of mind to enjoy pleasant living in semi-rural surroundings, less than an hour away from New York City.

Greater opportunity and more security—for yourself and your family—are a part of every job here at GPL.

In connection with **DOPPLER & INERTIAL Air Navigation and Guidance Systems** we have openings for work on Computers, Magnetic Amplifiers, Servos, Microwave Techniques, Transistorization, IF Amplifiers and Pulse Circuitry.

Research & Development: Applications • Systems Analysis • Systems Test • Mechanical Design • Mechanical Packaging • Project Engineering • Component Specification and Test • Proposal Writer • Contract Administrator.
Manufacturing Engineering: Systems Test • Quality Control • Mechanical Design • Production Follow-up.
Field Engineering: At Military Installations and Airframe Manufacturers' Plants.

Send your resumé to: Mr. Richard E. Hoffman, Employment Manager. We will pay the expenses of qualified applicants to come for an interview.

A SUBSIDIARY OF GPE

General Precision Laboratory Incorporated
63 Bedford Road, Pleasantville, New York

---

opportunities in
NEW HAMPSHIRE
for a few
ambitious, graduate

ENGINEERS

Electronics—general circuit design
Sales—electronics test equipment

ESTABLISHED mfgr. needs competent men who seek challenging broad-gauge work in small but progressive company.

Northeastern Engineering, Inc.
Manchester, N. H.

YOUR ORGANIZATION

Is it complete?

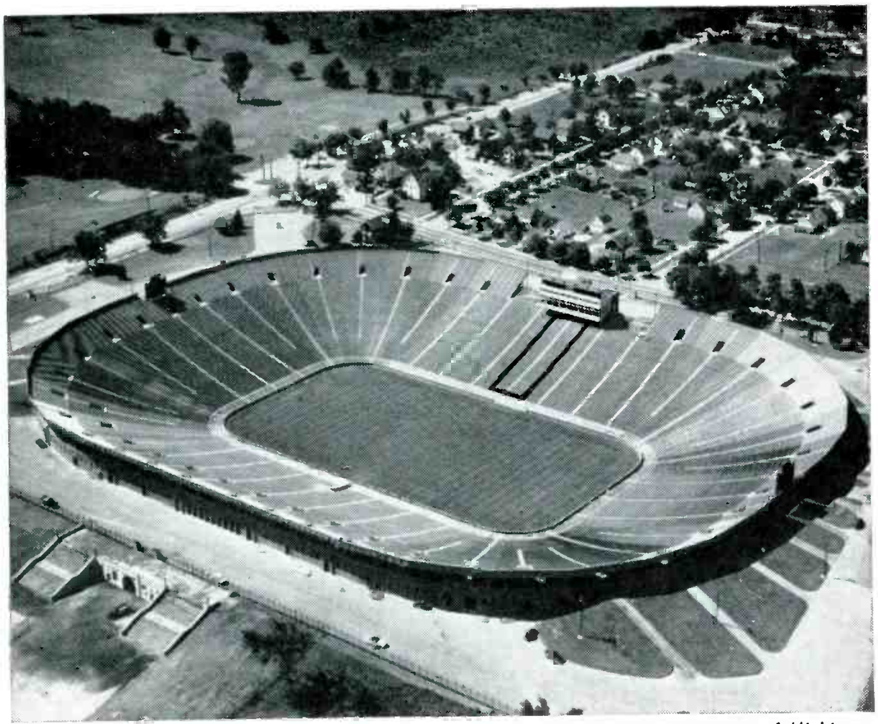
Are you expanding it?

Making Replacements?

Naturally, you are anxious to secure the most suitable man or men available. You want men with the special training that will make them an asset to your organization. You can contact such men through an advertisement in this Employment Opportunities Section of ELECTRONICS.

Classified Advertising Division

ELECTRONICS
P. O. BOX 12
New York 36, N. Y.



World's largest collegiate stadium—University of Michigan.

Now's the time to get a

50 YARD LINE SEAT!

The Bendix Systems Division is the newest division of Bendix Aviation Corporation. It is located adjacent to the University of Michigan in Ann Arbor. Its function is to integrate Bendix skills and facilities for systems planning, development and production.

This new organization is being expanded rapidly. It is a fine opportunity to get in on the ground floor of this big and important new part of Bendix, especially for men who feel their present chances for growth are not good.

Specifically, we need men with experience in:

SURVEILLANCE & RECON: radar, infrared, acoustics.
WEAPONS: missiles, aircraft subsystems, guidance and control.
DATA PROCESSING: analog and digital computers, displays.
NUCLEAR: reactors, propulsion, special weapons.
COMMUNICATIONS: radio, digital, data links.
NAVIGATION: radio, inertial, ground-controlled.
COUNTERMEASURES: ECM, decoys, electronic warfare.
OPERATIONS ANALYSIS.

For an interview, write or call (NOrmandy 5-6111) Bendix Systems Division, Ann Arbor, Michigan.

Bendix Systems Division
ANN ARBOR, MICHIGAN

Bendix
AVIATION CORPORATION

ARE YOU IN NEED
OF ENGINEERS
or of
HIGHLY TRAINED TECHNICIANS
for your Personnel Program?

We offer a free booklet especially prepared to help you solve this problem. It is called the "RESERVOIR of ENGINEERS and TECHNICAL MEN."

This booklet shows, through a listing of the major job titles held by readers of McGraw-Hill Publications, how these men are gathered in convenient, compact groups that you can economically reach with your advertising. Here are no huge, swollen circulations, with expensive price tags where maybe not one reader in a thousand would have the necessary job qualifications.

In a recent advertisement one of the leading aircraft manufacturers restated a well known, but seldom practiced principle:

A trained, experienced engineer in one specialty can be retrained in almost any other engineering specialty with a minimum of time and effort expanded.

It is one of the purposes of this booklet to show how you can best reach men specifically trained for your needs or technicians who can be easily and quickly retrained.

For your free copy of this booklet write us on your letterhead. You are under no obligation whatsoever. There is a limited supply so write us now.

McGraw-Hill Publishing Co., Inc.

Classified Advertising Division

P. O. Box 12
New York 36, N. Y.

RATES . . . . . .

"Employment Opportunities"

Displayed—The advertising inch is $25.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured 7/8" vertically on a column—3 columns—30 inches to a page.

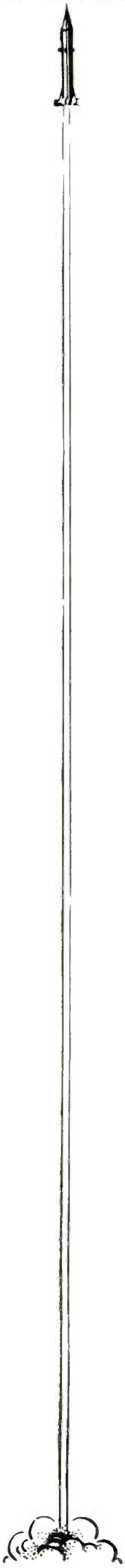
Subject to Agency Commission.

Undisplayed—$2.40 per line, minimum 3 lines. To figure advace payment count 5 average words as a line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to ELECTRONICS, Class. Adv. Div., P. O. Box 12, New York 36, N. Y., for August Issue Closing July 2nd.



SHOOT FOR THE TOP!

with

Chrysler Missile Operations

Detroit, Michigan

WHATEVER YOUR GOAL IN ENGINEERING
MISSILE OPERATIONS OFFERS CHALLENGING
CAREER OPPORTUNITIES IN

DESIGN
LABORATORIES
and
MANUFACTURING
for
Engineers with Experience
in

STRESS - WEIGHT - MECHANICS
HYDRAULICS - PLANT ENGINEERING
QUALITY CONTROL - PNEUMATIC TESTING
METALLURGY - AERODYNAMICISTS
AEROTHERMODYNAMICISTS
PRESSURE AND TEMPERATURE TEST PLANNING
ELECTRO-MECHANICAL PACKAGING
GUIDANCE AND CONTROL - ELECTRONICS
TELEMETRY - INSTRUMENTATION
ANTENNA AND TRANSFORMER ENGINEERING

TOP
CHRYSLER FRINGE BENEFITS

These are positions in suburban Detroit, Michigan.

WATCH YOUR LOCAL NEWSPAPER'S CLASSIFIED ADS FOR WORD OF MISSILE OPERATIONS RECRUITERS IN YOUR AREA

or write

CHRYSLER CORPORATION

Missile Operations, Personnel Dept.
P.O. Box 2628, Detroit 31, Michigan

FOR RATES OR INFORMATION

About Classified Advertising,

Contact The McGraw-Hill Office Nearest You.

ATLANTA, 3
1302 Rhodes-Haverty Bldg.
WAlnut 5778
R. POWELL

BOSTON, 16
350 Park Square
HUbbard 2-7160

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS
J. BRENNAN

CINCINNATI, 37
1825 Yorktown Road
Swifton Village, Apt. 2
G. MILLER

CLEVELAND, 15
1510 Hanna Bldg.
SUperior 1-7000
W. SULLIVAN

DALLAS, 2
Vaughan Bldg.,
RIverside 7-5117
G. JONES
E. SHIRMER

DETROIT, 26
856 Penobscot Bldg.
WOodward 2-1793
W. STONE

LOS ANGELES, 17
1125 W. 6 St.
MAdison 6-9351
C. DYSINGER
D. McMILLAN

NEW YORK, 36
500 Fifth Ave.
OXford 5-5959
S. HENRY
D. COSTER
R. LAWLESS

PHILADELPHIA, 3
17th & Sansom St.
RIttenhouse 6-0670
H. BOZARTH
R. EDSELL

ST. LOUIS, 8
3615 Olive St.
JEfferson 5-4867
W. HIGGENS

SAN FRANCISCO, 4
68 Post St.
DOuglas 2-4600
R. ALCORN

Young ENGINEERS *who want:*

Practical and Diversified Experience

Opportunities for Growth

Various Assignment Locations

Living Expenses Reimbursed

Investigate

GENERAL ELECTRIC
SERVICE ENGINEERING

Here is a challenging job with a good salary . . . and a wide open future

CHALLENGING WORK ON ELECTRONIC SYSTEMS FOR MILITARY AIRCRAFT

Fighter Armament
Flight Control (Auto-Pilot)
Bomber Armament

COMPANY TRAINING

VARIETY OF FIELD ASSIGNMENTS
(U.S. and Abroad)

STAY PUT OR MOVE ABOUT

GOOD EXPERIENCE DEALING WITH PEOPLE

TRAIN CUSTOMER PERSONNEL

WORK WITH TOP-FLIGHT MEN

G. E. EMPLOYEE BENEFITS

REIMBURSEMENT OF LIVING EXPENSES

ADVANCEMENT ON MERIT

ENGINEERS (including recent graduates) with military, industry, or educational backgrounds in electronics—preferably in radar and servomechanisms—may qualify.

If you are in the vicinity of Dallas, Dayton, Los Angeles, New York City, Seattle or Washington, D. C., phone collect to:

DISTRICT AVIATION MANAGER
Installation & Service Engr'g Dept.
GENERAL ELECTRIC

or send your resume in confidence to:
MR. S. FELDMAN, MANAGER

INSTALLATION & SERVICE ENG'RG DEPT.
GENERAL ELECTRIC
Johnson City, New York

8 laboratories at FTL
offer unlimited opportunities to top engineers and scientists

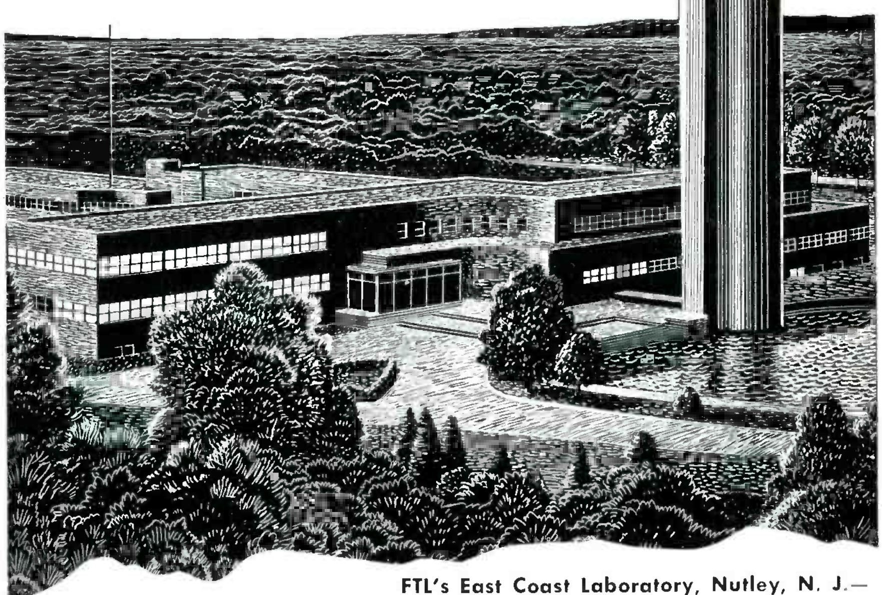
1. Radio Navigation **2.** Missile Guidance
3. Electronic Countermeasures **4.** Electronic Systems
5. Radio Communication **6.** Physical-Chemical
7. Electron Tubes **8.** Wire Communication

In suburban New Jersey—only a few minutes away from New York City—at least *one* of these 8 research and development "centers" comprising Federal Telecommunication Laboratories offers a solid future to you!

Whether your field is computers, data processing, radio communication, air navigation, missile guidance, electronic countermeasures, antennas, transistors, traveling wave tubes or telephone switching, you can be sure your assignment will be interesting, challenging and rewarding.

Opportunities at FTL are unlimited. Our program is long-range . . . commercial and military. We have the finest facilities . . . our future is expanding on both coasts. Ability reaches the spotlight quickly under our "small-company" project system.

Choose FTL-IT&T—*where you build 2 careers in 1.*



FTL's East Coast Laboratory, Nutley, N. J.—only 28 minutes by bus from New York City

If you prefer CALIFORNIA

Opportunities for relaxed living and career-building also at FTL's West Coast Laboratories: *San Fernando, Cal.*, 15151 Bledsoe St.—openings in Digital Computers, Inertial Navigation Systems and Infra Red Systems. *Palo Alto, Cal.*, 937 Commercial Street—openings in Carrier Systems.

MAIL THIS COUPON TODAY E-7

Federal Telecommunication Laboratories
500 Washington Avenue, Nutley, N. J.
Please send literature describing opportunities and benefits at FTL, in Nutley, New Jersey.

Name ______________________

Address ______________________

City ______________ Zone ______ State ______________

FTL A DIVISION OF IT&T

Federal Telecommunication Laboratories
A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

SENIOR RESEARCH PHYSICIST
SENIOR ELECTRONICS ENGINEER

The new Central Research Laboratory of Continental Can Company has several opportunities for versatile scientists and engineers with advanced degrees and industrial experience to pioneer in the application of acoustics, optics, mathematical physics, electronics, rheology, solid state physics, and other fundamental fields to long-range industrial problems in such areas as energy conversion, automatic controls, instrumentation, and communications.

The wide variety of materials manufactured or fabricated at high speeds by Continental includes metals, glass, plastics, paper, fiber, and combinations of these, and provides opportunities for advancing knowledge in many new fields. Research facilities of the Company's new Chicago laboratories are believed second to none, and are located so as to allow staff members to live in some of the finest western and southern suburbs of the city. Proximity to the John Crerar Library, Armour Research Foundation, the University of Chicago, Argonne National Laboratory, and many leading manufacturers of scientific and technical equipment enhances professional development and expedites accomplishment in chosen fields.

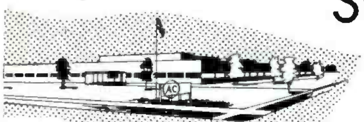
Staff members will be granted the full degree of individual recognition attainable in a total staff of 100 covering the fields of chemistry, metallurgy, engineering, and physics, and will have the opportunity to work closely with scientists and engineers in the other fields. Salaries and other benefits meet the highest industrial standards.

Please write, giving a brief resume of qualifications, to Director Physics Research, Central Research and Engineering Division, Continental Can Co, 7622 S. Racine Avenue, Chicago 20, Illinois.

Servo Engineers

ELECTRICAL MECHANICAL

Inertial Guidance System Program



Enjoy Challenging Opportunities in the further development and systems testing of Inertial Guidance Systems and their Servo Loops in the most versatile laboratories in the country.

Work with the top men in the field and with the finest test, research and development facilities. New plant being added in suburban Milwaukee as a part of Major, Permanent, Expansion Program.

AC will provide financial assistance towards your Master's Degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Milwaukee offers ideal family living combining small town hospitality with every metropolitan shopping and cultural advantage.

For personal, confidential interview in your locality send complete resume to

Mr. Cecil E. Sundeen
Supervisor of Technical Employment

Recent EE, ME Graduate Inquiries Also Invited

THE ELECTRONICS DIVISION
GENERAL MOTORS CORPORATION
FLINT 2, MICH. • MILWAUKEE 2, WIS.

ENGINEERS

If you have been looking for an Employment Agency that is skilled in the **STATE OF THE ART** of Technical Recruitment and **RELIABILITY OF INFORMATION** concerning positions, why not communicate with us at once! ALL POSITIONS FEE PAID.

FIDELITY PERSONNEL SERVICE
1218 Chestnut St. Phila. 7, Pa.
Specialist in Aviation, Electronics and Nucleonics

ELECTRONICS ENGINEER
$14 to $18,000 Yr.

Well known company seeks Supervisory Engineers with experience in Computer & Analytical devices. Should have Executive ability, & Technical background.

For Confidential & Prompt Service
Send resume to:
J. COOPER
202 S. State—Suite 1116 Phone: Harrison 7-6337
Chicago, Illinois

DEVELOPMENT ENGINEER CONTROLS
$9,000-11,000

Position will lead to chief engineers spot. Company recently purchased new plant in Mid-West. A graduate M. E. or E. E. with 3 or more years in design and development of industrial controls will qualify. Company assumes all expenses. Reply in strict confidence.

MONARCH PERSONNEL
28 E. Jackson Blvd. Chicago 4, Ill.

Engineers—Teaching

All rank appointments—depending upon backgrounds—needed at undergraduate college located in small resort area city. Electric Power and Electronics options are offered. M.S. or higher degrees preferred. Will assist B.S. degree men in financing advanced degrees. Investigate better than average salary offers.

P-4713, Electronics,
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRON TUBE ENGINEER

Challenging supervisory position with growth. Long range study project 3-7 yrs. exp. in mat'ls. and processing. Liberal employee benefits in an expanding organization.

BRIGGS ASSOCIATES, INC.
10 DeKalb St. Write-Phone
Norristown, Pa. Broadway 9-2120

Foreign Employment

RADIO TECHNICIAN

Minimum 5 years' practical experience maintaining and installing standard commercial communications equipment. Emphasis on V.H.F., fixed and mobile radio transmitters and receivers, both broad band and narrow band, some experience desirable with carrier equipment, HF mobile equipment, HF fixed stations transmitters and receivers, and television equipment. For work in Saudi Arabia.

High salary plus living allowances and liberal-inclusive benefits conducive to large savings.

Write outlining personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 223

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

ELECTRONIC ENGINEERS

LIVE IN THE MIDWEST

Enjoy the advantages of a smaller midwest city. Give your family a break. Get away from the traffic and rush. Outstanding school system.

Challenging opportunities in design and development work in Audio, TV or High Frequency, AM Broadcast Transmitters, and Communications.

Advancement. Complete benefits. Send details and photo to Personnel Director.

GATES RADIO COMPANY
Quincy, Illinois

REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS WANTED

Electronic engineer, Ph.D, 10 years business & administrative experience, at present in charge of electronic dept. of well-known producer of industrial controls, seeks connection with medium sized manufacturer of instruments or controls. Some investment capital available. Reply: PW-5081, Electronics.

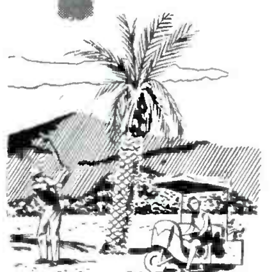
Communications Engineer for large power company seeks challenging position free from routine. Broad experience; system planning, installation, testing, maintenance; microwave, VHF, telemetering, carrier current, remote control. Wartime Radar Officer, test and development. Age 39, BS-EE. PW-5243, Electronics.

SELLING OPPORTUNITY WANTED

Export to Argentina: Long established export Company with extensive sales organization and excellent connections with Argentine industry and government departments would welcome contacts with manufacturers of electronic and related equipment not already represented in the above country. RA-5271, Electronics.

Personnel Manager—Need experienced Engineers and Technicians? We offer a booklet especially prepared to help you solve this problem. Write for your "free" copy of "Reservoir of Engineers and Technical Men". Electronics, P. O. Box 12, New York 36, N. Y.

COME TO WORK in Phoenix WHERE IT'S fun to live



A man does his best work when he and his family are enjoying life. That's one big reason Motorola located its new plants in sunny Arizona. In a choice residential and resort area northeast of Phoenix, Motorola men are free from traffic snarls, commuter trains, crowded buses, snow, smog and mud. The climate is warm and dry. There's plenty of room. Home construction costs are among the nation's lowest. Most Motorola men in Arizona live within 15 minutes of their work. Vast, scenic vacationlands are within easy driving distance for week-end family fun. The nearby colleges provide advanced courses for continuing scientific study, cooperating enthusiastically with Motorola and other national manufacturers moving into this growing electronics center. The result is, frankly, a perfect set-up for any man who wants to build a better career in electronics. Expansion is opening up new positions with a promising future.

Check these immediate opportunities with your capabilities and write today:

WESTERN MILITARY ELECTRONICS CENTER

Newest, most complete electronics development laboratories in the country.

ELECTRONIC ENGINEERS, MECHANICAL ENGINEERS, PHYSICISTS

- Transistor Applications
- Radar Systems Design
- Microwave Techniques
- Systems Test and Analysis
- Pulse and Video Circuitry
- R-F and I-F Circuit Design
- Servo Mechanisms

For above positions write:
Mr. William Beardsley
Motorola, Inc.—Dept. A
Western Military Electronics Center
8201 E. McDowell Road
Phoenix, Arizona

SEMI-CONDUCTOR DIVISION

A separate division developing, producing and selling semi-conductor devices:

ELECTRONIC ENGINEERS, MECHANICAL ENGINEERS, CHEMICAL ENGINEERS, PHYSICISTS, METALLURGISTS

- Transistor Applications
- Physical Chemistry
- Transistor Device Development
- Metallurgical Engineering
- Solid State Physics
- Production Engineering

SALES PERSONNEL

Field Sales Engineers Sales Administration

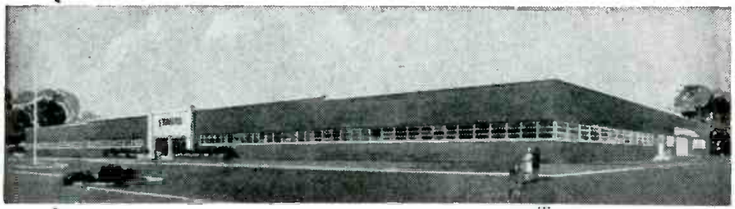
For above positions write:
Mr. Vernon Sorenson
Motorola, Inc.—Dept. E
5005 E. McDowell Road
Phoenix, Arizona

Engineering positions also available at Motorola, Inc. in Chicago, Illinois and Riverside, California.

MOTOROLA, INC.

electronic engineers

• *DESIGN* • *DEVELOPMENT*
• *FIELD ENGINEERING*



STAVID is engaged in design, development, modification, installation, testing and evaluation of military electronic and electro-mechanical equipment.

STAVID ENGINEERS possess an enviable reputation and are noted for their competence and diversification. You can fulfill your professional ambitions at STAVID.

(New Plant now under construction — 65,000 square feet)

STAVID offers challenging permanent field assignments in New Jersey, the Boston, Mass. area, and other desirable locations throughout the U. S.

Opportunities available in the following fields for those persons with EE or ME degree with minimum of 3 years' experience or equivalent:

- **Fire Control Radar**
- **Missile Electronics**
- **Coils, Transformers**
- **Transistors**
- **Filter Networks**
- **Instrumentation**
- **Microwave**
- **Servos**
- **Antennas**
- **Computers**
- **Simulators**
- **Telemetering**
- **Navigation Systems**

Call for interview arrangement or send complete resume to: Personnel Dept.

Stavid

STAVID
ENGINEERING, INC.

Route 22, Plainfield, N. J. PLainfield 7-1600

ENGINEERS

MUTUAL SATISFACTION: YOUR EXTRA BENEFIT FROM PLACEMENT BY ABBOTT'S

This serious matter of personnel placement requires complete satisfaction on both sides. No career develops properly when either employer or employee has reservations about the wisdom of his choice. For 33 years Abbott's has specialized in removing doubts beforehand . . . "balanced placement" makes certain that when a man takes a job, the result will be mutual satisfaction.

CHIEF COMPUTER ENGINEER — Digital programming

CHIEF ENGINEER — Missiles research and development

SEMI-CONDUCTOR ENGINEERING MANAGER — Advanced development

SALES ENGINEER — Semi-conductors

SALES ENGINEER — Microwave tubes

MAGNETRON TUBE ENGINEER — Advanced development

APPLICATIONS ENGINEER — Microwave tubes

SALARIES $9,000—$15,000

Of course, your reply will be held strictly confidential, and our client companies will assume all expenses and our service charges. Please send 3 copies of your resume to Mr. George S. Sandel, Director.

ABBOTT'S

EMPLOYMENT SPECIALISTS
333 Washington St. Boston 8, Mass.

CAREER OPPORTUNITIES

ARC

Navigation Systems
Communication Systems
Servos
Transistors
Transmitters
Receivers
Antennas

With a company making premium grade electronic equipment for aircraft for almost 30 years. Located in the beautiful lake region of Northern New Jersey, less than 35 miles from New York City.

- TRANSISTOR CIRCUIT PROJECT ENGINEER
- SERVO AND INSTRUMENT ENGINEERS
- GYRO DESIGN ENGINEER
- TECHNICAL WRITERS
- TRANSMITTER DESIGN ENGINEERS
- CHIEF ENGINEER TO HEAD SERVO AND INSTRUMENT DEPARTMENT

Enjoy the pleasure of working in a new laboratory in a company whose products are known as the highest quality in the industry.

Write or call collect: Personnel Manager

AIRCRAFT RADIO CORPORATION

Boonton, N. J. DE 4-1800 — Ext. 238

RADIO ENGINEER

As technical consultant to large national trade association in two-way mobile and microwave radio fields. Also act as contact man with FCC and other associations on technical matters and frequency allocations. Location: Washington, D. C. Send complete details in first application. Reply:
P-5345, Electronics,
Class. Adv. Div., P.O. Box 12, N. Y. 36, N. Y.

NEED ENGINEERS

Place an "Engineers Wanted" advertisement in this EMPLOYMENT OPPORTUNITIES section. *It's an inexpensive, time saving method of selecting competent personnel for every engineering job in the Electronics industry.* The selective circulation of ELECTRONICS offers you an opportunity to choose the best qualified men available throughout the industry.

UNIVERSITY OF ALBERTA RESEARCH APPOINTMENT WITH RANK OF ASSOCIATE PROFESSOR

Open September 1st for engineer with experience in transistor circuitry. The appointee must be capable of organizing a research program and directing activities of graduate students. Starting salary within range of University salary schedule, supplemented from research funds. Applications to **Dean R. M. Hardy, Dean of Engineering, University of Alberta, Edmonton, Alberta.**

ENGINEERS for GUIDANCE and NAVIGATION SYSTEMS

IMPETUS-

is the force that overcomes resistance to a solid body or, in the realm of thought, a new idea. At Sanders, it operates irresistibly whenever a new engineering concept encounters outmoded, textbook thinking.

Please address inquiries to D. H. Johnson.

SANDERS ASSOCIATES, INC.
NASHUA NEW HAMPSHIRE

ENGINEERS

Find out the full scope of opportunities in Electronics at.....

Practically any professional interest an electronics engineer may have will find a creative outlet at General Electric's Electronics Park, as you will see by the fields in the coupon on the right. But no mere listing can give you a complete picture of the scope of work at our operation here.

Electronics Park is a birthplace of new concepts and ideas in electronics. Engineers here are continually working on new problems...creating new components, systems, equipment...from which whole new product lines are developed. And as new lines are created, new independent G-E departments are formed. The nucleus of such new departments are often drawn from the development staff at Electronics Park...and the engineer may either follow his "brain-child" or begin anew on the spark of another idea.

Why not check your special professional interest on the coupon and send it to us at Electronics Park. A bachelor's or advanced degree in Electrical or Mechanical Engineering or Physics, and/or experience in electronics is necessary to qualify for current openings here.

GENERAL ELECTRIC

TO GENERAL ELECTRIC
Electronics Park
Syracuse, N. Y.
ATT.: Technical Personnel Dept.

I AM INTERESTED IN
...Advanced Development
...Design
...Field Service
...Technical Writing
...Sales

IN THE FIELD OF...
...Military Radio & Radar
...Multiplex Microwave
...Mobile Communications
...Semiconductors
...Electronic Components
...Computers
...Tubes
...Television Receivers
...Industrial Television
...Antennae

FROM:
NAME ____________
ADDRESS ____________
____
DEGREE ____________

7-7-E

TEST ENGINEERS

WILL YOU REACH YOUR MAXIMUM POTENTIAL?

No matter what your ability, you MUST HAVE the job opportunity and the BEST of TOOLS and FACILITIES to develop your talents to the fullest.

Investigate the Environment created at AC for its Advanced Development Programs on Missile Guidance and Aircraft Fire Control Systems.

OUR ENVIRONMENTAL LABORATORY

is one of the most versatile laboratories in the country and we are in the process of a Major, Permanent Expansion. 225,000 square feet plant being added in suburban Milwaukee.

Our men enjoy working with the finest of test equipment and lab facilities and with the top men in the field.

We are currently engaged in the following types of Test Activities.

- **VIBRATION TESTING**
- **COMPLEX WAVE ANALYSIS**
- **LOW TEMPERATURE–ALTITUDE**
- **HIGH TEMPERATURE**
- **RELIABILITY EVALUATION**
- **INSTRUMENTATION**

Mr. Cecil E. Sundeen, Supervisor of Technical Employment

AC

THE ELECTRONICS DIVISION

GENERAL MOTORS Corporation

FLINT 2, MICH. MILWAUKEE 2, WIS.

UNDERWATER ORDNANCE MISSILE SYSTEMS

Research and Development

Design electronic and mechanical control circuits for use in underwater acoustic homing devices and systems such as torpedoes, targets and decoys.

We have openings for engineers with either advanced or limited experience. There are openings in both Cleveland, Ohio and Key West, Florida.

Clevite Research Center develops new principles and new products for other units of Clevite Corporation. The Research Center provides the ideal environment for the engineer because it has been supplied with the facilities, equipment and library to provide new knowledge and new products for Clevite Corporation, a company whose entire product line is in the growth fields of electronics, semiconductors and automotive and aircraft power plants.

***WRITE* E. A. GENTRY or**

CALL* ULster 1-5500 *COLLECT

CLEVITE RESEARCH CENTER

540 East 105th Street

Cleveland 8, Ohio

Your engineering ability deserves a future...

AND HERE'S WHERE YOU WILL FIND IT!

Look ahead to tomorrow and beyond . . . as engineers always do, always will. Use your ability to the utmost with a world-acclaimed pioneer and leader in commercial electronics. You'll work with and for creative-minded engineers in small groups. You'll know recognized ability is rewarded financially, professionally.

As one of us, you enjoy the best view of electronic frontiers, for they're all around you. Among today's altogether new and stimulating design and development projects, there are these very desirable openings in:

Advanced Circuit Design — **Transistors & Magnetics**
Electron Microscopes & Diffraction Cameras — **Computer Logic**
Automatic Control & Inspection Techniques — **Electronic Test Equipment**
Broadcast Transmitters & Antennas

If you are opposed to applying your energies and ability on work beneath your fullest capacity . . . if you have Senior or Junior qualifications in electrical or mechanical engineering or physics . . . send complete resume to

P-5311, Electronics
Class Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

QUICK SOLUTION to MAN POWER PROBLEMS

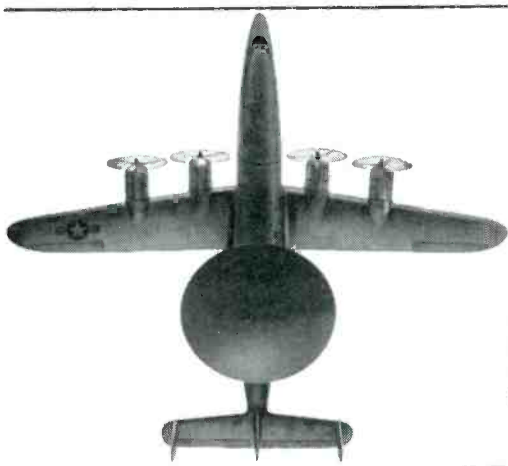
through the EMPLOYMENT OPPORTUNITIES SECTION of this publication. The market place for those offering or wanting the services of men on engineering, technical and executive level.

This section offers a quick, effective solution to your man power problems. Because its readership is confined to just the type of men you need, waste circulation is avoided . . . You reach only the men you want.

CLASSIFIED ADVERTISING DIVISION

ELECTRONICS

330 WEST 42ND ST.
NEW YORK 36, N. Y.



COUNTER-MEASURES TECHNICAL MANAGEMENT POSITIONS

Positions are open for engineers able to manage advanced countermeasures systems programs—from conception of the system up to production. Assignments cover radar search planes, high-speed fighters, propjet cargo and passenger transports, bombers, jet trainers, small turbojet transports and other significant classified projects.

Inquiries are invited from those possessing countermeasures experience and strong interest in technical management. Address E. W. Des Lauriers, Technical Management.

California Division **LOCKHEED**
AIRCRAFT CORPORATION
BURBANK, CALIFORNIA

Facts on Careers in Electronics with Otis Elevator Co.

1. The full resources of the 105-year-old Otis Elevator Company are available for expansion of its new Electronic Division.

2. Current prime contracts are on basic development work in the most advanced areas of bombing navigation systems, radar systems and missile launching test equipment. And Otis expects to fully explore the potential for commercial developments as well.

3. This means, to the engineer, ground floor opportunity now . . . with unlimited future in an interesting and rapidly broadening field.

Electronic and Mechanical Engineering Know-how is required in Servomechanisms, Analog Computers, Pulse & Sweep Generators, Microwaves

If you are interested in a high level career in electronics . . . with promotions waiting to be earned . . . send your resume now to William B. De Francis. All inquiries in strict confidence.

Electronic Division
OTIS ELEVATOR COMPANY
35 Ryerson St., Brooklyn 5, N. Y.

SEARCHLIGHT SECTION
(Classified Advertising)

BUSINESS OPPORTUNITIES

EQUIPMENT - USED or RESALE

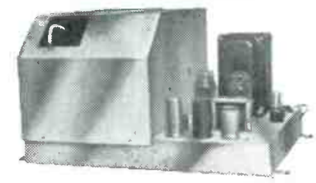
DISPLAYED RATE

The advertising rate is $21.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.
EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE

$2.40 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
PROPOSALS. $2.40 a line an insertion.
BOX NUMBERS count as one line additional in undisplayed ads.
DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DUMONT HIGH VOLTAGE
POWER SUPPLIES



Delivers 23 kv. fully regulated and adjustable

- RADAR
- SNOOPERSCOPES
- COLOR AND PROJECTION TV
- HIGH VOLTAGE TESTING, ETC.

Made by Dumont for RA119, 30 inch TV. Pulse Type H.V. generator and voltage-doubler with 3 tube voltage-regulator. Contains sweep protection circuits to disable the H.V. upon sweep failure. Low voltage also regulated by use of Sola Power Transformer with matching capacitor (cost over $30). Contains 13 tubes and 3 relays. Input 117 V. AC 60 cycles. Schematic diagram included. Original cost over $150.

NEW..........$49.95 ea F.O.B. BROOKLYN

WE HAVE LARGE QUANTITIES:

2AF4A	5639	5899	6101
6J4	5718	5902	6111
6J4 WA	5719	5977	6112
6J6 WA	5840	6021	

WE NEED:

R-30-U	Ear Phones
W.E. 187 A	Capacitors
W.E. 251 A	Retard Coils
W.E. 111 C	Inductors
W.E. 94 E	Repeat Coils
2X13	Crystals—FT 241
2X7	" —FT 243

SEG ELECTRONICS CO. INC.
1778 Flatbush Ave. Brooklyn 10, N. Y.
CL 2-6333
Terms: Check with order. Well-rated firms net 10 days

WANTED TO BUY A GOING BUSINESS

Conn. manufacturer wishes to purchase an established business or product line with sales up to $500,000 involving metal stamping work, secondary work, finishing, assembling, etc. Either a proprietary line of products having market acceptance or a general contract type of operation would be considered.

We are acting for our client, a nationally known eastern manufacturer. Brokers protected. Replies held in strict confidence. Write or Wire

Welling and Woodard
52 Vanderbilt Avenue, Dept. E7
New York, 17, New York
Industrial Consultants

ELECTRONIC

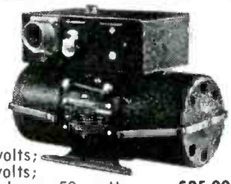
WAR TERMINATION INVENTORIES

WRITE OR WIRE FOR INFORMATION ON OUR COMPLETE LINE OF SURPLUS ELECTRONIC COMPONENTS. ALL PRICES NET F.O.B. PASADENA, CALIFORNIA

C&H SALES CO.

2176-E East Colorado St.
Pasadena 8, California
RYan 1-7393

INVERTERS



10042-1-A Bendix
DC Input 14 volts; output: 115 volts; 400 cycles. 1-phase; 50 watt **$35.00**

12116-2-A Bendix
Output: 115 VAC; 400 cyc; single phase; 45 amp. Input: 24 VDC, 5 amps. **$35.00**

1217 Bendix
Output: 6 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; amps. .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**

12142-1-A Bendix
Output: 115 volts, 3 phase, 400 cycle, 250 VA. Input: 27.5 VDC, 22 amps. Voltage and frequency regulated. **$99.50**

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, 60 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 rmps.; Exc. Volts 27.5. BRAND NEW **$30.00**

MG149F Holtzer-Cabot
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**

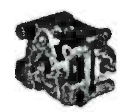
DMF2506M Continental Electric
24-30 volts input; 5.5-45 amps.; cont. duty. Output: 115 volts; .44 amps.; 400 cyc.; 1 phase; pf. 1.0; 50 watts. **$39.50**

AN 3499 Eicor, Class "A"
Input: 27.5 volts at 9.2 amps. AC. Output: 115 volts, 400 cycles; 3 phase, 100 voltamp; continuous duty. **Price $39.50 each**

VARIABLE SPEED BALL DISC INTEGRATORS

Forward & Reverse 4-0-4. Input shaft 5/16" dia. x 3/4" long. Output shaft 15/64" dia. x 9/16" long. Control shaft 11/64" dia. x 11/16" long. Cast aluminum construction approx. size 4½" x 4½" x 4".

No. 146
$17.50 ea.



Forward & Reverse 2¼-0-2¼. Input shaft spline gear 12 teeth 9/32" dia. 3/8" long. Output shaft 15/64" dia. x 15/32" long. Control shaft 11/32" x 3/8" long. Cast aluminum construction. Approx. size 3" x 3" x 2¾".

No. 145
$17.50 ea.

(All Shafts on Both Ball Bearing Supported)

SELSYNS-SYNCHROS

1CT Cont. Trans. 90/55V 60 cy.	$37.50
1DG Diff. Gen. 90/90V 60 cy.	37.50
1F Syn. Mtr. 115/90V 60 cy.	37.50
1G Gen. 115V 60 cy.	37.50
1SF Syn. Mtr. 115/90V 400 cy.	12.50
2J1F1 Gen. 115/57.5V 400 cy.	7.50
2J1F3 Gen. 115/57.5V 400 cy.	10.00
2J1FA1 Gen. 115/57.5V 400 cy.	7.50
2J1G1 57.5/57.5V 400 cy.	5.00
2J1H1 Diff. Gen. 57 5V 400 cy.	7.50
2J5D1 Cont. Trans. 105/55V 60 cy.	17.50
2J5F1 Cont. Trans. 105/55V 60 cy.	17.50
2J5H1 Gen. 115/105V 60 cy.	17.50
2J15M1 Gen. 115/57.5V 400 cy.	17.50
5CT Cont. Trans. 90/55V 60 cy.	34.50
5D Diff. Mtr. 90/90V 60 cy.	34.50
5DG Diff. Gen. 90/90V 60 cy.	34.50
5F Syn. Mtr. 115/90VAC 60 cy.	34.50
5G Syn. Gen. 115/90VAC 60 cy.	34.50
5HCT Cont. Trans. 90/55V 60 cy.	42.50
5SDG Diff. Gen. 90/90V 400 cy.	12.50
6DG Diff. Gen. 90/90V 60 cy.	25.00
6G Syn. Gen. 115/90VAC 60 cy.	34.50
7G Syn. Gen. 115/90VAC 60 cy.	42.50
R110-2A Kearfott Cont. Mtr. 115V 400 cy.	17.50
R200-A Kearfott Cont. Trans. 26/11.8V 400 cy.	15.00
R210-1-A Kearfott Trans. 26/11 8V 400 cy.	20.00
R220-T-A Kearfott Receiver 26/11.8V 400 cy.	20.00
R235-1A Kearfott Resolver 26/11 8V 400 cy.	22.50
C56701 Type 11-4 Rep. 115V 60 cy.	20.00
C69405-2 Type 1-1 Transm. 115V 60 cy.	20.00
C69406 Syn. Transm. 115V 60 cy.	20.00
C69406-1 Type 11-2 Rep. 115V 60 cy.	20.00
C76166 Volt. Rec. 115V 60 cy.	10.00
C78248 Syn. Transm. 115V 60 cy.	12.50
C78249 Syn. Diff. 115V 60 cy.	5.00
C78863 Repeater 115V 60 cy.	7.50
C79331 Transm. Type 1-4 115V 60 cy.	20.00
851 Bendix Autosyn Mtr. 22V 60 cy.	7.50
403 Kollsman Autosyn. Mtr. 32V 60 cy.	7.50
FPE-25-11 Diehl Servo Mfr. 75/115V 60 cy.	19.50
FPE-43-1 Resolver 400 cy.	25.00
FJE-43-9 Resolver 115V 400 cy.	19.50
999-0411 Kollsman 26V 400 cy.	15.00
13770410 Kollsman 26V 400 cy.	10.00
15158-0410 Kollsman 26V 400 cy.	20.00
10047-2A Bendix 26V 400 cy.	12.50
2900 Transicoil 115V 400 cy.	15.00
15CX4a Synchro Transmitter MK 22 MOD 1	15.00 ea.

SIMPLE DIFFERENTIAL

1:1 reverse ratio, 60 teeth on large gear; ¼" shaft. Size: 3" long with 1-15/16" dia.

$3.95 ea.

Stock No. 106

DIFFERENTIAL

Size 2-11/16" long 1-11/16" dia. 1-1 reverse ratio. ¼" shaft on each end; one shaft 25/32" long, one shaft 15/32" long. Input and output gear 1-23/32" dia. 53 teeth.

$3.50 ea.

Stock No. 150

SIMPLE DIFFERENTIAL

1 to 1 reverse ratio; 48 teeth on input and output gear, 1-1/32 inch diameter. Total outside diameter 1-25/32 inches. Shaft size is ¼ inch. One shaft is 9/16" long; other shaft is 3/16" long. **$5.00**

Stock No. 151

3800 CYCLE INVERTER

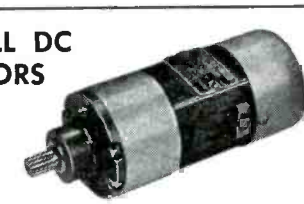
Mfgd. by Eclipse-Pioneer #12144-1-A. Input: 24-30 volts DC, 10 amps AC. Output: 115 volts, .95 amps, 3800 cycle, single phase. Approx. weight 2½ lbs. **Priced at $39.95**

VARIABLE AUTO TRANSFORMER

380-1600 CYCLE

Input: 115 volts, single phase. Output: 0-130 volts, at 500 volt amps. Adjusting knob for easy voltage variation. Completely housed in metal case with ventilating louvres. With four-prong amphenol connector. Dim; 4½ X 5½ X 2¼" H. **$10.00**

SMALL DC MOTORS



(approx. size overall 3¾" x 1¼" dia.:)

5067126 Delco PM, 27 VDC, 125 RPM, Governor Controlled	$15.00 ea.
5069600 Delco PM 27.5 VDC 250 rpm	12.50
5069230 Delco PM 27.5 VDC 145 rpm	15.00
5068750 Delco 27.5 VDC 160 rpm w. brake	6.50
5068571 Delco PM 27.5 VDC 10,000 rpm (1x1x2")	5.00
5069625 Delco 27.5 VDC 120 rpm w/governor	15.00
5069790 Delco PM, 27 VDC, 100 RPM, Governor Controlled	15.00 ea.
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.	15.00
206-1001 PM Planetary Gear Reduced Motor with Magnetic Brake. Mfgd. by Air Equipment 26 volts 600 ma 145 rpm	17.50
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 1⅝" x 3½"	5.00
C-28P-1A 27 VDC 1/100 h.p. 7,000 rpm	3.00
7100-B-PM Hansen 24 VDC 160 rpm	7.50
SSFD-6-1 Diehl PM 27.5 VDC 10,000 rpm	4.00
6-volt PM motor mfgd. by Hansen 5,000 rpm 1¼" in dia., 2" long overall	4.00

SAVE UP TO 70% OF WHOLESALE COST

ALL COMPONENTS 1ST QUALITY AND 100% GUARANTEED

WE INVITE YOUR INQUIRIES FOR ALL YOUR ELECTRONIC NEEDS

FROM ONE OF THE LARGEST INVENTORIES IN THE U.S.A.

SYNCHROS

COMPLETE LINE OF COMMERCIAL ARMY AND NAVY TYPES

1CT	$37.50	5N	$22.50
1DG	37.50	5SDG	12.50
1HCT	42.50	5SF	29.50
1F	37.50	5SG	29.50
1G	37.50	6G	34.50
3D	62.50	6DG	27.50
3HCT	62.50	6HG	42.50
5B	22.50	7G	42.50
5CT	34.50	7DG	47.50
5HCT	42.50	23CX6	45.00
5F	34.50	2J1F1	4.95
5G	34.50	2J1G1	3.95

MANY OTHER TYPES IN STOCK
QUOTATIONS ON REQUEST

POLYSTYRENE CAPACITORS

1% Tolerance

Hermetically Sealed-200VDCW-500VDCT
0.5 MFD.......................... $7.50 Ea.
1 MFD.......................... $12.10 Ea.
MFD. by Western Electric....Brand New

IMMEDIATE DELIVERY

TEFLON and KEL-F INSULATED HOOK-UP WIRE

In Stock for Immediate Delivery
VARIOUS COLORS and SIZES
Inquire For Complete Listing
At Money Saving Prices

TYPE "J" POTENTIOMETERS
2 Watt Carbon

Full Range of Values Available From Stock for Immediate Delivery

Single Type J Units............ $ .95 Ea.
Dual Type JJ Units............ 2.95 Ea.
Triple Type JJJ Units.......... 3.95 Ea.

SEND FOR COMPLETE LISTING

FREQUENCY METER

125KC to 20MC—Heterodyne Freq. Meter — Crystal Calibrated — Accur. — .02% to 2MC; .01% from 2-20 MC—Modulated—Battery Oper.—w/Calibration Books—Exc. Cond.—checked out—Gtd.....**Ea. $79.50**

MEGGER

Winslow 5G-1000—Insulation Resistance Test Set—Range 0-1000 Megohms at 500VDC—complete with Leads & Carrying Case—Brand New..................**$129.50**

HEWLETT-PACKARD WAVE GUIDE TEST EQUIP'T.

G-370B Fixed Attenuator 1" x 2" 6DB	$45.00
G-370D Fixed Attenuator—1" x 2" 20DB	45.00
J-370C Fixed Attenuator ¾ x 1½" 10DB	45.00
J-370D Fixed Attenuator ¾ x 1½" 20DB	45.00
S-370B Fixed Attenuator 1½ x 3" 6DB	52.50
S-370D Fixed Attenuator 1½ x 3" 20DB	52.50
G-870A Slide Screw Tuner 1 x 2" 3.95 to 5.85 KMC	95.00
J-870A Slide Screw Tuner ¾ x 1½" 5.85 to 8.20 KMC	95.00
AC-24 WAVE GUIDE STAND	2.50
S-25 Wave Guide Clamp 3" x 1½"	1.25
G-25 Wave Guide Clamp 2" x 1"	1.25

KOLLSMAN SERVO MOTORS WITH TACH GENERATOR

TYPE 890-0160640-MOTOR-115V-60Cy. 2Ph. 3350 RPM-5 Watts Output
GEN. 6.5V/1000 RPM.........**$59.50 Ea.**
TYPE 1623B-0410120-Motor-26V-400 Cy.-2 Ph. 6500 RPM .045 Watts Output.
GEN. 0.34V/1000 RPM.........**$42.50 Ea.**

Terms: 20% cash with order, bal. C.O.D. unless rated. All prices net F.O.B. our warehouse Phila., Pa., subject to change without notice.

Special Discounts on Quantity Purchases

TEST EQUIPMENT

GENERAL RADIO

GR 106M—1 Hy. Std. Inductance	*$32.00
GR 107N—Variable Inductor	*50.00
GR 219K Decade Condenser	*110.00
GR 419A Wavemeter 20-300 Mc	*75.00
GR 434B Audio Freq. Meter	*95.00
GR 475-BS2 Frequency Monitor	
GR 681-AS2 Frequency Dev. Meter	*300.00
GR 572B IKC Hummer	7.50
GR 620A Het. Freq. Meter	*345.00
GR 700P1 Voltage Divider	27.50
GR 713B Beat Freq. Osc.	*225.00
GR 715AE DC Amplifier	250.00
GR 720A Het. Freq. Meter	275.00
GR 723C VT Fork IKC	*89.50
GR 724B Precision Wavemeter	160.00
GR 726A VTVM	*85.00
GR 727A VTVM (Battery Oper.)	*105.00
GR 814-P2 Filter	*15.00
GR 830A Low Pass Filter	*20.00
GR 1110A Freq. Standard with GR1110P1 Multivibrator	*475.00
GR 1176A Freq. Meter 25-60.000 cy.	*170.00
GR 1535B Contactor	*75.00
GR 1861A Megohmmeter	*75.00
Boonton 207A Univerter	*180.00
Boonton 110A QX Checker	*170.00
Boonton 152A FM Signal Gen. 20-28 MC & 1-5 MC w/150R Pwr Supply	*185.00
Dumont 185 Electronic Switch	*57.50
Dumont 208 Oscilloscope	*89.50
Dumont 248 Oscilloscipe	*375.00
Esterline Angus-20 Pen Operation Recorder Portable type	320.00
Hewlett-Packard 325B Distortion Analyzer	*220.00
Hewlett-Packard 337B FM Monitor 25-175 MC	*465.00
Kay Megasweep 50KC-1000MC	*200.00
Lavoie La-239A Oscilloscope	*850.00
Measurements 62 VTVM	99.50
Measurements 78E Std. Signal Gen. 50-75MC	115.00
Measurements 79B Pulse Gen.	165.00
Rubicon 1168 Resis. Std. .001 ohms	85.00
Rubicon 1171 Resis. Std. .0001 ohms	150.00
Sperry Microline Model 291A Cavity Freq. Meter 2575-3780 MC—Accur. 0.15 MC	*395.00

Victoreen 247 AY Radiation Survey Meter 0-2.5/25/250/2500 milliroentgens/hr.	$115.00
Waterman S-12-B 3" Rakscope	325.00
Weston Model 1 Direct Reading Ohmmeter 0-2.5/25/50 ohms ¼%	120.00
Weston 45 DC Voltmeter 0-15V-¼% Acc.	*35.00
Weston 695 Power Level Meter	30.00
Weston 785 Industrial Circuit Tester	95.00
Weston 796 Megohmeter 0-20/200 megohms 500V. Battery Operated	*42.00
AN/UPM-2 Wavemeter 80-1220 Mc Accur. 1 MC	*97.50
AT-48/UP 3 CM Pickup Horn Antenna	9.95
AT-105/AP'K' Bard Pickup Horn Ant.	12.95
BC-221 Frequency Meter 125 KC-20.000 KC-Accur. .05%	*115.00
I-126 Signal Generator 15-25 MC & 195-225 MC-Int. Mod	115.00
I-138A 10CM Signal Generator 2700-2900 MC	*125.00
LAE-1 UHF Signal Generator 510-1300 MC Accur. 1%	225.00
LAF VHF Signal Generator 90-600 MC. Accur. 1%	*325.00
LAG Microwave Signal Generator 1200-4000 MC Accur. 1%	*375.00
LAJ Audio Oscillator-20-20,000 cy. Mfd. by Hewlett-Packard	*85.00
LP Std. Signal Generator 9.5 KC-50 MC.-2V. Output	*375.00
ME-11A/U. R.F. Wattmeter	*80.00
TS-33/AP 3 CM Frequency Meter 8700-9500 MC Accur. .03%	*145.00
TS-34/AP Oscilloscope 30cps-1Mc Portable	*195.00
TS-46/AP Wave Meter 3000 MC	49.50
TS-100/AP Oscilloscope-A. J. R & X Indication-Freq. video to 3 MC	89.00
TS-174/U Freq. Meter 20-230 MC Accur. .05%	385.00
TS-311A/UP Precision Echo Box 3730 to 8910 MC—Measures frequency, power, spectrum analysis. Incl. Crystal mixer tester	*225.00
STODDART TS-587/U Noise and Field Intensity Meter 15-400 MC	1200.00
TS-588A/U Std. Signal Generator 5KC-50MC 2V. output	390.00

WRITE FOR A COMPLETE LIST OF SURPLUS EQUIPMENT

LECTRONIC
RESEARCH LABORATORIES

715-19 Arch St., Phila. 6, Pa. • MArket 7-6771
Cable Address: LECTRONIC, Philadelphia

McGRAW-HILL BOOKS

FOR YOUR READY-REFERENCE LIBRARY

RELIABILITY FACTORS FOR GROUND ELECTRONIC EQUIPMENT

Methods and working data to help designers build greater reliability into military electronic equipment. Pinpoints causes of poor reliability. Discusses electrical and mechanical factors, human engineering, and components. Gives results of failed-parts studies. Edited by Keith Henney, 280 pp., 196 illus., $8.50

RANDOM PROCESSES IN AUTOMATIC CONTROL

Presents theory and practical techniques for analyzing linear control systems subjected to random inputs. Treats concepts of probability and random time functions in detail. Develops techniques for designing systems containing constant and time-varying components. Provides computational methods for use on computers. By J. H. Laning, Jr., and R. H. Battin, Instrument Lab., Mass., Inst. of Tech. 429 pp., illus., $10.00

ELECTRONIC ENGINEERING

Techniques of circuit analysis for radar, television, electronic control, instrumentation, and computers. Gives alternate methods for many circuits, and provides means, for combining circuits of different types. Examples relate techniques to practice. Discusses solid state theory, and transistors as circuit elements. By Samuel Seely, Prof. & Chrmn., Dept of Elec. Engrg., Syracuse U. 525 pp., 782 illus., $8.00

PROFESSIONAL ENGINEER'S EXAMINATION QUESTIONS and ANSWERS

Over 500 questions and complete answers to help engineers pass state license examination. Covers mechanical, electrical, civil, and chemical engineering, and includes engineering economics and land surveying. Latest questions—suitable for all states. Author has worked on New Jersey examination preparation for 19 years. By William S. Lalonde, Jr. 462 pages, 234 illustrations, $6.50.

THE MIGHTY FORCE OF RESEARCH

FORTUNE Magazine editors tell how 4 billion dollars for research is opening new business opportunities. Reveals who does research, who pays, how it is carried out, what is accomplished and *what it means to you*. By Editors of FORTUNE, 308 pp., 21 illus., $4.00

10 DAYS' FREE TRIAL

McGraw-Hill Book Co., Inc., Dept. FL-7
327 West 41st St., N. Y. 36, N. Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

- ☐ Henney—Reliability Factors for Ground Electronic Equipment—$8.50
- ☐ Seely—Electronic Engineering—$8.00
- ☐ Laning & Battin—Random Processes In Automatic Control—$10.00
- ☐ Lalonde—Professional Engineer's Examination Q & A—$6.50
- ☐ FORTUNE—The Mighty Force of Research—$4.00

(PRINT)
Name ....
Address ....
City ....Zone......State..........
Company ....
Position ....

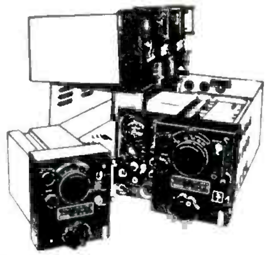
For price and terms outside U.S.
write McGraw-Hill Int'l., N.Y.C. FL-7

AN/APT-5 TRANSMITTERS

Make excellent power signal generators for the range 300-1625MC., rated at 58 watts CW RF at 500MC. Contains blower-cooled 3C22 in re-entrant cavity with precision cathode, plate and loading controls, plus 6 tube AM MODULATOR and amplifier flat from 50KC to 3MC. (easily converted to audio) with phototube noise generator. 115 volt 60 cycle filament supply. New, in export packing, with matching special plugs, lecher line, alternate feedback assembly, manual, audio conversion instructions and technical data, at $250.00. Limited stock.

AN/APR-4 RECEIVERS

With all five Tuning Units covering 38 to 4,000MC; versatile, accurate and compact, the aristocrat of lab receivers in this range. Complete with wideband discone antenna, wavetraps, 100 page manual, plugs, cables and mobile accessories as required.



The AN/APR-4 has been our specialty for over ten years. Over 40 hours of laboratory time is invested in each complete set immediately prior to shipment, so that we can not only guarantee it to pass A-N specifications, but to have the inevitable mass-production irregularities corrected and the latest improvements added. We maintain a complete stock of spare parts and expect to service our customers' sets indefinitely. Write for data sheet and quotation.

TEST EQUIPMENT

Of highest quality, new and reconditioned, military surplus and top commercial brands in stock at money-saving prices. Let us quote to your requirements.

ENGINEERING ASSOCIATES

434 Patterson Road — Dayton 9, Ohio

NEED METERS?

STANDARD or SPECIALS

ANY QUANTITY—NEW—MILITARY

FOR ELECTRONIC—MILITARY AIRCRAFT—HAMS

ALL MAKES—MODELS RANGES—SIZES

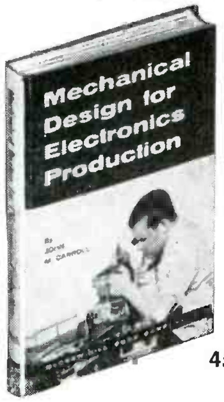
METERS REPAIRED RESCALED RECALIBRATED

WRITE - PHONE - WIRE

INSTRUMENT SERVICE

76-14 Woodside Ave.
Elmhurst 73, N. Y.
CAA No. 4264 Ltd. — HA 9-2925

Just Published



MECHANICAL DESIGN FOR ELECTRONICS PRODUCTION

By John M. CARROLL
Associate Editor
Electronics

452 pages, 6 x 9
illustrated
$6.50

Gives engineers an understanding of the special problems of manufacturing devices using electron tubes and transistors, to aid in designing equipment that will combine best qualities of durability and economy. Gives information on a wide variety of processes and materials, including mechanical layout of equipment, sheet-metal work, machining operations, electric and magnetic shielding, resins and other sealing compounds, mechanisms, electric motors, mechanized assembly and packaging.

RECENT McGRAW-HILL BOOKS

ELECTRONICS IN INDUSTRY

—Second Edition. Supplies the man who uses electronics equipment in plants with a thorough, nontechnical description of electronics circuits and equipment. Show how tubes and tube-operated circuits work in motor control, welding control, and other industrial applications. Explains a large number of commonly used industrial electron tube circuits. **By George M. Chute, Univ. of Detroit. 2nd Ed., 440 pp., 344 illus., $7.50.**

MUSICAL ACOUSTICS

—Fourth Edition. A simple treatment, describing the physics of sound and the important phenomena of musical reproduction—in terms of the characteristics of various musical instruments, the human voice, recording and reproduction devices, and accoustics of rooms used for musical auditions. Musicians and both professional and amateur high-fidelity workers will find much to interest them in this authoritative but nonmathematical treatise. **By Charles A. Culver, Carleton Coll. 4th Ed., 305 pp., 214 illus., $6.00.**

COMMUNICATION ENGINEERING

—Third Edition. Clear, step-by-step analyses of the major problems confronting the communications engineer. Emphasis in this edition is on the area which must precede the investigation of problems in all other divisions of communications—the fundamentals of linear-network analysis and synthesis. Develops both an analysis of various types of modulation and the transformation of transients from the time to the frequency domain. **By W. L. Everitt and G. E. Anner, Univ. of Ill. 3rd Ed., 644 pp., 349 illus., $9.00.**

TRANSISTORS IN RADIO AND TELEVISION

A simple, comprehensive guidebook for electronic technicians and radio and TV servicemen. Concisely presents facts about transistor circuits—their design, use, and maintenance. Takes you from a concise, sound explanation of modern electron theory to such subjects as point contact and junction transistors, transistor oscillators and amplifiers, transistor circuits, and servicing transistor circuits. **By Milton S. Kiver, author of Color Television Fundamentals and other books on electronics. 322 pp., 238 illus., $6.50**

FASTER, FASTER

A Simple Description of a Giant Electric Calculator and the Problems It Solves

Explains in non-technical language how a calculator operates, the nature of the problems it solves, and how the problems are presented to the calculator. Describes "memory," tapes, printers, test and repair facilities, programming, etc. **By W. J. Eckert and Rebecca Jones, Watson Scien. Computing Lab. 160 pp., 44 illus., $3.75.**

PULSE AND DIGITAL CIRCUITS

Tested methods of working with all types of pulse and digital circuits, to help meet the engineering requirements of today's electronic equipment. Expert, down-to-earth guidance helps you analyze every circuit—shows how each is designed—how it functions—how it is best applied in modern electronic fields. Covers the full range of circuits used in such systems as analog and digital computers, radar, television, telemetering, etc. **By Jacob Millman, Columbia Univ., and Herbert Taub, C. C. N. Y. 687 pp., 872 illus., $12.50**

FREE EXAMINATION COUPON

McGraw-Hill Book Co. Dept. FL-7-1
327 W. 41st St., New York 36, N. Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you send remittance with this coupon; same return privilege.)

- ☐ Carroll—Mech. Design for Electronics Prod., $6.50
- ☐ Chute—Electronics in Industry, $7.50
- ☐ Culver—Musical Acoustics, $6.00
- ☐ Everitt & Anner—Communication Eng., $9.00
- ☐ Eckert & Jones—Faster, Faster, $3.75
- ☐ Kiver—Transistors in Radio & TV, $6.50
- ☐ Millman & Taub—Pulse and Digital Circs., $12.50

(Print) Name ....

Address ....

City & Zone .... State ....

Company ....

Position ....

For price and terms outside U. S. write McGraw-Hill Int'l., N. Y. C. FL-7-1

RADAR

P.P.I. REMOTE REPEATERS

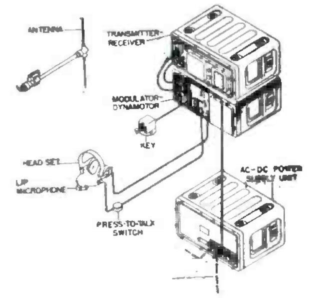
VD 7" Upright
VE-7" Table Type
VF-5" "B" Scope "5" P.P.I.
VG-24" Plotting Table
VJ-12" Upright
VK-12" Upright
VL-12" Upright R.H.L IND.
All indicators are 110v 60 cyc.

RADALAB INC.

87-17 124th St., Richmond Hill 18, New York, N. Y.

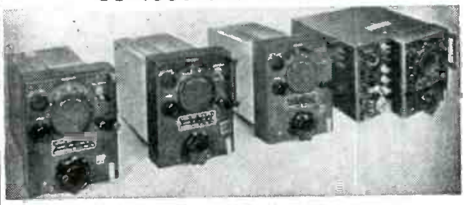
Phone Virginia 9-8181-2-3

OVERSEAS CUSTOMERS CALL US DIRECTLY BY TELEX OVERSEAS TELETYPE TWX N. Y. *4-4361



AN/APR-4

38-4000 MC RECEIVER



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 cyc.

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.

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 400cyc and 28v DC.

AN/GSQ-1 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.

AN/TPS-1B

200 MILE AIR SEARCH RADAR

The TPS-1B is a very late type L-band mobile or portable air search radar. This set will detect aircraft up to 200 miles and up to 40,000 ft. The set is composed of small portable carrying cases that are bolted together to make up the set. A 7" P.P.I. and a 5" "A" scope are provided. This set is in use by the Air Force and Marine Corps. Complete sets available. P.O.R.

GROUND INSTRUMENT LANDING SYSTEM

This set consists of a AN/CRN-10 localizer and a AN/CRN-2 glide path ground station. This equipment can be set up at an airport to provide a complete I.L.S. that will operate with the AN/ARN-5 and RC-103 airborne I.L.S. system to provide blind approach facilities. This system can be installed permanently or transported. Each station has complete monitoring facil. Input power is 110V 60 cyc.

AN/TRC-1-3-4

100 MC RADIO-RELAY EQUIPMENT

The AN/TRC series is a mobile portable set for duplex or simplex radio telephone point to point communication. This set will operate with the CF series carrier systems to provide multi channel operation. The TRC operates on 100 MC with an output of 10 50 watts. The set is crystal controlled. Complete sets avail. Input 110v 60 cys.

WILCOX 602A

30-200 MC CRYS. CONT. RECEIVER

The 602A receiver is a fixed freq crystal controlled communication receiver. This rec. can be tuned to any freq. in the range of 30-200 MC by simply changing the crystal and retuning the front end. There are no coils to change. The 30-200 MC range is covered in one band. Sensitivity is 5 microvolts. A squelch and automatic noise limiter is provided. Mounts in a 19" rack panel. Input 110V 60 cyc 60 watts.

MAR

POINT TO POINT RADIO SET

Portable 225-398 mc point to point 10 chan. crystal controlled voice and mcw radio set. This is a very late radio set used for point to point and ground to air communication. The transmitter output is 8 watts on 10 pre-set crystal controlled channels instantly selected by a band switch. The RFC is also crys. controlled on the trans. freq. The set is inclosed in 3 water proof shock proof cabinets that may be set up in a few minutes on location. This equipment is ideal where a reliable radio link easily transported is needed. Power input is either 24 VDC 115/230V AC or DC. Complete sets avail. Write

MISC. EQUIP.

SCR-193 1.5-18 mc field radio
SCR-291-A 1.5-20 mc direction finder
SCR-399 1.5 mc-18 mc mobile radio
SCR-499 1.5 mc-18 mc field radio
SCR-508-528 28 mc. FM field radio
SCR-608-628 30 mc FM field radio
SCR-505-A field radio
SCR-694 field radio
AN/APA-11 pulse analyzer
AN/APA-17 300-10,000 direction finder
AN/APR-5 1,000-3, 100 mc receiver
AN/ARC-1 100-156 radio set
AN/GRC-9 field radio
AN/TXC-1 page printing facsimile
AN/TRC 7 100-156 mc walkie talkie

Noise and field strength measuring equipment

Test sets TS-1 THRU 800

SQUARE D · ALLEN BRADLEY · KURM... · ...UTLER · STEVE... ARNO... · ...AMMER · ALLIED · WESTO... · GENERAL ELECTRIC · PHILLI... · CONTR... · CLARE · SIGMA · DORME... · ...OMATIC · WESTER... ELECTRI... · ...ECTRIC · LEACH · AMPERI... · ...RUTHERS · POTTER... BRUMFIE... · DUNN · NORTH ELECTRIC · LEDEX · GUARD... · ELECTRIC · WARD LEONARD · ADVANCE · STEPPIN... SWITC... · CONT... · ROTA... RACH... · TELEPH... TYPE · KEYING · MINIATURE AIRCRAFT

LARGEST STOCK OF RELAYS IN THE WORLD

Send for our latest bulletin E

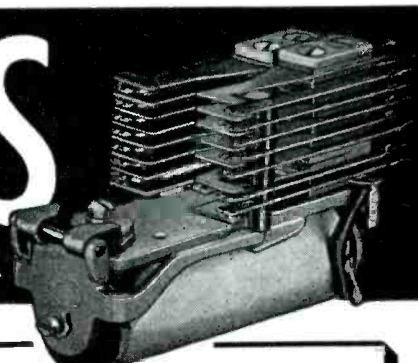
Universal RELAY CORP.

Formerly Universal General Corp.

42 WHITE ST. NEW YORK 13, N. Y. · WAlker 5-9612

RELAYS

world's largest stock



- ★ Immediate Delivery
- ★ Hundreds of Types
- ★ All Standard Makes
- ★ New-Inspected-Guaranteed

See our ad on page 123

Multiple Contact

Standard Telephone Type Relay

CODE 4 TWIN CONTACTS

11-Form A 1-Form B 1-Form C 1-Form D

Heavy duty armature bearing. Available in all standard coil resistances from 12 ohms to 12,000 ohms. Single or quantity prices on request. In stock.

24 HOUR DELIVERY OF THESE TYPES

Standard Telephone Relays
Short Telephone Relays
Midget Relays
Timers
Aircraft Contactors
Rotary Relays
Western Electric Type "E" Relays

Keyed Relays
Hermetically Sealed Relays
Voltage Regulators and Cutouts
Differential and Polarized Relays
Special Relays
BK Series

Antenna and Ceramic Relays
Motor and Control Relays
Relay Assemblies
Latching and Interlocking Relays
Mechanical Action Relays
Ratchet and Stepping Relays
Time Delay Relays

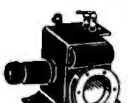
Write for New Relay Sales Catalog, C-7

Relay Sales

P. O. Box 186-AA, West Chicago, Ill. Phone West Chicago 1100

COMMUNICATIONS EQUIPMENT CO.

PULSE TRANSFORMERS



352-7150. Primary 50 ohms. Secondary 1000 ohms. 12,000v, 12.0 Amp. Pulse: 1 or 2 usec. at .001 duty ratio. Fitted with magnetron well and bifilar winding for filament supply $22.50

MAGNETRON PULSE TRANS. #964: 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, 16K-16 AMP DUTY RATIO: 001 400 CYCLE FIL. TRANS. "BUILT-IN" $17.50

GE #K-2449A Primary: 9.33 KV, 50 ohms imp. Secondary: 28 KV, 450 ohms. Pulse length: 1.05/5 usec @ 635/120 PPS. PK Power Out: 1,740 KW, Bifilar: 1.5 amps. $62.50

GE #K-2748-A, 0.5 usec @ 2000 Pps. Pk. Pwr. out 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: 3.½.8 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

400 CYCLE TRANSFORMERS

(All Primaries 115V. 400 Cycles)

RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/806MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300VCT/135MA	5.95
KS9336	110V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS80984	27V/4.3A, 6.3V/2.9A, 1.25V/.02A	2.95
52C080	650VCT/50MA, 6.3VCT/2A, 5VCT/-2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V 2MA	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5/3.5A	4.85
KS9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS9685	6.4/7.5A, 6.4V/3.8A, 6.4/2.5A	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/027A	4.95
352-7069	2-2.5V Wdgs at 2.5A, Each Lo-Cap., 22Kv Test	5.95
352-7096	2.5V/1.79A, 5V/13A, 6.5V/6A, 6.5V/1.2A, D/O BC800	4.95
352-7099	360VCT/20MA, 1500V/1MA, 2.5V/-1.75A, 6.3V/2.5A, 6.3V/6A, P/O BC-929	6.45

MICROWAVE PLUMBING

PARABOLOID DISH, 18" diam. Spun Aluminum 8" Focus. For AN/APS-6 ....$4.50

3 CM. 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 #658275, 180 deg. rotation, choke to choke. Has "Built-in" Di-Coupler, 20 DB, with "N" Takeoff....................$17.50

3 CM. DIPOLE FEED, 15" L. for APS-15.........$14.50

MITRED ELBOW, Cast aluminum, 1¼" x ⅝" 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

Cross-Guide Directional Coupler, UG-40 output flange. Main Guide is 6" Long, with 90 Deg. "E" Plane bend at one end, and is fitted with Std. UG 39/UG 40 flanges. Coupling figure: 20 db Nominal....$22.50

Bulkhead Feed-thru Assembly....................$12.00

Pressure Gauge Section with 15 lb. gauge........$10.00

Directional Coupler, UG 40/U take off 20db.....$15.00

MAGNET AND STABILIZER CAVITY For 2J41 Magnetron $24.50

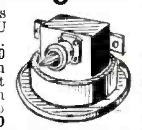
90 degree elbows, "E" Plane 2½" radius.........$8.50

X-BAND—R6, 52/U WAVE GUIDE

Beacon/receiver unit. Complete with dual klystron mount, TR/ATR section, duplexer, and 30 mc IF/-Mixer unit. Originally designed for 9000 mc receiving using 723A/B. New, less tubes............$22.50

Klystron mount for 723A/B. Front end of microwave receiver (SO-3), with balanced mixer crystal mt. and iris coupling for AFC. less tube. $15.00

10 CM.—RG48/U Waveguide



Waveguide-to Coax, adapter. Matches RG48/U. waveguide to RG 44/U rigid coax. Complete with flanges. "T" match $15.00

10CM ECHO BOX: Tunable from 3200-3333 Mc. For checking out radar transmitters, for spectrum analysis, etc. Complete with pickup antenna and coupling devices $17.50

POWER SPLITTER for use with type 726 or any 10 CM Shepherd Klystron. Energy is fed from Klystron antenna through dual pick-up system to 2 type "N" connectors $12.50

LHTR, LIGHTHOUSE ASSEMBLY. Parts of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/ assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27, Tunable APX 2400-2700 MCS. Silver Plated $15.00

McNally Klystron cavity for 2K28 or 707B, tunes 2700-2900 mc. Complete with tuning vanes...........$5.00

3000 MC WAVEMETER

Mfd. by GE for Armed Services. 3000-3700 MC. Comes furnished with variable attenuator, coax, adapter cord, Cal. chart and pickup antenna. Has output jack for external meter or other monitor device. Reasonance indicator is 3½ 20 microamp meter. Brand new, in portable wooden carrying case.............. **$75.00**

TEST EQUIPMENT

TS 102 Radar Range calibrator. Rep rates are 400/800/1600/2000 PPS. Operates from 115, 60-1600 cy. Used. exc.................... $95.00

RCA WR 39A TV Calibrator, 20-240mc, with crystal on 2.5 or .25 mc. Used, exc.......... $65.00

RCA WR 53A, FM Sweep Generator covers 88-108 mc and 8.5-10.7 mc*.................... $49.00

108 mc and 8.5-10.7 mc*.................... $49.00

RCA WR 67A. Test oscillator, 100kc-30 mc, internal or external mod.*.................... $43.00

RCA 710A Signal Generator, 380-560 mc........ $70.00

Kay Marka-Sweep, Model RF-P. TV alignment generator, channels 1-12, plus LF freq. Markers at pix and audio. Output 0.5v across 70 ohms.*.$125.00

P4E Synchroscope: 4 mc. bandwidth with a gain of 100. 5-inch display, includes 2-stage video amplifier. Writing speeds 0.04/0.166/0.5/2 in. per microsec* $75.00

TS 28/UPM Synchroscope. Uses 5CP1 tube, and may be used as a regular scope with repetitive sweeps. Signal gain is 100 with a bandwidth of 5mc. Triggered sweeps range from 1 to 6 microsec. per inch*....................$135.00

TS 13/AP. Signal source 9305-9445 mc, 50 microwatts. Comes with a wavemeter, thermistor-bridge power meter, and calibrated attenuator. Oscillator is a klystron type 723/a-b which may be internally (self-synch) or externally pulsed. Controls are provided for FM operation, variable pulse delay, pulse width and phasing. Operates from 115 v. 60-800 cps. New..$225

MICROWAVE MAGNETRONS

2J21A	$3.50	2J62	$4.75	706A	$14.50
2J22	$3.50	4J34	$32.50	706D	$14.75
2J27	$3.75	4J42	$22.50	706CY	$9.75
2J31	$9.00	5J23	$18.00	706EY	$9.75
2J32	$9.25	5J30	$4.75	725A	$2.90
2J38	$9.00	700B	$8.75	730A	$4.75
2J39	$22.50	700D	$8.75		

343 Canal St., New York 13, N.Y. Dept. E-7 Chas. Rosen Phone: CAnal 6-4882

BEARINGS —

Miniatures; Precision; Stainless Steel; Special Sizes, Tolerance & Construction.

RAWAY BEARING CO.

4-8 Forsythe St. Walker 5-8150 N. Y. C. 2, N. Y.

NEW MAHOGANY CABINETS

Suitable for V.H.F. Converters do-it-yourself radio kits, etc. 9½ x 3¾ x 6¼—samples sent on request—no reasonable offer refused.

HASSETT STORAGE

4906 Madison Street Chicago 44, Illinois

for the sweetest buys in the book

TRY CANDEE!

Here is part of our current inventory:

ARC-1 Transceiver	**R-268B** Recvr.
ART-13 Transmitter	**ARC-27** Transcvr.
BC-348Q Recvr.	& Parts
R5A/ARN7	**APS-15**

TEST EQUIPMENT

Hewlett-Packard 624-B Test Set

APR-4 TEST SET. Complete with all tuning units. Spare tuning units also available.

TS-175/U	**BC-221**
TS-173/U	**TS-34A**

DOMESTIC AND FOREIGN BUYERS: Write today regarding your current needs. We have been selling since 1945 and can save you money. Prompt action assured.

J. J. CANDEE CO. Dept. E.

4002 W. Burbank Blvd. Burbank, Cal.

PHONE: Victoria 9-2411

SUBMINIATURE RELAYS *HERMETICALLY-SEALED*

Hermetically Sealed

'DIAMOND H' Relays

Mfg. By

HART MANUFACTURING CO.

The "Diamond H" series R Hermetically sealed Relays will match or surpass USAF Spec. MIL-R-5757B.

26.5 V.D.C. Coil Res. 150 ohms 4PDT (4C) Contacts rated 2A @ 30 V.D.C.

Hart #R115B1P-1 Plug-in type Dim. 1-1/16" dia. x 1¾" High. R115B1P-1 **$1.75**

15 Pin SOCKET for above Relay. R101PS Each 25¢

STRUTHERS-DUNN RELAYS

4PST Norm. open (4A) 28v. D.C. Coil 280 ohm. Will operate on 18v. D.C. Hermetically Sealed . . . Size 2⅛" x 1½" x 2¾". Contacts 10 amp. at 30v. D.C. or 115v. A.C. non-ind.

Struthers-Dunn #182DXX107

$1.75

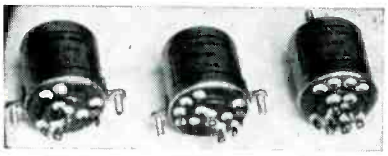


Fig. 1 Fig. 2 Fig. 3

STRUTHERS-DUNN Sub-Miniature RELAYS

Size 1¼" dia. X 1¼" high. Mounting centers 1½" except fig. #3⅝" mtg. Studs. 26.5 V.D.C. 150 ohms.

Fig. 1 Dunco #220XCX310 3PDT (3C) R103
Fig. 2 Dunco #220XDX310 4PDT (4C) R104
Fig. 3 Dunco #220XDX301 4PDT (4C) R105

Net each **$1.75**

K1097-P19 (7ACP-19) THREE BEAM CATHODE RAY TUBE

The Type 7ACP19 is a 6⅝" diagonal, rectangular face, three beam, post accolerator, electrostatic deflection and focus Cathode Ray Tube. Each beam is independently controlled except for Heater, Cathode and Accelerating voltages. The Deflection Electrodes of each beam are electrostatically shielded from each other. The Gun Structures are designed so as to give no appreciable Focus Voltage Current.

K1097-P19 (7ACP-19)

SPECIAL PRICE $35.00

Special Discounts on Quantity Purchases. Production Quantities

Write for Engineering Data Bulletin

C & B ELECTRONICS • 1949 W. ERIE ST. • CHICAGO 22, ILL. • TA. 9-8580

COMMUNICATIONS & TEST EQUIPMENT

Top quality communications and test equipment at low prices.

Here are a few leaders . . . .

- AN/TRC-1,2,3—Radio Telephone Repeater Sets
- ARC-1 & ARC-27—Transmitter Receivers
- ARN-6 & —14C—Radio Compass Receivers
- AS-313—Loop Antennas for ARN-6.
- ARN-7—Compass Receivers
- ES-396—75 Meg. Marker Beacon Antenna
- Mobile Marker Beacon Ground Equipment Model IF
- Model PQ-1 — Visual Recording Equipment (1 CIF—5517 4-A Visual Recorder) (Facsimile)
- R122A/ARN-12—Marker Beacon Receiver
- RCH—Navy Receiver
- RC-266—Antenna for SCR-717
- SCR-508—Mobile FM Radio Sets Complete
- TS-15A—Flux Meter 1200-9600 Gauss
- TS-125/AP—Power Output Meter
- TS-155A/UP—Signal Generators
- TS-323/UR—Frequency Meter Precision
- TU-5B—Tuning Units
- AN/FGC-1X — Teletype Terminal Equipment w/Spares 2-26 Meg. W.E.
- Modulator Carrier Control System W.E.

Prices on request only
Immediate Delivery

We buy clean communications and test equipment unmodified. Top prices.

MONTGOMERY EQUIPMENT CO.
14315 Bessemer St.
Van Nuys, California
Telephone: STate 6-4657
Telegraph Station YHV
Cable Address MONTEQUIP

Save your money!
Don't buy anything till you get our . . .

NEW FREE SALES BULLETIN S57!

It is loaded with bargains in ALL departments:

Tubes	Test Equip.
Meters	Mikes
Headsets	Transmitters
Receivers	Capacitors
Transformers	Etc., etc., etc.,

SEND FOR BULLETIN S57!
You'll be glad you did!

ARROW SALES, INC. Dept. E.
7460 Varna Ave. No. Hollywood, Cal.

ELECTRON TUBES

CONSISTENTLY HIGH QUALITY — *AT SENSIBLE PRICES!*

SPECIALISTS IN JAN, W.E., SUBMINIATURE, 5000/6000 SERIES AND RECEIVING TYPES

GUARANTEED • UNUSED • BOXED • 1st QUALITY • WRITE FOR COMPLETE LIST

1AD4	$1.24
1B24	5.50
1B24A	15.00
1B32	2.00
1B35	3.35
1B40	2.00
1B63A	19.00
1N21	.22
1N23B	.90
1N34	.45
1N65	.85
1N70	1.50
1P23	1.75
1P37	3.50
1P41	2.50
1Z2	1.50
CE2C	2.00
CL-2	10.00
2BP1	9.75
2C39A	11.00
2C43	8.00
2C51/396A	3.25
2C53	9.75
2D21W/5727	.95
2E24	2.35
2E25	2.75
2E26	3.20
2E35	1.95
2J21A	4.00
2J22	4.00
2J37	10.00
2J54	25.00
2K25	13.50
2K30/410R	90.00
2K45	35.00
2V3G	.80
3B24	1.50
3B24WA	10.50
3B25	5.00
3B26	3.95
3B28	4.00
3B29	4.75
3C23	3.95
3C24/24G	1.70
3C45	7.00
3E29	8.50
3J30	25.00
3K20000LK	Write
4-65A (Surp)	15.00
4-125A	30.25
4-250A	35.00
4B24/EL3C	4.50
4C35	13.50
4J21	75.00
4J36	70.00
4J37	70.00
4PR60A	30.00
4X150A (surp)	19.00
4X500A (surp)	75.00
4X500F	45.00
5BP4	3.95
EL5B/4B22	5.50
5C22	27.00
5CP1A	7.00
5D21	6.25
5D23/RK65	7.50
5JP2	5.00
5JP5	6.00
5J30/Z666	5.00
5R4WGY	3.00
5Y3WGT	1.50
6AK5W	1.40
6BA6W/5749	1.25
6BM6	30.00
6C4W	4.00
C6L/5528	5.00
6C21/450TL	13.50
6SN7WGT	1.75
8D21	175.00
12AT7WA/6201	3.00
FG-27A	10.00
FG-32	4.35
35TG (surp)	2.00
VC50/32 (cap.)	8.00
QK60	20.00
QK61	21.50
RK65/5D23	7.50
FG-81A	3.25
100TH (surp)	5.00
100TL (surp)	11.69
FG-105	11.00
F-123A	3.95
F-128A	10.00
VXR-130	1.50
FG-166	13.50
FG-172	17.50
QK-181	12.50
QK-185	90.00
QK-202	195.00
249B	3.50
HK253	5.00
HK-257B/4E27	7.50
262A	6.00
FG-271/5551	37.50
287A	2.20
304TL	10.50
307A	.60
311A	5.50
313C	2.70
313CD	4.00
WE315A(575A)	15.00
QK319	100.00
328A	3.50
338A	3.75
350B	2.00
354A	2.50
355A	11.00
371B/VT166	.75
375A	10.00
393A	4.50
396A/2C51	2.25
401A/5590	2.75
403A/6AK5 (WE)	1.20
403B/5591	3.25
404A/5847	12.50
408A	2.20
412A	3.50
416B	39.00
417A/5842	12.00
421A/5998	4.95
GL434A	5.00
UE578	7.00
Z666/5J30	5.00
GL-673	12.50
726A	5.00
726B	14.00
726C	13.00
750TL (surp)	32.50
800	.90
805	4.00
807W/5933	1.75
809	2.50
814	2.50
826	.60
829B	8.50
832A	6.75
833A	36.00
837	1.25
869B	22.00
872-A	1.00
872-A (GE)	2.75
902P1	2.50
918	1.10
927	1.00
954	.40
958/958A	.35
CK1007	.45
CK1026	2.35
R1130B	11.50
R161 (5C22)	35.00
HY-1269	3.35
1622	1.75
1626	.25
1635	1.60
1654	2.25
1850A (U-1)	39.50
1850A (N-1) RCA	150.00
5517	1.35
5528/C6L	5.00
5559/FG57	10.00
5636A	2.95
5638/SD828A	3.00
5639	8.50
5642	1.00
5721	140.00
5725	1.50
5726/6AL5W	.75
WL5736	110.00
5744	1.25
5787WA	6.50
5802	4.50
5812	1.00
5814	1.00
5819	25.00
5829	1.00
5829WA	3.50
5840A	5.50
5876	8.00
5879	1.40
5998/421A	4.95
6021	3.00
6096	1.40
6100/6C4WA	2.00
6130/3C45	6.00
6187	4.00
6211	1.40
6264	10.00
6278/C5F14	15.00
GL6283	90.00
6292 (Dumont)	30.00
6485	1.30
8005	5.95
8008/872A	3.25
8020	1.00
AX9903/5894	17.50

INDUSTRIAL XFMRS • VERY LARGE QUANTITY BRAND NEW, HIGH QUALITY COMM. TYPES • SPECIAL LOW PRICES • WRITE FOR LATEST LIST, FREE!

TUBE CARTONS • STACKERS

Super gloss red & black, or plain glossy white. Both types with new safety partition that meets U. S. government specifications! Specify white or colored when ordering:

SIZE	FOR TUBE TYPE	Quantity per case	PRICES Per case	PRICES Per 100
Miniature red & black 1" x 1" x 3"	6AU6, 6AL5, etc.	3000	$27.00	$1.00
Miniature glossy white	" "	3000	27.00	1.00
GT red & black 1¼" x 1¼" x 3⅝"	6SN7GT, 6W4GT, etc.	2000	22.50	1.25
GT glossy white	" "	2000	22.50	1.25
Large GT red & black 1½"x1½"x4½"	IB3, 6BQ6GT, etc.	1500	20.25	1.50
Large GT white	" "	1500	20.25	1.50
G red & black 2" x 2" x 6"	5U4G, 6BG6G, etc.	1000	18.00	2.00
G white	" "	1000	18.00	2.00
Small Jumbo, white 3" x 3" x 7½"	809, 866A, etc.	550	41.25	7.50
Large Jumbo, white 4" x 4" x 10"	813, 872A, etc.	300	27.00	10.00
Ministackers, white (holds 10 mintubes)		1000	13.50	1.50
GT stackers, white (holds 10 GT tubes)		1000	18.00	2.00
		Carton Lot	Per Carton	Each
Lead sheaths for crystal diodes		144	12.90	.10

TERMS: 25% Deposit with Order, Balance C.O.D.—or Send Full Remittance with Order. Well Rated (D&B) Firms Net 10. All Items Subject to Stock Depletion and Price Variation Without Prior Notice. All Merchandise Fully Guaranteed for Cost of Merchandise Only. Minimum Order $10.00.

WAlker 5-7000 - 24 Hour Phone Service

Cable: Barrylect, NY
Telegrams: Barry, Fax, NYC
Twx: NY1-3731-U

BARRY ELECTRONICS CORP.
512 BROADWAY N.Y. 12, N.Y.

MOTOR GENERATOR SETS

- 1 10 kw, 300/600 volt, 1-phase, 400 cps, synchronous.
- 1 30 kw, 120/208 volt, 3-phase, 400 cps, induction.

2 BEARING ALTERNATOR

- 1 only—50 kw, 60 cps, 1200 rpm, 480 volts.

KATO *Engineering Co.*
MANKATO, MINNESOTA PHONE 5031

a TERRIFIC BARGAIN in a

SOLA CONSTANT-VOLTAGE TRANSFORMER

Ends fluctuating line voltage!

Big Discount Off . . .

the factory price at a 1-input 2,000 VA unit! And here's another bonus! This Air Forces 2,000 VA overstock, Sola Cat. No. 30768, has 4 inputs! 90-125 V., 190-250 V., 60 cy. or 50 cy. Isolated secondary is constant 115.0 V. ±1% from no-load to full-load of 17.4 amp. So, if you choose, use it as a 220:115 V. step-down. And slash $97.50 off the factory 1-input price!

Brand new in original wood box. 4 cu. ft. Ship. wt. 254 lbs. F.O.B. Pasco, Wash. Only..... **$147.50**

THE M. R. COMPANY
P. O. Box 1220-B Beverly Hills, Calif.

RG-52 X-BAND 1" x ½"

SPECIAL TRANSITION, Waveguide to Type "N" CO-AX, UG-81/U used with TS-12, TS-13, etc. $6.00
LOTS OF TEN $4.00 EACH
90° "H" PLANE ELBOW, UG-40A and UG-39/U Flanges, 3" Radius with Hardware $6.00
18" FLEXAGUIDE, UG-39/U Flanges, Type CG-179 A/U $6.75
ROTARY JOINT 360°, UG-40A Flanges $25.00
WAVEMETER, Reaction Type, 8,990-9,170 mc. Calibrated 1 mc. per Division, UG-39/U Flange $30.00
WAVEMETER FIXED, Transmission Type-9,310 mc., UG 39/U Flange.... $19.50
(USED).. $10.00
(Note: either above Wavemeter can easily be Adapted to Cover 8,500 - 10,500 MC.)

RG-51 X-BAND ⅝" x 1¼"

VARIABLE ATTENUATOR, W. E. Co. Flanges, from TS-35, 0-34 db. range. $4.50
6" FLEXAGUIDE, UG-51/U Flanges, Type CG-165A/U $4.50

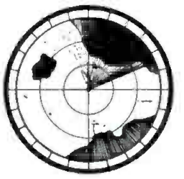
RG-48 S-BAND 1½" x 3"

90° "H" PLANE ELBOW, UG-70/U SQ. Flanges & Hardware.................. $8.50
HIGH POWER TRANSITIONS, Waveguide to co-ax .... P. O. R.

MICROWAVE ANTENNAS

PARABOLIC REFLECTOR 45½" Dia. $20.00
X-BAND 29.5" Dia., RG-52, 360 Degree PPI, 12 or 24 RPM., Sector Scan 30-360 Degree in 30 Degree Steps. Power 24-28 VDC. Tilt Plus 20 to Minus 20 Degrees Type AS-18A/APS Used with AN/APS-15 available in CSC2 or Pencil Beam $185.00
RADOME For AS-18A/APS.......... $225.00
S-BAND Type AS-17A/APS (Same as AS-18A Mechanically) $100.00

All equipment and components are new and in perfect condition unless specified.



RADAR DIVISION
RAMAGE & MILLER ENTERPRISES
1711 BARRETT AVE.
RICHMOND, CALIFORNIA
BEacon 2-1208

10 CM. R.F. HEAD

COMPLETE R.F. HEAD INCLUDING, Modulator-50 KW peak RF at 3000 MC. Pulser delivers 12 KV pulse at 12 amps to magnetron at .5, 1.0, or 2.0 microsec. power requirements: 115-v 400-2600 cycle, 1 phase @ 8.5 amps., 24-28 vdc. @ 2-amps. Ideal for use with AS-17A/APS antenna
Used Government Tested.... $185.00

RADAR SYSTEMS

COMPLETE AN/APS-4, any and all parts, cables to your specifications. **P. O. R.**
Parts For APS-2, 3, 4, 6, 15, 31...... **P. O. R.**

MAGNETRONS

2J51A (Used tested guaranteed)...... $165.00
QK-172 (Used subject to test)........ $550.00
4J50 (Used tested guaranteed)....... $65.00

PULSE NETWORKS

30E2-1-390-50 .... $45.00
15-A-1-400-50 .... $12.50

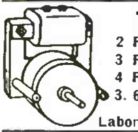
TEST SETS

O.B.U.-3 PRECISION ECHO BOX, 10 CM. with pick up.................. $75.00
S. O. ECHO BOX 10 CM.............. $15.00

KOILED KORDS 3 wires $1.26
22 inches long stretches to 9 ft.

Only a Few More Left **GONIOMETER**
TYPE CFT-47372 — 250 to 1500 K.C.

nightlighter — Automatic lightswitch. Darkness throws the switch — turns lights on at dusk . . off at dawn. Fools burglars who watch for signs of an empty house. Same as your city buys for $45 on top of street lamp posts. $15.95



TELECHRON Motors

2 RPM ...	$2.90	1 RPM	3.95
3 RPM ...	3.90	3 R.P. Hr..	2.85
4 RPM ...	2.90	1 R.P. 2Hr.	2.80
		1 R.P. 12Hr.	3.25
3. 6 RPM..	3.15	60 RPM ...	4.85

1 RPM—50 Cycles, $1.85
Laboratory Special 1 of Each Motor $25

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
6 RPM reversible...... $10.00
1 RPM $6.50

HAYDON TIMING MOTORS

110v 60 cycle 30 RPM.. $2.60
110v 60 cycle 1 RPM... 2.60
230v 2 RPM 1.00
60 cy 1 RPM.......... 1.00
HANSEN Synchron 4 rpm $4.24
CRAMER 4 rpm $4.65

DIEHL-DELCO
P.M. motors. Made for 24 volts. Will work at lower speed at 12v. or 6v Battery or Rectifier. Size 1"x1"x2" $3.75

PLEASE INCLUDE POSTAGE

BLAN
EST. 1923
64 Q Dey St.
New York 7,
N. Y.

---

for the sweet taste of money

TRY CANDEE!

Since 1945, we've been buying:

ARN-6	ARN-7
APN-9	ART-13
BC-224	BC-348
AS-313B Loops	Test Equip.

"Selling to Candee is dandy!"

J. J. CANDEE CO.
4002 W. Burbank Blvd. Burbank, Calif.

MAGNETS

MAGNETRON MAGNETS — As Pictured: Approx. 1800 Gauss, shown left: $12.95 — —Approx. 4800 Gauss, shown right:..... $14.95

HORSESHOE TYPE MAGNETS—As used with Magnetron Tubes:
25 lb. Lift—Size: 2½" x 2½" x 1½"......... $2.95
75 lb. Lift—Size: 4" x 3½" x 3" ... $4.95
Speaker Alnico Magnets—½, ¼, & 1 lb. Asst. of 3 .... $1.50

115 V. 60 CYCLE BLOWERS

At Left: 115, VAC 60 Cycle SINGLE TYPE — 100 CFM — 2¼" intake: 2" outlet. Complete size: 5" x 6"— No. 1C939.......... $9.95

15 VAC 60 Cycle DUAL TYPE —100 CFM—4" intake: 2" Dis. Each Side. Complete size: 8' x 6" No. 1C880 .... $14.95

115 VAC 60 cycle FLANGE TYPE—140 CFM; 3½" intake; 2½" Dis. Complete size; 7½" W x 7¼" H x 6¾" D—No. 1C807.......... $14.95

115 VAC 60 cycle FLANGE TWIN—275 CFM; 4½" intake; 3½" x 3" Dis. Complete size; 11¾" W x 2⅜" H x 8-1/16" D— No. 2C069 .... $22.95

DYNAMOTORS & GENERATORS

INPUT VOLTS	OUTPUT VOLTS	OUTPUT MA	STOCK No.	PRICES: USED	PRICES: NEW
12 VDC	220	80	DM-34	$2.95	$4.95
12	225	100	D-402	5.95	8.95
12	625	225	DM-35	9.95	
12	230	90	PE-133	4.95	6.95
12	540	450	DA-12		14.95
12	230	100	DA-14		8.95
14	220	70	DM-24	4.95	7.95
14	1030	260			
	515	215	DM-42	4.95	9.95
14	425	163	WE-377	5.95	
14 VDC	330	150	BD-87	3.95	5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	
14	230	90	DM-21	6.95	
24	250	60	DM-32	2.95	5.95
12	250	60	12V/DM-32		4.95
24	250	60	PE-86		8.95
28	1000	350	PE-73	8.95	

12 to 24 VDC PM Dynamotor—Supplies 24 VDC 2 A, from 12 VDC, also 500 V 50 MA, @ 6 VDC will Supply 12 VDC & 250 V 50 MA.
#0515 .... New $4.95

New List— *Just Out—Including many other Motors, Blowers, Dynamotors, etc. Free—Write for copy today!*

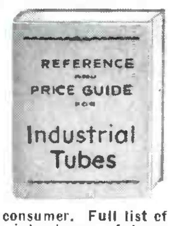
FAIR RADIO SALES • 132 SOUTH MAIN ST. LIMA, OHIO

CASH PAID! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, Klystrons, Broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone: WAlker 5-7000
Barry, 512 Broadway, New York 12, N. Y.

Just out!

Reference and Price Guide for Industrial Tubes

The most comprehensive and complete cross reference book of old and current tube types. Contains up to the minute facts about the entire tube field. It took 18 months of painstaking research and cross checking by a competent staff with the know-how and background in the Electronics industry.



Gives approx. distributor cost. Also approximate resale price to ultimate consumer. Full list of cross reference and complete interchange of types of industrial classifications. Send $3.00, book sent postpaid anywhere in U. S. A.

Mail Coupon Today

ELECTRONIC TUBE SALES INC.
74 Cortlandt St., N. Y. 7, N. Y.
Name ....
Address ....
City ....
State ....

APR-4 RECEIVERS

Tuning units covering 38 to 4,000 MC.
ALLTRONICS-HOWARD CO.
Box 19, Boston 1, Mass. *Richmond 2-0048*

WANTED

ART-13/T47A Transmitters $175.00
ART-13/T47 Transmitters $125.00
BC-788C Alt... $175.00
A R C - 3 Transceiver Complete $325.00
R5/ARN-7 Radio Compass $160.00
BC-348 Rec'r Unmodified Q and R Models $50.00
A R C - 1 Transceiver $225.00
BC-342 Rec'r ..$ 50.00
BC-312 Rec'r ..$ 40.00
Ship via Express C.O.D. Subject to Inspection to
H. FINNEGAN, 49 Washington Ave. Little Ferry, N.J.

TUBES • ALL FAMOUS ADVERTISED BRANDS ONLY • TUBES

RMA GUARANTEE—From 10% to 95% Below Manufacturers Price—Look and Compare

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	Prices
AB/150	$ '89
C3J	6.35
C5B	.99
C6J	7.99
CK-551AX/ 2E41	.99
CRP RK-72	.49
EC1	1.24
EF-50	.59
E1148	.29
EM-3GA	39.50
F123A	5.29
FG17	4.50
FG-105	14.99
FG-154	13.95
FG172	24.95
HF-100	7.49
HK-24	3.69
HK-54	3.99
HY-65	1.45

Type	Prices
VR-90	.89
VR-105	.69
VR-150	.69
OA2	.74
OB2	.69
1B22	1.69
1B24	5.99
1B29	2.39
1B30	1.99
2A4/G	1.10
2AP1	3.99
2AP1A	6.44
3B22	1.89
2BP11	7.99
2C21	.49
2C22	.29
2C26	.29
2C26A	.49
2C33	.69
2C39	4.99
2C39A	11.50
2C40	7.95

Type	Prices
2J39	11.00
2J49	39.50
2J61	16.40
2J62	9.60
2K22	14.50
2K23	16.50
2K25	15.75
2K28	29.50
2K33A	49.00
2K41	72.50
2K45	34.95
2K54	9.95
2K55	19.50
2V3/G	1.39
2X2	.34
2X2A	.89
3A5	.69
3APL	2.50
3AP11A	4.95
3B22	1.49

Type	Prices
3FP7	2.95
3GP1	3.95
3HP7	2.95
3J21	49.94
4A11	.49
4B36	4.69
4C27	8.95
4C28	35.50
4E27	9.95
5AP1	3.95
5BP1	2.49
5BP1A	8.99
5BP4	2.99
5C22	25.00
5CP1	3.99
5CP1A	12.49
5CP7	9.99
5CP11A	14.99
5D21	6.99
5FP7	3.99
5HP4	2.49
5JP1	16.99
5JP4	14.99
5J32	65.00
5J33	7.99
5LP1	13.99
5NP1	6.99

Type	Prices
7C22	49.95
12A6	.39
12AT7	.85
12DP7A	18.95
12AU7	.76
12GP7	12.95
15E	1.25
15R	.39
26C6	1.19
28D7	.89
7BP7	6.25
9LP7	5.00
10Y	.39
12X3	1.59
24R	1.89
35T	4.99
35TG	7.25
53A	2.29
QK-62	24.50
RK65 /5D23	12.50
89Y	.15
100TH	6.95
203A	5.99

Type	Prices
276A	7.25
282A	6.49
282	7.25
286A	7.50
304TH	7.95
304TL	11.95
307A	1.85
310A	3.99
316A	.69
329A	4.69
347A	3.88
350B	2.99
354C	14.95
388A	1.49
394A	2.99
WL-417A	2.74
GL-434A	6.66
446A	1.49
446B	1.79
WL-460	8.99
WL-464A	4.25
471A	1.25
CK-508AX	1.10

Type	Prices
714AY	24.95
715A	2.65
715B	6.45
715C	14.50
717A	.49
718AY/CY/ EY/DY	29.75
719A	14.65
720CY/DY/ EY	29.75
721A	1.49
721B	8.45
722	1.99
723A/B	8.99
724A	1.15
724B	1.45
725A	3.99
726A	9.50
726B	25.00
726C	24.50
728AY/BY/ CY/DY/ FY/GY	35.00
730A	7.95

Type	Prices
833A	31.50
836	1.99
837	1.99
838	3.50
841	.59
843	.49
845	6.49
851	16.50
860	3.49
861	19.00
864	.69
865	.49
866A	1.19
866JR/ 2B26	1.40
869B	30.00
GL-872A	2.49
872A	1.29
874	1.25
876	.99
878	.90
884	1.00
885	1.10
9-3	.69
902P1	2.99

Type	Prices
1641	1.88
1642	.39
1644	.48
1806P1	4.99
2050	.95
2050W	2.40
2051	.76
5591	2.95
5636	2.75
5651	1.39
5654	1.40
5656	3.25
5670	2.20
5686	1.79
5687	2.69
5702	1.49
5702WA	3.10
5703	1.19
5725	1.99
5726	1.00
5744	.29
5749	1.25
5751	2.15
5760	2.95

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.

HY-114B	.59
KU-610	2.45
HY-65	1.70
REL-21	1.00
RK-34	.29
RK-59	1.88
RK-60	1.99
RK-61	3.50
RK-73	.49
RX-233A	.69
VT25/10	.49
VT25A/10Y	.39
VT67/30Spec	.26
VT-158	17.50
VU-111	.19
1B32/532A	.99
QK-59	29.50
QK-61	32.00
QK-185	80.00
VR-78	.59

2C42	9.49
2C43	9.49
2C44	1.35
2C46	8.25
2C51	2.75
2C53	9.90
2E24	2.49
2E27	.95
2D21	.79
2D21W	1.29
2G22	2.29
2J21	2.99
2J21A	3.95
2J22	4.99
2J26	2.50
2J27	5.99
2J30	14.50
2J31	14.50
2J32	13.50
2J33	13.50
2J34	13.50
2J38	14.00

3B23	3.25
3B24	2.99
3B24W	4.99
3B25	3.99
3B27	3.49
3B28	4.69
3BP1	2.99
3BP1A	6.35
3C21	1.29
3C22	64.95
3C23	5.99
3C24	1.50
3C28	5.95
3C33	8.99
3C45	5.75
3CP1	2.25
3D23	4.99
3DP1	1.88
3E29	10.25
3EP1	1.88

5R4WGY	3.19
6C21	19.95
6AC7	.69
6AC7W	1.50
6AG7	1.10
6AJ5	1.19
6AK5	.64
6AK5W	1.35
6AN5	2.12
6AR6	1.49
6AS6	1.19
6AS7/G	2.49
6BM6	49.50
6C4	.49
6D4	2.99
6F4	2.99
6J4	2.50
6J4W	3.75
6J6W	1.29
6K4	3.99
6X4W	1.49
7BP1	9.95

205B	1.99
205D	3.99
207	49.50
211	.72
215A	3.25
217A	2.99
217C	4.99
221A	3.99
233A	1.19
242C	8.00
249B	2.99
249C	3.99
250TH	24.95
250TL	13.95
250R	4.99
253A	3.39
259A	5.99
264C	3.90
269A	13.50
271A	12.99
274A	5.95
274B	1.79

CK-521AX	1.10
527	14.50
WL-530	19.50
WL-531	6.25
532A	.99
700A/B/C/ D/E	10.99
701A	4.99
702A	2.25
703A	1.90
704A	1.59
705A	1.25
706A	6.75
706B	14.50
706C	17.50
706DY	35.00
707A	3.65
707B	3.95
708A	2.99
709A	1.69
713A	.96

800	1.29
801A	.42
802	2.89
803	2.69
804	9.99
805	3.75
807	1.25
807W	3.25
808	1.79
809	3.15
810	12.95
811	3.19
813	11.49
814	2.49
815	1.99
816	1.05
826	.75
829B	9.95
830B	2.99
832A	7.49

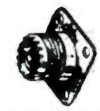
918	1.99
927	1.45
931A	2.99
954	.10
955	.29
956	.25
957	.33
958A	.39
959	1.40
991	.39
CK1005	.46
CK1006	1.97
1500T	94.50
1608	2.99
1613	.95
1614	1.49
1616	.59
1619	.92
1625	.29
1626	.29
1629	.29
1630	.79
1632	.59

5763	1.29
5814	1.35
5851	3.20
5379	1.15
5933	2.99
5963	1.19
5964	.74
5977	3.89
6080	2.99
6080W	3.90
6186	1.05
8002R	18.50
8005	4.50
8012	1.85
8013	2.50
8013A	3.49
8020	2.99
8025A	2.25
9001	.79
9002	.69
9004	.19
9006	.19

FAY-BILL DISTRIBUTING CO. DEPT. E1
418 Broome St., N. Y. 13, N. Y.
Telephone CAnal 6-8404

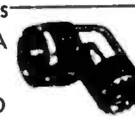
All boxed and fully guaranteed. Special quantity discount—10% on 100 or more of same type. Minimum order $10.00. Thousands of other types in stock . . . Send us your requirements. F.O.B. New York 25% deposit with order or if paid in advance save C.O.D. charges. Rated firms net 10 days. Prices subject to change without notice. For fast service ask for Sy.

COAX CONNECTORS



SO239
24¢
831R

M359A
15¢
831AD



4 GUN 5" C.R.T. 200 in stock $28.50

New Surplus—Not Rejects

K-1098P7 Long Persistance

5BPI	$2.50
5CPI	3.50
51P2A (750 in stock)	4.50
251A	22.50
829B	7.50
869B	22.50
4J52	35.00

MICROWAVE EQUIPMENT CO.
PAOLI, INDIANA Phone 2801

SELLING

Receivers
Transmitters
Radar
Special Purpose Tubes
Relays
Meters
Switches
Connectors
Rectifiers
Transformers
Motors & Generators
Wiring Cable
Instruments
and
All Electronic Components

WILL BUY ALL

New or Used

Leach Relay #5059-R
#5058
#5055
#5053-SM
#5053

Price Bros. Relay #10
Relay #5586
#5587

Antenna Switching Relay
Box # CBY 23049
BG-AN-198
BC -408

Tubes #53A
VT-127A VT-227A
35T VT-327A
WL-530 15E

Highest prices paid for most all types of aircraft sparkplugs any condition

Wholesale Only

RADIO & ELECTRONIC SURPLUS
14000 BRUSH STREET
Detroit 3, Mich. TO 9-3403

Wholesale Only

AN CONNECTORS

FAST DELIVERY

FROM STOCK
Let us quote on your requirements.

LOW PRICES

All comply with government specifications

Wilgreen Industries
99 MURRAY ST., NEW YORK 7, N. Y.
WOrth 4-2490-1-2

Cadmium or olive drab finish.

"TAB"
THAT'S A BUY

New Variable 0 to 6 & 12 Volt 12 Amp DC Power Supply

Battery Eliminator, Charger, Model RR, Plater, Aircraft, Marine or any DC Reg. Extra Hvy Duty Selenium Rectifier, 2 Meters V. & A. Dsgnd for Cont. Service and up to 20 Amp. Intermittent overload. 10% Ripple. **New Model T612V12AC Special** $33.00
T612V12ACC only 1% Ripple....$43.00

NEW "TEKPAK" RELAY 24 VDC SUPPLIES CASED FILTERED READY TO WORK

B24VAR 24VDC @ 1 amp....$8
B24VER 24VDC @ 2 amp....$11
B24VJR 24VDC @ 5 amp....$21

NEW "TEKPAK" VARIABLE 0 to 6 and 12 Volt

50 & 25 Amp FILTERED DC SUPPLY AIR-MARINE-POLICE-POWER SUPPLY DESIGNED FOR COMMUNICATIONS TRANSMIT & RECEIVE. RUGGED DESIGN 4" VOLT & AMP MTR. DESGNO FOR CONTINUOUS SERVICE 6 V @ 50 AMPS & 12 V @ 25 Amps FILTERED 2% RIPPLE 115VAC/6 CY/1Φ INPUT. ONE YEAR GTD.
T612SNACC....$200

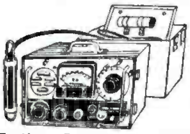
"DUMONT" TV-Hi-Fi-LAB

Hi-Lo-V Power Supply can be used for Radar, Color & Projection TV, Snooperscopes, HiV, Testing. Delivers 20 to 30 KV fully regulated & adjustable contains 3 tube voltage regulator, 3 sens relays & sweep protection ckts. SOLA 3% Regulated Constant Voltage Hi Current Powered; Delivers 420VDC @ 350ma pure DC & 6.3V/6A filament, includes 13 tubes 2/5U4, 2/6SN7 2/6AL5, 2/6BG6G, 2/1B3, OA3, 6W6, 6SJ7 input 117VAC/60cy/1Φ. DUMONT RA119 for 30" TV & Diagram. $200 value: $25@, 2/$45, 5/$100

SALE ! ! ! SALE

SPECIALS! TEST EQUIPMENT!

G.E. Time Interval Meter measures elapsed time From 1/1000 to 3 seconds in 8 ranges .001, .003, .01, .03, 0.1, 1 & 3 secds....$149
G.R. Type 561D Vacuum Tube Bridge....$195
Lavoie LA-61 (500 to 2000 mc's) Freq. Meter. Accy 0.001%. Sens 500 mv. Std freq. 2.5 mc's. accy 0.0001%. Input Imp. 50 ohms, output V. 50mv. Opr. 115-230 v., 50-1000 cy. New, late model Cost $3000;....$249
MIT Model III Calibrater Pulse Testing....$39



!SPECIALS! LATE ARRIVALS

OAX-1/USN HYDROPHONE UNDERWATER PORTABLE SOUND

Testing Equipment complete with 60 feet underwater cable & hydrophone. Op 115v/60cy used for underwater sound. Useful for fishing & detection visual (meter) & sound—In heavy duty metal case **$1200 cost. SPECIAL $69**

RAL5 USN RADIO RECEIVER 0.3 to 23 mcs. NEW with Power Pack....**SPECIAL $149**
RAL5/Used less power supply....$79
SLRF/USN 80 to 550 kc & 1.9 to 24 mcs Rec....$99
MICROWAVE ANTENNA AT49A/APR4....$6
MICROWAVE ANTENNA AS-125/APR....$6
SCANNER APG13 & Motor & Parabolic used $4
Carter DC-AC Converter 115....$12
AN-PRS15/USN Detector Geological Survey $45
ANCRW3/UHF Radio Transmitter....$3
Mitter/Citizens band 200 to 550 mcs....$4
30mcs IF STRIP less tubes Higain....$4
EE65 Telephone Test Set....$9
RM29A & Case NEW Telephone Remote & ringer generator....$5@, 2 for $8, 8 for $30

W.E. Model 2A Terminating Network....$19
PQ1/USN Pulse-Graphic Recorder....$99
0-2500VDC Insulation Tester & factory megger variac controlled. Shock & foolproof includes Weston 2500V mtr & V Regulator & cutout....$40
G.E. Magnetic Contactor 3 HP/3 Pole/dblbreak
115VAC/60cy in metal box....$10 @, 2 for $18
MICO #501 S-6 to 20 Cm Wavemeter....$35
MICO #433 L-20 to 75 Cm Wavemeter....$35
AN/PDR/T1B GEIGER COUNTER....$49
TS174U F.M. 20 to 250 mcs AC operated....$199
I-222 Signal Generator....$39

G.E. YYZ-1 HiSpeed Counting Nucleonics. $75
WESTON #45 LAB Std 0.5%/150VDC....$29
WILCOX CW3/1.9 to 16.5 mcs L/N less coils (AIRWAYS, Police Fixed Band....$34
F3 & CW3 COILS per Set (3)....$9, 2 for $15
MEASUREMENTS #84 std SIG GENERATOR 300 to 1000mcs 400, 1000 & 2500 cycs CW Modulation & Pulse Reg $1950....Special $249
TS34AP/W.E. SYNCHROSCOPE/CR....$75
TS47APR Freq MTR & OSC 40 to 115 & 115 to 500mcs....$180
G.R. 561D VACUUM TUBE BRIDGE....$195

KITS! KITS! KITS!

All kits contain most popular Values

35 Precision Resistors	35 Power Resistors
18 Switches	75 Mica Condsrs
150 Carbon Resistors	6 Crystal Diodes
42 Panel Lamps	250 Ft Hookup Wire
12 Electrolytic Cond's	100 Fuses Asstd
15 Volume Controls	100 Ceramic Condsrs
36 Tube sockets	18 Rotary Switches
50 Tubular Cond's	6 Xtals
500 Lugs & Eyelets	65 Inductors & Coils
10 Bathtub oil Cond's	5 Microswitches
5 lbs Surprise Kit	10 Wheat Lamps
10 Xmit Mica Cond's	40 Insulators
3 Relays	85 INSLTD Resistors

1 EACH ABOVE KIT ONLY....99c. 11 Kits $10

R.F. INTERFERENCE FILTERS

One KC to 1000 MCS/MIL SPEC'S.

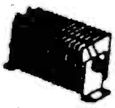
SPRAGUE. CD. TOBE. FILTRON

10amp @ 130vac....$1.49@, 7for$10
100amp & 50vdc....$1.49@, 8for$10
30amp @ 50vdc....$1.49@, 8for$10
15amp @ 115vac/400cys $1.29 @
50amp @ 600vdc/250vac Dual each side of line $10@, 2 for $18 7/$50
10A&20A @ 100vdc....$1@, 7for$5
FA446 Filtron 200amp@130vac, c.p.$56i $18@, 2for$30, 8for$100

NEW "TEKSEL"® SELENIUM RECTIFIERS*

ENGINEERED FOR AUTOMATION & INDUSTRY

"Technical Apparatus Builders" mfgrs. Power Rectifiers to your specs, 24 hour delivery. From one amp to and above 1000 amps.



*FULL WAVE BRIDGE ● DATED & ONE YEAR GTD

Max Amp	18VAC* 14VDC	36VAC* 28VDC	54VAC* 42VDC	72VAC* 56VDC	130VAC* 100VDC	266VAC 217VDC	3-phase 120VAC 150VDC	3-phase 208VAC 256VDC	3-phase 240VAC 300VDC
1	$1.50	$2.30	$3.75	$5.30	$8.75	$27.90	$21.45	$29.90	$45.90
2	2.40	3.75	5.70	6.45	11.70	33.60	24.90	47.90	58.80
3	3.45	4.80	6.30	9.60	14.70	42.90	27.60	63.30	73.95
4	3.90	7.50	11.70	16.15	27.75	49.80	31.15	69.75	84.15
6	4.50	8.85	12.90	19.30	32.85	63.90	48.45	81.90	99.90
10	6.60	12.60	21.90	27.90	42.50	89.70	63.60	117.75	139.50
12	8.10	15.90	24.00	32.75	45.90	111.45	69.75	137.90	159.60
20	13.20	25.50	39.90	52.50	87.75	177.90	124.15	165.75	195.90
24	16.15	32.40	48.45	63.60	96.15	210.60	149.70	279.90	299.70
30	19.80	37.80	61.95	78.75	120.75	256.15	189.60	363.75	396.90
36	24.90	48.45	72.45	95.70	147.60	326.70	225.75	399.60	444.40
50	33.45	63.75	121.50	135.75	192.75	445.90	297.90	591.75	690.90

WRITE FOR DC POWER CATALOG T187 — *Specials in 24 hours*

TEKAP-TABPAK®
High Current Power Supplies

One Year Guarantee Variable 0-28 VDC. Completely built. Ready to go. Full Wave selenium Rectifier, Transformer Variac Pilot Light 4" Volt & Amp Meters, Switch, Terminals & Fuse Hvy Duty Steel Cabinet Std 115V/60 Input or 220V† (3 phase) to order.

Stock Number	Continuous Rating	With Meters
T28V5A*	0-28 WVDC at 5 Amp	$57
T28V5ACC	5 Amp (1% Ripple)	84
T28VA2CC	5 Amp 0.01% Ripple	155
T28V12A	0-28 VDC at 12 Amp	138
T28V12ACC	12 Amp (1% Ripple)	168
T28V12A2CC	12 Amp 0.1% Ripple	250
T28V24A†	0-28 VDC at 24 Amp	175
T28V24ACC†	24 Amp 1% Ripple	250
T28V24A2CC†	24 Amp 0.01% Ripple	345
T28V50A†	0-28 VDC at 50 Amp	325
T28V50ACC†	50 Amp (1% Ripple)	450
T28V100A†	0-28 VDC at 100 Amp	550
T28V100ACC†	100 Amp (1% Ripple)	750
T35V16ACC	0-35V @ 16 Amp(.5% Ripple)	210
T35V25ACC	0-35V @ 25 Amp (.1% Ripple)	370
T35V50ACC	0-35V @ 50 Amp (.1% Ripple)	639

Variable 0-130 VDC Completely built. Ready to go. Includes F. W. Selenium Bridge Rectifier 4" Rectangular Volt & Ammeter. Specify for 115 or 230VAC 1 phase 60 cyc input

T130V5AC	0-130 VDC at 5 Amp	$225
T130V5ACC	5 Amp (1% Ripple)	275
T130V10AC	0-130 VDC at 10 Amp	275
T130V10ACC	10 Amp 1% Ripple	369

*2" Meters: All others 4" Meters 2% Acy.

New! Low Priced High Current Basic Supplies

Consisting of Transformer & Full Wave Bridge Rectifier mtd and wired, fused, outlet, pilot light & ventilated grill & chassis or cabinet. **Ready to deliver constant DC Power. 1 yr. Gtd.**

Stock Number	Continuous Rating	Basic
B28V/5A	0-28 WVDC at 5 Amp	$45
B28V/5ACC	5 Amp (1% Ripple)	69
B28V/12A	0-28 VDC at 12 Amp	90
B28V/12ACC	12 Amp (1% Ripple)	135
B28V/24A	0-28 VDC at 24 Amp	139
B28V/24ACC	24 Amp (1% Ripple)	189
B28V/50A	0-28 VDC at 50 Amp	225
B28V/50ACC	50 Amp (1% Ripple)	350
B28V/100A	0-28 VDC at 100 Amp	439
B28V/100ACC	100 Amp (1% Ripple)	600

INDUSTRIAL DC SUPPLIES

B100V1A	100 VDC @ 1 Amp	$39
B115V1.5A	115 VDC @ 1.5 Amp	52
B115V5A*	115 VDC @ 5 Amp	120
B220V5A*	220 VDC @ 5 Amp	234
B115V5ACC*	115 VDC @ 5 Amp/1% Rip	169
B220V5ACC*	220 VDC @ 5 Amp/1% Rip	333
B115V10ACC*	115 VDC @ 10 Amp/1% Rip	275
B220V10ACC*	220 VDC @ 10 Amp/1% Rip	468

* 115 & 230 VAC/60cy/1Φ Input

"TABTRAN" Rectifier Xfmrs

Sec'd Volts (DUAL† 0-9-15-18-&-0-9-15-18
Series Sec'ds 0-3-6-9-12-15-18-21-24-27-30-33-36 Volts

TR4001 @ 1 Amp† ea/sec/w $5.70
TR4002 @ 2 Amp† ea/sec/w 7.20
TR4003 @ 5 Amp† ea/sec/w 9.45
TR4005 @ 12 Amp† ea/sec/w 18.60
TR4006 @ 24 Amp† ea/sec/w 39.00
TR4007 @ 50 Amp†* per ea sec wndg. 66.00
TR4008 @ 100 Amp†* per ea sec wndg. 117.00
18 Volt 2 Amp....$1.98; 2 for 3.50
† Wndgs in Series at Ratings shown; Parallel 2X Current Voltage 0-9-15-18.
* Dual Pri 115 & 220V 60 cy.

"TABTRAN" Rectifier Chokes

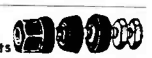
CR6001/ 1 Amp/0.1 HY/1.4 Ohm....$3.60
CR6002/ 2 Amp/0.1 HY/.67 Ohm....6.45
CR6003/ 5 Amp/.07 HY/.6 Ohm....9.45
CR6004/12 Amp/.01 HY/.1 Ohm....18.00
CR6005/24 Amp/.001 HY/.025 Ohm....33.00
CR6006/50 Amp/.001 HY/.001 Ohm....60.00

FILTER CAPACITORS
CE156M 6000MFD 15V....$2@: 2/$3: 10/$12
CE502M 2000NFD 50V....$4 ea, 10 for $30
CE2305M 500MFD @ 200V. $6@, 4/$22, 10/$45
BRACKET FOR CAPACITORS @ 25c

120* or 230V†DC Full Wave Bridge

AC-Rectifier Transformer (Only)
All Primaries 115 & 230VAC/60cy/1Φ Input
Secondary 0-125, 150, 160, 165,* Nema Specs
TR4009* @ 5 Amp Continuous Duty....$50
TR4010* @ 10 Amp Continuous Duty....$72
Secondary 0-250, 300, 320, 330, Nema Specs
TR4011† @ 5 Amp Continuous Duty....$65
TR4012† @ 10 Amp Continuous Duty....$105
◆ *Selenium F.W. Bridge Extra!*

New Five Way "Tekap" Binding Posts



Similar to Superior D F30*, takes plugs, tips, lugs, wire, 1/16" to ¼" panel, Red & Black.
BP30*, 30 Amp, 29c @....12/$3, 50/$11, 100/$19
BP10*, 10 Amp, 18c @....12/$2, 50/$6, 100/$11
BP60*, 60 Amp, 75c @....50/$30
BP100, 100 Amp, $1 @....24/$18

230 TO 115 V AUTOFORMERS

For 220v/60cy Input. To 110-120V or Step up.
† With Cord Plug & Receptacle.

TPA050/50W*....$2.55
TPA075/75W†....3.65
TPA100/100W†....4.00
TPA200/200W†....5.75
TPA250/250W†....6.75
TPA500/500W†....8.25
TPA750/750W†....11.79
Model TPA 1000 Watts: 1 kw†....16.95
TPA1500/1500W* **$22.50**; TPA2000/2KW*. **$34**
* Less Cord Plug & Receptacle.

TUBES

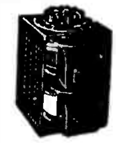
SINCE 1945 CERTIFIED TUBE TESTING AGEING & PRESELECT FACILITIES WRITE!

"TAB" TESTED INSPECTED GUARANTEED!!!

WRITE FOR COMPLETE TUBE LIST

6AG5	$ .69	RK20	$8.00	100L	$11.29	OZ4	$ .50	2J21A	$4.00	3D23	$5.00	534X	$2.00
6C4	.49	24G	2.00	G104	29.00	C1A	10.50	2J22	3.70	3E29	8.00	536X	1.49
6C21	14.00	25A6	1.19	G105	11.00	C1B	2.88	2J26	9.29	3J31	35.00	538X	1.45
6CA7	3.49	25A7	2.19	152L	32.00	1B3	.78	2J27	4.00	3K23	160.00	539X	2.00
6CB6	.80	25BQ6	1.39	F200	10.25	1B21	3.78	2J31	9.00	3K27	150.00	541X	2.00
6D4	2.39	25L6	.72	242	12.50	1B22A	5.00	2J32	9.00	3K30	200.00	543X	2.00
6F4	2.49	25T	7.00	245	14.75	1B23	5.00	2J33	19.00	3S4	.68	544X	1.45
6H6	.59	25Z5	.72	249B	3.30	1B24	5.00	2J34	14.00	3X2500	80.00	547X	2.00
6J4	1.72	25Z6	.75	249C	4.25	1B26	1.00	2J36	24.00	4A1	2.00	548	2.00
6J5	.59	26A7	3.69	250H	19.45	1B27	9.00	2J37	9.00	4A11	2/1.00	571	1.49
6K6	.59	FG27	8.28	250L	19.45	1B29	2.42	2J38	24.00	4B25	15.00	725A	2.50
6L6	1.19	28D7	.89	252A	14.35	1B35	3.00	2J39	50.00	4B26	7.50	726B	18.00
6N7	.99	FG33	15.00	H254	9.35	1B37	12.00	2J48	9.00	4B27	4.70	726C	12.00
6S4	.59	GZ34	1.54	254A	2.35	1B38	41.00	2J50	49.00	4B32	8.00	805	5.00
6SA7	.69	EL34	3.49	257B	7.40	1B41	48.00	2J55	50.00	4C35	19.00	807	1.19
6SB7	1.19	35T	4.49	259A	21.75	1B42	4.00	2J56	35.00	4-125	32.00	808	.85
6SC7	.89	35Z5	.57	274A	4.75	1B46	1.88	2K22	13.00	4E27	7.50	809	2.40
6SG7	.79	EL37	2.49	275A	3.40	1B53	25.00	2K23	11.00	4E27A	10.00	810	9.40
6SJ7	.69	TZ40	2.00	276A	19.75	1B63	19.00	2K25	13.00	4J22	98.00	811	2.50
6SK7	.72	50L6	.69	300B	4.90	1C	1.39	2K28	27.00	4J31	60.00	812	3.30
6SL7	.89	HK54	3.85	H300	19.45	1D21	4.70	2K30	125.00	4J50	95.00	813	8.00
6SN7	.72	T55	9.00	303A	8.45	1R5	.78	2K33A	27.00	4J51	215.00	814	2.35
6SQ7	.74	RK60	1.17	304H	12.50	1S4	.78	2K39	180.00	4J52	43.00	815	1.85
6T8	.98	RK61	2.50	304L	16.50	1T4	.78	2K41	125.00	4PR60	39.00	826	2/1.00
6U8	.98	HY65	2.90	310B	8.50	1U5	.89	2K42	125.00	4-65	15.00	827R	100.00
6V6	.90	KT66	3.45	313C	2.60	1X2A	.68	2K43	125.00	4-125	32.00	829B	8.00
6X4	.39	75T	15.50	322A	57.50	2C22	5/1.00	2K44	125.00	4X150	19.00	832A	6.00
6X5	.49	80	.59	323B	13.25	2C26	5/1.00	2K45	34.00	4-250	36.00	836	1.20
6Y6	.89	EM81	2.39	339A	9.85	2C33	.85	2K47	110.00	4X500	45.00	837	1.35
7C29	69.00	EC81	1.25	349A	4.95	2C39A	11.00	2K48	55.00	4-1000	70.00	845	3.50
10Y	1.00	EZ81	1.05	350A	2.45	2C40	6.00	2K50	169.00	5AW4	1.10	866A	1.20
12AT6	.59	EC82	1.05	350B	1.75	2C43	7.00	2K55	15.00	5B	4.00	872A	.95
12AT7	.89	83	.95	351A	12.75	2C44	.25	2K56	60.00	5C22	25.00	884	1.15
12AU6	.63	83V	.89	357B	43.50	2C51	2.00	2X2	3/1.00	5D21	5.00	889A	75.00
12AU7	.69	EC83	1.19	368AS	4.59	2C52	2.00	3B22	1.25	5D23	7.00	891R	170.00
12AX7	.79	EF86	1.29	387A	3.95	2C53	9.50	3B23	3.00	5J29	4.00	892	237.00
12AY7	1.29	EB91	.81	394A	3.45	2D21	.68	3B24	1.50	5J33	5.00	931A	4.00
12BA6	.65	EC90	1.26	434A	2.00	2D29	3.00	3B24W	4.00	5R4	1.25	954	10/1.00
12BA7	.99	EF94	.96	450H	44.00	2E22	2.00	3B27	3.00	5Y3	.59	955	3/1.00
12BE6	.59	EK90	.99	450L	44.00	2E24	2.25	3B28	3.50	6A	18.00	957	3/1.00
12BH7	.99	EZ90	.79	460	11.50	2E25	7.00	3C22	57.00	6J	18.00	991	5/1.00
12CU6	1.45	EB91	.81	473	165.00	2E26	3.00	3C23	3.95	6A5	3.00	1850A	36.00
12SA7	.69	EC90	1.26	502X	1.50	2E27	.70	3C24	1.72	6AC5	1.00	2050	1.25
12SJ7	.75	EF94	.96	503X	1.00	2E30	2.00	3C31	1.00	6AC7	.79	5654	1.20
12SK7	.75	EK90	.99	512X	2.00	2E31	2.00	3C33	6.00	6AD4	3.00	5691	4.70
15E	1.19	EZ90	.79	522X	2.00	2E32	1.22	3C34	6.00	6AD6	1.29	5692	5.00
FG17	3.49	EB91	.81	525X	2.00	2E35	2.00	3C37	19.00	6AD7	1.39	5693	5.00
19BG6	2.15	FG95	16.00	531X	2.00	2E36	2.00	3C39	80.00	6AE5	1.81	WE417A	12.00
19T8	1.16	FG98	14.75	532X	2.00	2E43	1.64	3C45	7.00	6AE6	1.81	5BP1	1.50
T20	5.00	100H	6.39	533X	2.00	2G21	2.26	3D21A	3.00	6AF6	.99	5BP4	3.50

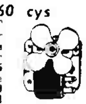
New Variable Voltage X-fmrs
Immediate Delivery From Stock



SUPERIOR-GR-STACO
0-132v-1.25A....$7.23
0-135V/3A....10.63
Cased 0-135V/7.5A....19.55
Uncased/0-135V/7.5A....15.30
Cased/0-270V/3A....22.10
Uncased/0-270V/3A....17.00
Cased/0-135V/15A....39.10
Cased/0-270/9A....39.10
Uncased 0-27V/7.5A....51.64
Cased 0-270V/9A....81.60
Cased 0-270V/12A....107.10
Cased 0-270V/15A....124.95
Cased 0-270V/130A....154.70
100BU3-3 Φ @ 240/out 0-240/520W/1.2A....$36
300BU3-3 Φ @ 230/out 0-230/1.2KVA/3A....50
500BU3-3 Φ @ 230/out 0-270/3.5KVA/7.5A....57
1500B3-3 Φ @ 230/out 0-270/7KVA/15A....132
3000B3-3 Φ @ 230/out 0-270/14KVA/30A....164
3000B6-3 Φ @ 230/out 0-270/28KVA/60A....354
Discounts to Labs, Schools, Colleges, Univs, Gov'ts & Industrial Users

WAREHOUSE-SALE

Quiet AC Min-Blower 60 cys



COOL THAT TUBE EQUIPMENT or TRANSISTOR. TAPPED for 6&12VAC/60cy. also wks 400cys as well. BARBER COLEMAN Mfgr
$1.50@, 3 for $4, 25 for $25
DC MINFAN 12 to 28VDC Mobile
$2.50@, 5 for $10
OSTER Size 10/115v/400cy Fan $4

STEVENS ARNOLD PRECISION DC-AC CHOPPER TYPE CH365

SPDT/COIL 26VDC800. Ω IMP 60Cys/830 Ω 400Cys/1100 Ω. Use as Chopper Rectifier, DEMODULATOR, Sq. Wave Generator Reg. **$20@** SPECIAL **$3@, 4 for $10.**

RELAY SALE!

R28AL5/ALLIED/MHX52/26.5VDC/"JAN"/6PDT H'SEALED LATEST TYPE $5@....5 for $25
RISTI/STEVENS ARNOLD 240Cys Resonant $2@....6 for $10
R4KUL/SPST/MINI/115VAC/4A $1.50@....2 for $2

R8RB1/SPNO/MIN/115VAC/8Acts **$2@**, 6for$10
R10SD1/SPNO/115VAC/30Acts....**$2.50@**, 4for$9
R11AC2/DPDT/115VDC/5Acts....**$1.50@**, 4for$5

R12AC3/DPDT/6VDC/5Acts....**$1.50@**, 4for$5
R13LE1/DPDT/28VDC/5Acts....**$1.50@**, 4for$5
R15GE1/SPNO/28VDC/50Acts....**$1@**, 3for$2

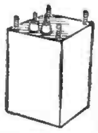
R16GE2/SPDT/2000Ω/8ma....**$2.50@**
R17GM1/SPNO2/24VDC/20Acts....**$1@**, 3for$2
R25RB2/4P-2NO&2NC/16to28VAC **$1@**, 6for$5

R26AV2/4PDT/12 to 24VDC/3Acts **$1@**, 6for$5
SILE1/RelaySPST/12VDC@50amps **$2@**
SILE2/RelaySPST/12VDC@70amps **$2@**
R27AV3/SP/6000Ω2/ma **$2@**....6for$10

R14AU1 DPDT&SPNO/12VDC/10A **$2@** 6for$9
R18LE2 DPSTNO/70VDC/10A....**$1.50@**, 4for$5
R24GA2 SPST/5maDC/5A....**$1@**, 3for$2
R34GA5/B9 NO8NC/28VDC/10A....**$1@**, 3for$2
R42AC5 SPDT/28VDC/2A....**$1@**, 3for$2
R39CL3 DPDT/115YAC/2A....**$3@**, 4for$10

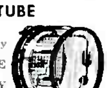
60mcs/85DB Gain IF STRIP W.E. Dsgn mfrd. by MOTOROLA contains 8/6AK5 & 1/6AL5 Tubes, Compact 2" W11 L 2 3/8 HGT. outpt JACK & COAXIAL INPT Plug Complete $14@, 2 for $25

450 MA CHOKE $3 @ Qtys. 10



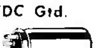
W.E. Mfgr for U.S.N. Rated 4Hy 450ma/3KV/27 ohms hermetic Sealed & Cased 4¼x3⅛x4⅛"x10 Lbs. #CH1001 SPECIAL $4@, 3for$10, 10for$30
TRANSFORMERS all 115V/60cy/1Φ PRIMARYS VAC H'Sealed PWR&FIL/U.S.N. 6V@8A/5V@3A&1200VCT @ 200ma. Tapped pri. 5H71.6"W....$7@, 5for$30
TP502/5500VCT@650ma/WST/USN....$39
TPF52/778VCT@200ma/5V@3A, 6.3VCT@5A $4@, 3for$11, 25for$70
TPF53/270VCT @ 50ma/6.3V@2A, $2@....4/$7
TPF54/150V @ 30ma/6.3V @ 1A, $1.49@....3/$4
TPF55/4.5KV@10ma/650VCT@275ma/6.4V@10A&5V@8A/2.5V@3A/HYPERSIL/OIL $7@....2for$12, 5for$25
TPF56/900VCT@35ma/2x2.5V @ 2A $3@, 2for$5
TPF57/2500@10ma/2.5V@2A....$4@, 3for$10
TPF58/5850, 5400, 5000VCT @ 40ma....$8@
TF01/2.5V@2A $1@, TF02/2.5VCT @ 10A/5KV $4@, 2for$7, 10for$29
TF03/2.5VCT@10A/12.5KV $7@, 2/$11;
TF4/24V@1A/$2@....4for$6, 100for$125
TF05/7.5VCT/12A/15KV KENYON....$7.50@
TF06/2X12V@2A/or 24V@2A $4@....2for$7
TPHI Isolation 110to220&440VAC/150W $4@.
MIL-T-27 TRANSF Hermetic Sealed
TFM10/6.3V/1.2A/$2: TFM11/5VCT@3A/6.3VCT@5A....$5@, 2for$9
TFM12/2x5V@3A/&2x5V@2A....$5@, 2for$9
TFM13/2x2.5V@6A at 3KV....$5@, 2for$9
TFM14/6.3VCT@9A/&2x6.3@1.2A, $6@, 2for$11
CHOKE 1000 Hys @5 ma/12KV Insulation $3@

SNOOPERSCOPE TUBE



INFRARED—SEE IN DARK
IMAGE Converter Hi Sensitivity 2" Dia.
Resolution up to 350l n/in TUBE & DATA $5@, 2for$18
PS2002B POWER 4500V SUPPLY Built $32

NEW VIBRATORS 6&12VDC Gtd.



FOUR PIN 6 or 12 volt $1.49@, 6for$8, 12for$15, 100for$110
4,5&6 pin 24/28V $1.49@, 6for$8
SPECIAL 25for$30

Isolation and Control Transformers

Indoor Power Circuit Type NEMA CASED Primary 230/460V & Secondary 115/230 V 1Φ 60 cys *NEMA Specs.

TPP050/50W	$10	TPP075/75W	$12
TPP100/100W	$13	TPP150/150W	$14
TPP250/250W	$17	TPP500/500W	$25
TPP750/750W	$32	TPP1000/1KW	$39
TPP2000/2KW	$59	TPP30000/3KW	$81

AIRCONDITIONING BOOSTER Transformers 104 to 115V TPB21/1Kva **$15**, TPB22/2Kva **$20**, 208 to 230V TPB23/1Kva **$16**, TPB24/1.5 Kva **$19**, TPB25/2Kva **$23**, PTB26/2.3Kva **$25**, TPB 3Kva/**$29**
Also 1-phase & 3-phase Booster Transformers. Discounts to Quantity Users.

THAT'S A BUY **"TAB"** THAT'S A BUY
Dept. 7E7 111 Liberty St., New York 6, N. Y., U.S.A. PH. RECTOR 2-6245 CABLE:"TABPARTS"

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order FOB N. Y. C. Add shpg. charges or for COD 25% Dep. Prices Subject to Change Without Notice.

INDEX TO ADVERTISERS

Want more information? Use post card on last page.

CLASSIFIED ADVERTISING

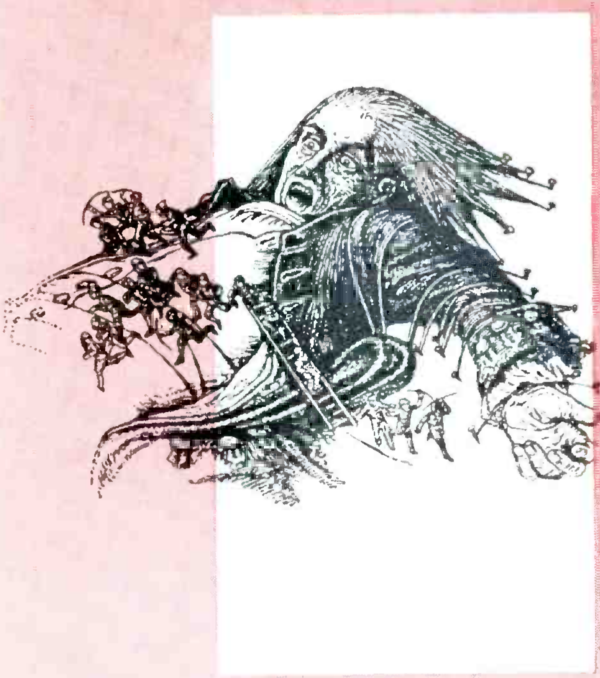
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES
ADVERTISERS INDEX

Want more information? Use post card on last page.

This index is published as a service. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

Size has nothing to do with accomplishment



Inside these fully encapsulated miniature precision wire wound resistors, Daven furnishes the solution to problems presented by space limitations. A new winding technique permits the use of extremely fine sizes of resistance wire to obtain two or three times the resistance value previously supplied on a miniature bobbin. This new development more firmly establishes DAVEN'S leadership in the field of miniature and standard size precision wire wound resistors.

Types and Specifications

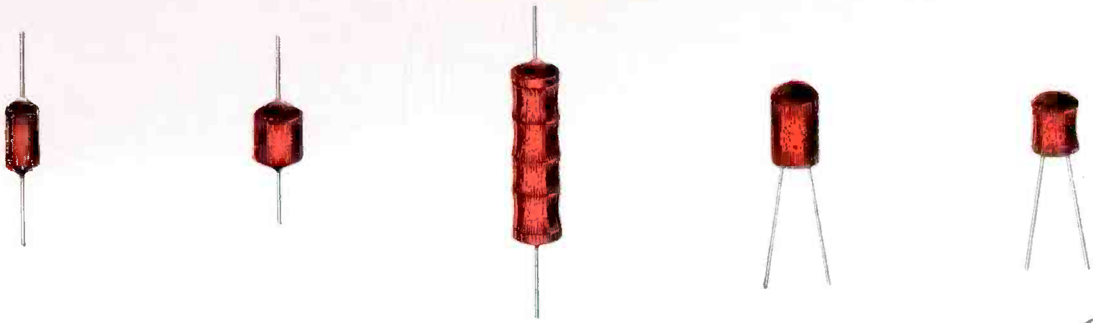
Type	Dia.	Length	Max. Res.	Wattage Rating	Terminals
1273	1/4	5/16	400K	.1	One End #22 Gauge
1283	1/4	5/16	400K	.1	Axial #22 Gauge
1274	3/16	3/8	100K	.1	Axial #22 Gauge
1284	1/4	27/64	.5 Meg.	.25	One end #20 Gauge
1192	1/4	1	1.0 Meg.	.75	Axial #22 Gauge

- Fully encapsulated.
- Meet and exceed all humidity, salt water immersion and cycling tests as specified in MIL-R-93A, Amendment 3.
- Operate at 125°C continuous power without de-rating.
- Can be obtained in tolerances as close as ±0.05%.
- Standard temperature coefficient is ±20PPM/°C.

Special coefficients can be supplied on request.

For maximum resistance in minimum space:

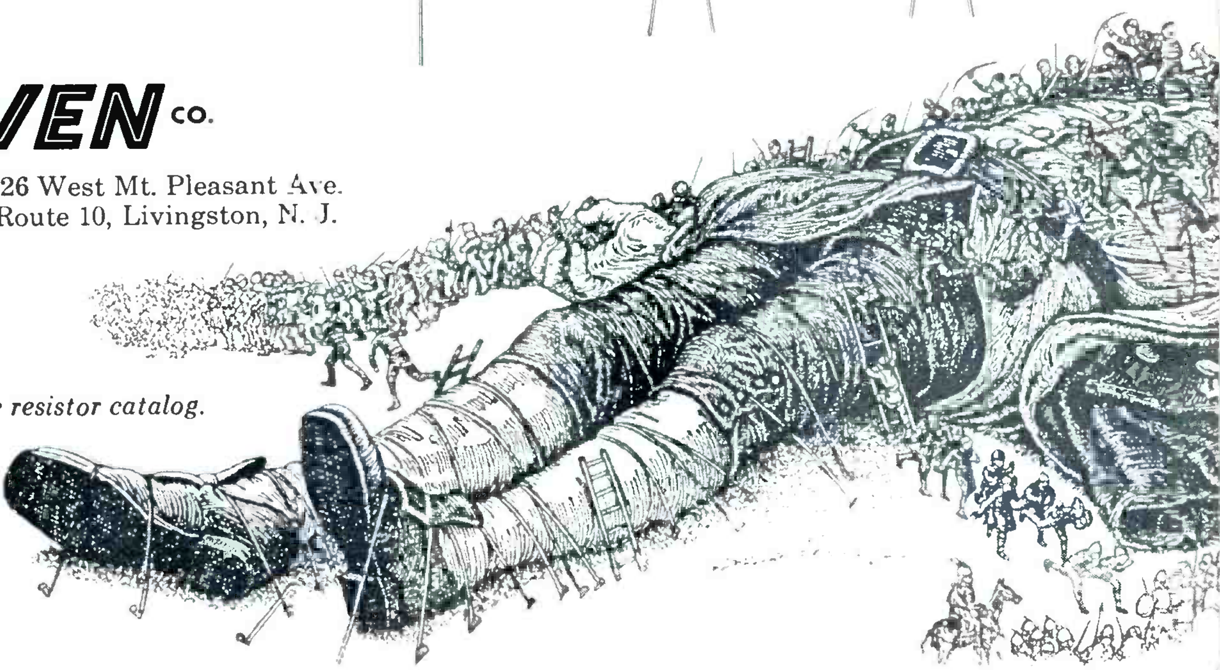
Daven's new winding technique cuts giants down to size



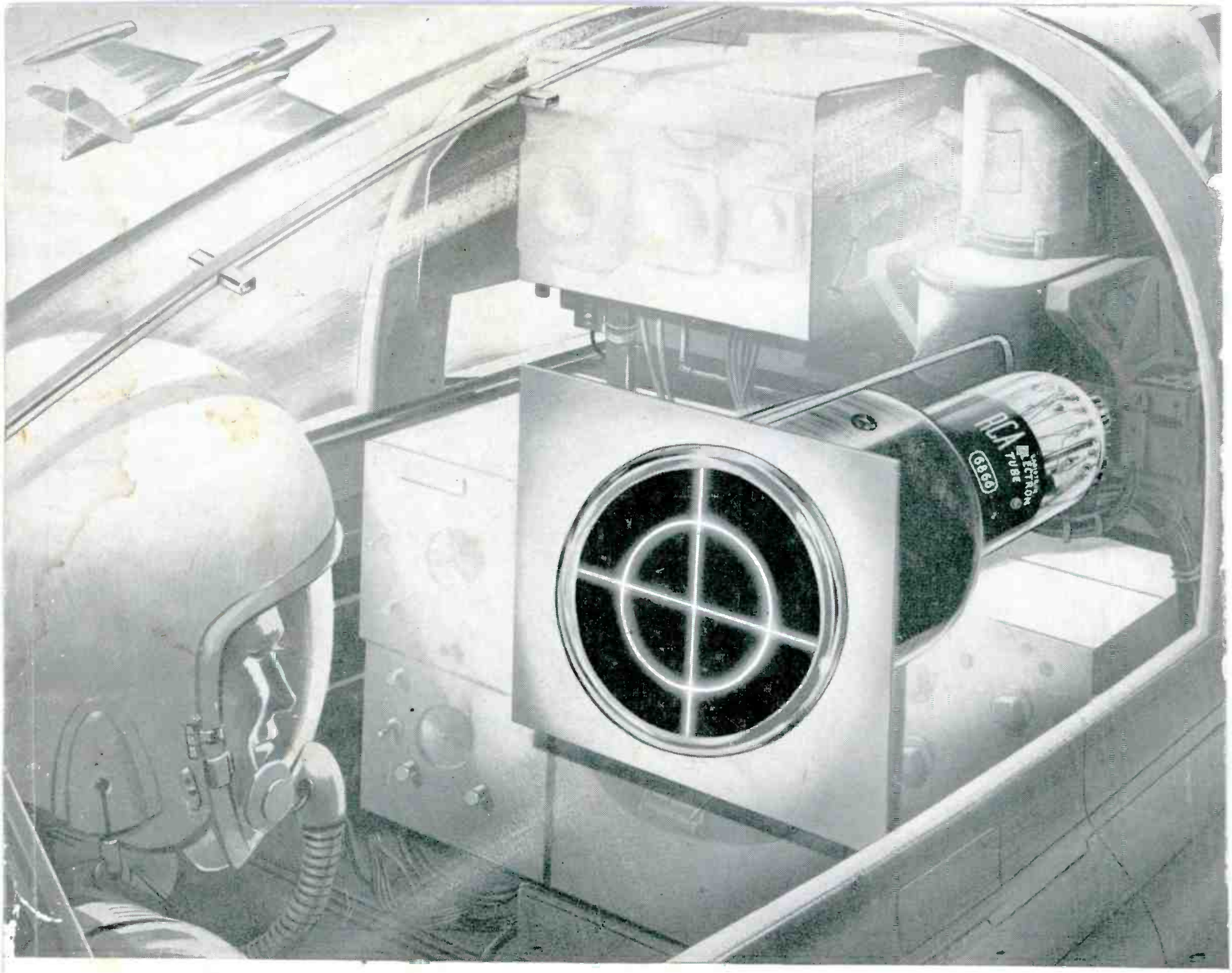
THE DAVEN CO.

526 West Mt. Pleasant Ave.
Route 10, Livingston, N. J.

Write for complete resistor catalog.



WORLD'S LARGEST MANUFACTURER OF ATTENUATORS



He "reads" his radar data...

IN BRIGHT DAYLIGHT

No hood needed for this presentation, because the RCA-6866 Display Storage Tube pictured here produces an average display brightness of 2750 foot-lamberts—brilliant enough to view directly in bright daylight!

In addition to its application in military electronics, RCA-6866 offers many exclusive features of special interest to equipment designers in the field of electronic data processing. For example, RCA-6866 can present non-flickering display of electronic information—for as long as 60 seconds after writing stops. It can "write" at speeds as high as 300,000 inches per second—fast enough to "freeze" microsecond transients for visual or photographic examination.

Are you working with airplane-cockpit radar—fire-control radar—airport surveillance—transient studies—data transmission, including half-tones—visual communications via narrow-bandwidth transmission? If you are, then don't overlook the unique advantages of the RCA-6866.

For technical bulletin on the 6866, write RCA, Commercial Engineering, Section G-19-Q-1 Harrison, N. J. For sales information on this and on other RCA display storage tubes now in development...contact the RCA Field Office nearest you.

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

Midwest: WHitehall 4-2900
Suite 1181
Merchandise Mart Plaza
Chicago 54, Illinois

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

RADIO CORPORATION OF AMERICA
Tube Division Harrison, N. J.