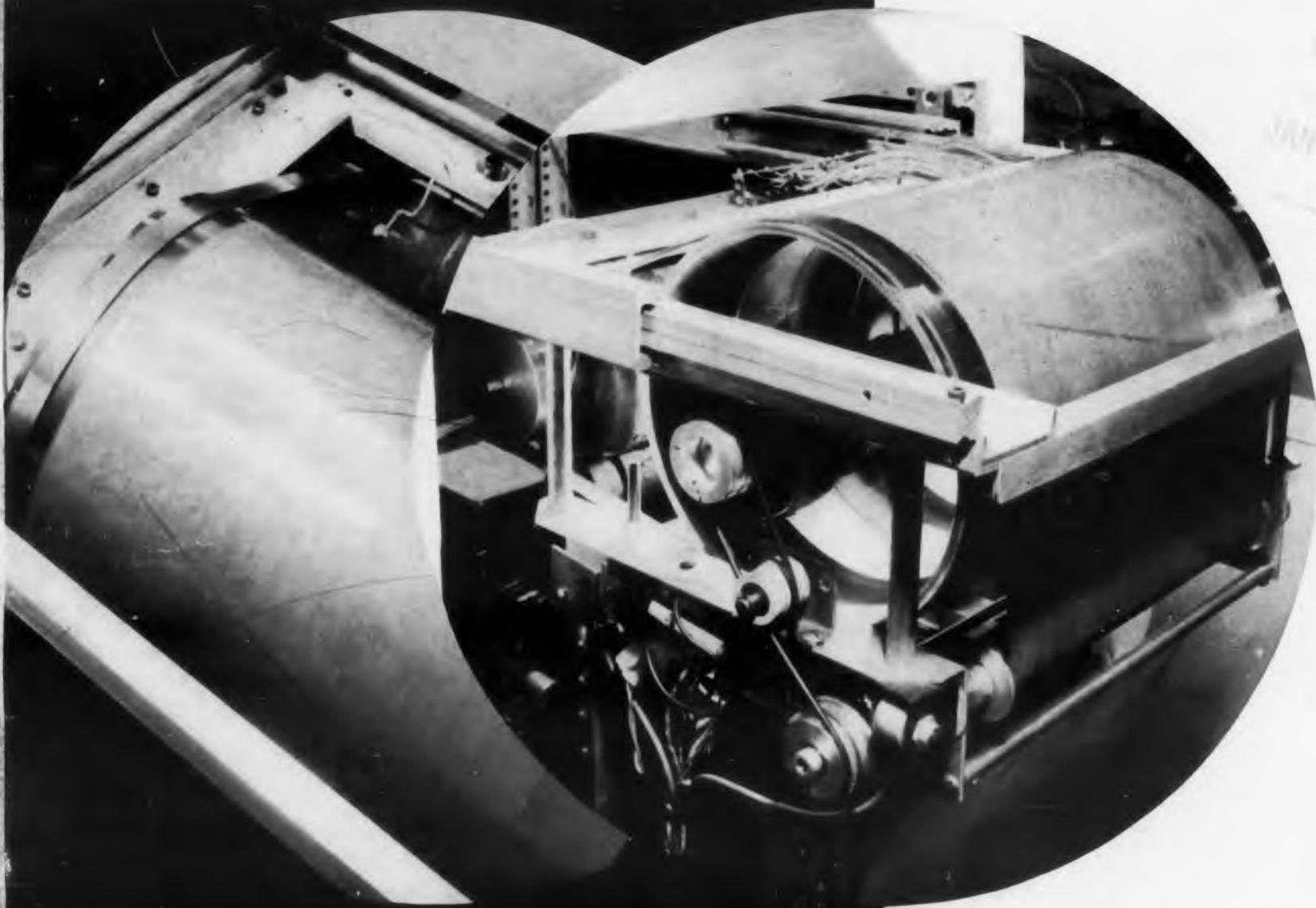


ELECTRONIC

DESIGN



Advantages of a drum and a tape recorder are combined in the Tapedrum whose recording section is shown here. A magnetic storage device, the Tapedrum has the rapid access normally available only in drums, as well as the storage capacity of magnetic tape recorders. Principle application for the Tapedrum is in data handling applications such as processing of test information.

January 1955



HERMETICALLY SEALED COMPONENTS



COMMERCIAL COMPONENTS



HI-FIDELITY TRANSFORMERS



FREEDSEAL TREATMENT



MINIATURE TRANSISTOR TRANSFORMERS



PULSE TRANSFORMERS



MINIATURE AUDIO TRANSFORMERS



LOW-FREQUENCY HI-Q REACTORS



TOROIDAL INDUCTORS



SUB-MINIATURE TOROIDS



HI-TEMPERATURE COMPONENTS



SLUG TUNED COMPONENTS



CHARGING REACTORS



HI-LEVEL PULSE TRANSFORMERS



SUB-MINIATURE HERMETICALLY SEALED COMPONENTS



STEP-DOWN TRANSFORMERS



POWER TRANSFORMERS



CHANNEL MOUNTING



PRECISION FILTERS



HIGH-Q REACTORS



SATURABLE CORE REACTORS



MAGNETIC AMPLIFIERS



1900 MAGNETIC A.C. VOLTAGE REGULATOR



1020-B MEGOHMMETER



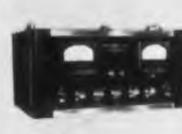
1010-A COMPARISON AND LIMITED BRIDGE



1110-A INCREMENTAL INDUCTANCE BRIDGE



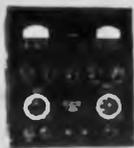
1150 UNIVERSAL BRIDGE



1210-A NULL DETECTOR AND VACUUM TUBE VOLTMETER



1140-A NULL DETECTOR-AMPLIFIER



1030-A LOW FREQUENCY "Q" INDICATOR



1620 MEGOHMMETER



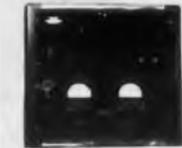
1870 INCREMENTAL INDUCTANCE COMPARISON BRIDGE



1040 A.C.-V.T. VOLTMETER



1060 VACUUM TUBE VOLTMETER



1560 DIFFERENTIAL VOLTMETER



1580 DB DECADE AMPLIFIER



1570 COMPARISON BRIDGE



1170 D.C. SUPPLY

While this page shows a representative group of Freed Products, it only indicates the vast facilities we have for engineering and advanced development. Our five plants are integrated in one area and are well coordinated from basic research to finished product. Solving difficult engineering problems is a challenge we are always ready to accept. Inquiries will be handled promptly.

SEND FOR COMPLETE TRANSFORMER AND INSTRUMENT CATALOGS



DECADE CAPACITORS



DECADE INDUCTORS



1410 DISTORTION METER



1950 NULL "T" FILTERS

FREED TRANSFORMER CO., INC.

1727 WEIRFIELD ST., BROOKLYN (Ridgewood) 27, N. Y.

Staff

Edward E. Grazda Editor
M. Mandell Associate Editor
J. A. Lipke Associate Editor
D. S. Viebig Assistant Editor
R. Graham Contributing Editor
J. M. Montstream Contributing Editor
G. C. Foster Editorial Assistant
M. L. Bradley Editorial Assistant
N. Asto Art Director
E. Dadinis Production Manager
P. L. Canfield Business Manager
J. B. Gilchrist Circulation Manager
A. Farnsworth Reader Service

Co-Publishers

T. Richard Gascoigne
James S. Mulholland, Jr.

Advertising Representatives

New York: T. Richard Gascoigne,
James S. Mulholland, Jr.
Blair McClenachan
19 East 62nd St.
New York 21, N. Y.
TEmpleton 8-1940

Chicago: Thomas P. Kavooras
664 No. Michigan Ave.
Chicago 11, Ill.
SUperior 7-8054

Los Angeles: Robert E. Ahrensdorf
1140 Wilshire Blvd.
Los Angeles 17, Calif.
MAdison 9-2681

Circulation Policy

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies.

If design for manufacturing is your responsibility, you qualify for a subscription without charge provided you send us the following information on your company letterhead: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineers are typical qualifying titles.

If you have a design responsibility not indicated by your title, add a description of those responsibilities.

Any job change requires requalification.

Hayden Publishing Company, Inc.
19 East 62nd Street
New York 21, New York

Back issues of **ELECTRONIC DESIGN**, when available, may be obtained at a charge of \$1.00 per copy.

◀ CIRCLE ED-1 ON READER-SERVICE CARD

C
Cov
Edi
Eng
Fea

Des

Dep

ELEC
York
Ralph
DESIG
the d
labor
1955
ELEC

ELECTRONIC

DESIGN

TK7800
E437

Vol. 3
No. 1
January 1955

Contents

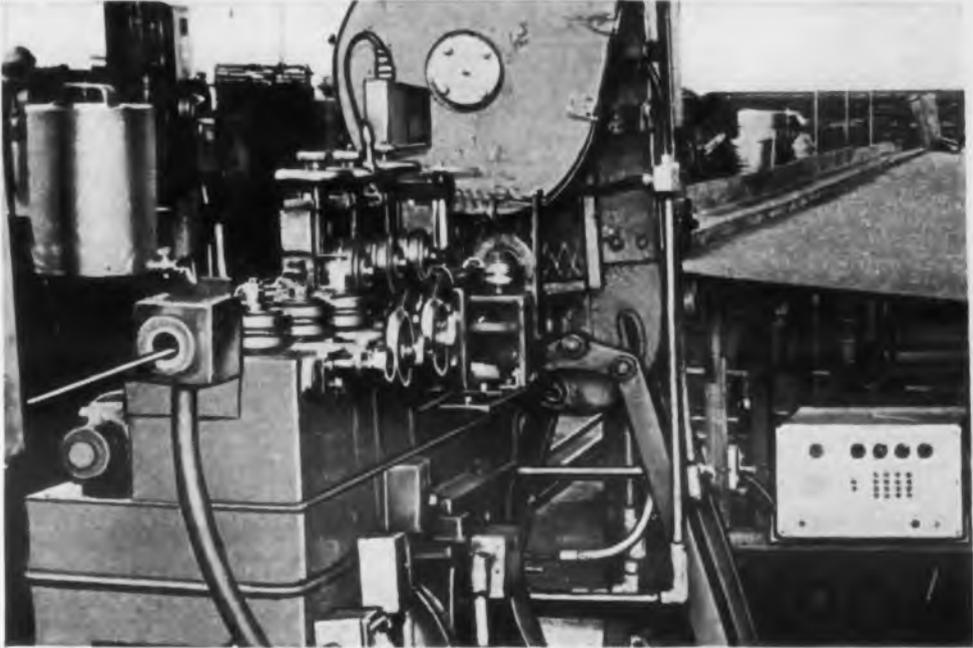
Cover	(see page 32)
Editorial	4
Engineering Review	5
Features	
Designing With Pulses, by Arthur Fitzpatrick	20
Multi-Tube Oscillograph	28
Low Output Impedance Transducer	30
High-Capacity Magnetic Memory	32
Long-Life Tubes	36
Ternary Counter	38
Printed Circuit Design: V—Applications, by George Maisch	40
Power Transistors	44
Experimental Encapsulation Technique, by George Quayle and Sherman H. Hubelbank	46
Tube Tester	50
Design Forum	
Audio Goes "Flat"	24
Printed-Circuit TV Chassis	34
Miniature AM-FM Radio	48
Departments	
New Products	52
New Literature	100
Books	110
Patents	114
Advertisers' Index	122

ELECTRONIC DESIGN is published monthly by Hayden Publishing Company, Inc. at 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer, and Ralph E. Marson, Secretary. Printed at Publishers Printing Company, New York, N. Y., ELECTRONIC DESIGN is circulated monthly without charge to men in the electronic industries who are responsible for the design and specification of manufactured devices, including development and design men of consulting laboratories and government agencies. Acceptance under section 31.64 P. L. & R. authorized. Copyright 1955 Hayden Publishing Company, Inc. 24,000 copies this issue.

BPA

NBP

JAN 26 1955



Model 144 Predetermined Electronic Counter permits cutting length selection to nearest inch by simple switch settings.

POTTER COUNTERS CONTROL REVERE COPPER and BRASS TUBE SHEARING with 0.1% ACCURACY AT 100"/SEC.

Revere Copper and Brass uses Potter counting equipment to automatically control tube shearing into precise, pre-selected lengths. The photoelectric detector generates a count impulse for each incremental length, and the predetermined electronic counter actuates the shear mechanism at the preset count.

Automation need not be complicated or expensive. Many users install Potter systems without interrupting production. Exclusive circuits assure long-lasting, trouble-free operation.

Send full details of your packaging or control problems today. Our engineers will be pleased to submit a detailed proposal. No obligation, of course.



Model 608 Photoelectric Detector. Disc makes 1 revolution per foot of tube travel. 12 holes provide counting in inches. Resolution of measurement can be increased if desired.

Potter

POTTER INSTRUMENT COMPANY, INC.

115 Cutter Mill Road, Great Neck, N. Y.

CIRCLE ED-2 ON READER-SERVICE CARD FOR MORE INFORMATION

For maximum resistance in minimum space!

NEW Lollipop Precision Resistor Davohm Type 1273

It's no trick at all with Daven's unique and extremely small size resistor to achieve ease of mounting in new printed circuit and transistor assemblies. The trick is **inside** this tiny unit . . . it's a completely new specialized winding technique developed by Daven, which enables them to use extremely fine sizes of resistance wire to obtain two or three times the resistance value that was previously supplied on a bobbin of this size.

Editorial

We Thought You'd Like to Know . . .

. . . that 1954 was a record year for **ELECTRONIC DESIGN**. Thanks to you, **ELECTRONIC DESIGN** now leads in advertising page growth and in reader requests . . . over 62,000 cards, more than 330,000 inquiries requesting information on more than 1100 electronic components and devices which we have featured. Since you have been reading **ELECTRONIC DESIGN**, the products of 1046 different companies serving the electronic industries have been brought to your attention.

New features: "Ideas for Design" . . . "Design Forum" . . . "Transistor Data Chart". Expanded editorial . . . new quarters . . . new advertisers. But even more gratifying has been your enthusiasm, your responsiveness, your continued interest and support. We hope that our appreciation will show itself to you in the pages of **ELECTRONIC DESIGN** during the months to come.

Sincerely,

T. Richard Gascoigne
James S. Mulholland, Jr.

You can't lick Daven's new wire-wound Lollipop Resistor

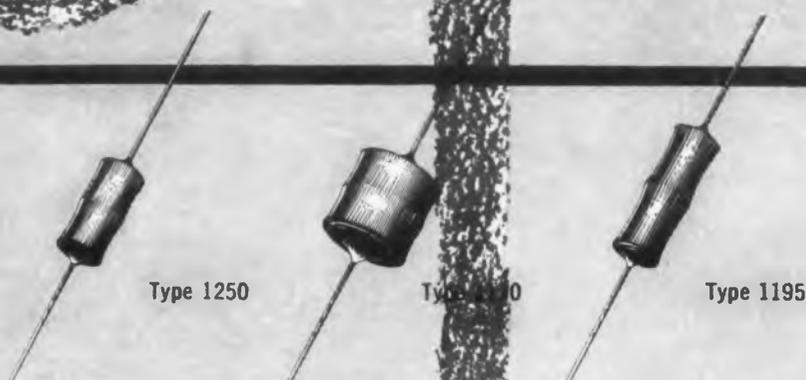
Only 1/4" in diameter by 5/16" long, yet is available in values as high as 400,000 ohms:

- * Fully encapsulated
- * Exceeds all humidity, salt water immersion and cycling tests as specified in MIL-R-93A
- * Exceeds all standard continuous power and de-rating
- * Can be obtained in tolerances as close as $\pm 0.02\%$
- * Standard temperature coefficient is ± 20 PPM/ $^{\circ}$ C. Special coefficients can be supplied on request

Below are shown miniature encapsulated Daven resistors part of the largest selection of precision wire-wound resistors available:

	Type 1250	Type 1170	Type 1195
Max. Ohms	450K	2 Meg.	760K
Dia.	1/4	1/2	1/4
Length	1/2	1/2	3/4
Max. Watts	1/8	1/3	1/4

All Daven resistors can be operated at 125 $^{\circ}$ C continuous power without de-rating.



Write for complete resistor catalog.



THE **DAVEN** CO.

191 Central Avenue, Newark 4, New Jersey

WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

◀ CIRCLE ED-3 ON READER-SERVICE CARD

Engineering Review . . .

For more information on developments described in "Engineering Review", write directly to the address given in the individual item.

Light Amplifier . . . The discovery of a special light-amplifying phosphor film has led to the development of an experimental light amplifier that amplifies as much as ten times. Discovered by D. A. Cusano of the General Electric Research Laboratories, the film verifies earlier theoretical studies that indicated such phosphors were feasible. Future uses for the amplifier may be in X-ray fluoroscopy, photography, "seeing-in-the-dark" devices, and "picture-on-the-wall" TV receivers (*ED*, September, 1954, p. 5).

The construction of the amplifier is illustrated right. In a demonstration, an ordinary lantern-slide projector was employed to provide the input picture, which was a photo slide. The amplifier's viewing screen gave off a faint glow when an ultraviolet light source was used in the projector. As the voltage applied to the 4" diameter screen was increased, the picture became brighter and clearer. During the over-all brightening of the projected picture, the contrast remained virtually unchanged, as shown by the photographs below. The demonstration also showed that applying voltage to the amplifier does not of itself cause the screen to give off light.

The light amplifier is the result of extensive research at the Laboratory in Schenectady, N. Y., on electroluminescence. Modulation of photoluminescence by an electric field has been previously reported by several scientists in both the United States and abroad.

Five Billion in 1954 . . . The electronics industry did an estimated \$5 billion business in 1954, Max F. Balcom, chairman of the board of directors, Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C., reported in a year-end statement. If related sales and services are included, such as set servicing and radio and TV broadcasting, the industry's dollar volume in 1954

would be nearer \$8 billion, he reported.

Military sales again represented about half of the business, Mr. Balcom noted. Deliveries of electronic equipment to the Armed Services were below the 1953 level by about 10% but probably represented a larger percentage of the total armament expendi-

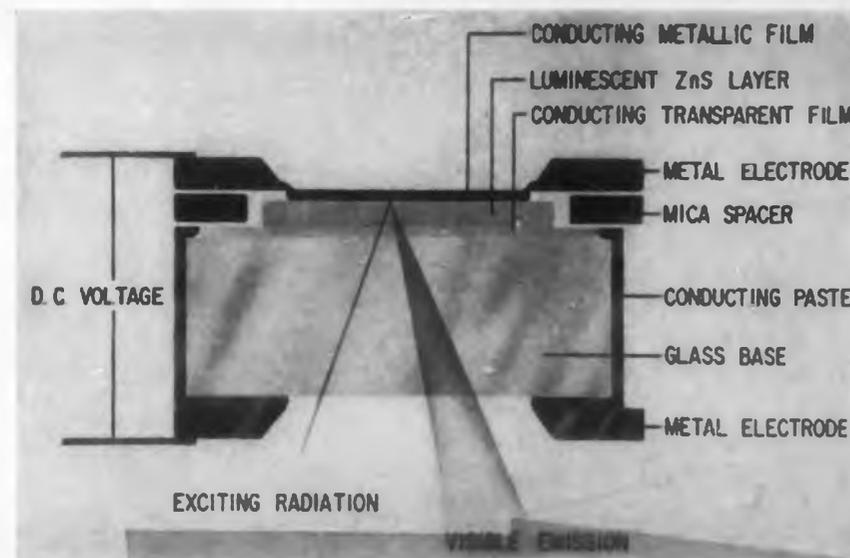
tures than for the previous year.

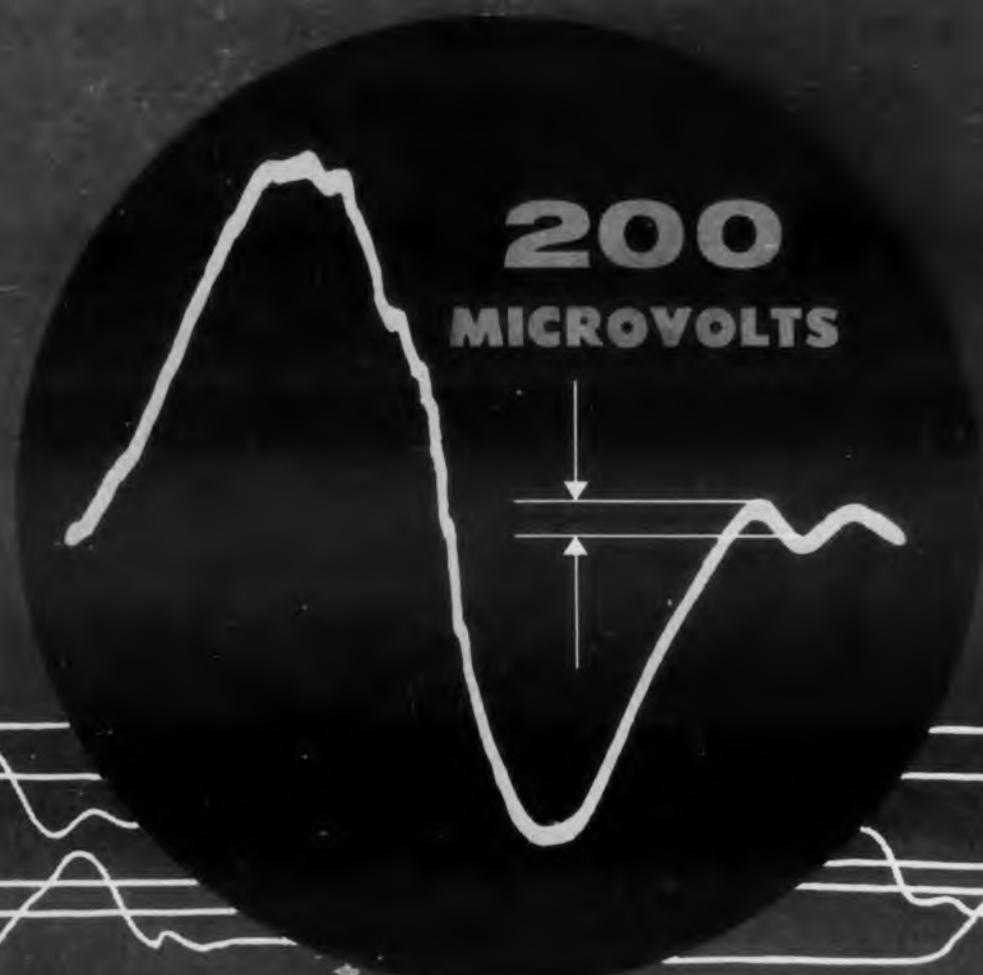
According to the report, the \$5 billion volume of industry factory sales in 1954, slightly under the 1953 total, breaks down roughly into the following categories: radio and TV sets, \$1225 million; phonographs, record players, etc., \$175 million; replacement parts and tubes, \$550 million; broadcast, communication, and industrial equipment, etc., \$550 million; military business, \$2500 million.

While final RETMA figures are not yet available, it seems that 1954 retail sales of TV receiver sets will be 7 million units and establishes a new record for the industry. Factory production of TV sets also rose to new weekly records in the fall. Radio receiver production and sales declined substantially despite continued high public interest in high fidelity-combination receivers.

While unit production and sales in 1954 were near record level, the profit picture for the industry as a whole was not so favorable as for 1953 due to sharp competition resulting in lower prices in the home entertainment equipment field and a narrowing of the base in military procurement.

Cross-section of the light amplifier. The photographs demonstrate the ability of the device to amplify light proportionally. The two exposures were taken with different voltages applied to the screen. The same lens, lens opening, and exposure time were used for both photos, and they were printed simultaneously.





Mortar-Detecting Radar . . . The development of a mortar-detecting radar, already battle proven during the Korean war, has been announced by the U. S. Army. Within a short time after an enemy mortar commences firing, the detector system relays its position to an artillery fire direction center. Artillery fire is then pin-pointed on the mortar.

Known as counter-mortar radar AN/MPQ-10, the device was jointly developed and designed by the U. S. Army Signal Corps and the Sperry Gyroscope Co., Div. of Sperry Corp., Great Neck, N. Y. Early production models were flown direct from the factory in time for front-line service in Korea. American ground forces in several theatres already are equipped with these detector systems.

The radar is compact and mobile, and can be towed by a light Army truck for quick movement in battle. The system consists of a large automatic radar tracker with dish-shaped antenna, a light-weight gasoline-powered motor-generator, a portable tracker mount resembling a 40mm gun carriage for mobility, and a separate remote control console. The control console, which contains the radarscopes and all controls used during operation of the radar, is about the size of a home TV-phonograph-radio console.

The modified gun carriage, illustrated above, mounts six major assemblies of the radar system, including elevation and range computers. Extension cables permit operation of the radar from positions more than 100' from the tracker, which tilts up or down and rotates in any direction.

Yarn Imperfection Counter . . . Electronic counting of yarn imperfections is possible with the use of a new instrument developed by Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio. The counter is accurate to speeds of 100 yards per minute.

A permanently positioned yarn handling mechanism accepts any size yarn package and all yarn sizes. The number of imperfections is read directly.



(ACTUAL SIZE PHOTO)

. . . and this amazing sensitivity is only one of many outstanding characteristics of the entirely new DuMont Type 324 cathode-ray oscillograph. New standards of stability, low noise and hum level assure full use of the Type 324 for d-c to 300 kc measurements even in the microvolt region. Furthermore, the Type 324 is completely calibrated to read time and amplitude directly. There are so many features incorporated in this new instrument we can't begin to give you the whole story here. Write us for complete specifications, or better still, ask for a demonstration of the

NEW DU MONT TYPE 324

For further information write to:

Technical Sales Department • ALLEN B. DU MONT LABORATORIES INC. 760 Bloomfield Ave., Clifton, N. J.

CIRCLE ED-4 ON READER-SERVICE CARD FOR MORE INFORMATION

Predictions for 1955 . . . The year 1954 has been "excellent" for the electronics industry from a production and sales point of view and 1955 ". . . has every promise of being equally good in production and sales and perhaps better in profits." This was the view of J. D. Secrest, executive vice-president of the Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C.

Both in civilian and military fields, more and more applications are being found for the products of the electronics industry, Mr. Secrest noted. Sales of TV receivers, high-fidelity phonographs, and radio-phonograph combinations are expected to increase.

Dr. W. R. G. Baker, vice-president and general manager, Electronics Div., General Electric Co., Syracuse, N. Y., also predicted that the electronics industry would continue its rapid development and advancement in 1955. As principal developments during the coming year, he named the trend to higher power in broadcasting; more TV stations, especially among those able to transmit network color programs; increase in TV set sales; advancements in radio chassis construction using printed wire boards; quantity production of general purpose transistors; new designs of germanium rectifiers; and increased use of mobile two-way radio communications.

High Power for Testing Equipment

. . . One of the largest generators of electronic power has been built with a power output of 20,000w. It will supply the power for vibration testing equipment for airplane components, completely assembled planes, missiles, rockets, and heavy machinery.

The power supply, which is made by LM Electronics, Inc., Los Angeles, Calif., can also be used for in-flight testing. Recordings are relayed to the ground through a telemeter system and then the recording is played back through the electronic power supply. A replica of the tested missile component is mounted on the shake table, and the testing equipment then duplicates the identical vibrations that occurred during the flight.

CIRCLE ED-5 ON READER-SERVICE CARD ➤

For
close control,
clean make and break,
leading manufacturers
specify . . .

Stevens Type C Thermostats



HERMETICALLY SEALED

STANDARD



If your product requires a high degree of temperature stability . . . if compactness is a must—specify Stevens Type C* thermostats. Since contacts open only when bimetal overcomes spring pressure and friction of bimetal against spring surface, electrically independent bimetal responds only to heat from controlled device—for a clean, positive break.

Another advantage is that Stevens makes the widest range of bimetal thermostats in the industry. This means that, in most cases, there is a production Stevens thermostat to fit your special requirements to open or close the circuit on any predetermined temperature rise from -75 to 600 F. So consult with Stevens when your product is in the design stage and assure better performance, longer life.

STEMCO

STEVENS

Manufacturing Company, Inc.
Stevens, N. J.

A 177

Magnesium Corrosion Resistance Higher . . .

A new impregnating process has increased magnesium's resistance to corrosion from 300% to 400%. "Magseal," as the process is called, was developed by the Nu-Line Plastic Impregnating Co., 3457 E. 15th St., Los Angeles, Calif., after two years of research. This process may prove to be an important step in furthering the use of both magnesium sheets and castings in modern industrial design and production.

In numerous industries, Magseal, a resin combination, can mean new applications for magnesium. With this increased corrosion protection around critical areas such as precision-fit spots where dissimilar methods touch, and in alloy castings with temperatures up around 450°F, much greater flexibility in the use of magnesium is anticipated.

High Plastics Demand . . . The plastics industry, especially for such plastics as polyethylene and polyvinyl chloride, should enjoy unparalleled markets in 1955, according to Dr. J. A. Neumann, president, American Agile Corp., 5461 Dunham Rd., Maple Heights, Ohio.

This prediction for sales increases is based on two factors. First, recent widespread use of polyethylene and polyvinyl chloride materials for self-supporting structural units to provide such benefits as reduced weight, inertness, resistance to corrosion, long functional service life, and comparatively low cost. Second, the introduction of irradiated polyethylene, which opens up new markets where plastics may be incorporated in components operating at temperatures up to 350°F without adverse effect to the plastics' basic properties. (*ED Sept., 1954, p. 11; April, 1954, p. 6*)

John Fritz Medal to H. A. Winne . . . Harry A. Winne, retired vice-president of the General Electric Company, has been awarded the 1954 John Fritz Medal by the four founding engineering societies. Mr. Winne was honored ". . . for service to his country in war and peace through his distinguished leadership in the electrical industry." The medal will be presented during the Winter General Meeting of the AIEE in New York City. Mr. Winne is the 51st winner of the medal, which was established in 1902.

TV with Bar Included . . . Some Italian TV receivers shown at the recent TV Fair in Milan, Italy, are equipped with bars and card tables, according to the *Du Mont Dispatch* of the International Div., Allen B. Du Mont Laboratories, Inc., Empire State Bldg., New York, N. Y. Fifty-five Italian TV manufacturers exhibited their products at the fair. It was not stated

PROVED

- PULSE TRANSFORMERS
- REACTORS
- RECTIFIER TRANSFORMERS
- FILAMENT TRANSFORMERS
- POWER SUPPLIES
- MODULATION TRANSFORMERS
- HIPERCORES

Those in industry who require the utmost in transformers for electronics can look to Moloney. Long famed for superior product dependability in industrial and utility applications, Moloney now offers this same product leadership to manufacturers of electronic equipment. To prove the point, Moloney has developed and installed the finest and most complete test facilities in the industry. Regardless of how exacting and unusual your requirements may be . . . Moloney can meet them . . . and prove it . . . by tests.

Engineering experience plus the most modern and complete manufacturing equipment combine with these testing facilities to produce products of unexcelled performance and dependability.

ME54-46



PULSE GENERATOR

This Moloney-built equipment is capable of testing charging reactors and pulse transformers at peak powers up to 40,000,000 watts over a wide range of pulse length and pulse repetition rates. It is used in production testing of pulse transformers and in pulse research.



RADIO INTERFERENCE AND CORONA TESTS

Isolation of units under investigation for interference-free operation is provided by this screened enclosure. Provisions for inter-winding and intra-winding corona threshold measurements while unit is under excitation are available.

M O L O N E Y E L E C T

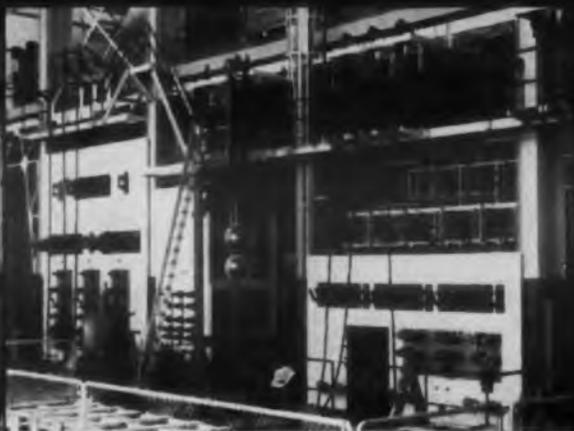
*Power Transformers • Distribution Transformers • Step Voltage
Load Center Transformers • Unit Substations • Network Transformers*

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST.

CIRCLE ED-6 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

BEST BY THE



TRANSFORMER TESTBOARDS

Testboards located throughout the plant provide facilities for testing ratio, core loss, impedance, exciting current, heating, induced voltage and high potential tests in accordance with NEMA, ASA and RETMA standards.



VARIABLE FREQUENCY REACTOR TESTBOARD

Reactors are tested under simulated operating conditions by applying rated alternating currents simultaneously with direct current. Incremental inductance, linearity and other factors relating to reactor quality are determined here.



SURGE GENERATOR

Transformers having impulse test requirements are accommodated in either of two modern surge generators. Standard impulse tests as well as special tests can be performed as required.



HIPERCORE TESTS

All HiperCores for use in electronic transformers are given final tests for core loss and exciting current at the appropriate frequency to insure top performance in the customers' application.

R I C C O M P A

*Regulators • Regulating Transformers • Load Tap Changing Tr
Constant Current Transformers • Capacitors • Transformers for*

LOUIS 20, MISSOURI AND TORONTO, ONTARIO

CIRCLE ED-6 ON READER-SERVICE CARD FOR MORE INFORMATION

EST



D. C. POWER SUPPLY LOAD TESTER

A wide range of rectifier transformers are load tested by this mobile rectifier load unit. Output voltage, regulation, heating and other factors are determined under actual load conditions.



PULSE GENERATOR

This pulse generator, having a peak power rating of 1,000,000 watts, is used to production test the smaller sizes of pulse transformers and all HiperCores for pulse applications.

N Y
Transformers
Electronics

NO, CANADA
TION



whether the card table was used when the set was off or only during commercials.

Recalling the early history of TV in the United States, the sets with bars are obviously intended for use in the Italian equivalent of the corner pub.

Never too Old to Learn . . . According to a poll of industrial, college, and business association leaders, conducted by Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia, Pa., approximately half of the nation's 60 million workers are engaged in some kind of educational training. This training consumes about 5 to 10 billion man-hours and is estimated to cost \$10 billion annually. It ranges from apprentice programs to college-type courses.

The overall business and industry training program has grown so big in the last decade that no one has been able to gather complete information on it, stated C. L. Peterson, vice-president of the division. However he estimated that about 15 million employees are receiving on-the-job training. Just how much training employees are getting outside the plant is an unknown. Business and education leaders have little idea how many employees are off-hour students in high schools and colleges.

Increasing the tempo of this training, Mr. Peterson said, is the need for higher type skills required by automation in industry. Apparently the worker has sensed this need and is taking steps to better his own position.

Computer Determines Low Bidders . . . Methods which utilize high-speed electronic computers for quickly and accurately determining low bidders on Government contracts have been developed by H. Bremer, L. Gainen, A. J. Hoffman and associates of the National Bureau of Standards, Washington 25, D. C.

First the various conditions imposed by the Government and the bidders for the contract are interpreted mathematically as problems in linear programming. On the basis of this analysis, one of the several linear programming procedures previously coded for the computer is applied to the data of the specific problem.

The computer chooses an award which satisfies the various restrictions but is not necessarily the least costly. The machine then searches for a cheaper allocation among bids submitted. If there is none, the answers corresponding to the award first selected are printed on the output teletype. If a cheaper allocation has been found, the computer substitutes it for the original award and begins again to search for a cheaper one. This process continues until no cheaper award can be found.

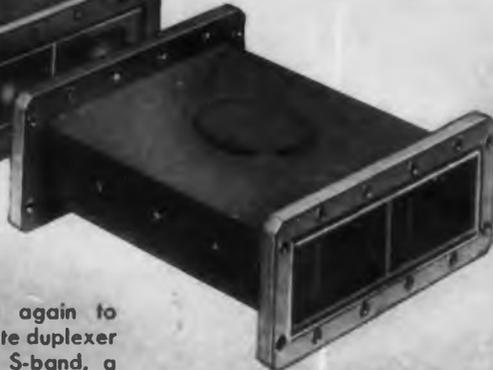
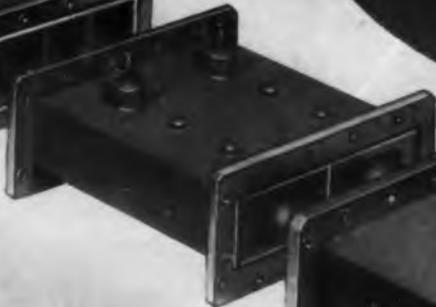
6378 . . . First again in the field of tube miniaturization, Bomac developed a new type TR tube designated the 6378. Designed specifically for airborne radar equipment, the 6378 is a miniaturized version of the 1B24A (another Bomac first), 1B60 and the 1B24. Size was cut in half, and weight was reduced by one fifth with no sacrifice in performance or efficiency.



1N23D . . . Bomac was the first to manufacture the 1N23D silicon diode. System designers, for the first time, could obtain a diode with greatly increased sensitivity and superior electrical characteristics in relation to existing types.



BL-25 . . . The BL-25 TR tube, designed and developed by Bomac, was the first cell-type tube system — engineered to withstand high power levels and maintain recovery time over a long period of life. The BL-25, although originally designed for a specific piece of equipment, has proven its versatility in various applications within the industry.



BL-58 . . . Bomac was the first to develop shutter tubes and integral TR-shutter combinations for continuous crystal protection. The BL-58 was the first integral TR-shutter combination developed by Bomac. With integral TR-shutter operation, bulky waveguide shutters could be eliminated at considerable savings in size and weight. This tube has now been superseded by improved models.

BL-87 . . . Now, Bomac is first again to introduce a new concept in complete duplexer operation. For the first time in S-band, a complete duplexer is offered to the industry. The BL-87 is a dual TR tube, complete with perfectly matched hybrids to assure maximum efficiency and long life. Systems designers can now be assured of reliable duplexer operation because Bomac's hybrids are designed specifically for their dual TR tubes. Bomac is first again in design and development of microwave tubes.

BOMAC DUAL TR DUPLEXERS			
Tube	Frequency (MC)	Tube	Frequency (MC)
6334	8490-9578	BL71	8500-9600
(BL-27)		BL78	8490-9578
BL29	9325-9425	BL87	2700-2900
BL35	15000-17000	BL507	8490-9578
BL47	9325-9425	BL600	8490-9578
BL60	5400-5900		

BL-509 . . . Bomac's BL-509 was the first complete duplexer offered in one compact unit. Combining a Bomac dual TR tube having integral shutters with two perfectly matched hybrid junctions in a single unit, the BL-509 provides duplexer operation and continuous crystal protection in one package. Light weight and compact, the BL-509 assures superior electrical performance and mechanical simplicity.



Bomac Laboratories, Inc.

2500 W. 12th St.
Cincinnati, Ohio 45228

TELEPHONE
513-763-1111

TELETYPE
513-763-1111

GAS SWITCHING TUBES · DIODES · HYDROGEN
THYRATRONS · DUPLEXERS · MAGNETRONS
MODULATORS · CAVITIES

1975 Predictions . . . Output per man-hour and resultant buying power will more than double by 1975, according to Dr. H. A. Leedy, Director, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Dr. Leedy believes that most guesses into the future are not as optimistic as they might be because they are based on thinking that is too conservative. He pointed out that spending for organized technological research in 1954 was stepped up even in the face of a slight business recession.

Of several scientific fields to receive greater research emphasis in the coming years, he mentioned nuclear energy, automation, electronics, and human engineering.

In electronics, he prophesied that much of the research will be devoted to maintenance. Printed circuits and the use of transistors will be important aspects of future research.

For the distant future, Dr. Leedy pointed to food technology as another field to undergo a transformation through research and development. He saw the ocean as an increasing source of food where great "farms" of plankton and algae one day might supplement inland harvests. Sonar could be used to detect the plankton.

Radio-Controlled Traffic . . . A proposed traffic light system in Chicago, Ill., will be controlled by signals transmitted by f-m radio instead of underground cable. Installation of the new system would avoid tearing up streets at great expense and inconvenience. Initially, traffic lights at 13 intersections will be radio controlled.

The radio antenna and transmitter for the system, which is being supplied by the General Electric Co., Syracuse, N. Y., will be located on top of the Board of Trade Building, the highest point in Chicago.

At pre-determined times each day, a master mechanism in the central control station will activate a tone signal. The signal will be carried by underground cable to the transmitter and broadcast to the lights. In the receiver, at each intersection that the signal is intended to control, will be a

◀ **CIRCLE ED-7 ON READER-SERVICE CARD**

corresponding tone switch, or decoder. Each decoder will select the signal designed for its intersection, and ignore those for other intersections.

The corresponding tone switch in the traffic light control box at the intersection will respond to the received tone signal by changing the program (the length of time of green, yellow, and red) of the traffic light.

Titanium Castings . . . Successful production of true centrifugal castings of titanium has resulted from research by Wisconsin Centrifugal Foundry, Inc., Waukesha, Wis., and Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Overcoming difficulties encountered in melting and pouring the metal—one of the major problems in designing parts using titanium—is regarded as a big step toward eliminating production bottlenecks. This was reported in the December, 1954, issue of *Industrial Research Newsletter*, published by the Foundation.

Weights and Measures Conference

. . . Among the accomplishments of the 10th General Conference on Weights and Measures, which met in Paris, France, October 5 to 14, 1954, was the adoption of a new definition of the thermodynamic or absolute scale of temperature. Definite progress was reported on a project to redefine the standard meter in terms of wavelength of monochromatic light from a single isotope, and the results of a recalibration of national standards of mass were considered.

Other subjects discussed, according to the National Bureau of Standards, Washington 25, D. C., included international comparison of electrical and photometric standards, redetermination of the force of gravity, intercomparison of international and national meter bars, definition of a more constant unit of time, and establishment of a standard value for normal atmospheric pressure.

CIRCLE ED-8 ON READER-SERVICE CARD ➤

9



0%

of those
"SPECIAL DESIGN REQUIREMENTS"

can be obtained
with standard items

from *Ketay*

FOR ECONOMY IN DESIGN... CHOOSE KETAY
... the complete line of synchros, servo motors, and resolvers.

SYNCHROS: From Size 10 to Size 37. There are units for every purpose including dual synchros as a control transmitter or a control transformer. Transolvers*—special purpose devices for use in converting 3-phase data into 2-phase data.

SERVO MOTORS: Ketay offers 400 and 60 cycle Servo Motors. High torque to inertia servos are available as small as a penny and up to Size 23. Torques of 0.1 in.-oz. to 7.5 in.-oz.

RESOLVERS: Another highly developed Ketay specialty, Ketay offers resolvers for all applications... from Coarse $\pm 0.2\%$ to Precision $\pm 0.05\%$. For use in computers, radar sweep circuits, phase shifters, and accurate transmission systems.

Ketay also manufactures a wide selection of aircraft, missile, marine, and ordnance instruments; and control systems.

Ketay has pioneered in the design of rotating precision instruments. For example, as design agent for Frankford Arsenal and the Bureau of Ordnance, Ketay designed the military Size 15, 16, 18, 19, 23, 31, and 37 synchros. The services of the Research and Development Division are available to you!

Other Standard Items Include:

Resolver Amplifiers
Magnetic Amplifiers
Gears and Gear Trains
Airborne Instruments



Ketay

555 Broadway, New York 12, N. Y.
Pacific Division
12833 Simms Avenue, Hawthorne, California

USE COUPON FOR COMPLETE INFORMATION ON KETAY PRODUCTS!

Ketay Instrument Corporation, 555 Broadway, New York 12, N. Y.

- Please send me bulletin on synchros, servos, resolvers.
- Please send me information on _____
- Please add my name to your mailing list.
- Please have a representative call.

Name _____

Company _____

Address _____

City _____ State _____

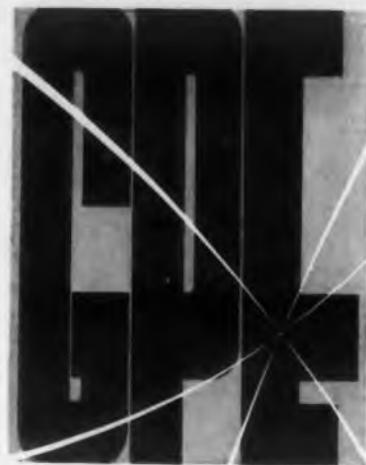
Computer Analyzes Oscillograph Data . . . Computing flight test data from oscillograph records has been speeded up 10 times by a semi-automatic-analog computer developed by Chance Vought Aircraft, Inc., Dallas, Tex. The computer has three assemblies, a position-sensitive tracing board, an analog computer, and a graphic recorder.

Oscillograph data is fed into the machine by following the outline of each trace on the roll with a special tracing head. The computer automatically plots a complete time history of each function analyzed on a chart drawn to the time and trace-amplitude scales most favorable for clear presentation. The time scale can be expanded or contracted or tracings widely separated on the oscillogram may be placed next to each other on the plotted chart.

Dr. Buckley Receives Edison Medal . . . Dr. Oliver T. Buckley, retired president of Bell Telephone Laboratories, Inc., has been awarded the 1954 Edison Medal by the American Institute of Electrical Engineers. The medal, one of engineering's major awards, will be presented to Dr. Buckley on Feb. 2, 1955, during the Winter General Meeting of the AIEE in New York, N. Y. Dr. Buckley was cited ". . . for his personal contributions to the science and art which have made possible a trans-Atlantic telephone cable; for his wise leadership of a great industrial laboratory; for outstanding services to the Government of his country." Dr. Buckley is the inventor of an ionization manometer, a mercury vapor aspirator, and a submarine telegraph cable.

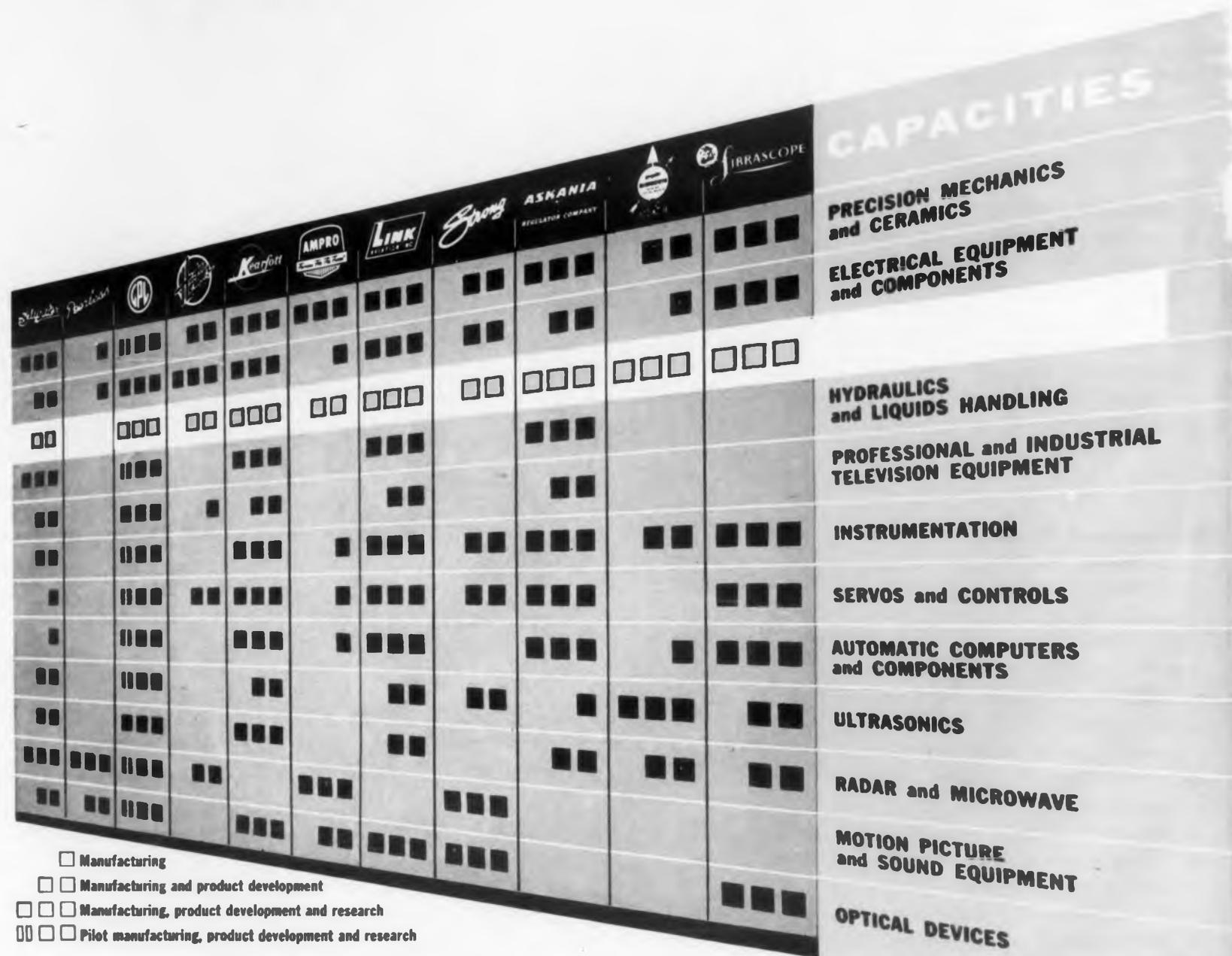
Remote Control Balancing Machine . . . All controls and unbalance indicators can be located at any distance from the

CIRCLE ED-9 FOR MORE DATA ►



SERVES INDUSTRY

THROUGH *coordinated* p



THE PRODUCING COMPANIES



Simplex

Peerless



INTERNATIONAL PROJECTOR CORPORATION—BLOOMFIELD, N. J.

J. E. MAULEY MFG. CO. CHICAGO

GENERAL PRECISION LABORATORY INCORPORATED—PLEASANTVILLE, N. Y.

THE HERTNER ELECTRIC COMPANY—CLEVELAND

KEARFOTT COMPANY, INC. LITTLE FALLS, N. J.

One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

d precision technology

GPE Coordinated Precision Technology is the basic GPE operating policy which inter-relates the research, development and manufacturing facilities, techniques and capabilities of the producing companies of General Precision Equipment Corporation. Thus each company's specialization in its particular areas of competence is supplemented by the application of the resources of the other companies, wherever relevant. A diversified line of advanced precision equipment of superior design and performance has resulted from this application of the newest and most advanced techniques possessed among the companies in every technical capacity.

e.g. in

ELECTRONICS

Ten of the GPE Producing Companies work in this important field. These companies were "born in electronics" and pioneered in its development before the word was coined. Their work covers every phase of electronics and GPE coordination relates each new electronic problem to the specialized knowledge and experience which is most valuable. This secures the optimum solution for the customer with minimum expenditure of time and money.

GPE Producing Companies have been re-

sponsible for the research, development and manufacture of a wide range of electronic precision components, equipment and systems, including Theatre Sound Systems, Sonar Equipments, Flight Simulators, Industrial Control Systems, Analogue Computers, Digital Computers and Components, Industrial and Studio Television, Navigation Systems—both airborne and marine. GPE systems, in most instances, are advanced concepts, often employing components specifically developed for the purpose by one of the GPE companies. Of the great number, two are shown.



Kearfott X-band Test Set, frequency range 8,500 to 10,000 MC; a unique all-purpose portable radar test set, comprising a power monitor, spectrum analyzer, wavemeter and signal generator which supplies an accurately calibrated signal of known level with variable amplitude and pulse-width combinations. Also provides FM, square wave and CW output.

Librascope X-Y Plotter and Recorder; automatically displays data derived from punch cards, mechanical or electronic computers or sensing elements; features rapid graphic 2-axis display with provision for 10-fold scale expansion and zero suppression. Used in aero-dynamic and electronic research, as well as in mass data reduction systems for business and industry.



Most advanced technological products which utilize electronics also call for other advanced technological skills. Though space allows only for an outline of GPE's work in electronics, both the capacities chart on the

facing page and most of the products mentioned above serve to suggest the broad coordination of technical capacities in all fields which exists as a result of GPE Coordinated Precision Technology.

Address inquiries to:

GENERAL PRECISION EQUIPMENT CORPORATION

92 GOLD STREET, NEW YORK 38, NEW YORK

body of a new static-dynamic balancing machine developed by the Tinius Olsen Testing Machine Co., 4044 Easton Rd., Willow Grove, Pa. The amount and angular location of unbalance in the work piece is indicated on two meters by the highly sensitive "Electodyne" electronic indicating system. Voltage take-offs are provided so that a permanent record of the unbalance readings can be made automatically on special recorders.

RETMA Cited . . . The Grand Award for large trade associations of the American Trade Association Executives has been presented to the Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C. The award was based on the outstanding service to the industry and the public performed by the National Television System Committee, headed by Dr. W. R. G. Baker, in the field of color TV. This committee was formed and operated under RETMA to develop color TV standards approved by the FCC.

Another Air Force TV Station

. . . Another package TV station designed for small-area operation at military bases has gone into operation at the U. S. military air transport station in the Azores (*ED*, September, 1954, p. 8). The peak visual output is 50w, which is fed into a simple ring type antenna with a gain of approximately 0.8. The signal may be transmitted about 10 miles, depending on receiving antenna height.

Dage Television Div., Thompson Products, Inc., Michigan City, Ind., makers of the packaged system, also foresee its use in other areas outside the United States which previously could not afford the high costs of erecting and maintaining a commercial TV station.

◀ CIRCLE ED-9 FOR MORE DATA



AMPRO CORPORATION
CHICAGO



LINK AVIATION, INC.
BINGHAMTON, N. Y.



THE STRONG ELECTRIC
CORPORATION—TOLEDO



ASKANIA REGULATOR
COMPANY—CHICAGO



BLUDWORTH MARINE
NEW YORK



LIBRASCOPE, INCORPORATED

Here's What's New in Vitamin Q[®] Capacitors



Now you can have Sprague's famous subminiature paper capacitors in new styles that make vibration-proof mounting simple . . . make harness wiring faster. New straddle milled flats on standard threaded neck units let you insert the neck in flatted openings. A simple nut and lock washer permanently locks the capacitor to the chassis. In addition, you can now obtain Sprague subminiature paper capacitors with solder tab terminals, eliminating the problem of splicing leads to wires. Insulating outer sleeves for 125°C mounting are also available.

Sprague's Vitamin Q capacitors are available in ratings and mechanical designs far beyond

those called for in specification MIL-C-25A. For example, both inserted tab and extended foil designs are available in working voltage ratings up to 1000 vdc.

Positive hermetic closure is assured by glass-to-metal solder seals, which unlike rubber compression-type terminals, cannot be twisted during wiring assembly.

Complete information on Sprague subminiature paper capacitors in all thirteen case styles, is provided in Engineering Bulletin 213C, available on letterhead request to the Sprague Electric Company, 347 Marshall Street, North Adams, Massachusetts.

WORLD'S LARGEST CAPACITOR MANUFACTURER

SPRAGUE

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

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

NEW

subminiature paper capacitor mounting styles speed and simplify circuit assembly with—

- **Flatted Necks**
 - **Solder Tab Terminals**
 - **Insulating outer sleeves**
- for 125°C applications**

Eta Kappa Nu Awards . . . Ruben F. Mettler, 30, of the Hughes Aircraft Co., Culver City, Calif., has been named the outstanding young electrical engineer of 1954 by Eta Kappa Nu. Formal presentation of the award will take place at the annual banquet of the society, Jan. 31, 1955, during the Winter General Meeting of the AIEE in New York City.

Mr. Mettler was voted the outstanding young engineer ". . . by virtue of his outstanding planning and development of air defense control systems, his participation in civic affairs, and his various artistic attainments . . ."

Certificates of honorable mention have been awarded to Lindon E. Saline and Leon K. Kirchmayer, General Electric Co., Schenectady, N. Y.; Edward E. David, Jr., Bell Telephone Laboratories, Inc., Murray Hill, N. J.; and Jackson F. Fuller, General Electric Co., Denver, Colo.

The award, which was first made in 1936, is given annually to an outstanding electrical engineer who has been out of college not more than 10 years and who is not more than 35 years old, in recognition of his technical achievements and for meritorious service to his fellow men.



Silicon Carbide Varistors

All home telephones now being manufactured by Western Electric Co., Indianapolis, Ind., for the Bell Telephone System incorporate these silicon carbide varistors. They are used to control the flow of current to the sets to insure equal signal strengths no matter how far each set is from the central office. The silicon carbide crystal is supplied by Norton Co., Worcester, Mass.

Color TV Service Publication . . . To assist manufacturers of color TV receivers in carrying out individual educational programs for the benefit of their field technicians and distributors and the nation's servicing industry, the RETMA Service Committee has published a booklet, "Fundamentals of Color TV for Service Technicians." The publication is intended for use with lectures that present the technical features of color TV.

Small Data Processing Computer . . . "Miniac", a small low-cost electronic computer using a magnetic tape capsule, has been termed completely adequate for most data processing by G. B. Greene, president, Marchant Research, Inc. Speaking before the Eastern Joint Computer Conference, Mr. Greene declared that the "giant brain" type of electronic computer embraces computation of a complexity out of proportion to the needs and importance of the usual data to be processed by most businesses.

Manufactured by Marchant Calculators, Inc., Emeryville, Oakland, Calif., "Miniac" uses a magnetic tape capsule as the source of data fed into the computer. The magnetic tape would carry as much data as could be prepared in 22 hours of manual typing. It would permit automatic operation of the computer. The computer may be used with present data source combinations as well as the single tape system.

Tiny Radio Transmitter . . . Mounted in the nose of a 20mm projectile, the tiny radio transmitter illustrated below must stand acceleration shocks to 30,000g. The plastic-encapsulated unit incorporates transistors and is powered by a mercury cell smaller than itself. Known as the "20mm spin sonde", it will have special importance in studies of projectiles using fins as a means of providing spin in flight.

Use of telemetering devices, such as the new transmitter, previously had been limited to projectiles larger than 20mm. The new unit was designed in the Electronics System Branch, Technical Evaluation Dept., U. S. Naval Ordnance Laboratory, Silver Springs, Md., by Roy J. Smollet, Chief, VT Fuze Section. The transmitter will aid in eliminating unsuitable models before they get into pilot production as full-size weapons.

As used on the ballistic ranges, the device transmits signals of uniform amplitude. However, the amplitude appears to vary because of changes in orientation of the transmitter antenna in relation to the receiving antenna. The receiving antenna is installed along the path of the projectile.



Only 1" long, this plastic encapsulated transmitter has an even smaller mercury battery beside it. The transmitter and 200hr cell fit into the nose of the illustrated projectile.

NEW!

Two more PLUG-IN UNITS for Tektronix Type 531 and 535 Oscilloscopes

Type 53E Low-Level Differential Preamplifier

50 microvolt/cm to 10 millivolt/cm calibrated sensitivity. Frequency response, 0.06 cycles to 60 kc. Rejection ratio, 80,000 to 1 for in-phase signals at full gain. 7 μ v rms maximum combined noise and hum with input grids grounded at the input connector \$165



Type 53G Differential Wide-Band DC Preamplifier

DC to 10 mc, risetime 0.035 μ sec. 0.05 v/cm to 20 v/cm calibrated sensitivity. Separate step attenuators for both inputs. Better than 100-to-1 common-mode rejection at full gain for the entire passband \$175



A new micro-sensitive preamplifier, Type 53E . . . and a new wide-band differential preamplifier, Type 53G . . . greatly expand the working range of Type 531 and Type 535 Oscilloscopes. Application areas entered with

these new plug-in units ordinarily require the acquisition of cumbersome auxiliary equipment or separate specialized oscilloscopes. But you can equip your Type 531 or Type 535 for either or both types of work for just the cost of the plug-in unit . . . without loss of performance in its other applications. *Your Type 531 or Type 535 becomes potentially more useful to you each time Tektronix announces a new plug-in unit.*

OTHER PLUG-IN UNITS

- Type 53A** — DC to 10 mc, 0.035 μ sec risetime; 0.05 v/cm to 50 v/cm, calibrated \$85
- Type 53B** — Same as Type 53A with additional calibrated ac-sensitivity to 5 mv/cm \$125
- Type 53C** — Dual-trace unit. Two identical amplifier channels, dc to 8.5 mc, 0.05 v/cm to 50 v/cm. Electronic switching triggered by oscilloscope sweep . . . or free running at about 100 kc \$275
- Type 53D** — Differential input, high gain. DC to 350 kc at 1 mv/cm — passband increasing to 2 mc at 50 mv/cm. Full range — 1 mv/cm to 125 v/cm \$145

OSCILLOSCOPE CHARACTERISTICS

Advanced Cathode-Ray Tube
Entirely new metallized crt provides full 6cm x 10cm undistorted viewing area . . . 50% more vertical deflection than previous high-sensitivity tubes. 10 kv accelerating potential permits single-sweep photography at the fastest sweep speed.

Wide Range of Triggered Sweeps
0.02 μ sec/cm to 12 sec/cm, continuously variable. 24 calibrated sweeps from 0.1 μ sec/cm to 5 sec/cm, accurate within 3%. Accurate 5-x magnification.

Wide-band Output Amplifier
DC-coupled amplifier designed for use with all Type 53-series Plug-in Units.

Balanced Delay Network
0.25 μ sec signal delay in vertical amplifier.

Sensitive Horizontal Amplifier
0.2 v/cm to 20 v/cm sensitivity.

Versatile Triggering
Internal or external, with amplitude level selection or automatic triggering.

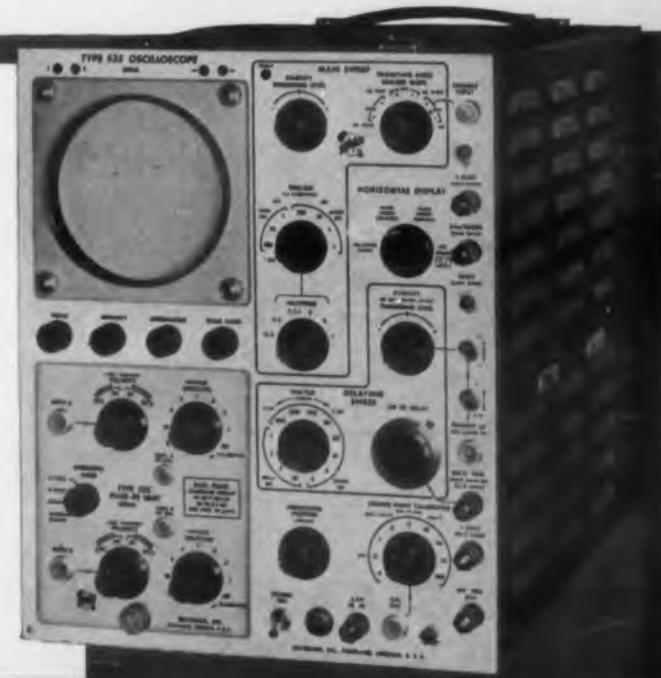
Square-Wave Amplitude Calibrator
0.2 mv to 100 v in 18 steps, accurate within 3%.

DC-Coupled Unblinking

CRT Beam Position Indicators

Electronic Voltage Regulation

Write for A-101, free 12-page specification booklet



TYPE 535

➡ Your Tektronix Field Engineer or Representative will gladly arrange a demonstration at your convenience . . . call him today.

Tektronix, Inc.

P. O. Box 831W • Portland 7, Oregon
CYpress 2-2611 • Cable: TEKTRONIX



Type 531 — \$995 plus price of desired plug-in units.

Type 535 — Same characteristics — plus delayed sweeps, 1 μ sec to 0.1 sec calibrated delay in 12 ranges, incremental accuracy within 0.2% of full scale. Conventional or triggered operation \$1300 plus price of desired plug-in units. Prices f.o.b. Portland (Beaverton), Oregon

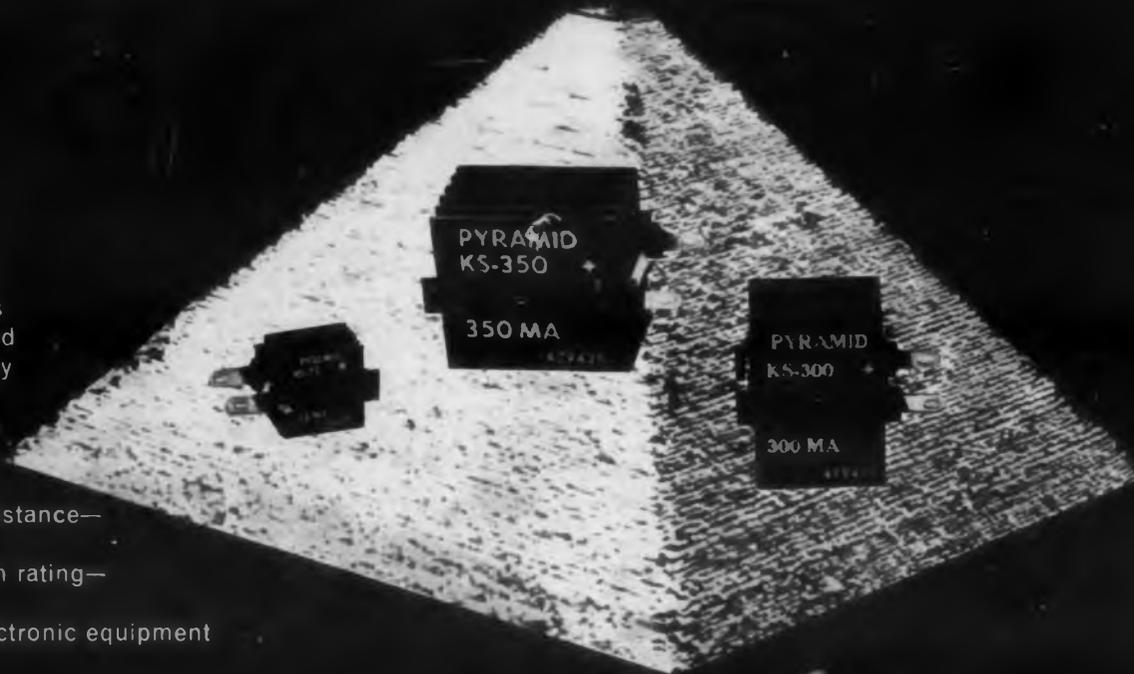
CIRCLE ED-11 ON READER-SERVICE CARD FOR MORE INFORMATION

the first NEW DESIGN of selenium rectifiers IN OVER 20 YEARS

Kool-Sel
Pat. pend.
by PYRAMID

No center mounting
Full air ventilation between plates
Light contact and constant assembly pressure
No center hot spots
Lightest weight per unit of output power
Lower initial forward resistance—better voltage regulation
Smaller overall size for each rating—cost no more
Better for all electrical and electronic equipment because of

- Improved convection cooling
- Simpler mounting
- Longer life and minimum aging
- Designed for more rugged service and rated for use in high ambient temperatures



Kool-Sel **Important**
is the rectifier
most readily adaptable to
printed circuit applications.

Because of the fixed edge mount yoke, assembly requires only one whistler die, one hole fixed, one hole variable to three dimensions. For complete information write

RECTIFIER DIVISION

 **PYRAMID ELECTRIC COMPANY** North Bergen, N. J.

Inventor Honored . . . Marvin Camras, inventor of modern magnetic recording, will be presented the John Scott Award for scientific achievement on Jan. 31, 1955, at the Hotel Statler, New York, N. Y. Since the establishment of the fund by John Scott in 1816, periodic awards have been made to inventors whose accomplishments ". . . definitely add to the comfort, welfare, and happiness of mankind." Mr. Camras' discoveries in magnetic recording are used in radio broadcasting, memory units for high speed electronic computers, instrumentation, guided missiles, and many others. Mr. Camras is senior physicist at Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Computer for Refinery . . . A high-speed electronic digital computer called "Mobilac" is being installed at the Socony-Vacuum Oil Co. Research and Development Laboratories, Paulsboro, N. J. It will figure out how to set the valves and fire the stills in an oil refinery to achieve most efficient operation.

Another Mobilac will be installed soon at the Field Research Laboratories of Socony-Vacuum's affiliate, Magnolia Petroleum Co., Dallas, Tex., where it will be used to solve problems relating to crude-oil exploration and production. Both of the computers are made by the ElectroData Corp., Pasadena, Calif.

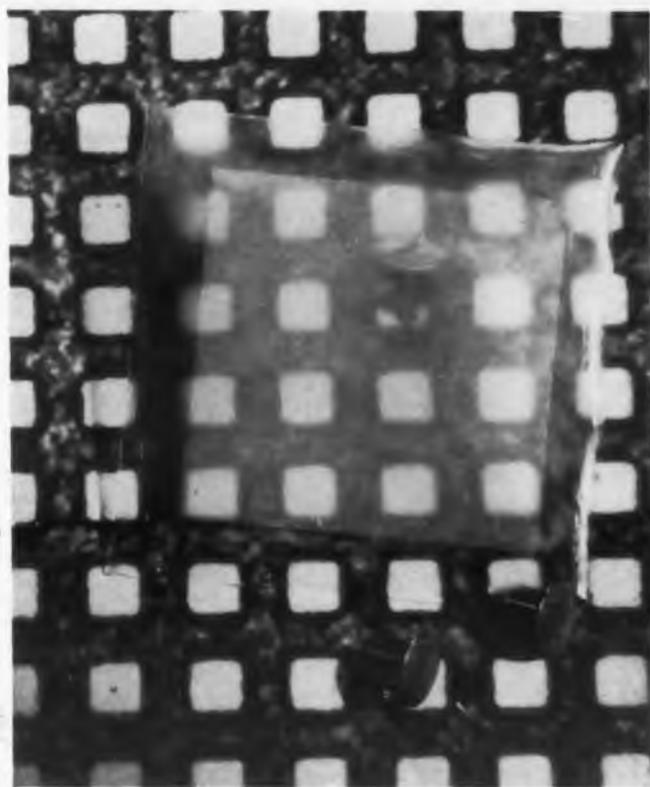
Exchange Program . . . Fellowships are available for the summer of 1955 for college professors who wish to devote six weeks to an on-the-spot study of a business firm. The College-Business Exchange Program for 1955 has been announced by Dr. W. M. Curtiss of the Foundation for Economic Education, Inc., Irvington-on-Hudson, N. Y. From the applications received, the Foundation gives the companies a list of candidates for the summer visit. The company then selects the Fellows they want and pays each \$500, plus transportation to and from their homes. Applications for fellowships must be received not later than Feb. 15.

◀ CIRCLE ED-12 ON READER-SERVICE CARD

Radio Interference Problems . . . The nation's complex weapons system will be affected seriously by how successfully the problems of radio interference are solved, according to John W. Klotz. Mr. Klotz, secretary of the advisory panel on electronics to the Assistant Secretary of Defense for research and development, spoke at the recent Radio Interference Reduction Symposium sponsored by the Department of Defense and Armour Research Foundation.

Most of the post-war advances in weapons are dependent upon complex electronic systems that often jam because of radio interference, Mr. Klotz explained at the 2-day meeting held at Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill. Some of the weapons that could be affected, he stated, were the Nike anti-aircraft missile, the continental air warning network, the new bombing system used by the Strategic Air Command, and jet interceptors.

In explaining the Defense Department's program for reducing radio interference, Mr. Klotz said that every area of equipment development had undergone some phase of the interference study to insure that the equipment would operate effectively in the field.



Glass Screens

This small glass screen, shown against a background of a microphotograph of itself, contains 200,000 accurately spaced holes so small they cannot be threaded with a human hair. The 300-mesh screen is used in cathode ray tubes and offers sharper definition and simplifies manufacturing. The screens, developed by Corning Glass Works, Corning, N. Y., are made from "Fotoform" glass, which is a photo-sensitive glass that can be formed and cut with photographic precision.

KEPCO

Presents 2 New VOLTAGE REGULATED POWER SUPPLIES

KEPCO Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions within the range of the instrument.

REGULATION: As shown in table for line fluctuations from 105-125 volts and load variations from minimum to maximum current.

SPECIAL FEATURE: Provision is made for picking up the error signal directly at the load, compensating for the voltage drop in external wiring.



Model 2600

OUTPUT	VOLTS	CURRENT	REGULATION	RIPPLE
1	0-60	0-2 Amp.	5 Mv.	1 Mv.

Model 2650

OUTPUT	VOLTS	CURRENT	REGULATION	RIPPLE
1	0-60	0-5 Amp.	5 Mv.	1 Mv.

30 MODELS

AVAILABLE FROM
STOCK. COMPLETE
CATALOG ON REQUEST

WRITE DEPT. 135



KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, N.Y. • INDEPENDENCE 1-7000

CIRCLE ED-13 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

January 17-19: High Frequency Measurements Conference, Hotel Statler, Washington, D. C. Sponsored by AIEE and IRE. One-hundred-word abstracts of papers to be submitted should be sent to the chairman of the appropriate session listed as follows: Frequency and Time Measurements, Dr. B. M. Oliver, Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.; Power and Attenuation Measurements, E. W. Houghton, Bell Telephone Laboratories, Murray Hill, N. J.; Impedance Measurements, Dr. D. D. King, Johns Hopkins Univ., Baltimore, Md.; and Measurements in Transmission and Reception, B. Parzen, Olympic Television and Radio Co., 34-01 38th Ave., Long Island City 1, N. Y. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

January 20-21: Printed Circuit Symposium, University of Pennsylvania, Philadelphia, Pa. Sponsored by the Engineering Dept., Radio-Electronics-Television Manufacturers Association. Tentative subjects of the six sessions are: "Product Design Applications"; "Reliability and Serviceability"; "Management Considerations"; "Techniques of Producing Printed Wiring Boards" (panel session); "Printed Components and Components For Use With Printed Wiring"; and "Production Techniques and Manufacturing Methods". Submit papers to and request information from Donald E. Cottle, General Electric Co., Electronics Park, Syracuse, N. Y.

January 23: Industrial Amateur Electronics Show, Park Sheraton Hotel, New York, N. Y. For information, write to Arrow Electronics, 65 Cortlandt St., N. Y. C.

January 31-February 4: AIEE Winter General Meeting, Hotel Statler, New York, N. Y. For information, write to AIEE, 33 West 39 St., New York 19, N. Y.

February 8-10: Reinforced Plastics Division Conference, Hotel Statler, Los Angeles, Calif.

February 17-18: Transistor Circuits Conference, Univ. of Pennsylvania, Philadelphia, Pa. Sponsored by IRE Professional Group on Circuit Theory, and AIEE Science and Electronics Division. For information, write to IRE, 1 E. 79 St., New York 21, N. Y.

March 1-3: Western Computer Conference, Hotel Statler, Los Angeles, Calif. Sponsored by IRE, AIEE, and Association for Computing Machinery. Will include exhibits by computer manufacturers. For information, write to William Gunning, International Telemetry Corp., 2000 Stoner Ave., Los Angeles 25, Calif.



RAYTHEON FLAT PRESS SUBMINIATURE TUBES provide freedom from catastrophic glass failures. The Flat Press is your Seal of Reliability.

Raytheon has 15 years experience in manufacturing over 10,000,000 Flat Press Subminiature Tubes.

The Record shows:

Operation Life. Only 0.0017% glass failures per hundred hours life — only one failure per 6,000,000 tube hours in 4,200 Raytheon Flat Press Subminiature Tubes operated for 10,000 hours each during the past nine years as part of Raytheon's quality control procedures.

Shelf Life. Less than 0.05% failures for glass envelopes and seal defects out of 151,600 Raytheon Flat Press Subminiature Tubes subjected to six years of shelf life. No other known tube design has equalled this performance.

RAYTHEON'S FLAT PRESS SEAL offers these time-proven advantages over conventional miniature tube metal-to-glass seals.

- Longer length of lead sealed to glass.
- The lead material matches the coefficient of expansion of the glass throughout the entire seal length. No nickel is

sealed into the glass thus eliminating one of the major sources of button cracks.

- Flexible leads on Raytheon's Flat Press Subminiatures permit socketing without stressing the glass seal.
- This eliminates glass button fatigue failure.

CIRCLE ED-14 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

RAYTHEON

FLAT PRESS PRESS

SUBMINIATURE TUBES with

the

Note these advantages over subminiature button types:

Longer glass to metal seal

Glass heated only once

- no button
- no glass strain
- no lead burning

Reentrant seal eliminates breakage from short bends

Leads completely tinned right to glass seal by dipping in hot solder pot — an automatic glass strain test — no lead corrosion

Flat press with in-line lead arrangement means easier socketing, easier wiring, and adaptability to printed circuits

* Raytheon makes all varieties of reliable, high quality tubes yet countless users testify that none have the reliability of Raytheon Flat Press Subminiature Tubes with the Seal of Reliability.

RAYTHEON MANUFACTURING COMPANY

RAYTHEON MAKES ALL THESE:

CIRCLE ED-14 ON READER-SERVICE CARD FOR MORE INFORMATION

March 21-24: *Radio Engineering Show and IRE National Convention*, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

March 22: *ECDA (Electronic Commercial Development Association) Spring Meeting*, New York, N. Y. For information write to J. S. Mulholland, Jr., Secretary, ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.

April 6-10: *World Plastics Fair and Trade Exposition*, National Guard Armory, Los Angeles, Calif.

April 12-15: *Symposium on Modern Network Synthesis*, Engineering Societies Building, New York City, N. Y. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

May 2-5: *Semiconductor Symposium*, Cincinnati, Ohio. For information, write to F. J. Biondi, Bell Telephone Laboratories, Murray Hill, N. J.

May 4-6: *International Aviation Trade Show*, 69th Regiment Armory, New York, N. Y. For information, write to Aircraft Trade Shows, Inc., Hotel McAlpin, New York 1, N. Y.

May 9-11: *National Aeronautical Electronics Conference*, Biltmore Hotel, Dayton, Ohio.

May 18-20: *National Telemetering Conference*, Hotel Morrison, Chicago, Ill. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

May 26-27: *Electronic Components Conference*, Ambassador Hotel, Los Angeles, Calif. Abstracts of papers and requests for information should be addressed to Dr. Lester M. Field, 8820 Bellanca St., Los Angeles, Calif.

June 20-25: *International Symposium on Electromagnetic Wave Theory*, Univ. of Michigan, Ann Arbor, Mich. Sponsored by Commission VI of URSI. For information, write to J. W. Crispin, Jr., Univ. of Michigan, Ann Arbor, Mich.

June 27-July 1: *AIEE Summer General Meeting*, New Ocean House, Swampscott, Mass. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

September 12-16: *10th Annual Instrument Conference*, Shrine Exposition Hall, Los Angeles, Calif. For information, write to Fred Tabery, Exhibit Manager, 3443 S. Hill St., Los Angeles, Calif.

Designing With Pulses

By Arthur Fitzpatrick

Burroughs Corp., Electronic Instruments Div.,
Philadelphia, Pa.

PULSE testing can be utilized by the electronic designer for making many valuable tests at all stages in the design of new equipment. The examples of pulse testing given in this article can be applied during the design of computers, audio or broadband amplifiers, automatic controls and servo systems, and counters, as well, of course, as pulsed equipment.

Pulses can be generated over a wide range of frequencies, accurately timed, sequenced, delayed and counted to provide an important laboratory tool for electronic design engineers. The ease of pulse testing has been greatly increased by the development of building-block pulse control units—pulse generators, coincidence detectors, delay lines and other single function packages—which can be speedily interconnected into a specific pulse-test network without recourse to the time consuming job of "breadboarding" a special

circuit design. Thus, designers, working directly from pulse timing charts or block diagrams, can readily assemble a specific test system. Later the same building-blocks can be rearranged into different pulse systems to meet other needs.

Relay Performance Study

The performance of magnetic relays can be closely observed on a scope screen by means of the system blocked out in Fig. 1. With this simple pulse system—including pulse generator, flip-flop and two multivibrator-type delays—the design engineer can visually determine pull-in time, dropout time, transfer time, and "bounce" of the relay contacts.

Pull-in time, for example, is determined by observing coil current in the relay under test. The discontinuity in the curve of rising coil current marks the

point where the closing relay clapper stops moving. The pull-in time then is determined by measuring the distance from the start of current to this point.

In the test the relay coil is inserted in the plate circuit of a tube biased to cut-off. A series of positive square pulses causes the tube to conduct and thus close the relay. Since the action is repetitive, it can be viewed on a scope screen. Since the triggering square pulse is extremely sharp, plate current rise time will depend solely on the relay's characteristics.

Pulses from the free-running generator are fed through the delays to the "One" and "Zero" inputs of the flip-flop. Each pulse, arriving first at the "One" input, produces a sharply rising wavefront at the "One" output of the flip-flop. The delayed pulse, arriving slightly later at the "Zero" input, drops the output voltage of the flip-flop. The result is a sharp square pulse.

The first delay is inserted in the line to provide a convenient scope trigger that will permit viewing of the coil current in the linear portion of the sweep. By taking sweep sync from the leading edge of the multivibrator waveform of delay No. 1, the scope sweep can be triggered well in advance of the test relay.

Amplifier Frequency Response

The pulse generator and flip-flop in Fig. 2 are set up to provide a square wave for the standard frequency response test of vacuum-tube amplifiers. Output of the free-running generator complements the flip-flop. That is, successive pulses alternately switch the voltage at each flip-flop output from high-to-low, low-to-high.

The resulting waveform, which could be taken from either of the two flip-flop outputs, is a very fast rising square wave. This is fed directly to the amplifier under test. Comparison of amplifier output and input waveforms on a scope provides a relative measure of both high and low frequency responses.

Cathode Interface Impedance Check

The pulse system for checking cathode interface impedance, shown in Fig. 3, is somewhat similar to that used for testing relays. This particular pulse network uses the same pulse generator, delay and flip-flop employed in our previous test circuits.

It is thought that cathode interface impedance results from a deposit that builds up between the barium-strontium coating and nickel sleeve of a cathode when the tube is hot, but not conducting. The deposit, in effect, inserts unwanted parallel resistance and capacitance in the cathode circuit. Once formed, the condition remains as long as the tube is operating on a relatively light duty cycle. Continuous passage of electron current reduces the effect.

Because of its transient nature, a special test technique is used to detect the phenomenon. This technique, as shown here, is used in checking tubes for digital computers, where circuit may operate only intermittently, yet, when called upon, must operate infallibly.

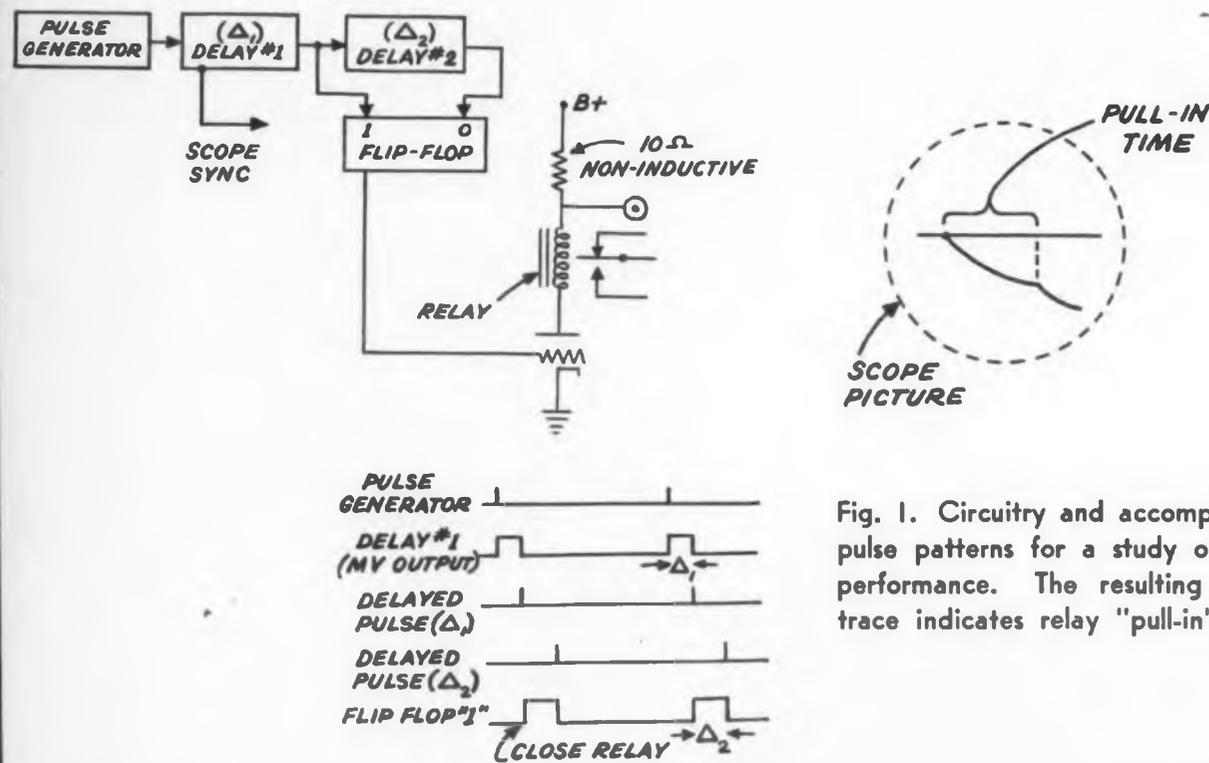


Fig. 1. Circuitry and accompanying pulse patterns for a study of relay performance. The resulting scope trace indicates relay "pull-in" time.

In the test, the tube is triggered by a series of square pulses. The pulses are widely spaced to keep the duty cycle low. The cathode interface impedance, if any, will appear as degeneration in the output waveform as shown in Fig. 3.

The pulse test system is operated as follows: pulses from the free-running generator are fed directly to the "One" input of a flip-flop and through a delay to the "Zero" input; the pulse at the "One" input, arriving first, produces a sharply rising wavefront at the "One" output of the flip-flop; and the delayed pulse arriving slightly later at the "Zero" input, switches the state of the flip-flop, dropping the voltage at the "One" output to produce the square pulse.

In this fashion, each pulse from the generator produces a square pulse. The width of the output pulse is determined by the delay time; its frequency by the frequency of the generator.

Frequency Measurement

Counting of a different sort is performed by the pulse system shown in Fig. 4. Here an unknown frequency is accurately measured by comparing it to a source of known frequency. This frequency measuring system gives highly accurate results whenever the unknown frequency is much higher or much lower than the known frequency. The circuit shown is set up to handle the latter case.

The system—composed of two flip-flops, three coincidence detectors and a counter—measures frequency by counting the number of high frequency pulses that occur between two consecutive low frequency pulses. The measurement is started by either a push-button or sync signal that opens the "One" gate of flip-flop A. The first pulse from the unknown source passes through this gate to the "One" input of flip-flop B. This pulse opens the associated gate, permitting a stream of pulses from the known frequency source to enter the counter. The same pulse is also fed back to the "Zero" input of flip-flop A in order to close the "One" gate, open the "Zero" gate.

This action permits the second pulse from the unknown source to get through to the "Zero" input of flip-flop B. It closes the associated gate and thus stops the flow of pulses to the counter. By this time the counter has registered the number of known frequency pulses that appeared in the interval between the two pulses of unknown frequency. This number then is the ratio of high (known) frequency to low (unknown) frequency.

Crystal Diode Test

The previous example was one of pulse patterning. It is here that pulse control equipment proves most versatile—in the selection and sequencing of pulses to perform a specific test job.

Another pattern commonly used is a series of discrete pulse bursts—each burst containing as many closely spaced pulses as desired. The circuit in Fig. 5

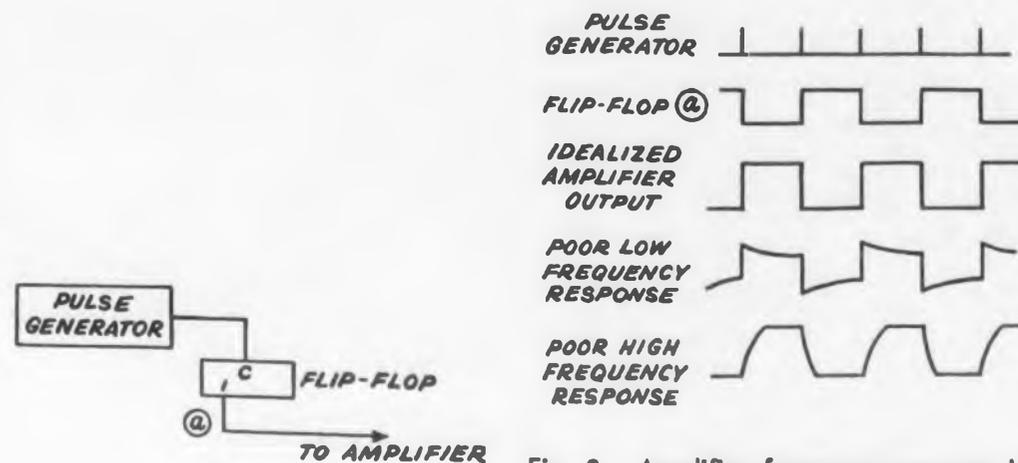


Fig. 2. Amplifier frequency response test circuit and pulse patterns.

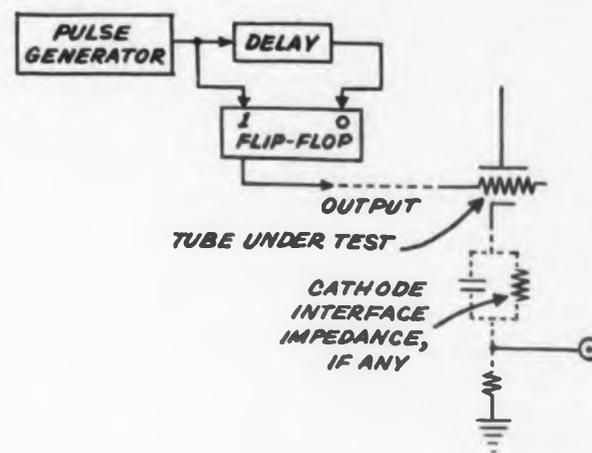


Fig. 3. Circuitry for cathode interface impedance check and accompanying pulse patterns.

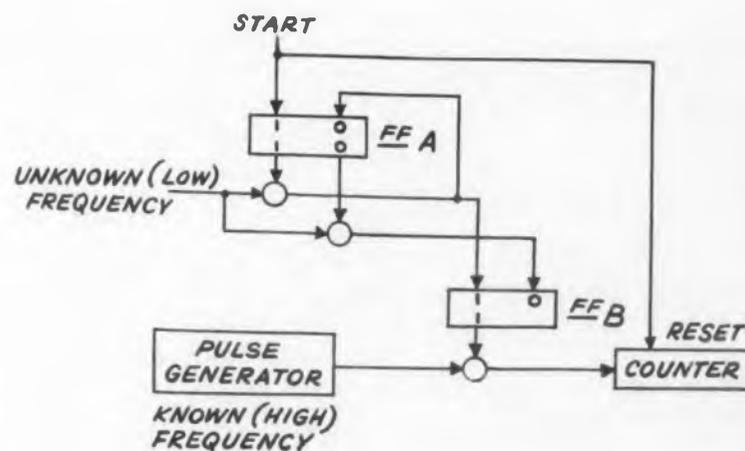


Fig. 4. Frequency measurement by means of a counter and a known frequency is accomplished by this circuit.

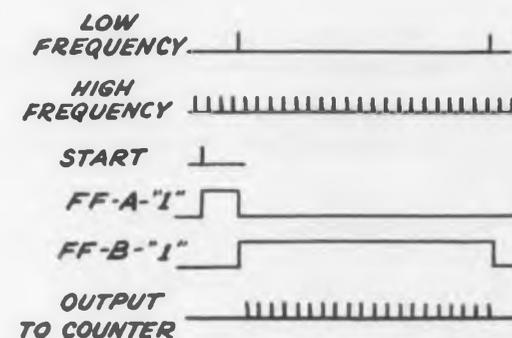


Fig. 5. Crystal diode test circuit and accompanying pulse patterns.

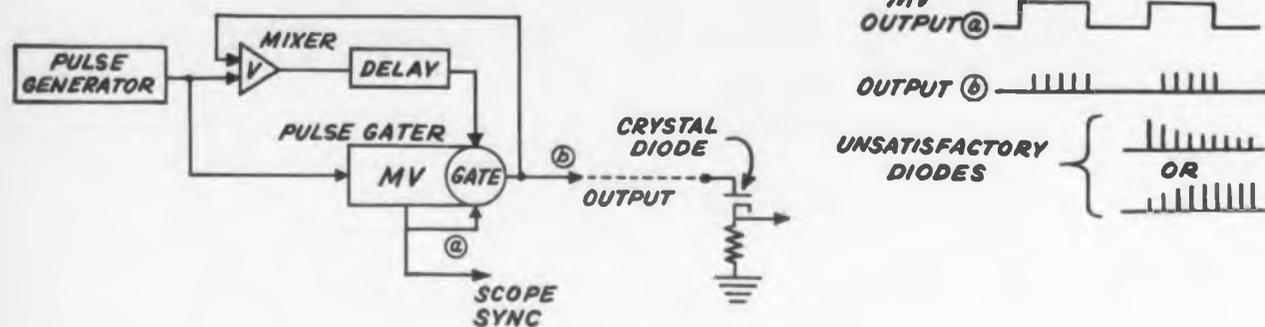


Fig. 6. An alternate circuit for the crystal diode test and a representation of its output.

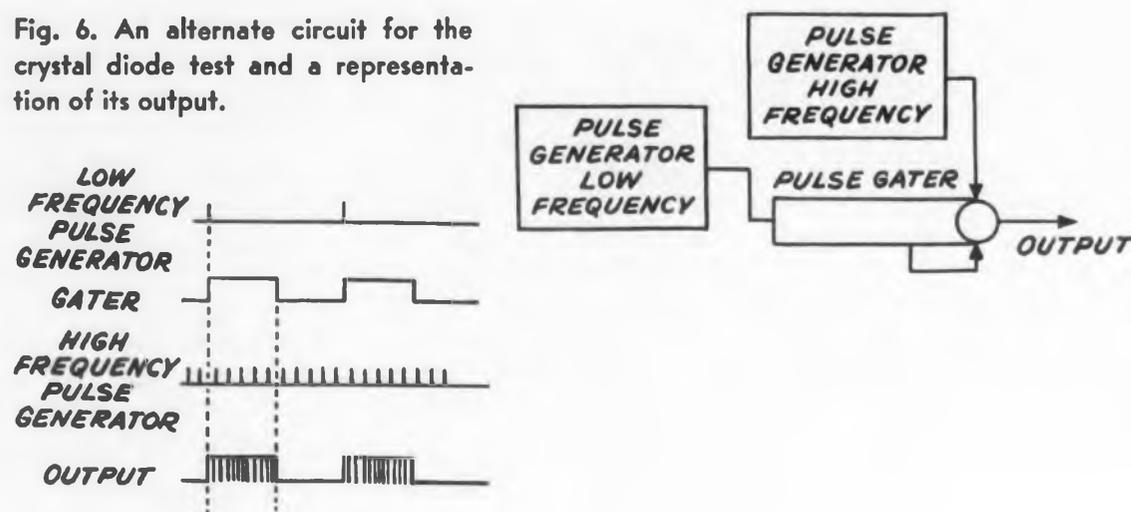


Fig. 7. The decimal counter test circuit incorporates a "divide-by-sixteen" counter.

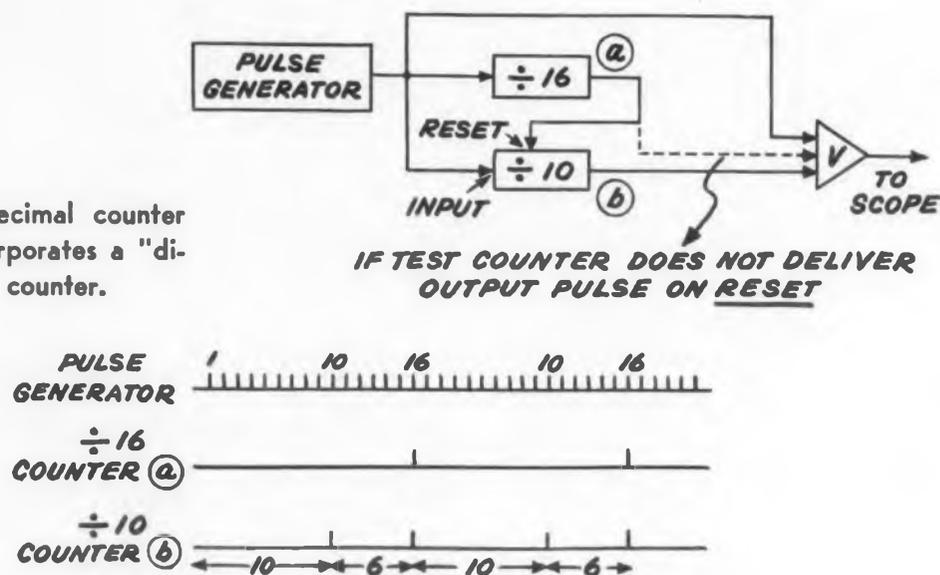
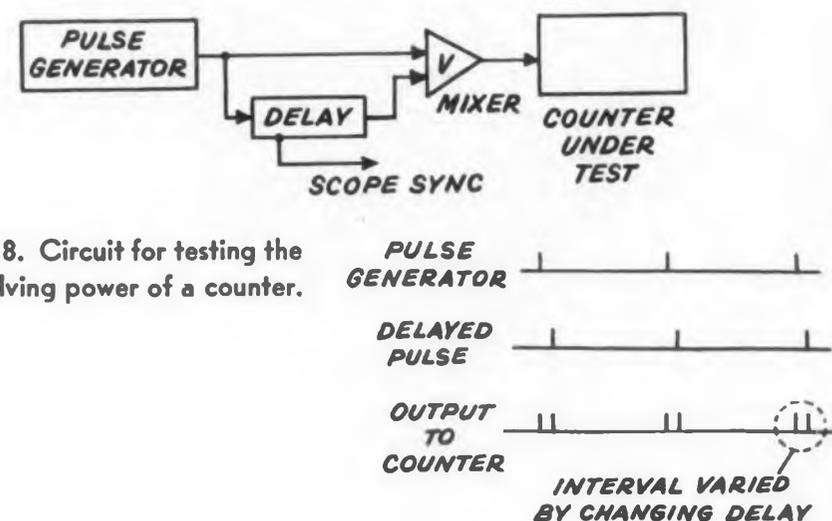


Fig. 8. Circuit for testing the resolving power of a counter.



generates bursts of pulses, often used to test crystal diodes, pulse transformers and similar components. It uses a delayed feedback loop to generate the required pulse trains.

In this system a mixer and a pulse gater are added to the basic equipment. The pulse gater, as used here, combines a one-shot multivibrator and coincidence detector in a single panel. The mixer permits the triggering of a unit by one or more signals without interaction between the inputs.

Pulses from the free-running generator are fed to the input of the multivibrator and through a mixer to the delay line. The pulse from the generator first triggers the multivibrator, which in turn provides a direct current waveform to open the gate of the coincidence detector. The delayed pulse arrives at the coincidence detector slightly later, finds it opened by the multivibrator, and is passed to the output. This output pulse is also fed back through the mixer into the delay line. The result is a series of output pulses that continues until the multivibrator turns off and closes the gate, breaking the feedback loop.

At the next pulse from the pulse generator, a second burst of pulses is generated in the same manner—and so on. The number of pulses in a burst is determined by the gating time of the multivibrator and the delay in the loop; the interval between bursts is determined by the pulse generator frequency. The pulse bursts thus generated are fed to a crystal diode and the resulting output observed on a scope. The

leading edge of the multivibrator waveform provides a convenient scope trigger. Satisfactory diodes will pass all the pulses in a burst with equal attenuation. Faulty diodes will attenuate either the leading or trailing pulses.

A somewhat simpler set-up for achieving practically the same result is shown in Fig. 6. Here a low frequency generator is used to gate pulses from a high frequency generator (which replaces the delayed feedback loop). Since there is no fixed phase relationship between high and low frequencies, each output burst from this system appears on the scope, not as a train of separate pulses, but as a square blur of light formed by the rapidly shifting pulses.

Decimal Counter Check

A "divide-by-sixteen counter" plus a pulse generator can be used to provide a simple visual check of both count and electronic reset circuits of a decimal counter. The test circuit and resulting scope pattern are shown in Fig. 7.

Pulses from the free-running generator are fed to both the decimal counter and the divide-by-sixteen circuit (both of which have been set to zero). After ten pulses, the decimal counter delivers an output pulse that is fed to the scope input. Six pulses later the count-by-sixteen unit delivers an output pulse that resets the decimal counter. In resetting to zero, the decimal counter may deliver another output pulse to the scope. If the decimal counter is not of this type, the pulse from the count-by-sixteen unit is also fed directly to the scope, as shown in Fig. 7.

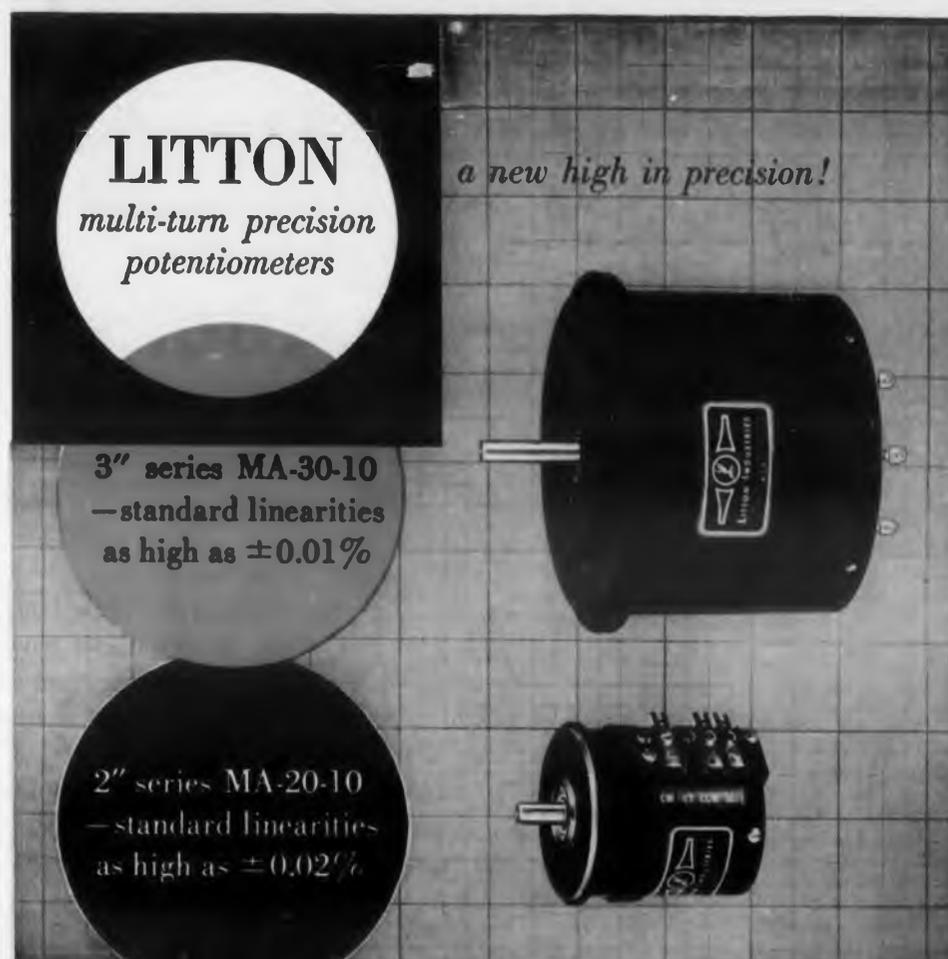
After an additional ten input pulses the decimal counter again delivers an output to the scope. The pattern, therefore, is first an output pulse after ten inputs, then after six input pulses. This pattern repeats itself and thus can be viewed on the scope. If the spacing of output pulses deviates from the "ten-six" pattern, the operator knows that either the reset or the counting circuit is faulty.

The pulses from the generator are also fed directly to the scope screen where they are superimposed on the "ten-six" pulse pattern. These background pulses provide a built-in time scale to permit a rapid visual check of output pulse spacing.

Resolving Power Test

The ability to vary pulse intervals, makes pulse test equipment ideal for testing the resolving power of counters. The circuit in Fig. 8 can generate two closely spaced pulses, then gradually reduce the time interval between the two until the counter under test cannot distinguish between them.

The system shown makes use of a pulse generator, mixer and delay. Because of the delay, two pulses are fed to the counter for every one coming from the pulse generator. The interval between the two is determined by the delay time.



The electrical precision expected of laboratory instruments, with the mechanical ruggedness required for dependable duty under the most severe military and industrial conditions are combined in Litton Potentiometers.

ELECTRICALLY, "ultra-precision" distinguishes Litton "pots". Recently developed high-speed, servo-controlled coil winding techniques make possible consistently high linearities. Linearity data supplied with each unit. Close total resistance tolerances can be held. For some resistance values resolution is several times that of similar models. "Infinite resolution" (stepless) pots are available.

MECHANICALLY, Litton Potentiometers are outstanding examples of precision design and ruggedized construction. All metal case—machined aluminum, anodized—is rust-proof and dust-proof. Shielded stainless steel ball bearings are standard.

DESIGN-WISE, Litton Potentiometers simplify many application and assembly problems. Extremely rugged traveling-nut type stops eliminate need for external stop assemblies for many applications. 3600° of actual electrical rotation with 90° of electrical and mechanical overtravel at each end is a unique feature. Special mountings and shafts are available as well as other electrical angles, extra tap connections, and gage versions.

CONDENSED SPECIFICATIONS		series MA-30-10	series MA-20-10
ELECTRICAL	Independent Linearity—Standard Range	±0.5% to ±0.1%	±0.5% to ±0.02%
	Special Order	±0.005%	±0.01%
	Standard Total Resistance Range	2K to 300K ohms	1K to 100K ohms
	Resistance Tolerance Standard	±5%	±5%
	Special	±0.5%	±0.5%
	Actual Effective Electrical Angle	3600° ^{+1°} / _{-0°}	3600° ^{+1°} / _{-0°}
MECHANICAL	Case Diameter	3.000 inches	1.820 inches
	Starting Torque maximum at 20°C.	1.0 ±0.5 inch-ounces	0.75 inch-ounces
	Total Mechanical Angle—Nominal	3780°	3780°
	Mechanical Overtravel Each End—Nominal	90°	90°

design details subject to change without notice, certified drawings available on request.

write for complete data LITTON INDUSTRIES (incorporated)
336 N. Foothill Road · Beverly Hills, California · CRestview 4-7344
215 S. Fulton Avenue · Mount Vernon, New York · Mount Vernon 7-6609
or contact our sales representative nearest you . . .

for complete information regarding Litton Potentiometers and other Litton components*

CONTACT LITTON SALES REPRESENTATIVE NEAREST YOU:

ATLANTA, GEORGIA
MURPHY & COTA
1409 Peachtree St., N. E.
EL 3020

BALTIMORE 28, MD.
KEN RANDALL CO.
1303 Midvale Ave.

CHICAGO 13, ILLINOIS
PIVAN ENGINEERING CO.
2871 N. Lincoln Avenue
DIversy 8-6885

CLEVELAND 21, OHIO
J. R. DANNEMILLER ASSOC.
P.O. Box 116
1791 Oakmount Street
EVergreen 1-5100

DALLAS 1, TEXAS
ARNOLD BARNES CO.
504 Interurban Bldg.
RA-4585

DAYTON 2, OHIO
J. R. DANNEMILLER ASSOC.
18 W. Monument Ave.
MICHigan 1123

DETROIT 38, MICHIGAN
J. R. DANNEMILLER ASSOC.
2980 W. Davison Ave.
TOwnsend 9-3141

NEW YORK CITY
E. R. A. INCORPORATED
340 Great Neck Road
Great Neck, N. Y.
HUNter 2-9320

LOS ANGELES 16, CALIFORNIA
E. V. ROBERTS & ASSOC.
5068 W. Washington Blvd.
WEBster 3-5731
WEBster 8-2541

PHILADELPHIA 7, PENNSYLVANIA
KEN RANDALL CO.
121 N. Broad Street
LOcust 4-2151

PHOENIX, ARIZONA
E. V. ROBERTS & ASSOC.
909 N. First St.
ALpine 4-4664

SAN FRANCISCO, CALIFORNIA
E. V. ROBERTS & ASSOC.
988 Market Street
GRaystone 4-6655

SEATTLE 8, WASHINGTON
TESTCO
Boeing Field—Rm. 105
MOhawk 4895

WINSTON-SALEM, N. C.
MURPHY & COTA
35 Burke St.
Tel.: 5-6691

EXPORT
FRATHOM COMPANY
33 W. 42 Street
New York 36, N. Y.
BRyant 9-1296

*Other products of the Litton Components Division include single-turn potentiometers, Metalohm metal film precision resistors, load isolators, rotary joints, and delay lines.

CIRCLE ED-17 ON READER-SERVICE CARD FOR MORE INFORMATION

Audio Goes "Flat"

Design Forum

UNITIZED or "bookshelf" audio amplifiers, first discussed extensively in *ELECTRONIC DESIGN* in August of this year (pp. 28-29), have now been designed by nearly a dozen more manufacturers. These newer units, many of them illustrated on these pages, all share the "flat" construction and attractive appearance of the three combined amplifier-preamplifier-control-power supply units compared previously. All are handsome enough to be given a prominent position in the living rooms of American homes. At the same time, these high-quality, inexpensive amplifiers are not too difficult to install and operate.

To further extend the furniture-like quality of their amplifiers, two manufacturers offer their units in

wood cabinets. By designing the amplifiers to fit into cabinets that match other component enclosures in their respective lines, Altec-Lansing, Harman-Kardon, and Bell should achieve greater sales of both amplifiers and tuners or speakers.

Two of the amplifiers incorporate "diagonal" mounting of some tubes, with removal through an uncovered hole in the bottom of the chassis for ease of servicing. These tubes are mounted in tent-like enclosures in the chassis, which also provide shielding. The "HFA-100", made by Sonotone Corp., Elmsford, N. Y., is one of this type. The other three tubes in the 10w unit are mounted horizontally and are removed from the back. To provide cooling for the two diagonally

Functions of tubes in 16 models of unitized amplifiers.

Amplifier	Number of Tubes	Cathode-Follower Input	Phono Preamplifier	Voltage Amplifier	Amplifier & Phase Inverter	Power Tubes (2)	Rectifier
Allied "Knight 935X312"	6		12AX7	12AX7	12AX7	6V6GT	5Y3GT
Altec-Lansing "Melodist"	6		12AY7	12AX7	12AU7	6CM6	6AX5GT
Bell "2256"	6		12AX7	12AX7	12AX7	6V6GT	5Y3GT
Bogen ¹ "DB110"	6		12AX7		12AX7	6V6GT	5Y3GT
Brociner "Mark 12"	6		12AX7	12AX7	12AX7	6AQ5	6X4
Brook ² "22A"	9		6SJ7; 6C4	12AU7 ³	12AU7	2A3 ⁴	5U4
Harman-Kardon "Melody"	6		12AY7		12AT7	6CM6	5Y3GT
Lafayette "LA-54"	6		12AX7	12AX7 ⁵	12AX7	6AQ5	6X4
McGowan "WA-410"	7		Z729	12AX7(2)	12AX7	6V6	5Y3
National "Horizon 10"	5		12AX7		12AX7	6V6GT	5Y3GT
Newcomb "Compact 12"	6		12AX7	6AV6	12AX7	6V6GT	5Y3
"Compact 10"	5		12AX7		12AX7	6V6GT	6AX5
Pilot "AA-420"	7		12AX7	6C4	12AU7	5881	5Y3GT
Radio Craftsmen "Solitaire"	7		12AX7	12AX7; 6U8 ⁶	6SL7	6L6	5V4
Scott "99-A"	6		12AX7		12AU7	6V6GT	5Y3GT
Sonotone "HFA-100"	5	12AX7		12AX7	12AX7	6V6GT	5Y3GT

¹ This amplifier is a combined amplifier-control unit, but it does not have the "flat" construction characteristic of the other units discussed.

² Discontinued.

³ One section of this tube is employed in the tone control circuit.

⁴ Two impedance-coupled 6C4's drive these power tubes.

⁵ One section of each of these two tubes functions as a cathode follower.



The wooden cabinet of the Sonotone "HFA-100" is 4-7/8" high x 14-1/4" wide x 8-3/4" deep. The bottom view of its chassis shows the two tubes in a "tent".



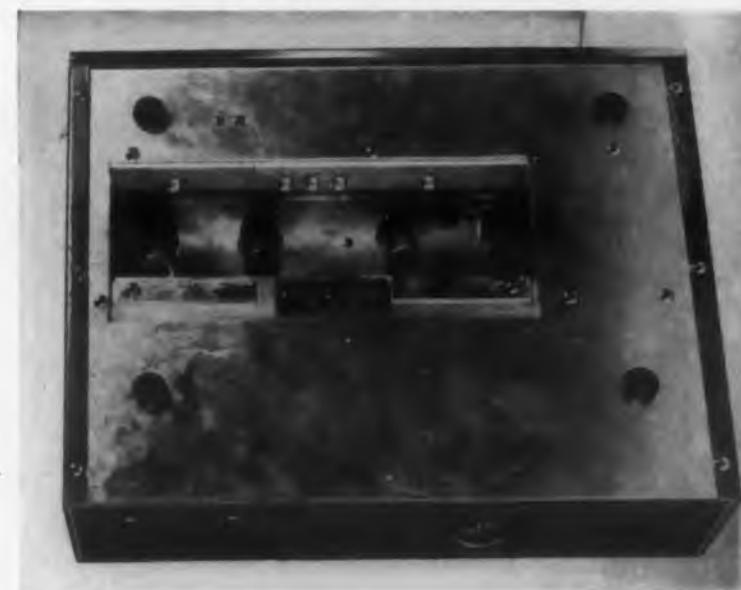
mounted *12AX7*'s the louvered wooden cabinet stands on small feet to permit the circulation of cooling air.

Three of the tubes in the "Solitaire", made by Radio Craftsmen, Inc., 4401 N. Ravenswood Ave., Chicago 40, Ill., are diagonally mounted in a "tent". At 20w, it has the highest power output of the units discussed. This amplifier features a dual filter system to eliminate turntable rumble and spurious high and low frequencies.

The "A-339A Melodist", manufactured by Altec-Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., has a wood cabinet styled to match this firm's "700A Melodist" loudspeaker. By using only small envelope types, all the tubes are mounted verti-



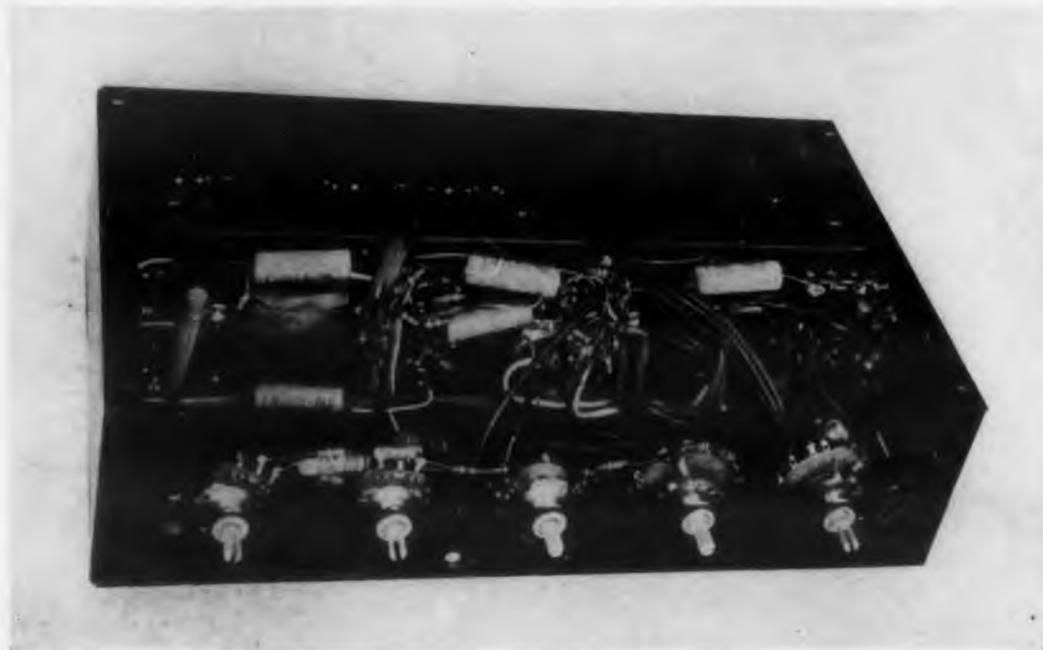
The cabinet (4" x 14-1/2" x 11-1/2") of the Radio Craftsmen "Solitaire" has a simulated leather finish. The bottom view of the chassis shows the diagonally mounted tubes and input and output terminals.



The wooden cabinet of the Altec-Lansing "A-339A Melodist" matches the cabinet of this firm's "700A Melodist" speaker. The heat shield over the rectifier and power tubes of the amplifier produces a "chimney effect".



The Harman-Kardon "C-100 Melody" ("3-1/4" high x 12-1/2" wide x 7-1/4" deep) matches this firm's "Theme" am-fm tuner. Most of the wiring of the amplifier is exposed for easy repair by removing a few screws. The tubes are hidden by the grate.



The Bell "2256" (top) is the same size (4" x 9-1/2" x 8-3/4") as the "2255" tuner. The bottom view of the unit shows its "split-chassis" construction, which also aids cooling.



cally in this 10w amplifier. The cabinet is available either in blond or mahogany finish.

Like similar units in the National Company's "Horizon Line", the "C-100 Melody" amplifier made by Harman-Kardon, Inc., 520 Main St., Westbury, N. Y., is styled in the same manner as one of this firm's am-fm tuners. Featuring a Williamson "ultra-linear" circuit, this 10w amplifier is only 3-1/4" high.

Bell Sound Systems, Inc., 555 Marion Rd., Columbus 7, Ohio, features a unitized amplifier that is the exact same size as the matching tuner. The Model 2256 amplifier shown at the right has a 12w output. For tape recording, it has a special high-impedance output at the back that by-passes the output stage.

Lafayette's "LA-54" "bookshelf" amplifier features printed circuits. All tubes are mounted horizontally and can be removed at the back. Lafayette Radio Co. is located at 100 Sixth Ave., New York, N. Y.

Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif., has designed two models (not illustrated) of "unitized" amplifiers, the "Compact 12", a 12w type, and the "Compact 10", a 10w unit. The former has more controls (eight) than most other amplifiers of this type. It is 4-1/8" high x 12-1/2" wide x 9" deep. The Compact 10 is 3-7/8" high x 9-3/8" wide x 7-3/4" deep and weighs 9lb. All inputs and outputs to these two amplifiers are made at the bottom of the chassis, which stand on small feet.

The 15w Model AA-420 amplifier made by Pilot Radio Corp., 37-06 37th St., Long Island City 1, N. Y., uses 5881 power tubes. It incorporates a Williamson-type circuit. All tubes are mounted horizontally.

Most of these amplifiers are either furnished without cabinets for rack mounting or can be rack mounted in their present cabinets. All have a variety of output

terminat
Altho
\$100, th
price di
observe
consume
other co
greater s
probably
compone
Provis
complexi
bottom c
minals a
preferen
Among
"bookshe
cooler-op
tors, and
and resis
to be op
addition,
hot, whic
Stimul
chase hi
audiophil
plete auc
Within t
and powe
illustrate
amplifiers
for high-
tronic de
ingenuity
and pack

terminations to match different speakers.

Although most of these amplifiers are priced about \$100, the prices vary from \$52 to \$130. Keeping this price differential in mind, it will be interesting to observe which of these amplifiers gain the greater consumer acceptance. If the styling of tuners and other components to match the amplifiers leads to greater sales of all of these components, designers will probably repackage or redesign one or another of the components in their lines to match the amplifiers.

Provisions for removing tubes without using tools, complexity of controls, wood over metal cabinets, and bottom or back placement of input and output terminals are other design factors that affect consumer preference.

Among the technical advances that could affect "bookshelf" amplifier design are the availability of cooler-operating and shorter tubes, inexpensive transistors, and less expensive high-temperature capacitors and resistors. Designers must expect these amplifiers to be operated in poorly ventilated locations. In addition, the metal cabinets must never become too hot, which would affect their safe use.

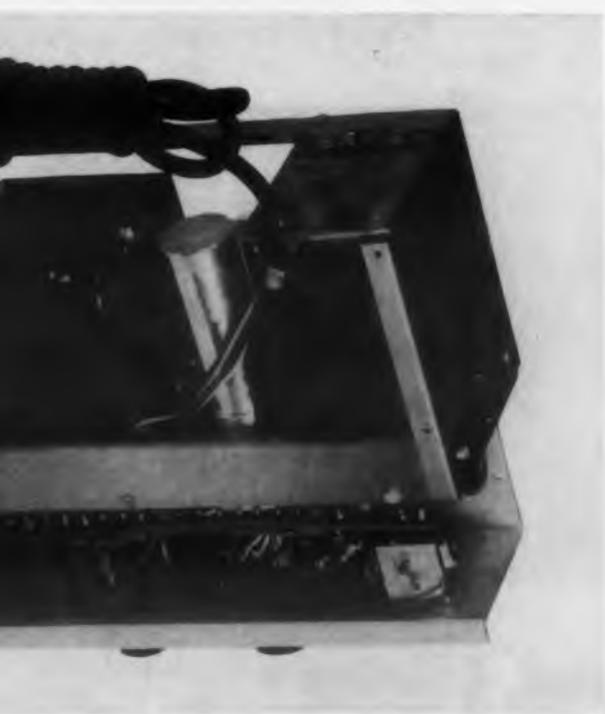
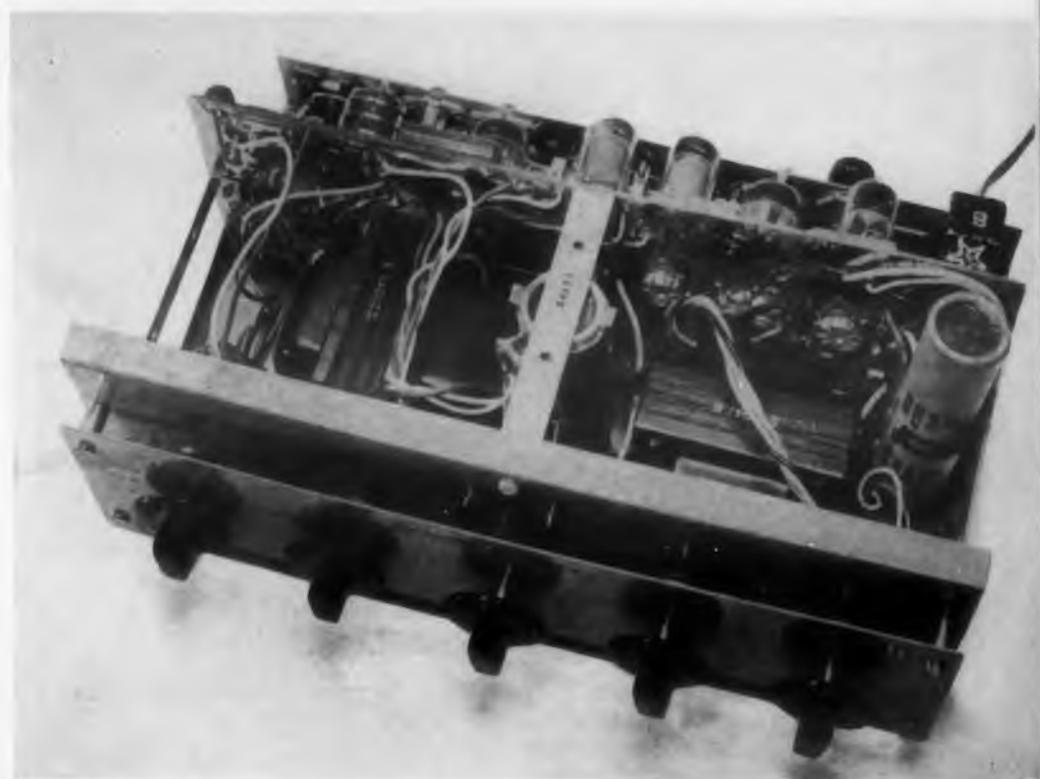
Stimulated by a vast library of record titles to purchase high-quality audio equipment, the fledgling audiophile will be governed in his purchases of complete audio systems by appearance and compactness. Within the framework of about the same size, shape, and power output, he has a variety of amplifiers, as illustrated on these pages, to choose among. These amplifiers should help to open a large new market for high-quality audio equipment, offering the electronic designer many opportunities to exercise his ingenuity in reducing costs, simplifying circuitry, and packaging to mass tastes.

The printed-circuit board in the Lafayette "LA-54" (4-1/2" x 10-7/8" x 8") is firmly mounted.



The Pilot "AA-420" (5" x 13" x 10") has a grated top. In the bottom view of the chassis, the snap switch at the left, bottom, is for high and low-impedance phono cartridges. The right-hand adjustment is a hum control.



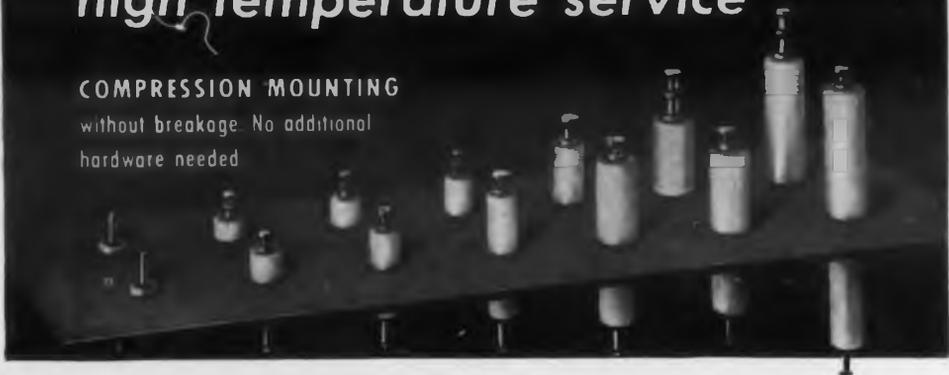


Tough TEFLON

*replaces brittle materials for
high frequency, high voltage,
high temperature service*

COMPRESSION MOUNTING

without breakage. No additional
hardware needed



CHEMELEC STAND-OFF AND FEED-THROUGH INSULATORS

Tough, resilient TEFLON is fast replacing brittle glass in miniature components. CHEMELEC components permit compression mounting, facilitate miniaturization, greatly reduce assembly costs, withstand shock and vibration in service.

• TEFLON's superior insulating characteristics made these miniatures possible—for high frequency, high voltage or current, high temperature service.

HIGHER surface and volume resistivity.

LOWER loss factor and dielectric constant.

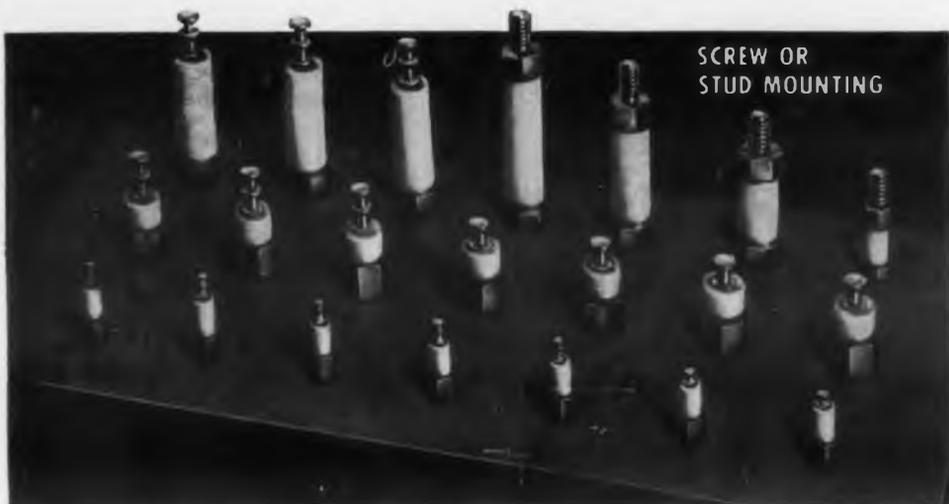
WIDER service temperature range (-110°F to $+500^{\circ}\text{F}$).

WON'T CARBONIZE under arcing or DC-plate.

INVESTIGATE CHEMELEC Stand-Off and Feed-Through Insulators for superior service and lower assembly costs.

NINETEEN STOCK SIZES, including sub-miniatures. Other dimensions feasible. WRITE for CHEMELEC Bulletin EC-1153.

FLUOROCARBON PRODUCTS, INC.,
Division of
UNITED STATES GASKET COMPANY
CAMDEN 1, NEW JERSEY



USG

FABRICATORS OF
FLUOROCARBONS & OTHER PLASTICS

Representatives in principal
cities throughout the world

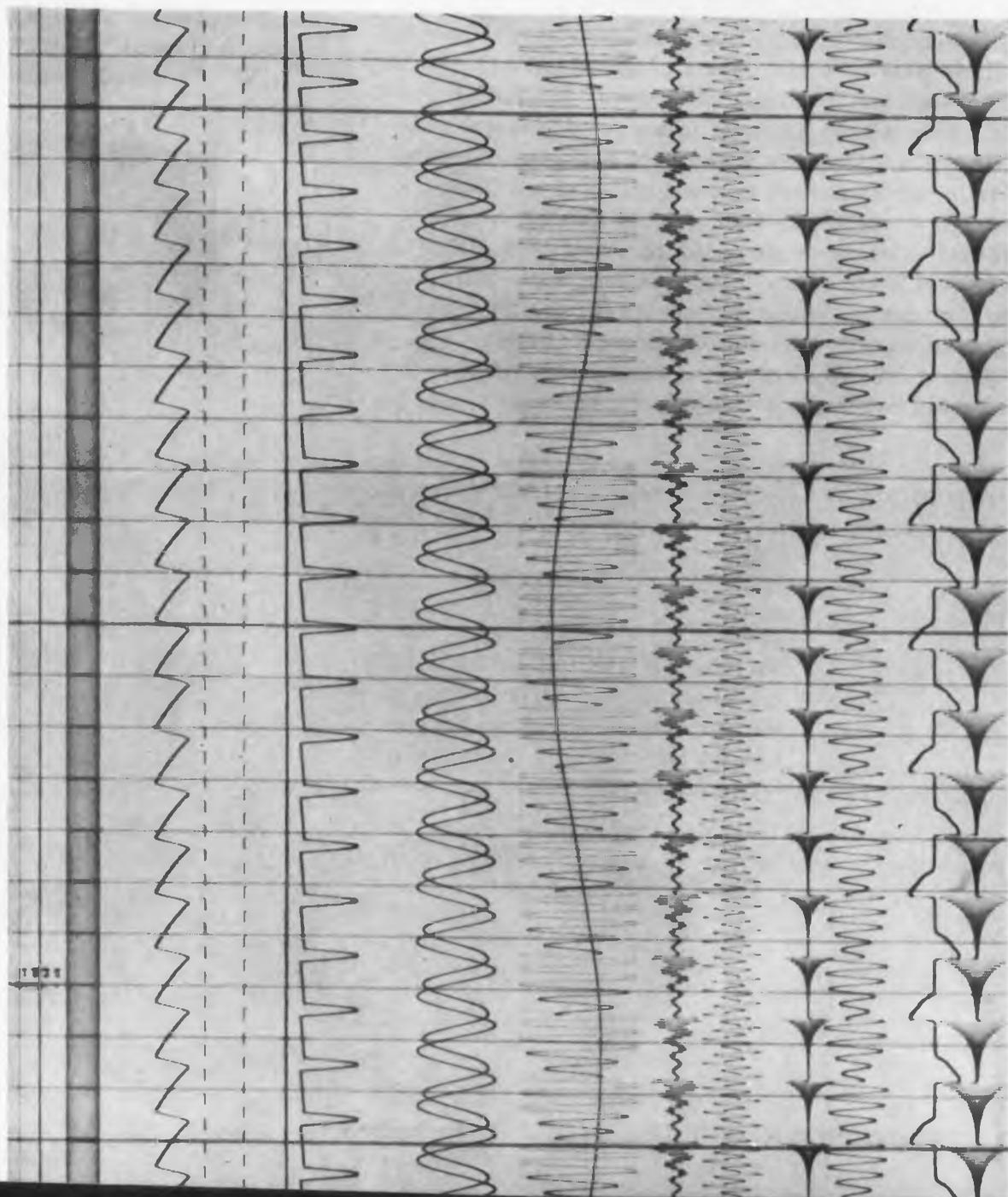


CIRCLE ED-21 ON READER-SERVICE CARD FOR MORE INFORMATION

The 16-channel CR-1 Oscillograph. The eight tubes are in the lowered position for photographing one or more traces.



Time marks are regularly recorded on the left edge of the record paper by the oscillograph.



SIXT
 rec
 of the
 The in
 system
 amplifi
 Eight
 Phen
 as high
 recordi
 400" p
 be run
 taken
 selector
 reaches
 and is
 tinuous
 direct,
 faces h
 Typi
 instrun
 lators,
 switchi
 by pus
 Manu
 325 N.
 device
 in size,
 stabiliz
 tivity i
 on tub
 deflecti
 level is
 For mo
 to the
 ELECTR

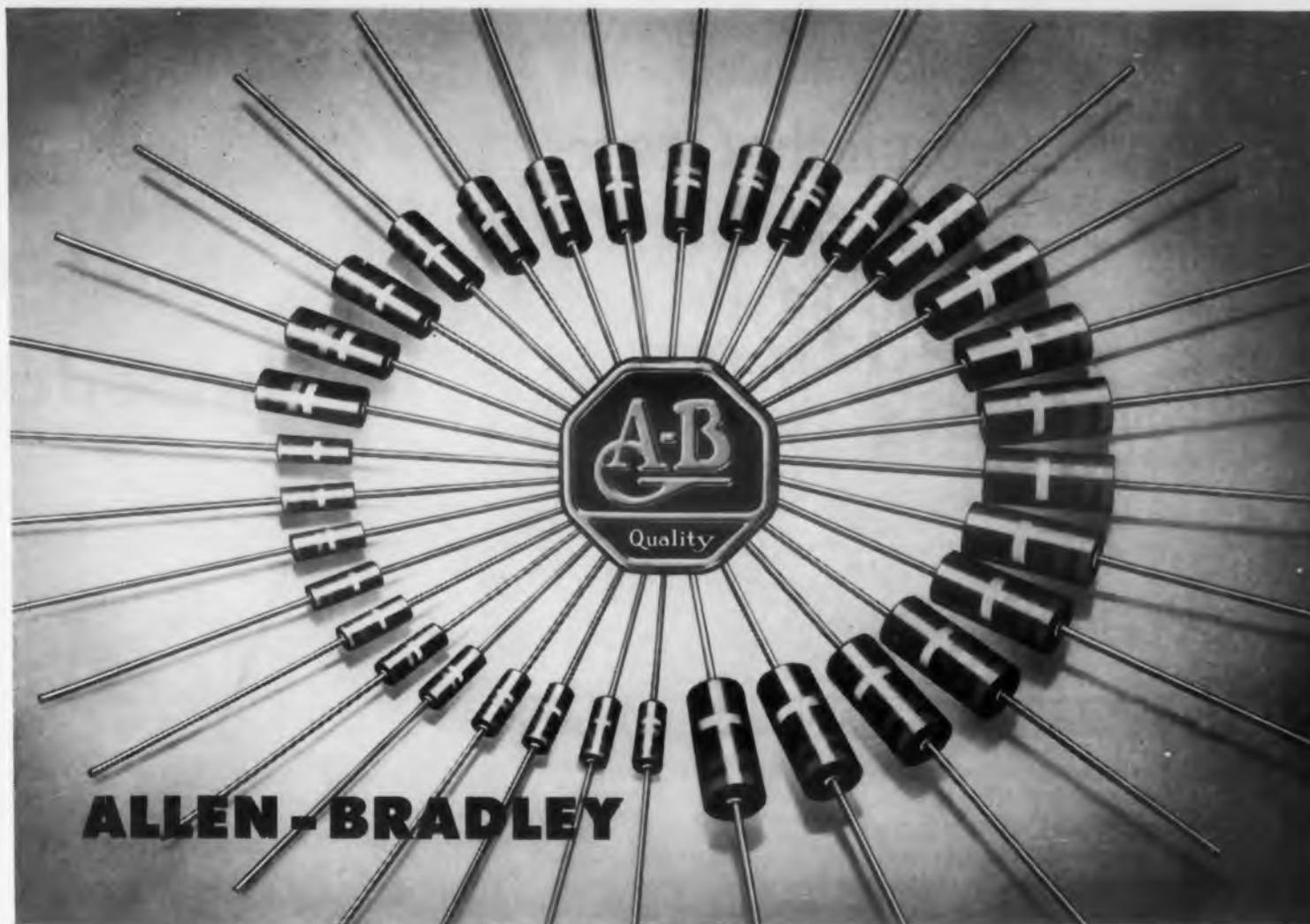
Multi-Tube Oscillograph

SIXTEEN high-frequency phenomena can be recorded at once as shown at the left by means of the CR-1 Cathode-Ray Recording Oscillograph. The instrument is actually a complete recording system incorporating its own power supplies, pre-amplifiers, deflection amplifiers, and recorder. Eight dual-gun 3" cathode ray tubes are employed.

Phenomena from static conditions to frequencies as high as 250kc can be recorded on the 8" wide recording paper at recording speeds from 3" to 400" per second. The full 300' roll of paper can be run, or shorter records from 1' to 50' can be taken automatically by means of a pre-set length selector. The recording paper or standard film reaches the predetermined recording speed in 1sec and is braked to rapid stops. In addition to continuous records, the oscillograph is adaptable to direct, "single-sweep" photography of the tube faces by means of an accessory camera.

Typical design laboratory applications for the instrument include synchronizing radar modulators, transformer tests, and circuit-breaker or switching analyses. It is simple to operate, mainly by push-button controls.

Manufactured by Wm. Miller Instruments, Inc., 325 N. Halstead Ave., Pasadena 8, Calif., the device weighs 1750 lb and is 65-1/2" x 48" x 27" in size. The plug-in input amplifiers are chopper stabilized. Input impedance is 100,000 ohms. Sensitivity is 5mv, d-c, per 1" peak-to-peak deflection on tube faces and 15mv, d-c, per 1" peak-to-peak deflection on moving photographic paper. The noise level is 0.03mv, rms, or less, referred to the input. For more data on this laboratory instrument, turn to the Reader's Service Card and circle **ED-22**.



ALLEN-BRADLEY

THE NAME THAT GUARANTEES *Quality* IN MOLDED RESISTORS

When you specify Bradleyunits for your radio, electronic, or television circuits you are "playing safe" with your reputation as an electronic engineer . . . because Bradleyunits are ultra-conservatively rated.

All Bradleyunits are rated at 70C ambient temperature . . . not at the usual 40C. They do not exhibit erratic resistance changes nor do they open circuit. They will operate at full rating for 1,000 hours with less than 6 per cent resistance change. Bradleyunits require no wax impregnation to pass salt water im-

mersion tests. Their differentially tempered leads prevent sharp bends near the body of the Bradleyunit. In every way, Bradleyunits are a QUALITY product . . . trouble free, accurate, and always dependable.

Let us send you our latest technical data sheets.

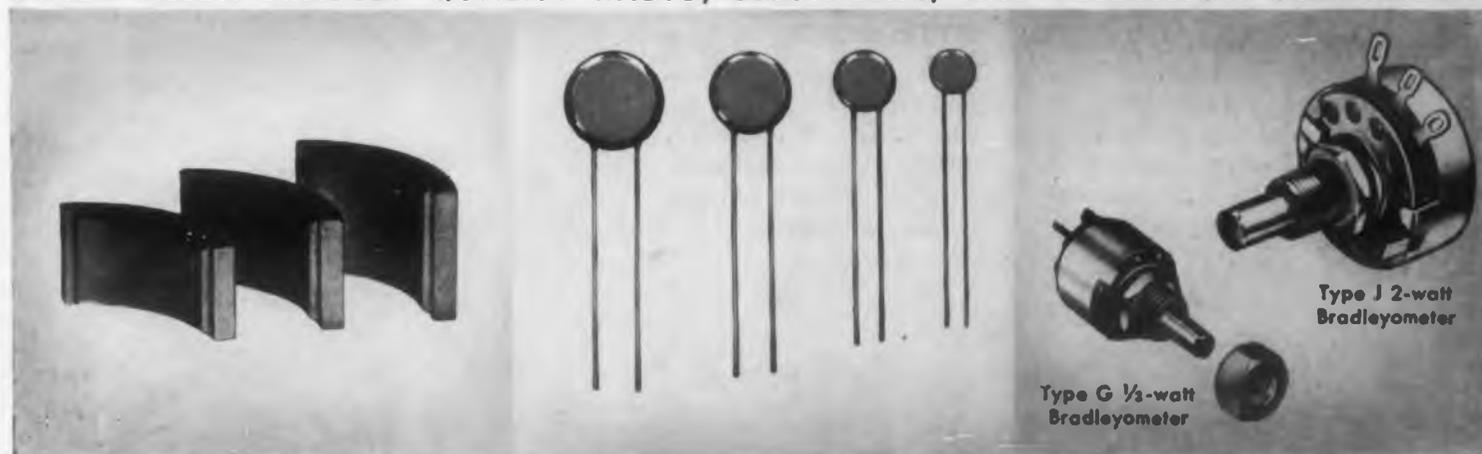
Allen-Bradley Co.

1344 S. Second St., Milwaukee 4, Wis.

In Canada

Allen-Bradley Canada Limited, Galt, Ont.

OTHER ALLEN-BRADLEY QUALITY RADIO, ELECTRONIC, AND TELEVISION COMPONENTS



FERRITE CORES

CERAMIC CAPACITORS

ADJUSTABLE RESISTORS

Type G 1/2-watt
Bradleyometer

Type J 2-watt
Bradleyometer

CIRCLE ED-23 ON READER-SERVICE CARD FOR MORE INFORMATION

EVERY ELECTRONIC ENGINEER

Should Measure the Chances

FOR A
FUTURE
WITH



Westinghouse

CREATE with our ELECTRONICS DIVISION!

Advanced development work at the Westinghouse Electronics Division has increased our need for experienced and creative engineers.

These top-level positions, involving design and development of the "projects of tomorrow", provide for income and other benefits commensurate with the qualifications of the individuals selected.

Write today to arrange for confidential interview:

R. M. Swisher, Jr.
Employment Supervisor, Dept. 76
WESTINGHOUSE ELECTRIC CORP.
2519 Wilkens Avenue
Baltimore 3, Maryland

CURRENT OPENINGS INCLUDE:

ELECTRONIC CIRCUIT ENGINEERS (MILITARY)

Applied research, development and design of electronic apparatus for communications, radar and missile guidance systems.

MECHANICAL ENGINEERS

Applied research, development and design. Application and specification of things mechanical for missile guidance systems, radar, and communication equipments.

ANTENNA AND WAVEGUIDE ENGINEERS

Applied research, development and design of antennas and waveguide systems for military communications and radar equipment.

RADAR INDICATOR SYSTEMS ENGINEERS

Planning, studying, proposing, and applied research, development, design to include search, fire-control and missile guidance systems.

YOU CAN BE SURE...IF IT'S

Westinghouse

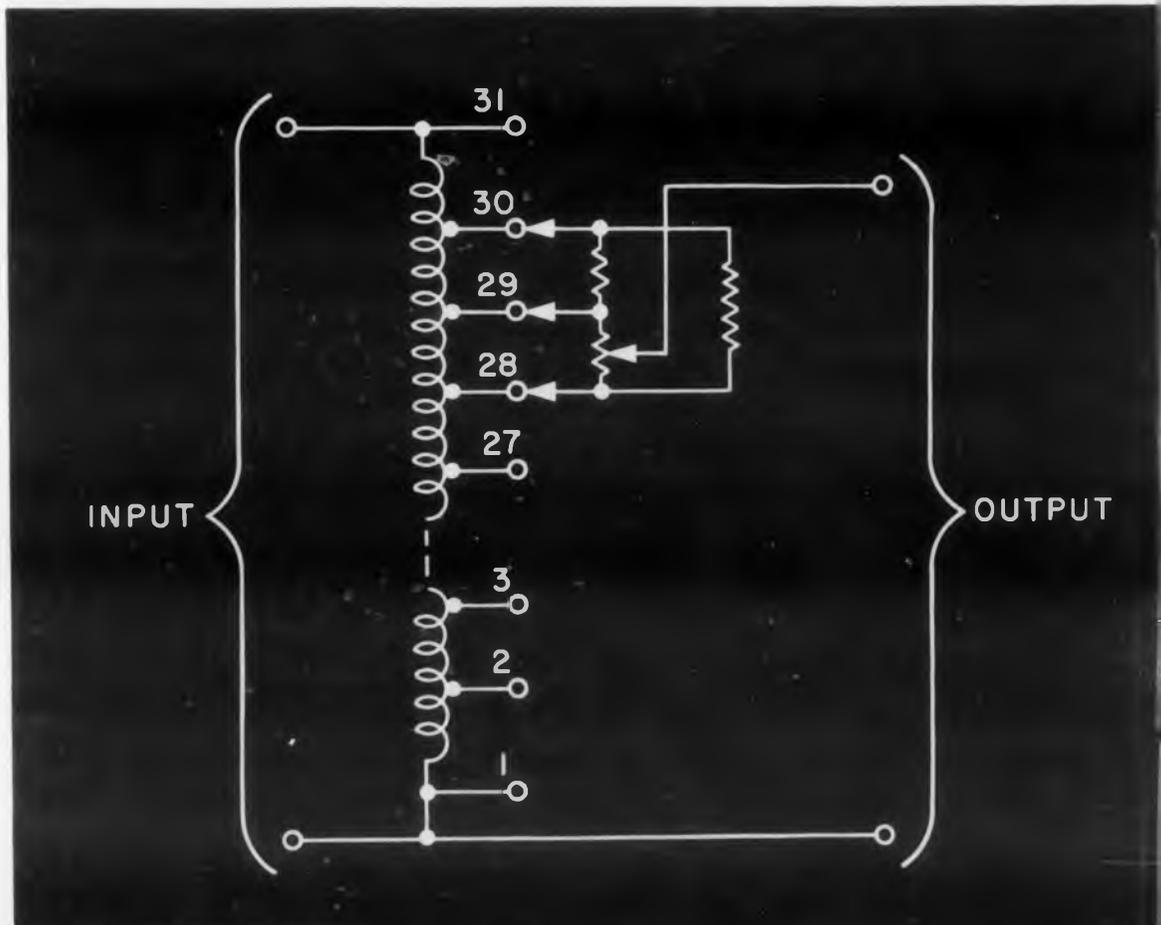
CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION

Low Output Impedance Transducer

ESSENTIALLY a combination of a potentiometer and an auto-transformer, the "Vernistat" electro-mechanical transducer has the linearity of the former and the low output impedance of the latter. In many servo or analog computer applications it can function without the need for impedance-matching or isolating amplifiers.

The device consists of a mechanically driven, tapped auto-transformer which provides the basic division of voltage into several discrete levels. These levels are selected and further sub-divided by a continuous one-turn interpolating potentiometer as shown in the circuit diagram. This potentiometer is connected sequentially across sections of the auto-transformer in synchronism with movement of the potentiometer arm or wiper so that

Circuit diagram of the "Vernistat" variable-ratio auto-transformer.



the vol
one lev
of the
The po
interpo
taps m
any nat
Manu
Elmer
a linea
resoluti
dance o
range o
mechanic
lated f
turn to

ELECTR

the voltage of the wiper is varied smoothly from one level to another throughout the entire range of the voltage supplied by the auto-transformer. The potentiometer moving through about 3500° interpolates between 30 transformer taps. The taps may be adjusted to approximate a curve of any nature.

Manufactured by the Vernistat Div., Perkin-Elmer Corp., Norwalk, Conn., the transducer has a linearity tolerance of better than $\pm 0.05\%$ and resolution better than 0.01% at an output impedance of 130 ohms maximum. It operates over a range of 50 to 3000cy. Although designed for mechanical rotation, it can also be manually manipulated for certain applications. For more data, turn to the Reader's Service Card and circle **ED-19**.



The transducer can be mechanically or manually driven. It is about 3" in diameter.

1 to 5 ratio your quality insurance

- 21 INSPECTORS to each 100 production workers—a 1 to 5 ratio.
- ALL units thoroughly inspected on exacting custom equipment.
- UNIQUE inspection procedure for each application.

EXTREME MANUFACTURING ACCURACY

- EVERY gear cut with an AA hob and rolled against a master.
- EVERY final grind on every shaft run through a Sheffield comparator set by "jo" blocks.
- EVERY bearing bore checked with an air gauge and XX plug gauge.

A wide variety of rotating electrical components for electronic and airborne applications . . . designed and produced to your specifications. Send your requirements to OSTER design engineers. Write for "The Oster Story of Quality" today.



John Oster

MANUFACTURING CO.
AVIONIC DIVISION
RACINE, WISCONSIN

Your Rotating Equipment Specialist

Oster



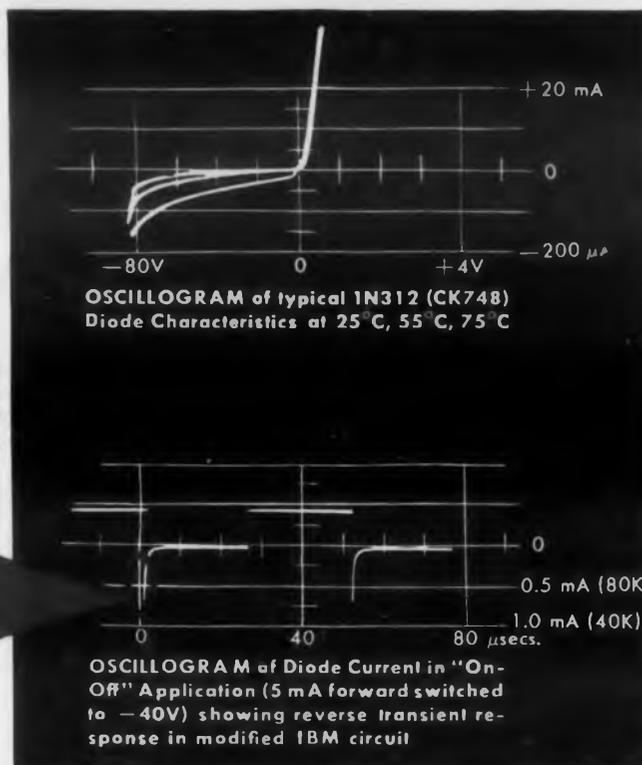
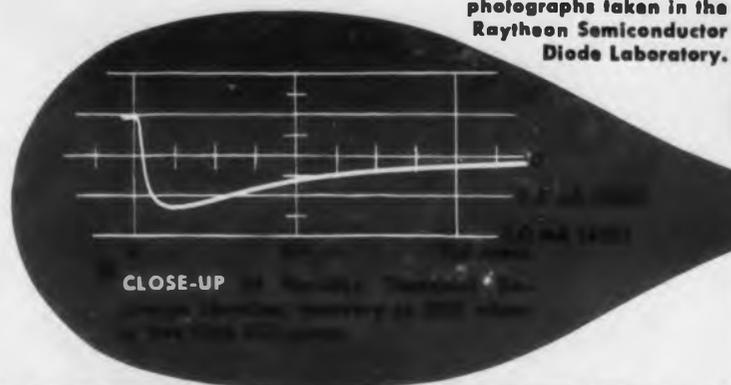


the world's no. 1 producer
of semi-conductors

presents **GOLD BONDED DIODES** of "GOLD STANDARD" PERFORMANCE

Look at the "specs"! Look at the actual, unretouched oscillograms. These pre-tested Raytheon Gold Bonded Diodes have the characteristics and the uniformly dependable performance to make them your No. 1 choice. Many other Raytheon Gold Bonded point contact and silicon diodes are available. Write for data.

*These are unretouched photographs taken in the Raytheon Semiconductor Diode Laboratory.



Representative Gold Bonded Types	FORWARD		REVERSE	
	25°C ma. at +1 volt	25°C µa at volts	25°C µa at volts	55°C µa at volts
1N308 (CK741) with 50% higher conduction than its nearest competitive type	300		500 at -8	1500 at -8
1N310 (CK745) for high voltage, high resistance	15		20 at -20 100 at -100	150 at -20 300 at -100
1N309 (CK747) with unbeatable transient characteristics	100		100 at -20	350 at -20
1N312 (CK748) 100% tested for forward and reverse transient response	30		50 at -50	200 at -50
1N313 (CK749) high voltage, extra high resistance	20		10 at -20 50 at -100	50 at -20 200 at -100

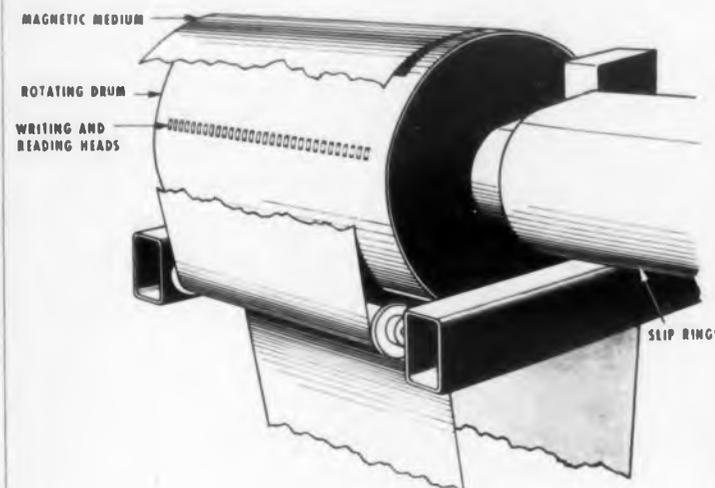
ALL with 150 milliwatt dissipation rating
ALL with -50°C to +90°C ambient temperature rating

RAYTHEON MANUFACTURING COMPANY

RAYTHEON MAKES ALL THESE:

CIRCLE ED-24 ON READER-SERVICE CARD FOR MORE INFORMATION

Some of the magnetic tape is cut away in the drawing to reveal the mounting of the heads.

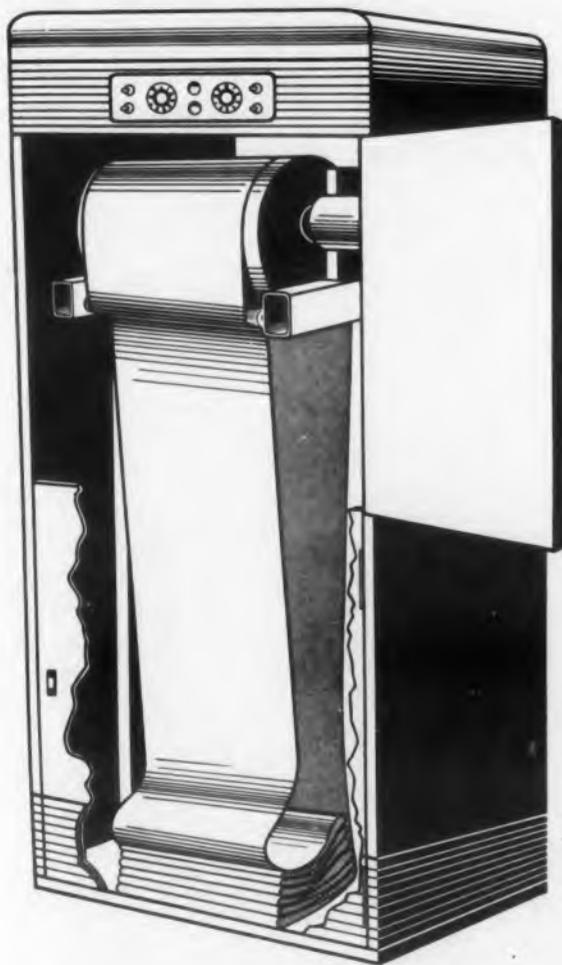


REVERSING the usual arrangement of magnetic tape moving past recording heads, the "Tapedrum" Magnetic Memory has the heads mounted on a drum spinning past a stationary sheet of tape. High capacity is achieved by mounting the sheet on rollers in a continuous roll that advances by coded sections. The memory's capacity is determined by the amount of tape in the roll. The unit is also illustrated on the cover.

Suitable for data-processing and inventory systems, the memory can store more than 100,000,000 bits of information and repetitively scan 200,000 bits 20 times per second. The drum mounts a bank of 128 recording and reading heads. The device is manufactured by Clevite-Brush Development Co., Clevite Corp. Research Center, 540 E. 105th St., Cleveland 8, Ohio.

Tape can be fed either in a continuous loop from a basket, as illustrated above, or from reels for greater capacity. A natural air cushion separates the spinning drum from the tape. This feature virtually eliminates wear on the tape, and at the same time eliminates the need for costly close tol-

High-Capacity Magnetic Memory



One method of mounting the Tapedrum, with the added tape stored in loose folds.

erances. The tape may be mounted so that the magnetic coating is on the side of the plastic base that faces away from the drum. For more information on this new digital computer accessory, turn to the Reader's Service Card and circle **ED-25**.

LORD FACTS ON VIBRATION

ANYONE CAN MAKE VIBRATION CONTROLS

Practically every mechanism is subjected to either destructive wear or impaired performance because of vibration or shock . . . and practically anyone could make a unit to "solve" these problems to some degree. It is important, however, that the vibration control units contribute to improved operation and efficiency of the mechanism—and at reasonable cost.

The use of makeshift or incorrectly applied units usually makes the condition worse instead of better.

LORD has devoted over 30 years to the successful solution of thousands of vibration and shock problems. LORD research, engineering, and production facilities have produced over 27,000 types of highly effective control units for all kinds of applications.

Exceptional engineering and manufacturing skills plus the use of only the best materials provide users of LORD products with several outstanding advantages:

EFFECTIVE VIBRATION ISOLATION—LORD units reduce operating vibration, shock, and noise to the lowest practical level—over a long, service-free operating life.

LOWER MAINTENANCE COSTS—Effective isolation provided by LORD systems reduces destructive vibration—lowering maintenance adjustment and parts replacement costs.

FLEXIBILITY IN USE—LORD extensive design and production facilities have developed a group of standard mountings of several types. These are adaptable to many standard vibration control applications and provide effective and economical solutions to a wide range of problems.

The extensive facilities at LORD are available on request for solution of your problems, whether they are simple or complex. Simply call or write the Home Office, Erie, Pa. or the LORD Field Engineer nearest you.

LORD MANUFACTURING COMPANY • ERIE, PENNSYLVANIA

DALLAS, TEXAS DAYTON, OHIO
PProspect 7996 Michigan 8871

LOS ANGELES, CAL. CLEVELAND, OHIO
Hollywood 4-7583 Superior 1-3242

NEW YORK, N. Y. PHILADELPHIA, PENNA.
Circle 7-3326 LOcust 4-0147

DETROIT, MICH. CHICAGO, ILL.
TRinity 4-2060 Michigan 2-6010



PLATE FORM MOUNTING



SYNAPOCAL MOUNTING



TUBE FORM MOUNTING



CHAIR-L MOUNTING



IBM PROOF MOUNTING



FLEXIBLE COUPLING



DESIGNERS AND PRODUCERS OF BONDED RUBBER PRODUCTS

SINCE 1924

CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

new approach to THERMAL RELAY DESIGN

G-V TIME DELAY RELAYS

- Hermetically Sealed
- Still Adjustable
- Amazingly Rugged
- Thoroughly Dependable



G-V ENGINEERING OFFERS A NEW APPROACH TO THERMAL RELAY DESIGN

- Stainless steel mechanism welded into a single integral structure and supported at both ends for unequalled resistance to vibration and shock
- Heater built inside expanding member for maximum efficiency and protection
- Rolling contact action for positive operation
- Easy adjustability where desired
- Precise operation never before available in thermal relays
- Time ranges: 3 seconds to 5 minutes
- Hermetically sealed in metal shell
- Heater voltages up to 230 volts
- Fully temperature compensated
- Suitable for military and industrial use
- Unequalled for ruggedness and precision

U. S. and Foreign Patents Pending

G-V
CONTROLS INC.

The stainless steel structure of G-V Thermal Relays, encased in a metal shell, delivers dependable, trouble-free performance under the most severe operating conditions . . . proved in commercial and military service for three years.

Thermal Relays are the simplest, smallest, lightest, most economical means of introducing a substantial delay into an electrical circuit.

G-V Relays offer performance never before available.

Why not find out by writing today how they can help you. G-V Controls are Thermal Relay specialists. They originated the 7-pin miniature and now make more of these than all other producers combined.

Only G-V offers complete technical data and helpful engineering cooperation on THERMAL TIME DELAY RELAYS.

Write for bulletin and help with your particular problems.

18 Hollywood Plaza
East Orange, New Jersey

Greatly expanded production facilities assure prompt deliveries.

CIRCLE ED-27 ON READER-SERVICE CARD FOR MORE INFORMATION

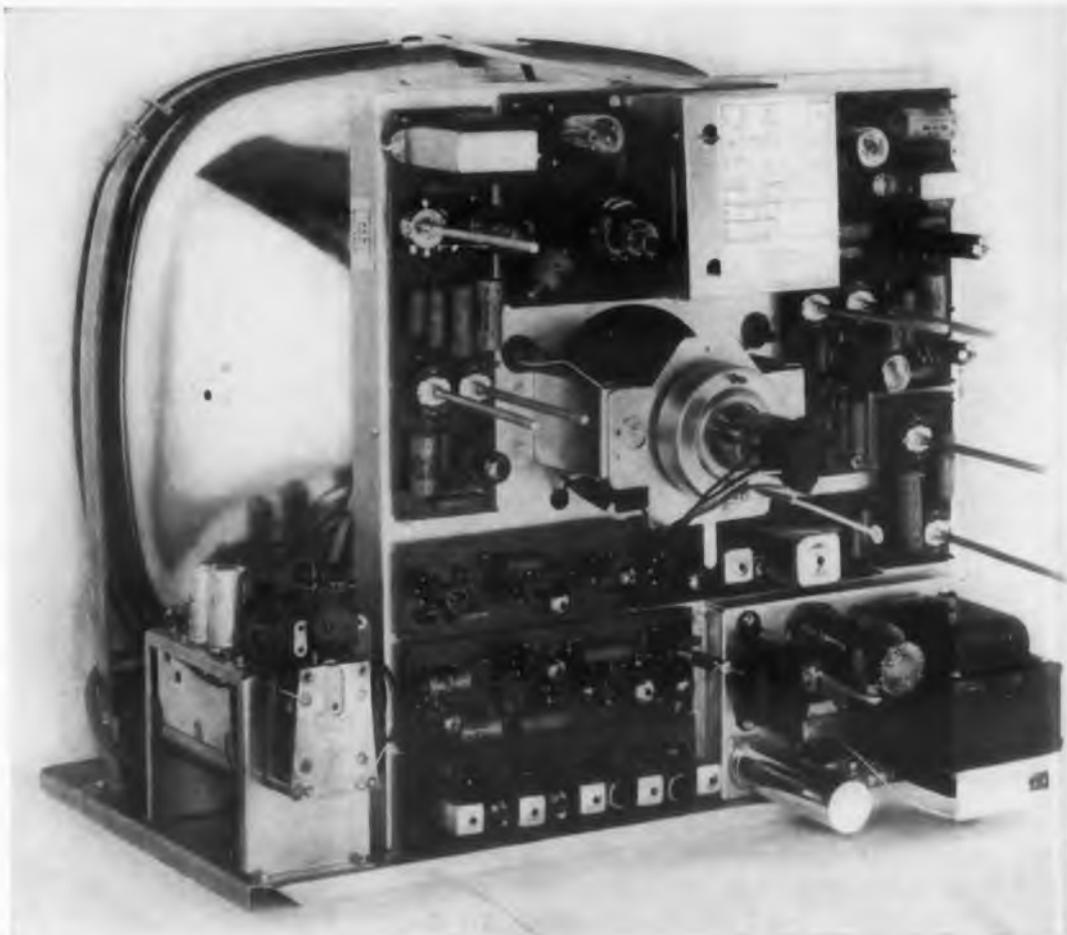
WIDESPREAD adoption of the printed-circuit construction techniques employed in the PC-9 Television Chassis illustrated on these pages could revolutionize the servicing of television receivers. Each function of the circuit has been concentrated on one plug-in printed circuit board. There are nine such plug-in assemblies. Whenever a set is inoperative, the serviceman can quickly determine which subassembly is defective, replace it and return the set to operation, and then

repair or decide to discard the defective subassembly at the shop.

Ease of servicing is only one of the advantages of this design, in which hand soldered connections have been reduced to a total of only 56. Marketed by Walsco Electronics Corp., 3602 Crenshaw Blvd., Los Angeles 16, Calif., the chassis is available without a picture tube for installation in custom cabinets. It can drive 90° deflection 21", 24", or 27" picture tubes. It also features a remote control unit that

automa
lected c
design,
The
cuit sub
sitions
shown
sis, whi
TV ma
servicin
move th
place p.

Rear view of the chassis showing how accessible are all the tubes, controls, and subassemblies.



The t
vert
chass
small
conne

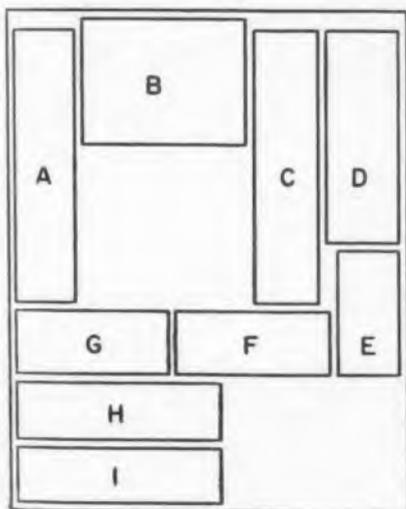
Printed-Circuit TV Chassis

automatically tunes and locks-in the selected channel. There are 26 tubes in the design, including the picture tube.

The functions of the nine printed circuit subassemblies and their respective positions on the vertical metal chassis are shown by the diagram. The vertical chassis, which has been incorporated by other TV manufacturers*, also makes for easier servicing, since it is not necessary to remove the chassis from the cabinet to replace parts or subassemblies.

The increasing use of electronic devices in homes, factories, and offices could conceivably lead to a shortage of servicing personnel. The design and construction of the Walsco chassis should be studied by manufacturers of electronic devices other than television receivers as a possible method of insuring rapid and efficient servicing of their products.

* Vertical Chassis TV Receiver, ELECTRONIC DESIGN, May, 1954, p. 18.



Location, function and tube complement of each printed-circuit subassembly.

- A Vertical sweep (6W6; 12AU7).
- B Horizontal output (6W4; 1B3).
- C Horizontal oscillator (6SN7GTA; 6AU5).
- D Audio amplifier (6AU6; 6AQ5).
- E Control.
- F Sound i-f (2-6AU6; 6AL5).
- G Synchronization separator and horizontal phase discriminator (6AU6; 6C4; 6AL5).
- H Video amplifier (2-6AU6; 6AR5; 6AL5).
- I Video i-f (4-6CB6).

(The tuner and power supply tubes are a 6BQ7A and 6J6, and a 5U4, respectively.)

The front of the vertical metal chassis has only a small number of connections.



Amerac's low-priced . . .

"S" BAND WAVEMETER



The model #131 "S" Band Wavemeter (Amerac's version of the popular military model TS-117) covers the frequency range from 2400 MC to 3400 MC in 16 revolutions of the micrometer thimble, by either the transmission or absorption method.

— FEATURES —

- Rugged, cast metal case, attractively finished in gray baked wrinkled enamel.
- Micrometer reading window of magnifying glass makes reading easy.
- Highly sensitive indication of resonance.
- Sensitivity control for setting sensitivity of indicating instrument.
- Rugged components give long, accurate, trouble-free service.
- Precision cavity assembly for accurate repeatable readings.
- Anti-backlash device to give further accuracy.
- Silver-plated parts are Rhodium flashed to minimize corrosion.

— SPECIFICATIONS —

Accuracy (at 3260 MC/S)..... $\pm \frac{1}{2}$ MC.
(Hand calibrated graphs accurate to
 $\pm .02\%$ can be supplied at extra cost)
Loaded Q.....Approximately 1500
Ruggedized 50 microampere indicating
Instrument.
RF detector.....Selected type 1N21-B
silicon diode.
Input connections.....2 type N jacks
Output connections (video).....UHF jack
Overall size...6" long, 5½" wide, 3¼" deep
Weight.....3½ lbs.

PRICE—\$325.00

(antenna and fittings
available at extra cost)



Amerac, Incorporated

116 TOPSFIELD ROAD
WENHAM, MASSACHUSETTS

CIRCLE ED-28 ON READER-SERVICE CARD FOR MORE INFORMATION

Another
Burnell
exclusive!

3 BIG REASONS

to check

BURNELL

first!

"See us at the IRE Show Booth No. 678,
Kingsbridge Armory, New York City,
March 21, 22, 23, 24".

3 EXTRA REASONS TO CHECK

BURNELL FIRST!

- * Proven Top Quality
- * Competitive Prices
- * Prompt Deliveries

Write Department A
for Catalog 102A



BURNELL & CO., INC.

Yonkers 2, New York

PACIFIC DIVISION: 720 Mission Street, South Pasadena, California

CIRCLE ED-29 ON READER-SERVICE CARD FOR MORE INFORMATION



ROTOROIDS®

A continuously variable, stepless toroidal inductor which can provide a 4:1 range of maximum to minimum inductance in 180° rotation of a shaft. Write for new brochure which gives complete technical data.



TOROIDS

Combining the advantages of toroidal type winding with the molybdenum permalloy dust core and other specially selected materials, these toroids provide higher Q than any other structure. They also provide greater stability of inductance vs. temperature and level in a smaller space. Their self-shielding properties permit compact assemblies of coils with a minimum of deleterious effects. Supplied to an inductance accuracy of 1%. Available in standard, miniature and sub-miniature sizes. Also in a wide variety of finishes, including for the first time toroids molded in a new special material.



TELEMETERING FILTERS

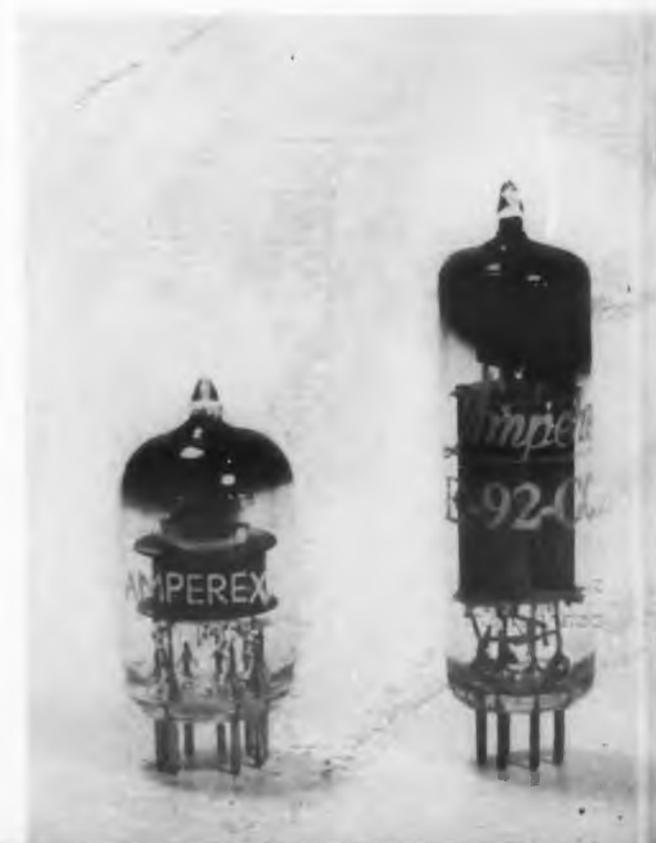
Band pass filters available for every channel ranging from 400 to 70,000 cycles for band width between 15 - 40%. Low pass filters available for operation in either unbalanced or balanced line, and range in cut off frequency from 6 up to 10,500 cycles. Also, miniaturized filters that do not sacrifice attenuation characteristics, save up to 80% space.

FIRST IN TOROIDS
AND
RELATED NETWORKS

Long-Life Tubes

DESIGNED for use in unattended control and communications service where long life is essential, these "Premium Quality" Tubes are guaranteed to have a minimum life of 10,000hr. Available in various versions such as pentodes and twin-triodes, the tubes are all miniature types, generally with 9-pin bases.

Among the types available are the 6084, a ruggedized pentode similar to the 5693; the E92CC, a twin-triode similar to the 5964; the 6085, a medium-mu twin-triode similar to the 5692; and the E83F, a pentode whose prototype is the 6AH6. Other tubes in the line are the 6227 pentode, the



E811
E180
twin-
puter
Ma
230 I
featu
and
obtai
the m
volta
±5%
to th

and
es-
ran-
able
win-
ally

E81L internally screened output pentode, the *E180F* broad-band amplifier pentode, and the *5920* twin-triode. The last tube is designed for computer circuits.

Manufactured by Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y., these tubes feature stability, resistance to shock and vibration, and narrow electrical tolerances. In order to obtain useful lives of 10,000hr with these tubes, the maximum variation of their respective heater voltages in parallel supply should be less than $\pm 5\%$. For more information on these tubes, turn to the Reader's Service Card and circle **ED-30**.

Four of the types in the new Amperex line of 10,000hr-guaranteed-life tubes are shown here actual size.



Get this 56-page Guide to

STACKPOLE ELECTRONIC COMPONENTS



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



CIRCLE ED-31 ON READER-SERVICE CARD FOR MORE INFORMATION

IT'S **CHICAGO** FOR
High Fidelity

**BROADCAST
MILITARY
MINIATURE
COMMERCIAL
HOME**



Where fine audio quality is essential, for private, commercial or military equipment, you can depend on CHICAGO high fidelity transformers for distortionless sound reproduction.

CHICAGO

**ULTRA-LINEAR
HIGH FIDELITY**

**Output Transformer
BO-13**

This "super-range" transformer, specifically designed for ultra-linear Williamson amplifier circuits, is typical of the many high fidelity transformers available from CHICAGO.

Amplifier frequency response, with the BO-13, is flat from 20 to 60,000 cycles at 20 watts output. At a 1 watt listening level, the BO-13 is flat from less than 10 cycles to beyond 200,000 cycles.

Intermodulation distortion, measured at 60 and 7000 cycles, 4:1 ratio, is less than 3% at 21 watts. Total harmonic distortion is below 0.1%, measured at 1000 cycles, up to 21 watts.

The BO-13 is housed in a compact, seamless steel case measuring $3\frac{5}{16}$ " x $3\frac{1}{16}$ " x $4\frac{1}{16}$ " high. CHICAGO's famous "sealed-in-steel" construction provides maximum shielding and full humidity protection.

CHICAGO Bulletin 33 lists performance curves and other useful information on the BO-13. Write for your FREE copy, or get it from your CHICAGO distributor.



**CHICAGO CATALOG
CT-554.**

listing complete electrical and physical specifications on over 500 CHICAGO transformers. Available from your CHICAGO distributor or from Chicago Standard Transformer Corporation.

CHICAGO STANDARD TRANSFORMER CORP.

3501 ADDISON STREET

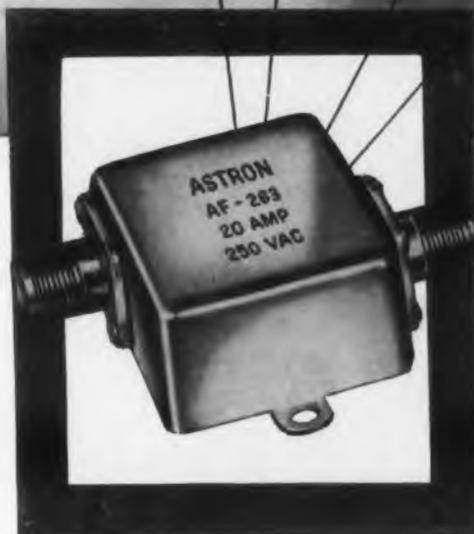
CHICAGO 18, ILLINOIS

EXPORT SALES:
Roburn Agencies, Inc.
431 Greenwich Street
New York 13, N. Y.

CIRCLE ED-32 ON READER-SERVICE CARD FOR MORE INFORMATION

Ternary Counter

The enclosure of the Ternary Counter is 2" x 2" x 2".



ASTRON AF-263
Subminiature Filter

Under every environmental extreme—dependable operation.

Find out today how Astron can reduce your filter costs... write for your personal copy of the new Astron filter catalog NOW!

How to SILENCE four throbbing hearts...

In each engine nacelle of the World's Longest Range Airliner — the Lockheed Super Constellation — are electrical fuel pumps... the airliner's four throbbing hearts.

Constant pumping action of these units sets up pulsing interference in the Constellation's radio equipment... upon which the well being of 99 passengers depends. The electrical interference from these four pumps must be filtered out for good... a unique R.F. noise suppression filter is required, one tough enough to withstand extensive temperature changes, constant high engine heat, the freezing cold of high altitudes, rapid changes in atmospheric pressure, successive acceleration and deceleration plus the twisting, ripping vibration set up by each engine's torque.

Lockheed handed this "toughie" to Astron, recognized leader in the development and manufacturing of high quality R.F. interference filters. Astron's engineers had developed a subminiature filter with solid dependability that significantly cut maintenance and replacement cost. So successful and versatile is this Astron filter that the USAF now uses a similar hermetically sealed unit in one of its "drone" target planes, whose exact flight performance is governed by the clarity of the radio control signals received.

Efficient and economical solutions to complex interference problems like these have become commonplace over the years at Astron... whether you require a conventional unit or a unique type—rely on Astron to recommend or develop the proper design to fill your most exacting specifications. Astron "know how" gives you true filter miniaturization with an absolute minimum of size, weight and volume achieved through a highly successful combination of miniaturized elements with most modern design concepts, and construction techniques.

ASTRON
CORPORATION
255 GRANT AVENUE, E. NEWARK, N. J.



Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y. In Canada: Charles W. Pointon, 6 Alcina Ave., Toronto 10, Ontario

Be sure to see us at Booth #368 March IRE Show

CIRCLE ED-15 ON READER-SERVICE CARD ➤

Printed Circuit Design

V—Applications

By George Maisch, Chief Electronic Designer

Photocircuits Corp., Glen Cove, N. Y.

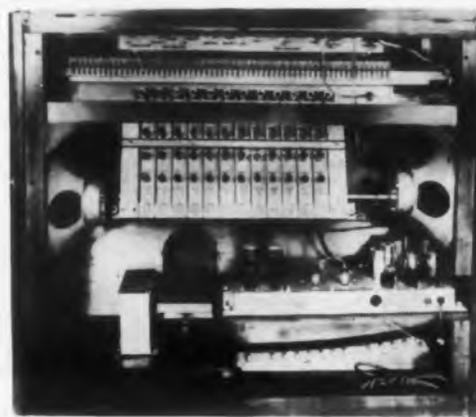


An easily serviceable device is the result of redesigning the Lear "Arcon". The original conventionally wired instrument is shown in the lower photo at the right.

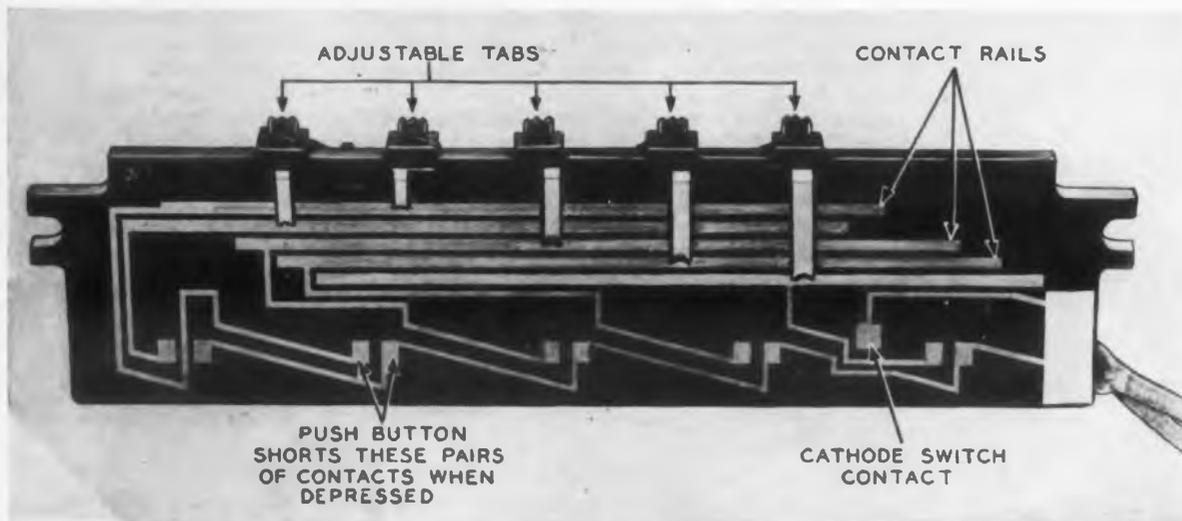
PRI NTED circuit techniques are now being employed by a number of manufacturers throughout the nation as an aid in reducing production, testing, and servicing costs, improving assembly methods, and to achieve some design difficult to obtain by any other method. As machines for automatic assembly of printed circuits become commercially available (*ED*, Sept., 1954, pp. 12, 13, 32, & 33.) and as new components for specific use with printed circuits are developed, the technique will find even more widespread use. But the primary stimulant to the in-

creased use of printed circuits will always be the ability of individual electronic designers to adapt the technique to the specific design problem at hand.

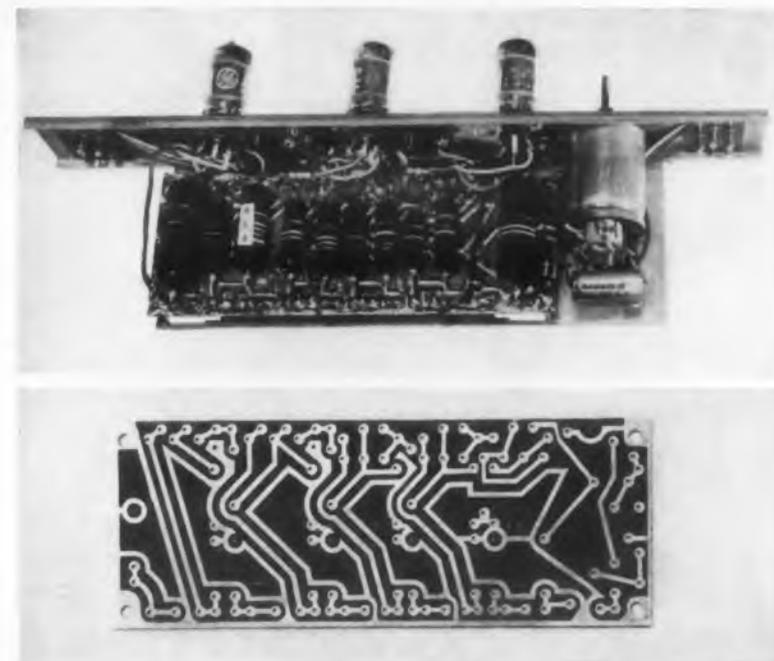
A dozen electronic assemblies are illustrated and discussed here as examples of what is being accomplished in printed circuitry to solve varied problems. *Aircraft Instrument*: Far easier servicing was gained by redesigning the "Arcon" aircraft instrument into a printed-circuit version, although the redesign results in a larger package. The device is made by Lear, Inc., 11916 W. Pico Blvd., Los Angeles 64, Calif.



The positions of the 12 tone generators in the Minshall electronic organ are shown at the left. The standard etched circuit and one of the complete generators are shown below. Some of the foil pattern acts as shielding.



This printed circuit is part of the push-button tuning mechanism of a Delco auto radio. The etched copper foil is silver plated.



Pushbu
mechan
nated b
tuning
Deleo
Ind., th
dial an
button
and sim
quiet by
the sign
comes
button,
The
ing" ra
at the
five fav
also cor
the rad
Tone C
and har
variatio
Model S
Co., In
The
eally id
quencie
half of
the uni
similar
that p
ponents
are add
hand-so
facturer
of a su
product
Comput
achieve
as an 'e
neering
The ele
be read
blocks"
ELECTR

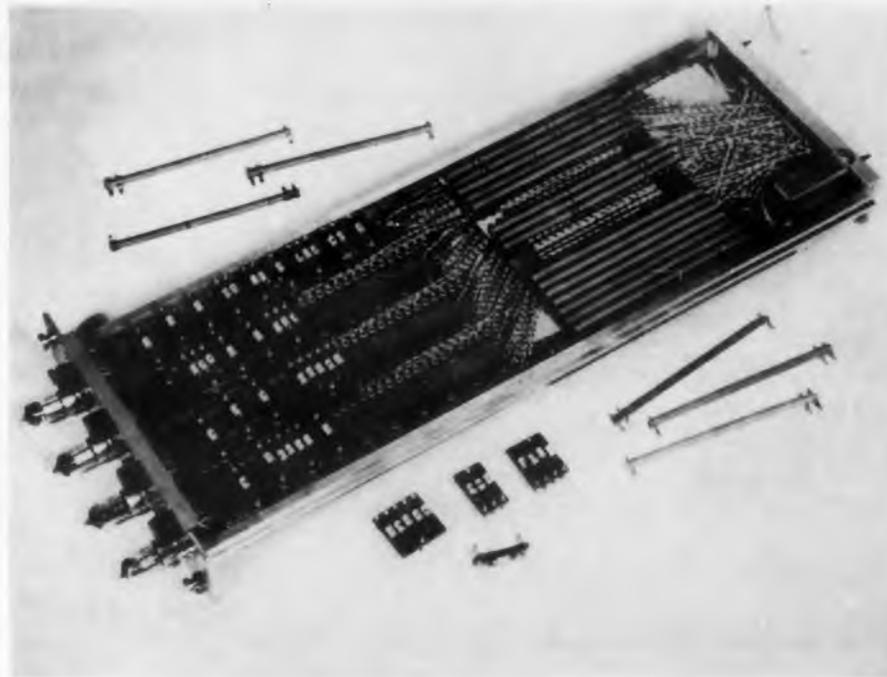
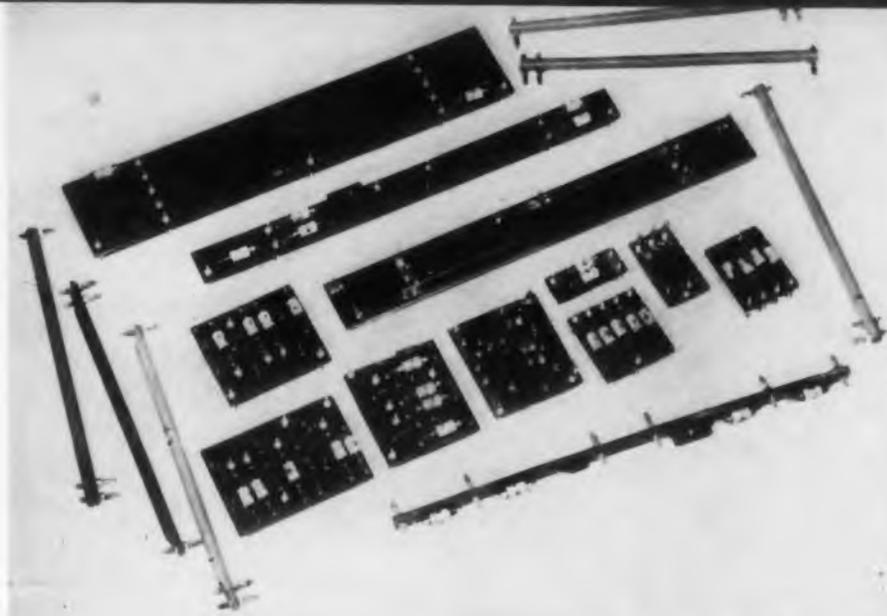
Pushbutton Tuning Assembly: A number of expensive mechanical parts and much hardware were eliminated by using printed circuitry in the auto radio tuning mechanism shown opposite. Designed by Delco Radio Div., General Motors Corp., Kokomo, Ind., the assembly is mounted between the tuning dial and a row of five pushbuttons. When a pushbutton is depressed, the appropriate station is selected, and simultaneously the set is made insensitive and quiet by opening the r-f cathode switch contact, and the signal seeking drive is started. When the pointer comes to the tab corresponding to the depressed button, it grounds the tab through the circuit board.

The device is for "Favorite Station Signal Seeking" radios, and the five adjustable tabs are visible at the dashboard to enable the driver to select his five favorite stations for pushbutton tuning. It is also compact and requires only two connections to the radio. It is not dip soldered.

Tone Generator: A combination of dip-soldering and hand-soldering is used to provide the necessary variations in "tone generators" incorporated in the Model S Electronic Organ made by Minshall Organ Co., Inc., Brattleboro, Vt.

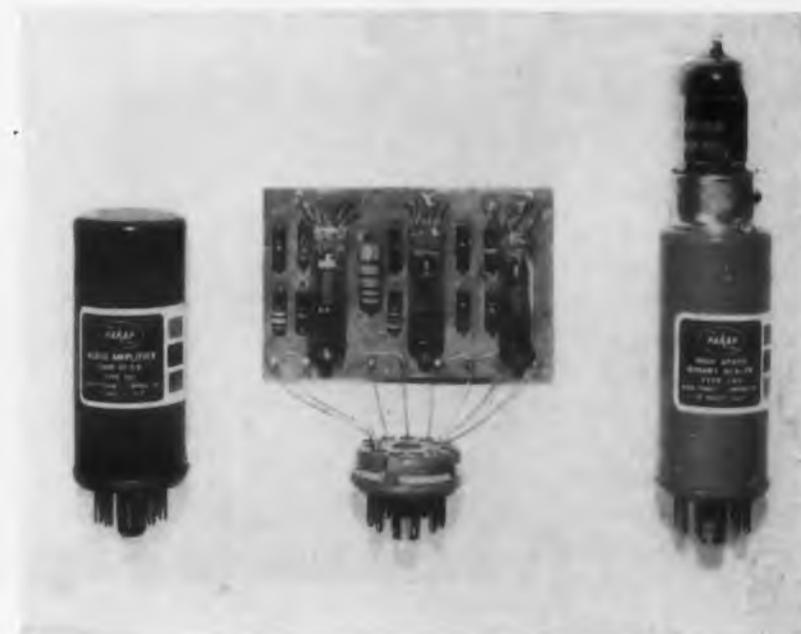
The 12 tone generators in each organ are mechanically identical, but must produce different tone frequencies. Since the electronic circuit and more than half of the components are the same, fabrication of the units is the same up to the point where the dissimilar components are added. This procedure means that printed-circuitry and dip-soldering of components can be utilized. The dissimilar components are added to the other side of the circuit board by hand-soldering. This technique is ideal for a manufacturer who does not produce enormous quantities of a subassembly, but still wishes to gain the mass-production advantages of printed circuitry.

Computer Package: "Double-layer" construction is achieved in the computer subassembly package known as an "Operation Unit" made by Technitrol Engineering Co., 2751 N. Fourth St., Philadelphia 33, Pa. The electrical characteristics of the subassembly can be readily changed by varying the plug-in "sub-blocks" inserted in the two main printed-circuit



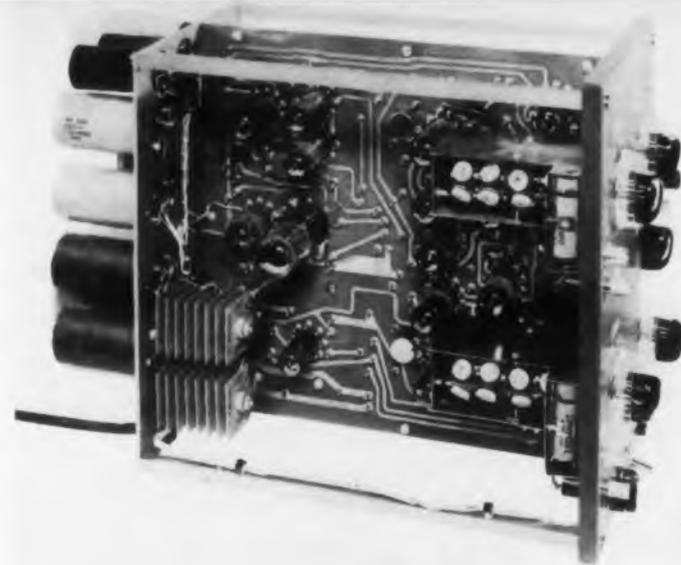
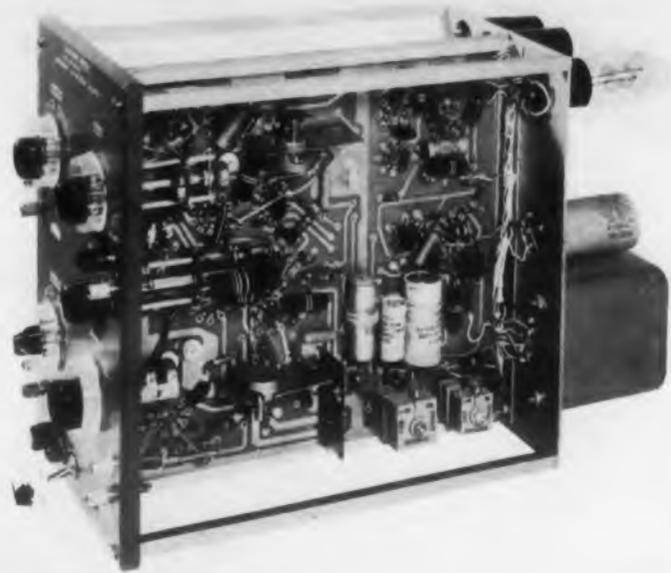
The printed circuit "sub-blocks" at the top are inserted in the main printed circuit boards of the Technitrol "Operation Unit" to change its computation functions.

The components are soldered to this Teflon-base printed-circuit while it is flat, then it is rolled and inserted in the metal can. Known as "Pakaps", the two versions of these Audio Products Corp. plug-in units are an audio amplifier (left) and a binary scaler.



boards. The sub-blocks incorporate diodes, diodes plus resistors, and delay lines. Each sub-block has two or more banana plugs that mate with standard eyelets inserted in the etched-foil pattern in the main circuit boards, which do not mount any components.

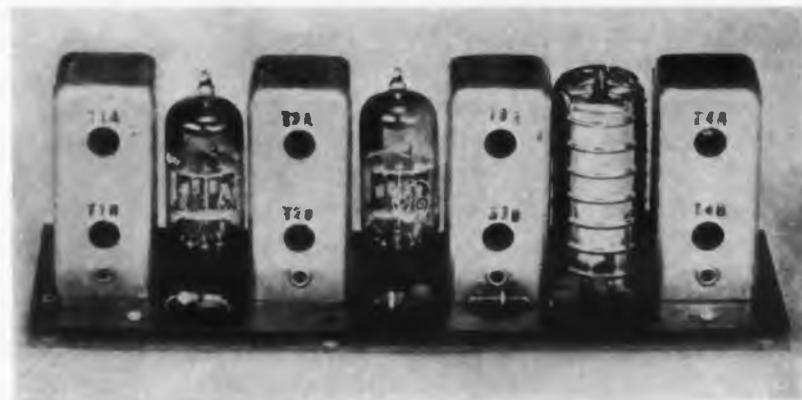
Additional features of this construction method are the short time required to dip-solder the diodes to the small sub-blocks (diodes are sometimes not recommended for dip soldering because of the danger of damage due to heat), and the ease of handling the



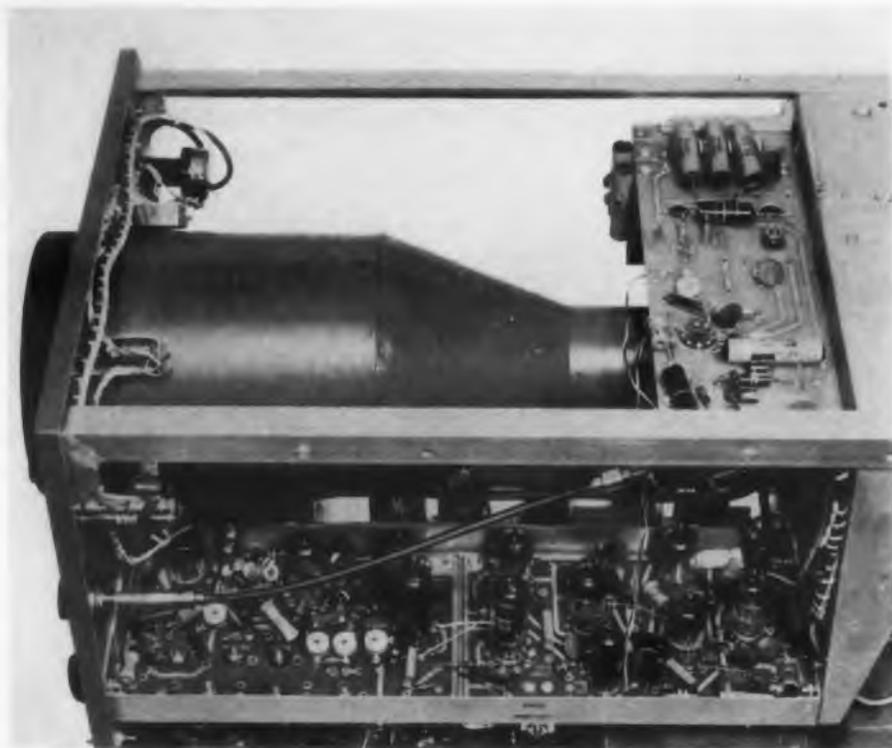
The two sides of the firmly mounted printed circuit used in the Du Mont Type 330 Electronic Switch are shown above. Notice the special "pin" connections.



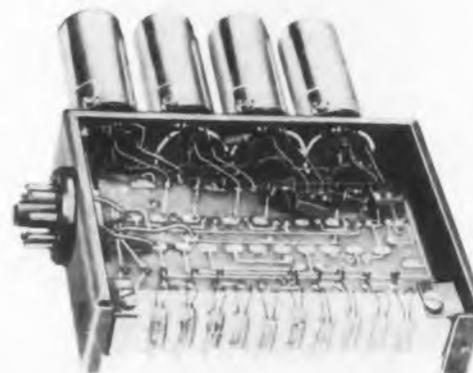
The Cardwell video i-f amplifier shown at the right can be incorporated in many TV receivers.



Practically all the circuitry in the Du Mont Type 329 Oscilloscope is on subassembly printed-circuit boards.



A Gurley Code Wheel. Base material is polished glass for use with photoelectric as well as magnetic or contact pick-ups.



The neon lamps (bottom) on this Detectron Decade Totalizer indicate one digit of the count.

large boards during fabrication because no components need be inserted in them for dip-soldering.

Plug-In Subassemblies: Flexible printed circuits are utilized in the plug-in subassembly circuits developed by Audio Products Corp., 2265 Westwood Blvd., Los Angeles 64, Calif. After the components are inserted in the pattern and hand-soldered, and the base is added, the assembly is rolled into a cylinder, wrapped in some insulation and inserted in a metal enclosure. A considerable saving in labor results over any stacked method of construction of the same size. This construction could be varied by placing the etched-foil pattern on the outer surface of the roll.

Electronic Switch and Oscilloscope: To protect the laminate from the effects of hot solder and fluxes, a method of dip soldering without dipping the laminate in the solder bath is employed in fabricating the printed-circuit boards incorporated in the Du

Mont Type 329 Oscillograph and Type 330 Electronic Switch. As illustrated, tubular pins are inserted in the circuit pattern prior to component assembly. (These are the same pins used in vacuum-tube bases, and they are available in a number of sizes.) Component wire leads are passed through the pins, and the assembly is soldered by dipping only the tips of the pins in the solder. Capillary attraction draws the melted solder up inside the pins providing a positive solder joint. The heat conducted by the pin to the etched-foil pattern fuses the connection between the pin and the etched foil. Because of the added cost of this method, it will most likely be limited to expensive instruments such as oscilloscopes, which must last many years. This equipment is made by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.

Video I-F Amplifier: The Cardwell printed-circuit

video i-f amplifier is an example of a type of product where printed circuitry should find great application. This subassembly can be incorporated in a number of different TV receivers, offering the receiver manufacturer a part that he could not manufacture as cheaply himself. The receiver manufacturer can also field test the printed-circuit technique without first being required to invest any large amount of capital. Once proven in this manner, the printed-circuit technique can be applied to other subassemblies in the equipment, or the entire circuit. This subassembly is manufactured by Allen B. Cardwell Electronics Production Corp., 97 Whiting St., Plainville, Conn.

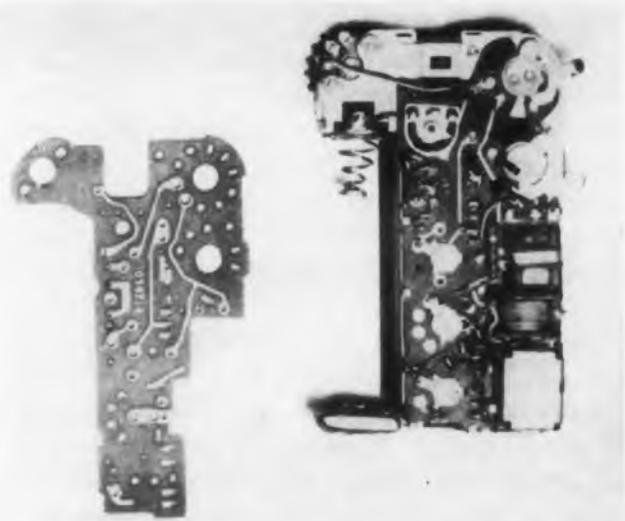
Code Wheel: Printed circuits are the only practical method of making code wheels. Such wheels are readily designed with unlimited variations by simply calculating the code and preparing the necessary master drawing. Code wheels are ordinarily made in a flush pattern with a hard, long-wearing nickel-rhodium finish. Wheels may be made with single or multiple discs depending on mechanical limitations. The base material can be glass for use with photoelectric pickups, as in the example shown, which is made by W. & L. E. Gurley, Inc., Troy, N. Y.

Decade Totalizer: No tube sockets are mounted on the printed-circuit board used in the Model TU-100P decade totalizer made by Detectron Corp., 5420 Vine-land Ave., N. Hollywood, Calif. The unit is only 1-3/4" thick. When a tube socket that mounts a tube in a plane parallel to that of the printed-circuit board is available, this design could be simplified by adding the sockets to the board while still retaining its compact "flat" configuration. Various manufacturers are working on the development of such sockets.

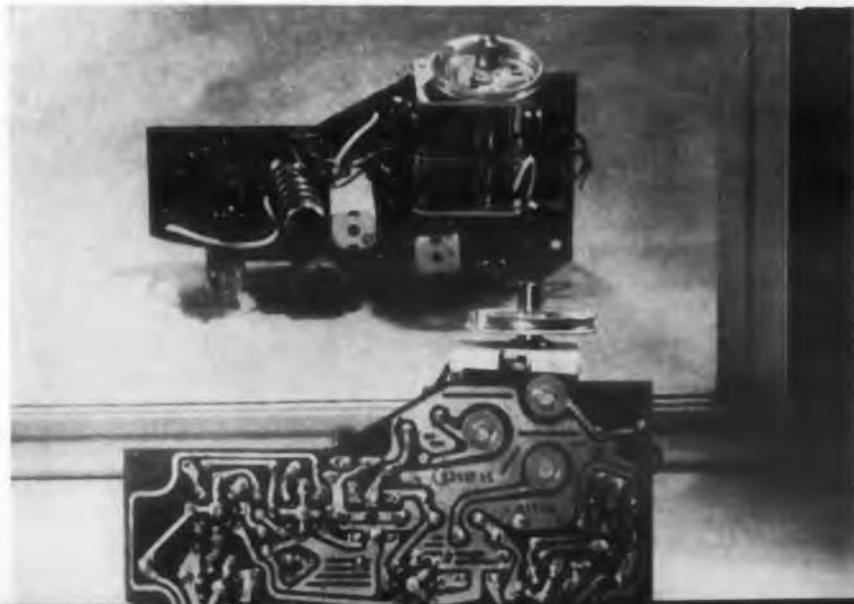
Hearing Aid: Built-in switch contacts are a feature of the printed-circuit of the Model 1200 hearing aid made by Sonotone Corp., Elmsford, N. Y. The switch contacts are rivets inserted in the etched-foil pattern.

Table-Size Radio: "Localized" dip-soldering techniques for speedier soldering are employed in fabricating all the table-size radios made by Philco Corp., Tioga and C Sts., Philadelphia, Pa. After the components are inserted in the etched-foil pattern in the usual manner, a special process prepares the pattern at those points where a connection is to be made. When the printed-circuit board is soldered by this firm's selective soldering method, the solder adheres only to the prepared connection points instead of the entire etched-foil pattern.

These examples indicate the applicability of printed circuit techniques to all branches of the electronic industry. Small and large manufacturers, and manufacturers of complete equipments or of subassemblies can all take advantage of this new construction method. In view of its present development and varied possibilities, no electronic designer today can afford to overlook printed circuitry.



The transistorized Sonotone hearing aid has switch contacts inserted in the printed circuit board (indicated by the two arrows).



The top of the printed-circuit chassis of this table-model Philco radio can be seen in the mirror. "Localized" dip-soldering is used to connect components. Large areas of etched foil are broken up to prevent blistering of the laminate during dip-soldering.

**CUT CORES
TOROIDAL
SQUARE.
RECTANGULAR**



Anything You May Need in TAPE-WOUND CORES

RANGE OF MATERIALS

Depending upon the specific properties required by the application, Arnold Tape-Wound Cores are available made of DELTAMAX . . . 4-79 MO-PERMALLOY . . . SUPERMALLOY . . . MUMETAL . . . 4750 ELECTRICAL METAL . . . and SILECTRON.

RANGE OF SIZES

Practically any size Tape-Wound Core can be supplied, from a fraction of a gram to several hundred pounds in weight. Toroidal cores are made in twenty-seven standard sizes with protective nylon cases. Special sizes of toroidal cores—and all cut cores, square or rectangular cores—are manufactured to meet your individual requirements.

RANGE OF TYPES

In most of the magnetic materials named, Arnold Tape-Wound Cores are produced in the following standard tape thicknesses: .012", .004", .002", .001", .0005", or .00025", as required.

For complete details, write for Bulletins TC-101A and SC-107.

Applications

Let us help with your core problems for Pulse and Power Transformers, 3-Phase Transformers, Magnetic Amplifiers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Reactors, etc.

ADDRESS DEPT. ED-51

W&D 5485

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

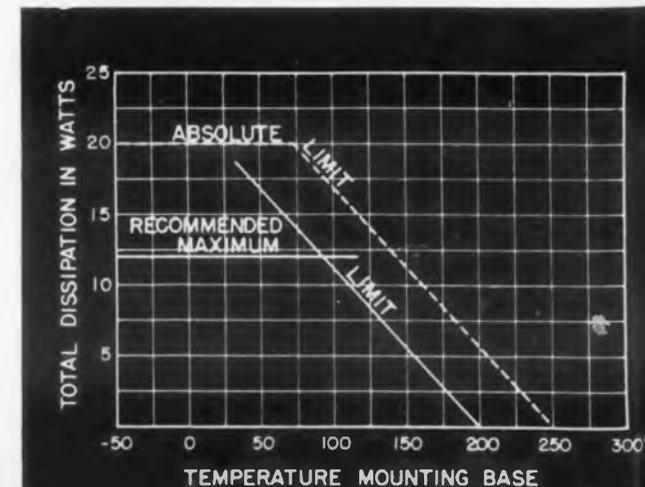
CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Transistors

CAPABLE of delivering currents in amperes, five new types of Power Transistors feature an improved shell design to permit more rapid heat flow to the unit's surroundings. One type supersedes this firm's earlier version of the 2N57 transistor, furnishing about five times the capacity of the other version. All of the same physical size, these p-n-p germanium junction devices are specially designed for control applications, and can drive a servo motor directly.

These transistors are made by Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave., Minneapolis 8, Minn. In order to prevent damage to the transistor, adequate means of conducting heat away from the junction must be provided as illustrated in the mounting diagram. The power handling capacities of the units drop sharply with a rise in ambient temperature. The collector voltage limit for the grounded-base configuration is 60v. The collector current limit for the H-1, H-2 and 2N57

Derating curve for the 2N57 transistor.



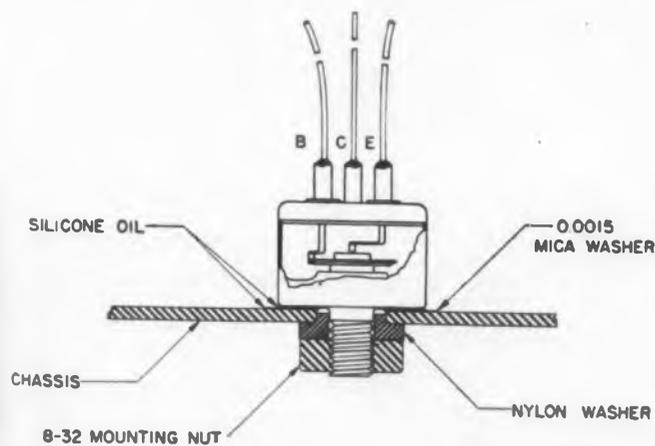
five
im-
flow
edes
stor,
the
hese
ally
ve a
olis-
Min-
re to
heat
llus-
han-
rise
limit
The
2N57



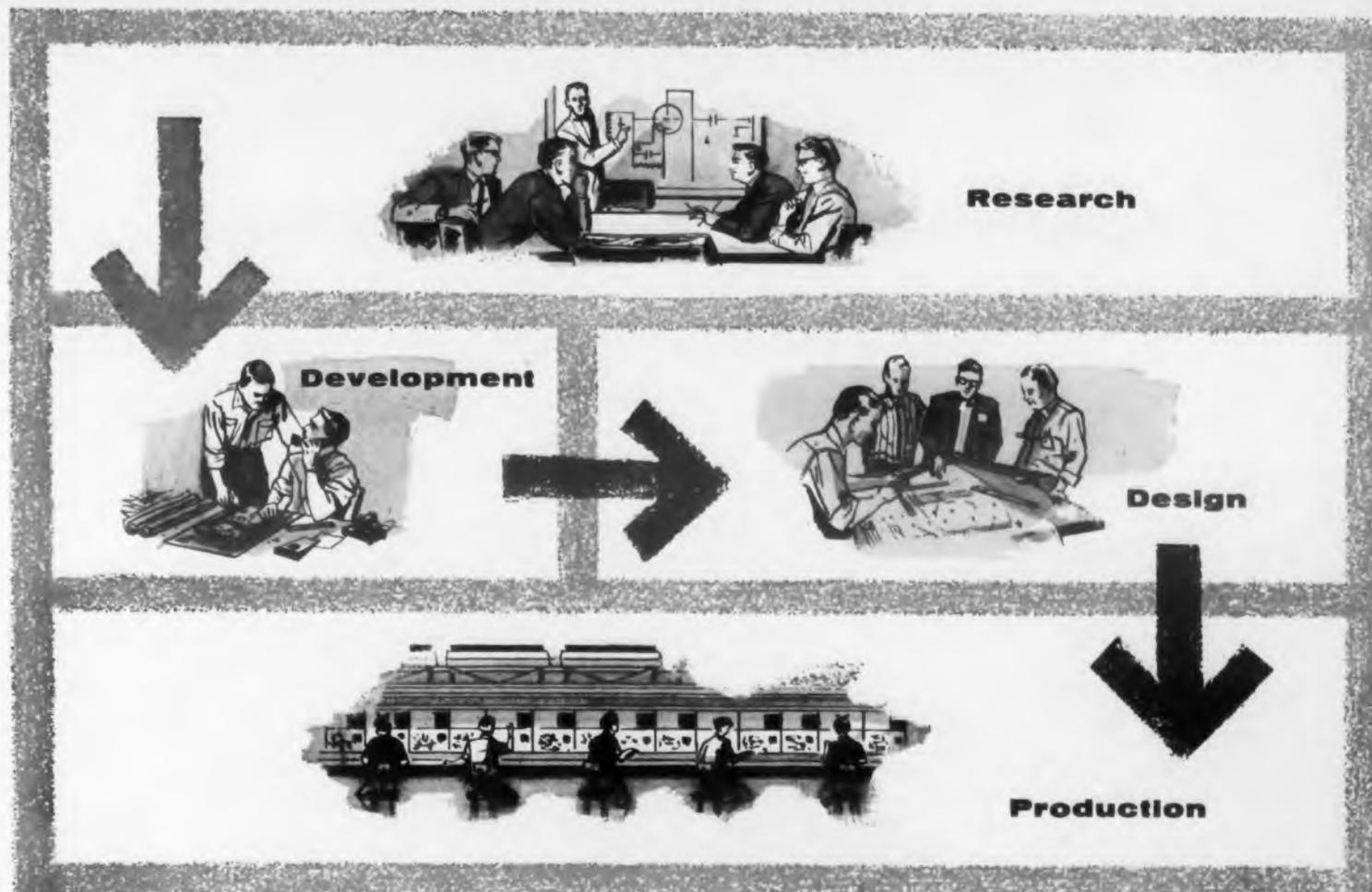
All five types of Power Transistors have shells that are $35/64$ " diam x $13/32$ " high.

types is 800ma. The same limit for the H-3 and H-4 is 400 ma. These limits theoretically mean high switching power. Their high dissipative capabilities are not useful except for non-ohmic loads, transient conditions, or in regulator service as a series-variable resistance.

Because of the non-linearities of the units, small-signal parameters are of little use in designing circuits or predicting performance. Large signal graphical analysis is needed. For more data on these transistors including graphs of parameters, turn to the Reader's Service Card and circle **ED-36**.



Transistor mounting diagram. "B", "C", and "E" are base, collector, and emitter terminals, respectively.



AN INTEGRATED ELECTRONICS OPERATION

Navigational Gear
 Guided Missiles
 Radar
 Noise Rejection
 Counter Measures
 Computers
 Communications
 Terminal Equipment
 Transistors



Hoffman's reputation for getting things done is due, in part, to the unification of Research-Development-Design-Production into one closely integrated electronics operation. At Hoffman — instead of the usual four completely separate operations — one technical director is assigned to co-ordinate each new project from start to finish. Every new project is developed in close cooperation with the divisions ahead, including the practical problems of quantity production. This integration practically eliminates the all-too-common duplications and overlapping of functions, the errors and re-work caused by poor liaison, and materially cuts down the usual time lag between the testing of the prototype and actual production. Hoffman has become a leader in electronics by doing progressively complex jobs — to specifications — to cost estimates — and on schedule.

Write for your copy of a
REPORT FROM HOFFMAN LABORATORIES

HOFFMAN LABORATORIES, INC.
 A Subsidiary of Hoffman Radio Corp.
 3761 South Hill Street, Los Angeles 7, California

Challenging opportunities for outstanding electronics and mechanical engineers. Write Director of Engineering.

CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

Experimental Encapsulation Technique

By George Quayle and Sherman H. Hubelbank
Connecticut Telephone & Electric Corp., Meriden, Conn.

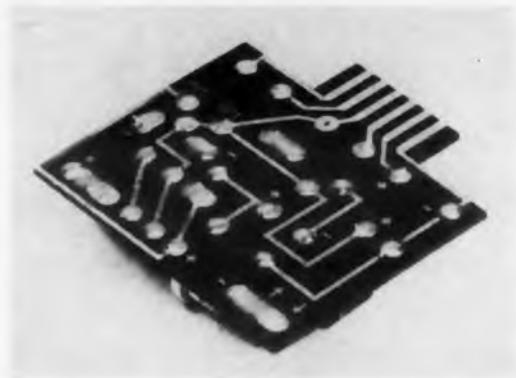


Fig. 1. Bottom of the amplifier showing the etched-foil pattern after dip soldering.



Fig. 2. Transistorized amplifier mounted on phenolic printed circuit board.

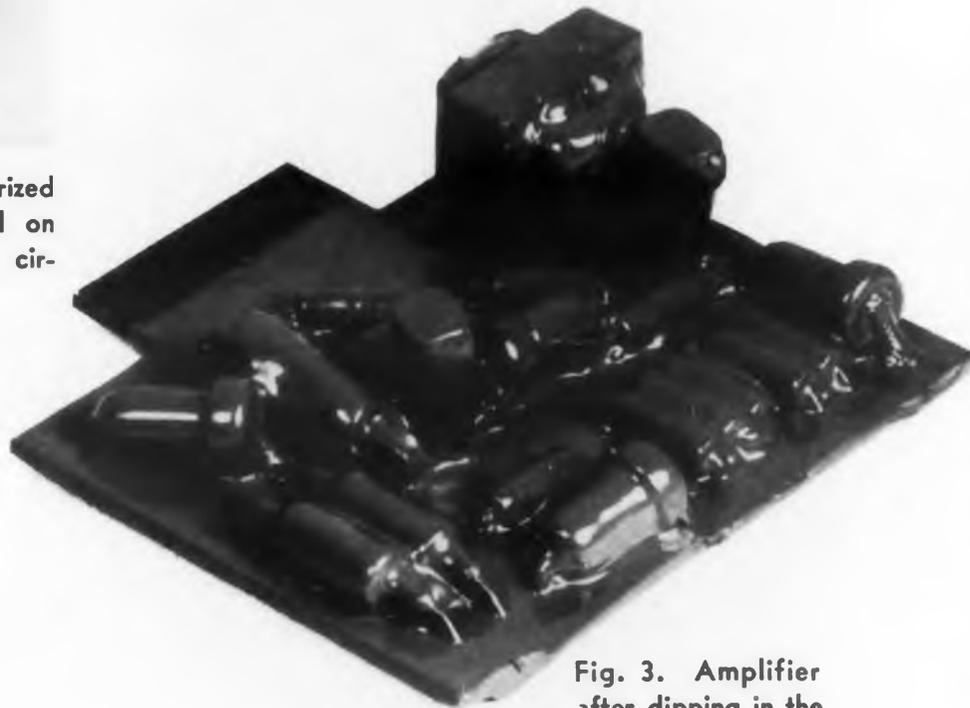


Fig. 3. Amplifier after dipping in the neoprene compressible coating.



Fig. 4. Polyethylene sheet mold, with assembly mounted in position prior to pouring encapsulating compound.

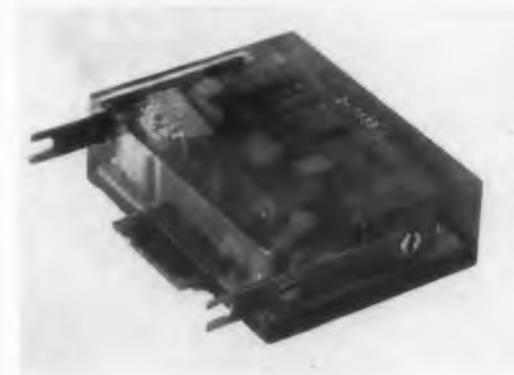


Fig. 5. Complete encapsulated amplifier, showing female printed circuit connections and the two mounting brackets.

ENCAPSULATION of electronic circuits can afford the designer more reliability and greater adaptability in design. This is particularly true when designing transistorized equipment utilizing printed circuits. The encapsulation technique described here was used on a two-transistor audio frequency amplifier. This amplifier was encapsulated in order to hermetically seal the assembly and thereby give protection against fungus growth and moisture. In addition, it achieved a three-dimensional circuit construction, which assisted in miniaturizing the overall design of the apparatus.

The use of transistors in an encapsulated assembly poses two special problems not usually found in a conventional encapsulated design. The first problem is the sensitivity of transistors to heat. This is a complex problem, for the question of whether or not the temperature will rise too high in the center of a mass of encapsulating compound during the cure period is determined by: (1) the geometry of the mass; (2) the relative amounts of materials and their thermal conductivity; (3) whether or not a catalyst is used in the process; (4) the presence of inert filler; and (5) ambient and pouring temperatures.

It was found that the long-time curing, epoxy-type resins were most suited to the solution of this prob-

tem. In
indicate
center c
served i
junction
by the
Paul, M
determin
posed co
The s
encapsu
breakag
during s
The s
has bee
from br
plying
ments,
The con
liquid m
Enginee
The e
steps: n
dipping
the enc
The f
associat
shown i
After
a coati
plied an
vided s
taminat
handlin
by Kry
The m
sembly
3 for a
compres
The m
ethylene
rods an
of mold
phenoli
were de
ness of
With
the resi
plifier
which
permitt
capsula
the enc
which
sion ar
shows
It sl
techniq
was no
lated a
ELEC

tem. In general, the longer cure times of these resins indicate relatively low exotherm temperatures in the center of the mass. The maximum temperature observed in using "Scotchcast" Resin No. 2, in conjunction with "Scotchcast" Hardener "B", both made by the Minnesota Mining & Manufacturing Co., St. Paul, Minn., was about 32°C. It had been previously determined that the transistors might be safely exposed to a temperature of 70°C.

The second basic problem involved in transistor encapsulation is the possibility of transistor lead breakage due to the stresses which would be applied during shrinkage of the resin upon gelling.

The solution of this stress problem was one which has been commonly used to protect vacuum tubes from breakage in encapsulations. This involves applying a compressible coating over the circuit elements, prior to the use of the encapsulating resin. The compressible coating used was grey "Gaco" N-700 liquid neoprene coating, air-drying, made by Gates Engineering Co., P. O. Box 1711, Wilmington, Del.

The encapsulation technique consisted of four basic steps: mounting the assembly; spraying with a sealer; dipping into a compressible compound; and pouring the encapsulation resin.

The first step was to mount the transistors and the associated components on a printed circuit board as shown in Figs. 1 and 2.

After assembly of the circuit on the phenolic board, a coating of clear "Acrylic" Spray No. 1302 was applied and allowed to dry for 10min. This spray provided sealing against the possibility of harmful contamination that might occur during subsequent handling and processing. The acrylic spray is made by Krylon, Inc., Philadelphia, Pa.

The next step was the dipping of the sprayed assembly into the Gaco N-700 liquid neoprene. See Fig. 3 for an example of an assembly coated with the compressible liquid neoprene.

The mold used was constructed of 1/2" thick polyethylene sheets, held together by means of threaded rods and wing nuts (see Fig. 4). A slot in the far end of the mold was cut to receive the connection end of the phenolic laminate board. The dimensions of the mold were designed to permit not less than an 1/8" thickness of resin between any part and the mold wall.

With the mold positioned upright, the mixture of the resin and hardener was poured in around the amplifier unit. A 24hr cure period was allowed, after which removal of the mold assembly screws easily permitted separation of the mold sides from the encapsulation. A standard milling cut along the top of the encapsulation was used to square off that surface, which became somewhat uneven due to surface tension and shrinkage during the cure period. Fig. 5 shows the completed encapsulated audio amplifier.

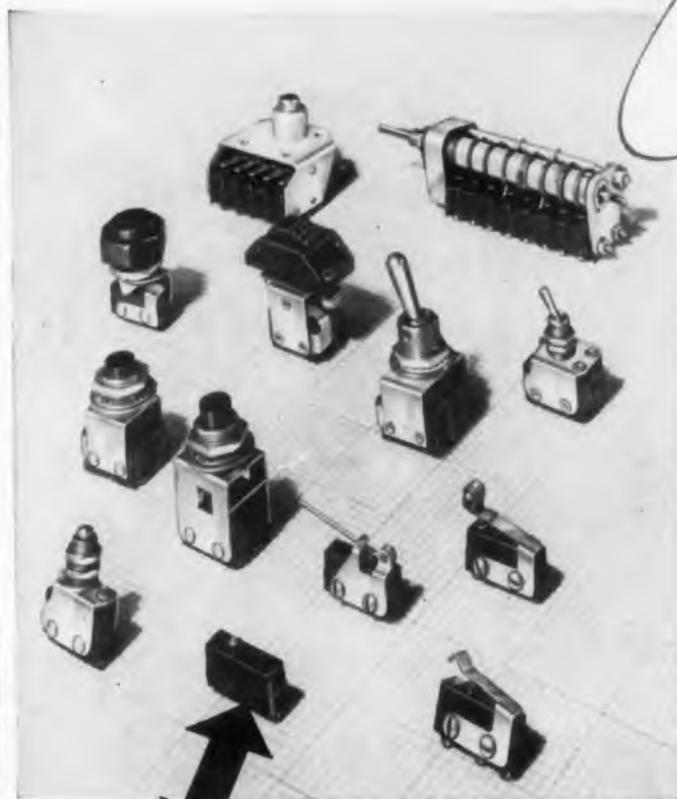
It should be noted that the above encapsulation technique was the result of experimental work and was not attempted for mass production of encapsulated assemblies.

MICRO SWITCH Precision Switches

A PRINCIPLE OF GOOD DESIGN

Here's the small switch Electronic

Designers have learned to count on



Subminiature
Switch Assemblies
to meet every
switching need

Ask for Catalog 75

MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

Designers of electronic equipment are extremely critical of day-in, day-out performance of components. Reliability of MICRO SWITCH products has made them first choice for a myriad of uses in this industry where component failure is intolerable.

In the subminiature switch MICRO SWITCH provides this superior reliability with extremely small-size, light-weight switches and assemblies that meet the requirements of the most streamlined design. Long experience has made MICRO SWITCH men expert in many complex problems of the electronics industry. Both in the field and at the factory they have participated in the development of many special switches to meet unusual specific requirements.

There comes a time in your development work when it will save you time and money to talk to an experienced switch man. Then is the time to call on MICRO SWITCH, the first name in precision switches. There is a MICRO SWITCH branch near you. Look in the yellow pages of your phone book.



MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

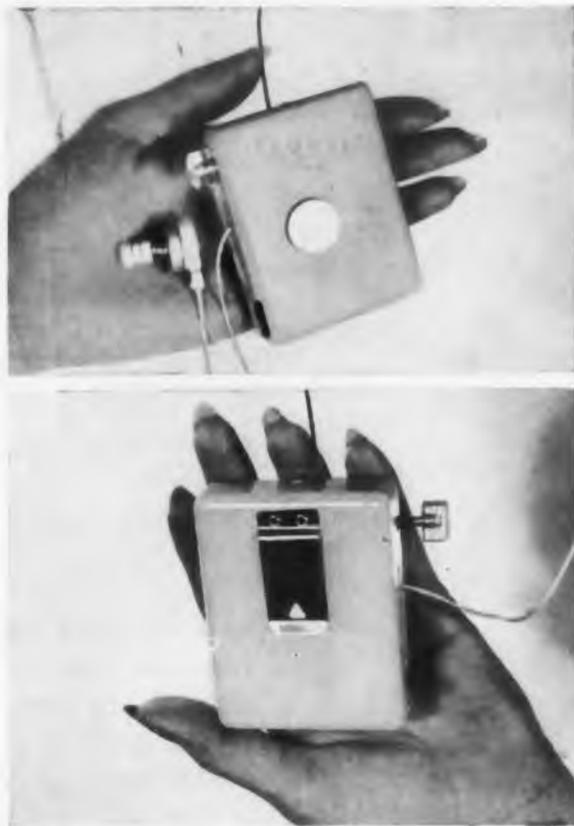
In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature AM-FM Radio

The unmarked tuning knob is turned all the way in for the 88Mc signal. Only the one screw holds the two halves of the plastic housing together. The black knob is a combination on-off volume control.

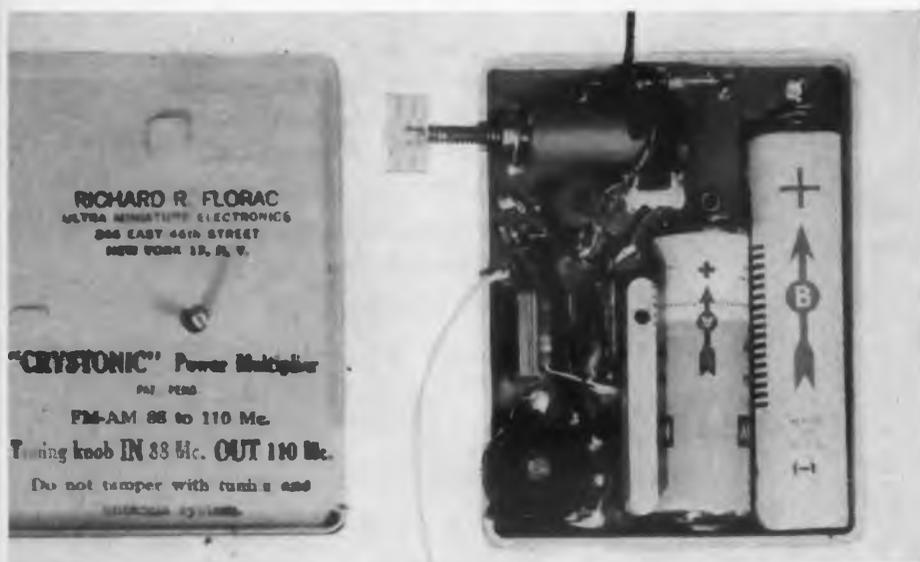


The back of the radio showing the pocket clip. The tuning knob is turned out for the 110Mc signal.

BY DEVELOPING an unusual circuit utilizing few components, Richard M. Florac, the designer of the miniature radio shown on these pages, has been able to package an a-m—f-m unit in a container the size of a package of cigarettes. Its price is also less than that of most small portable radios. The circuit automatically discriminates an f-m signal or demodulates an a-m signal depending on the type of signal it is receiving. The production model receives over the 88Mc to 110Mc standard f-m range, and therefore handles only f-m signals.

An explanation of the high-gain tuning circuit of

The melamine-canvas chassis swings out for tube replacement. The upper tube has a protective rubber coating. The retaining-spring-contacts for the batteries are attached to the chassis.



The two batteries make up the largest part of the radio, which has surprisingly few components. The diode is mounted above the tuning assembly.



the F
appea
future
"cryst
Onl
theon
crysta
tube
the d
to a
ampli
In
x 3/4
The t
all the
range.
to the
that
favori
coupli
The g
relativ
hearin
All
canvas
recess
of the
batter
half o
specia
uses N
Mr.
tronic
design
New Y
using
packag
an ing
in min
ELECT

NEW GERMANIUM POWER RECTIFIERS REDUCE VOLUME AND WEIGHT 75%

...and actually cost less!



GERMANIUM POWER RECTIFIERS



OVERALL SIZE IS 4" x 5" x 10"

Because of the higher efficiency of germanium, these new G-E rectifiers achieve a full 75% saving in size and weight—and yet actually cost less than any conventional type dry rectifier in use today. This sharply-reduced weight and volume is a result of greatly-increased power per cell in G.E.'s unique low-loss rectifier.

Compare and see! For new efficiency in your 1955 designs go the limit with new G-E Germanium Power Rectifier. Tell your rectification problem to the G-E application engineer—write today to: *General Electric Company, Germanium Products, Section X7415, Electronics Park, Syracuse, New York.*

SAMPLE DELIVERIES ARE SCHEDULED FOR FEB. 1955!

These rectifiers are available in standard combinations consisting of one or more rectifying elements. A few typical ratings are listed below.

CIRCUIT	D-C OUTPUT AT 55° C (Resistive Load)
Half Wave	30 amps @ 60 V 15 amps @ 120 V 10 amps @ 180 V
Full Wave Center Tap	30 amps @ 60 V 10 amps @ 180 V
Full Wave Bridge	10 amps @ 125 V
Three-Phase Half Wave	30 amps @ 95 V 15 amps @ 190 V
Three-Phase Bridge	15 amps @ 190 V
Three-Phase Star	30 amps @ 95 V

Be "money-wise" and "pound-wise" too, with these stand-out design features:

- Weight and volume reduced 75%
- Rectifier losses have been reduced to 1/3 or less
- No forward aging effects...no need for age-compensating devices

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION

the Florac radio will be discussed in an article to appear in *ELECTRONIC DESIGN* in the near future. This versatile tuning circuit is known as the "crystonic" circuit.

Only two inexpensive subminiature tubes, a Raytheon 5676 and the same firm's 6088 pentode, and a crystal diode are incorporated in the radio. The first tube functions as an oscillator in conjunction with the diode. The germanium diode, which is similar to a 1N54A, functions as both an r-f and an audio amplifier. The 6088 is an audio amplifier.

In order to package the radio in its 3" x 2-1/4" x 3/4" container, certain limitations were necessary. The tuning knob is unmarked. When it is turned all the way in, it is at the lower or 88Mc end of the range. When it is turned out, the radio is tuned to the upper or 110Mc signal. The designer believes that the user will quickly learn to recognize his favorite stations. To further save space, resistance coupling is employed instead of transformer coupling. The gain of the circuit is sufficient to overcome the relative power inefficiency of resistance coupling. A hearing-aid earphone is the speaker.

All the components are mounted on a melamine canvas chassis. The unmarked on-off-control knob is recessed. Only one thumb screw holds the two halves of the plastic enclosure together. When the two batteries are removed, the chassis swings out of one half of the enclosure. The subminiature choke is specially wound in England for this application. It uses No. 46 AWG wire.

Mr. Florac, whose firm is Ultra Miniature Electronics, 246 E. 46th St., New York 17, N. Y., also designed a radio paging system for Aircall, Inc., New York, N. Y. He is exploring the possibility of using transistors in this radio. The circuitry and packaging of Mr. Florac's unique radio represents an ingenious and stimulating solution to a problem in miniaturization.



KEARFOTT ANNOUNCES

a new product line from the West

CUSTOM AND STANDARD

MICROWAVE EQUIPMENT

STANDARD microwave equipment by Kearfott for laboratory or production includes attenuators, directional couplers, crystal-mixers, wavemeters and all universally-used microwave components. Units have been developed for the S, C, X_u, X, and K_u microwave bands. Components to applicable AN specifications are available in brass or aluminum—other materials to order.

CUSTOM-DESIGNED microwave equipment is a specialty of Kearfott. Manufacturing facilities, engineering-design personnel, a complete test laboratory and wide experience can be brought to bear on your problem. Kearfott can supply specialized components such as rotary joints, RF sources, matched assemblies and test equipment such as:

X-BAND TEST SET MODEL W-109

A four-in one instrument that saves time and money. Precision Wavemeter, Signal Generator, Spectrum Analyzer and Power Monitor in a single instrument for rapid field or assembly line testing. Designed by Kearfott engineers, utilizing Kearfott specialized microwave components.

Write for brochures

- X Band Test Set.
- Microwave Components.

Kearfott COMPANY, INC.
LITTLE FALLS, NEW JERSEY

WESTERN MANUFACTURING DIVISION

14844 OXNARD ST. • VAN NUYS, CALIF.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

SALES OFFICES

EASTERN OFFICE:
1378 Main Ave.
Clifton, N.J.

MIDWEST OFFICE:
188 W. Randolph St.
Chicago, Ill.

SOUTH CENTRAL OFFICE:
6115 Denton Drive
Dallas, Texas

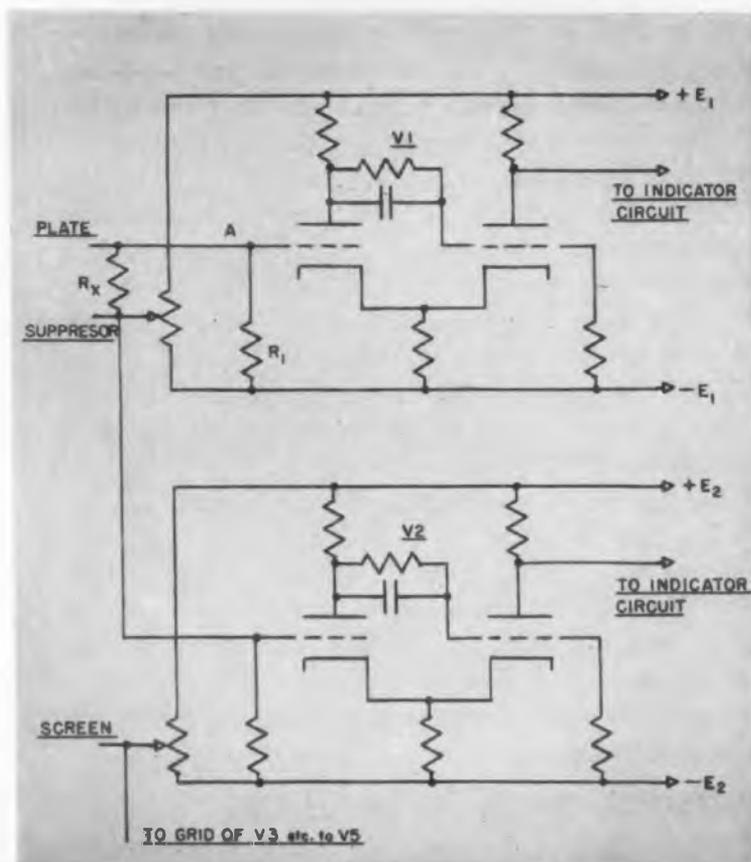
WESTERN AREA OFFICE:
253 Vinado Ave.
Pasadena, Calif.



CIRCLE ED-38 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Tester

In addition to standard tube tests, the Rheem Tube Tester indicates instantaneous or steady shorts between tube elements. This unit was built for the Boeing Airplane Co.



The circuitry employed to determine instantaneous or steady shorts between elements of a tube.

SHORT

0.5) shown a tubes p instrum is mad Hall R

The automa into th the uni compon tube. I each ad tory. T while b the sid externa

Exce cuitry i tion of R, and two tul vider n A, the Normal operati conduc become conduc and the a sharp to fire lamp in a short origina the thy

Each be testo ating f possibl detecti ing. T shorts i

If th parts o indicat this us to the

ELECTR

DOW CORNING
CORPORATION

Silicone News

FOR DESIGN ENGINEERS

SHORT circuits between elements as brief as $0.5\mu\text{sec}$ can be detected by the Tube Tester shown at the left. It also performs all the tests for tubes prescribed by Specification MIL-E-IB. The instrument, housed in a dual five-foot cabinet, is made by Rheem Manufacturing Co., 9236 E. Hall Rd., Downey, Calif.

The selection of proper tube parameters is automatically determined by inserting a subchassis into the two connectors located on the front of the unit. This subassembly contains the necessary components to provide the circuitry for a specific tube. Different subchassis must be constructed for each additional tube type to be tested in the laboratory. The tubes may undergo shock and vibration while being tested. Two connectors are located on the side of the enclosure from which cables to the external test fixtures may be attached.

Except for the short detector, most of the circuitry in the tester is standard. Here is a description of the short-detector circuit. Two resistors, R_1 and R_2 , the unknown resistance between the two tube elements under test, form a voltage divider network that determines the voltage of point A, the input grid of a Schmitt trigger circuit. Normally, the first half of the Schmitt trigger is operating at cutoff while the second half is in a conducting condition. When the voltage at A becomes high enough to allow the cutoff tube to conduct, the circuit reverses its original condition and the plate voltage of the second tube undergoes a sharp positive rise. This positive pulse is used to fire a thyratron, which in turn causes a neon lamp in its plate circuit to ignite and thus indicate a short condition. The circuit is returned to its original condition by opening the plate circuit of the thyratron tube.

Each adjacent pair of elements of the tube to be tested requires one short detecting circuit operating from an independent supply. To detect all possible short conditions simultaneously, the short detecting circuits are stacked as shown in the drawing. The ability of the tester to detect very brief shorts is of interest to computer designers.

If the entire tester is not required, separate parts of it, such as the short detector or noise indicator, are available. For more information on this useful design laboratory instrument, turn to the Reader's Service Card and circle **ED-39**.



Low Density Silicone Foams Are Nonflammable; Have Heat Distortion Temp Above 700 F

There's a solution now to problems involving nonflammable, low density foamed structures with good thermal and electrical insulating properties, buoyancy after long exposure to water and superior compressive strength at temperatures in the range of 500 to 700 F. What's more, such structures are easily made by foaming completely formulated silicone powders in place or sandwiched between metal sheets or silicone-glass laminates, by thermoplastic shaping before curing or by cutting from cast sheets or blocks.

Identified as Dow Corning R-7001, R-7002 and R-7003, these non-toxic silicone powders produce foams with a uniform, multipore structure that is predominately spherical and unicellular. Densities in the range of 10 to 18 pounds per cubic foot can be produced. Here are typical properties of open pan foams.

TABLE I			
	R-7001	R-7002	R-7003
Expansion Temp, F	320	320	320
Density, lb/cu ft	12	14	16
Cell Size, inch diameter	<0.08	<0.08	<0.08
Compressive Strength, psi			
at 77 F	100	200	325
at 77 F, 200 hr at 500 F	100	190	210
at 500 F, 1/2 hr at 500 F	5	25	70
at 500 F, 200 hr at 500 F	20	45	80
Weight Loss, %			
during expansion	1.2	1.3	1.0
1000 hr at 500 F	3.5	2.6	2.6
1000 hr at 570 F	8.0	4.2	4.2
72 hr at 700 F	8.5	5.2	3.2
Water Absorption, %			
24 hr immersion	3.2	2.3	2.1
Heat Distortion Temp, F	>700	>700	>700
Flame Resistance		Do Not Burn	
Dielectric Constant, 10 ³ cycles	1.23	1.25	1.26
Power Factor, 10 ³ cycles	0.0004	0.00102	0.00105
Thermal Conductivity			
BTU/hr/sq ft/°F/in. thickness	0.3	0.3	0.3

5 MIL SILASTIC DIAPHRAGMS SENSITIVE FROM -22 to 230 F

Wanted—A diaphragm for aircraft use that can be produced in commercial quantities to register, in thousandths of an inch, changes in air pressure at temperatures from -22 to 230 F; must resist moisture; withstand vibration and shock. That's a problem that Westinghouse materials engineers couldn't solve with such conventional materials as thin metals, natural or butyl rubber. So they met all requirements by developing commercial techniques for molding Silastic membranes, as little as 5 mils in thickness, to aluminum discs. The process requires utmost cleanliness and precision including extremely accurate control of processing time, temperature and curing schedules. **No. 20**

Among many potential applications, foamed structures with these properties and handling characteristics may be useful as core materials for propellers and airfoils and, in the form of sandwich structures, as radomes and fire walls in aircraft. They hold promise as thermal insulation for range oven doors and portable ovens.

Low density combined with low water absorption and nonflammability suggest a possible use as buoyant components in boats and ships. Heat stability combined with good dielectric properties suggests application as electrical insulating materials at high temperatures or where conventional insulation is hard to apply. **No. 19**

New 1955 Reference Guide to Dow Corning silicone products gives in 8 pages a brief but comprehensive summary of the properties and applications for the silicone products that are most widely used. Products are indexed by type of application. With increasing effort devoted to product improvement and cost reduction, such a reference guide to this remarkably stable group of engineering materials becomes increasingly important to design, production and maintenance engineers. **No. 22**

Scratching or breaking of glass containers during filling operations or in shipping can be substantially reduced by treating them with Dow Corning EF-4010 Emulsion. Easily applied in the final steps of manufacturing glass containers, it requires no special equipment; curing temperatures are not critical. It can also be applied to aged glass and cured by heating. **No. 23**



Silicone Finish Improves the Appearance of Space Heater

Distinctive appearance and longer service life at no extra cost have been achieved by the Perfection Stove Company of Cleveland through the use of Glidden's Nubelon-HR, a modified silicone finish based on Dow Corning resins.

According to Perfection, "Rich as aged leather in appearance, the finish we get by applying a light coat of mahogany over a primary coating of russet colored Nubelon-HR is rugged, tough, and very heat resistant. It retains its color and luster for long periods of time. We have been using it for over two years on all our oil heaters, with excellent results."

Nubelon-HR is also more consistent and easier to apply than organic resin based enamels. Supplied at a proper consistency for spraying, the labor and material cost of thinning are eliminated, and its slightly higher cost per gallon is offset by the effectiveness of thinner coatings. Finished parts are baked 30 minutes in a traveling oven at a top temperature of 480 F. **No. 21**

Design Edition 5

DOW CORNING CORPORATION - Dept. 4701
Midland, Michigan

Please send me more data on numbers:

19 20 21 22 23

NAME _____

TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

Canada: Dow Corning Silicones Ltd., Toronto; England: Midland Silicones Ltd., London; France: St. Gobain, Paris

CIRCLE ED-40 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Speaker-Microphone

Weights 1-1/2oz



The Model No. 100 speaker-microphone is housed in a steel and thermoplastic case which can be mounted in the microphone housing of dictation machines, portable radio trans-

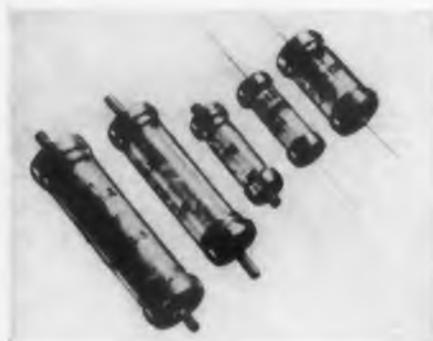
ceivers, and other electronic apparatus where a transmitting-receiving unit is desired. An externally-mounted miniature transformer for matching the microphone to grid circuit is available.

Sensitivity of the microphone with transformer is 52db below 1v/dyne/sq cm of sound pressure. As a receiver, the unit will deliver 120db of sound pressure with 10mw of power input. Nominal impedance is 10 ohms. Dimensions of the speaker-microphone are only 1" x 1" x 3/4", and weight is about 1-1/2 oz. Telex, Inc., Dept. KP, Telex Park, St. Paul 1, Minn.

CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Take Voltages to 60kv



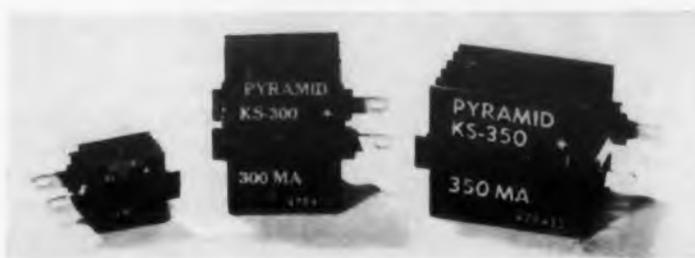
These high voltage capacitors have extremely small size and lightweight due to use of a new "high breakdown" plastic film. They operate at temperatures to 125°C, with voltages from 2-60kv

They are available with hermetic glass or plastic tube housings with wire leads or threaded stud mountings. Film Capacitors, Inc., Dept. ED, 3400 Park Ave., New York, N. Y.

CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION

Selenium Rectifier

Features Edge-Mounted Plates



The construction of this rectifier features edge-mounted plates, providing full air circulation between plates; light constant contact pressure, which eliminates center hot spots; rigid construction, eliminating loose plates; smaller overall size per rating; and simpler mounting. The design will operate at and is rated for use in high ambient temperatures.

The rectifiers, which are available in all current ratings, can be used in many types of electronic equipment, including radio and TV circuits. They can be used as replacements for all existing standard rectifiers. Pyramid Electric Co., Dept. ED, 1445 Hudson Blvd., North Bergen, N. J.

CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometer

Precision Unit with 1-1/16" Shell



The miniature Model 106 has been added to this firm's regular line of precision wire-wound potentiometers. The combination of small size, lightweight, wide choice of resistance values or functions, and ganging features, facilitates the application of the

potentiometer to fire control, navigational, guided missile, or other devices where compactness and precision are mandatory.

The unit retains the advantageous features of linear or non-linear functions of high accuracy for an OD of 1-1/16". George Rattray & Co., Inc., Dept. ED, 116-08 Myrtle Ave., Richmond Hill 18, N. Y.

CIRCLE ED-46 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Thermocouple

For -70° to +250°F Range



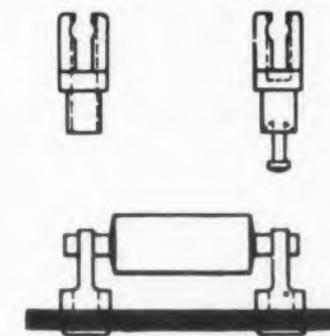
A new 0.035" O.D., stainless steel protected, copper-constantan thermocouple assembly, Model TC-1A, is available for temperature measure-

ments throughout the range of -70° to +250°F. This unit is ruggedly constructed, hermetically sealed, and normally supplied with an 8' extension cable. The unit is designed to facilitate rapid temperature determinations and create a minimum of system disturbance. Complete electrical insulation of the couple from the protection tube permits gradients to be accurately measured in solids or fluids. Medical-Electronics Development Co., Dept. ED, P. O. Box 443, Great Neck, N. Y.

CIRCLE ED-47 ON READER-SERVICE CARD FOR MORE INFORMATION

Diode Clips

Can be Reused Many Times



Three types of diode clips available from this firm are capable of holding crystal diodes with shaft diameters of 0.075" to 0.080". Model No. 9000 is designed for front panel mounting, and Model No. X9000 is for front panel mounting with a blind hole

for dip solder application. Model No. 9020 is for rear-of-panel connections. Each model of terminal clip is available for standard terminal board thicknesses, or to specifications.

Silver plate on half-hard brass assures good contact resistance. Mechanically, the clips retain excellent grip after multiple insertions. They are available from stock separately, or mounted per specifications. Lerec Div., Lynn-Deatriek, Inc., Dept. ED, 501 S. Varney, Burbank, Calif.

CIRCLE ED-48 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

Transistor Transformer Standard and Custom Types



This transformer is designed for reduced cost with no sacrifice in quality. Because of its extremely compact design, the TS 001 transformer is

suited to transistor circuitry in input, intermediate, or output stages. The standard model shown has a primary impedance of 20,000 ohms, with a maximum direct current of 1ma. The secondary impedance is 1000 ohms. Dimensions are only 3/8" x 3/8" x 3/8".

Transformers with other turns-ratios or impedances can be furnished on quantity order. Special types will also be developed to meet the user's demands. Made in Germany, they are available from Arka Imports, Dept. ED, 904 San Pasqual St., Pasadena 5, Calif.

CIRCLE ED-49 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Inductors In Variety of Values



Available both shielded and unshielded, Style A Type 1 Variable Inductors are supplied in 10 standard values from 56μh to 1.8mh, and up to a maximum of 25mh in special units. They feature an inductance variation range of 2:1; Q's of approxi-

mately 200; operating temperature range from -50° to +100°C; and temperature coefficients of inductance less than 50ppm/°C.

Inbedment of the entire powdered carbonyl-iron cup core and coil assembly in epoxy resin gives these inductors high resistance against the effects of large-amplitude vibration or shock, as well as providing good protection against moisture and chemical attack. Type 1 Core formula gives unusually constant inductance, free from non-linear effects.

Capable of dissipating 2.5w with a temperature rise of 20°C, the units have voltage ratings of 400v max, and dimensions of 1-1/8" long by 3/4" diam. They weigh approximately 1 oz. The same range of inductance values and other corresponding characteristics can be provided with approximately 10% higher Q's when mounted in slightly larger cans. The inductors are also available in the form of completely sealed tuned circuits with shunt capacitors included to specifications. Levinthal Electronic Products, Inc., Dept. ED, 2758 Fair Oaks Ave., Redwood City, Calif.

CIRCLE ED-50 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • January 1955

PERKIN

New!! Compact!!

28 VOLTS @ 100 AMPERES ± 1/2% REGULATION

SPECIFICATIONS

DC OUTPUT: 24-32 Volts at 100 amperes

AC INPUT: 230 or 460V. ± 10%, 3 phase, 60 cycles

RIPPLE: 1% rms

VOLTAGE REGULATION: ± 1/2%: (a) from no load to full load; (b) from 24-32 Volts DC; (c) for 230 (or 460) Volts ± 10%

RESPONSE TIME: 0.2 seconds WEIGHT: 250 lbs.

DIMENSION: 25" long x 15" deep x 15" high

Price: \$1,149.00, including meters & cabinets

PROMPT DELIVERY



MODEL MR532-15

5 to 32 VOLTS @ 15 AMPS (CONT.)
IMMEDIATE DELIVERY!!!

REGULATION: ± 1% (a) from 5-32 Volts D.C.; (b) from 1.5 to 15 amps.; (c) from 105-125 Volts A.C. (Single phase, 60 cps.)

RIPPLE: 1% rms @ 32 Volts and full load, increases to max. of 2% rms @ 5 Volts and full load.

RESPONSE: 0.2 seconds

METERS: 4 1/2" Rectangular AM and VM—2% Accuracy

DIMENSIONS: 22" x 17" x 14 1/2"

MOUNTING: Cabinet or 19" Rack Panel

FINISH: Baked Grey Wrinkle

WEIGHT: 150 lbs.

Price: \$524 w/o cabinet, \$549 w/cabinet

All prices F.O.B. El Segundo. Terms: 1%—10 days, net 30.
Phone collect for quantity discounts.

Write for Bulletin MA154.
Also write (on company letterhead) for Free Subscription to technical periodical "PERKIN," Power Supply Bulletin.



Rectifier Specialists Since 1932

345 KANSAS ST. • EL SEGUNDO, CALIFORNIA

TUBELESS!!! MAGNETIC AMPLIFIER REGULATED DC POWER SUPPLIES



Model MR2432-100X
24 to 32 volts @ 100 amps



MODEL M60VMC

0 to 32 VOLTS @ 25 AMPS (CONT.)
IMMEDIATE DELIVERY!!!

REGULATION: ± 1% * (a) At 28 Volts D.C.—increases to 2% max. over the range 24-32 V.; does not exceed 2 volts regulation over the range 4-24 volts D.C.; (b) from 1/10 Full Load to Full Load; (c) at a fixed A.C. Input of 115 volts.

RIPPLE: 1% rms @ 32V. and Full Load — 2% rms max. @ any voltage above 4 volts.

A.C. INPUT: 115 Volts, Single Phase, 60 cps

FINISH: Baked Grey Wrinkle

WEIGHT: 130 lbs.

DIMENSIONS: 22" x 15" x 14 1/2"

*This unit is an economical solution to your power supply needs if stabilization for A.C. Voltage changes are not required. If this is required, write for spec. on Model MR1040-30.

Price \$439 w/o cabinet, \$474 w/cabinet

PERKIN ENGINEERING CORP.

PHONE: ORegon 8-7215

CIRCLE ED-51 ON READER-SERVICE CARD FOR MORE INFORMATION

announcing . . . a new source for

Permalloy POWDER CORES

MAGNETICS inc.
*Performance-
Guaranteed*

Here's something to ring bells about, for Magnetics, Inc., the nation's largest manufacturer of tape wound cores, is now licensed by the Western Electric Company to manufacture molybdenum permalloy Powder Cores.

So now Magnetics, Inc. brings to powder core users the same "Performance-Guarantee" which has already provided a major free bonus to users of our tape wound cores, bobbin cores, magnetic shields and magnetic laminations. This is a guarantee of performance to your specifications.

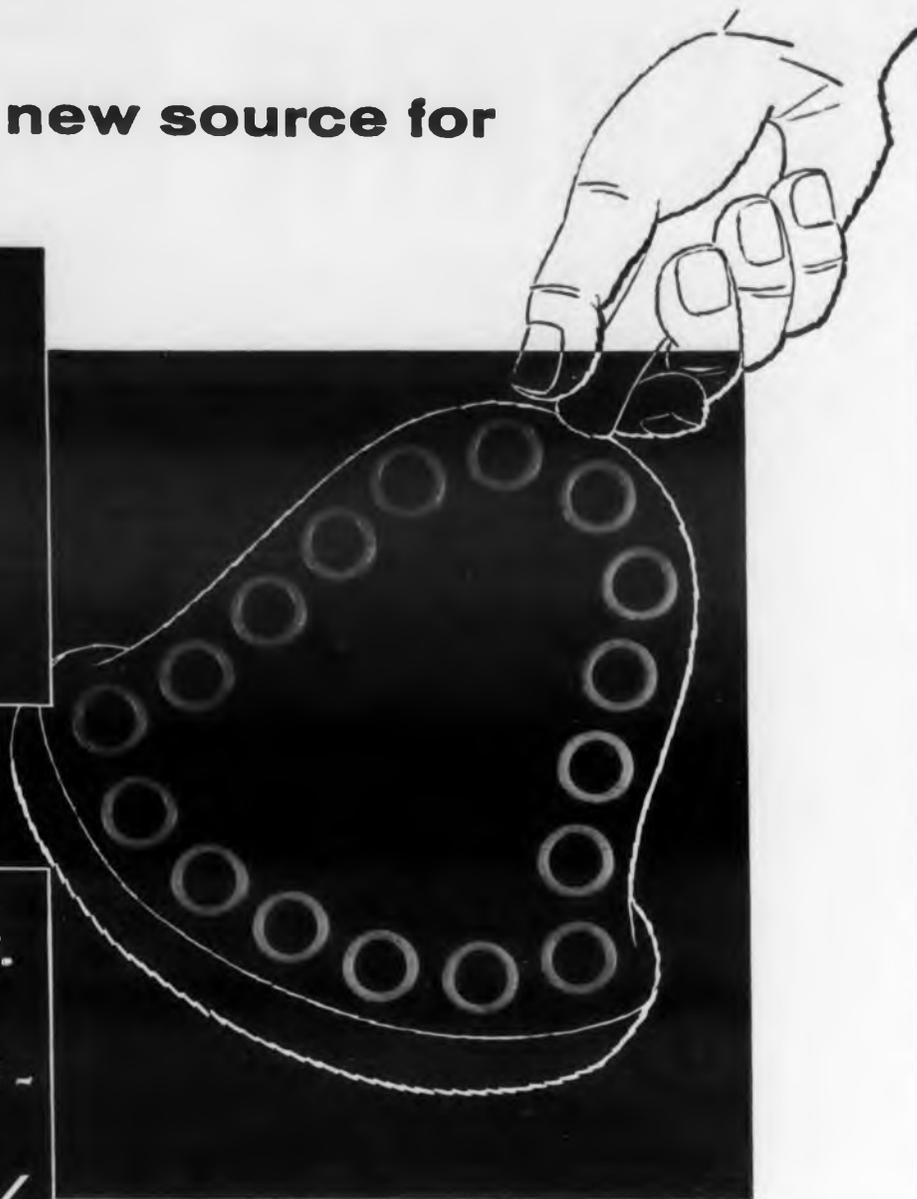
"Performance-Guarantee" is your assurance of savings in production and assembly. It costs you no more . . . our prices are standard in the industry . . . so make sure your next permalloy powder core order reads, "Magnetics, Inc. Performance-Guaranteed."

READILY AVAILABLE Why wait to have your Performance-Guaranteed Powder Core orders filled? Our expanded production facilities can have your order on its way almost as soon as it arrives. And send for our Bulletin PC-103 today so that you're ready to order Performance-Guaranteed Powder Cores as soon as you need them.

Write on company letterhead

MAGNETICS inc.

DEPARTMENT ED-19, BUTLER, PENNSYLVANIA
CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION



Frequency Meter

Checks A-C in 400cy Range

The Model 360 Frequency Meter is for checking frequency in the 400cy range. It operates on the principle of a series of progressively tuned reeds, with frequency indicated by vibration of the corresponding reed or reeds falling within a sharply peaked resonance response curve.



Insulated test probes are provided for shunting a portion of the voltage in the tested line across the 10,000-ohm internal resistance of the meter. An electromagnetic coil-armature combination applies mechanical energy at the frequency to be measured to the entire row of reeds. Only the reed having a natural frequency corresponding to line frequency will undergo vibrational response.

Instrument and probes are set in a heavy-gage, aluminum case, 6-1/8" x 3-1/4" x 3-1/4", equipped with carrying ring, snap lock, and slip-hinged removable cover. Voltage range is 100-130v a-c. Frequency increments are 5cy. Accuracy is $\pm 0.3\%$. Energizing input is less than 1.5w. Winslow Co., Inc., Dept. ED, 9 Liberty St., Newark, N. J.

CIRCLE ED-191 ON READER-SERVICE CARD FOR MORE INFORMATION

Bulkhead Mounting For Airborne Instruments



This mounting system, Model 1102, incorporates three all-metal double-acting mounting units. Located in the vertical plane of the center-of-gravity of the instrument, the mounting units combine to give a natural frequency of approximately 15cy. Effectively isolating vibration and shock forces, the system provides multi-directional protection to instruments installed on bulkheads or airframe structures. It meets requirements of MIL-E-5272B, Procedure 1.

The system is recommended for navigation instruments, oxygen flow indicators, potentiometers, fuel and pressure gages, timing devices, warning indicators, and other instruments in jet aircraft, helicopters, guided missiles, and rockets. Robinson Aviation Inc., Dept. ED, Teterboro, N. J.

CIRCLE ED-192 ON READER-SERVICE CARD FOR MORE INFORMATION

Electric Motors In Three Miniature Styles



Three styles of miniature electric motors are available from this firm for use in actuators or for other high-speed applica-

tions. The first is a split series type 24v d-c, or 110v a-c unit, rated at 2.5 oz-in for intermittent duty to 160°F. It is available for unirotational and reversible operation, and can be supplied with or without an integral filter. Weight is 13 oz, and overall dimensions are 3" x 3" x 2-1/2".

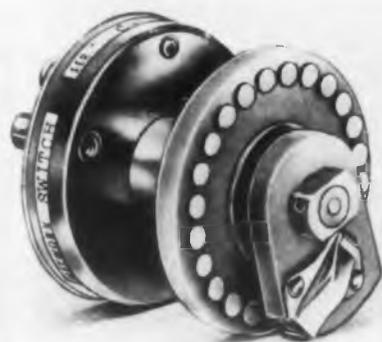
The second unit is a "square" motor designed to specifications AN-M-40 and MIL-E-5272. It is rated at 4 oz-in torque, intermittent duty to 165°F. This is a split series 24v d-c motor. It is available for unirotational or reversible operation and with or without a magnetic brake. Size is 1" square x 2" long. This model is also made for use in ambients up to 275°F.

The third motor is shunt-field type for 24v d-c, unirotational only. It is rated at 1 oz-in for continuous duty to 160°F. The motor incorporates thermistors in the field to compensate for temperature affect on motor speed. Weight is 13 oz. Pacific Div., Bendix Aviation Corp., Dept. ED, 11600 Sherman Way, North Hollywood, Calif.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

Transfer Switches

Contact Resistance Under 0.004 Ohms



"Thermocouple Transfer Switches" have extremely low and uniform contact resistance. The contact resistance is less than 0.004 ohms and will not vary more than ± 0.0003 ohms over the life of the

unit, thus fulfilling the basic requirement of a precision standard transfer switch for laboratory or production testing.

These units are available in all combinations of poles per deck, number of decks, and positions per deck. Silver alloy contacts, slip rings, and rotor arms are used exclusively, and no thermal emf is present. These durable switches have a life of up to several million operations. Daven Co., Dept. RC, 191 Central Ave., Newark 4, N. J.

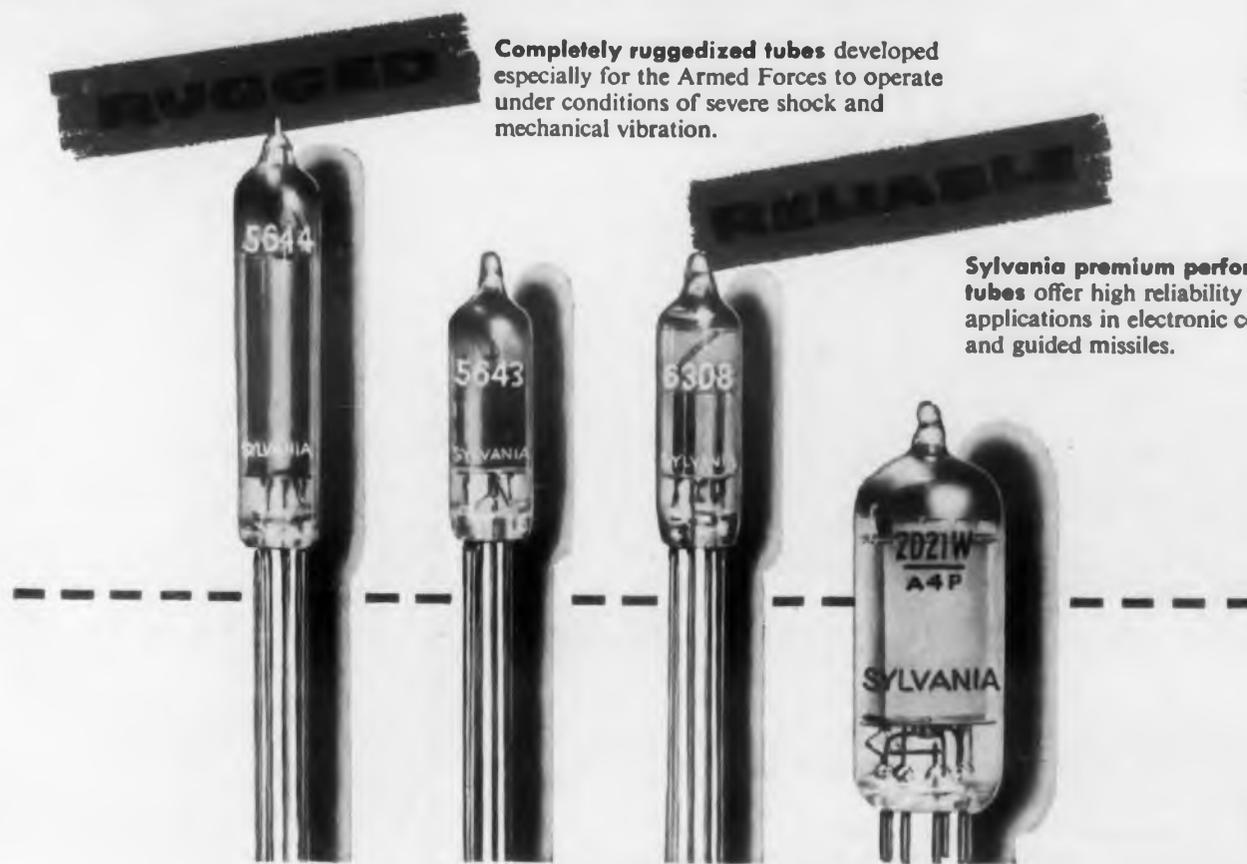
CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

NOW!

For your most important electronic control applications

Completely ruggedized tubes developed especially for the Armed Forces to operate under conditions of severe shock and mechanical vibration.



Sylvania premium performance tubes offer high reliability for applications in electronic computers and guided missiles.

SYLVANIA GAS TUBES

To MEET your electronic control equipment needs, whether military or commercial, Sylvania offers a wide selection of gas tubes engineered to meet the most rigid specifications. These include tubes for commercial use in applications where reliable performance is required under difficult conditions of shock and vibration. Some Sylvania gas tubes have been especially designed to meet MIL-E-1 specifications.

Whatever your needs, you can select any Sylvania gas tube with confidence that it is manufactured under the same standards of quality and dependability which recommend their use in vital military equipment.

Sylvania's complete line offers you dependable tube types for your most important control functions.



A SYLVANIA TYPE FOR EVERY NEED

Type	Application
0A2	voltage regulator
0A4G	relay and grid controlled rectifier
0B2	voltage regulator
0B3	voltage regulator
0C3	voltage regulator
0D3	voltage regulator
1B59/R1130B	glow modulator diode
1D21/SN4	strobatron
2D21	relay and grid controlled rectifier
2D21W	relay and grid controlled rectifier
R4330	strobatron
S413	strobatron
SA309	strobatron
1237	full-wave rectifier
20A5	trigger tube
5643	relay tube
5644	voltage regulator
5651	voltage reference
5823	relay, rectifier
6D4	relay, relaxation osc. noise generator
6308	voltage reference
6483	trigger tube

Send for new bulletin for complete data on Sylvania Gas Tubes.

SYLVANIA



SYLVANIA ELECTRIC PRODUCTS INC. • 1740 BROADWAY, NEW YORK 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

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

Please send Technical Data on Sylvania Gas Tubes.

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION

**Save Time, Reduce Errors...
Determine and Record Data
Automatically with These Two
Versatile Berkeley Instruments**



Model 5510 Universal Counter and Timer offers direct-reading digital display of count, frequency or microsecond time interval. Time bases from 1 mc. to 1 cps; gate times from .00001 to 10 sec. Accuracy ± 1 count, \pm crystal stability (1 part in 10^6). Price \$1,100.00 f.o.b. factory.

1. UNIVERSAL COUNTER AND TIMER, Model 5510, combines the functions of four instruments in one single, compact unit. It will:

- a. Count at speeds to 1 million per second.
- b. Count events occurring during a selectable, precise time interval.
- c. Measure time intervals in 1 microsecond increments, from 3 microseconds to 1 million seconds.
- d. Determine frequencies or frequency ratios from 0 cps to 1 megacycle.
- e. Operate directly the BERKELEY printer (below), BERKELEY digital-to-analog converter, or BERKELEY data processor to drive IBM card punches, typewriters or teletype systems.

2. BERKELEY DIGITAL RECORDER, Model 1452, combines scanner and high speed printer in a single unit; prints up to 10 digits on standard adding machine tape. Can be modified to print "Time" or "Code" information simultaneously with count data on same tape.

Model 1452 prints 6 digits (8 or 10 on special order) on standard adding machine tape. Is only 19" wide x 10 1/2" high x 14" deep, weighs 60 lbs. Price, \$750.00 f.o.b. factory.



Write for complete specifications and data; please address Dept. D 1

Berkeley

division

BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVE., RICHMOND, CALIF.

INDUSTRIAL INSTRUMENTATION AND CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

CIRCLE ED-52 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermistor

Combines Speed, Extreme Stability



The Type L118 thermistor combines the high speed response of this firm's smallest commercially available model with extreme stability at high operating temperatures.

The unit is a tiny, glass-coated ceramic element less than 0.018" in diameter, with 1 mil diameter platinum alloy leads.

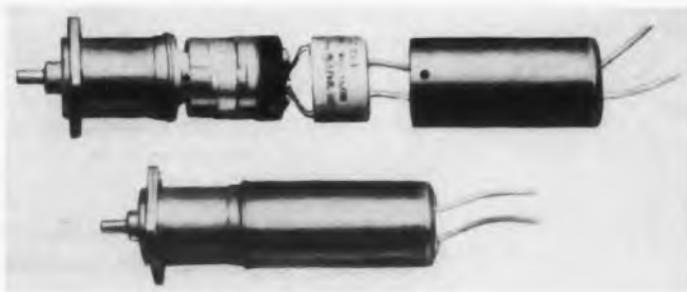
Thermistors of this size previously available were rated for a maximum continuous temperature of 150°C. The new type is rated at 300°C, where it is extremely stable, and is useful even to 400°C with good stability. The thermal time constant of this tiny sensing unit is only 1 sec in still air, and faster in liquids. In still air, 1mv of electrical power will heat the thermistor more than 10°C above the ambient temperature. About 10 of these units can be placed on the head of a common pin without stacking. Thermistor Corp. of America, Dept. ED, Metuchen, N. J.

CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION

Noise Filter

Integral with Motor

This miniature molded radio noise filter is designed to fit a small motor and gear assembly. Measuring only 1-3/16"OD x 3/4" long, it serves as an integral part of the motor instead of as an external accessory.



Replacing a conventional assembly, it reduces overall filter length approximately 50%.

Along with its miniature size, this continuous duty, dual-section filter features greater than 50db attenuation over the range of 150ke to 1000Mc. It operates satisfactorily in ambient temperatures as high as 125°C. It exceeds Air Force Specification MIL-I-6181-B as applied to small motors, and meets metalized paper size with paper and foil reliability. A molded metal insert is drilled and tapped to simplify mounting. Potter Co., Dept. EDN, North Chicago, Ill.

CIRCLE ED-54 ON READER-SERVICE CARD FOR MORE INFORMATION

PLATINUM ALLOY

potentiometer windings give

LONGER LIFE and greater

RELIABILITY



in the new *Pacific*
RATE GYRO

Precious metal potentiometer windings, of special platinum alloy, plus Pacific Scientific's advanced production techniques make possible unequalled quality at prices competitive with ordinary designs. Precision potentiometer, new motor and wheel design give maximum dynamic range and exceptionally high natural frequency. Powerful signal suitable for either ac or dc intelligence systems. Maximum output up to ± 50 volts.

The simple, rugged design of the new Pacific Rate Gyro makes it ideal for checking flight test characteristics, telemetering systems, automatic pilot and guided missile control. Check these specifications against your design problems:

MOTOR POWER—115 volt, 400 cps. or 28 volt d.c., Approx. 10 watts.

RANGE—Any range from $\pm 10^\circ/\text{sec.}$ to $\pm 1000^\circ/\text{sec.}$

NATURAL FREQUENCY—From 3 cps. to 200 cps. depending upon rate range. Example: $\pm 50^\circ/\text{sec.}$ unit, Natural Frequency—above 25 cps.

DAMPING—Viscous fluid damper, normally 0.5 to 0.7 of critical damping.

POTENTIOMETER RESISTANCE—From 500 ohms to 20,000 ohms, with or without taps, single or dual pots available.

RESOLUTION—0.25% to 0.8% of total potentiometer resistance.

ACCURACY—Within 1.0% to 2.5% of full rate depending upon range of instrument.

**PACIFIC SCIENTIFIC —
PIONEERING IN THE FIELD OF
AIRCRAFT INSTRUMENTATION
SINCE 1919**

Pacific **SCIENTIFIC CO.**

LOS ANGELES, CALIF., 1430 Grande Vista Ave.
SAN FRANCISCO, CALIF., 25 Stillman Street
SEATTLE, WASHINGTON, 421 Michigan Street
ARLINGTON, TEXAS, 111 East Main Street
Eastern Representative: Aero Engineering Inc

CIRCLE ED-55 ON READER-SERVICE CARD

ELECTRONIC DESIGN • January 1955

Vacuum Tube Voltmeter
0.001-300v Range in 12 Steps



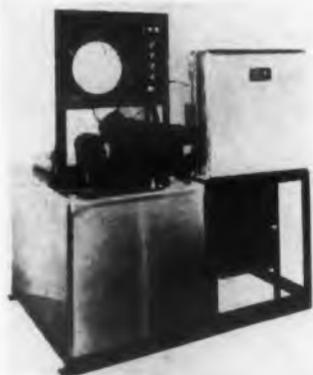
The Model 202 Voltmeter has a wide frequency range from 20cy to 2Mc and full scale ranges from 0.001v to 300v in 12 steps. Its input impedance of 10 megohms shunted by 15mmfd (4mmfd on the lower ranges) minimizes errors due to loading of the circuit under test. Accuracy is $\pm 3\%$ to 100kc, and $\pm 5\%$ to 2Mc. Separate terminals are brought

out from the input and output of the amplifier section of the instrument, permitting its use as a separate amplifier with maximum gain of 50db.

The Model 202 utilizes four-channel chassis construction, which provides great strength in conjunction with excellent cooling, shielding, and serviceability. The large illuminated meter is calibrated to read both in volts and db, and has scales specifically designed for greater accuracy in reading. Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE ED-95 ON READER-SERVICE CARD FOR MORE INFORMATION

Cold Chamber
Utilizes Dry Ice

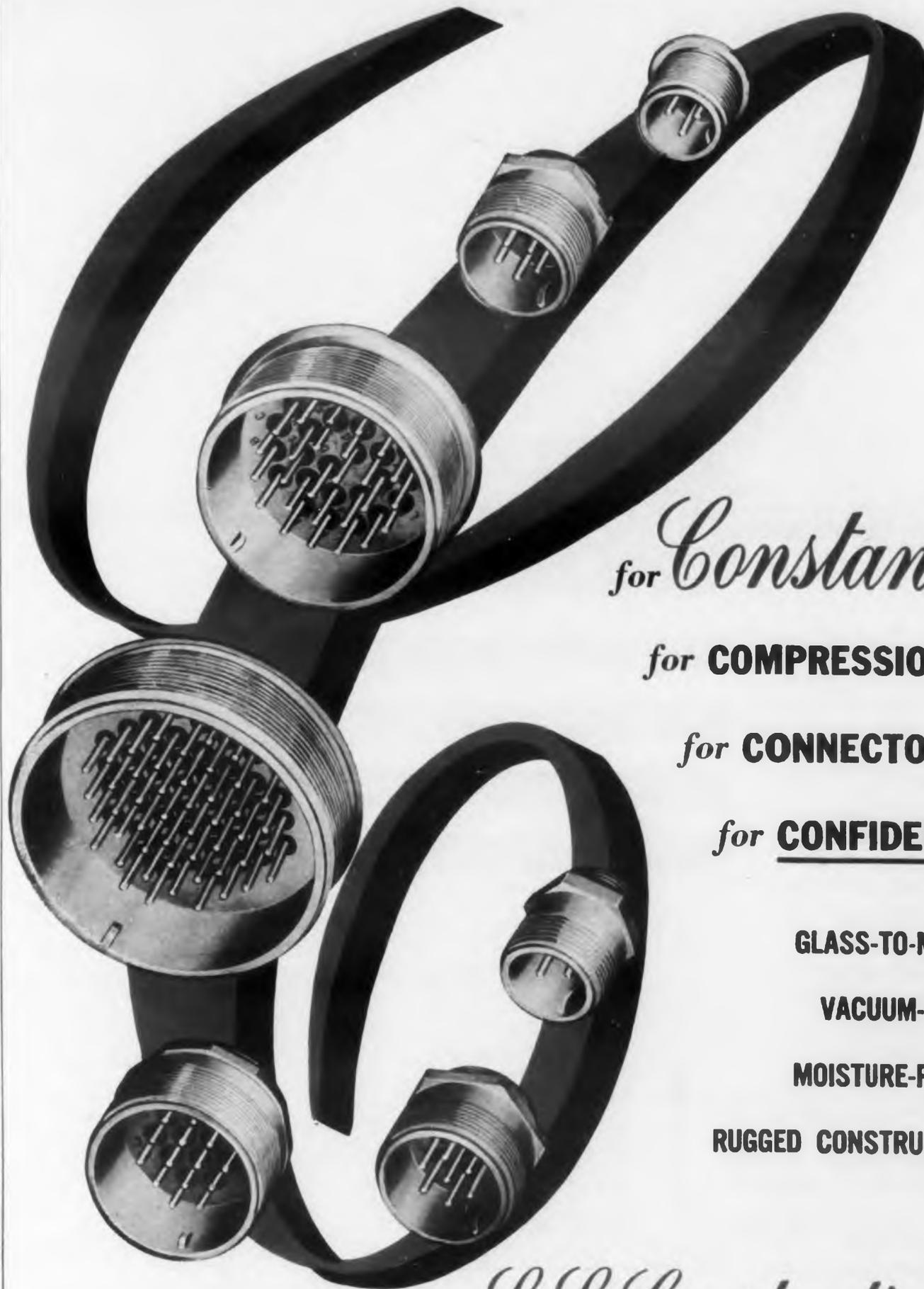


This low cost, low temperature test cabinet is especially designed for occasional testing and where the power supply is limited or no water is available for cooling freon. It utilizes dry ice as a refrigerant which is placed in a holding tank and immersed in brine. The brine is then circulated through cooling

coils in the test space, making possible close control of temperature tolerance and eliminating the disadvantages and loss of efficiency caused by water ice forming on dry ice applied directly to the test space.

The chamber has a range of from -65°C to $+65^{\circ}\text{C}$, and temperatures can be controlled within 1°C throughout the range. The equipment can be operated on 115v, 30amp, 60cy, outdoors as well as indoors since no water supply is required. Cabinets are available from 4 cu ft of test space up, with simulated high altitude if required, and with any penetrations desired in all walls. American Research Corp., Dept. ED, 11 Brook St., Bristol, Conn.

CIRCLE ED-96 ON READER-SERVICE CARD FOR MORE INFORMATION



for Constantin

for COMPRESSION

for CONNECTORS

for CONFIDENCE

GLASS-TO-METAL

VACUUM-TIGHT

MOISTURE-PROOF

RUGGED CONSTRUCTION

L. L. Constantin & Co.

MANUFACTURING ENGINEERS
Route 46 Lodi, New Jersey



Also manufacturers of Glass-to-Metal

HEADERS • TERMINALS • END SEALS • TRANSISTOR MOUNTS • CRYSTAL BASES & COVERS • VACUUM COATING EQUIPMENT

CIRCLE ED-97 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

NEW! HUGHES NOW OFFERS

Silicon Junction Diodes



Hughes continues to set industry standards for quality and reliability of semiconductor devices. These NEW Hughes Silicon Junction Diodes now provide you with devices which will operate at high temperatures. They combine high forward conductance with extremely high back resistance. In several diode types, this resistance is in the order of 10,000 megohms! This means that, in many applications, there is essentially an open circuit in the back direction. The phenomenal back resistance of these diodes has opened up many possibilities for entirely new circuit applications, in addition to meeting requirements for higher temperature operation, which germanium cannot satisfy. Before completing design work on your next equipment, be sure to investigate the outstanding new Hughes Silicon Junction Diodes.

HIGH FORWARD CURRENT

EXTREMELY HIGH BACK RESISTANCE

VERY SHARP BACK VOLTAGE BREAKDOWN

HIGH TEMPERATURE OPERATION

Hughes Subminiature Silicon Junction Diodes are fusion-sealed in a one-piece glass body, impervious to moisture and external contamination. Flexible dumet leads are tinned for easy soldering or spot-welding. The diode envelope is coated with black silicone enamel to shield the crystal from light. Ambient operating temperature range, from -80°C to $+200^{\circ}\text{C}$. Actual size, diode glass body: 0.265 by 0.103 inches, (approx.) maximum.

HUGHES SILICON JUNCTION DIODES ELECTRICAL CHARACTERISTICS				
Type	Saturation Voltage (E_s)	Forward Current at +1V (I_f)	Back Current	
			at 25°C	at 150°C
HD 6001	25V	15mA	.5 μA @ - 25V	.030mA @ - 25V
HD 6002	70V	5mA	.5 μA @ - 60V	.030mA @ - 60V
HD 6003	200V	1mA	.5 μA @ -175V	.030mA @ -175V
HD 6005	30V	40mA	.025 μA @ - 25V	5 μA @ - 25V
HD 6006	70V	20mA	.025 μA @ - 60V	5 μA @ - 60V
HD 6007	150V	7mA	.025 μA @ -125V	5 μA @ -125V
HD 6008	200V	3mA	.025 μA @ -175V	5 μA @ -175V
HD 6009	150V	3mA	.5 μA @ -125V	.030mA @ -125V

The ORIGINAL Glass-Body, Fusion-Sealed Germanium Diodes.

Hughes

SEMICONDUCTOR SALES DEPARTMENT

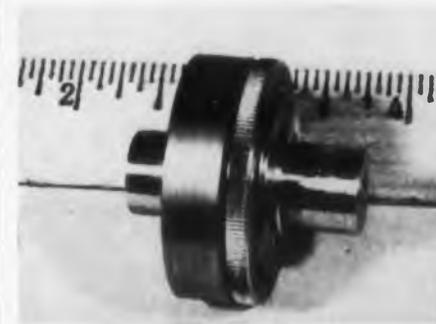
Aircraft Company, Culver City, Calif.



New York Chicago

CIRCLE ED-98 ON READER-SERVICE CARD FOR MORE INFORMATION

Slip Clutches High-Accuracy Miniatures



A complete line of miniature slip clutches is available for use to limit or control torque while permitting variation in speed between driving and driven mechanisms. These slip

clutches are specially designed for use in products where space is at a premium, thus requiring extremely small clutches, and where constant slip ratings at low torques are required. They are also designed for long periods of slip, without altering the slip torque rating.

The above features are made possible by utilizing new principles of operation. One series of slip clutches uses silicone putty as the transmission material between the driving and the driven members. The second series utilizes the principle of cantilever spring deflection. In both cases, accurate torque ratings can be constantly maintained in torques up to 20 in.-lb. Because the conventional friction principle is not used, the heat normally caused by constant slipping is not present to affect operation.

Sizes of the clutches range from 1-1/8" diam x 3/8" wide to 2-1/4" diam x 1/2" wide. The principle of operation is such that even smaller clutches can be made for special applications, without affecting the accuracy or consistency of the slip torque ratings. Radial Metal Products, Inc., Dept. ED, 1044 Linwood St., Brooklyn 8, N. Y.

CIRCLE ED-99 ON READER-SERVICE CARD FOR MORE INFORMATION

Pen-Pencil Combination Has 3 Pencils and Ball-Point Pen



The "Mechanical Pen-Pencils Combination" is made of chrome-plated brass and includes two colored leads, an ordinary pencil lead, and a ball-point pen. There

are extra leads of each type and a refill cartridge for the pen with each instrument. Refills are easily inserted by the user in a few seconds. The instrument is made to give long-time service. Norma Pencil Corp., Dept. ED, 127 W. 14th St., New York 11, N. Y.

CIRCLE ED-100 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • January 1955

The Model TC-2 Temperature Test Chamber is a portable, self-contained, easy-to-operate unit ideal for laboratory and production line use. Write for literature.

Temperature Range: -65°F to $+350^{\circ}\text{F}$.
 Holding Accuracy: $\pm 2^{\circ}\text{F}$.
 Coolant: Dry ice, 15 lbs. capacity.
 Dry Ice Loading Port.
 Heater: Electric Strip Heater.
 Control: Thermostat, balancing heat against dry ice evaporation. Permanent Thermometer.
 Test Load Access: Removable tray, with 15 through ports.
 Test Load Capacity: 600 cubic inches.
 Power Requirements: 115 volts, 5 amperes, 50-60 cycles, single phase.

STATHAM DEVELOPMENT CORPORATION
 12411 W. Olympic Blvd., Los Angeles 64, Calif.



PRICE \$550.00
 F.O.B. LOS ANGELES

FOR RAPID AMBIENT TEMPERATURE TESTS
PORTABLE TEMPERATURE TEST CHAMBER

CIRCLE ED-64 ON READER-SERVICE CARD

Delay Line

Continuously Variable



In this delay line, continuous variation of delay time is effected by rotary motion of a shaft. Variation

can be as wide as 4:1 (e.g., from 10-40 μsec , with practical extremes being 2.5-5 μsec and 20-75 μsec).

Other features include high stability (short-time jitter non-existent); smooth, positive action; ruggedness, and dependability. Electrical specifications of the 10-40 μsec unit are: carrier frequency, 15Mc; bandwidth, 3Mc; attenuation, 48db; and dynamic range, 25db. Andersen Laboratories, Inc., Dept. ED, 39 Talcott Rd., West Hartford, Conn.

CIRCLE ED-65 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratron

For Supplies, Motor Control



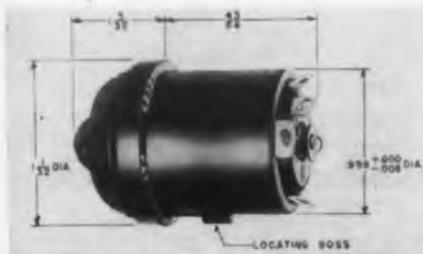
This single end thyratron, the NL-716, is rated at lamp d-c and 8amp peak current. It is designed especially for motor speed control and low current regulated voltage supplies.

The tube is gas-and-mercury filled for quick-starting and long life. Its constant characteristics through wide temperature ranges and long life make it particularly valuable for industrial control applications. Other ratings are: filament voltage, 2.5v; filament current, 6.3amp; peak forward and peak inverse voltage, 1250v. National Electronics Inc., Dept. ED, Geneva, Ill.

CIRCLE ED-66 ON READER-SERVICE CARD FOR MORE INFORMATION

Switch

Used in USAF Stick Grips



The 446100 Series switch is designed for use in pilot's control wheels, stick grips, hoists, and many similar applications. It is a compact, heavy-duty, four-throw unit, with momentary contact, positive action construction. It is rated 20amp, 28v, d-c.

This switch is approved by the USAF under specification MIL-S-9419. Mason Electric Corp., Dept. ED, 107 N. Ave. 64, Los Angeles 42, Calif.

This switch is approved by the USAF under specification MIL-S-9419. Mason Electric Corp., Dept. ED, 107 N. Ave. 64, Los Angeles 42, Calif.

CIRCLE ED-67 ON READER-SERVICE CARD FOR MORE INFORMATION



VECO Thermistors, too, can do almost anything!

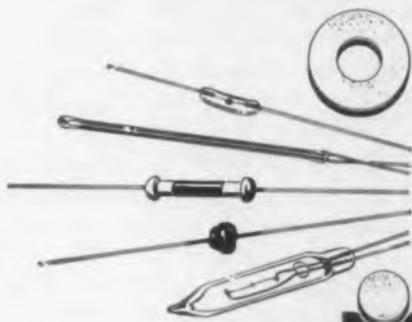
These tiny metal oxide components are virtually unlimited in the measurement and control functions they can perform in electrical circuits.

Because their principal characteristic is extreme sensitivity to thermal changes, they can be used in temperature measurement and control, switching, voltage surge protection, flow measurement, fire detection, gas analysis, liquid level gauging, time delay control; power measurement, overload protection, voltage regulation, automatic gain control, temperature compensation, etc.

The big name in thermistors is VICTORY, which has done the most to develop and improve these elements. "VECO" thermistors assure you of the utmost in quality, uniformity and dependability.

To learn more about VECO thermistors and their uses, write for Experimenter's Kit No. M-168 of 6 thermistors and 1 varistor, with suggested circuitry, \$5.00 postpaid.

Also available, 36-page Data Book, \$1.00 (free if requested on business stationery.)



Victory Engineering Corporation

102 Iorio Court, Union, New Jersey
Tel. MURdock 8-7150



THERMISTORS
 VARIATORS
 TEMPERATURE
 SENSING DEVICES
 ELECTRONIC AND
 THERMAL CONTROL
 INSTRUMENTS

CIRCLE ED-68 ON READER-SERVICE CARD FOR MORE INFORMATION



J. L. ADRIAN, CHIEF PROPELLER DESIGN ENGINEER, PROPELLER DIVISION, CURTISS-WRIGHT CORPORATION, CALDWELL, N. J.

G-E aircraft motors meet C-W's toughest specs

"When Curtiss-Wright was developing its now famous Electric Propeller," says J. L. Adrian, Chief Propeller Design Engineer of the company's Propeller Division, "it faced very strict design requirements. For instance, C-W needed a propeller pitch-changing motor that would function with precision under the rigors of combat military service—extremes of altitude, temperature, vibration, shock, and centrifugal force.

"Then G-E engineers were called in. They came through with a basic motor design that not only met Curtiss-Wright's toughest specifications but, with variations, has been used in 55 different Curtiss Propeller applications

since—on such planes as the B-50 Superfortresses, C-124 Globemasters, and DC-6, CV-240, and Constellation transports."

IN SERVING YOU, G-E engineers can draw on unmatched experience gained in solving this and many hundreds of other aircraft motor problems. In addition, they'll have at their disposal complete aircraft motor development and testing facilities.

To take full advantage of this service, contact your local G-E Apparatus Sales Office *early in your planning*. And, for more information, write today to Section 704-30, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

Insulating Spray

Also Applied by Brush or Dipping

Designated "E-26", this air-drying coating has many desirable physical, chemical and electrical characteristics. It provides a coating 0.75mil thick with one spray stroke. A film can be built up to any desired thickness by repeated application. Dielectric strength is 800 to 1000v per mil. Available clear and in colors, the coating may be applied by dip and brush as well as by spraying. Insl-X Sales Co., Dept. ED, 26 Rittenhouse Pl., Ardmore, Pa.

CIRCLE ED-69 ON READER-SERVICE CARD

Microscope

Makes Direct Measurements

A direct-measuring erect-image microscope mounted on an industrial-type base allows much greater flexibility in use than unmounted pocket comparator. The microscope is used to obtain accurate readings of dimensions, radii, angles, and holes. Linear dimensions are given both in decimal inches and millimeters.

Direct linear measurements may be taken up to 1/2" in units of 0.005". Working distance between objective and object being examined is 5-1/2". Edmund Scientific Corp., Dept. ED, Barrington 3, N. J.

CIRCLE ED-70 ON READER-SERVICE CARD

Plastic Tubing

Improved Heat Deformation

This firm's black "Temflex 105" plastic tubing has been improved by a modified formulation, which provides significant improvement in heat deformation characteristics and greater resistance to "cut through". In addition to these improvements, it also provides enhanced color stability under conditions of sustained operation at elevated temperatures. Irvington Varnish & Insulator Div., Dept. ED, Minnesota Mining & Manufacturing Co., Irvington, N. J.

CIRCLE ED-71 ON READER-SERVICE CARD

◀ CIRCLE ED-72 ON READER-SERVICE CARD

T
K



CL

Meets All Co
Required

A complete
MIL ele
specific
housed in
tional case
factory p
ance at su
savings. I
Listing C I

HO
MIL-T-2
TH

The new
Lines f
using th
tion now
core ma
reasona
the requ
cations.
matic is
on each
ratings
availabl
tity. W
receive



840

CIRCLE E
ELECTRO

THE Kenyon TWINS



M LINE

Meets All MIL-T-27 Requirements

Completely hermetically sealed to meet MIL-T-27 specifications. Military Standard types are included. Catalog Listing M L

C LINE

Meets All Commercial Requirements

A complete line to MIL electrical specifications, housed in conventional cases. Satisfactory performance at substantial savings. Catalog Listing C L



HOUSED IN CASES WITH STANDARD

MIL-T-27 DIMENSIONS... BOTH LINES CARRY THE USUAL KENYON GUARANTEE

The new Kenyon Military and Commercial Lines feature the very latest practice, using the best class "A" wire and insulation now available, and the latest types of core material, to obtain minimum size at reasonable cost... Cases are identical to the requirements in the MIL-T-27 specifications. Full rating information and schematic is furnished in the form of a stencil on each case... Special units with other ratings and the same or similar cases are available on short delivery, in any quantity. Write for catalog. Your inquiry will receive prompt attention.



Kenyon

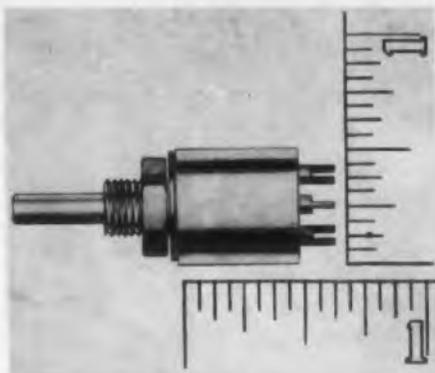
TRANSFORMER CO., INC.

840 Barry Street, New York 59, N. Y.

CIRCLE ED-196 ON READER-SERVICE CARD

Potentiometer

High Resistance in 1/2" diam



The No. 500 "Acept" is a standard, sub-miniature, wire-wound precision potentiometer. It features a 1/2" diam, with resistance from 200 ohms to 50,000 ohms in a standard tolerance of

$\pm 2\%$ (closer when specified). Linearity is $\pm 0.3\%$ on standard models. Closer tolerances are available on special order. Effective electrical angle is 325° . Ambient temperature range is -55° to $+125^\circ\text{C}$. Power rating is 2w for 60°C rise. Temperature coefficient is ± 0.00002 ohms per $^\circ\text{C}$.

The case is one-piece, precision-machined aluminum with a clear anodized finish. Maximum static torque is 0.035 oz-in at 20°C , which can be less on special order. Weight including lock washer and nut is 0.25oz. Mechanical rotation is 360° continuous. On special order units can be ganged on one shaft.

The unit is completely sealed against sand, dust, and foreign matter to avoid abrasive action between moving parts. All materials and metals are treated for maximum resistance to corrosion, humidity, and salt spray; they conform to shock and vibration tests per applicable military specifications. Ace Electronics Associates, Potentiometer Div., Dept. ED, 125-129 Rogers Ave., Somerville 44, Mass.

CIRCLE ED-197 ON READER-SERVICE CARD FOR MORE INFORMATION

VSWR Amplifier

With Multiple Test Functions



The Model 2000 Microwave VSWR Amplifier, with multiple test functions, offers ease of operation with fast, accurate readings. Incorporated in this high-

gain unit are such features as: crystal current measurement for monitoring CW levels; a 100amp Weston meter; dual channel inputs, which eliminate continuous cable changes; sensitivity of 0.3v for full-scale deflection; a 60db range calibrated to $\pm 0.1\text{db}$ per 10db step; crystal or bolometer inputs; and plug-in filter units from 250cy to 2500cy. Waveline, Inc., Dept. ED, Caldwell, N. J.

CIRCLE ED-198 ON READER-SERVICE CARD FOR MORE INFORMATION



BENJAMIN DELANO ELECTRON
1791-1942
FOUNDER*

We take our share of pompous pride, shyly calling attention to our own contribution, in fatuously welcoming the Billionium. General Motors has built 50,000,000 self-propelled hydrocarbon energy converters, General-Whats-his-name has gotten his family of scientists to develop the prestige-pump. The BEV is dashing the modesty of the nucleus, and the lowly potato, long the friend of the TV-less, deepfreezeless proletariat, now coyly minces garbed in snobba-peel.

Our own bosom-swelling pride stems from our tradition of back-slapping familiarly with the greats of electricity and magnetism, whose august names are memorialized by the lower-case initial — joe volt, sam ampere, ed gauss, john henry, fred faraday — to us, each of these is a saint of science, their spirits blazoned on our banners boldly.

And now, in our humble way, we place on the altar of science at the epicenter of the Billionium our intellectual contribution for posterity. We are memorializing one of our staunchest researchers, who has reduced to hitherto unknown limits of accuracy, the measurement and observation of energy loss (or FRICTION), both magnetic and mechanical.

The New Unit is equal, for obvious reasons of national pride, to the friction

overcome when the Battleship Missouri was pulled off the mud. As with the farad, in ordinary use, it is prefixed micro, or micro-micro, and for export to Europe, pica. It is the mccarthy (micromccarthy, micromicromccarthy, picamccarthy). M. K. S. and C. G. S. adherents may obtain metric conversions from Navy Bu-Ships data on the big Mo. Absolute units are of course the abmccarthy and the statmccarthy.

Sensitive relays with good repeatability of operating characteristics never have more than 130 centimeter-micromicromccarthys (50 inch-micromicromccarthys) of pivot friction at all extremes of temperature. Sigma relays don't even have that much.

*THIS ISN'T OUR FOUNDER, BUT WE THINK HE SETS THE RIGHT TONE, AND IS MORE PICTURESQUE THAN OURS, WHO ISN'T EVEN DEAD YET!

SIGMA

SIGMA INSTRUMENTS, INC.
91 PEARL ST., SO. BRAintree, BOSTON 85, MASS.

CIRCLE ED-199 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Limit Trip

Accurate to $\pm 2\text{cy}$



Designed to protect equipment from the effects of high or low power frequencies, the Model 440HF Frequency Limit Trip will open (or close) a circuit when the signal frequency exceeds a predetermined limit. It opens (or closes) a relay when the signal frequency reaches $440 \pm 2\text{cy}$. For all values of frequency below this, the relay is in one state; in all values of frequency between this and 800cy , the relay is in the other state.

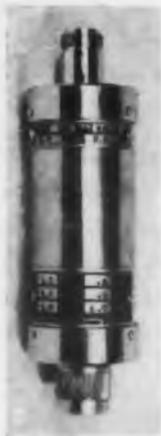
The critical frequency of this company's limit trips can be predetermined to within $\pm 1/2\%$ for any value of frequency between 50cy and 5000cy . At the critical frequency, the trip operation is independent of voltage over very wide limits. The Model 440 operates within the accuracy given above from $30\text{-}150\text{v}$.

Two trips may be combined in one $3'' \times 4'' \times 5''$ package to operate independently at two different values of frequency, thus affording protection at both a high frequency and a low frequency limit. Arga Div., Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-81 ON READER'S SERVICE CARD FOR MORE DATA

Power Pads

With Small Power Sensitivity



These coaxial pads are designed for a 10w input. Their power sensitivity is below 0.001 db per watt ; e.g., a 10w input to a 10db pad changes the insertion loss less than 0.1 db . A bilateral model is offered in 1 db , 2db , and 3db , and unilateral models are offered with values of 4- , 5- , 6- , 7- , 8- , 9- , and 10db .

The design makes microwave equipment available with accuracies usually found at audio frequencies. The 3db and 10db pads are within 1 db of nominal between d-c and 1000Mc . A calibration, accurate to 0.05db , is furnished for 400Mc , 750Mc , and 1000Mc , and to 0.02db at d-c. The long-term stability of these precision pads is commensurate with the accuracy of calibration. Weinschel Engineering Co. Inc., Dept. ED, 10503 Metropolitan Ave., Kensington, Md.

CIRCLE ED-82 ON READER'S SERVICE CARD FOR MORE DATA



CIRCLE ED-83 ON RE

NEW **A-M-P**

PATENTED "F" CRIMP

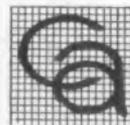
TAPER PINS

FOR WIRING

AN TYPE CONNECTORS



Find out about the New
AMP "CREATIVE AP-
PROACH TO BETTER
WIRING"



... An evaluation service
without cost or obligation

ORDER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

ELEC

IMPROVE RELIABILITY SAVE TIME REDUCE COST

Now AN type connectors can be wired 5 to 10 times faster **with even superior performance reliability**. There are no cold solder joints, burned insulation, embrittled wire and breakage at solder cups or short circuits due to loose strands and excess solder.

For many years the Aircraft, Electronics and Communication industries have awaited this new and simpler method, since the soldering of wires to conventional AN connector contacts is a slow and painstaking process involving much skill and repeated inspection checks.

With AMP's new Taper Technique, a special AMP Patented "F" Crimp Taper Pin is attached to the wires by high speed automatic machines. This pin is then installed in the connector with one easy and positive stroke of AMP's new "measured energy" CERTI-LOK insertion tool. The result is uniformly better connections, produced in much less time with tremendous cost savings.

Tests prove that AMP Taper Pins provide a greater degree of uniformity than soldered connections. Reliability is actually increased because the possibility of human error in assembly has been greatly reduced.

Leading Connector manufacturers are now supplying AN and other types of multiple contact connectors for use with AMP Taper Pins. Write today for further information.



AMP Trade-Mark Reg. U.S. Pat. Off. © AMP

AIRCRAFT MARINE PRODUCTS, INC.
200 PACIFIC STREET, BOSTON, MASS. 02109

AMP

CIRCLE ED-83 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Meters

1-1/2" Panel Instruments



These high precision miniature meters, for front or rear panel mounting, have terminal studs and mounting flange internally sealed for waterproofing. Designated Model 152, they are square 1-1/2" panel instruments sealed by means of an internal locknut between the instrument mounting flange and case barrel. The locknut compresses a heavy-duty gasket uniformly and concentrically. Thus, damage to the scale window will not destroy the water-tight properties of the associated equipment.

Maximum accuracy and stability of adjustment between jewels and pivots is gained by the use of miniaturized external pivots with this company's D'Arsonval movement. Another feature is the use of high torque Alnico magnets. DeJur Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE ED-84 ON READER'S SERVICE CARD FOR MORE DATA

Thermal Switch

With $\pm 2\%$ Accuracy



The "Minitherm", shown full size, is a chemical-type thermal switch only 3/16" in diameter x 3/16" long. Below a predetermined switching temperature, its resistance exceeds 10 meg-ohms. When it reaches its switching temperature, the resistance of the device becomes permanently less than 0.10 ohm.

Current rating is 5amp, a-c or d-c, continuous duty. "Minitherms" are available at switching temperatures from +150° to +400° in increments of 25°, and from +400° to +1000°F in increments of 50°. Accuracy is $\pm 2\%$.

The extremely small mass of the unit permits it to follow temperatures rising at the rate of 100° per sec, and it operates under extreme vibration or shock. Very low temperatures do not alter the operating point. High power capacity permits controlling solenoids, motors, etc., directly. Strong, stable telemetering signals are obtained without any need for d-c amplifiers. MiniTec, Dept. ED, 423 Delaware Ave., Los Angeles 41, Calif.

CIRCLE ED-85 ON READER'S SERVICE CARD FOR MORE DATA



EIMAC Vacuum Switches

for high voltage, airborne service

Compact, fast action Eimac vacuum switches are custom designed for high voltage application. Single pole, double throw action contacts are precision spaced in high vacuum, permitting reliable performance regardless of ambient atmospheric conditions. In antenna switching service, RF peak potentials as high as 20kv may be applied between the switch terminals. Eimac vacuum switches are not limited to this service, however, as they will handle 1.5 amps at 5kv in DC switching. Efficient operation in severe airborne conditions, small size and instant response give these switches a distinct advantage over conventional relays. Now available are four Eimac switch types, including one for pulse service.

For further information contact our
Application Engineering department

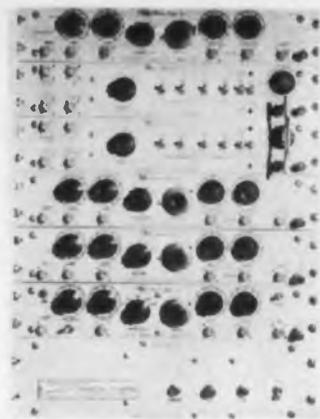


EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION

Double Pulse Generator

With 0.1-1000sec Widths



The Model 2140A Double Pulse Generator is a precision instrument providing low source impedance, fast rise time, variable separation width, amplitude, and polarity pulse pairs. All parameters of each pulse are independent, and pulses may be superimposed or be separated in time.

Rise time of either pulse is 0.02sec, with variable amplitude of either polarity to at least 50v from an internal impedance of 50 ohms. Widths of both pulses are direct reading and variable from 0.1sec to 1,000sec in four decade ranges. Frequency of operation is variable from 10cy to 100,000cy from a direct reading internal oscillator or external source. Single shot operation is also provided by this device.

One pulse is at 1sec fixed delay (from internal sync pulse), and the other at delay variable from 0 to 10,000sec in five decade ranges. Delay and pulse widths are calibrated to 0.5% of full scale accuracy. Eight sync pulses in each cycle and other intermediate waveforms are available at the front panel. Electro-Pulse, Inc., Dept. ED, 11811 Major St., Culver City, Calif.

CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

Servometer

For Variety of Sensing Elements



The R1040-6 Servometer is designed for resistive bridge-type sensing elements, such as pressure gages, accelerometers, and mechanical force measuring devices.

The sensing element output is amplified by a high-gain nonlinear amplifier driving a servo motor within the indicator.

The complete unit is composed of two instruments: a high-gain servo amplifier, and an aircraft type instrument panel indicator. This system has 1/2% full scale accuracy over the temperature range of -55° to +160°F. It has a voltage range of 105-125v with frequency variations from 300-450cy. The unit will also furnish, with a digital converter, digitized information for local recording purposes. Radiation, Inc., Dept. ED, Melbourne, Fla.

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

Aerohm

A Complete Line of
Micro-miniature and
Miniature Wire-wound

Precision Potentiometers

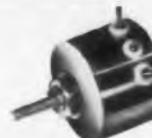
"LO-TORK"
POT



Designed for minimum-torque use.
Torque as low as 0.010 inch-ounce.
Dissipates one watt at 80° C.
Resistances — 100 to 100,000 ohms.
Weight is only 1/2 ounce.
Ganging to six decks, internal
clamps hold 1/8 in. diameter.

These potentiometers have standard linearity of .5%, on special order .25%; precision toroidal winding allows winding angles up to 360°, standard is 354°

"HOT-
POT"



Designed for high-temperature use.
At 200° C., dissipates one watt.
Dissipates five watts at 80° C.
Resistances — 1000 to 25,000 ohms.
Stainless-steel case, one inch dia. by
1 1/8 inch depth behind panel.
Teflon-insulated terminals.

AP-1/2 RT/RTS-7/8 AP-1 1/8



- 3 micro- and miniature potentiometers
- Two, three, and four watts continuous at 80° C respectively.
 - 3 resistance ranges, 10 - 100,000 ohms.
 - Compact — 1/2, 7/8, and 1 1/8 in. dia.
 - Weights only 1/4, 1/2, and 3/4 ounce.

These potentiometers are precision machined, and have line-reamed bushings of phosphor bronze, centerless-ground stainless steel shafts, anodized aluminum bodies, and gold-plated fork-type terminals. All units are fully sealed, moisture-proofed and fungicide treated. On special order, potentiometers processed for operation up to 125° C.



Write today for detailed information and prices

WATERS MANUFACTURING, inc.
Waltham 51, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

CIRCLE ED-151 ON READER-SERVICE CARD

ELECTRONIC DESIGN • January 1955

Coil Impregnants

Wide Selection of Characteristics

Three new coil impregnants have a wide range of physical and electrical characteristics. All have broad application in electronic manufacturing. "Acrylic base A-107" is particularly useful for impregnating and sealing coils and precision type resistors, including those constructed of fine wire. "Insl-X E-67," a new cellulose modified coil coating provides a highly desirable sealing and mechanical binding effect. Applied by brushing or dipping, E-67 finds wide application in the coating of relay, magnet and choke coils, electronic and bushing current transformers, and in moisture-proofing radio parts. A new thermoplastic impregnant formulated from a polystyrene resin, "Insl-X Q-101" is made especially for low-loss applications. Insl-X Sales Co., Dept. ED, 26 Rittenhouse Place, Ardmore, Pa.

CIRCLE ED-56 ON READER-SERVICE CARD

Cable

Cut to Specification

Shielded and multiconductor cable cut to multiples of 25' instead of hundreds of feet are offered by this firm. Cable cut in this manner should lead to production savings. Alpha Wire Corp., Dept. ED, 430 Broadway, New York 13, N. Y.

CIRCLE ED-57 ON READER-SERVICE CARD

Structural Plastic Sheets

Larger Sizes Available

"Lamcor"—a structural material—is now available in larger sheet sizes. A glass-fiber reinforced polyester resin laminate, it was first used for the sides and roof panels of heavy-duty, corrosion-proof truck-trailers and truck bodies. The material is now made on a press that will produce sheets up to 51" x 105", in any desired thickness. Strick Plastics Co., Dept. ED, 31-06 38th Ave., Long Island City 1, N. Y.

CIRCLE ED-58 ON READER-SERVICE CARD

CIRCLE ED-59 ON READER-SERVICE CARD

GUDEMAN COAST-TO-COAST SERVICE

Manufacturers of Capacitors, Filters, Pulse Transformers, Delay Lines and Linear Variable Differential Transformers.

- 6 Plants
- Main Plant
340 West Huron Street
Chicago 10, Illinois
- 20401 Old U.S. 12 W.
Chelsea, Michigan

- 190 Commercial Street
Sunnyvale, California
- Dilectron Division
2661 South Myrtle
Monrovia, California
- 9200 Exposition Boulevard
Los Angeles 34, California
- Terryville, Connecticut

Write for latest technical data on any of the following:

- MIL-C-25A Capacitors
- High Voltage Glass Cased Capacitors (GC Type)
- Motor Starting Capacitors (Paper Dielectric-Oil Impregnated)
- Paper Tubular Capacitors
- Hi-Temperature-Plastic Dielectric Capacitors (XC Types-165°C)
- Miniature Hi-Temp Capacitors (XH Types-125°C)
- Dry Electrolytic Capacitors
- Noise Suppression Filters
- Delay Lines
- Pulse Transformers
- Ceramic Capacitors
- Plastic Dielectric Capacitors (337 & 338 Types)
- Linear Variable Differential Transformers
- Metallized Paper Capacitors

See these products at Booth 407 I.R.E. Show

*Gudeman Sales Offices and Representatives
in 17 U.S. and 2 Canadian Cities.

MAIN OFFICE: 340 WEST HURON STREET • CHICAGO 10, ILLINOIS
PHONE DELAWARE 7-7400

Manufacturers of Electronic Components for Military and Commercial Applications.

THE
Gudeman
COMPANY



NEW CAPACITORS
by **Electron**
FOR SUPERIOR PERFORMANCE

Electron Products, Inc. — recently created by a group with approximately 100 years total experience in Capacitor Engineering, Production and Sales Engineering. It is doing business under an advanced concept of electronic design and processes. The "Epi-con" capacitor line announced above is typical of this new approach.

ELECTRON PRODUCTS, INC.

CIRCLE ED-102 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply Supplies 45-2000cy Power



The Model VFS - 250 Variable Frequency Power Supply is a compact, semi-portable source of 45cy to 2000cy alternating current, with available output up to 300va. Voltage, frequency, and power output of this multi-purpose frequency changer make it suitable for three main categories of use: (1) testing airborne electronic and

electrical systems, synchro equipment, servo amplifiers, transformers, inductors, etc.; (2) powering choppers, vibrators, vibrator shakers, and magnetic amplifiers; (3) controlling synchronous motors and processing equipment.

The supply is completely self-contained and operates with 105-130v, 50-60cy input. Output voltage is continuously controllable from 0 to 130v on the standard model. The output power, up to 300va at 100 to 130v, is sufficient for most laboratory and test purposes.

Other features of the instrument include multiple negative feedback networks for instantaneous regulation of output without thermal lags; built-in stabilized dual range frequency generator; 4-1/2" output voltmeter with frequency correction; and grounded polarized output connector for maximum safety and code conformity. Veetron, Inc., Dept. ED, 380 Main St., Waltham 54, Mass.

CIRCLE ED-103 ON READER-SERVICE CARD FOR MORE INFORMATION

Receiver For Stations WWV and WWVH



This receiver is constructed expressly to receive radio stations WWV and WWVH, the time and frequency

standard stations of the National Bureau of Standards. It is crystal controlled, having six bands at 2.5, 5, 10, 15, 20 and 25Mc, selectable by panel switch. The circuit features dual conversion and narrow band i-f stages for maximum selectivity and image rejection. Four i-f stages insure adequate sensitivity for good reception under the most difficult conditions. A cathode coupled crystal oscillator circuit is used, utilizing six plug-in crystals. Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296-Station A, Richmond, Calif.

CIRCLE ED-104 ON READER-SERVICE CARD FOR MORE INFORMATION

For ANY speed...

use **Metron** MINIATURE VARIABLE SPEED DRIVES

Variable speed drives give you variable speeds from 1-5 increase through 1-1, to 5-1 decrease! Just move the lever to the desired speed ratio and the miniature variable instantly produces the speed you want!

- Speeds up to 10,000 Rev/minute or down to 1/4 Rev/day
- Small — to fit into your product
- Permanently lubricated
- Your choice of 6 controls
- Output up to .025 HP

*representative speeds only

for details write for Bulletin No. 99A

Metron INSTRUMENT CO.
450 Lincoln St., Denver 3, Colorado
DISTRICT OFFICES • NEW YORK • CHICAGO • LOS ANGELES

CIRCLE ED-105 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!

NEW LOWER PRICES

GRC
die cast
CAP NUTS

... AND THEY NEED NO PROTECTIVE FINISHES IN MOST APPLICATIONS! Like all GRC die cast fastenings, they are non-ferrous, rustproof, and corrosion-resistant. GRC zinc alloy fastenings are furnished with clean threads and a bright finish that withstands normal usage —are available in all commercial finishes when desired.

ECONOMICAL

Write today for samples, revised price schedules and bulletins.

GRIES REPRODUCER CORP.
40 Second St., New Rochelle, N. Y.—New Rochelle 3-8600

OTHER GRC ZINC ALLOY FASTENINGS
GRC WING SCREWS
GRC WING NUTS
Exclusive Finger-Grip Design!
GRC SMALL TUBULAR RIVETS
Diameters up to 9/64"
lengths up to 5/16"
THUMB NUTS—SCREWS
large diameter round head

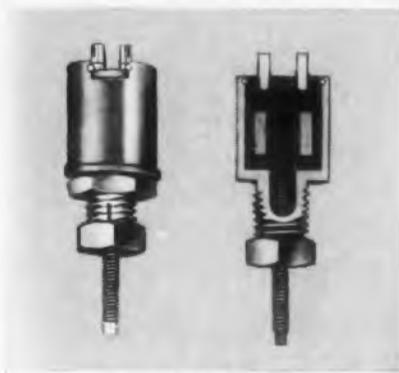
World's Foremost Producer of Small Die Castings

GRIES

CIRCLE ED-106 ON READER-SERVICE CARD FOR MORE INFORMATION

New Miniature LS-9 Coil Form

Unusually well shielded, rugged



Shown actual size

First of its kind! C.T.C.'s new LS-9 coil form assembly is particularly suited for applications that require miniature size, a rugged, shock-resistant construction and a mechanically enclosed, protected coil.

Electrically and mechanically shielded, the new assembly is excellent in I. F. strips and numerous receiver designs as they can be mounted adjacent to one another and can be used in circuits requiring coils shielded from outside radiation. Forms can be used as simple R. F. coils, tapped R. F. coils or R. F. transformers.

Each LS-9 assembly consists of a brass shell enclosing a powdered iron cup-core, tuning slug, phenolic coil form and silicone fibreglas terminal board. Three terminal boards are available with either a two, three or four terminal layout. Forms can be wound to customers' specifications. For complete information, write Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-107 ON READER-SERVICE CARD FOR MORE INFORMATION

Stop Corrosion with RHODIUM PLATING

New uses for Rhodium Plating are constantly being found by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required.

RHODIUM PLATE offers these advantages:

- assures low and stable contact resistance
- allows higher pressures to be used in sliding contacts
- not affected by atmospheric changes
- oxide-free contacts eliminate partial rectification and unwanted signals
- provides low noise level for moving contacts
- extremely long-wearing

These properties are particularly well-suited to electrical and electronic applications. RHODIUM plate affords excellent protection against atmospheric corrosion for printed circuits and permits incorporation of sliding contacts as part of the circuit.

Write for Free, detailed booklet on RHODIUM PLATING.

BAKER PRECIOUS METALS
& COMPANY, INC.

113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • CHICAGO • LOS ANGELES

CIRCLE ED-108 ON READER-SERVICE CARD FOR MORE INFORMATION

Reference Standard

With 14 D-C Ranges



The Model C "Poly-Ranger" Reference Standard is offered in a redesigned version with 14 d-c voltage and current ranges in two combinations. Accuracy of this unit is 1/4%, and its period is less than 1sec. Scale length is 6.3", for easy reading.

One of the combinations has full scale current ranges of 10-, 30-, 100-, and 300ma; and 1-, 3-, and 10amp, and full scale voltage ranges of 1-, 3-, 10-, 30-, 100-, 300-, and 1000v. The other combination (1-C) has full scale ranges from 1ma to 3amp, and 3v to 1000v. Sensitive Research Instrument Corp., Dept. E119, Mount Vernon, N. Y.

CIRCLE ED-109 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Impedance Meter

Measures Resistance Directly



Model 541-A (TS-710/TSM) Crystal Impedance Meter is designed to measure directly the effective resonance and anti-resonance of quartz

crystal units and to be used as a reference standard in the quartz crystal industry. It replaces this firm's earlier Model 460 (TS-537/TSM).

The meter consists of a two-tube, resistance-capacitance coupled oscillator covering a frequency range of 10ke to 1100ke in five bands. A built-in vacuum tube voltmeter measures the voltage across the crystal unit and enables the operator to determine the power dissipated in the crystal unit. For convenience in measuring the resistance of the variable resistance adapters during the test procedure, an ohmmeter is also included in the equipment.

Furnished with the equipment is a 5' output cable with plug attached, 14 fixed calibrating resistors, and three variable resistance adapters. The three variable adapters have maximum resistance values of 500,000 ohms, 50,000 ohms, and 5,000 ohms. Two other adapters are furnished that allow the testing of crystal units contained in HC-5/U and octal base holders. All fixed resistors and adapters are contained in a small metal box about 7-1/2" x 5" x 2". Over-all dimensions are 19" x 10-1/2" x 7" high. Radio Frequency Laboratories, Inc., Dept. ED, Boonton 11, N. J.

CIRCLE ED-110 ON READER-SERVICE CARD FOR MORE INFORMATION

COMPACT DEPENDABLE LONG LIFE



AMRECON[®] RELAYS

ALL-PURPOSE

In Current Ratings up to 25 amp a-c or d-c, and in All Standard Voltages

Amrecon relays are small, compact units that can handle power loads usually demanded of larger, heavier relays. Careful design and construction make them an *exceptionally dependable* line for such diverse applications as industrial controls, aircraft controls, etc. When the wire size permits, cellulose-acetate sealed coils, which give a high degree of protection from ambient conditions, are used.

Amrecon relays are available with screw, plug, or solder-wire terminals; with five standard contact arrangements; and with hermetically sealed or dust-protective enclosures. Thirty different types now available from stock. Amrecon's engineers will also be glad to help you work out special relay applications.

WRITE FOR
FREE CATALOG AND
DESCRIPTIVE BULLETIN R-10



**AMERICAN
RELAY & CONTROLS, Inc.**

3643 Howard St., Skokie, Illinois
(Suburb of Chicago)

A Subsidiary of **OHMITE[®]** MANUFACTURING COMPANY

CIRCLE ED-111 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW

adjustable

POLYSTYRENE CAPACITORS

with Accuracy

in the order

of 0.1% or better

and Long Time

Stability in

the order

of 0.03%



Check these outstanding features:

- I. R. - @ 25° C - 10^{-7} OHMS
- Dielectric Absorption - .015%
- Dissipation Factor - .0002
- Temp. Coeff. (-20° to 140° F.) 100 P.P.M. per °C

Excellent for Computer Integration.

Test Equipment

or Secondary Standards

Join these other leading firms in

specifying Southern Electronics' precision polystyrene capacitors

for your most exacting requirements

Reeves Instrument Corp.

Electronic Associates, Inc., Concord

Berkeley Scientific, M.I.T., Calif.

Inst. of Tech., and many others

Write for complete catalog -

Available from 0.1 MFD. to 8 MFD.

SOUTHERN ELECTRONICS



Corporation

239 West Orange Grove Ave., Burbank, Calif.

CIRCLE ED-200 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Supply Highly Stable Design

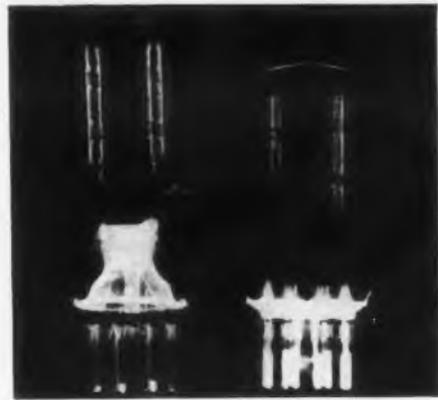
The Model 300R is designed to be a super-regulated, ultra-stable d-c supply capable of delivering 0.3amp of current at any output voltage from 0 to 1514v. Four decade switches permit selection of output voltage in 1v steps, while a 1.1v vernier calibrated in 0.1 increments affords resolution of 2mv at any output voltage. Calibration accuracy is better than 1/4%.



Regulation of the supply is 0.002% for 20% change in line voltage, and 0.002% for load current change from no load to full load. These figures obtain over the entire output voltage range. Long term stability is 0.01% or better. John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle, Wash.

CIRCLE ED-201 ON READER-SERVICE CARD FOR MORE INFORMATION

TV Receiving Tubes Shorter than Prototypes



These three new tubes feature wide interchangeability in varied makes and sizes of TV receivers. The 12-SN7-GTA has a button-stem base for tightness, shorter leads, and better lead insulation, as well as for

improved heat conduction, reduced electrolysis, and reduced tube leakage. It has 28% less bulb height than its predecessor as illustrated. Maximum plate voltage per plate is 450v.

The 6AX4-GT has a new "pigtail" winding which places a separate, insulated barrier between heater wire and cathode to prevent heater-cathode shorts. It also incorporates a notched plate to avoid contact with mica spacers in critical plate-cathode areas; slotted micas for electrical conduction barriers; and a button stem base.

The 6BX7-GT has "flipper" (criss-cross) apertures in mica spacers for four-corner grip to grid legs, to reduce microphonics and help cut down vertical video "jitter". The design has a covered box enclosure shielding cathode and heater from getter contamination; special slots in mica spacers and a notched plate design to reduce arcovers and leakage; and gold-plating of grid wires to cut emission. Tube Dept., General Electric Co., Dept. ED, Schenectady 5, N. Y.

CIRCLE ED-202 ON READER-SERVICE CARD FOR MORE INFORMATION

If YOU'RE between the



Designing and manufacturing special-purpose devices you can't buy off the shelf is our business.

We do this for the Navy and Air Force as well as for industry — in electrical, electro-mechanical and electronics fields.

Improving, simplifying, reducing size, changing shape to fit limited space are also functions which we perform.

If you can't buy it, don't know how to make it or don't want to — call on RAM.

Send your specifications or requirements to us for prompt quotations.

Ask for Brochure J54

RAM METER, INC.

Founded 1936

1108 Hilton Road, Ferndale
DETROIT 20, MICHIGAN
Telephone Lincoln 4-7220

CIRCLE ED-203 ON READER-SERVICE CARD

Sili

"Cohr
silicone
used as
ing, in v
for aire
fabric w
yard. T
thick clo
nesses. I
be silico
and 0.01
air impe
tric stro
mil, a us
-70°F
ally flex
cut Har
East St.

CIRCLE

Fe

"Resin
specifica
Sleeving
7444A
treme 1
-90°F
with fur
sistance
strength
per mil
Industr
Santa B

CIRCLE

En

Self-s
wire ax
Type er
range a
sistors r

The c
sistors
applica
from 0.
sistance
megohm
Pusey

CIRCLE

CIRCLE

Silicone Coated Fabric

Very Light

"Cohrlastic" 2804 thin lightweight silicone rubber-coated fabric can be used as electrical insulating, gasketing, in very sensitive diaphragms, or for aircraft septum material. The fabric weighs only 4.5 oz per square yard. The base glass fabric is a 0.001" thick cloth coated to minimum thicknesses. However, this same cloth can be silicone-rubber coated to 0.007" and 0.010" thicknesses for increased air impermeability. It has a dielectric strength of 1100 to 1400v per mil, a useful temperature range from -70°F to 500°F, and is exceptionally flexible and rubbery. Connecticut Hard Rubber Co., Dept. ED, 407 East St., New Haven, Conn.

CIRCLE ED-169 ON READER-SERVICE CARD

Sleeving

Features Cold Flexibility

"Resinite EP-93", a new aircraft specification grade Vinyl Insulation Sleeving, conforms to Spec. MIL-I-7444A(1). This sleeving features extreme low-temperature flexibility to -90°F (by impact test) combined with fungus resistance, full flame resistance in all sizes and a dielectric strength averaging better than 500v per mil in 0.020 wall thickness. Resin Industries, Dept. ED, P. O. Box 1589, Santa Barbara, Calif.

CIRCLE ED-170 ON READER-SERVICE CARD

Encapsulated Resistors

Eight New Types

Self-supporting on No. 20 AWG wire axial leads eight additional "P" Type encapsulated resistors extend the range and ratings of commercial resistors now available from this firm.

The complete line of "P" Type resistors for commercial and military applications now has wattage ratings from 0.50 to 2.75w and maximum resistance ratings from 0.05 to 15 megohms. Shallcross Mfg. Co., 524 Pusey Ave. Collingdale, Pa.

CIRCLE ED-171 ON READER-SERVICE CARD

CIRCLE ED-172 ON READER-SERVICE CARD

The NEW WAY to product improvement at LOWER COST!

Photocircuits

PRINTED-CIRCUIT

SWITCH PLATES

COMMUTATOR DISCS

and associated
ELECTRO-MECHANICAL
ASSEMBLIES
(to your specifications)



We can supply either the fabricated plates and discs or complete electro-mechanical assemblies.

Photo Courtesy of Link Aviation Corporation

Photocircuits has made many important advances in the art of printed circuitry and now offers its skill and experience in the design, engineering and production of these components and "packaged" electro-mechanical assemblies to effect great improvement and cost reduction of your end products.

COST ADVANTAGE EXPERIENCED!

In the case of a 6-deck, 27-position decade switch assembly using raised silver-plated contacts on one side with inter-connecting conductor pattern on second, and terminal lugs at pattern terminations for external wiring, a cost reduction of approximately 40% has been realized.

These are some of their ADVANTAGES:

FLUSH SURFACE. For long wearing "bounceless" rotary action.

NICKEL-RHODIUM Plating. For smooth, hard, long life contacts. (Silver-Rhodium, Silver and Gold plating available as needed.)

COMPOSITE LAMINATE. Of appropriate plastic core to insure flatness and good mechanical strength. **IMPORTANT!** Switch plates and commutator discs can be backed with either aluminum or steel for rigidity and strict flatness.

LONG LIFE. With proper combination of laminates, brush pressures and contact materials, satisfactory life experiences from 10 million to 100 million revolutions have been reported.



APPLICATIONS where Photocircuits' SWITCH PLATES and COMMUTATOR DISCS have proved their value:

- BINARY CONVERTERS
- STEPPING SWITCHES
- SHAFT READ-OUT DEVICES
- PROGRAMMING & TIMING SWITCHES
- TELEMETERING SWITCHES
- CODE DISCS



This
Engineering
Brochure
FREE
on request.

For full information
call or write

Photocircuits

CORPORATION



Trade Mark

Dept. EDI, GLEN COVE, NEW YORK

Glen Cove 4-4000

Flushing 3-5050

BOSTON: 25 Huntington Ave. • Commonwealth 6-7705
CHICAGO: 425 W. Irving Park Rd. • Palisades 5-1170
DAYTON, O.: 25 South Main Bldg. • Fulton 6377
LOS ANGELES: 7407 Melrose Ave. • Webster 3-7276
PHILADELPHIA: 1531 Spruce St. • Kingsley 5-1205

ROCHESTER: 3 Juniper St. • Culver 7635
KANSAS CITY: 903 McGee St. • Victor 8090
CHARLOTTE, N. C.: 1323 The Plaza • Edison 4-9739
BIRMINGHAM, ALA.: 404 Dexter Ave. • Phone 2-1368

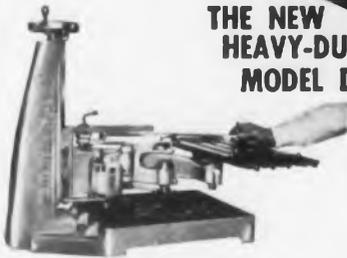
unique in design —
rugged in construction

GREEN PANTOGRAPH ENGRAVERS

THE FAMOUS
MODEL 106



THE NEW
HEAVY-DUTY
MODEL D-2



The three-dimensional bench Model 106 cuts costs — engraves, routs, models and profiles, giving you expert results even by unskilled workers.

The Model D-2 two dimensional heavy-duty Pantograph is a precision machine with a multitude of new features. Open on three sides, it permits complete freedom for engraving, milling, profiling large panels (up to 30" in diameter) or bulky pieces. Single, micrometer adjustment controls vertical depth of cut, automatically adjusting copy table with pantograph. Range of reduction ratios from 2-to-1 to infinity! Vertical range over 10 inches!

For complete information, write to

GREEN INSTRUMENT COMPANY
361 Putnam Ave. Cambridge, Mass.

CIRCLE ED-260 ON READER-SERVICE CARD FOR MORE INFORMATION

SMALL SEAMLESS TUBING

Straight
Formed
Machined



Copper, brass, aluminum and other analyses up to 1/8" O.D.—any wall thickness. "Pointer" tubing from .010" to .048" O.D.; walls to .0010". Miniature tubing components for electronic devices. Enlist our 20 years experience and newly-expanded facilities. Tubing furnished straight, formed or machined to your spec's. Reasonable prices; 3-4 weeks delivery. Write for catalog and quotations.



UNIFORM TUBES, INC.

1202 Level Road, Collegeville 2, Pennsylvania
Agents in Principal Cities

CIRCLE ED-261 ON READER-SERVICE CARD FOR MORE INFORMATION

Demodulator

Does Not Use Vacuum Tubes



The PRD Type 808 is a phase sensitive demodulator producing a full wave, reversible polarity, d-c voltage output from a reversible phase, a-c voltage input. It will also

function as a modulator, producing an in-phase a-c output of carrier frequency that is proportional to the d-c voltage input. It is well suited for feeding a d-c controlled magnetic amplifier from an a-c signal source. It may also be employed as a small, light, low-cost lead or stabilizing network for servo systems. Other important uses are to drive a d-c meter from and a-c source, operate polarized and non-polarized d-c relays, and indicate phase angles.

The unit features a drift of less than 1% over an ambient temperature range of -55° to $+85^{\circ}\text{C}$. Operation at temperatures of up to 100°C is permissible if slightly higher drift can be tolerated. It is useful over a wide range of carrier frequencies, from 50cy to 5000cy. Containing only static components and no vacuum tubes, it is highly resistant to shock and vibration. Polytechnic Research & Development Co., Inc., Dept. ED, 202 Tillary St., Brooklyn 1, N. Y.

CIRCLE ED-262 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Voltmeter

With Expanded Scale



Voltage readings accurate to 0.5% over the frequency range of 50cy to 2000cy are obtained with the "Expanded Scale Panel Voltmeter". Use of a thermal bridge permits the indication of a narrow voltage

range. The scale is expanded about a given normal voltage which may be as low as 6.25v with a span of $\pm 30\text{v}$.

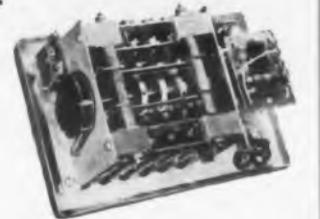
A complete line of 3-1/2" and 4-1/2" diam models is supplemented by square (3-1/2") and rectangular (4" x 6") models. Hermetically sealed and ruggedized models offer extreme durability under exacting conditions. Arga Div., Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-263 ON READER-SERVICE CARD FOR MORE INFORMATION



"icing conditions heavy—de-icers working fine—bandits on screen . . ."

7800 Series
A. W. HAYDON
Repeat Cycle
Timer
Lockheed Wing De-Icer



Custom Designed By THE A. W. HAYDON COMPANY To Control the Power for 10 De-Icing Circuits carrying 35 amperes 3 phase 220 Volt 400 Cps. A.C. to the de-icing heaters in 10 wing sections. Each heater is energized for a 10 second interval in an accurately controlled sequence.

WHEN TIMING POSES A PROBLEM — CONSULT . . .



The
A. W. HAYDON
COMPANY
NORTH ELM STREET
WATERBURY 20, CONNECTICUT

general
catalogs
sent on
request

Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE ED-264 ON READER-SERVICE CARD FOR MORE INFORMATION

Lower installed costs . . . with
**COMPRESSION TERMINALS, TERMINAL BLOCKS,
AND DISCONNECT CLASPS**
for all electrical and electronic applications



Burndy Electrical connectors have wide electrical and electronic application. Tool-installed HYRINGS provide rapid, simple, efficient termination for shielded and coaxial cables. Compression - installed HYLUGS are widely used in terminating all sizes of solid, stranded or flexible cables. Nylon-insulated INSULUGS have extensive use in terminating wire

in the electronic gear of aircraft. Designed with spring-loaded socket connectors, CRABLOKS, lightweight molded phenolic terminal blocks, provide quick plug-in connections and disconnections that speed terminating and testing procedures. For equipment requiring a quick-disconnect, compression HYCLASP disconnect splices and HYCLASP lug disconnect terminals are available. All HYCLASPS remain locked under tension. HYTOOLS and HYPRESSES, Burndy installation tools for compression-type connectors, provide efficient connections at minimum cost.

For detailed information, write

BURNDY, 600 Richards Avenue, Norwalk, Connecticut.

CIRCLE ED-265 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

Plastic Impregnant

Stycast 62

A new low-loss plastic impregnant, designated "Stycast 62," for capacitors, filters and r-f coils has a useful temperature range from -55°C to $+125^{\circ}\text{C}$. The material is supplied as a low viscosity liquid. When cured to a solid plastic, it has outstanding electrical properties.

Properties of the cured solid plastic are: dielectric constant at 60 to 10^8cy —2.6; dissipation factor at 60 to 10^8cy —below 0.0003; dielectric strength—above 500v mil. Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE ED-164 ON READER-SERVICE CARD

Transistor Kit

Makes 12 Circuits

Twelve fundamental transistor circuits can be constructed with this kit. The kit has a special designed chassis on which there is mounted the necessary components. It has two manuals covering general information on transistors, and a second manual covering necessary general technical information regarding the building of fundamental circuits. An additional 14 circuits can be built by adding components to the kit. Sutton Electronic Co., Inc., Dept. ED, 426 W. Short St., Lexington, Ky.

CIRCLE ED-165 ON READER-SERVICE CARD

Vitreous Coating

Applied at Moderate Temperatures

This firm has developed a new line of inorganic silicate coatings for fusing to ferrous metals at temperatures from 900° to 1200°F . Known as "Porcenells," they will see service in applications where metal warpage has not permitted the use of porcelain enamel on thin-gage metals—applications where synthetic enamels, galvanizing and expensive exterior-service metals have found wide usage. Allied Porcenell, Inc., Dept. ED, 851 S. Market St., Waukegan, Ill.

CIRCLE ED-166 ON READER-SERVICE CARD

CIRCLE ED-167 ON READER-SERVICE CARD

ALSiMAG[®]

Widest selection of latest materials. Constant addition of new special-purpose bodies. Over 50 years accumulated experience and "know how." A highly trained staff, alert for improvements and new techniques.

low...

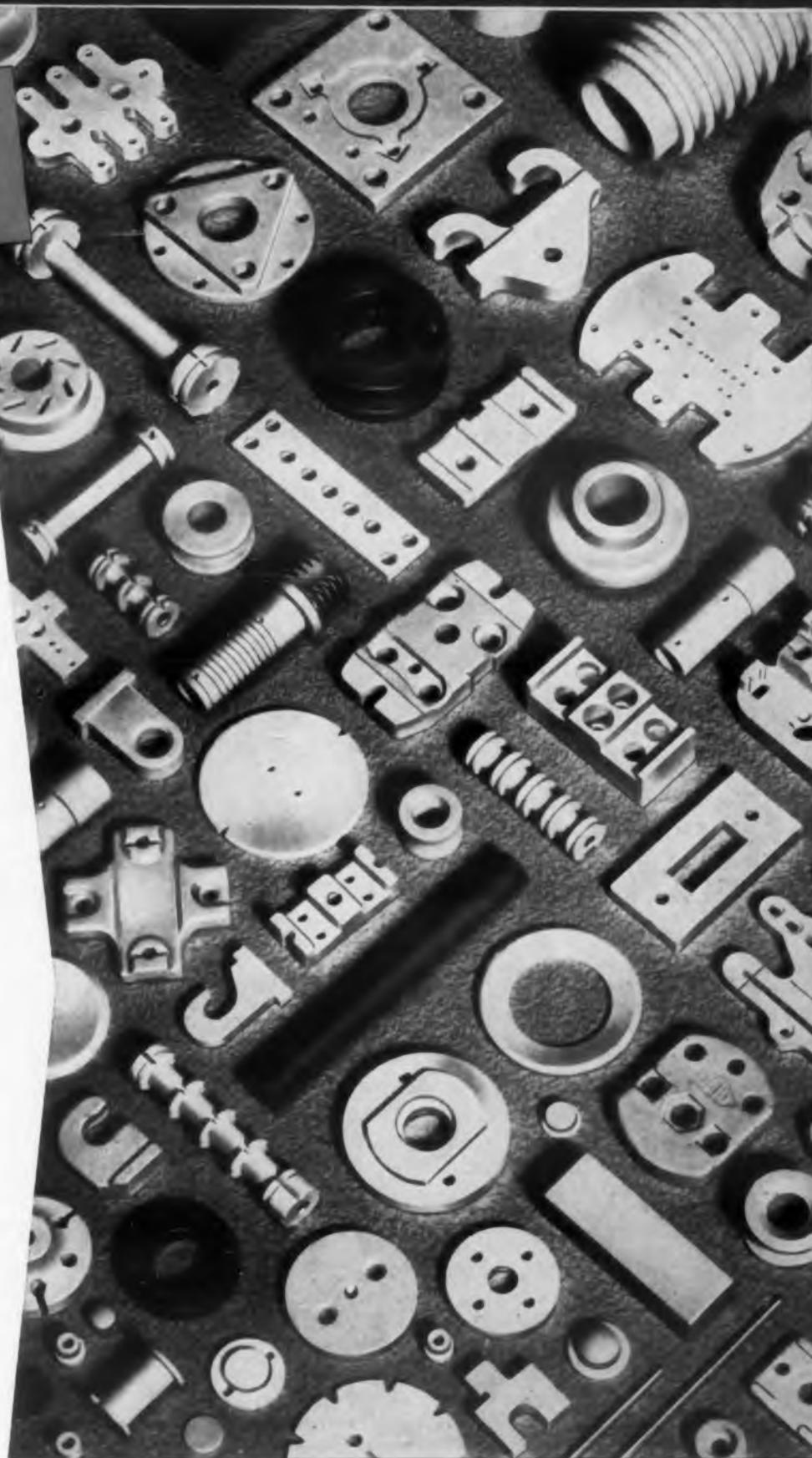
True cost is what you get for what you pay. It's risky to buy ceramics by price alone. It may mean mediocre material and outdated design. You'll profit by investigating the recent "giant steps" taken in the ceramic field.

cost...

ALSiMag offers the best possible ceramic for your job at a price that's right. Modern, large-scale equipment cuts production costs. Shipments are on time and to specification. ALSiMag extra services include free redesign service and use of open dies.

ceramics

Assembly lines run on deliveries, not promises. That's why we're careful to make delivery estimates that are dependable. True, ceramics are temperamental. But you'll find ALSiMag's "shipment as promised" average is high. Ask any of our customers.



• Send a blueprint and outline of operating conditions and see what American Lava can do to save you money.

53RD YEAR OF CERAMIC LEADERSHIP
AMERICAN LAVA CORPORATION
A SUBSIDIARY OF MINNESOTA MINING AND MANUFACTURING COMPANY
CHATTANOOGA 5, TENNESSEE

Branch offices in these cities (see your local telephone directory):
Cambridge, Mass. • Chicago, Ill. • Cleveland, Ohio • Dallas-Houston, Texas
Indianapolis, Ind. • Los Angeles, Calif. • Newark, N. J. • Philadelphia-Pittsburgh, Pa.
St. Louis, Mo. • South San Francisco, Calif. • Syracuse, N. Y. • Tulsa, Okla.

We 

are the originators of
Engineered Economy**
Iron Cores



 **Radio Cores, Inc.,** created and originated ENGINEERED ECONOMY IRON CORES . . . which are available at money saving prices and from stock.

Now . . . we have added six new Engineered Economy Iron Cores to expand our line to fourteen, covering most insert and threaded applications.

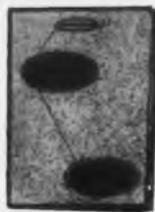
As the originators and creators of Engineered Economy Cores . . . leaders in engineering, quality, delivery and supply of samples, we are pleased that our tremendous volume enables us to lead in lower prices, too.

This has been achieved through our efficient production and your acceptance of "EE" cores.

We maintain an inventory of "EE" cores to eliminate your inventory problems and save you down time. Make certain that your "EE" cores come from the originator . . . RADIO CORES, INC.

We welcome your inquiries on "Custom Engineered Cores."

Write for our new "EE" specification data booklet



** TRADE MARK

Radio Cores, Inc.

9540 Tulley Avenue • Oak Lawn, Illinois

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION



Blower

Moves 960cfm



Designed and built to conform to applicable military specifications, this fan has 960cfm air volume NEMA code (free air). The unit, Model F7-1, is equipped with a 7" five-bladed fan and operates at a speed

of 3,400rpm. Under the NEMA code, it will move 525cfm free air.

The motor case is totally enclosed. Weight is 5 lb, 10 oz. Required voltage is 115v a-c, 60cy, single phase, 0.4amp. Mission-Western Engineers, Inc., Dept. ED, 132 W. Colorado St., Pasadena 1, Calif.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Piston Capacitor

Variable Trimmer Type



The Model VC-13G variable trimmer piston capacitor employs an expansion piston with a traverse motion, free from mechanical backlash, giving smooth capacitance tracking over the complete range. There is a rigid grip at all times between the piston and inner wall of the dielectric tube. Consequently, the capacitor is relatively free from effects of vibration and shock. The positive wipe, due to the constant spring tension of the moving parts, assures good r-f contact and low noise ratio.

The flat ductile copper lead of the capacitor offers low loss at high frequencies, vibration damping, and ease of attachment. Temperature stability enables it to operate continuously beyond 125°C and below -55°C. Voltages in excess of 10,000v d-c can easily be withstood, because the unit has a long flashover path from the outer electrode to the mounting base. Provision can be made for anti-corona protection.

The glass tube closed-end construction achieves excellent mechanical shock resistance. The sealed end prevents dust or oil film from forming on the inner dielectric surface, and reduces the possibility of increased series or parallel resistance caused by track formation. JFD Manufacturing Co., Inc., Dept. ED, 6101 16th Ave., Brooklyn 4, N. Y.

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

HARD WORK WANTED!

magnetic fluid clutch recording milliammeter

If you must make SENSITIVE RECORDINGS under ADVERSE CONDITIONS, the Texas Instruments field-proven Dual Recording Milliammeter was designed with you in mind. It is a durable, ink-writing, accurate recorder with two independent channels and four selective chart speeds... all in a 15½ lb, portable instrument.



MAGNETIC FLUID CLUTCH meter movements make possible a sensitivity of 0.45 inch per 100 microamps combined with adherence to rigid military aircraft requirements for shock, vibration, explosion, and humidity resistance. High resultant torque permits the startling reduction in recorder size and weight and creates a new degree of independence from shock, vibration and pen drag.



write today
for bulletin
DL-C 4001

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVE. DALLAS 9, TEXAS

CIRCLE ED-155 ON READER-SERVICE CARD

Insulating Varnish

Reduces Noise

No. 186 Insulating Varnish is a clear, heat-reactive coil varnish with special properties for the reduction of noise in stators, transformers, and coils. It may be thinned with mineral spirits, but has dip tank stability even under severe operating conditions. It gives very good penetration, bakes rapidly, and results in an oil-proof dielectric film that will not embrittle with age. Schenectady Varnish Co., Dept. ED, P. O. Box 1046, Schenectady 1, N. Y.

CIRCLE ED-60 ON READER-SERVICE CARD

Coated Yarns

To Any Wall Thickness

A new process coats any natural or synthetic yarn, particularly glass fiber yarns, in virtually any count size, both single and plied, with a consistent, uniform diameter coating of vinyl, silicone, silicone rubber, Teflon, nylon, or latex. The coatings can be applied in wall thicknesses and compositions to suit the specific needs of insulated wire and cable manufacturers. Colors available in the various types of coatings are brilliant and stable. Chemo-Textiles, Inc., Dept ED, P. O. Box 169, Warwick, R.I.

CIRCLE ED-61 ON READER-SERVICE CARD

Rectifier Kits

Contain Many Selenium Rectifiers

Designed to save the development engineer time in obtaining samples, this series of seven selenium rectifier kits contain fully assembled vacuum-processed rectifiers with commercial coding. The series offers a complete range of sizes and ratings from 3/16" diam plates to 5" x 6" plates, with ratings from 1.5ma d-c up to 3700v peak inverse to types rated at 10amp and 222v. Bradley Laboratories, Inc., Dept. ED, 168 Columbus Ave., New Haven, Conn.

CIRCLE ED-62 ON READER-SERVICE CARD

CIRCLE ED-63 ON READER-SERVICE CARD ➤

Series No. 1 KOVAR BASES

WITH NICKEL
SILVER CASES

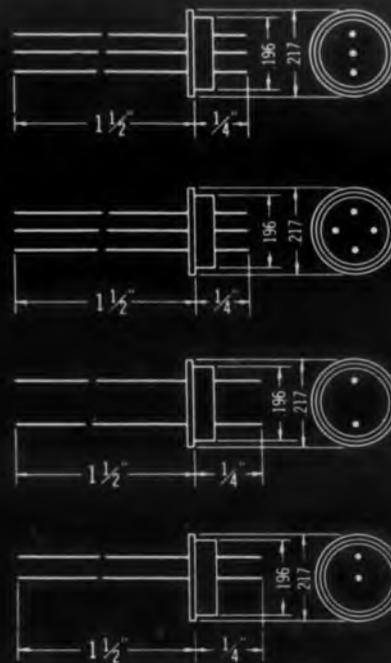
Three electrode hermetically sealed Kovar bases supplied with closures. Lead lengths and pin layouts as illustrated. Cases are available in three types. Closures are press-fit to bases.



Series No. 3 COMPRESSION TYPE BASES & CLOSURES

WITH NICKEL
SILVER CASES

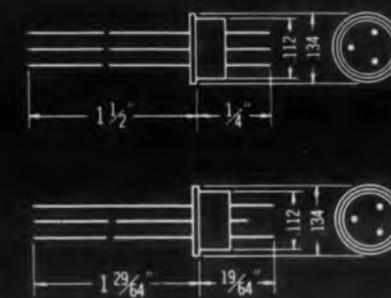
Compression type bases available in two, three and four lead types. Type TC-3 or TC-3A cases, illustrated, can be supplied. Cases are press-fit to bases.



Series No. 5 COMPRESSION BASES

WITH NICKEL
SILVER CASES

Available as illustrated. Cases are press fit to bases.



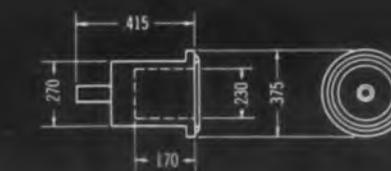
Type TB-6 TRANSISTOR BASE

AVAILABLE WITH
TC-6 CLOSURE



Type DC-5 GOLD PLATED

With welding projection. Available as DC7 without welding projection.



ALL CASES .300"
IN LENGTH



TC-1A
plain

TC-1B
with hole



TC-1C
with hole
and dimple



CASES AVAIL-
ABLE WITH OR
WITHOUT
DIMPLE

TC-3
with dimple
.300" long



TC-3A
plain
.340" long



Where Special cases
are required, EI will
quote on your re-
quirements on re-
ceipt of your draw-
ings or speci-
fications.

TC-5
with dimple



TC-5A
plain

TC-5B
with .025" hole
All .325" long

TC-5C
plain .240" long



TC-6 CLOSURE
Plain case .300"
in length.

E-I

HEADQUARTERS
FOR YOUR
HERMETICALLY
SEALED
MINIATURE

TRANSISTOR and DIODE BASES and CLOSURES*

Electrical Industries is your dependable source of supply for all hermetically-sealed miniature components. Miniaturized transistor and diode bases with closures and sealed components for specialized requirements can be supplied quickly and economically. For samples and quotations on standard components or recommendations on "specials", call or write E-I, today!

ELECTRICAL INDUSTRIES

44 SUMMER AVENUE
NEWARK 4, NEW JERSEY

DIVISION OF AMPEREX
ELECTRONIC CORP.

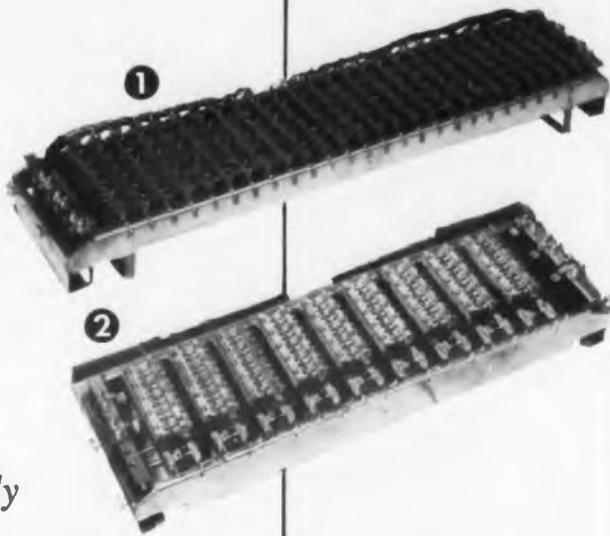


*PATENT PENDING ALL RIGHTS RESERVED

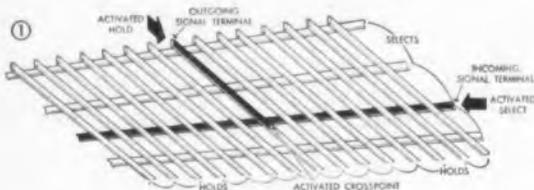
"Up a Tree" with a Relay Tree? . . .

KELLOGG CROSSBAR

*solves complex
switching
problems
quickly, easily
and inexpensively*

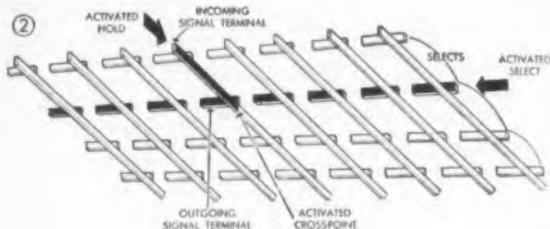


The Kellogg *Crossbar Switch* illustrated below establishes the different types of electrical connections possible. Any cross point can be activated in less than 50 milliseconds by energizing one select magnet and one hold magnet. Standard contact material used in the Kellogg *Crossbar Switch* is palladium (gold can also be provided). Mounting brackets are available which provide drawer-like removal for easy inspection. Circuits can be maintained while the Kellogg *Crossbar Switch* is in the process of switching other circuits.



1

Drawing No. 1 illustrates the basic Crossbar principle which permits any of several incoming circuits to be connected to any of several output circuits. This type of switch can connect any of 60 circuits, 3 at a time, to any of 75.



2

Drawing No. 2 shows a means of switching one incoming circuit to many possible outgoing circuits—accomplished by removing every other vertical. Thus, instead of having one cable terminal at one end of the switch, each remaining vertical has its own cable connection. This type of switch can easily be adapted to switch one circuit to any of 936.

Write for Technical Bulletin
Today! Dept. 68-A

A Famous Name
in Communications
Now Solving
Problems in the
Control Industry

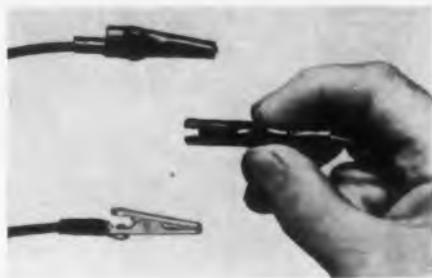
KELLOGG

DIVISION OF
IT&T

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
A Division of International Telephone and Telegraph Corporation
SALES OFFICES: 79 West Monroe Street, Chicago 3, Illinois

CIRCLE ED-272 ON READER-SERVICE CARD FOR MORE INFORMATION

Alligator Clips Insulated to Permit Crowding



A tight two-piece insulator is incorporated into this Alligator Clip. It adds negligible size to the clip (15/64" OD) and covers it right down to the tip. A special lip-

action slot in the flexing insulator allows the clip to "bite" the connection without "baring its teeth". The design permits dozens of clips to be closely compacted on crowded connections, at all angles, with complete protection against shorts and shocks.

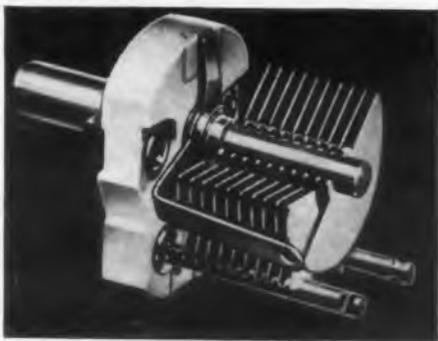
The tough, thin insulating material is formed of a special plastic with high dielectric strength, and it will stretch and contract as the clip jaws are opened and closed. A tubular insulator covers the tail of the clip, while a tapered insulator covers the jaws. The two parts of the insulator overlap for complete protection. The tail of the clip accommodates a banana plug, and also prevents bending of the bared wire when using the screw connection. The screw connection is readily made by temporarily slipping one insulator forward.

Two insulated alligator clip types are available. One is cadmium-plated steel, the other is solid copper with a brass screw connection. Each type is available with either red or black insulators for easy "hot" or "cold" lead identification. Mueller Electric Co., Dept. ED, 1580H E. 31st St., Cleveland 14, Ohio.

CIRCLE ED-273 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Capacitors

Available with Extended Shafts



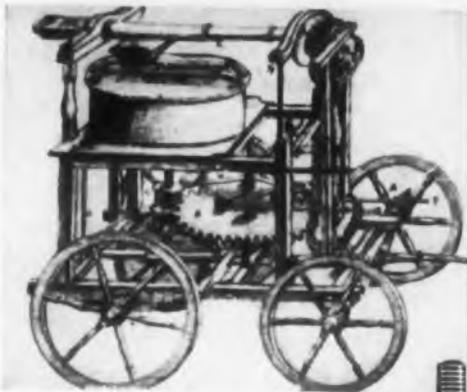
The APC and MAPC type variable capacitors are now available with extended shafts. In the past, these items have been available only without shafts and were adjusted by

screwdriver. They are now being made available with 1/2" shaft extension for knob control.

The APC trimmer is used in all classes of equipment where a compact high-quality air dielectric trimmer is needed. The MAPC type is similar to the APC except that it is a miniaturized version. Hammarlund Manufacturing Co. Inc., Dept. ED, 460 W. 34th St., New York 1, N. Y.

CIRCLE ED-274 ON READER-SERVICE CARD FOR MORE INFORMATION

17th century PENCIL SHARPENER?



Well, whatever it is, complex as it appears, this drawing is not nearly as complex as the engineering drawings of today. The need for drafting precision has increased steadily over the years.

To keep pace with this need, Staedtler has made constant improvement in pencil design and manufacture ever since the first Staedtler pencils were produced in Nurnberg, Germany, in 1662—about the time the above drawing was made.

Today, the Mars-Lumograph is America's finest imported drawing pencil. In the clutch pencil field, the combination of the new 1001 Mars Technico push-button lead holder and 1904 Mars-Lumograph imported drawing leads insures your having the very best.



The 2886 Mars-Lumograph drawing pencil gives you precise thickness and the blackness of line needed for crisper, cleaner prints. Perfectly graded in 19 degrees—EXEXB to 9H. \$1.50 per dozen—less in quantity.

The 1001 Technico Mars-Lumograph push-button lead holder costs no more than ordinary holders, has a noiseless, smooth-working, low-friction clutch mechanism, lightweight wood construction with perfect balance and, built into the push-button cap, a unique lead sharpener. \$1.50 each—less in quantity.

1904 Mars-Lumograph Imported Drawing Leads are so opaque that inking-in is not necessary. Leads are ribbed for firm clutch grip and each has a metal cap which prevents sliding from holder. Available in 18 degrees—EXB to 9H. \$1.20 per dozen—less in quantity.



J.S. STAEDTLER, INC.

41 DICAROLIS COURT

HACKENSACK, NEW JERSEY

CIRCLE ED-275 ON READER-SERVICE CARD

ELECTRONIC DESIGN • January 1955

"Silas
tric coa
for ext
electron
hr at 20
which
ture-pr
dation,
indicate
coated
easily
tant an
require

Supp
sistency
drawing
may be
molds.
directly
canizat
gradua
white,
Dow C
land, M

CIRCLE

A gl
set sty
lent u-
impact
ity an
nated
from a
rene. I
Rd., A

CIRCLE

En

"Da
tables
labels.
made t
but e
slides,
etc. T
P. O.

CIRCLE

CIRCLE

Resilient Coating Cures Quickly

"Silastic" S-2007, a resilient dielectric coating or encapsulating material for extreme temperature electric and electronic components cures in 2 to 4 hr at 200° to form a rubberlike jacket which is uniform, heat-stable, moisture-proof and highly resistant to oxidation, ozone, and weathering. Tests indicate that transformers properly coated with this new material will easily pass both the moisture resistant and low temperature flexibility requirements of MIL-T-27 grade 1.

Supplied as a solvent free, low consistency paste, it may be applied by dipping, vacuum impregnating, or may be molded in fitted encapsulating molds. Coated parts may be placed directly into a hot air oven for vulcanization. Neither pressure nor a graduated cure is necessary. Normally white, it may be tinted any shade. Dow Corning Corp., Dept. ED, Midland, Michigan.

CIRCLE ED-184 ON READER-SERVICE CARD

Insulating Laminate Glass Reinforced

A glass reinforced sheet of thermoset styrene copolymer, having excellent u-h-f electrical properties, high impact strength, excellent punchability and good machinability, is designated "Rexolite 2101". It is produced from a cross-linked copolymer of styrene. Rex Corp., Dept. ED, Hayward Rd., Acton, Mass.

CIRCLE ED-185 ON READER-SERVICE CARD

Engineering Data Tables Stick to Lamps

"Datables" are engineering data tables on split-back, self-adhesive labels. These labels, 2-5/8" x 17" are made to fit on fluorescent lamp shades, but can be used on desk drawer slides, inside tool box covers, walls, etc. Timber-Top Products, Dept. ED, P. O. Box 14, Sherman, Conn.

CIRCLE ED-186 ON READER-SERVICE CARD

CIRCLE ED-187 ON READER-SERVICE CARD

New Sub-Miniature Relay

Now Double Pole Double Throw with Increased Ratings



ACTUAL
SIZE

TYPE KH-6D

ELECTRICAL SPECIFICATIONS

CONTACTS: Double pole double throw rated at 0.5 amperes at 26.5 volts DC or 115 volts AC resistive

COIL: Sensitivity—nominal 1.0 watts, maximum 0.3 watts
Resistance—up to 1500 ohms standard

TEMPERATURE: Minus 60° C to plus 125° C

VIBRATION: 10 G up to 500 cycles

SHOCK: 100 G plus (operating)

SPEED OF OPERATION: 2 milliseconds at nominal voltage direct from battery supply and 1 millisecond with series resistance

ALTITUDE: 350 volts rms at 80,000 feet

TERMINAL TYPES: Printed circuit, solder terminals and plug-in

CAPACITY: N. O. contact to case 0.6 mmf.



Weights 0.33 oz.—has low capacity for RF switching. Applicable to printed circuits.



Write for catalog sheet giving complete information



ALLIED CONTROL



ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N. Y.



FRONT VIEW



SIDE VIEW

Hartwell Flush Latches

AVAILABLE
FOR OVER



BACK VIEW

300 COMBINATIONS
OF DOOR AND FRAME
THICKNESSES

HARTWELL Trigger-action Flush Latches are produced in over 300 standard combinations of bolt and trigger offsets. We can supply a latch for any door to be latched in any frame within thickness ranges common to standard sheet metal practice.

No altering of panels and frames is necessary when **HARTWELL** Flush Latches are installed. Offsets of bolt and trigger are stamped on each part for rapid and accurate selection of the correct latch for each installation.

All **HARTWELL** Flush Latches and Hinges are the result of nearly two decades of continuous specialized design and manufacture.



← *New 1954 Catalog illustrates and gives full details of complete line.*

MAIL THIS COUPON

HARTWELL COMPANY

9035 Venice Blvd., Los Angeles 34, Calif.

Send Illustrated 1954 Catalog.

Name _____

Company _____

Address _____

City _____

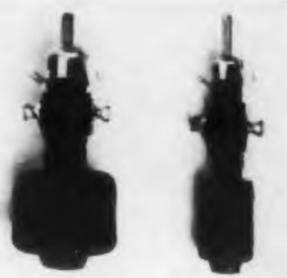
Zone _____

State _____

CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Inductors

In Ranges from 400 microhenry to 0.5h



By use of new ferrite materials, this firm has made available two compact additions to its line of high "Q" "Vari-Chokes"—variable inductors. These additions make available seven inductors covering the range of 40 μ h to 0.5h, inclusive.

One of the new inductors, the U-80, has an inductance range of 0.25h to 0.5h. The other unit varies from 100mh to 260mh. Superex Electronics Corp., Dept. ED, 23 Atherton St., Yonkers, N. Y.

CIRCLE ED-224 ON READER-SERVICE CARD FOR MORE INFORMATION

Strain-Gage Terminal Simplifies Measurements



The Model 125 Strain-Gage Terminal is designed for use with this firm's Model 220 Wide-Band D-C Amplifier or other instruments with differential input. It contains a metered voltage source to energize

resistance strain gages usually used in bridge circuits. It also contains provisions to obtain initial balance of the strain gage bridge circuit, as well as a number of precision resistors which may be used to complete the bridge circuit, if less than four external strain gages are used.

Output terminals are arranged so that short, direct connections to the input terminals of the wide-band amplifier can be made. A voltmeter indicates voltage applied to the strain-gage bridge circuit, and an adjacent control permits adjustment of this voltage. A selector switch permits selection of the circuit used. Another control permits balancing of the bridge circuit. Selection of a resistor matching the value of a single strain-gage is possible by another control.

A reversing switch permits momentary reversal of polarity of the bridge output. This provides a convenient way to recover "zero output" of the bridge circuit when making dynamic measurements. A self-contained power supply is available as an accessory. The Model 125 permits the matching and balancing of external strain-gages between 10 ohms and 2500 ohms. Furst Electronics, Dept. ED, 3322 W. Lawrence Ave., Chicago 25, Ill.

CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

Curtis
Terminal Blocks
Make Better
Connections
Economically—
Quickly.
A type for every
purpose.

CURTIS Type "E" Terminal Blocks with wire clamp feature



No lugs, looping or
hooking of wire



Without a doubt, the simplest space, labor and cost saving Terminal Block made. Stripped wire is inserted between clamping members without looping or other preparation and the screw tightened — it's there to stay unless the wire itself breaks. Screws nest in blind holes in the solid molded base, eliminating danger of shorting. The type "E" is factory produced in any number of terminals from 1 to 22.

Write for Bulletin DS-123. Also, ask about wide selection of other Curtis Blocks available.

CURTIS DEVELOPMENT & MFG. CO.

3236 North 33rd Street, Milwaukee 16, Wisconsin

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION



vernistat... The Revolutionary New Precision Variable-Ratio Transformer

Analog Computers? Servos? Control Systems? The Vernistat is a completely new type of voltage divider that combines low output impedance with an inherently high resolution and linearity not ordinarily attainable by precision potentiometers.

The Vernistat consists of a tapped auto-transformer which provides the basic division of voltage into several discrete levels. These levels are selected and further sub-divided by a continuous interpolating potentiometer that moves between 31 transformer taps.

Because of its unique operating principles, electrical rotation is held to close tolerances eliminating the need for trim resistors. In many applications there is no need for impedance matching amplifiers.

Specifications of the standard model Vernistat are shown below. Other versions are under development to meet specific end uses.

What are your requirements for this unique precision voltage divider?

SPECIFICATIONS

Linearity Tolerance better than $\pm 0.05\%$	Frequency	50-3000 cps
Output Impedance 130 ohms (max.)	Max. Output Current	50 ma
Minimum Voltage Increment	better than	.01%

Other models including a miniaturized 400 cps version will soon be available.

vernistat division Perkin-Elmer Corporation, Norwalk, Conn.

CIRCLE ED-223 ON READER-SERVICE CARD FOR MORE INFORMATION

TV Receiver Tubes

Horizontal Deflection Amplifiers

Three tubes designed for use as horizontal deflection amplifiers in television receivers, and rated for Continuous Television Service, are the 6CU6, 12CU6, and 25CU6. The electrical characteristics of these CTS-Rated tubes are similar to those of the 6BQ6GT, 12BQ6GT, 25BQ6GT, respectively, with which they are interchangeable. The new series has an increased peak-positive-pulse voltage, and is designed to provide longer life at high-line conditions, increased ruggedness to withstand momentary overloads, and higher reliability. CBS-Hytron, Dept. ED, 100 Endicott St. Danvers, Mass.

CIRCLE ED-90 ON READER-SERVICE CARD

Temperature Indicators

In Liquid Form

"Tempilaq^o" liquid temperature indicators are available from 113° to 500°F in 12-1/2° steps—and in 50°F intervals from 500° to 2000°F. Tempilaq^o is applied by daubing or brushing and will dry quickly to a dull, opaque film. On subsequent heating this coating will liquefy as soon as its temperature rating is reached. Free 1/2 oz Tempilaq^o samples available. Tempil Corp., Dept. ED 132 W. 22nd St., N. Y. 11, N. Y.

CIRCLE ED-91 ON READER-SERVICE CARD

Encapsulated Controls

Various Potting Compounds Used

Any one of several compounds may be used to encapsulate this firm's controls depending on requirements of the customers' specifications. Encapsulating is applicable to controls constructed with a cover. If it is required, mounting and shaft seals may be utilized with the process. Encapsulation materials available are acrylic, epoxy, resins and enamels. Clarostat Mfg. Co., Inc., Dept. ED, Dover, New Hamp.

CIRCLE ED-92 ON READER-SERVICE CARD

CIRCLE ED-93 ON READER-SERVICE CARD ➤



MINIATURIZATION

*When there's only room for improvement
...there's a treasury of ideas in*

KEL-F[®] PLASTIC



Space saving insulation... machined from KEL-F Plastic rod.



Miniature Test Jacks for 500 volt RMS "HF" circuit... injection molded of KEL-F Plastic.



Contact Bar insulated with KEL-F Plastic... injection molded directly to beryllium-copper.

When you have to squeeze more and more into less and less space... when materials lack the specific properties you need for miniaturization, we suggest you look into the possibilities of KEL-F Plastic.

The development of KEL-F Plastic, a fluorocarbon polymer, was inspired by a vital problem of miniaturization in the field of electronics. What it accomplished then, it can repeat for your products.

KEL-F Polymer is a dense, tough thermoplastic with outstanding resistance to the effects of high and low temperatures. In wire insulation, tube sockets, connector blocks, printed circuit bases, transistor seals, and other applications its zero moisture absorption, non-wettability and dimensional stability can provide high level performance under severe conditions of temperature and humidity.

The compressive strength is high. Bearing loads

of 8,000 psi result in only 4% to 5% permanent set. KEL-F Plastic can actually be used for structural members. Electrical properties are outstanding. They include superior resistance to arcing, surface flash-over and thermal cycling.

KEL-F Plastic is readily moldable by extrusion, compression, injection and transfer methods. Molding techniques are fully perfected, and molded components can be depended on to exhibit all the inherent characteristics of the original molding material.

KEL-F Plastic is available as a molding compound, or it can be obtained in rods, tubing, sheets and film from a number of suppliers. It is also available in dispersions, suitable for bake-coating of metals and certain non-metals. The full story of KEL-F Polymer should be in your active file. Write us.

®Registered trademark for The M. W. Kellogg Company's Fluorocarbon polymers.

Miniature Rectifier and mount for parts... injection molded of KEL-F Plastic.



THE M. W. KELLOGG COMPANY

Chemical Manufacturing Division, P. O. Box 469, Jersey City, N. J.

SUBSIDIARY OF PULLMAN INCORPORATED

TO THE FINE ENGINEERING MIND
SEEKING THE CHALLENGING PROJECTS IN



MICROWAVE ENGINEERING

Convair, in beautiful San Diego, now earnestly needs skilled **MICROWAVE ENGINEERS AND PHYSICISTS**: to solve design problems of an advanced nature in microwave antennas and scanners. Must be experienced in pencil beam and shaped beam designs for guided missile and airborne radar applications. For analytical and experimental work in the design of microwave components for specialized microwave radar systems and test equipment. For experimental development of components in the fields of dielectric and metallic media including familiarity with radome and microwave lens design. Unusual opportunities for senior level engineers with advanced degrees or equivalent experience.

At **CONVAIR** you will find an imaginative, explorative, energetic engineering department... truly the "engineer's" engineering department to challenge your mind, your skills, your abilities in solving the complex problems of vital, new, long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

Generous travel allowances to engineers who are accepted.

Write at once enclosing full resume to:

H. T. Brooks, Engineering Personnel, Dept. 1001

CONVAIR

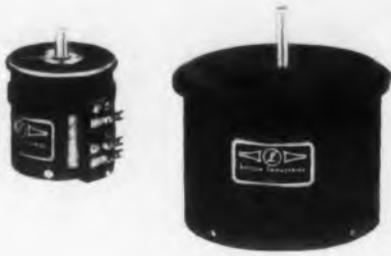
A Division of General Dynamics Corporation

3302 PACIFIC HIGHWAY SAN DIEGO, CALIFORNIA

Lovely, sunny, **SMOG-FREE SAN DIEGO**, ever-growing area of three-fourths million people, offers you and your family a way of life judged by most as the Nation's finest for climate, natural beauty and easy (indoor-outdoor) living. Housing is plentiful and reasonable.

Multi-Turn Potentiometers

Linearities to $\pm 0.01\%$



These two series of multi-turn potentiometers are designed for ultra-high precision. The Series MA-20-10 10-turn potentiometer (shown at left) is made with

standard independent linearities from $\pm 0.5\%$ to $\pm 0.02\%$, with special linearities as high as $\pm 0.01\%$. Case diameter is 1.820", and resistances from 1000-100,000 ohms are offered.

The Series MA-30-10 10-turn potentiometer (shown at right) is made with standard independent linearities from $\pm 0.5\%$ to $\pm 0.01\%$, with linearities as high as $\pm 0.005\%$ available on special order. Case diameter is 3.000", and resistance range is 2000-300,000 ohms. Fifteen-turn models are available with case diameters of 3" and are designated the MA-30-15 Series. Litton Industries, Dept. ED, 215 S. Fulton Ave., Mount Vernon, N. Y.

CIRCLE ED-277 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Has Variable 0-50v D-C Output

The Model 2600 Voltage Regulated Power Supply features a continuously variable 0-50v d-c, 2amp output. Excellent regulation, low ripple content, and low output impedance are features.



In the range of 0-50v, the output voltage variation is less than 5mv for line fluctuations from 105-125v, and less than 5mv for load variations from 0-2amp. The ripple voltage is less than 1mv. Either the positive or negative terminal may be grounded.

Provision is made for compensating for the voltage drop in wires connecting the power supply to the load. A 10-turn potentiometer coarse voltage control varies the voltage from 0-50v. A three-turn potentiometer fine voltage control varies the voltage 5v. There are input and output fuses on the front panel, and a time delay relay is included to prevent unregulated voltage from appearing at the output terminations.

This unit is designed for relay rack mounting or bench use. Panel height is 10-1/2", width 19", and depth 17". The panel is engraved. Kepco Laboratories, Dept. ED, 131-38 Sanford Ave., Flushing, N. Y.

CIRCLE ED-278 ON READER-SERVICE CARD FOR MORE INFORMATION

SINGLE SPIDER GEAR DIFFERENTIALS

by FORD INSTRUMENT are

7 ways superior



AVAILABLE IN

four sizes: 1/8", 3/16", 1/4", and 5/16" shaft diameters

FOR EARLY DELIVERY

Ford Instrument's single spider gear differentials are engineered to highest military and commercial standards . . . to provide *extreme accuracy* in addition and subtraction, and in servo loop applications.

- 1—High sensitivity.
- 2—Minimal lost motion.
- 3—Precision Zerol gears.
- 4—Corrosion- and wear-resistant materials throughout.
- 5—Minimum working diameters for compactness.
- 6—Minimum weights.
- 7—Rugged, long-life design.

FREE a fully illustrated data bulletin gives performance curves and characteristics. Please address Dept. ED.



42



FORD INSTRUMENT COMPANY

Division of The Sperry Corporation

31-10 Thomson Ave.
Long Island City 1, N. Y.

Ford Instrument's standard lines



CIRCLE ED-276 ON READER-SERVICE CARD

Automatic Plotting Board

Takes Card, Tape, Keyboard Inputs



This automatic plotting board, the "Electroplotter" Model G, accepts inputs from punched tape, and keyboard. It plots on a 30" x 30" surface with an accuracy of one part in 1500, or 0.02", whichever is greater.

Numerical inputs of ± 9999 may be expanded to full scale or compressed to one-third full scale in both X and Y coordinates. Physically, its origin may be placed at any desired location on the table. Roll paper may be used, and a vacuum paper hold down system is provided for smooth wrinkle-free hold down.

Other features include multiple symbol printing, serial keyboard, plug-in component construction, and light bank indication of numbers in the X and Y registers. Benson-Lehner Corp., Dept. E, 2340 Sawtelle Blvd., West Los Angeles 64, Calif.

CIRCLE ED-279 ON READER-SERVICE CARD FOR MORE INFORMATION

R-F Coaxial Switch

Used to 8000Mc



This rugged, compact, light-weight switch is specifically engineered to meet miniaturization demands under tough environmental conditions. Designed

to meet requirements of MIL-E-5272, it has a frequency range of 0 to 8000Mc. Vswr is 1.3 max. Insertion loss is 0.2 max. Cross talk is 50db min. Life duration is 500,000 operations minimum. It has type "N" connectors.

Contacts are spdt. Actuator power rating is 18-30v d-c at 0.18amp max per coil. Weight is 4.8oz (approx.). Ambient operating range is -65° to $+225^{\circ}$ F. Actuating time is 1/200sec max.

The r-f power rating of the switch is equal to that of improved Type "N" connectors. It can be operated with r-f positions 1 or 2 both "on" or "off" simultaneously. The r-f positions may be operated as "make before break" or "break before make". Stacking dimensions are 0.850" x 2.48". Transeo Products, Inc., Dept. ED, 12210 Nebraska Ave., Los Angeles 25, Calif.

CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW ... FROM

Transitron[®]

GOLD BONDED SUBMINIATURE GLASS DIODES

designed for specific applications

HIGH INVERSE VOLTAGE TYPES

The 1N55B with a 150 volt rating, and the T5G with a 100 volt rating are particularly suitable for circuits where high voltages are encountered.

HIGH TEMPERATURE TYPES

The T18G and 1N198 diodes are rated, specified, and 100% tested for operation at 75°C. They are specifically intended for use where high inverse resistance and reliable performance is required at elevated ambient temperatures.

HIGH CONDUCTANCE TYPES

For applications requiring high forward conductance, types such as the T7G and T25G with over 200 ma at +1 volt provide improved circuit performance.

HIGH RESISTANCE TYPES

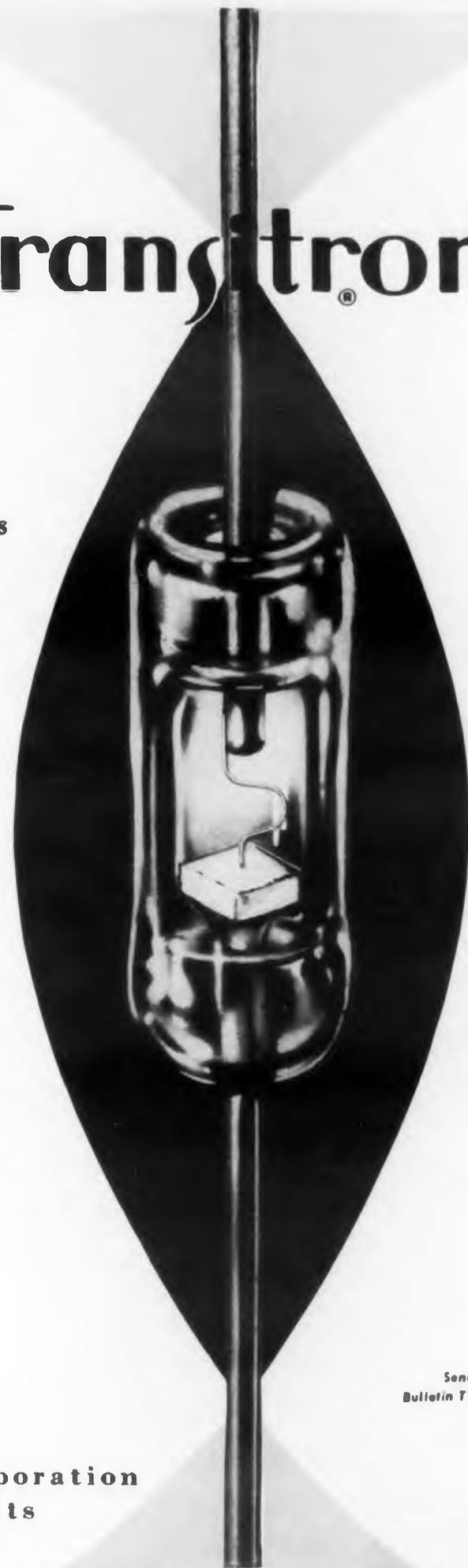
The T8G and T9G offer several megohms inverse resistance and are ideal for critical circuits requiring a minimum of diode loading.

COMPUTER TYPES

Specified for recovery time, the T16G, T17G, 1N191, and 1N192 are suited for critical pulse circuitry. Types T7G, T6G, and T25G have been designed especially for fast core switching.

JAN TYPES

The 1N126, 1N127, 1N128, and 1N198 are designed and tested to meet all requirements of MIL-E-1B.



actual
size

Send for
Bulletin T1312

Transitron electronic corporation
melrose 76, massachusetts



Power Transistors



Transistors



Germanium Diodes



Silicon Diodes



Quads

CIRCLE ED-281 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • January 1955

*It takes more than
parts to make an*

ARGA RESOLVER



15 size 23 size
Uncompensated
Resistor compensated
Feedback winding compensated

maximum error

Grade 1 — .05%
Grade 2 — .10%
Grade 3 — .20%

Null voltage less than
1 millivolt per volt
Built to military
specifications

Write for data file, 1-11



Arga

division

BECKMAN INSTRUMENTS, INC.
220 PASADENA AVE., SOUTH PASADENA, CALIFORNIA

CIRCLE ED-73 ON READER-SERVICE CARD FOR MORE INFORMATION

Connectors

Designed for Computer Applications



Designed for the particular demands of the computer field, the Cannon K Miniature Series Connectors are adaptable to wide use in aircraft, electronics, radio, and general electrical industries. They are subjected to electrical and environmental tests in strict adherence with military specifications. Contractual approval on military contracts may be used.

Shell types available include straight, angle 90°, and angle 45° plugs, all with integral clamps. A standard KO2 (3102) box mounting receptacle and hermetically sealed receptacles with steel shells are also available. Construction and design are especially adapted to potting (sealant) techniques. Barrel assemblies and end bells are ordered separately.

Shells and end bells are lightweight aluminum alloy; contacts are copper alloy, gold-plated; current rating is 5amp. Insulators are Nylon (FM10001). Inserts are currently available in three sizes, with 10-, 20-, and 30-contact arrangements, respectively. Cannon Electric Co., Dept. ED, 3209 Humboldt St., Los Angeles 31, Calif.

CIRCLE ED-74 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicating Meter

Offered in Multitude of Ranges



The Model No. 23 Meter can be provided in all ranges of microamperes, milliamperes, amperes, volts, and millivolts. It is available for use in electronics, automotive, radio, radio test equipment, industrial equipment, and all other types of equipment wherever an indicating electrical instrument is required.

The meter has a 4-5/8" x 4-3/16" clear styrene plastic case for easy reading and to permit additional and more informative data on the dial. The case is molded in such a manner that each customer may individualize the lower portion of the clear plastic front with his own design at a slight additional cost. Beede Electrical Instrument Co., Inc., Dept. ED, Penacook, N. H.

CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION

MAINTAIN ACCURACY

from -65° to +550° F.



with this new

Pacific

high temperature ACCELEROMETER

Now, Pacific Scientific presents a unique new *high temperature* accelerometer, designed by Humphrey to give accurate, clear signals at temperatures from -65° to +550° F. — far in excess of former operating ranges! The rugged stainless steel and ceramic construction provides long life and allows precision tolerances for maintaining repeatability.

For the higher temperatures encountered in missile work, as well as for use in all types of aircraft where heat dissipation is a problem, this new unit provides the ideal answer!

SPECIFICATION DATA:

- **Environmental**—Temperature: -65° to +550° F. Shock: 60 G's in any direction without damage to the instrument.
- **Accuracy**—Within 1/2% to 2% depending upon G range and potentiometer resistance. (Including linearity, resolution and environmental conditions.)
- **Range**—Any range from -1 G +1 G and -50 G +50 G. Also available in asymmetrical ranges.
- **Resolution**—0.4% to 0.2% of full range. Potentiometer resistance can be furnished with any DC value between 300 and 20,000 ohms for all ranges.

PACIFIC SCIENTIFIC—pioneering the field of aircraft instrumentation since 1919

Pacific Write for full details and specifications—today!
SCIENTIFIC CO.

LOS ANGELES, CALIF., 1430 Grande Vista Ave.
SAN FRANCISCO, CALIF., 25 Stillman Street
SEATTLE, WASHINGTON, 421 Michigan Avenue
ARLINGTON, TEXAS, 111 East Main Street

CIRCLE ED-76 ON READER-SERVICE CARD

Delay Line

Variable from 0 to 3.1 μ sec



The Model V 103-A Delay Line provides a variable delay of zero to 3.1 μ sec. It is particularly designed for permanent installation in manufactured equipment, such as computers, and radar and TV test equipment. In radar range

calibrating test equipment, for example, this line can provide continuous adjustment of the 500 yard markers. The box is hermetically sealed with an "O" ring seal for the shaft.

The delay is obtained with a lumped-constant circuit consisting of 60 coil and capacitor sections. A shorting-type rotary switch selects the desired delay from 120 steps of 0.025 μ sec per step.

Overall accuracy is 5%. The rise time varies from 0.04 μ sec to 0.14 μ sec, according to delay. Nominal impedance is 2700 ohms. Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Sta., N.Y.

CIRCLE ED-77 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Timer

For Control of Automatic Machines



The "Type 12 MC" is a low-cost electronic interval timer, suitable for incorporation into many machines that require dependable, accurate cycling. It is suitable for

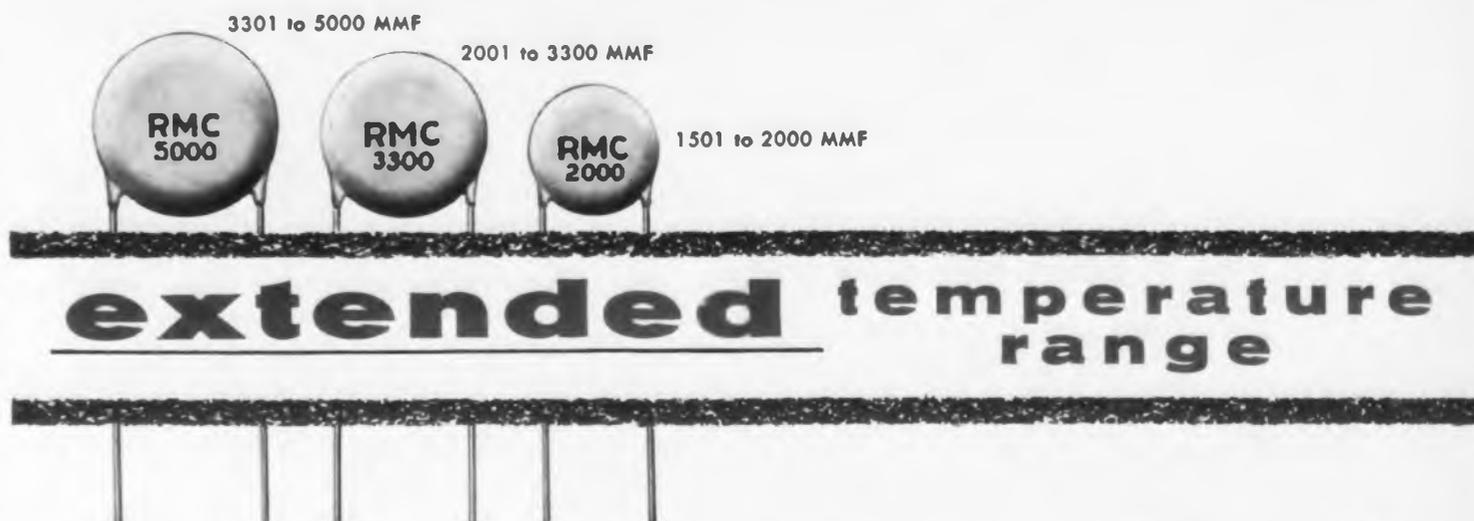
pushbutton, foot switch, or other actuation of controlled interval operation of such units as spot welders, heat sealers, punch presses, and vending, washing, or molding machines.

Design of the timer utilizes an electronic circuit with two cold cathode tubes, so that warm-up time is eliminated for accurate timing intervals ranging from 0.05sec to 7sec. Duration of the interval is continuously adjustable. Output of the electronic circuit is fed into a simple, spdt electromagnetic relay with normally open, 10amp contacts.

This timer requires only 0.1w for operation from any 105-125v, 25-400cy a-c source. It is supplied as Model No. 1 for panel mounting, or as Model No. 2 with a lacquered steel box measuring 3" x 4" x 5". Similar timers designed for intervals below 0.01sec can be supplied. G. C. Wilson & Co., Dept. ED, 1950 Eighth Ave., Huntington, W. Va.

CIRCLE ED-78 ON READER-SERVICE CARD FOR MORE INFORMATION

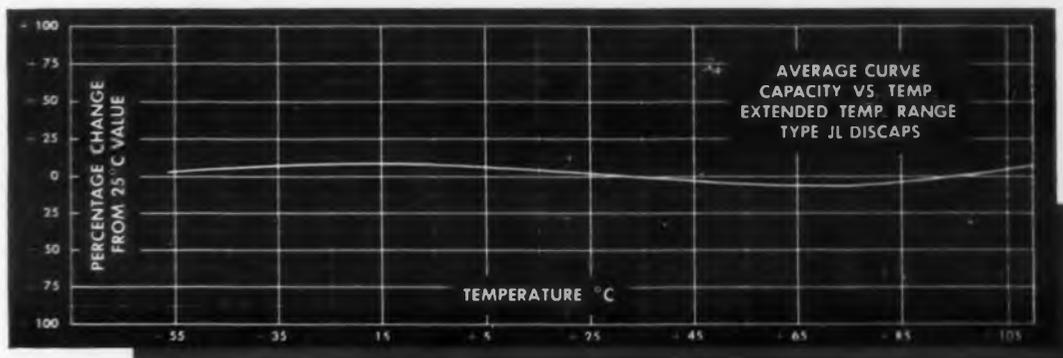
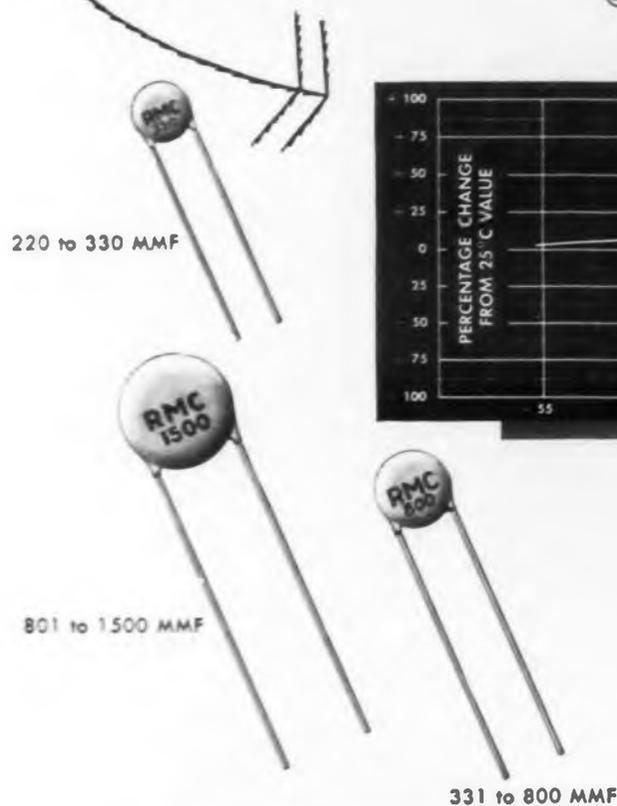
ELECTRONIC DESIGN • January 1955



Close TOLERANCE

Type JL RMC DISCAPS

®



POWER FACTOR: 1% max. (@ 1 K C (initial))
 POWER FACTOR: 2.5% max. (@ 1 K C, after humidity)
 WORKING VOLTAGE: 1000 V.D.C.
 TEST VOLTAGE (FLASH): 2000 V.D.C.
 LEADS: No. 22 tinned copper (.026 dia.)
 INSULATION: Durez phenolic—vacuum waxed
 INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
 AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
 CAPACITY TOLERANCE: $\pm 10\%$ $\pm 20\%$ at 25° C

DISCAP
 CERAMIC
 CAPACITORS



RADIO MATERIALS CORPORATION

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

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

CIRCLE ED-79 ON READER-SERVICE CARD FOR MORE INFORMATION

MINIATURE • SUBMINIATURE • PRINTED CIRCUIT • HERMETIC SEAL • POWER • PRESSURIZED • QUICK RELEASE

New
SPECIFY A PRECISION

Continental Connectors

Foremost manufacturer of precision connectors



PCW22 RECEPTACLE
ILLUSTRATING
SOLDERLESS
WIRE WRAP

PRINTED CIRCUIT CONNECTORS for solderless WIRE WRAP

Printed circuit receptacle, developed primarily for computer applications, uses the New BELL TELEPHONE "Wire Wrap" solderless wrapped connections. Twenty-two gold plated phosphor bronze contacts accommodate three #24 gauge wires per contact, and .093" thick board. This unit is available in Mineral filled Melamine, Plaskon reinforced (glass) Alkyd 440A, or Orlon filled Diallyl Phthalate.

DeJUR

ELECTRONIC SALES DIVISION

DeJUR-Amsco Corporation
45-01 Northern Blvd.
Long Island City 1, N. Y.

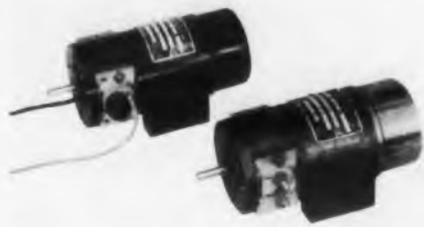
*SPECIAL DESIGNS—
Submit your connector
problems to our
engineering department.*

*Remember
to write for
data sheet!*

CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION

Motors

Miniature Precision Devices



The units in this series of compact, lightweight, high-performance d-c motors and tachometer-generators of the permanent-magnet type measure

only 3-11/16" long x 1-3/4" diam. Weighing under 20oz, they are highly suitable for airborne and other applications in which space, weight, and dependability are factors.

As continuous-duty motors from 1/30hp to 1/100hp, they operate on voltages from 6v to 27.5v and from 3000rpm to 9000rpm. As tachometer-generators, their outputs are from 0.46v to 2.4v d-c per 100rpm up to 9000rpm.

Close manufacturing tolerances; use of die-cast aluminum, stainless steel, cadmium plating, and other durable materials; plus a variety of brushes and commutators, make these units applicable to many special and critical uses. Instrument Motors, Dept. ED, P. O. Box 5, Acosta St., Stamford, Conn.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

Noise Measure Unit

Accurate to ± 0.25 db



The "Rada-Node" Noise Measure Unit includes i-f and micro-wave noise sources, 30Mc and 60Mc amplifiers, calibrated attenuators, and an indicating meter. The

noise source has a frequency range with Noise Diode "A" of 5-400Mc, with Noise Diode "B" of 100-300Mc, and with gas tubes of 1200-26,500Mc in eight bands, depending on wave-guide size. Noise figure range is 0 to 21db.

Accuracy of the instrument is to ± 0.25 db. I-f amplifier frequency is 30Mc or 60Mc. Amplifier gain is 75db. Amplifier bandwidth is 14Mc. Input impedance is 50 ohms. Range of attenuators: (1) 21db main attenuator, steps 1, 2, 3, 5, 10db. (2) 3db (2x-power) attenuator; (3) 0-2db interpolation control. The noise output meter is in conjunction with noise-source current meters.

Power supplies include: electronically regulated supply for i-f amplifiers; regulated supply, with variable control, for noise diodes and for gas tubes. Kay Electric Co., Dept. ED, Pine Brook, N. Y.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

PROBLEM: Selenium rectifiers plus control transformers for direct current power in industrial applications.

WHY



BUY



SPECIALS?



You don't have to go to the inconvenience, expense and delay of ordering special transformers for use with selenium rectifiers in industrial control applications.

MERIT

has a complete line of standard transformers specifically for this application.

MERIT

The line will cover better than 90% of your applications. Request

MERIT

form #55 and form #6353A for full information.

MERIT

is the only supplier with a complete line of transformers, coils, yokes and chokes for all radio, TV, communication, sound and industrial applications.



MERIT COIL & TRANSFORMER CORP.
4427 N. Clark Street
Chicago 40, Illinois

CIRCLE ED-183 ON READER-SERVICE CARD

ELECTRONIC DESIGN • January 1955

NEW
MOLD

T
ME
CR
sup
100

CIRCLE

It'

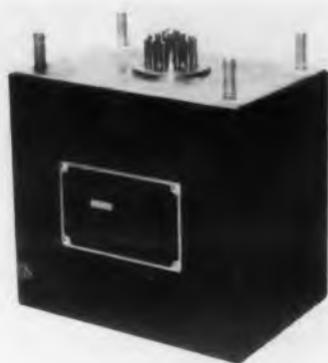
A-1104
(AN-33)

A-51-10
(AN-33)

A-1106
(AN-33)

CIRCLE
ELECT

Magnetic Amplifier For 400cy Servo Systems



The SMA 4-103 is a servo amplifier designed for use in servo systems employing 2 phase, 400cy, low inertia induction motors. It is an all-magnetic amplifier requiring no external tubes or separate bias supplies, and is operated directly from a 115v 400cy supply.

It operates with motors having control windings rated from 26v to 57v and 10w or less. Electrical specifications include: input impedance, 10,000 ohms; input signal, a-c, d-c, or pulse; phase-reversible output; power gain (at 0.50v signal), 50,000 (approx); response time, 1/200sec (approx); standby power, 12w; continuous duty cycle; ambient ranges of -30° to $+55^{\circ}\text{C}$, and -55° to $+71^{\circ}\text{C}$. Ketay Manufacturing Corp., Dept. ED, 555 Broadway, New York 12, N. Y.

CIRCLE ED-268 ON READER-SERVICE CARD FOR MORE INFORMATION

Counters

Available in 3, 4, or 5 Digits



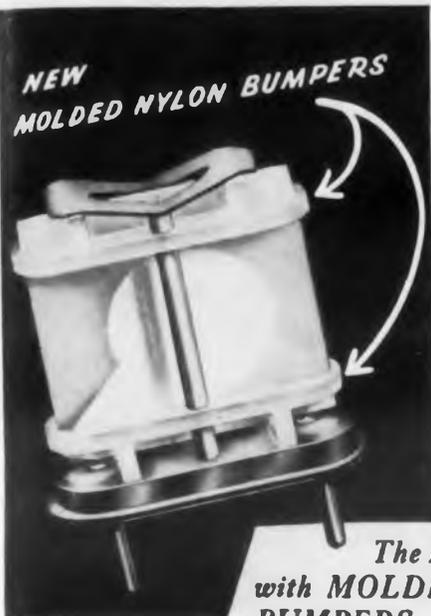
The "Micro Meter" series of small die cast counters comprises several types to fit a wide variety of applications. The

series is available in ratchet style, with either internal or external stops; and ratchet rotary, direct drive and revolution. All are available in 3, 4, and 5 figure capacity, with either base flange, or window flange for panel mounting. Two directions of rotation are provided, top going or top coming, and the drive may be on the right or left side of the counter.

The design has engraved figures in white against a black background, 11/64" high. Approximate dimensions are 3/4" wide x 13/16" high; the flange is 1-1/4" long, and the shaft extension is 3/8". Weight is about 2oz. Speed range is from 500cy to 1000cy.

The units are suited for many types of installations, such as addressing machines, check-writers, postage meters; coin counting, operating or sorting machines; duplicating, mimeograph, multigraph, and tabulating units; vending machines of all description; projectors, lockers, "Recordaks"; and light production machinery. Durant Mfg. Co., Dept. ED, 1993 Buffum St., Milwaukee 1, Wis.

CIRCLE ED-269 ON READER-SERVICE CARD FOR MORE INFORMATION



**NOW
100 G SHOCK
PROTECTION
DESIGNED
INTO
MINIATURE
CRYSTAL
UNITS**

*The Bliley BH6A,
with MOLDED NYLON
BUMPERS, Assures De-
pendable Performance In
Range 800 kc - 2000 kc .*

This new design meets the exacting requirements of MIL-C-3098A as applied to types CR-18, CR-19, CR-27, CR-28, CR-35 and CR-36. It includes the supplemental specification calling for tests under 100 G's in three planes.

Bliley ELECTRIC COMPANY
UNION STATION BLDG., ERIE, PA.

CIRCLE ED-266 ON READER-SERVICE CARD FOR MORE INFORMATION

It's the Principle...

Relay Basic Unit
A-1105



This structure is the principle contained in 3 AN approved Hermetically Sealed type relays, manufactured by Electrical Products Corporation.

Used for control of vital airborne electronic equipment, it is unusually rugged and provides exceptional resistance to shock, vibration and acceleration.

Has balanced rotary armature with unique, close-coupled contact linkage for speedy, low-inertia operation.

SPECIFICATIONS:

Nominal Coil Voltage.....24-28 VDC
Dimensions.....1 1/8 x 1 1/8 x 1 1/8 inches
Weight.....3 ozs.
Contacts.....DPDT
Rated (Resistive and Inductive).....10 amps.
Also available in other enclosures.

Electrical Products offers:

*Uniformly high quality by rigid inspection and testing.

*Extra rugged construction on all type Relays.

Send for Brochure and Specifications on our complete line.



A-1104
(AN-3306-1)



A-51-108
(AN-3311-1)



A-1106
(AN-3307-1)

Electrical Products CORP.

1100 North Main Street, Los Angeles 12, California

CIRCLE ED-267 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

**POT
R**

POTENTIOMETERS

Precision Servo Components of
ULTRA LOW TORQUE



TYPE 11

1.002" diam.

Extreme accuracy — .5% or less

Linear or non-linear characteristics

Ganged assemblies available —

up to 6 on a single shaft

Ball bearings and servo mounting

Certified performance data furnished with

each instrument.

TYPE 9

.878" diam.

ELECTRO-MEC Laboratory, Inc.

21-09 43 Avenue Long Island City 1, N. Y.

CIRCLE ED-270 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C INDUCTION TYPE New Series 15 and 18 SERVO MOTORS

Two new G-M Miniature Servo Motors are now available for use in electronic control circuits. The motors are standard frame sizes 15 and 18 which are 1.437" and 1.750" in diameter respectively, and are designed for use in a wide variety of equipment such as computers, gun sights, navigation equipment, guided missiles, radar and similar applications. These

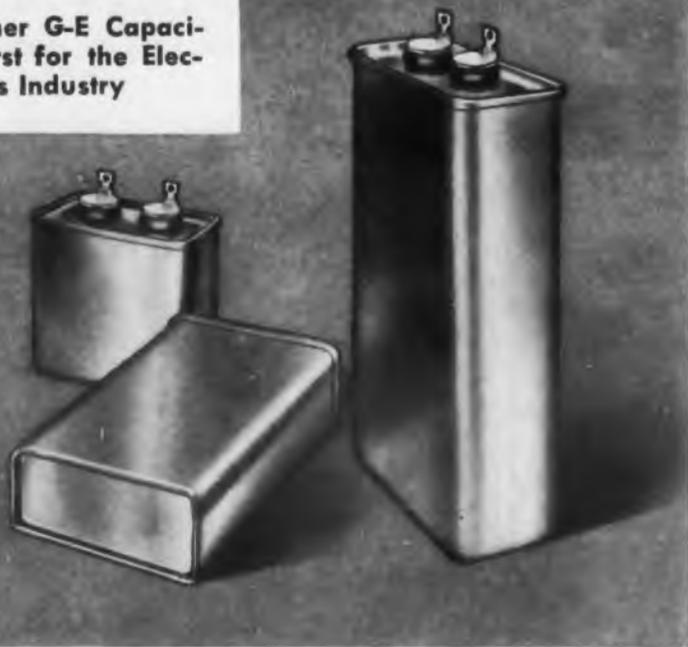
light weight, high torque, low inertia, two-phase induction motors are available in 2, 4 and 8-pole models for 400 or 60 cycle supply, and can be supplied to meet performance specifications for military servo motors, Mark 7 and Mark 8. The control phase can be wound for connection by the user for either series or parallel operation. The stators of the motors, as in all G-M Servo Motors, are embedded in an insulating compound of high dielectric strength and high temperature stability. This material has a low mechanical coefficient of expansion and great stability at high temperatures. High dielectric strength is maintained between windings and housing when at high altitudes. Write for information on G-M Size 15 and/or Size 18 Servo Motors to



G-M LABORATORIES, INC.
4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-271 ON READER-SERVICE CARD FOR MORE INFORMATION

Another G-E Capacitor First for the Electronics Industry



DRAWN-RECTANGULAR CASE has no soldered seams, does not depend on solder for mechanical strength and effective sealing.

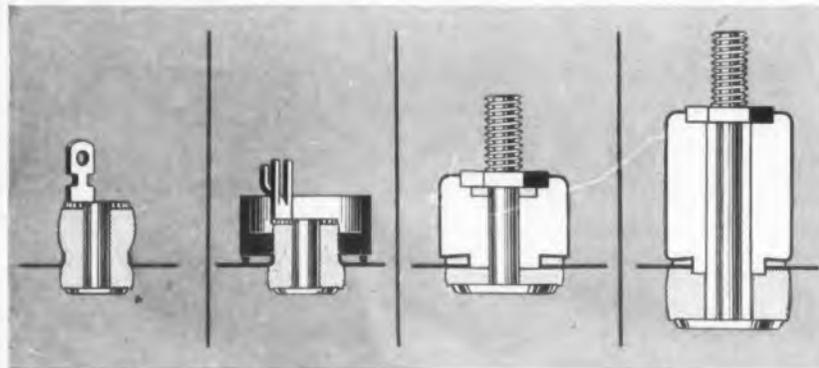
new . . . G-E CAPACITORS IN DRAWN-RECTANGULAR CASES

- Solderless, double-rolled cover seam
- Seamless case with standard dimensions

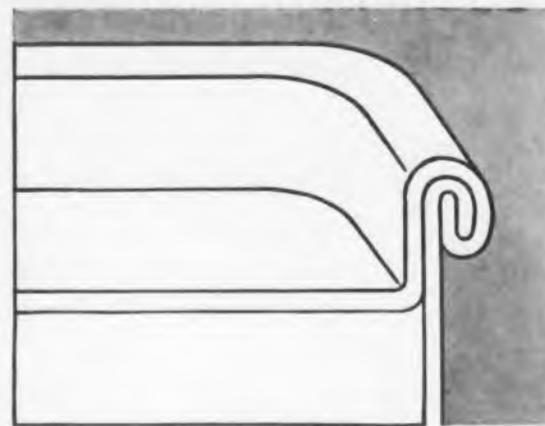
General Electric is now producing fixed paper-dielectric capacitors in seamless, solderless cases with standard dimensions that comply with or exceed MIL specifications. For complete information contact your G-E Apparatus Sales Office or write for Bulletin GEC-809A to Section 442-24, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

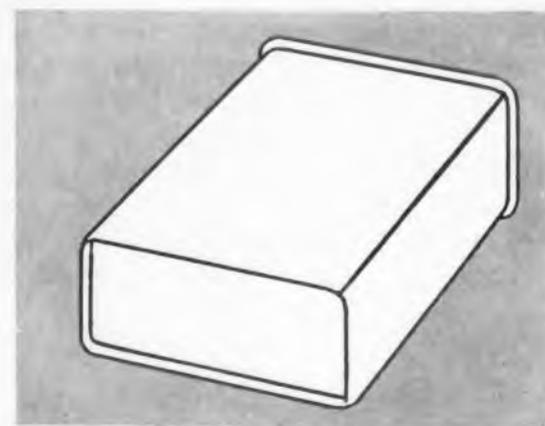
GENERAL  ELECTRIC



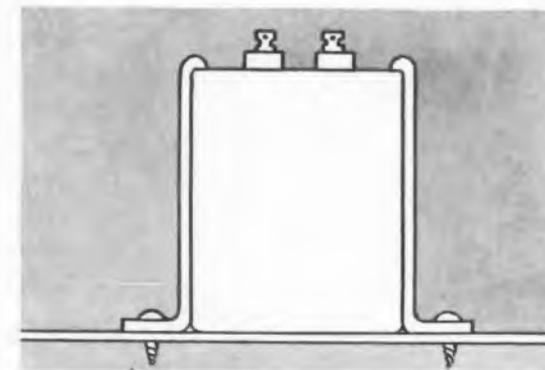
FOUR BUSHINGS STYLES are available for applications below 2000 volts d-c., special skirted bushings for higher voltages.



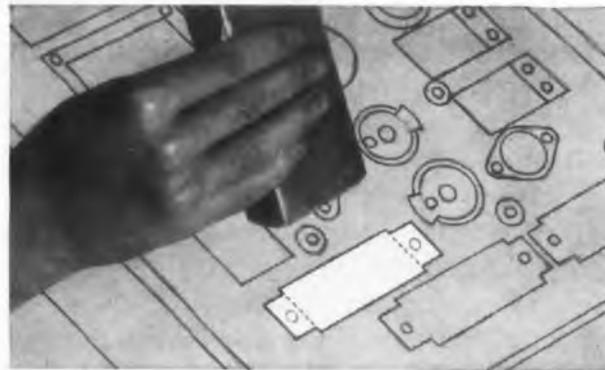
SOLDERLESS DOUBLE-ROLLED COVER SEAM makes a mechanically strong, hermetic seal.



BOTTOM OF CASE IS INDENTED to permit mounting in inverted position.



UPRIGHT OR INVERTED MOUNTING is possible using either spade lug, or footed brackets (above)

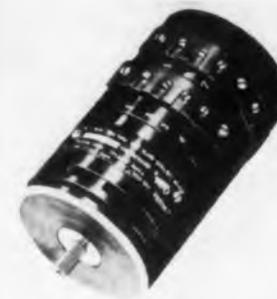


STANDARD CASE SIZES are interchangeable, making it unnecessary to change drawings or circuit layouts.

CIRCLE ED-236 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor

Compact, Self-Cooled Design



This compact self-cooled servo, Series 5100-2237, weighs only 3.188 lb yet pulls as much as 1/15hp at 6000rpm and has 22 oz-in of stall torque. Overheating is prevented by a blower which functions independently yet is an integral part of the servo.

The unit is designed to drive an antenna on airborne military radar or for any other application demanding dependability, compactness and powerful response.

The servo is a 2-phase, 115v, 400cy motor with a no-load speed of 10,000rpm and a full load speed of 6000rpm. Stalled power input is 150w per phase. Acceleration is 31,000rad/sec² minimum. Rotor inertia is 500gr-cm² maximum. The blower has a single-phase, 115v, 400cy motor; power input total is 35w. John Oster Manufacturing Co., Avionic Div., Dept. ED, Racine, Wis.

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Counter

Adds and Subtracts



The Model MC-505AS lightweight, high-speed, precision counter was developed to add and subtract magnetic pulses in a digital control system. It is a five-digit, electrically actuated counter that adds or subtracts

from 0000.0 to 9999.9 when magnetic pulses are applied to "add" or "subtract" terminals respectively. Each wheel may be individually set to any predetermined number.

Typical applications of this continuous-duty-cycle counter are for net pulse counting in pulse-guidance systems, and for the remote indication of net totals in any reversible system.

Also available is the model MC-504 SZL, a four-digit electrically actuated counter that subtracts from 999.9 to 000.0 when actuated by magnetic pulses, and opens or closes a micro switch at zero level (000.0). Typical uses include automatic stop or start of a system after a predetermined number of magnetic pulses, and remote indication of net total in a subtractive-pulse system. Photocon Research Products, Dept. ED, 421 N. Foothill Blvd., Pasadena 8, Calif.

CIRCLE ED-238 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

Deposited Carbon Resistors Hermetically Sealed Types

A line of hermetically sealed deposited carbon resistors has been added to this firm's line. The new units feature a treated ceramic shell which provides high mechanical and electrical protection for the resistive element under unusually severe extremes of humidity and temperature. The requirements of MIL-R-10509A are far exceeded.



The resistors are available in five sizes, including three in the 1/2w rating, as well as 1w and 2w units. Radell Div., I. D. E. A., Inc., Dept. ED, 7900 Pendleton Pike, Indianapolis, Ind.

CIRCLE ED-239 ON READER-SERVICE CARD FOR MORE INFORMATION

Rate Generators

For Many Computer and Other Uses



This precision a-c Rate Generator is designed for any use which requires a high degree of accuracy in the linear translation of rotational motion into voltage. It is a "drageup tachometer", incorporating a specially

designed high purity copper alloy cylindrical drageup which serves as the rotating element. The instrument functions as a two-phase induction generator. When one stator phase is excited by a constant frequency, constant amplitude voltage source, the output voltage from the other stator phase has an amplitude proportional to the speed of the drageup and a frequency identical to that of the excitation voltage.

A major use for this rate generator is as a velocity feedback element in servo systems. It has also been used in tachometric applications, and as a computing element where rate is a direct function. In general, it is used anywhere it is desired to convert speed to a-c voltage. The unit is available in four models for 60cy and 400cy operation. Features include lightweight high accuracy; fungus-proof and highly corrosion and humidity resistant design; and high functional voltage output. Ford Instrument Co. Div. of Sperry Corp., Dept. ED, 31-10 Thomson Ave., Long Island City 1, N. Y.

CIRCLE ED-240 ON READER-SERVICE CARD FOR MORE INFORMATION

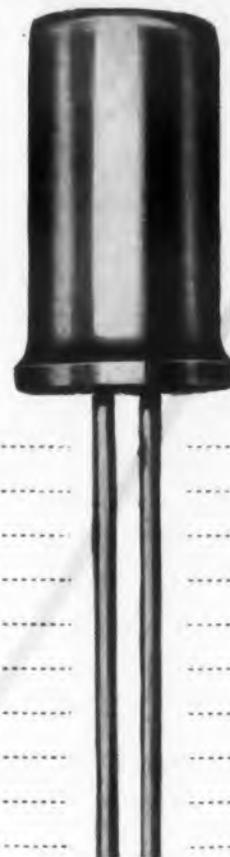
ELECTRONIC DESIGN • January 1955

SILICONDUCTORS*

TRADE-MARK

TYPES

TYPES	E_b max (v)
IN138A.....	18
IN137A.....	36
A3B.....	3.3
A4B.....	3.9
A5B.....	4.7
A6B.....	5.6
IN200.....	6.8
IN201.....	8.2
IN202.....	10
IN203.....	12
IN204.....	15
IN205.....	18
IN206.....	22
IN207.....	27
IN208.....	33
IN209.....	39
IN210.....	47
IN211.....	56
IN212.....	68
IN213.....	82
IN214.....	100
IN215.....	120
IN216.....	150
IN217.....	180
IN218.....	220
IN219.....	270
IN220.....	330
IN221.....	390
IN222.....	470



ENLARGED FIVE TIMES
ACTUAL SIZE

* SINGLE CRYSTAL SILICON JUNCTION DIODES

LICENSED BY WESTERN ELECTRIC CO., INC.

NATIONAL SEMICONDUCTOR PRODUCTS

DIVISION OF NATIONAL FABRICATED PRODUCTS, INC.

930 PITNER AVENUE

DAvis 8-0800

EVANSTON, ILLINOIS

CIRCLE ED-241 ON READER-SERVICE CARD FOR MORE INFORMATION

famous

AMPHENOL

BLUE RIBBON CONNECTORS



now available with

Panel & Latch-Lock shells!

AMPHENOL's crack engineering team have completely redesigned the famous *Blue RIBBON* connectors and the results will be of interest to every company engaged in electronics.

The basic improvement has been the design of a new method of polarization. Instead of conventional guide pin and bushing polarization, male and female *Blue RIBBON* connectors are now mated by means of proper matching of the barrier heights between the contacts. Following this first important improvement AMPHENOL's engineers designed a complete line of front panel shells and cable-clamp latch-lock cans to fit the connectors—a step forward that makes the versatile *Blue RIBBON*s even more useful to the electronics industry.

What are the advantages of these design changes to you? Barrier polarization allows increased contact spacing without extending the overall length of the connector—mismatching is impossible. Front panel shells and latch-lock cans are available for *Blue RIBBON*s in a wide variety of keying arrangements, making possible the mounting of large numbers of connectors side by side without the possibility of connector mismatching by untrained personnel. Latch-lock types may be safety-wired and the cans are available with either end or side cable outlets.



Complete details on all AMPHENOL
Blue RIBBON connectors in
CATALOG R1

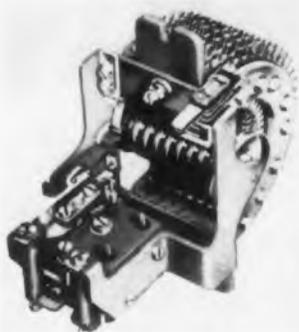
AMPHENOL

AMERICAN PHENOLIC CORPORATION *chicago 50, illinois*

In Canada: AMPHENOL CANADA LIMITED, Toronto

Stepping Switch

For Heavy-Duty Operation



Designed for heavy-duty operation extending beyond 100 million steps (impulse or self-drive), the "Uniselecto," when fitted with up to five double-ended wipers, has a stepping speed of 68 steps/sec. When fitted with up to eight double-ended or 10 single-ended wipers, the

speed of stepping is 60 steps/sec average. Continuous action, even in tropical climates, is a feature.

The switch features simple maintenance and adjustments which are easy and permanent. The mechanism is designed for use with standard 25-contact banks, and by the simple expedient of fitting a new wiper-brush assembly, it can be used to replace existing mechanisms. The standard range of coils covers 22v, 40v, 50v, and 60v d-c operation. Coils can be especially made for other voltages. Made by General Electric Co. of England. Available from Intra Corp., Dept. ED, 58 Charles St., Cambridge 41, Mass.

CIRCLE ED-313 ON READER-SERVICE CARD FOR MORE INFORMATION

Spectrum Analyzer

With Interchangeable R-F Heads



The FXR Spectrum Analyzer, designed for greater accuracy and convenience in microwave spectrum analyses, provides push-pull deflection to both the horizontal and vertical plates. Versatility of the

unit is increased by interchangeable r-f heads. The i-f amplifier has a center frequency of 20Mc. An overall gain of approximately 110db is obtained with the use of a cascode input.

Visual indication of spectra is provided by a large 5" oscilloscope tube with a sweep rate of 10cy to 20cy. Frequency dispersion is 1Mc to 10Mc/inch, with viewable pulse lengths of 2μsec to 20μsec. A large 4-1/2" panel meter aids accuracy of measurements. Electronics & X-Ray Div., F-R Machine Works, Inc., Dept. ED, 26-12 Borough Pl., Woodside 77, N. Y.

CIRCLE ED-314 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE ED-315 ON READER-SERVICE CARD

1/4 million
to date!



VO-TRON T-10h
262 KC IF TRANSFORMER

Dimensions: 1/2" diam., 1/2" high; Tuning: Single-tuned; Capacitor (included): 200 mmfd; Q: 80 (unloaded).



VO-TRON C-801
262 KC OSCILLATOR COIL

Dimensions: 1/2" diam., 1/2" high; Tuning: Slug-tuned; Q: 57 (minimum).

SMALLEST ever mass-produced — Vo-Tron Subminiature Components, recently introduced, supply the answers to primary subminiature problems of top performance within limited space.

Also available in the Vo-Tron line: 455 KC components of comparable size—various LC ratios—highest Q. Others to your specifications.

Let us know your requirements!

Wire or write for samples.

Vo-Tron Division
VOKAR CORPORATION
Dexter 5, Michigan

CIRCLE ED-316 ON READER-SERVICE CARD

Bourns sub-miniature TRIMPOTS



PROVIDE THE ULTIMATE
IN CIRCUIT TRIMMING

Simple screwdriver adjustment . . . The TRIMPOT is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS Laboratories. Electrical settings in increments of 1/4 to 1/2% are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS' unique self-locking design eliminates cumbersome locknuts. Power rating is 1/4 watt at 100° F. Standard resistance values from 250 ohms to 25,000 ohms are available for immediate delivery. Information on higher and lower resistances on request.

BOURNS TRIMPOTS are accepted as standard components by aircraft and missile manufacturers and major industrial corporations.

9 TRIMPOTS TAKE LESS SPACE THAN A 2¢ STAMP

Tiny cross-sectional size—only 1/4" x 5/16"—and rectangular shape save valuable panel space. Instruments are easy to mount individually or in stacked assemblies with two standard screws through the body eyelets.



Bourns also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.

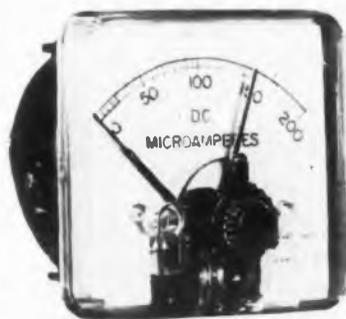


BOURNS LABORATORIES
6135 MAGNOLIA AVE. • RIVERSIDE, CALIFORNIA
Technical Bulletin On Request, Dept. 232
© B L PATENTS PENDING

CIRCLE ED-317 ON READER-SERVICE CARD FOR MORE INFORMATION

METER-RELAYS

For Sensitive and Accurate Control



RANGES:

0/20 Ua. to 0/50 A.
0/5 Mv. to 0/500 V.
The trip point is adjustable to any point on the scale arc. These meter-relays are sensitive to changes of as little as 1%. One contact is carried on moving pointer. The other is on a semi-fixed pointer. When two pointers meet contacts close and lock. Holding coil is wound directly over moving coil. Reset can be manual or automatic. Spring action in contacts kicks them apart forcefully. Three sizes of clear plastic case models, 2 1/2, 3 3/4 and 4 1/2 inches (all rectangular). Two ruggedized and sealed models, 2 1/2 and 3 1/2 inches (round metal cases).

Contact arrangements: High Limit Single, Low Limit Single or Double (both high and low). Contact rating is 5 to 25 milliamperes D.C.

Suggested circuits for meter-relays and complete specifications including prices are covered in new 16-page Bulletin G-6, which you can get by writing Assembly Products, Inc., Chesterland 17, Ohio.

CIRCLE ED-318 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • January 1955

Receiver

Has 55-260Mc Continuous Range



Similar to the Type 167-J1, the new 167-J2 Receiver has a continuously tunable frequency range from 55Mc to 260Mc both a-m and f-m. This wide range makes it particularly suitable as a general purpose laboratory receiver.

A squeelch circuit with an adjustable threshold is incorporated in the unit to add to its usefulness. This receiver is designed for rack mounting and operates on 115v or 230v, 50-60cy, a-c. The 300kc i-f permits reception of signals with high frequency modulation and facilitates tuning. Clarke Instruments, Div. of National Electrical Machine Shops, Inc., Dept. ED, 919 Jesup-Blair Dr., Silver Spring, Md.

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulation Meter

Gives Direct Measurements



The Model D-1 "Reg-meter" provides direct measurement of power supply internal resistances without a complex laboratory setup. It measures from 0.02 ohms to 1,000 ohms in voltage sources with outputs ranging from 0 to 500v. The instrument may also be used as an accurate, stable a-c voltmeter

for measurements from 5cy to 10kc. It further serves as a general linear ohmmeter, and measures ripple and noise.

Output terminals are provided so that transient response of a source under test may be viewed on an oscilloscope; or so that the voltmeter output can be viewed in general testing. Four linear resistance ranges are provided, 0-1 ohms, 0-10 ohms, 0-100 ohms, and 0-1000 ohms full scale. There are also four voltage ranges: 0-10mv, 0-100mv, 0-1v, and 0-10v rms full scale. Alto Scientific Co., Dept. ED, 3404 Cowper St., Palo Alto, Calif.

CIRCLE FD-320 ON READER-SERVICE CARD FOR MORE INFORMATION

portable **FREQUENCY COUNTER
STRAIGHT (Batch) COUNTER
TACHOMETER**

direct reading MODEL
DS-6100 FREQUENCY COUNTER

INPUT .1 Volts RMS	MULTI-SAMPLING 3 to 60 second manual
FREQUENCY RANGE 20 to 100,000 CPS	MANUAL RESET Display until reset
GATE TIME 1 second (.1 and 10 sec. available)	AUTOMATIC RESET Display .5 to 6 sec. variable
STABILITY Short Term — 1 part in 10 ⁵ (10 ⁴ with crystal oven)	READ-OUT direct in events per sec. to 100,000
ACCURACY Inherent ± 1 Event	SIZE and WEIGHT 14 1/2" W x 7 1/2" H x 13 1/2" D — approx. 28 pounds
TIME BASE 100 KC Crystal Oscillator (Oven Available)	

COMPUTER MEASUREMENTS
DIVISION OF THE **Detectron CORP.**

Dept. 76-B—5528 Vineland Ave., North Hollywood, Calif.

CIRCLE ED-321 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature ELASTIC STOP nuts *



Here is the world's smallest self-locking nut, developed especially for your miniaturization program. Sizes as small as .109 across flats. The famous red nylon locking collar damps out severe shock and vibration—grips the bolt thread—holds adjustment indefinitely. One-piece fasteners—no extra parts can drop into delicate equipment and short out circuits. Weight, installation space and assembly time are cut to a bare minimum. Nylon collar makes miniature ELASTIC STOP nuts reusable many times. And the installed cost is considerably less than set screws or other double-operation fastening methods.



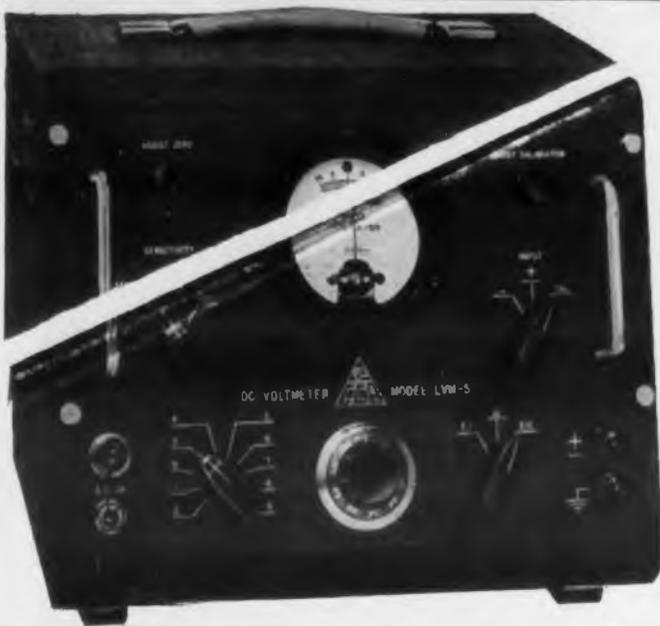
For information on all electronic fastener problems write ESNA—address Dept. N56-157.

**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

CIRCLE ED-322 ON READER-SERVICE CARD FOR MORE INFORMATION



Computer Company of America, Division of Bruno-New York Industries Corp. also manufactures the IDA analog computers and accessories. Their usefulness in the field of dynamics has been proven over the years. A complete line of standard computers, instruments and regulated power supplies is supplemented by the ability to design and manufacture specialized equipment for your particular applications. Your inquiries are invited.

HIGH RESOLUTION LABORATORY STANDARD DC VOLTMETERS

For most applications these rugged portable, self-contained nulling voltmeters replace a potentiometer, voltbox, galvanometer and standard cell combination. They are suitable for laboratory use, production line testing and field service.

Model LVM-5

Voltage Range: 0-100 Volts DC
Resolution: At least 50 microvolts between 0 and 1 volt
500 microvolts between 1 and 10 volts
5 millivolts between 10 and 100 volts
Absolute Accuracy: $\pm 0.1\%$ of reading
Input Impedance: Infinite at null

Model PVM-4

Voltage Range: 0-600 Volts DC
Resolution: At least 5 millivolts between 0 and 10 volts
50 millivolts between 10 and 600 volts
Absolute Accuracy: $\pm 0.1\%$ of reading
Input Impedance: Infinite at null

The Model LVM-5 may also be used as a deflection potentiometer, a sensitive null indicator and a precision millimicroammeter. Write for catalog PL which describes these instruments completely. Address Dept. ED 1

Computer Company of America
DIVISION OF BRUNO-NEW YORK INDUSTRIES CORP.
460 WEST 34TH STREET • NEW YORK 1, N. Y. **CCA**

CIRCLE ED-296 ON READER-SERVICE CARD FOR MORE INFORMATION



Here is a pair of "Problem-Solvers"
For Designers of Electrical Control Systems
FRAHM® REED RELAYS ▶
◀ **FRAHM® OSCILLATORS**

Frahm Resonant Reed Relay is an electro mechanical device which responds to an alternating signal having frequency and amplitude values that lie within specified bands. A number of control signals over a single circuit is possible with all types of communication circuits, including radio. A signal is transmitted either on a wire line, or as a modulated carrier to some remote location

where it operates a reed relay to indicate the control function at that point. Since each reed relay will respond only to a narrow band of frequencies, it is possible to operate a number of relays simultaneously by making use of an equal number of source generators arranged so that none of the operating frequency bands overlaps. In a range of 200 to 500 cycles it is possible to operate up to 16 channels with no interference.

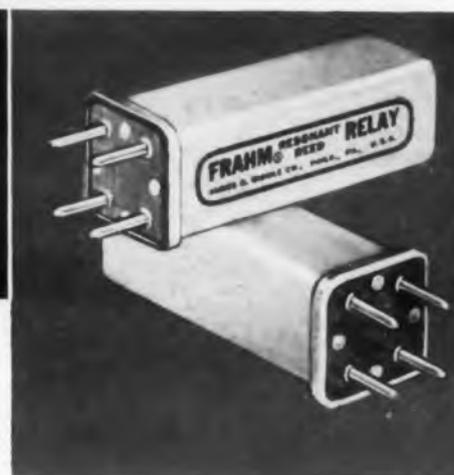
Frahm Oscillator controls are miniature tuning forks for use in electronic oscillators to provide stable output frequencies. By their use good sine wave signals with output better than 1 volt can be obtained. They are available for any frequency in the range of 50 to 1000 cps with accuracies better than 0.2%. A series of standard units is available to match the standard Frahm Reed Relays.

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

CIRCLE ED-297 ON READER-SERVICE CARD FOR MORE INFORMATION



Frahm Reed Relay and Oscillator combinations may be used for controlling, signalling, monitoring, and protection and frequency matching. Check coupon for new bulletin on Frahm Relays and Frahm Oscillator Controls.

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.
Gentlemen:
Please send me Bulletin 33-ED—
Frahm Relays
 Bulletins 34-10-ED—Frahm
Oscillators

NAME

JOB FUNCTION

COMPANY

ADDRESS

Photocell Cadmium-Sulfide Type

This sub-miniature single crystal cadmium sulfide "Sensitron Photocell" has a luminous sensitivity comparable to some multiplier phototubes. The luminous sensitivity exceeds 1 amp per lumen. The dark resistance exceeds 1000 megohms. The sensitive area is about 1 square millimeter.



The cell is available with a flat glass or small collecting lens. The spectral response peaks in the visible range at about 0.5 microns, and falls off rapidly in both the infrared and ultraviolet ranges. Selected units can be applied directly to the 110v a-c line. Maximum internal power dissipation is about 50mw.

The cell is a secondary photoconductor, i.e. the quantum efficiency is greater than unity, and may exceed 100,000. Over most of the region of interest, the voltage-current characteristics are approximately linear, and the conductivity defined therefrom is approximately linear with radiant flux (power). This photodetector is ideal for "off-on" types of applications. For example, a flashlight in conjunction with a small collecting lens is sufficient to trip a plate relay in series with the photocell and B battery power supply. Photocell Dept., Section ED, Scientific Specialties Corp., Snow & Union Sts., Boston 35, Mass.

CIRCLE ED-298 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope Offers Identical Amplification

The Wideband Oscilloscope Model 320 utilizes identical horizontal and vertical amplifiers which allow phase shift indication for frequencies up to 5Mc. The instrument opens up fields of measurement which are not possible without the feature of identical wideband vertical and horizontal amplifiers.

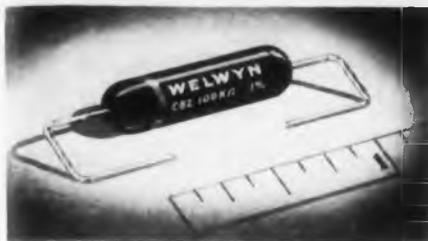


The high deflection sensitivity of 35mv, rms, per inch, from 10cy to 5Mc on both amplifiers, is another feature. This general purpose, high-gain instrument is particularly designed for color TV measurements. Crosby Laboratories, Inc., Dept. ED, Box 233, Hicksville, L. I., N. Y.

CIRCLE ED-299 ON READER-SERVICE CARD FOR MORE INFORMATION

Deposited Carbon Resistors

Insulation Stands 8000v



With a new type of insulation, the stability, tolerance, noise, and other performance characteristics of these resistors are the same as for this

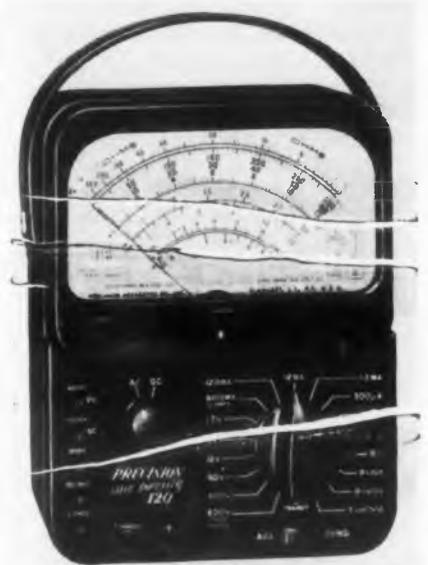
firm's standard "Welwyn" Deposited Carbon resistor line. The new insulating material permits the encapsulated resistor to withstand an applied potential of 8000v without flashover or breakdown. Its insulating effectiveness is in excess of 100,000 megohms.

The resistors can be mounted directly on terminal boards, and contiguous to each other without the need for additional insulating material. They are also effectively protected against failure due to extreme humidity changes. They are available in 1/4w, 1/2w, 1w and 2w ratings. Rockbar Corp., Dept. ED, 215 E. 37th St., New York 16, N. Y.

CIRCLE ED-300 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Set

Has 44 Ranges



This 20,000 ohms per volt d-c, 5,000 ohms per volt a-c, multi-range test set, the Model 120, has 44 self-contained ranges which start extra-low and go extra-high. It includes an extra-low resistance range with 2 ohm center scale; an extra-low voltage range which offers 1.2v full scale, both a-c and

d-c; and an extended low d-c current range which starts at 0 to 60 μ amp.

Simple range selection is achieved through an 18-position, positive-detenting, master range selector, low-resistance banana-type plugs and jacks specially designed of solid brass, a large and easy-reading scale face with a full 4-3/4" wide window.

The unit has 16 voltage ranges up to 6000v, ac and dc. Besides 15 current ranges, there are five resistance ranges (up to 20 megohms) and eight decibel ranges (from -20 to +77db). Precision Apparatus Co., Dept. ED, 9227 Horace Harding Blvd., Elmhurst, L. I., N. Y.

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955



- Excellent Uniformity
- Greater Elongation
- Higher Tensile Strength

NEW!

Solves your flat or stretch grid problems

SYLVANIA 50/50 TUNGSTEN- MOLYBDENUM WIRE...

Developed to meet the exacting requirements of newer tube types that require flat or stretch grids—this new Sylvania grid wire offers a higher degree of uniformity than previously achieved in an alloy of this type.

In addition to excellent uniformity, Sylvania 50/50 tungsten-molybdenum wire has higher elongation than tungsten; greater tensile strength than molybdenum—a combination of properties that mean fewer rejects, lower production costs in your tube manufacturing operations.

Sylvania offers you the only line of grid wires—plain

or plated—made every step of the way by a single manufacturer. It is a complete line, meeting the highest requirements of tube manufacturers... tungsten, molybdenum, 50/50 tungsten-molybdenum, D-nickel, in a full range of sizes. Plating available includes gold, rhodium, silver or nickel.

Precision manufactured and quality-controlled through drawing and plating. Sylvania wires have the characteristics known to be needed for producing the world's finest radio tubes. Write for complete information.

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



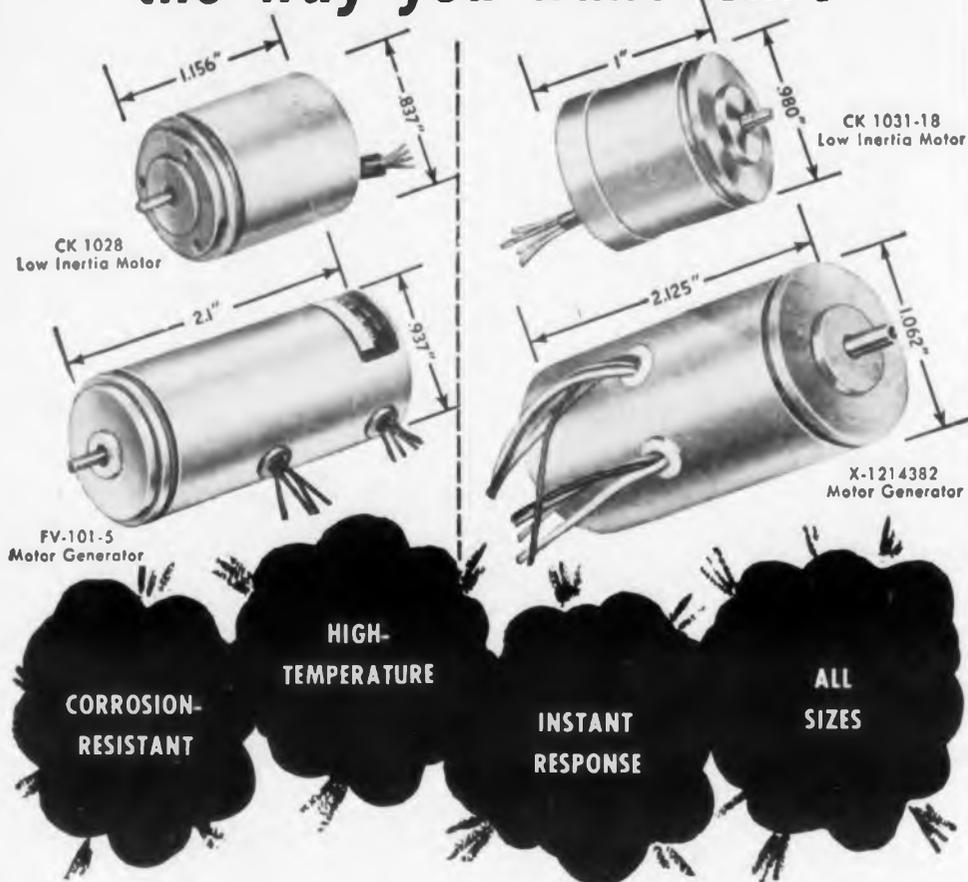
SYLVANIA

Lighting • Radio • Electronics • Television • Atomic Energy

CIRCLE ED-302 ON READER-SERVICE CARD FOR MORE INFORMATION

servo motors

the way you want 'em!



As one of the world's oldest and largest producers of servo components, we are ideally qualified to provide you with the right answer to your motor and motor generator needs. Why not take advantage of our long, practical experience? Call on us for recommendations based on your individual problem.

TYPICAL CHARACTERISTICS

Type Number	Rated Voltage		Max. Power Input Total (Watts)	No Load Speed (RPM)	Stall Torque (oz. inches)	Torque to Inertia Ratio (Radians per Sec. ²)	Weight (oz.)
	Phase 1	Phase 2					
LOW INERTIA MOTORS							
CK-1018-7	18	18	5	10,000	0.13	13,000	1.6
CK-1022-13	115	115/57.5	12	4,800	1.45	33,800	8.0
CK-1027-14	115	115/57.5	7	6,200	0.63	41,500	4.5
CK-1028-16	26	26	6	10,000	0.28	13,000	1.6
CK-1031-18	26	55	9	6,400	0.35	10,000	2.2
CK-2006-1	64	64	30	7,200	2.6	70,000	10.0
CK-3000-1	110	220	80	3,700	14.0	3,750	30.0
MOTOR GENERATORS							
FV-101-5	26	26	9.5	10,000	0.28	10,000	2.9
FV-2001-2	115	115	30	6,600	3.0	70,000	12.6
FV-3000-1	110	220	80	3,700	14.0	3,750	30.0
X-1214382	26	26	9.7	6,000	0.5	21,000	5.5

WRITE DEPARTMENT C

ECLIPSE-PIONEER

TETERBORO, NEW JERSEY

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



West Coast Office: 117 E. Providencia Ave., Burbank, Calif.

CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION

Time-Data Printer

Gives Data, Identity, and Time



This Time-Data Printer, can record (1) one or two sets of manually or remotely-entered data, (2) an entry identification number or symbol, and (3) the time-of-day when the data are taken. Time is indicated to 0.01

minutes or in full seconds. Time is obtained internally from a synchronous motor.

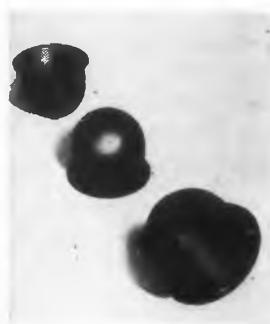
The arrangements for choice of data, identification, and time are very flexible, but a typical type might appear as P11 :.1 J418.9, where the first column on the left indicates AM or PM; the next four columns the time of day; the next two columns are data identification symbols; and the last four columns are for data readings.

There are a total of 11 entry columns not counting A and P. Printed tapes can be dated and stored for eventual correlation. Time is entered from a keyboard. The exact time of a future initiating event is set into the keyboard by depressing the proper keys up to the last 0.01 minute. When the instant of the event arrives, an electrical signal from the event can start the clock or it can be started by manual depression of a button. If it is desired to start the clock at any other given time, the time a minute or so ahead is punched into the keyboard. When the given time arrives the start button is depressed. Clary Multiplier Corp., Dept. ED, 408 Junipero St., San Gabriel, Calif.

CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION

Molded Laminates

For Temperatures to 500°F



Radomes, fiberglass laminates, and plastic sandwich structures to operate at temperatures up to 500°F, are production items at this firm.

Illustrated is one of a number of specialized laminate materials molded to specification. Room temperature properties of this fiberglass-cloth-reinforced laminate are: flexural strength, 65,000psi; modulus of elasticity, 2.9×10^6 psi. After 100hr at 500°F (measured at 500°F), flexural strength is 31,000psi, and modulus of elasticity is 2.5×10^6 psi. Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION

TRANSISTOR &

DIGITAL COMPUTER

TECHNIQUES

applied to the design, development and application of

AUTOMATIC RADAR DATA PROCESSING, TRANSMISSION AND CORRELATION IN LARGE GROUND NETWORKS

ENGINEERS & PHYSICISTS

Digital computers similar to the successful Hughes airborne fire control computers are being applied by the Ground Systems Department to the information processing and computing functions of large ground radar weapons control systems.

The application of digital and transistor techniques to the problems of large ground radar networks has created new positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or with exceptional ability, are invited to consider joining us.

fields include

TRANSISTOR CIRCUITS
DIGITAL COMPUTING NETS
MAGNETIC DRUM AND CORE MEMORY
LOGICAL DESIGN
PROGRAMMING

VERY HIGH POWER MODULATORS AND TRANSMITTERS

INPUT AND OUTPUT DEVICES
SPECIAL DISPLAYS
MICROWAVE CIRCUITS

Scientific and Engineering Staff

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

Relocation of applicant must not cause disruption of an urgent military project.

MISSILE SYSTEMS

*Research
and
Development*

PHYSICISTS
AND ENGINEERS

Inquiries are invited from those who can make significant contributions to, as well as benefit from, a new group effort of utmost importance.

Lockheed

MISSILE SYSTEMS DIVISION

*research
and
engineering
staff*

LOCKHEED AIRCRAFT
CORPORATION

VAN NUYS • CALIFORNIA

CIRCLE ED-282 ON READER-SERVICE CARD

Servo Motor

With Integral Stator, Housing

This servo motor features an integrally molded stator and housing. Liberal design characteristics are built in so that long life can be expected, even under severe ambient temperature conditions.



The motor presently is offered in 2-phase, 2-pole, 60cy units with ratings of 1w and 5w. Locked torque is 1.5oz-in and 5.5oz-in, respectively, and theoretical acceleration is 9650rad/sec² and 19,000rad/sec² respectively. Control phase is 50v and 115v, while reference phase is 115v for both units.

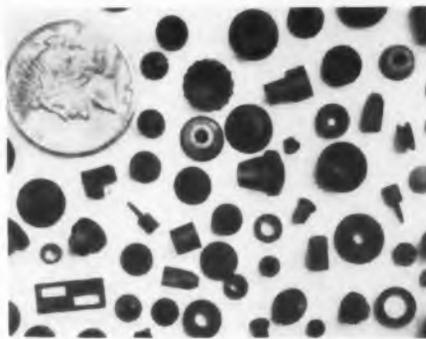
If desired, the servo motors may be wound, at some additional cost, with high impedance control windings for operation directly from the plates of electron tubes. The 1w motor may be controlled with a maximum of 3w, since most of the power required is applied to the reference phase.

While intended primarily for commercial use, these motors meet pertinent JAN specifications for resistances to humidity, salt spray, fungus, shock, and vibration. Diehl Manufacturing Co., Dept. ED, Somerville, N. J.

CIRCLE ED-283 ON READER-SERVICE CARD FOR MORE INFORMATION

Rubber Parts

In Tolerances to $\pm 0.001''$



Miniature custom molded rubber parts having complex structures can be injection molded by this firm with dimensional tolerances as close as $\pm 0.001''$. Other shapes and designs

in addition to those illustrated can be made to customer specifications.

Properties of the injection molding process permit greater quality control on these parts by eliminating flash and such secondary operations as hand or machine trimming. Many compounds of Neoprene, Buna N and Silicone synthetic rubbers can be injection molded. Minnesota Rubber & Gasket Co., Dept. KP, 3630 Wooddale Ave., Minneapolis 16, Minn.

CIRCLE ED-284 ON READER-SERVICE CARD FOR MORE INFORMATION

TUNG-SOL Series String TUBES

**For the TV Set
Manufacturer . . .**

building series string sets, Tung-Sol can provide the "series string" tube types, the quality and the service needed for a successful competitive program.

2AF4 (Prototype—6AF4) Heater Current 0.6 A Heater Volts 2.35	3CB6 (Prototype—6CB6) Heater Current 0.6 A Heater Volts 3.15	5V6GT (Prototype—6V6GT) Heater Current 0.6 A Heater Volts 4.7	12BQ6GA (Prototype—6BQ6GA) Heater Current 0.6 A Heater Volts 12.6
3AL5 (Prototype—6AL5) Heater Current 0.6 A Heater Volts 3.15	4BQ7A (Prototype—6BQ7A) Heater Current 0.6 A Heater Volts 4.2	6AU7 (Prototype—12AU7) Heater Current 0.6 A Heater Volts 3.15*	12BQ6GT (Prototype—6BQ6GT) Heater Current 0.6 A Heater Volts 12.6
3AU6 (Prototype—6AU6) Heater Current 0.6 A Heater Volts 3.15	4BZ7 (Prototype—6BZ7) Heater Current 0.6 A Heater Volts 4.2	6AX7 (Prototype—12AX7) Heater Current 0.6 A Heater Volts 3.15*	12BY7A (Prototype—12BY7) Heater Current 0.6 A Heater Volts 6.3*
3AV6 (Prototype—6AV6) Heater Current 0.6 A Heater Volts 3.15	5AN8 (Prototype—6AN8) Heater Current 0.6 A Heater Volts 4.7	6S4A (Prototype—6S4) Heater Current 0.6 A Heater Volts 6.3	12L6GT (Prototype—25L6GT) Heater Current 0.6 A Heater Volts 12.6
3BC5 (Prototype—6BC5) Heater Current 0.6 A Heater Volts 3.15	5AQ5 (Prototype—6AQ5) Heater Current 0.6 A Heater Volts 4.7	6SN7GTB (Prototype—6SN7GTA) Heater Current 0.6 A Heater Volts 6.3	12W6GT (Prototype—6W6GT) Heater Current 0.6 A Heater Volts 12.6
3BE6 (Prototype—6BE6) Heater Current 0.6 A Heater Volts 3.15	5BK7A (Prototype—6BK7A) Heater Current 0.6 A Heater Volts 4.7	12AX4GTA (Prototype—12AX4GT) Heater Current 0.6 A Heater Volts 12.6	19AU4 (Prototype—6AU4GT) Heater Current 0.6 A Heater Volts 10.9
3BN6 (Prototype—6BN6) Heater Current 0.6 A Heater Volts 3.15	5T8 (Prototype—6T8) Heater Current 0.6 A Heater Volts 4.7	12B4A (Prototype—12B4) Heater Current 0.6 A Heater Volts 6.3*	25CD6GA (Prototype—25CD6G) Heater Current 0.6 A Heater Volts 25
3BY6 (Prototype—6BY6) Heater Current 0.6 A Heater Volts 3.15	5U8 (Prototype—6U8) Heater Current 0.6 A Heater Volts 4.7	12BH7A (Prototype—12BH7) Heater Current 0.6 A Heater Volts 6.3*	* Using heaters connected in parallel. Other Series String Tube Types in Development.

All Tung-Sol Series String Tubes have uniform heater warm-up time to safeguard against failures from initial voltage surge.

Heater ratings are based on 600 milliamperes of current with the heater voltage adjusted for the same power as in the prototype. All other characteristics and ratings are identical to those of the prototype.

Use of these tubes provides completely satisfactory receiver characteristic during warm-up.

For more information about Tung-Sol "Series String" TV Tubes, write to Commercial Engineering Department, Tung-Sol Electric Inc., Newark 4, New Jersey.

SALES OFFICES

Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Philadelphia, Seattle.

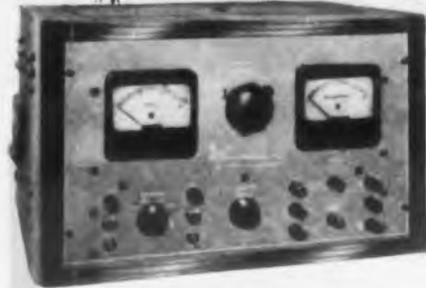
Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

TUNG-SOL®

Radio, TV Tubes, Dial Lamps

Versatility Plus!

A New Voltage Regulated DC POWER SUPPLY



\$275.00
f.o.b. N. Y.

Features:

- Wider than usual output range: "B" supply 0 to $\pm 600V$. at 200 ma. "C" supply 0 to $-250V$. at 5 ma.
- Additional fixed supply $-250V$. at 50 ma. and unregulated 6.3V. filament supply.
- Excellent voltage regulation ($\pm .25V$.)
- Low ripple (less than 4 mv.)
- Input 115 or 230 V. ac, 50/60 cps, single phase.

— for general laboratory and production line use

PRD Type 807 is a general purpose, constant voltage power supply, conservatively rated for continuous service. Flexible ground permits stacking of supplies to provide up to -600 v. cathode voltage and an additional 0 to -250 v. for the reflector of low voltage klystrons. Write for bulletin.



Polytechnic RESEARCH & DEVELOPMENT CO. Inc

202 TILLARY STREET, BROOKLYN 1, NEW YORK—ULster 2-6800
1 SO. NORTHWEST HWY., PARK RIDGE, ILLINOIS—TAlcot 3-3174
741 1/2 NO. SEWARD ST., HOLLYWOOD 38, CAL.—HOLLYwood 5-5287

CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION



JENNINGS VACUUM CAPACITORS ARE BEING USED IN THESE VHF AND UHF APPLICATIONS

- ✓ Tank and antenna tuning capacitors in TV transmitters
- ✓ Feed-through capacitors for harmonic attenuation on power supplies
- ✓ Pulse shaping capacitors in the output circuit of magnetrons
- ✓ RF bypass capacitors

The years of patient research and development work at Jennings has made possible practical, stable, and efficient miniaturized vacuum capacitors for the VHF and UHF fields. Their vacuum dielectric and all-copper construction result in high power ratings, small physical size, and extremely wide capacity ranges. They are thoroughly out-gassed so that they are not damaged by moderate overloads that cause internal arcing.

Therefore, where high power requirements at high frequencies have created difficult problems for other types of capacitors, consider utilizing the inherent advantages of these new fixed and variable capacitors with a vacuum dielectric!

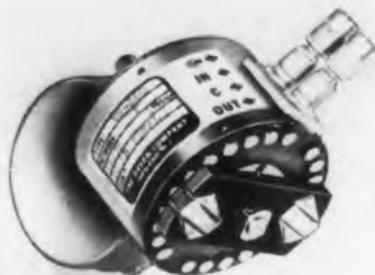


Send for our catalogue summary, or let us send you specific recommendations with respect to your capacitor problems.

JENNINGS RADIO MANUFACTURING CORP. - 970 McLAUGHLIN AVE. - P. O. BOX 1278 - SAN JOSE 8, CALIF.

CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Attenuators For Wide Band Applications



Series V-250 Video Variable Attenuators are recommended for use in wide band equipment where precision and dependability are of prime importance. Sturdy, rotary, step-type switch construction is used. General construction and mounting dimensions are interchangeable with this firm's standard attenuators.

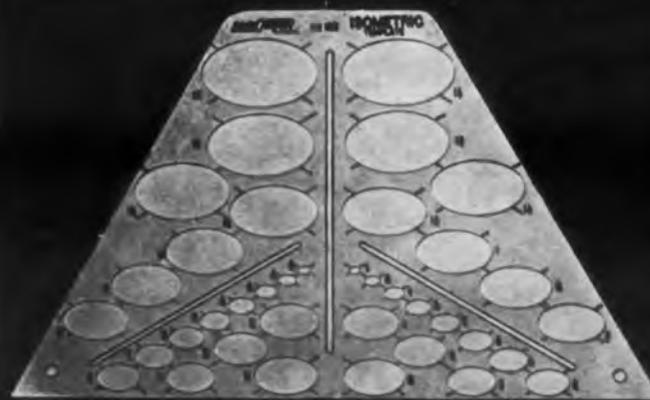
The units are especially adaptable for TV circuits where a wide frequency range without change of impedance is of special importance.

The units have zero insertion loss and constant input and output impedance. They have a flat frequency response from 0 to 10Mc. Standard impedance is 75 ohms, but other impedances are available on request. Impedance accuracy is $\pm 2-1/2\%$. These video pads can be obtained in either 10, 20, or 45 steps. Standard lug terminal board or BNC (UG-185/U) connectors are supplied. Daven Company, Dept. ED, 191 Central Ave., Newark, N. J.

The units are especially adaptable for TV circuits where a wide frequency range without change of impedance is of special importance. The units have zero insertion loss and constant input and output impedance. They have a flat frequency response from 0 to 10Mc. Standard impedance is 75 ohms, but other impedances are available on request. Impedance accuracy is $\pm 2-1/2\%$. These video pads can be obtained in either 10, 20, or 45 steps. Standard lug terminal board or BNC (UG-185/U) connectors are supplied. Daven Company, Dept. ED, 191 Central Ave., Newark, N. J.

CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

NO. 123 ISOMETRIC TEMPLATE



ALL THREE AXES ARE AVAILABLE
WITHOUT TURNING THE TEMPLATE

.040 clear mathematical quality double cured plastic. All cut-outs are smooth-milled to give engraving-machine accuracy.

One of more than 35 Rapidesign time-saver templates—all of which are better made, more useful and lesser priced.

\$3.00 AT YOUR LOCAL DEALER
CATALOG No. 50 MAILED ON REQUEST

RAPIDESIGN INC.

BOX 592 GLENDALE CALIF.

CIRCLE ED-207 ON READER-SERVICE CARD FOR MORE INFORMATION

To build a better Flyback transformer start with a

RESINITE COIL FORM



Resinite flyback transformer coil forms are fabricated from select materials and resin impregnated by a special process to provide optimum dielectric characteristics. In volume resistivity... low power factor... resistance to voltage break down... excellent thermal properties... and low moisture absorption... Resinite outperforms all other resinated products.

Resinite flyback transformer coils are available in any size or shape and are notched to your specification. Delivery is prompt in any quantity.

Request full information and samples.

RESINITE CORPORATION

Sales Representatives in:

New England: Framingham, Mass., Framingham 7091
New York, New Jersey: Jersey City, New Jersey, Journal Square 4-3574
Upstate New York: Syracuse, N.Y., Syracuse 76-8056
Maryland: Baltimore, Maryland, Plaza 2-3211
Philadelphia: Philadelphia, Pa., Chestnut Hill 8-0282
Northern Ohio, Western Pennsylvania: Cleveland, Ohio, Atlantic 1-1060
Indiana, Southern Ohio: Logansport, Indiana, Logansport 2555
Missouri, Southern Illinois, Iowa: St. Louis, Missouri, Sterling 2318
California: Pasadena, California, Sycamore 8-3919
Canada: Montreal, Quebec, Canada, Walnut 2715

Division of

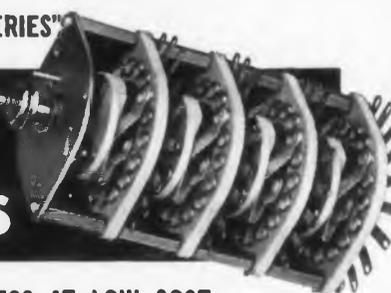
PRECISION PAPER TUBE COMPANY

2035C W. CHARLESTON ST. • CHICAGO 47, ILLINOIS

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

VERSATILE "12,000 SERIES"

Ceramic Switches



MEET "CUSTOM" SPECS AT LOW COST

Avoid the delay and cost of "specials" when ordering quality switches for prototypes or quantity production of instruments, control systems and assemblies.

Thousands of "12,000 Series" Switches to meet virtually any requirement are quickly assembled from basic stock parts. All types have solid silver contacts and collector rings, low-loss steatite decks, and silver-plated beryllium-copper wiper springs for uniformly low contact resistance and exceptional durability.

For complete data, write for Bulletin L-32.
SHALLCROSS MFG. CO., 526 Pusey Ave., Collingdale, Pa.

CONDENSED SPECIFICATIONS

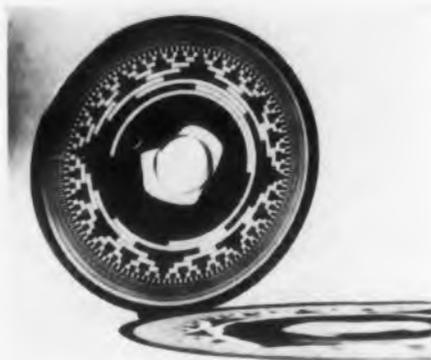
ACTION—shorting or non-shorting
POLES—1, 2, or 3 per deck
DECKS—up to 10
DEYENT—optional
SHAFT—completely isolated
CONTACT RESISTANCE—
0.0025 ohm
RATINGS—nominal—1a., 110v.,
60 cy.
de-rated current—2500v.,
60 cy.
de-rated voltage—40 amperes

Shallcross

CIRCLE ED-209 ON READER-SERVICE CARD FOR MORE INFORMATION

Binary Code Disks

Four Types on Polished Glass



These four versions of the binary code disk are for use in either photoelectric, magnetic, or contact types of pickups. The disks contain concentric zones of information in the gray code. Each zone contains alternating opaque and clear angular sectors. The thin annual rings separating adjacent zones are opaque. The number of sectors per zone increases by doubling to 2^{12} , or to 4096 in the outer zone. Up to 8192 words can be read with all zones.

Of the four types, one utilizes photo-engraver's glue, with colloidal (black) silver, and is essentially grainless for transmission contrast; another is with etched metal coating, possessing both reflectivity and transmission contrast; another is with chemically deposited ferrous alloy possessing both magnetic and optical transmission contrast; and the last is metal bonded on glass for electrical contact use as well as in optical systems.

All four types are on polished glass and are made to precision tolerances. Total metal thickness is approximately 0.001". Density of opaque portions to transmitted light is over 2.5; the transparent areas are bare, optically polished glass without emulsion. Pattern edges are sharp since the coating process leaves no gray tones in density. W. & L. E. Gurley, Industrial Div., Dept. ED, Troy, N. Y.

CIRCLE ED-212 ON READER-SERVICE CARD FOR MORE INFORMATION

Flip-Flop

For Counting, Frequency Division

This high-speed flip-flop is designed for use in counting and frequency division applications. It has a 0 to 1Mc range for decade operation. Packaged as a plug-in with an 11-pin base, the unit as a 1-1/2" OD and a seated height of 3-21/32".

A minimum input signal of 80v is required for input frequencies from 0 to 500ke. Its output signal has an amplitude of 80v, which is sufficient to drive a similar flip-flop without the use of amplifiers.

The plug-in unit is designed for disassembly and reassembly without using any tools. Ecco Production Co., (subsidiary of Electronic Engineering Co. of California), Dept. ED, 827 Vermont Ave., Los Angeles 5, Calif.



CIRCLE ED-213 ON READER-SERVICE CARD FOR MORE INFORMATION

free! the most widely used
ELECTRONIC SUPPLY GUIDE

send for **ALLIED'S**
1955 CATALOG

HEADQUARTERS FOR

RAYTHEON ELECTRON TUBES
FOR INDUSTRY

WE STOCK all types of RAYTHEON special-purpose electron tubes, diodes and transistors for industrial, broadcast and government use. To save time and money—phone, write or wire us—and we'll have your RAYTHEON tubes on the way to you in just hours. RAYTHEON special-purpose tubes are always in stock at ALLIED for quick delivery.

Simplify and speed all your electronic supply purchases. Order from the world's largest stocks of electron tubes (all types), test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.). Our expert Industrial supply service saves you time, effort and money. Send today for your FREE 308-Page 1955 ALLIED Catalog.

ALLIED RADIO

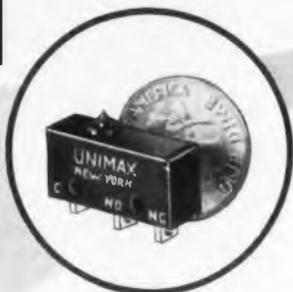
100 N. Western Ave., Dept. 69-A-5
Chicago 80, Illinois

Send for FREE Catalog

CIRCLE ED-210 ON READER-SERVICE CARD FOR MORE INFORMATION

SUB-MINIATURE SWITCH

- 5 amperes
125/250 v. a-c
- 4 amperes
30 v. d-c



ACTUAL SIZE

UNIMAX type USM

This compact, single-pole double-throw, snap-acting switch is built for easy wiring in miniaturized apparatus. Its sturdy, phenolic case is 25/32 x 23/64 x 1/4 inch, with sturdy, standard flat terminals widely spaced for rapid wiring and easy soldering. Available in plain or leaf-actuator styles.

Free detailed data sheet on request.

UNIMAX

Division of the W. L. Maxson Corporation

460 WEST 34th STREET, NEW YORK 1, NEW YORK

CIRCLE ED-211 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955



NOW!
Easy
Dependable
Direct Measurements
of Transistor
Characteristics



MODEL
GPI



with the Baird Associates

Transistor Test Set

AT ANY FREQUENCY 100 cps to 1 megacycle

FEATURING

- | | |
|---|---|
| ● NPN and PNP | ● JUNCTION and POINT CONTACT |
| ● GROUNDED BASE and GROUNDED EMITTER | ● COLLECTOR SATURATION CURRENT I_{co} |
| ● HYBRID COEFFICIENTS h_{11} h_{12} h_{21} h_{22} | ● T-NETWORK COEFFICIENTS r_e r_b r_c α β |
| ● ALPHA CUT-OFF | ● COLLECTOR CAPACITANCE |

- ★ PRECISION for the transistor laboratory
- ★ VERSATILITY for the circuit designer
- ★ SPEED for the production line

The Baird Associates Model GPI Transistor Test Set is a versatile precision instrument designed to analyze transistors at any frequency from 100 cps to 1 mc in terms of well-known standard parameters. The transistor coefficients thus obtained enable the circuit designer to predict the performance of amplifiers in the AUDIO, INTERMEDIATE and LOW RADIO FREQUENCY ranges.

PLEASE REQUEST TECH. CIRC. RD511

Baird Associates, Inc.



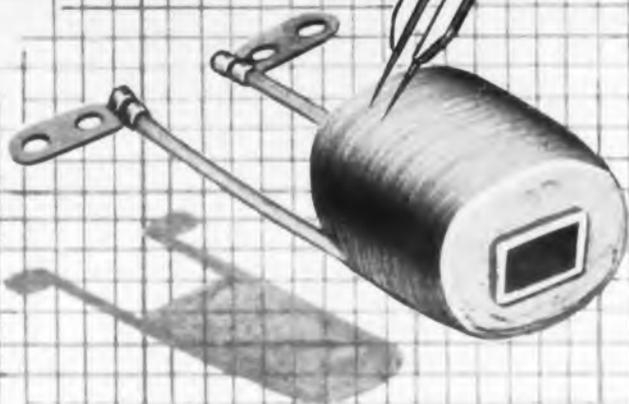
33 UNIVERSITY ROAD
CAMBRIDGE 38, MASSACHUSETTS



CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION

Solve Coil Designing Problems with

Coto-Coil Service



We can be very valuable at the design stage! With nearly 40 years' experience in coil design and manufacture, we can solve your coil problems at the design and/or production level.

Furthermore . . .

Our automatic equipment and up-to-the-minute shop practices result in top volume with peak efficiency.

Write for information to Coto-Coil Company, 66 Pavilion Avenue, Providence 5, R. I. New York Office: 10 East 43rd Street, New York 17, New York.

PRECISION

Coto



Coils

WOUND

CIRCLE ED-292 ON READER-SERVICE CARD FOR MORE INFORMATION

U-H-F Power Triode

Liquid and Forced-Air Cooled



The 6383 is a compact, liquid- and-forced-air-cooled u-h-f power triode. It is designed primarily for applications where transmitter design factors of compactness, light-weight, and high power output are prime considerations. It has a maximum plate dissipation of 600w and can be operated with full plate voltage and plate input at frequencies up to 2000Mc.

The design of the tube features an integral cooling jacket with associated inlet and outlet pipes, and a coaxial-electrode structure for use with circuits of the coaxial-cylinder type. The structure provides low-inductance, large-area r-f electrode terminals for insertion into the cylinders, and permits effective isolation of the plate from the cathode. The latter feature makes the tube particularly suitable for cathode-drive circuits.

Small in size for its power capability, the 6383 has an overall length of 4-1/4", a diameter of 1-3/4", and a weight of 8oz. Tube Div., Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE ED-293 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Tester

Checks All Commerical Types



This dynamic tube tester, Model VTT-1, is capable of measuring the true dynamic mutual conductance as well as the plate current of all tubes normally encountered in electronic work, including sub-miniature, ruggedized, and hearing-aid tubes. Actual operating conditions of the

tube under test may be simulated by independent adjustments of plate, screen, filament, signal, and bias voltages. Positive protection against accidental tube damage is provided by a simple switch interlock system, while a low-voltage short circuit test protects delicate tubes of the sub-miniature type.

The unit is completely self contained, including spare tubes, neon lamps, and fuses. It is a rugged instrument which combines the accuracy, versatility, and reliability of a precision-type tester with simplicity of operation and compactness. Special Contract Div., CBS-Columbia, Dept. ED, 3400 47th Ave., Long Island City 1, N. Y.

CIRCLE ED-294 ON READER-SERVICE CARD FOR MORE INFORMATION

there's a

BETTER WAY...



use BIRTCHER KOOL KLAMPS!



KOOL KLAMPS will help keep your miniature and subminiature tubes COOL — and will hold them firm and secure, no matter how they are shaken or vibrated.

KOOL KLAMPS are made of a specially developed heat-treatable alloy 99 1/2% pure silver. They combine high thermal conductivity with great strength — in a one-piece unit. No need for special "inserts" which slow up installation and make maintenance difficult.

KOOL KLAMPS are available with new "independent finger" construction or standard solid construction.

Where heat conditions are less critical, beryllium copper KOOL KLAMPS are available.

SEND FOR KOOL KLAMP CATALOG ED-1-55

The BIRTCHER CORPORATION
4371 Valley Blvd. Los Angeles 32, California

CIRCLE ED-295 ON READER-SERVICE CARD

ELECTRONIC DESIGN • January 1955

FOR PRINTED CIRCUITS

PRINTED
CIRCUITRY

FLUXES

**3 NON-ACTIVATED
AND
4 ACTIVATED
FLUXES**

A TRUSTED NAME IN



ELECTRONIC INDUSTRY

PRINTED
CIRCUITRY

SOLDERS

**5 BAR SOLDERS
FOR DIP SOLDERING
SOLDER PLATE, GOLD,
SILVER AND
COPPER
SYSTEMS**

The facilities of a modern, well equipped metallurgical laboratory, competent research staff and field engineers are available to help you solve printed circuitry problems.

write for informative literature

ALPHA METALS, INC.

69 Water St., Jersey City 4, N. J.

HENDERSON 4-6778

CIRCLE ED-232 ON READER-SERVICE CARD



Thyatron

For Relay and Servo Uses

The Type AX5727 Thyatron, a ruggedized version of the standard Type 2D21, is designed for relay and servo-control applications where reliability of operation and mechanical ruggedness are important. These uses, for example, include mobile and aircraft operation.

The tube is an inert gas filled thyatron with negative control characteristics. It has a high control ratio, which is stable over a wide temperature range, and features low grid-anode capacitance and low grid current. The heater-cathode construction is made to withstand the rigorous requirements of intermittent operation. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., N. Y.

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

Counter Chronograph

Tests Radar and Sonar



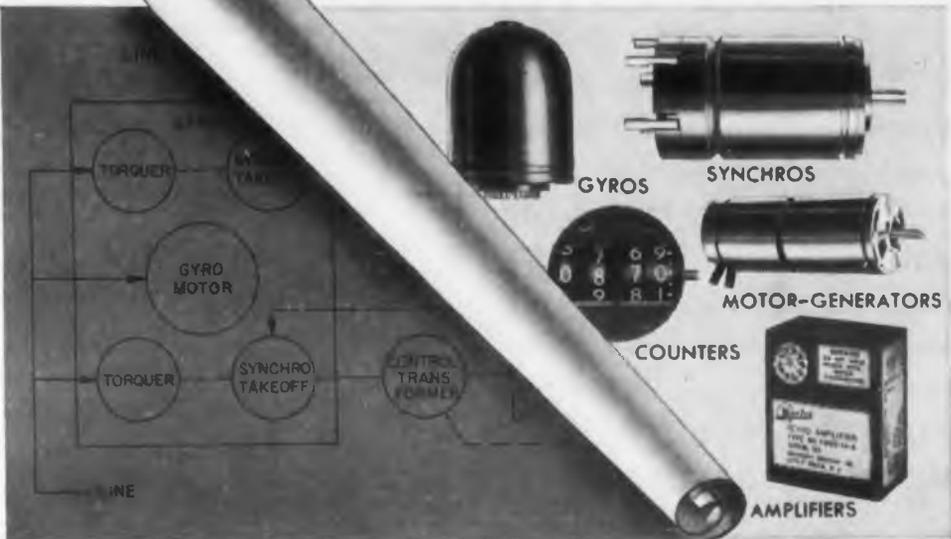
The 8Mc Counter Chronograph, Model 471, is a rugged instrument for testing radar and sonar equipment. It is designed to permit calibration and other detailed tests under field or shipboard conditions. Housed in two drip-proof heavy-gage reinforced aluminum cabinets, it contains

a temperature-compensated crystal-controlled 8Mc oscillator that produces timing pulses exactly 1/8sec apart. These pulses are gated into a high-speed electronic counter during an unknown interval. Upon completion of a measurement, neon lamps give direct indication of the exact number of microseconds and eighths of microseconds contained in the interval. Results may be observed visually or applied to a recorder or printer which is also available.

Maximum interval range is 1sec, and measuring accuracy is $\pm 1/8$ sec. Pulses defining time intervals to be measured may be applied on separate lines or on a common line. A lockout arrangement prevents pulses other than those intended for starting and stopping from affecting the instrument, thus making it possible to time intervals between two pulses occurring in a repetitive train. With a high-speed recorder or printer, the unit recycles for another measurement as soon as one reading is recorded. Potter Instrument Company, Inc., Dept. ED, 116 Cutter Mill Rd., Great Neck, N. Y.

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION

KEARFOTT...



from
problem
through
production

Engineering ability and production facilities are as important to you as the characteristics of the components you select. After components are approved, you are dependent upon your supplier . . . dependent upon him for engineering assistance . . . dependent upon his ability to produce quality products in the required quantities.

Many of the servo motors, synchros, gyros and systems in use today had their inception on the drafting boards of Kearfott's engineers. This is proof of Kearfott's engineering ability. Kearfott offers complete engineering service before, during and after the purchase of a component.

A modern building, over 430,000 square feet of floor space, equipped with the latest in precision machinery, manned by 3,000 highly skilled specialists, is your assurance of Kearfott's ability to produce.

Yes, Kearfott is a dependable source of supply. If you have a design problem or require a special or standard component, contact Kearfott.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Send for bulletin giving data of components of interest to you.

Kearfott

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

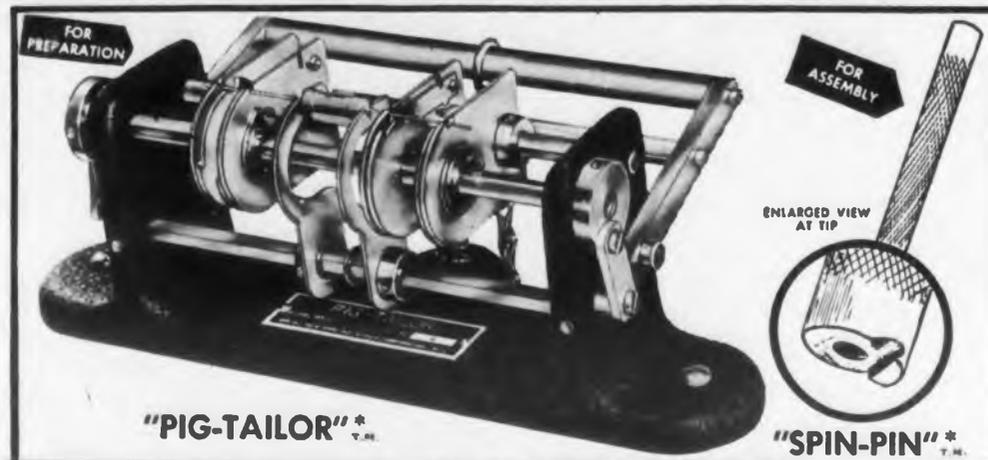
KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

CIRCLE ED-235 ON READER-SERVICE CARD FOR MORE INFORMATION

"PIG-TAILORING"

... a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

PIG-TAILORING provides:

- | | |
|-------------------------------------|-------------------------------------|
| 1. Uniform component position. | 6. Individual cut and bend lengths. |
| 2. Uniform marking exposure. | 7. Better time/rate analysis. |
| 3. Miniaturization spacing control. | 8. Closer cost control. |
| 4. "S" leads for terminals. | 9. Invaluable labor saving. |
| 5. "U" leads for printed circuits | 10. Immediate cost recovery. |

PIG-TAILORING eliminates:

- | | |
|--------------------------------|-----------------------------------|
| 1. Diagonal cutters. | 6. Broken leads. |
| 2. Long-nose pliers. | 7. Short circuits from clippings. |
| 3. Operator judgment. | 8. 65% chassis handling. |
| 4. 90% operator training time. | 9. Excessive lead tautness. |
| 5. Broken components. | 10. Haphazard assembly methods. |

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. ED-1

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

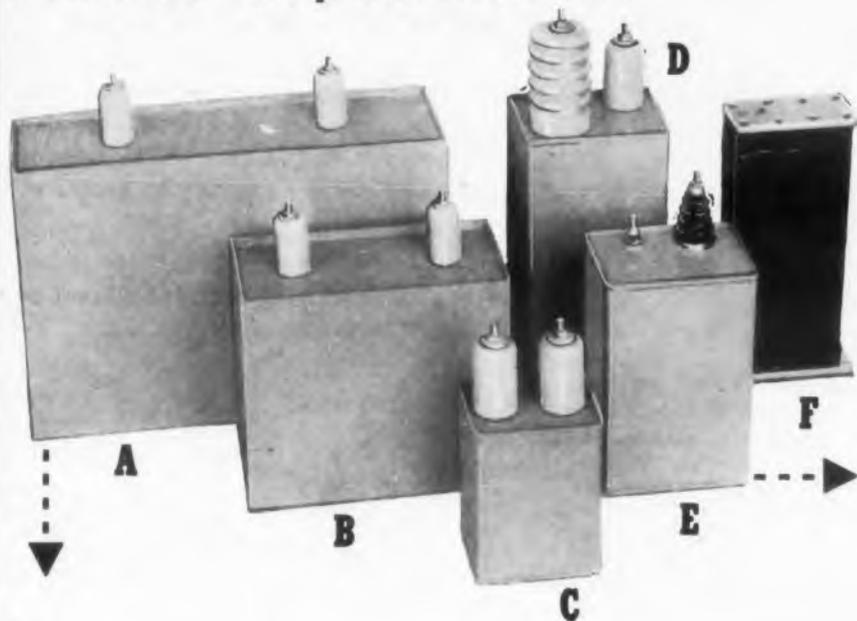
460 WEST 34th STREET

NEW YORK 1, N. Y.



CIRCLE ED-305 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Capacitors'...



- (A) 10 mfd, 7500 V
- (B) 10 mfd, 6000 V
- (C) 0.1 mfd, 20 KV
- (D) 0.1 mfd, 30 KV
- (E) 0.5 mfd, 15 KV
- (F) 0.08 mfd, 60 KV

- Plastic Film Capacitors
- High Voltage Power Packs
- Pulse Forming Networks



Plastic Capacitors, Inc.

2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

We invite inquiries on High Voltage Capacitor Design
Ask for our complete catalog on your company letterhead

HIGH VOLTAGE CAPACITORS

for DC filter applications

- Small size
- Extremely wide temperature range
- Economical
- Durable

Our specially designed facilities guarantee faster delivery.

CIRCLE ED-306 ON READER-SERVICE CARD FOR MORE INFORMATION

Retaining Ring Eliminates Hardware

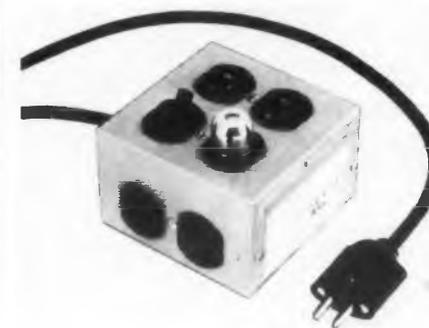


The "Series 5139" is a radially-applied retaining ring which can be locked positively in its groove and used as a shoulder against rotating parts, replacing expensive nuts and bolts and eliminating the need for springs, washers, and other accessory fastening devices. It is made of spring steel and is shaped like a bowed horseshoe. When fastened to a shaft, it is locked in its groove by two prongs extending from the inner circumference of the open end (illustrated at the top).

The ring is manufactured in sizes to accommodate shafts ranging in diameter from 1/8" to 1/2", with larger sizes available for special applications. It is mounted on a shaft in the following manner: The ring is placed next to the shaft and is compressed until the locking prongs enter the groove. The ring is then pushed forward in the groove until the prongs pass the outer diameter of the shaft, at which time the ring springs back to its normal bowed shape and the prongs lock around the shaft. It may be removed from the shaft merely by reversing the mounting procedure. Waldes Kohinor, Inc., Dept. ED, 47-16 Austel Pl., Long Island City 1, N. Y.

CIRCLE ED-307 ON READER-SERVICE CARD FOR MORE INFORMATION

Outlet Box With Fused Wires



The primary feature of the "Safe-corde" portable multiple electric output box is that both wires are fused, eliminating the possibility of blown fuses at the switch box, thus preventing downtime to other equipment and lighting circuits. The unit is particularly useful in electronic laboratories for setups and testing equipment, where several pieces of test apparatus, soldering irons, etc., are required. One flick of the switch provides complete control without pulling individual cords.

The unit consists of six heavy-duty outlets, control switch, pilot light, and fuses rated at 10amp on 115v a-c or d-c. The assembly is in a rugged steel housing 5" x 5" x 2-1/2". Kenru Co., Dept. ED, Box 121 Parsippany, N. J.

CIRCLE ED-308 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1959



OVER 12 YEARS EXPERIENCE

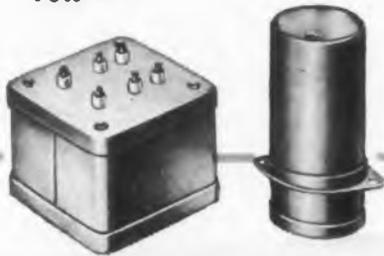
*in Specialization
and Standardization*

Ask "OLYMPIC" to apply its Accumulated Knowledge, Skills and Techniques to YOUR Design Problems.

Use OLYMPIC'S "complete coordination" from design to delivery. It's to your advantage now to consolidate your speculations or your specifications with OLYMPIC.

- **ENGINEERING and DESIGNING** . . . of housings and hardware.
- **PRODUCTION** . . . with prompt, scheduled deliveries.
- **FINISHING** . . . centrifugal hot-tin dipping, cadmium plating, and black oxide finish.
- **SAMPLE SHOP FACILITIES** . . . in addition to production facilities.
- **TOOL and DIE SHOP** . . . fully equipped.

*** OLYMPIC Plans Today for
Your Products of Tomorrow***



OLYMPIC

METAL PRODUCTS COMPANY, INC.
ALPHA, NEW JERSEY

CIRCLE ED-309 ON READER-SERVICE CARD

Headset

Weights Only 1.6oz



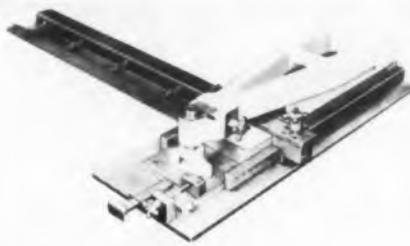
This over-the-head style headset, with a variety of applications from stenography to aviation, resembles a pair of ultra-thin earmuffs. It consists of a sensitive plug-in mechanism, thin stainless steel band that slips over the head, and two clear "Plexiglas" air cushions. The cushions slide on the band, adjusting to the correct length; and a ball-and-swivel joint at the base of the cushions permits comfortable adjustment to the ear. Sound, transmitted from the receiver in the plug, is piped into the cushions through sturdy, light, hollow plastic tubing.

Impedance of the standard units is 128 ohms and 2000 ohms. Special impedances can be provided on request. The headset unit is recommended by the manufacturer for use in aviation, transcription, radio monitoring, and various TV applications. Telex, Inc., Dept. KP, Telex Park, St. Paul 1, Minn.

CIRCLE ED-310 ON READER-SERVICE CARD FOR MORE INFORMATION

Hole Punching Unit

For Short Runs



The "Quickset Unit" is a single hole piercing tool that will pierce from 3/32" to 2-1/8" diam holes in up to 1/8" thick mild steel. It is

useful for low run production or laboratories.

The interchangeable punch heads and die holders used in this unit can be quickly and easily changed on the frame. It has a 24" throat depth, and is furnished complete with a 36" combination back gage and end stop bar. The gage and bar slide along a pair of rails in which holes at 1" intervals are provided. A screw type adjustment on the C-frame allows for setting up any dimensions between 1" intervals.

Maximum accuracy is assured, as there are no friction clamps on the unit. Once the gage has been set up, it is locked in place by solid metal in shear. The initial operation of the "Quickset Unit" can be quickly set up for production by placing the unit in a standard press or press brake, or the punch can be accuated by an air or hydraulic cylinder. Toolset Div., General Riveters, Inc., Dept. ED, 777 Hertel Ave., Buffalo, N. Y.

CIRCLE ED-311 ON READER-SERVICE CARD FOR MORE INFORMATION

More Reliability in less space without external DC Power Supply



This compact plug-in Type SA118H Amplifier is primarily designed for analog computer servo loops. Its excellent reliability is the result of a circuit design which allows operation directly from the output of a tapped transformer—no external DC supply is required. A single input power winding will supply multiple amplifiers. Output, when used with Servomechanisms, Inc. Type 17ID motor (below), is 100 Volts at 400 cps (max.). Voltage gain, with an input of 0.01 V. ac (rms) at 400 cps, is 7300 ± 25 percent. Damped natural frequency approximates 10 cps in a typical servo loop. Hermetic sealing and silicone fluid filling allow for rapid heat dissipation and cushion against shocks and vibration.

This remarkably small and light amplifier—Type SA118H—is a culmination of our years of leadership in the design of amplifiers.



Servomechanisms, Inc. Type 17ID, for use with the amplifier, is a damped-control motor whose control winding is the output load for the amplifier.



For additional information

Write to:

Westbury Division, Post and Stewart Avenues, Westbury, N.Y.

West Coast Division, 316 Washington Street, El Segundo, California

CIRCLE ED-312 ON READER-SERVICE CARD FOR MORE INFORMATION

5 idea starters for product improvement in Metallized Glass

In each of the components shown here, the unique properties of metallized glass have helped solve a design problem and make a better product.

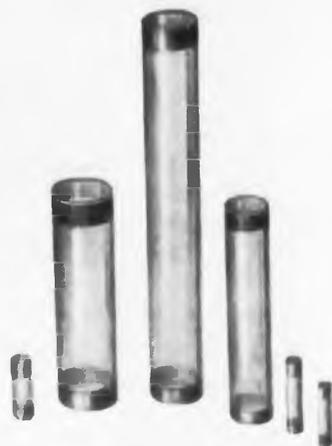
A basic idea starter is the Metallized Glass Enclosure Tube. You see six of the many available sizes at the right.

You can use these tubes to hermetically enclose many kinds of components. Such enclosure gives the components performance characteristics they otherwise do not have.

Corning's metallizing process makes possible a true hermetically sealed enclosure. Components encased in metallized glass enclosures are impervious to moisture, moulds, and atmospheric changes. Assemblies complete with end caps are capable of withstanding severe temperature changes. Glass has excellent electrical characteristics, and its transparency permits visual inspection. Bond strength for metallizing used on enclosure tubes has been measured at 1500 to 2000 pounds per square inch.

These characteristics can perhaps broaden your use of some product, expand its performance limits, or reduce servicing and minimize breakdown possibilities.

Illustrated below are other applications of Corning's metallizing process. If none of them exactly meets your needs—or, if metallized glass characteristics suggest solutions to other problems, write us your requirements. Chances are, we'll be able to help you. There is no obligation.



CORNING METALLIZED GLASS INDUCTANCES are made with a precision that guarantees duplication within close limits. When used in either FM or TV circuits, you can be sure that they will contribute negligible drift even under unusual temperature changes.



METALLIZED GLASS INSTRUMENT WINDOWS are made of both tempered and untempered glass with metallized bands on the edges. They can be easily soldered into a bezel to form a hermetic seal. Available in sizes and shapes to meet your needs.



MIDGET TRIMMER CAPACITORS are available in standard types from 0.5 to 12.0 mmfds., or they can be designed to your requirements. Temperature coefficient for brass core units is approx. 200 ppm/deg. C.; for invar core units, approx. 50 ppm/deg. C.



METALLIZED BUSHINGS AND STANDOFF INSULATORS for high voltage applications. Bushings can provide hermetically sealed insulators for high voltage transformer and capacitor terminals. Standoff insulators are made of tempered low loss glass. Both can be furnished in special sizes.



CORNING GLASS WORKS, CORNING, N. Y.

New Products Division

Corning means research in Glass

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Clamp Shields Rugged One-Piece Construction



Series 100 and 200 subminiature tube clamp shields are designed for use in moderate environmental uses. They are manufactured

to the same rigid standards as shields used in exceptionally severe applications, such as guided missiles and other military electronic equipment. They are of simple, rugged one-piece construction and are carefully formed with no sharp bends to break or crack under severe vibration conditions. The design permits many insertions and removals of tubes without the shields losing their spring tension.

The shields are available in silver alloy for maximum heat transfer and in silver-plated beryllium copper. The beryllium copper units give excellent results where the primary purpose of the shield is to hold the tube in place under moderate severe shock and vibration. They are priced lower than the silver-alloy tube shields.

The design is extremely compact. The sleeve-type shields fit into a 0.420" x 0.420" x 1.0" space. The clip-type shields can be mounted on 1/2" centers when loaded from the top and on 7/16" centers when loaded from the end. Both use the same broad base mounting hole pattern. International Electronic Research Corp., Dept. ED, 177 W. Magnolia Blvd., Burbank, Calif.

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION

Snap Switch

With Movement of Only 0.0005"



A movement differential of only 0.0005" maximum and low actuating force, combined with high repeat accuracy, are featured in Series WHB precision snap-switches. These

switches are particularly suitable for use in pressure-sensitive thermostatic controls and short-motion gaging devices.

Three styles of over-travel plungers are available. The basic switch in the series has an Underwriters' Laboratories listing of 15amp, 125/240/480v a-c. It is 1-15/16" long x 15/16" high (exclusive of the over-travel plunger) x 11/16" wide. Unimax Div., The W. L. Maxson Corp., Dept. ED, 460 W. 34th St., New York 1, N. Y.

CIRCLE ED-219 ON READER-SERVICE CARD FOR MORE INFORMATION

SAVE TIME



IN CIRCUIT DESIGN

Completely assembled units

All commercially coded—

Conveniently boxed—

The seven different Bradley Selenium Rectifier Kits contain the high-quality, vacuum processed rectifiers you need for design and development work. With Bradley kits on hand you have the rectifier you need — when you need it! No more waiting for samples, no more delayed projects. Write today or ask your jobber for details.



BRADLEY LABORATORIES, INC. 174 Columbus Ave., New Haven 11, Conn.

CIRCLE ED-220 ON READER-SERVICE CARD FOR MORE INFORMATION

PILOT LIGHTS

Protect valuable equipment with

JOHNSON pilot lights . . .

Used as indicators, inexpensive pilot lights can protect your equipment from further damage should circuit failures occur. Available in a wide variety of types, JOHNSON panel indicators include continuous indication neon types, and models for high and low voltage incandescent bulbs. Standard or wide angle glass and lucite jewels available in clear, red, green, amber, blue, or opal lenses. Variations from standards, including those meeting military specifications, are available in production quantities.



For further information write for pilot light catalog



E. F. JOHNSON COMPANY

3409 2nd Ave. S.W. • Waseca, Minnesota.

CIRCLE ED-221 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

DATA SHEET

FAIRCHILD

PRECISION POTENTIOMETERS



TYPE 751
7/8"



TYPE 741
1 1/8"

Miniature Single Turn Pots linear and nonlinear
Precision performance in linear or nonlinear functions is assured with these Fairchild miniature pots. The Type 751 (7/8" dia.,—weight 13 grams) has a resistance range up to 75,000 ohms. The Type 741 (1 1/8" dia.,—weight 20 grams) has a resistance range up to 100,000 ohms. 0.5% standard accuracy, 0.25% special accuracy available. Terminals are gold-plated for reduced contact resistance and easier soldering.

SAMPLES AVAILABLE ON ORDER

These units show how Fairchild can help you solve all your precision potentiometer problems. For more information write Fairchild Camera & Instrument Corporation, Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Department 140-60N.

CIRCLE ED-323 ON READER-SERVICE CARD FOR MORE INFORMATION

Camera Tube

Adaptable to Variety of Lenses



The 6198 is a small camera tube designed for industrial, military, TV broadcast, and amateur uses. The tube combines high sensitivity and resolution together

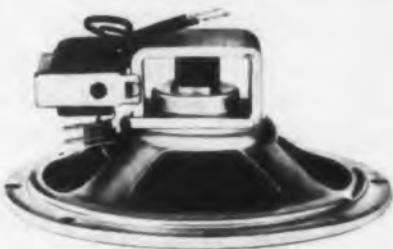
with long life. Dimensions are approximately 1" face diameter x 6-1/4" high (including pins).

The photoconductive spectral response approximates very closely that of the human eye. However, photoconductive surfaces of different spectral responses are available upon request. This tube design is adaptable to a wide selection of commercially available lenses. Resistron Laboratories, Inc., Dept. ED, 2025 Pontius Ave., Los Angeles 25, Calif.

CIRCLE ED-325 ON READER-SERVICE CARD FOR MORE INFORMATION

Speakers

Low-Price 4" and 5" Designs



This line of 4" and 5" speakers is produced by new manufacturing techniques which permit lower price. Either a break-off or a cast magnet

may be used. Plugs, transformers and/or brackets are to the customer's specifications. Heppner Manufacturing Company, Dept. ED, P. O. Box 1207, Round Lake, Ill.

CIRCLE ED-326 ON READER-SERVICE CARD FOR MORE INFORMATION

Lock Nut

Digs Into Metal for Ground



This washer-type lock nut is now available with tooth-like elements in the flanged base to dig through non-conducting materials to achieve an electrically grounded assembly.

It was originally developed for automobile manufacturers for grounding lamp assemblies through non-conductive coatings on metal.

The lock nut and flat washer in one piece exerts a double locking spring action on the screw threads, as the teeth of the washer engage the metal seat. It is available in No. 10-24 and 1/4"-20 sizes. The Palnut Co., Dept. ED, 61 Cordier St., Irvington 11, N. J.

CIRCLE ED-327 ON READER-SERVICE CARD FOR MORE INFORMATION

POWER

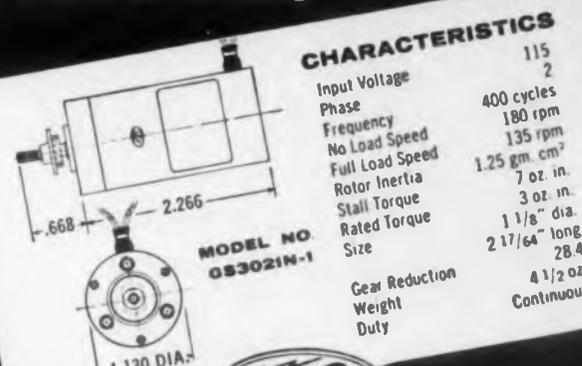
in a pillbox



EAD'S

new miniaturized
1/8 inch
servo-gear motor

For instant response and maximum torque in a miniature package it's EAD's tiny servo-gear motor, precision-designed for applications where size and weight are at a premium. Modifications available in hysteresis-synchronous and induction designs... Tell us your requirement. Write for our new catalog.



EAD
EASTERN AIR DEVICES, INC.
SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD



391 CENTRAL AVE., DOVER, NEW HAMPSHIRE

CIRCLE ED-328 ON READER-SERVICE CARD FOR MORE INFORMATION

RING A BELL
LIGHT A LIGHT
STOP or START a MACHINE

C.O.U.N.T.S. ELECTRICALLY

DURANT Electric 'SP' PREDETERMINED COUNTER

(COUNTS ELECTRICALLY and CLOSES SWITCH AT END OF PRE-SET COUNT)
Eliminates costly over-runs or time consuming under-runs. Actuated by Photo Electric Cell, Tube, Relay, or Contact Switch. Counter can be located where desired. Predetermined count may be set at any figure to 99,999. Hundreds of applications in all phases of production and instrument work.

SMALL • COMPACT • RUGGED • FAST • ACCURATE

DURANT MANUFACTURING CO.
1993 N. Buffum St. 193 S. Water St.
Milwaukee 1, Wis. Providence 3, R. I.
Representatives in Principal Cities

PRODUCTIMETERS
SINCE 1879 *Count Everything*

CIRCLE ED-324 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

*precision-designed
to your specifications*

Now you can order direct! Your call to Thermador's new, completely self-contained Electronics Plant quickly brings you the engineering ingenuity... the precision designing... the dependable, quick delivery that has gained Thermador's world-wide reputation for excellence. 35 years of quality service!

Let a Thermador engineer work with you to develop the

Thermador Transformers

finest transformer for your application, chassis, or performance standards. Thermador's complete environmental testing facilities make certain that each transformer exceeds your specifications and MIL requirements. One or a thousand — certified without delay — delivered quickly. Order direct. Call us today. Request literature from: Electronic Division, Thermador Electrical Manufacturing Company, 2000 South Camfield Avenue, Los Angeles 22, Calif. PARK-VIEW 8-2105



THERMADOR
Electronic Division



SEVEN LEAGUES AHEAD
3-918

CIRCLE ED-329 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Servo Analyzer 330

Analysis of servomechanisms and process equipment using frequency response techniques is speeded by this servo analyzer. Bulletin 1170 describes and illustrates the components and operation of the instruments in this automatic transfer function measuring and plotting system. Block diagrams, schematics, and vector and waveform plots illustrate the operating principles. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Precision Stock Gears 331

Catalog No. D-64 lists the precision gears available from stock from this firm. Included are dimensional drawings, reference data, and prices for hub type, hubless, clamp type, slip clutch, and solid gears. Dynamic Gear Co., Inc., 20 Merrick Rd., Amityville, L. I., N. Y.

Radio Interference 332

A 6-page catalog describes noise meters, distortion analysers, impulse generators, attenuators, and crystal mixers. Fully illustrated, it details, for each product, data on design specifications, operating ranges, recommended uses, and lists of accessories. Empire Devices Products Corp., 38-15 Bell Blvd., Bayside 61, N. Y.

Constant-Speed Motor 333

Form SC-23 describes, in 2 pages, a motor recommended for continuous-duty applications calling for constant speed under varying voltage, load and ambient conditions throughout a wide range of temperature, pressure, and humidity variations. The motor is suitable for radar antenna spin drives, as well as similar applications, particularly those requiring an r-f filter capable of meeting rigid interference specifications. Performance curves are included. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

New Microwave Components For 12.5 to 18.0 Kmc/s

New Frequency Meter for RG-91/U systems is a precision adjustable cavity for the TE₀₁ mode. Applied signal frequency is indicated by power reduction observed by a separate detector such as the MA-595.

Tuning plunger of polished invar is micrometer driven. Invar construction minimizes errors resulting from differences between calibration and ambient temperatures. Individual curves furnished with each meter permit calibrating accuracy of 0.1%.

Meter is mounted on a short section of waveguide. Input and output terminals are standard UG-541/U and UG-419/U connectors. Conducting surfaces are silver plated.

MODEL-582	FREQUENCY RANGE Kmc/s — 12.4 to 18.0
NOMINAL DIP—20%	APPROXIMATE LOADED Q—8000

A New Crystal Holder designed for use with the IN78 crystal over the frequency range 12.5 — 17.0 Kmc/s offers a VSWR of less than 1.80 over the specified range when terminated with a matched dummy crystal such as MA-594.

IF output is at a standard BNC type connector. The input is a standard choke flange. Holder is mounted on a short section of RG-91/U rectangular waveguide. Material is brass and conducting surfaces are silver plated.

MODEL-595	CONNECTORS UG-541/U; UG-89/U
VSWR max.—1.50	OUTPUT CAPACITY uuf—5

In addition to the above, complete specifications and drawings for more than 60 other components in the 3 to 75 Kmc/s range are described in our new Waveguide Component Catalog#55W. Send for complete specifications and prices.

Microwave Associates Inc., 33 Cummington St., Boston 15, Mass., Copley 7-7577

CIRCLE ED-334 ON READER-SERVICE CARD FOR MORE INFORMATION

VALPEY

Quartz Crystals

symbol of craftsmanship for over 23 years

Valpey-originated equipment for inspecting raw quartz. A special light source vividly shows visual flaws in crystalline structure; polarized light outlines optical twinning characteristics.

Only flaw-free quartz blanks are used for Valpey Crystals. Constant inspection during their manufacture insures custom-grade, precision crystals. From Valpey's large range of conventional and specialized crystals, there's a precision crystal for all applications from 40 Kc. to 100 Mc. Write for Bulletin FE-1.

Shown: Type VR-6 for general frequency control; range 1 to 100 megacycles.



VALPEY

1244 Highland Street
Holliston, Mass.

Crystal CORPORATION

Craftsmanship in Crystals since 1931

CIRCLE ED-335 ON READER-SERVICE CARD FOR MORE INFORMATION

Compact Electrical Reset Counter



Features
**INSTANTANEOUS
ELECTRICAL
RESET**

Four-tenths of a second is all the time required to reset this new electrical impulse counter to zero. And the voltage that does it may be different from the counting impulse voltage. This fact, plus the neat compact size (it measures only 1-3/8" x 2-3/8" x 4-3/8" and is suitable for flush mounting) explain why these new counters have become so popular with quality conscious designers.

They are fast, and power requirements are low: 1.4 to 2.5 W for 10 impulses/sec. models, and 5.9 to 8.4 W for 25 impulses/sec. models. Reset coils require 8.0 to 10.12 W.

It will pay you to investigate the SODECO line of electrical counters. Complete data is available.

LANDIS & GYR, Inc.

45 WEST 45TH STREET, NEW YORK 36, N. Y.

CIRCLE ED-336 ON READER-SERVICE CARD FOR MORE INFORMATION

TENSION GAUGE is PRE-SETTABLE



For GO/NO-GO Tests of Springs and Contact Pressures

Speedy, one-hand operation and precise calibration over a range of 4 to 2500 grams, with adjustable zero setting, are the important features of G. E. C. tension gauges. Designed for GO/NO-GO checking of spring tensions or other resistive forces, these gauges permit inspection or production testing by unskilled personnel.

To use this gauge: just preset the tension by turning the micrometer knob until the pointer shows the desired tension on the scale and apply the tip of the gauge-operating strip where force is to be checked. If the force being checked matches the gauge setting, the operating strip and the resisting element will move at the same time. Attention is focused on one point only—movement at the point of contact; there are no dials or scales to be read.

Six models are available, covering ranges of 4-24, 10-80, 50-250, 100-500, 200-1600, and 500-2500 grams. For detailed descriptive bulletin and prices, write: General Electric Company, Limited, c/o Imtra Corporation (U. S. Agents), 58 Charles Street, Cambridge, Massachusetts, U. S. A.

CIRCLE ED-337 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

Thermostats 338

This 2-color, 4-page bulletin (No. L-9070A) describes this company's line of thermostats for electronic and avionic devices, appliances, and apparatus. Hermetically sealed and semi-enclosed styles are covered. The bulletin gives the operating principle and illustrates it with a schematic diagram; it also includes performance data, ratings, dimensions, construction details, etc. Stevens Mfg. Co., Inc., 69 S. Walnut St., Mansfield, Ohio.

High-Frequency Generator 339

A high-frequency generator eliminates the need for a shielded room where dielectric heating devices are used by staying within the FCC-assigned 27Mc band. Two generators, rated 1 and 2kw, respectively, with accurately rated output and single dial selector for a complete range of sealing capacity, are described in this 2-page data sheet. Industro Corp., 50 Brook Rd., Needham Heights 94, Mass.

Instrument Components 340

Industrial automation, computer, and gunfire control systems and servomechanism components are described in a 4-page bulletin. Included are a grid plate system, remote control positioner, precision instrument differentials, high-speed magnetic clutches, ball-and-disc integrator, stock precision instrument gears, and low backlash servo motor gear heads. Instrument Components Inc., Div. of Belock Instrument Corp., 14-34 112th St., College Point 56, N. Y.

Vibration Damping 341

The 8-page design guide entitled "Motion Control by General Silentbloc" explains how vibration damping units can be designed and manufactured by this firm for specific applications, from instruments to giant punch presses. Numerous data are provided on a variety of types of damping devices, including mounts, bearings, bushings, and special devices. Industrial Products Div., General Tire & Rubber Co., Wabash, Ind.

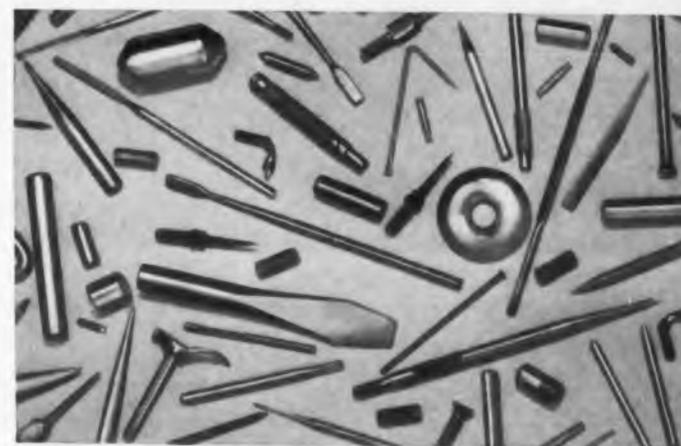
Nylon Washers 342

This 2-page bulletin describes the use and application of this firm's nylon thrust washers. The washers are the result of testing on fractional hp motors. Originally developed for such applications as record players, light power tools, etc., they are standard specifications for many other applications. Prices, sizes, and other data are provided. Cosmo Plastics Co., 3239 W. 14th St., Cleveland, Ohio.



When Close Tolerances
are Vital...

Call on **TORRINGTON** for
Your Small Precision Parts



When you want "precision," you can count on Torrington. Almost 90 years devoted to producing metal parts exactly to the tolerances specified by customers assures you parts exactly "as ordered."

What's more, Torrington can give you the temper, hardness and finish you want—in any quantity—faster, better and for less than you can produce them yourself. Send your blueprint or a sample part for our quotation. And ask for our Condensed Catalog, showing many types of parts on which you can save.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street, Torrington, Conn.

TORRINGTON SPECIAL METAL PARTS

Makers of
Torrington
Needle Bearings



CIRCLE ED-343 ON READER-SERVICE CARD FOR MORE INFORMATION

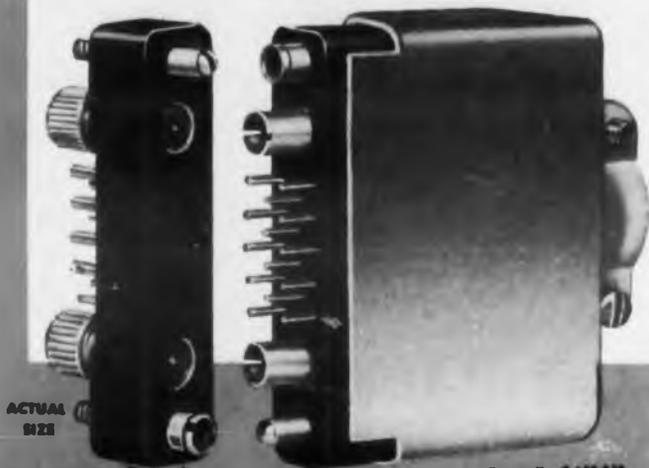
WINCHESTER ELECTRONICS, INC.

NEW!
MRX 14-2

MINIATURE CONNECTOR WITH COAXIAL CONTACTS

FOR AIRCRAFT, INSTRUMENTS, PORTABLE EQUIPMENT

Compact — Lightweight — Polarized



Receptacle
MRX 14-2S-G

Plug
MRX 14-2P-G

This special dual-purpose connector contains 14 miniature (5-amp) contacts and two general purpose coaxial contacts. The coaxial contacts have a nominal impedance of 53 ohms and are designed for RG-58, U or similar cable diameters. For low RF loss, Teflon is used as the coaxial dielectric.

Bodies are mineral filled MELAMINE for high arc resistance, high dielectric and mechanical strength. Contacts are all precision machined, gold plated over silver... for low contact resistance, corrosion prevention and soldering ease.

For complete information on all connector designs and problems . . . write or telephone

"The undeniable, and unequalled, best."

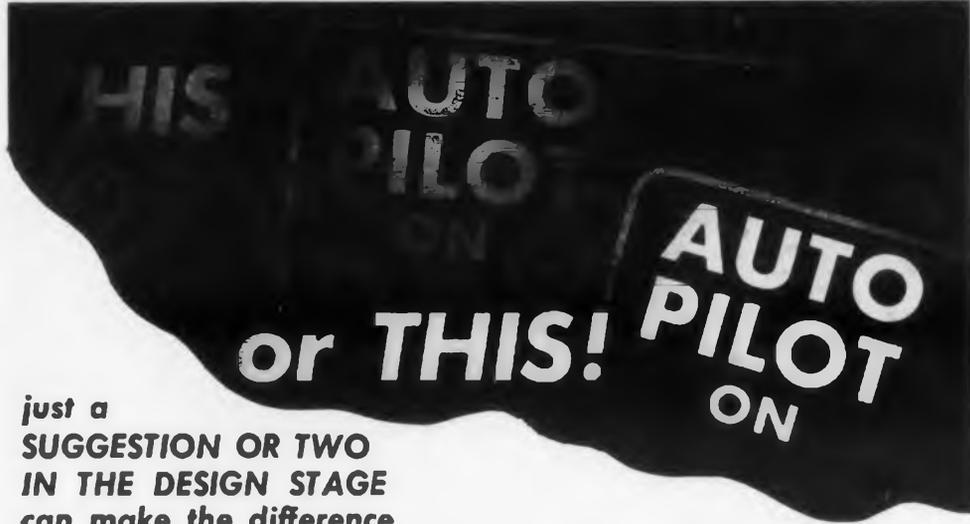
WINCHESTER ELECTRONICS, Inc. PRODUCTS and DESIGNS ARE AVAILABLE ONLY FROM WINCHESTER ELECTRONICS, Inc.

WINCHESTER ELECTRONICS
INCORPORATED

NORWALK, CONNECTICUT

West Coast Branch: 1729 Wilshire Blvd., Santa Monica, California

CIRCLE ED-344 ON READER-SERVICE CARD FOR MORE INFORMATION



just a **SUGGESTION OR TWO IN THE DESIGN STAGE** can make the difference

Production difficulties can usually be resolved in the design stage. Flexibility in the location of a light hole, the possibility of a slight relocation of a letter, word or legend, the introduction of a special light diffuser, or carrier, can make the difference between a uniform, well lighted unit or a unit which just falls within specification limits.

Our plants are completely equipped and staffed by experienced engineers trained to produce to the exacting requirements of specification MIL-P-7788, or any special requirement your particular application may demand.

your problems should be our problems in
**EDGE-LIGHTED
PANELS and DIALS**

If there is any question about it—just ask!



UNITED STATES RADIUM CORPORATION

Executive and Sales Offices - 535 Pearl Street, New York 7, N. Y.

Plants and Laboratories at: Bloomsburg, Pa., Bernardsville, N. J.

Whippany, N. J., North Hollywood, Cal.

CIRCLE ED-345 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Metals 346

Technical Data Sheet No. PMS-24 gives a typical analysis and the prices of "Plast-Iron" in the form of high purity electrolytic iron melting stock. A small sample is attached to the sheet. Also available are sheets 28A and 28B, which give the chemical and physical characteristics of "Plast-Iron" B-212, a reduced-oxide iron powder designed specially for compacting parts requiring high tensile or transverse strength. National Radiator Co., Johnstown, Pa.

Aluminum Chassis 347

The "SeeZak Expandable Chassis" is illustrated and described in a 4-page catalog. This design is made from a number of standard parts which permit the user to build chassis to meet a wide variety of radio and electronic needs. Numerous types of panels, rails, connectors, couplers, and other basic components are covered, and a price list is included. Also available is a 2-page bulletin on the "SeeZak Circuit Assembler" which uses a variety of simple parts to simplify breadboard problems. U. M. & F. Manufacturing Corp., 10929 Vanowen St., N. Hollywood, Calif.

Black Light 377

"Ultra Violet Black Light, the Newest Medium of Science" is the title of a 16-page brochure. The object of the publication is to provide factual information and answers to many specific questions on applications and uses of ultra violet black light. It includes numerous charts and many data about the subject, including uses and potentialities in research, scientific laboratories, industrial production, and inspection. Burton Manufacturing Co., 11201 W. Pico Blvd., Los Angeles 64, Calif.

Motor-Generator Sets 378

A 6-page, 2-color brochure (No. P 400-54) describes and illustrates a new line of "Precise Output" 400cy M-G sets. Units are 2-bearing, common shaft, synchronous driven, 40-pole alternator M-G sets (1200 rpm) with magnetic amplifier controls, in ratings from 5kw to 100kw. The brochure presents detailed specifications and covers voltage regulation, output wave form, performance characteristics, applications, and construction. Palmer Electric Manufacturing Co., Subsidiary of Leach Corp., 6629 Bear Ave., Bell, Calif.

Laminating Compounds 348

Typical formulations and methods of processing laminates from liquid polymer/liquid epoxy resins are presented in an 8-page booklet. It gives starting information on the formulation of binders for laminates from combinations of liquid polymers with several liquid epoxy resins by wet lay-up methods. Fiber glass laminates of this type are characterized by improved flexibility, improved impact strength, reduced voids and bubbles, lower shrinkage during cure, and improved mold release. Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J.

Regulated Power Supplies 349

Complete information on magnetic amplifier-selenium rectifier regulated d-c power supplies is provided in 4-page Bulletin No. 8000. Included are photographs of the equipment; a description of its design, operation, and application; and complete electrical and dimensional data on all models, in a range of ratings from 5kw to 50kw. Electric Div., Vickers, Inc., St. Louis 3, Mo.

Cast Stainless Alloys 379

A set of data sheets covers the properties of all the more popular grades of alloys used for corrosion resistant (stainless steel) castings. Consisting of 13 individual data sheets describing each of the cast corrosion resistant alloy grades, the complete set is bound in a folder. Each sheet lists chemical compositions, physical properties, mechanical properties, and includes a discussion of design considerations, metallurgical structure and characteristics, and preferred heat treatments. The general industrial fields of applications are listed, together with the various corrosives in which each grade has been successfully employed. Alloy Casting Institute, 32 3rd Ave., Mineola, N. Y.

Toroid Coils 380

This 4-page Bulletin (No. STP) supplies complete technical data, including general characteristics, specification charts, and standard case styles, for this firm's toroid coils. The coils are available in three forms; uncased, cased, and type "p" plastic encapsulated. Hycor Company, Inc., 11423 Vanowen St., N. Hollywood, Calif.

48

of
ner/
an
erma-
for
quid
sins
lam-
by
pact
ower
hold
D N.

Industrial Tubes

"Industrial Tube Characteristics", a 24-page publication, discusses over 450 industrial types comprising 17 distinct tube classes, ranging from reliable subminiature and miniature tubes to transistors—providing full technical data and basing information. Since the last edition, 75 new types have been added, including a section covering gold-bonded germanium diodes and pencil tubes. Receiving Tube Div., Raytheon Mfg. Co., Newton 58, Mass.

349

am-
d-e
Bul-
aphs
s de-
com-
a on
5kw
, St.

Shock, Vibration Control 352

The "Product Digest" is a 4-page illustrated brochure with brief descriptions of this company's product line. Standard isolators in the brochure include miniature mounts for electronic gear in aircraft, shock mounts for mobile and shipboard packaging, and leveling mounts which incorporate mobility features with vibration isolation for metalworking machinery. The brochure also lists technical articles on various aspects of shock and vibration. Barry Corp., 1000 Pleasant St., Watertown, Mass.

379

oper-
of al-
nless
idual
cor-
plete
lists
rties,
a dis-
allur-
and
al in-
isted,
es in
sfully
2 3rd

380

pplies
eneral
and
toroid
three
plas-
Inc.,
alif.

y 1955

351

Engineering Service

353

An 8-page facilities brochure describes the ability of this firm to perform services in engineering, research and development, machine and product design, manufacturing methods and tool design, drafting, technical publications, and special technical and statistical services. The company maintains its own laboratory and also has available as consultants the faculty and graduate students of the Newark College of Engineering, as well as the laboratory facilities of the college. Desco, 50 Broad St., New York 4, N. Y.

Wire and Cable

354

Miniature and sub-miniature plastic insulated wire and cable are described in this 20-page, 2-color catalog. Wires are available with "Teflon", lacquered nylon over shielded "Teflon", thermoplastic, plain nylon, textile braid, and other coverings. Many data on properties are provided. Also described are a variety of wire kits. Tensolite Insulated Wire Co., Inc., Tarrytown, N. Y.

NOW...
100% MICROSCOPICALLY
INSPECTED
GROUND SEAL
TUNGSTEN ROD

other
ELECTRONIC
PARTS
QUALITY
TUNGSTEN &
MOLYBDENUM
COMPONENTS
include:
● "PRECISION" LEADS
● HAND WOUND COILS
● SUPPORT WIRE & ROD
● CUT AND BEVELLED
PIECES
● ELECTRODES
● MACHINED TUBE
PARTS

Now you can get ground seal rod, and cut pieces of tungsten to Electronics Parts' high standards — precision fabricated and 100% microscopically inspected for cracks and similar flaws to assure lowering of your production costs.

Send your prints or "specs" for a money-saving quotation. *Do it now!*



ELECTRONIC PARTS MANUFACTURING CO., Inc.

508-10 25th STREET • UNION CITY, N. J.

CIRCLE ED-355 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

*Output from this rugged
Genisco Accelerometer*

(GLH MODELS)

**is measured in volts
... not millivolts!**

*minimizes
need for
amplifying
devices!*



**IMPORTANT
GLH PERFORMANCE
CHARACTERISTICS**

Damping Factor: Instruments up to ± 7.5 G's inclusive can be damped .4 to .6 critical; ± 7.5 G's to ± 10 G incl. .35 to .55 critical; above 10 G's .3 to .5 critical.

Range: ± 2 G's to ± 30 G's; zero acceleration at midpoint.

Natural Frequencies: 6 to 23 cps. (depending upon range).

Potentiometer Resistance: From 1000 to 10,000.

Resolution: Normally from .25 to .3%, depending upon resistance requirements.

Steady State Acceleration: Can withstand 75 G's in all planes without damage; somewhat less along sensitive axis in low range units.

Linearity: $\pm 0.5\%$ of best straight line through calibration points.

Resistance to shock: 40 G's in any lateral direction; shock loads in 2 directions, equal to range, without damage.

Crosstalk error: Less than 1% change caused by lateral acceleration equivalent to total range of instrument.

Weight: 2 to 2 $\frac{1}{4}$ lbs., depending on "G" range.

Overall Physical Size: 3 $\frac{1}{4}$ " x 3 $\frac{1}{8}$ " x 2 $\frac{5}{8}$ "

Static Friction: .075 G max. up to and including ± 7.5 G's.
0.5% full scale output above ± 7.5 G's.

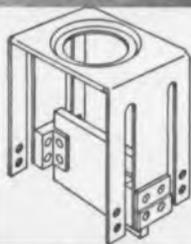
(special modifications for higher natural frequencies and greater damping can be supplied.)

**A precision built potentiometer
is the secret behind the high output
of Genisco's GLH Accelerometer**

As much as 50 volts can be put across the potentiometer of the standard GLH, and up to 72 volts on special models. Since the wiper scans the full voltage range, use of the GLH eliminates the need for amplifying devices in many guided missile control and flight test applications.

Keeping the resistance winding free from foreign materials during assembly, careful adjustment of the wiper pressure to precise tolerances, and hermetic sealing of the instrument in inert gas result in electrical output noise so low it can be considered negligible—over a life span in excess of 4 million cycles.

Complete specifications and prices on the GLH are available from Genisco, Inc., 2233 Federal Ave., Los Angeles 64, California. Write today.



A parallelogram suspension confines the mass of the GLH to a virtual straight line motion and provides excellent lateral rigidity.

Genisco
INCORPORATED

Other accelerometer models also available!

Write today for information on Genisco's new CMO miniature potentiometer-type accelerometer (weighs only 7 ounces), the new tapped-potentiometer-type accelerometers, and the new DDL Dual-Damped (oil and magnet) accelerometers. Prompt deliveries on all models.

CIRCLE ED-356 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRIC OVEN - Only

\$89⁵⁰

F.O.B. Chicago

GRIEVE-HENDRY
PORTABLE
ELECTRIC
OVEN

FOR
PRODUCTION
OR
LABORATORY
USE



Model CR-1
10 cu. ft. capacity—30" wide x 25" deep x 24" high. Removable shelves and drip pan.

Quick Quotations
—Prompt Delivery—Reasonable Prices—on Ovens made to your specifications.

Portable. Adjustable temperature control to 225°F. Fan driven forced air circulation. Uniform temperature throughout. Plugs into any 110V wall outlet—no special wiring required. Can be used in a group or bank.

Other standard models with temperature ranges to 1000°F available.

Write for literature.

GRIEVE-HENDRY CO., INC.

Export Dept. 306 W. Washington Blvd., Chicago 6, Illinois
1419 W. Carroll Ave., Chicago 7, Ill.

CIRCLE ED-248 ON READER-SERVICE CARD FOR MORE INFORMATION



Get This Informative Free Booklet on New Uses for Straits Tin

New, 20-page booklet tells important story of Straits Tin and its many new uses today. Fully illustrated. Includes sections on new tin alloys, new tin solders, new tin chemicals. Covers tin resources and supply, Malayan mining. Booklet is factual, informative—could well prove profitable to you. Mail coupon now.

THE MALAYAN TIN BUREAU

Dept. C. 1028 Connecticut Ave., Washington 6, D.C.

Please send me a copy of your free booklet on new uses for Straits Tin.

Name _____
Firm Name _____
Street _____
City _____ Zone _____ State _____

CIRCLE ED-249 ON READER-SERVICE CARD FOR MORE INFORMATION

104

Crystal Diodes 242

The 2nd edition of this guide attempts to list all crystal diodes, regardless of make. It includes 185 types of which 95 are new, 18 dimensional drawings, and all pertinent data. CBS-Hytron, 100 Endicott St., Danvers, Mass.

Stepping Relays 243

This 12-page bulletin (No. P-84) contains illustrations, dimensional drawings, technical chart data, and general informative copy featuring 12 types of stepping relays. It includes midget, high speed, vibration resistant, and interlock types. Guardian Electric Manufacturing Co., 1621 W. Walnut St., Chicago 12, Ill.

Rubber and Plastics 244

A 16-page, 2-color brochure, "From Plans to Products in Plastics and Rubber," describes the complete design-development-production package program offered by this company's industrial products division. It deals with molded and extruded rubber, extruded plastics, rubber-to-metal bonded parts, vibration and shock control units, and plastics-reinforced fiber glass parts. Industrial Products Div., The General Tire & Rubber Co., Wabash, Ind.

Write today for your free copy of this Technical Paper.

ask for data file

107

Characteristics of Precision Servo Computer Potentiometers

BY D. C. DUNCAN
General Manager, Helipot Corporation

Presented at A.I.E.E. CONFERENCE ON
FEEDBACK CONTROL SYSTEMS

388

Helipot first in precision potentiometers

Helipot Corporation / South Pasadena, California

a division of BECKMAN INSTRUMENTS, INC.



CIRCLE ED-245 ON READER-SERVICE CARD FOR MORE INFORMATION

Need a complete complement* of High Voltage Capacitors for developmental color TV?

Leaders for over two years in experimentation with component parts for color TV, Jeffers Electronics has developed this first complete complement of high-voltage capacitors.

Drawings and additional technical information furnished on request. Complete kits of high-voltage capacitors listed below available at nominal cost.

Each kit includes the following units:

No. per kit	Capacity	Voltage Rating
1	10,000 MMFD	6KV
1	2,000 MMFD	30KV
1	500 MMFD	30KV
2	1,000 MMFD	10KV
3	1,200 MMFD	15KV

*Typical quantities proposed

Other Divisions: Speer Resistor International Graphite & Electrode



CIRCLE ED-252 ON READER-SERVICE CARD FOR MORE INFORMATION



OUT OF AN IBM BUSINESS MACHINE POPS THIS TUBING IDEA FOR YOU

This is the contact roll of an IBM Collator—which performs electronic sleight-of-hand with 240 punched cards per minute! Steel fingers that sort the cards give the roll a high-speed workout. And it must resist corrosion and be a good electrical conductor. IBM employs Superior WELDRAWN* Beryllium Copper and low carbon steel composite tubing for the roll because it meets tight specifications for wear resistance, peak hardness and conductivity. Chances are this tubing—or one of our more than 55 other analyses—will meet your requirements for equally critical applications. Send for free Technical Bulletin #7-2 and tell us about your tubing needs.

*Reg. U.S. Pat. Off.

All analyses .010" to 3/4" O.D.
Certain analyses in light walls up to 2 1/2" O.D.

SUPERIOR TUBE COMPANY
2050 Germantown Ave., Norristown, Pa.

Superior Tube
THE BIG NAME IN SMALL TUBING

CIRCLE ED-253 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

INSURE
Proven Quality

with **JONES**
PLUGS
AND
SOCKETS

Plug, Cable Clamp Jones Series 300 illustrated. S-306-AB
P-306-CCT Small Plugs & Sockets for 1001 Socket with
in Cap. Uses. Cap or panel mounting. Angle Brackets.

- Knife-switch socket contacts phosphor bronze, cadmium plated.
- Bar type Plug contacts brass, cadmium plated, with cross section of 5/32" by 3/64".
- Insulation molded bakelite.
- All Plugs and Sockets polarized.
- Metal Caps, with formed fibre linings.
- Made in two to 33 contacts.
- For 45 volts, 5 amperes. Efficient at much higher ratings where circuit characteristics permit.

Ask for Jones Catalog No. 20 showing complete line of Electrical Connecting Devices, Plugs, Sockets, Terminal Strips. Write or wire today.



HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

CIRCLE ED-119 ON READER-SERVICE CARD FOR MORE INFORMATION

Every User
of
SOLDERING
LUGS
•
TERMINALS
•
SMALL
STAMPINGS



CAN PROFIT through MALCO'S
Low Cost, Quantity Production

We manufacture a complete line of standard and custom-made solder and solderless lugs, terminals, corona rings, and small stampings for radio, television, industrial and military electrical/electronic use.

Precision tooling and rigid quality control insures tolerances to your most critical specifications. High production techniques, plus over 1000 different standard parts permit prompt delivery at lowest possible unit cost.

Let us know your requirements.
Request our new 38-page
convenient reference catalog.



Malco TOOL and MANUFACTURING CO.
4027 W. LAKE ST., • CHICAGO 24, ILLINOIS

CIRCLE ED-120 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

Toroidal Inductors 121

Two types of precision-wound toroidal inductors are listed in a 4-page Bulletin No. TL2-P4. Both types are available in six different sizes with various Q's and inductance ranges. One coil type is wound on "Carbonyl" iron cores for high frequency applications, the other is wound on Molybdenum-Permalloy cores for low frequency applications. Q curves, dimensions, and other data fully describing each type of coil are included. All coils are specially wound to within 1% of specified inductance value. Lenkurt Electric Sales Co., 1109 County Rd., San Carlos, Calif.

Transformers 122

This 32-page catalog (No. CT-554) contains detailed descriptions of over 500 "Sealed-in-Steel" stock transformers for military, new equipment, general replacement, and power and control circuit applications. A simplified classification system makes it easy to locate any particular unit, and the dimensions of all cased units are shown diagrammatically. Almost 100 new units are listed, including many not previously available as stock units. These include Military Standard transformers, hermetically sealed 400cy types, and molded toroidal inductors. Chicago Standard Transformer Corp., 3501 Addison St., Chicago 18, Ill.

Investment Casting 123

An 8-page color brochure presents the complete story of the uses and advantages of a frozen mercury process for producing larger and more complex precision castings. Step-by-step action photographs of the process, plus numerous pictures of finished parts are provided. Engineering drawings and charts are also included. A section is devoted to basic problems of producing complex and exacting parts which were solved by the process with accompanying cost savings and increased design and operating efficiency. Mercast Corp., 295 Madison Ave., New York 17, N. Y.

Charts 124

"Charts for Recording Instruments" is a 44-page current stock list of over 8000 circular, strip, and rectangular charts. Charts are available for approximately 100 makes of recording instruments. Technical Charts, Inc., 189 Van Rensselaer St., Buffalo 10, N. Y.

Delay Lines 125

This 12-page general catalog (No. 54) provides illustrations, descriptions, and technical data covering this company's lumped constant, distributed constant and ultrasonic delay lines. Richard D. Brew & Co., Inc., Airport Rd., Concord, N. H.

TRANSFORMERS . . .

. . . specified for the usual
. . . demanded for the
unusual



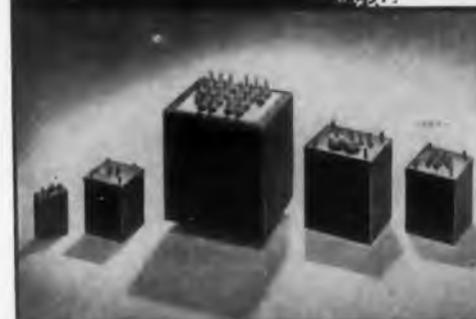
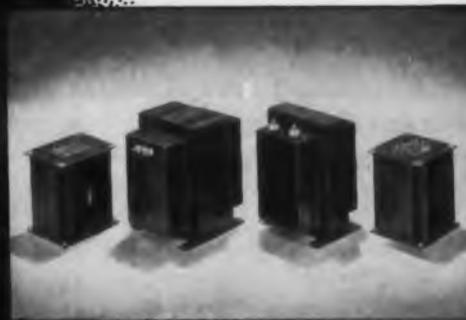
"GTC" Transformers for television receiver applications . . . custom designed for high quality at minimum cost.



NEW Complete Catalog Now Available . . .
easy specifying of custom requirements. Your quick approach to

"GTC" Transformers for industrial and commercial applications . . . accurately engineered and fully recognized for finest quality.

Manufacturers specify "GTC" . . . for audio uses, communication, radar devices, test equipment, transmitters, and various other electronic controlled devices.



"GTC" Military Transformers . . . designed to meet rigid government specifications and to perform under the most severe and continuous operating conditions. MIL-T-27 and JAN-T-27.

Skilled engineering techniques make GTC a source for transformers in highly specialized and extremely unusual applications. Utilization of these techniques results in greater dependability, quality and better construction.

Our completely self-contained plant's modern equipment guarantees transformer production in any quantity, to meet your requirements. We welcome your inquiry and will supply production samples where desired.



GENERAL
TRANSFORMER COMPANY

serving industry since 1928

18240 Harwood Avenue, Homewood, Illinois
(Suburb of Chicago)

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

New 300-watt Vitrohm ring rheostat with exclusive "twin-shoes"



Ward Leonard's exclusive sintered self-lubricating twin-shoe construction insures uniform contact pressure, plus unusually smooth and trouble-free operation.

Other features of the new 6" Vitrohm ring rheostat eliminate backlash, insure contact pressure, prevent arm over-travel or radial motion. It takes less back-of-panel space, too.

Write for Bulletin 1116, Ward Leonard Electric Company, 77 South St., Mount Vernon, N.Y. 4.13



CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

designed for application . . . where size, sensitivity—low and high temperatures are a major factor.

pacific
sub-miniature
relays
"CPL" series
available in
SPDT / DPDT



TYPICAL SPECIFICATIONS

CONTACTS: 5 amps. resistive @ 28 V. D.C. or 115 V. A.C., 60 C.P.S., 3 amp. inductive @ 28 V. D.C.

Manufactured in accordance with spec. MIL-R-5757B. Satisfies test requirements of spec. MIL-R-6106A with the exception of overload, rupture and contact drop.

AMBIENT TEMPERATURE: 65° C. To +125° C.

LIFE @ RATED LOAD: 50,000 cycles min.

WEIGHT: .08 lb. max. (1.25 oz.)



write for catalog

pacific relays, inc.

6819 MELROSE AVE. • LOS ANGELES 38, CALIFORNIA

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo System

115

A 4-page technical reference bulletin (No. 54B) pictures and fully describes a recently developed servo-mechanism system. Components of this system are a synchro-mechanism control transformer (balancing synchro), servo amplifier, and servo motor. Listed are 10 new uses for the system; these include non-weighing or general processing applications, as well as weighing operations. Information is also included on how remote recorders and tape printers may be hooked up and synchronized with servo units. Richardson Seale Co., Van Houten Ave., Clifton, N. J.

Framing Cameras

116

Two models of High-Speed Framing Cameras are described in a 4-page bulletin (Form 189). Designed for engineering and research studies of combustion, corona-discharge, explosions, plastic and elastic deformation, and shock-wave phenomena. The cameras are capable respectively of 1.2 million and 2.4 million frames per second, total number of frames in each case being 25. Included are typical photographs, descriptive material covering the overall operation of the cameras, details of the optical system, special features of the equipment and its remote control facilities, an overall schematic view of the complete camera system, and specifications. Beckman & Whitley, Inc., 1085 E. San Carlos Ave., San Carlos, Calif.

Quality Control

"Quality Control and Research—insure your product in tomorrow's market" is the title of this 24-page booklet which is concerned with the establishment and operation of quality control and research laboratories in small businesses. A major section of the booklet is devoted to answering questions for the executive about the transition from previous methods to scientific quality control. Price: \$0.25. Write directly to Scientific Apparatus Makers Association, 20 N. Wacker Drive, Chicago 6, Ill.

Electronic Components

117

This 2-color pamphlet illustrates this company's line of precision electronic components. Included are meters, transmitters, inductors, turrets, rotary coils, capacitors, etc. Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa.

Scaler, Counter

118

"Decimatic" scalars and decimal counting units are described in these technical data sheets. Block diagrams and charts of specifications are provided. Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond Calif.

here's new might for miniatures

Dur-Mica DM15
WORLD'S SMALLEST MICA CAPACITOR



THE FIRST MINIATURE DIPPED MICA CAPACITORS WITH PARALLEL LEADS.

IDEAL FOR PRINTED CIRCUITS — Meets all Humidity, Temperature and Electrical Requirements of MIL-C-5 Specifications. El Menco's Dur-Mica DM15 establishes a "new dimension" in capacitor performance with ranges from 1 to 390 mmf. at 500vDCw and 1 to 510 mmf. at 300vDCw. A new, tougher phenolic casing provides temperature co-efficient and stability equal to or better than characteristic F. in all but the lowest capacity values . . . efficient operation at temperatures as high as 125°C. El Menco's Dur-Mica DM15 can be used in a variety of transistor circuits and other miniature electronic equipment in military and civilian applications. Sells for Less than the famous El Menco CM-15 — Provides Economy of Size with Maximum Performance and Widest Application.

(Shown Actual Size)

NOW!
ALSO AVAILABLE
EL MENCO Dur-Mica DM20
1 to 3900 mmf. at 500vDCw —
1 to 5100 mmf. at 300vDCw.

TEST EL MENCO "Dur-Micas" FOR YOURSELF!

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

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC

CONNECTICUT

molded mica • mica trimmer
tubular paper • ceramic

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

CIRCLE ED-114 ON READER-SERVICE CARD FOR MORE INFORMATION

Metron MINIATURE components
for **VARIABLE SPEED**
in **SMALL SPACE**



now in use

in countless precision devices where continuously variable speed is required... If small space and variable speed is your problem, investigate Metron Miniature Variable Speed Drives TODAY!

- ▶ Extremely small
- ▶ Up to .025 HP and 10,000 RPM
- ▶ Choice of 6 speed controls
- ▶ Complete, ready-to-go
- ▶ Compact, adaptable
- ▶ Quick delivery

Write for Bulletin 99 for details...



Metron INSTRUMENT COMPANY
450 Lincoln St., Denver 3, Colo.

CIRCLE ED-254 ON READER-SERVICE CARD FOR MORE INFORMATION

This fastener works through thick and thin!



Spring-Lock works whether panel thicknesses run over or under specifications! Spring wire deflects automatically to handle greater or lesser thicknesses. Spring-Lock's design flexibility makes it more than a fastener: it can be adapted as a shelf support, door strike, knob or any similar panel-mounted device. Many standard shapes and sizes of Simmons Spring-Locks are available from stock.

HERE'S HOW SPRING-LOCK WORKS



1. Insert fastener. 2. Half-turn to lock.

- Installation is **BLIND**
- Installation is **EASY**: no special tools are needed
- Installation is **QUICK**: a half-turn locks it in place
- Installation is **SECURE**: the spring steel locks the fastener, resists vibration

Send for details and samples, or write us about your fastening problem.

SIMMONS FASTENER CORPORATION
1763 North Broadway, Albany 1, N. Y.
Spring-Lock • Quick-Lock • Roto-Lock

CIRCLE ED-255 ON READER-SERVICE CARD FOR MORE INFORMATION

Line Support Clamps; Busbars 413

Engineering Manual No. 201G covers this firm's complete line of 40,000 types and sizes of bare metal and cushioned or insulated line support clamps, wire harness clamps, and multiple support clamps. It also covers related items manufactured, including brackets, busbars, and laminated anchor nut or reinforcing slims. The manual contains 68 loose-leaf pages which are plastic bound. It gives 112 detailed prints and complete specifications covering materials and finishes in aluminum, steel, and stainless steel. A special 2-page chart tabulates design data and specifications of 16 cushioning materials available for cushion clamps. Thomas Associates, 4607 Alger St., Los Angeles 39, Calif.

Glass Products 414

The 34-page catalog (No. NP-54) of glass products for the electronics industry includes descriptive and application information for fixed glass dielectric and trimmer capacitors; accurate grade, high temperature, power, and high frequency resistors; and other components made of glass. Also included is descriptive material covering new compositions and production methods in glass, such as glass-to-metal seals, soldering metal to glass, photosensitive glass, and fused silica. Corning Glass Works, Corning, N. Y.

TEST THEM FREE!
SEND FOR YOUR SAMPLE KIT OF
SHAKEPROOF LOCK WASHERS
T.M. REG. U.S. PAT. OFF.
Only **SHAKEPROOF** Lock Washers give you the powerful, positive locking action of tapered-twisted teeth. They actually bite deeper as vibration increases! A complete line of standard types and sizes meets nearly every fastening need.

WRITE FOR FREE
SAMPLE KIT TODAY

SHAKEPROOF
"Fastening Headquarters"
DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois
Offices in principal cities

CIRCLE ED-257 ON READER-SERVICE CARD FOR MORE INFORMATION



Yes, it's been a hard pull but it looks like we'll finally make it over the hump. When we asked for your cords and cord set business we had no idea of the carloads of orders you would send our way. All the facilities of Cords, Ltd. were swamped. But by really pouring the coal on... working nights and Sundays... we have supplied all our customers with enough cords to meet all production schedules. No customer of Cords, large or small, has had to shut down a minute because of us. Now we are rapidly getting things under control. In the meantime all your inquiries will receive immediate attention and Cords will soon be able to make deliveries in full right on time.



CORDS LIMITED
DIVISION ESSEX WIRE CORPORATION
121 DODGE STREET, DEKALB, ILLINOIS

CIRCLE ED-258 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature and sub-miniature



multiple contact

CANNON PLUGS

DPM-14

for diminutive applications

Turn to Cannon when you want midget connectors! Type DPM-14 illustrated has 2 (10 amp.) No. 16 and 12 (5 amp.) No. 20 brass contacts. Entire assembly only 3/4" x 2". Similar unit, Type DPM-A20 has 2 No. 16 and 18 No. 20 contacts. Ideal for rack, panel, and instrument applications.

You get positive contact, rugged, rectangular mounting assembly, Cannon high quality performance, with or without shell support. Types D, U, and miniature K's... all in extremely small space.

Write TODAY for Bulletins covering all the lines of Cannon Miniature and Sub-Miniature Connectors. **CANNON ELECTRIC COMPANY**, 3209 Humboldt Street, Los Angeles, California. • Factories in Los Angeles; New Haven; Toronto, Canada; London, England. Representatives and distributors in all principal cities.

Refer to Dept. 143

CANNON ELECTRIC Since 1915



CIRCLE ED-259 ON READER-SERVICE CARD FOR MORE INFORMATION

MINIATURE

Magnetic Servo Amplifier
Size: 1 Cu. Inch — Weight: 50 Gr.

Here's the perfect miniature magnetic amplifier, designed by Atlas engineers to match the Oster Company, 18V, 400 cycle, 2 phase servo motor type 2 ET-123 Model 2. The SA-427 occupies only 1 cubic inch of space; weighs but 50 grams. It is available with either a high impedance control winding to work with a vacuum tube pre-amplifier, or a low impedance control winding to operate with a transistor pre-amplifier. The Atlas SA-427 has a gain of 1,000 and a response time of less than one-and-one-half cycles of supply frequency. **FREE FOLDER . . . contains complete electrical and mechanical specifications. Write today for Booklet SA-427.**

ATLAS ATLAS ENGINEERING CO., Inc.
3 EDGEWOOD ST., ROXBURY, MASS.

In Canada
CANADIAN ATLAS TRANSFORMER CO. LTD., 17 CARLAW STREET, TORONTO, CANADA

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION

NEWLY-
DEVELOPED
Sub Miniature
Type 10
H-SERIES

hermetically sealed resistors

The "H" Series Precision Resistors are encapsulated in a tough plastic compound. The result is a solid, homogeneous unit with unparalleled ruggedness, impervious to the effects of moisture, thermal shock and mechanical shock. The plastic is filled with heat conducting mineral which dissipates the heat and equalizes the "hot spots" in the resistor winding. The sealed-in terminal connections are welded.

SPECIFICATIONS:

MILITARY SPECIFICATIONS:
Performance characteristics satisfy all requirements of MIL-R-93A & JAN-R-93.
TEMPERATURE COEFFICIENT: $\pm 0.0022\%$ per degree C.
OPERATING TEMPERATURE:
-65°C. to +125°C.
RESISTANCE ACCURACY:
Standard resistance tolerances are 1%, 0.5%, 0.25% and 0.1%.
TYPE 10 (illustrated):
1/4" dia. x 1/2" long.
Resistance range: 1.0 ohm — 0.35 meg.

Send for Bulletin H for complete description on other physical sizes and wattage ranges.

11423 Vanowen St., North Hollywood 4, Calif.

HYCOR
Company, Inc.

CIRCLE ED-137 ON READER-SERVICE CARD FOR MORE INFORMATION

Electroplating

133

Technical data sheets on electroplated gold, rhodium, palladium, and platinum provide physical, thermal, chemical, and electrical properties, electroplating specifications, thickness requirements, and applications. Charts and prices are included. Technic Inc., 39 Snow St., Providence 1, R. I.

Servo System Components

134

Data sheet No. 10.20-3b describes the Brown Electronik servo systems and components, amplifiers, d-c to a-c converters, 2-phase reversible balancing motors, and the new high impedance input amplifier. Graphs of amplifier input vs speed for constant torque, charts of balancing motor specifications, and typical servo component combinations are included. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Etched Circuits

135

This data sheet shows this company's facilities for the design, screening, plating, and soldering of etched circuits. Manufacturing processes and applications are illustrated. Hico Instruments Div., Hastings Instrument Co., Warwick, Va.

Where **SHOCK** and **VIBRATION**
are a Problem . . .

ENGINEERS CHOOSE
the rugged *Phil-trol*
27
RELAY

For
AVIATION
and
ELECTRONIC
INDUSTRIES

TYPE 27QA — 3 POLE
Patent No. 2,405,319



Proved performance of Phil-trol 27 Relays in many vitally important applications has built great demand for this sturdy, sensitive and highly efficient relay. For instance, they are used for: propeller pitch control . . . cabin pressure and temperature control . . . guided missiles . . . computers . . . communication equipment . . . and many other electronic devices.

Phil-trol 27 Relays have unusual features like two-coil construction, which allows greater operating force for a given power input, and also completely eliminates magnetizing force losses at the armature hinge. The rigid frame and balanced armature design provides stability under conditions of high acceleration, severe vibration or shock.

For complete details on all of the many Phil-trol Relays available, write for the new Catalog.

Phil-trol Type 27 Relays are available in 1, 2, 3, 4 or 5 pole, single or double throw. Operating voltage up to 230 D.C., resistance up to 13,400 ohms, minimum operating current is .001 amps. Available enclosed in dust cover or hermetically sealed.

Phil-trol
IS THE REGISTERED TRADEMARK OF
PHILLIPS CONTROL CORP.
Dept. ED
JOLIET, ILLINOIS
A THORN CORPORATION SUBSIDIARY
OFFICES IN ALL PRINCIPAL CITIES

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

Special Purpose WIRE

**BERYLLIUM
COPPER**
Silvercote®

titanium

phosphor bronze

ALUMINUM

OTHER NON-FERROUS

Consider WIRE and the importance of its function in your product. Whether a highly engineered application or a simple stapling purpose, your choice of the proper alloy or composition, temper and type of wire could mean success or failure during crucial test.

round • flat — square ■ half-round —
Precision gauges from 1/8 to .002. Close tolerances held.

**SPRING WIRE — WIRE FOR INSTRUMENTS
ELECTRONICS — STRAND FOR WIRE ROPE AND
BRAIDED APPLICATIONS — MANDREL WIRE
WIRE FOR FORMS — RIVETS — STAPLING**
Send for descriptive folder.



LITTLE FALLS ALLOYS
INCORPORATED
195 Caldwell Avenue • Paterson 1, N. J.

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

Another **FLASH-O-LENS** at work
... checking pigment dispersion at
B. F. Goodrich



The inspection tool that *lights* and *magnifies*—FLASH-O-LENS—is in daily use at The B. F. Goodrich Company in making laboratory checks on the dispersion of pigments in milled rubber stocks.

The built-in bulb of a FLASH-O-LENS brightly illuminates the inspection area—the accurately ground lenses give sharp, detailed enlargement. Result: quick, simple inspection!

Battery and plug-in models from \$10.95. Write for free literature on applications, types, prices.

E. W. PIKE & COMPANY
492 NORTH AVENUE ELIZABETH 3, N. J.
CIRCLE ED-141 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • January 1955

they're SELF-LOCKING



IN ANY POSITION

on a threaded member

FLEXLOCS stay put in any position on a bolt or stud the moment the locking threads are fully engaged; they do not have to be seated. And FLEXLOCS stay tight, no matter how severe the vibration; are one piece, all metal; can be used repeatedly. One nut covers a temperature range up to 550°F. Call upon your local industrial distributor for literature and samples or write STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

FLEXLOC LOCKNUT DIVISION

SPS
JENKINTOWN PENNSYLVANIA

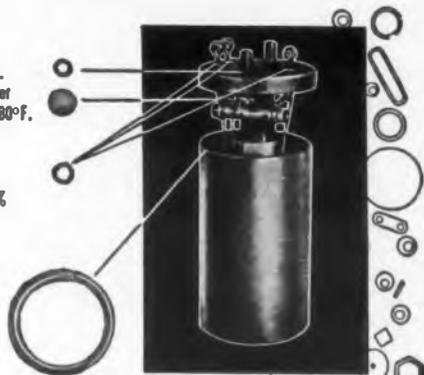
CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

3 Soldering Operations in 1 Easy as ABC with KESTER "SOLDERFORMS"

A Solder screws and stud to can cover.
"Solderform" Disc & Rings 5% Silver
—95% Lead Alloy. Melting Point 680°F.

B Solder glass terminals to cover.
"Solderform" Rings 63% Tin—37%
Lead Alloy. Melting Point 361°F.

C Hermetically seal cover on can.
"Solderform" Ring 28.5%
Bismuth—28.5% Tin—43%
Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

KESTER
SOLDER COMPANY

4266 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

Air Gaging Service

130

An air gaging member reconditioning service has been developed for the restoration of members and masters for all air gaging circuits; flow, back pressure, or differential. Special machinery, and tools to restore gaging members for all purposes, open air, contact, etc., are shown in this 4-page brochure. Freeland Gauge Co., 9940 Freeland Ave., Detroit 27, Mich.

Special Transformers

131

This 4-page brochure provides a description of special transformer designs produced by this company for use in communications, nucleonics, ordnance, and electronic controls. Of special interest is the page devoted to formulae frequently used in transformer and reactor computations. Central Transformer Co., 910 W. Jackson Blvd., Chicago 7, Ill.

Fastener

132

A new multi-purpose fastener with a one-piece metal head and pre-assembled neoprene washer is described in this 4-page illustrated brochure (No. TL-97). The brochure explains the design and application of the fastener. Townsend Co., New Brighton, Pa.

Fault-Location Wheatstone Bridge



FOR FIELD OR LAB USE

Shallcross #6100 rapidly locates grounds, crosses, opens, and shorts by Murray, Varley, Hilborn, or Fisher Loop and Capacitance Tests. It measures resistance from 1 ohm to 1.001 megohms with a 4-decade rheostat and ratio arm. Decades may also be used as a resistance box.

Rugged, easy-to-read galvanometer has 3-second period for rapid, accurate measurement. Low temperature-coefficient Shallcross resistors throughout bridge maintain accuracy within 0.1%. Readily accessible controls are easy to operate, even with a gloved hand.

Housed in waterproof aluminum carrying case with removable hinged lid and carrying strap. 8 7/8" x 7 3/8" x 5 3/4" overall, with built-in battery compartment. Weighs only 8 pounds.

Complete specifications on #6100 Wheatstone Bridge are in Bulletin L-19. SHALLCROSS MFG. CO., 526 Pusey Ave., Collingdale, Pa.

Shallcross

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

SHOCK ISOLATORS

Effective in All Directions



Combination shock and high-frequency-vibration isolators, cupmounts Type 1000-2000-3000-4000 series, will isolate short-duration shocks and vibrations above 45 cps. The isolators use rubber in compression to give smooth load-deflection curves and approximately equal stiffness in all directions. The design and assembly of the metal parts make the mounts self-captivating for maximum security. Four sizes of these cup-style isolators are available, ranging from Type 1000 (load range 7-50 pounds) to Type 3000 (load range 100-450 pounds). Vertical natural frequency at rated load is approximately 25 to 30 cps.

For additional information write to: The Barry Corp., 775 Pleasant St., Watertown 72, Mass.

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

GO - NO GO matching to Any Desired Tolerance between 0 and 5% or 0 and 20%

RESISTORS	INDUCTORS	CAPACITORS
2 Ohms to 20 Megohms	200 Microhenrys to 1500 Henrys	50 Micromicrofarads to 100 Microfarads

This Comparison Bridge is for rapid testing of components both in production and in the laboratory. Its features include: Three test frequencies of 400 c, 1 kc and 5 kc; Basic Accuracy 0.1%; CRO Visual Indicator; Either Grounded or Ungrounded Measurements; Requires No Accessories.



Type 1604-B
Comparison Bridge: \$390

For Detailed Information
Write Our Main Office at
Cambridge or Branch
Engineering Offices in
New York, Chicago or
Los Angeles.

GENERAL RADIO Company

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

85 West 42nd Street, New York 36, New York • 535 North Dearborn Street, Chicago 10, Illinois • 1000 Wilshire Boulevard, Los Angeles 17, California

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

GLOBE A.C. or D.C. MOTO-MITE* MOTORS

...for MAXIMUM POWER in MINIMUM SPACE!



D.C. MOTO-MITE*
Shown actual size. Length 1 3/4" Diameter 1 3/16"
Weight 3.5 oz. Larger, smaller sizes available.
A.C. MOTO-MITE*
Length 2 1/4" Diameter 1 1/4" Weight 6 oz. Larger and smaller sizes available.

*Trademark

Miniature, compact, powerful, custom-built and quality controlled motors, characterized by high output and high efficiency. Designed as components for precision airborne accessory equipment, Globe Motors meet all military requirements. Speed governors, gear reducers, radio noise filters, electromagnetic clutches, brakes, etc., are available as standard assemblies. D. C. Motors can be made for various voltage applications ranging from 6 to 100V, and from 5,000 to 22,000 R.P.M. and with power output from 1/100 H.P., and up to 1/50 H.P. dependent on frame size. A.C. Motors, 400 C.P.S. Hysteresis-Synchronous type, can be made for voltage applications up to 115V, with power output up to 1/200 H.P. for 4-pole types, and up to 1/100 H.P. for 2-pole types. Single phase capacitor-run or two phase windings available. A.C. Motors, 60 C.P.S. also available.

Let Globe's complete engineering facilities investigate and resolve your motor problems. WRITE FOR COMPLETE INFORMATION TODAY!

Globe industries, inc.

MOTORS • GEAR REDUCERS • GENERATORS • GOVERNORS • SERVOS
BLOWERS • FANS • ACTUATORS • SWITCHES • GYROS • VIBRATORS

1797 STANLEY AVE., DAYTON 4, OHIO

CIRCLE ED-390 ON READER-SERVICE CARD FOR MORE INFORMATION

SEE THE LATEST IN
Electronics
EQUIPMENT



FREE

Send for
Newark's 1955 Catalog

Here are the latest releases in tubes, transformers, capacitors, test instruments and everything in electronics parts and equipment. See also the newest developments in Radio, TV and High Fidelity.

NEWARK

ELECTRIC COMPANY

Dept. ED-1, 223 W. Madison, Chicago 6, Ill.

CIRCLE ED-391 ON READER-SERVICE CARD FOR MORE INFORMATION

110

Books . . .

Industrial Design in America, 1954 . . . Edited by the Society of Industrial Designers. 224 pages. Farrar, Straus and Young, Inc., 101 Fifth Ave., New York 3, N. Y. \$12.50.

In order for a product to sell on the American market today it must not only work well but look good—even beautiful. Every electronic designer concerned with enclosed equipment for the consumer or commercial market should be aware of the state of the public taste. This impressive survey of the work of the nation's leading industrial designers can function as just such a useful guide to American taste in mass-produced merchandise. By photography it samples the best work of the 153 members of the Society of Industrial Designers. Each photograph or group of photographs is accompanied by some text describing the manufacturer's or designer's problems.

Following a slightly apprehensive introduction on the cultural implications of modern design by the president of Steuben Glass, Inc., the book is divided into 10 sections. Nearly every section includes a number of electronic devices. The first section, "Appearance Design", discusses Goodyear's RS Geda desk recorder among a number of other products of the electronic industries. The next two sections are entitled "Better Use of Materials" and "Visual Selling Aids", respectively. The fourth section, "New Approaches", includes a number of picture stories. One of these deals with an experimental console radio resembling a hemisphere.

The fifth section discusses "Lowering Costs of Manufacture". The Meyers' "Radioear" hearing aid is elaborately considered in the sixth section on "Safety and Health". The next section on "Color" discusses three radios, two TV receivers, and the Edison "Voicewriter" dictating machine.

Among the examples in "Product Character", the eighth part, is an RCA table-model radio. By product character the editors mean striking features that enable the consumer to recognize a product as belonging to a certain manufacturer's line. Product character, is, of course, more easily attained in automobiles, for example, than electronic devices.

A number of electronic products and many household articles are discussed in section nine, "Convenience of Use". The last section deals with foreign designs, including some of the striking designs that

For knots that tie easier—faster—tighter
and will not slip!



Fungus-Proof

NYLON LACING CORD and FLAT BRAIDED TAPES

- Nylon's greater strength means minimum breakage—minimum rejects.
- Revolutionary synthetic resin coating prevents knots from slipping. Lacing actually tightens itself after knot is made.
- Special coating retains desirable malleability of wax and yet has melting point of over 190° F. Non-toxic to humans.
- These Lacing Cords comply with ALL requirements of Gov. Spec. Jan-T-713 and Jan-T-152.

Also available with wax finish

For FREE SAMPLES and prices write:

The Heminway & Bartlett Mfg. Co., ELECTRONICS DIV., 500 5th Ave., N. Y. 36.
Sales Offices: Chicago, Philadelphia, Boston, St. Louis, Cincinnati, Dallas, San Francisco, Los Angeles, Charlotte, N.C., Gloversville, N.Y., Lynchburg, Va.
Foreign Agent: Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE ED-392 ON READER-SERVICE CARD FOR MORE INFORMATION



Take The Signal—
From

SIGNAL

Fans

and go

PHALO Cord

for

**POWER SUPPLY
DEPENDABILITY!**

The newest of the fine line of portable SIGNAL FANS, the SIGNAL Jet Stream shown here features the famous Stout Heart motor and is built for quality performance over a long fan life right down to the power supply cord which is, of course, a PHALO Cord!

Take this production signal from SIGNAL . . . get the PHALO Cord story from your PHALO representative . . . ask us for his name.

Remember PHALO is in the current picture to stay!

PHALO PLASTICS CORPORATION
25-1 FOSTER STREET, WORCESTER, MASSACHUSETTS
Southern Plant: Monticello, Miss.

Insulated Wire and Cables—Cord Set Assemblies

CIRCLE ED-393 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955



SAVE with MILWAUKEE ECONOMY RESISTORS



RESISTORS MUST BE GOOD before they bear the "Milwaukee" name! That's what we said when we set about developing these ECONOMY resistors. Our engineers checked many materials and worked with factory production to assure top ranking performance. THE RESULT — resistors embodying more costly raw materials, but greatly reduced in cost by the new manufacturing techniques these materials afford. They are available in the same sizes and ohmages as our vitreous enameled resistors. Write, wire or phone for quotations — samples!

MILWAUKEE RESISTOR COMPANY
702 W. VIRGINIA ST., MILWAUKEE 4, WIS.

CIRCLE ED-394 ON READER-SERVICE CARD FOR MORE INFORMATION

**WRITE, WIRE
or PHONE FOR
YOUR CATALOG
TODAY**

BOLTS & CAP SCREWS
SOCKET, SET & CAP
NUTS, WASHERS
MACHINE SCREWS
SHEET METAL SCREWS
WOOD SCREWS
PIPE FITTINGS



- Class 3 Screws
- Dowel & Taper Pins
- AN Drilled Fillister Heads
- Binding Heads #0/#1/#2
- Screw Machine Products
- Piano Hinges

Star Stainless
screws have CLEAN
BRIGHT AND SHINY HEADS

STAR STAINLESS SCREW CO.
CORROSION-RESISTANT
Telephone: Little Falls 4-2300
663 Union Blvd. • Paterson 2, N. J.
Direct New York Telephone: Wlconsin 7-9041

CIRCLE ED-395 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

have influenced or stimulated American design efforts. Each of the first nine sections is introduced by a statement by some leading industrialist.

The volume concludes with a list of business enterprises served by the Society, lists of members of the S.I.D. and contributing foreign design organizations.

The book itself is an example of good design. Handsomely bound in embossed cloth, it is made with heavy high-gloss paper to give the more than 450 illustrations the greatest clarity.

America has not as yet made any great contributions to the world's culture in the older arts. Industrial design may well become America's most characteristic art form. This book is recommended to all design departments and to every engineer who is interested in the appearance of the many products resulting from our advancing technology.

Television—The Electronics of Image Transmission in Color and Monochrome . . . By V. K. Zworykin and G. A. Morton. Second edition. 1037 pages. John Wiley & Sons, Inc., 410 Fourth Ave., New York 16, N. Y. \$17.50.

In the 14 years since the publication of the first edition of this standard work, television has grown from a laboratory research project into a major American industry. This growth, of course, has been accompanied by many engineering advances. As a result, the authors of this work have been forced to revise or rewrite every chapter in the original work.

The organization of the book remains the same. The first part discusses "Fundamental Physical Principles". Newly added material here is on semiconductors, photoconductors, and recent developments in photoemitters and phosphors. The other three parts are entitled "Principles of Television", "Component Elements of an Electronic Television System", and "Color Television, Industrial Television, and Television Systems", respectively.

Many charts, photographs of components, tables, and wave-form representations are included to supplement the text. Mr. Zworykin is the Director of Electronics Research, RCA Laboratories, Princeton, N. J., and Mr. Morton is a member of the laboratory.

Methods of Reasoning . . . By P. D. Scott. Paperbound, 16 pages. Cleveland Engineering Society, 2136 E. 19th St., Cleveland 15, Ohio. \$1.00.

The solutions to many design problems lie not in the lack of new components and circuitry, but in the inability of the designer to utilize his present knowledge and available components and methods to the fullest. This booklet offers engineers a quick, easy-to-read review of the scientific method. A basic understanding of reasoning methods, such as this work fosters, is one of the most valuable tools of the electronic designer.

DONNER analog computer

\$995

model 30 with 30-3
problem board
as illustrated.
f.o.b. Berkeley, Calif.



This versatile and compact Donner Model 30 is the first electronic computer specifically designed as a personal tool of the engineer, mathematician and scientist. It offers the speed and accuracy of electronic computation with slide rule operating simplicity wherever differential equations are used.

Write for Booklet No. 302 on the Model 30 and its applications.

DONNER SCIENTIFIC COMPANY

2829 SEVENTH STREET • BERKELEY 10, CALIFORNIA

CIRCLE ED-396 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW FREE CATALOG

FOR

- Designers
- Purchasing Agents
- Engineers
- Superintendents
- Managers

FREDDY FEDERAL
will rush your
copy today!



Costs, materials, and procedures graphically illustrated. New catalog tells where and how you can save money using Short Run Stampings. Also design tips to reduce stamping costs.

Write for your copy of catalog 201 today.

CIRCLE ED-397 ON READER-SERVICE CARD FOR MORE INFORMATION



R-B-M Relays

**FOR EVERY ELECTRONIC
APPLICATION**

Meeting Commercial and Government Requirements

OPEN TYPE. Circuit switching—power and dynamotor loads—plate circuit—low capacitance.

HERMETICALLY SEALED. Stud or bushing mounting—solder or plug-in headers—circuit switching—power—low loss applications.

TRANSPARENT PLASTIC COVER. Most R-B-M relays now available in low cost transparent plastic cover.

OTHER PRODUCTS: Motor starting relays and overload protectors for refrigeration, appliance and general purpose motors. Industrial contactors and across-the-line starters. NEMA size 1 and smaller. Low cost general purpose relays. Low voltage D.C. manual and magnetic devices.

Let R-B-M engineering and production facilities serve you. Contact us immediately—Phone 5121

“Write Dept. L-1 for ASR Bulletin”

R-B-M DIVISION
ESSEX WIRE CORPORATION
Logansport, Indiana

*Controls for Electronic,
Refrigeration, Industrial, Appliance,
Communication and
Automotive Industries*



CIRCLE ED-398 ON READER-SERVICE CARD FOR MORE INFORMATION

Servomechanisms . . . By John C. West. 238 pages. English Universities Press, Ltd. Distributed by the MacMillan Co., 60 Fifth Ave., New York 11, \$5.00.

Written as a textbook, this slim volume is of value to the design engineer who must review or relearn the theory and design of servomechanisms after a long period of specialization in some other branch of the electronic art. Each phase of the subject is introduced by simple examples before proceeding to the generalized principle. The explanations are aided by numerous charts, wave form representations, and simple mathematical derivations. There are 21 chapters. The author is a lecturer at the University of Manchester, England.

Dielectrics and Waves . . . By Arthur R. Von Hippel, 284 pages. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. \$16.00

Written not only for the electronic engineer, but for the physicist and chemist as well, this definitive work discusses dielectrics by two methods, the macroscopic

and molecular approaches, respectively. By dielectrics the author means not just the narrow class of insulators, but any nonmetal acted on by electric, magnetic, or electromagnetic fields.

The macroscopic approach, the more familiar one to engineers, deals with large or at least visual amounts of a specific material. All the physical laws of fields are developed. Some of the chapter titles in this section are: "Description of Dielectrics by Various Sets of Parameters"; "Boundary Conditions"; "Electromagnetic Fields in Wave Guides"; "Short-Circuited Guides and Cavity Resonators"; and "Representation of Dielectrics by Lumped Circuit Equivalents".

The section on the molecular approach considers the interaction between electrons, atoms, and molecules that causes the microscopic phenomena discussed in the first section. The classic investigations of the structure of the atom, such as Bohr's Quantum Theory, are considered in this part. Among the chapter titles are: "Piezoelectricity"; "Dipole Moments, Piezoelectricity and Crystal Structure"; "Ferro-

electric
Semi
Space-

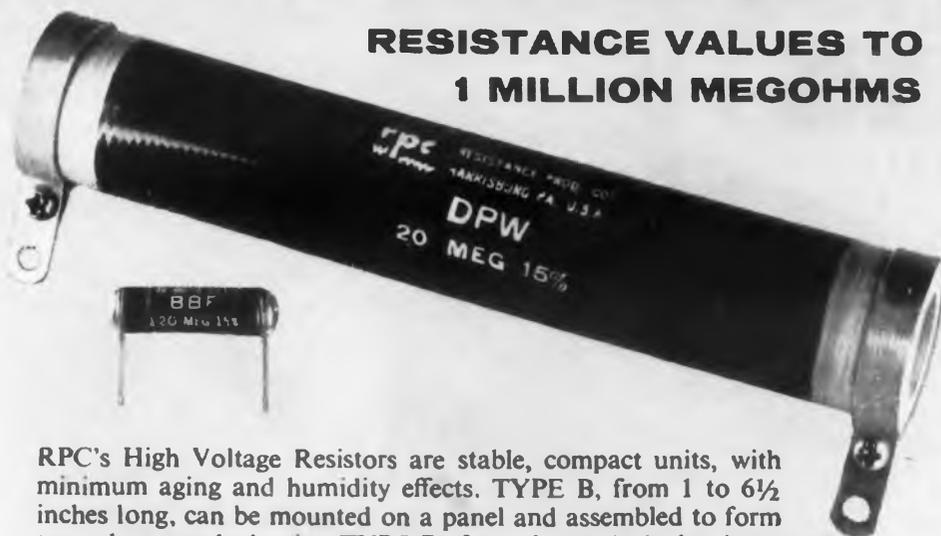
The
ber of
A con
and A
v. 10
the D
Resear
nology
mende
freque
waves,
entire

Proce
ons I
. . . 1
search
Kansa

All
nteres
volum
duction
of into

HANDLE HIGH VOLTAGES AT MODERATE POWER . . .

RESISTANCE VALUES TO 1 MILLION MEGOHMS



RPC's High Voltage Resistors are stable, compact units, with minimum aging and humidity effects. TYPE B, from 1 to 6½ inches long, can be mounted on a panel and assembled to form tapped or matched pairs. TYPE D, from 6½ to 18 inches long, can be supplied with silver bands, terminal lugs or ferrules.

For special assemblies, Corona problems or special sizes, free consultation is available.



RESISTANCE PRODUCTS CO.

914 South 13th St. • Harrisburg, Penna.

Makers of Resistors — High Megohm, High Voltage, High Frequency, Precision Wire Wound.

CIRCLE ED-399 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

ELECT

electricity"; "Ferromagnetic Metals and Semiconductors"; and "Interfacial and Space-Charge Polarization".

The extensive appendix includes a number of problems and illustrative examples. A companion book to *Dielectric Materials and Applications* (ED, November, 1954, p. 101), this volume was written by the Director, Laboratory for Insulation Research, Massachusetts Institute of Technology, Cambridge, Mass. It is recommended for design engineers working with frequencies from direct current to microwaves, in other words, practically the entire profession.

Proceedings of a Symposium on Operations Research in Business and Industry . . . 185 pages, paper-bound. Midwest Research Institute, 4049 Pennsylvania Ave., Kansas City, Mo., \$5.00.

All phases of Operations Research of interest to management are covered in this volume. Of primary concern to the production executive, these proceedings are of interest to the design engineer as an

introduction to the subject and as a possible source of clues to needed electronic equipment for the factory and office. There are a number of graphs, diagrams, tables, and drawings, and flow charts. Sponsored by the Midwest Research Institute, the symposium was held in April, 1954.

How to Locate and Eliminate Radio and TV Interference . . . By Fred D. Rowe. Paper-bound, 122 pages. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. \$1.80.

One of the most important but frequently neglected duties of the electronic designer is designing equipment for ease of servicing. The many books written for servicing and maintenance personnel can help give the designer valuable insights into the requirements of the serviceman. This readable and well-illustrated volume is one of that type. Among its more interesting sections are Chapter 5 on "Electrical Equipment and Appliances as Noise Sources" and Chapter 12, which discusses "Eliminating Interference at the TV Receiver".

"AMERICAN 40" (pat. pending)

Lindgren **SCREEN ROOMS**

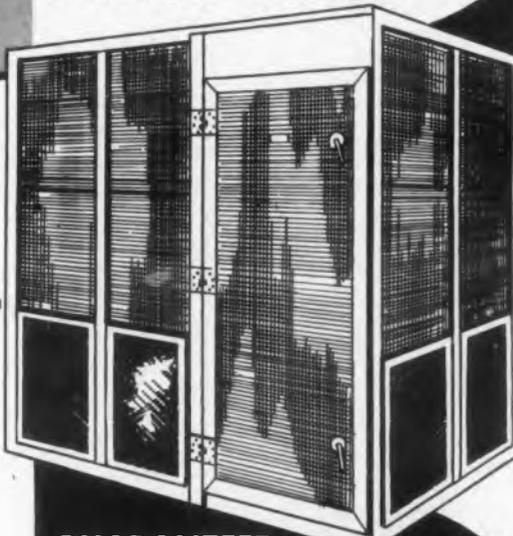
THE FINEST SCREEN ROOMS ON THE MARKET TODAY

At the Lowest Prices!

IMPROVED "AMERICAN 40" FEATURES:

- New extra-strong floor — cross beams every 12".
- 1" plywood flooring — covered with 1/8" linoleum.
- New pat. pend. door — completely leak-proof.
- New pat. pend. air intake — no leaks.
- New pat. pend. service door — slides inside screen panels.
- All rooms have expanded metal protection on outside
- THE BEST NAMES IN AMERICAN INDUSTRY USE LINDGREN PORTABLE, TRUE DOUBLE SHIELDED SCREEN ROOMS.
- (Names of companies supplied on request.)

Meets U. S. Gov't performance specifications



GUARANTEED HIGHEST ATTENUATION RATINGS

146 DB-Copper
128 DB-Bronze

WRITE FOR ILLUSTRATED BOOK
Contains specs., performance charts

ERIK A. Lindgren & ASSOCIATES
Established 1939

4515-17 N. Ravenswood Ave., Dept. ED1, Chicago 40, Ill. SUNNYSIDE 4-0710

CIRCLE ED-400 ON READER-SERVICE CARD FOR MORE INFORMATION



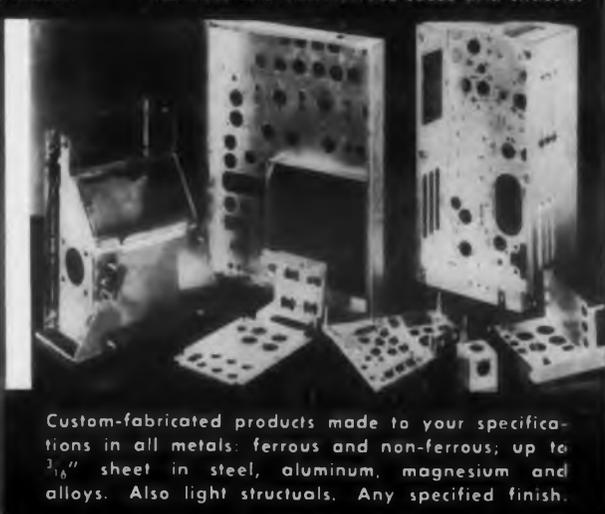
Custom-made Metal Enclosures and Components
for Radio - Electronic Industries

A prime and dependable source in metal
fabrication since 1906.

Cabinets • Consoles • Enclosures
Panels • Chassis • Frames

Shock-mounted cabinet, telescoping chassis.

Stainless and non-ferrous cases and chassis.



Custom-fabricated products made to your specifications in all metals: ferrous and non-ferrous; up to $\frac{3}{16}$ " sheet in steel, aluminum, magnesium and alloys. Also light structurals. Any specified finish.

BENNETT
MANUFACTURING COMPANY

38 RAILROAD STREET
ALDEN, NEW YORK

WRITE TODAY for our new
FACILITIES CATALOG —
a colorful 16-page brochure.

REPRESENTATIVES:
Some territories open.
Write for details.

Dept. ED-1.



CIRCLE ED-401 ON READER-SERVICE CARD FOR MORE INFORMATION

THE NEW FREQUENCY CONVERTER *by* AVION

A 400-CYCLE POWER SUPPLY
BENCH SIZE

- PLUGS INTO 60-CYCLE LINE
- DELIVERS 100 VOLT-AMPERES
- OUTPUT FREQUENCY ADJUSTABLE
380-420 cps—Panel Control
200-1700 cps—External Control
- OUTPUT VOLTAGE ADJUSTABLE
90-130 volts—Panel Control



Frequency Regulation: Better than ± 1 cps
Voltage Regulation: Better than $\pm 1\%$
Harmonic Distortion: Total better than 3%

Independent of
power factor and
10% line variation

The small size (17" long x 9" high x 13" deep), power output (100 V-A), and low cost afford the convenience of using one converter for each bench set-up. Four hundred cycle power handling capacity need be paid for only as required.

Send for complete data on this new Avion product

OTHER AVION PRODUCTS

Electronic Choppers • Voltage Regulators & References • Altitude & Air Speed Control Units
Magnetic Memory Systems • Miniature Plug-In Amplifier Units • Multron
Power Supplies • Replaceable Subminiature Amplifier Assemblies • Signal Generators

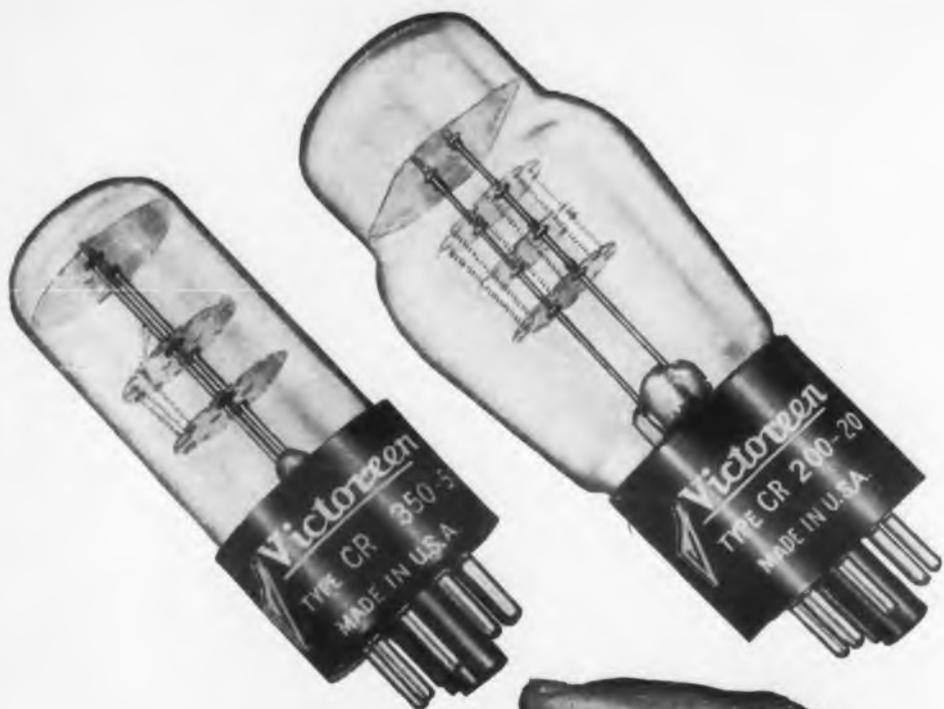


AVION
INSTRUMENT CORP.

Division of A C F Industries, Incorporated

299 Highway No. 17 • Paramus, New Jersey

CIRCLE ED-402 ON READER-SERVICE CARD FOR MORE INFORMATION



CURRENT REGULATOR TUBES



VICTOREEN OFFERS GREATER CHOICE *Of Standard Designs* *Or Will Build Specials to Your Specification*

Chances are Victoreen engineers have already engineered and produced in quantity a current regulator tube exactly fitted to your needs. These standard tubes are available on short notice. But, if your requirements are *special* we have the facilities, from engineering to production, to supply you with a current regulator that will help maintain high performance for your equipment.

Supply us with your specifications for quotation.

PIONEER ELECTRONICS CORP.

SUBSIDIARY OF



The Victoreen Instrument Co.

COMPONENTS DIVISION: 3811 Perkins Ave. • Cleveland 14, O.
CIRCLE ED-403 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents . . . By John Montstream

Integrating Circuit . . . Patent No. 2,673,929, Charles E. Huffman (Assigned to Allen B. Du Mont Laboratories, Inc., Clifton, N. J.).

Integrating circuits are used in television circuits to convert pulses of short duration into a signal of longer duration that controls the vertical deflection of the beam of the picture tube. The integrating circuit shown in Fig. 1 is responsive to negative and positive pulses and will maintain a constant level of output voltage between input pulses. Furthermore, it resets quickly

to its initial condition in response to a reset pulse.

The input pulses (12) are fed to the anode (13) of one diode and the cathode (14) of the other diode of a 6H6 double diode (16). The battery (32) and resistors 46, 41, 43, and 47 maintain proper voltages on anode 13 and cathode 14 so that for a positive input pulse the diode 13-21 conducts to charge the integrating capacitor (23) with a positive polarity and for a negative pulse diode 14-22 conducts to charge this condenser with a negative polarity. This action is shown in the

14

REASONS WHY VARIABLE TRIMMER PISTON CAPACITORS ARE PREFERRED

1. Vernier Micrometer Adjustment
2. Ultra Linear Tuning
3. Freedom From Microphonics
4. No Tuning Backlash
5. Negligible Temperature Drift
6. High Dielectric Strength
7. Rugged Shock & Vibration Resistance

8. High Surface Resistivity
9. Wide Operating Temperature Range
10. Coaxial Tuning
11. Q Measurements Beyond 10,000
12. Precision Workmanship
13. Dust-proof Construction
14. Meet Strictest Military Demands



actual size (one inch)

AIR EXPRESS DELIVERY ON STANDARD MODELS

MODEL	CAP. MMF	TEMP. COEFF. PPM PER °C	DIEL.	ROTOR ELECTRODE	TEMP. RANGE
VC 5	.5 to 5	approx. zero	Quartz	Invar	-55°C to +200°C
VC 11	1 to 10	approx. zero	Quartz	Invar	-55°C to +200°C
VC 12	10 to 20	approx. zero	Quartz	Invar	-55°C to +200°C
VC 1G	.5 to 8	+50 ± 100	Glass	Invar	-55°C to +125°C
VC 3G	.7 to 8	+600 ± 100	Glass	Brass	-55°C to +125°C
VC 4G	1 to 18	+600 ± 100	Glass	Brass	-55°C to +125°C
VC 11G	.7 to 12	+100 ± 50	Glass	Invar	-55°C to +125°C
VC 11GRB	.7 to 10	+750 ± 100	Glass	Brass	-55°C to +125°C
VC 11GRC	.7 to 10	+275 ± 100	Glass	Invar Brass Screw	-55°C to +125°C
VC 13G	1 to 10	+100 ± 50	Glass	Special Alloy	-55°C to +125°C

Other models available for ungrounded operation, larger ranges, fixed standards, etc.



Consult with JFD Engineers for piston capacitors designed to meet your specifications. Write today to be placed on the JFD Capacitor Bulletin mailing list.

JFD ELECTRONICS JFD MFG. CO., Inc.,
1462-62nd STREET, BROOKLYN 19, N. Y.



CIRCLE ED-404 ON READER-SERVICE CARD FOR MORE INFORMATION

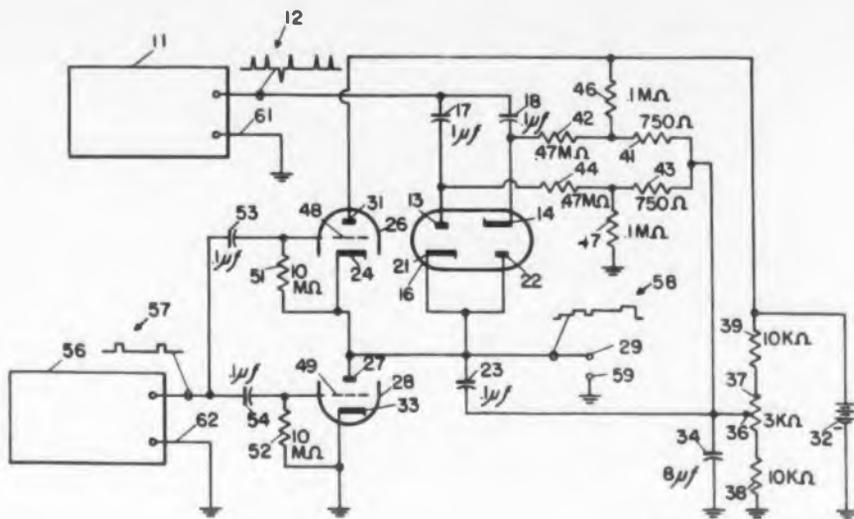


Fig. 1. Integrating circuit.

output signal (58) at the output terminals (29, 59). The resistors also are of such a value that capacitor 23 is equally charged by positive and negative pulses. The connection between the terminal for the lower plate of condenser 23 and the junction of resistors 41 and 43 maintains this side of the condenser at a potential which is the

intermediate of that on cathode 14 and plate 13. The adjustable connection (36) permits adjustment of the applied voltages.

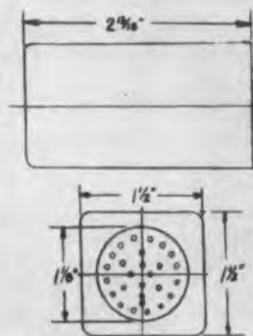
The integrating condenser is discharged by pulse 57 from source 56. This pulse is applied to the control grids of the 6SN7 triodes (26 and 28) to render them conducting and thereby short circuit the condenser. A positive charge on the capacitor is discharged through triode 28 and a negative charge through triode 26.

**INCREASE
CAPACITY with
REDUCTION in SIZE.....**

**CONSERVES SPACE
COMPACT • LIGHTWEIGHT
HERMETICALLY SEALED
NITROGEN FILLED**

8

**POLE
MINIATURE
RELAY
DOUBLE
THROW
5 AMP.
CONTACTS**



TYPICAL ENCLOSURE

1. Satisfies test requirements of spec. MIL-R-6106A.
2. Contact Rating: 5 amps @ 28 volts D.C. or 115 volts A.C.
3. Manufactured in accordance with spec. MIL-R-5757B.
4. Life: 50,000 operations — minimum.
5. Ambient Temperature: -65°C to $+125^{\circ}\text{C}$.
6. Weight: approximately 9 ounces.

WRITE FOR CATALOG



ELECTRO-MECHANICAL SPECIALTIES CO., INC.

6819 MELROSE AVENUE • LOS ANGELES 38, CALIFORNIA

CIRCLE ED-405 ON READER-SERVICE CARD FOR MORE INFORMATION

**MADE
TO
SURVIVE**



10-Watt
Type RS-10

5-Watt
Type RS-5

2-Watt
Type RS-2

Also Available — RH Types—25, 50 and 250 Watts

Miniature POWER Resistors

Carefully crafted for matchless performance, Dalohm miniature power resistors are made to survive the most severe environmental, shock, and vibration conditions. Smallest in size, they also represent the answer to the space problem.

Dalohm RS type miniature power resistors are completely welded from terminal to terminal; silicone sealed, offering maximum resistance to abrasion, and high dielectric strength. They are 100% impervious to moisture and salt spray.

- Temperature coefficient 0.00002/deg. C
- Ranges from 0.1 Ohms to 55,000 Ohms, depending on type
- Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3% and 5%
- Manufactured in accordance to applicable JAN and MIL specifications.

DALE PRODUCTS, INC.

CIRCLE ED-406 ON READER-SERVICE CARD FOR MORE INFORMATION



FOR ALL YOUR REQUIREMENTS IN MAGNETIC HEADS

• The performance of magnetic recording equipment depends on the quality of the magnetic head—which records, reproduces or erases. Brush offers a complete line of heads, outstanding for precision alignment

and balanced magnetic construction. For assistance in application, call on Brush's unequalled experience in this field. Write Brush Electronics Company, Department J-1, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS

INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZO-ELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT
ULTRASONIC EQUIPMENT



COMPANY

formerly
The Brush Development Co.
Brush Electronics Company
is an operating unit of
Clevite Corporation.

CIRCLE ED-407 ON READER-SERVICE CARD FOR MORE INFORMATION

YOU CAN PROFIT

with the **BEAD CHAIN**
ECONOMICAL
MULTI-SWAGE
METHOD



this
FREE
catalog
can help
you to...

LOWER PRODUCTION COSTS on Tiny Metal Tubular Parts

Bead Chain's exclusive multi-swage method automatically swages almost any type of tiny metal tubular part from flat stock into precision forms with positive, tight seams. High-volume production can be delivered speedily and at far less cost than with conventional methods of manufacture! Parts can be beaded, grooved, shouldered and made of almost any metal. Diameters up to $\frac{1}{4}$ ", lengths to $1\frac{1}{2}$ ".



WRITE
TODAY!

THE BEAD CHAIN
MANUFACTURING CO.

58 Mountain Grove St., Bridgeport, Conn.

CIRCLE ED-408 ON READER-SERVICE CARD FOR MORE INFORMATION

LIGHT, COMPACT, INEXPENSIVE JK09 CRYSTAL OVEN

- +Only 1.28" dia. x 1.70" high, and weighs only 1.5 oz.
- +Minimum temperature gradient at crystal.
- +Rapid warm up with no overshoot.
- +Capable of maintaining a set temperature around crystal with less than $\pm 1^\circ\text{C}$ variation over the range of -55° to $+100^\circ\text{C}$.
- +Production tooled, assuring uniformity, economy, reliability

Write for detailed specifications



JAMES KNIGHTS COMPANY
SANDWICH, ILLINOIS

The JK09 matches the performance of many ovens employing multi-stage heaters and massive heat retaining elements. Houses one or two crystals, heater voltage choice from 6 to 28 volts. Features patented "Thermaflow" design.



CIRCLE ED-409 ON READER-SERVICE CARD FOR MORE INFORMATION

Electron Multiplier Device . . . Patent No. 2,674,661. Russell R. Law (Assigned to Radio Corp. of America, New York, N. Y.).

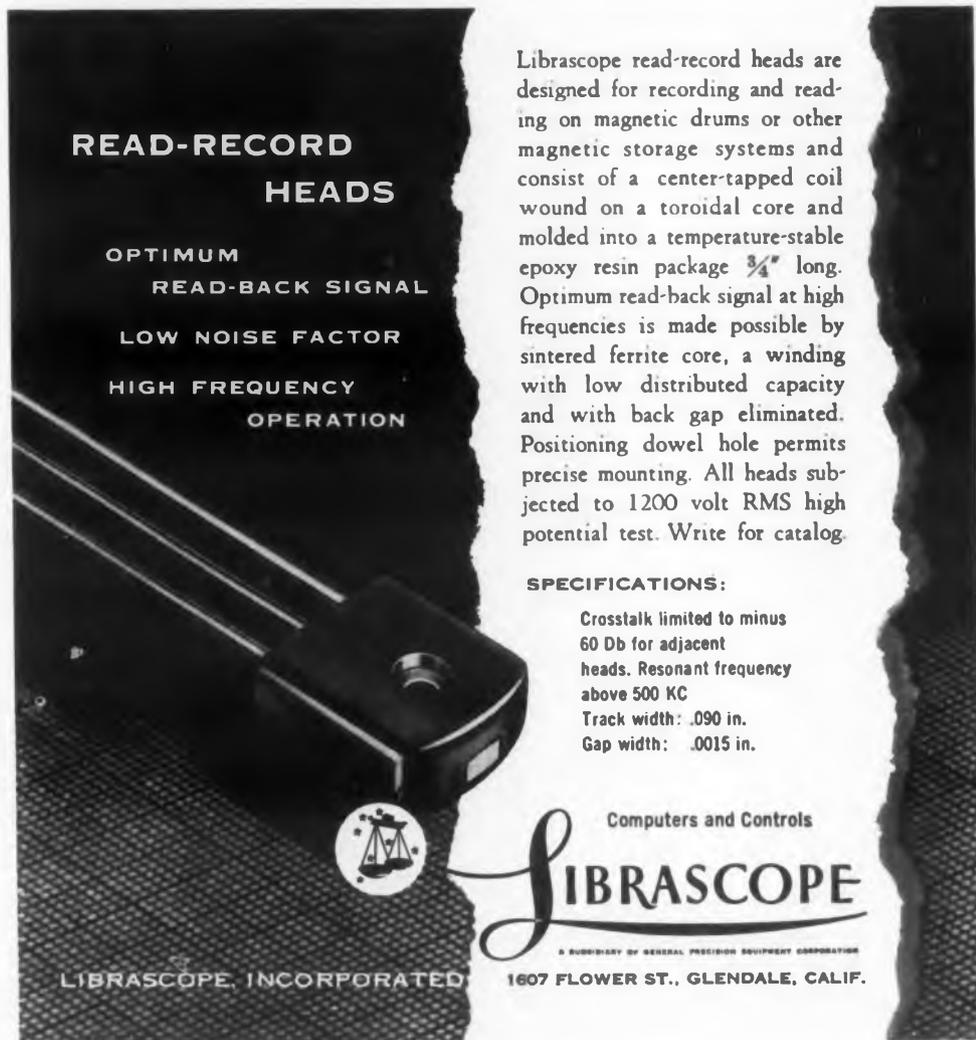
The utilization of secondary electron emission by electron bombardment of an electrode or dynode in order to increase current flow has been practiced for some time. The patentee, however, has invented a new form of dynode that is particularly efficient for electron multiplication and has devised an improved tube structure in conjunction with the form of the dynode. In addition, he has devised a tube structure with which high power at high frequency may be secured.

The tube structure and the dynode electrodes shown in Fig. 2 has a cathode (108) for the initial or primary source of emission of electrons. The dynodes or secondary emission electrodes are grouped in front of the collectors (1 and 2). Fig. 2 shows them before collector 1 only). The dynodes are generally trapezoidal in shape, but the particularly pertinent feature is the curved sides or flanks on each side which direct electrons that strike the sides towards the side of the next dynode

towards the collector and in the adjacent column of dynodes. At least three horizontal rows of dynodes are provided in staggered relation and each row has a progressively increasing potential applied to them, such as increments of 300v each as indicated by the voltages marked on the resistor with which they are connected. As the electrons enter the cluster or rows of dynodes, they are directed towards the curved flanks by a directing triangular electrode at the front end of each row after which the curved flanks direct the electrons towards the curved flank of the next dynode in the adjacent row. As each electron strikes a dynode, secondary electrons are released so that the number multiplies for each row of dynodes until they reach the collector. The dynodes have a forward flat dimension of about 0.075" and a length of about the same dimension so it follows that the tube can be relatively small.

The tube may serve as a generator of high power current at radio frequency. A pair of spaced deflecting plates (124) are located between the cathode and the dynodes and a high frequency alternating potential is applied to them through the

coupl
of el
from
the el
emissi



READ-RECORD HEADS

OPTIMUM
READ-BACK SIGNAL
LOW NOISE FACTOR
HIGH FREQUENCY
OPERATION

Librascope read-record heads are designed for recording and reading on magnetic drums or other magnetic storage systems and consist of a center-tapped coil wound on a toroidal core and molded into a temperature-stable epoxy resin package $\frac{3}{4}$ " long. Optimum read-back signal at high frequencies is made possible by sintered ferrite core, a winding with low distributed capacity and with back gap eliminated. Positioning dowel hole permits precise mounting. All heads subjected to 1200 volt RMS high potential test. Write for catalog.

SPECIFICATIONS:

- Crosstalk limited to minus 60 Db for adjacent heads. Resonant frequency above 500 KC
- Track width: .090 in.
- Gap width: .0015 in.

Computers and Controls
LIBRASCOPE
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
1607 FLOWER ST., GLENDALE, CALIF.

LIBRASCOPE, INCORPORATED

CIRCLE ED-410 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

ELEC

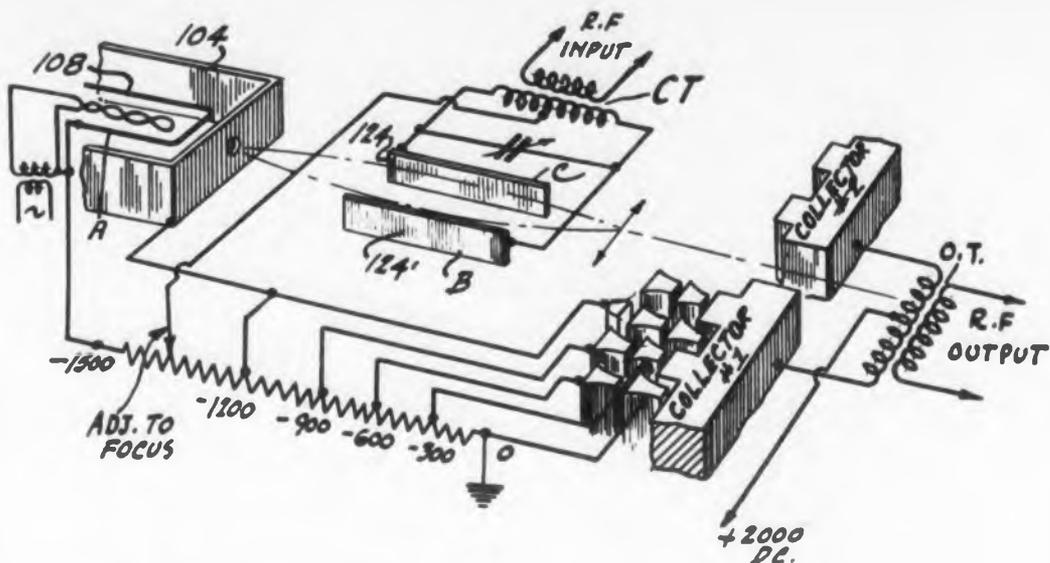


Fig. 2. This illustration shows both the construction and circuitry of an electron multiplier device.

coupling condenser *CT*. The primary beam of electrons from the cathode is swept from one collector to the other and with the electron multiplication from secondary emission from the dynodes, the output in

the output transformer *OT* is a heavy current output at radio frequency. Another form of tube is also described as well as novel details of the mounting for the rows of dynodes within the tube.

a complete line of relays



EARLY DELIVERIES

SUPER RUGGED

Vibration 10 G's - 500 cps
MIL R 5757B

SUB-MINIATURE

1/2 cu. in. - 1/2 oz.

HIGH CONTACT RATINGS

5 amp., 24VDC, 115 VAC
RESISTIVE

SENSITIVE
from .020 Watts

HI-TEMPERATURE
- 65° to 200° C.

FAST OPERATING
TIME DELAY

HERMETICALLY SEALED

ALL TO MIL R 5757B
SPECIFICATIONS

*Manufacturer's of High Precision Sub-Miniature
Electro-Mechanical Devices.*

ELGIN-NEOMATIC, INC.

A SUBSIDIARY OF ELGIN NATIONAL WATCH COMPANY
9010 BELLANCA AVE. • LOS ANGELES 45, CALIF. • OR 8-3814

CIRCLE ED-411 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

LOOK TO INTERNATIONAL RECTIFIER

Diodes



GERMANIUM DIODES
 JAN and RETMA types available in production quantities. New "RED DOT" series offers high temperature operation to 100°C.
 Write for Bulletin GD-1A



SELENIUM DIODES
 DC output current from 100 μ a to 11 MA. DC output voltage 20 volts to 160 volts. Subminiature cell diameter from .062" to .375"
 Write for Bulletin SD-1B

Widest Range in the Industry

Photo Cells



SELF-GENERATING
 Mounted and unmounted photoelectric cells available in custom and standard sizes. Optimum load resistance range, 10 to 10,000 ohms. Output in ave. sunlight from .2 MA to 60 MA.
 Write for Bulletin PC-649



INTERNATIONAL RECTIFIER CORPORATION

EL SEGUNDO, CALIFORNIA • OREGON 8-6281
 World's Largest Supplier of Quality Industrial Rectifiers
 NEW YORK CHICAGO

CIRCLE ED-412 ON READER-SERVICE CARD FOR MORE INFORMATION

2 New
Capacitors
by

EFCON

Where Close tolerance
is Standard tolerance

MINIATURE PLASTIC FILM CAPACITORS

- The new EFCON Type PH Polystyrene Film Capacitors are designed for *extreme stability* and very high insulation resistance;
 - the new Type TH "Teflon"* Film Capacitors, for *high temperature* applications.
- Same as EFCON Type MH "Mylar"* Film Capacitors — both new types are produced with tolerances of $\pm 5\%$, $\pm 2\%$ and $\pm 1\%$ in *standard production*. Leads are soldered directly to foil. Hermetically sealed in metal cases. Also available: Type MC- "Mylar" polyester film capacitor in wax impregnated cardboard tubes; Type S, molded silvered mica capacitor. Write Dept. A for informative brochure.

• DUPONT TRADEMARK

ELECTRONIC FABRICATORS, Inc.
682 Broadway, New York 12, N. Y.

CIRCLE ED-361 ON READER-SERVICE CARD FOR MORE INFORMATION

RAYTHEON

"Single Line" MAGNETIC SHIFT REGISTERS

SR-100 ● 100 KC
SR-500 ● 500 KC

Raytheon "Single Line" Shift Registers are "two-state" storage devices designed to be interconnected so that stored information may be advanced by the application of a current pulse. They employ only one magnetic core and only one diode per unit of information stored. Available in 100 KC and 500 KC single-stage units packaged in plastic cases with diodes clip-mounted for easy removal.

OTHER MAGNETIC CORE PRODUCTS

In addition to the above standard items, Raytheon can design and produce to specification complete shift register systems, coincident-current memories, core-diode buffer memories as well as logical and arithmetic circuits.



Write for Bulletin DL-Y-7
TECHNICAL SALES DEPARTMENT

RAYTHEON
MANUFACTURING COMPANY
WALTHAM, MASSACHUSETTS

CIRCLE ED-362 ON READER-SERVICE CARD FOR MORE INFORMATION

Cathode Ray Focusing Apparatus . . .
Patent No. 2,692,532, Ernest O. Lawrence
(Assigned to Chromatic Television Labora-
tories, Inc., San Francisco, Calif.).

The cathode ray tube of the patent is particularly applicable for color television receivers, although it has wider applicability and may be used in oscilloscopes, for radar and for monochromatic television. The direct view polychrome cathode ray tubes used in early demonstrations gave excellent results. However, it was thought that the received picture had low luminosity. One such tube had a perforated diaphragm of many closely spaced holes and the diaphragm was located close to but spaced from the target. On the viewing screen or target at each hole, three different color phosphors were spaced in three quadrants of each small circle in order to provide the color in the picture and an electron gun was provided for each color so that the color produced depended upon the gun or guns which were supplying the beam at each hole. The low luminosity no doubt was caused by the fact that for a large part of the time the beam was not on

the target but was directed on the diaphragm structure between holes as the beam traversed the diaphragm and target. Another form of tube "spun" the electron beam in order to direct it onto the color phosphor to be illuminated. In order to avoid color contamination with this tube, the beam is blanked during transition from one color to another.

The tube of the patent uses the customary electron gun, beam focusing means, and beam deflection means. The patentee secures color selection by utilizing deflecting electrodes which form a secondary electron lens adjacent to the target. These electrodes give a secondary deflection of the beam to one of three color areas on the target. The basic construction of the color tube is illustrated in Figs. 3, 5, and 6. As shown in Fig. 4 the target (25) is made up of different areas of color phosphors, comprising a plurality of parallel vertical strips 47 which would number about 500 with present day picture standards. Each vertical strip carries three vertical strips of a different color phosphor on the target or left hand face as shown in the figure. The lower strip is shown as blue, the

Fig. 3.
middle
red. A
be dep
creased
may a
strip
The
the tar
focusing
upon a
phosph
plural

Another
CHATHAM
Exclusive Design!

Type VC-1258
MINIATURE HYDROGEN
THYRATRON
with 10KW
peak rating!

MAX. PEAK ANODE VOLTS	1000
MAX. PEAK ANODE AMPS	20
MAX. AVER. ANODE AMPS	0.05
NOMINAL FILAMENT WATTS	12.6

MANY OTHER TYPES AVAILABLE—

This tube is one of many CHATHAM thyratrons ranging in size to 40 megawatts, all of which represent an advantageous departure from conventional designs and are the result of several years of concentrated development work. Full information on request.

Specifically designed for pulse generating applications, this tube handles peak pulse power up to 10 KW. Repetition rates in excess of 10,000 pps are possible at lower power. Type VC-1258 operates at zero bias, fits a standard ceramic miniature socket, and is designed to withstand all shock and vibration tests of a ruggedized electronic tube.

CHATHAM ELECTRONICS CORP.
 Executive and General Offices: LIVINGSTON, NEW JERSEY
 Plants and Laboratories: NEWARK and LIVINGSTON, NEW JERSEY



CIRCLE ED-367 ON READER-SERVICE CARD FOR MORE INFORMATION

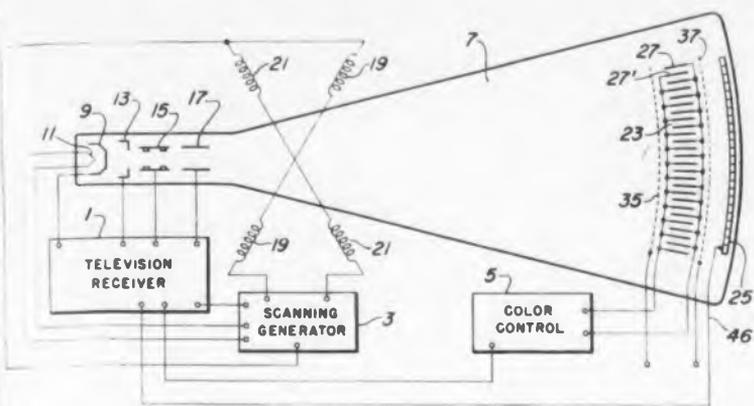


Fig. 3. Schematic of the Lawrence tube.

middle strip as green and the upper as red. An electron transparent film 19 may be deposited over the phosphors to give increased brilliance to the picture. This film may also extend between the sides of each strip 17.

The electron lens is located adjacent to the target for giving the beam more precise focusing and in order to direct the beam upon one of the particular strips of color phosphors. The lens is made up of a plurality of parallel metal plates (27)

extending vertically over the entire target area between which are a second set of parallel plates (27') of the same width and length. The two sets of plates are insulated from each other. The spacing between the plates corresponds with the width of vertical target strips 15. A metallic mesh or gauze electrode (35 and 37) is placed adjacent to the forward and rear face of the lens structure and a positive potential of about 5000v is applied to electrode 35 through the connection 43 and

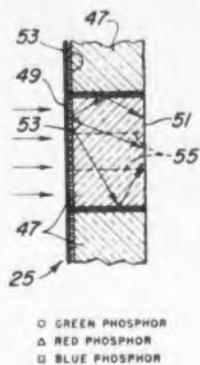
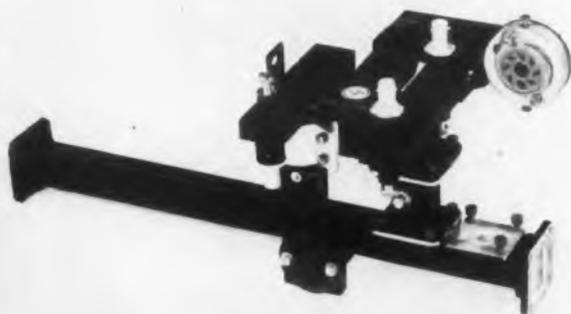


Fig. 4. Magnified cross-section of the target.



Microwave
Assemblies,
Radar Components,
and Precision
Instruments . . .
manufactured and
designed to your
specifications.



N.R.K. MFG. & ENGINEERING CO.

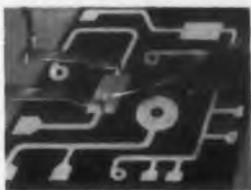
4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPing 7-2970

West Coast Representatives TUBERGEN ASSOCIATES 2232 W. 11th St., Los Angeles 6, Calif.

CIRCLE ED-372 ON READER-SERVICE CARD FOR MORE INFORMATION

Don't call any cutting job "impossible"

... until you've investigated the "AIRBRASIVE" PROCESS



Excellent for cutting and shaping fragile crystals.



Ideal for abrading resistance elements on printed circuits.

- Cool, fast and shockless action. Ability to cut through
- wafer-thin sections of hard, brittle materials. A range
- of controlled cutting effects including drilling, notching, etching, scoring and accurate removal of deposited surface coatings. These are a few of the features
- that make the "Airbrasive" process ideal for jobs
- which can't be handled by conventional methods.
- It will pay you to investigate this unique and versatile process. We'll be glad to conduct
- tests on your samples or arrange a demonstration at either our New York or California office.
- For complete information write for Bulletin 5411.
- Address Dept. 10.



THE *S. White* INDUSTRIAL DIVISION
DENTAL MFG. CO.



10 East 40th Street
New York 16, N.Y.

Western District Office • Times Building, Long Beach, California

A-1

CIRCLE ED-373 ON READER-SERVICE CARD FOR MORE INFORMATION

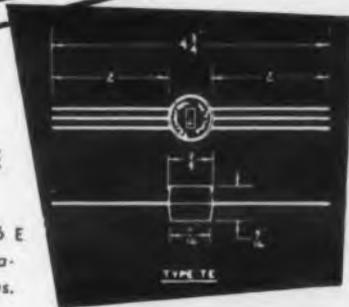
encapsulated
PULSE TRANSFORMERS
wound to your requirements

SMALL IN SIZE

Weight—1/3 oz.



TYPE TE

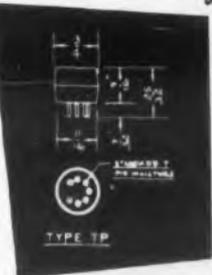


Write for Bulletin 166 E
for additional information
and specifications.

TYPE TP



SMALL IN PRICE



TYPE TP

T
ECHNITROL
ENGINEERING COMPANY
2751 N. 4th St., Philadelphia 33, Pa.

CIRCLE ED-374 ON READER-SERVICE CARD FOR MORE INFORMATION



CONVENIENCE

With **8** Velocity Ratings

Rotron "Determinator Kit" allows quick experimental determination of air velocity and of air turbulence at any point in an air circuit. The "Kit" consists of a Rotron Model 2A Electrical Air-Interlock switch together with 8 clip-on sensing vanes of different rating ranging from 1000 to 4000 Ft./Min.

A handy kit for every radio design engineer to keep in his desk—nothing like it for prototype work.

Immediate delivery ● \$14.50 Each—Quantity Discounts ● Incl. Application notes

- Works in both up and down stream
- Interchangeable actuating vanes
- Mounts on round and flat ducts through simple round hole
- SPDT contacts—5 AMP 250 VAC—Differential better than 25%
- Two metal-to-metal bearings



**DETERMINATOR
KIT**

ROTRON MFG. CO.

7 Schoonmaker Lane

Woodstock, N. Y.

CIRCLE ED-375 ON READER-SERVICE CARD FOR MORE INFORMATION

for all applications
requiring exceptionally
high insulation
resistance and unusual
stability at high
temperature



2082 Lincoln Ave.,
Altadena, Calif.
SYcamore 8-1185
Offices in
WASHINGTON, D.C.
and DETROIT

HOPKINS "HY-THERM"

New sub-miniature
high temperature

CAPACITOR

Hermetically sealed and metal encased, new HY-THERM capacitors have been designed to meet or exceed military requirements (Mil-C-25A). Example: At 125°C the minimum insulation resistance is 20 megohm-microfarads and maximum insulation resistance is 500 megohms. Available in all standard values and tolerances. Variety of mounting and circuit combinations. Special units designed to meet individual requirements.

HOPKINS
Engineering Co.

Have a special problem? Write,
wire or phone for details, TODAY!
Catalog available.

CIRCLE ED-376 ON READER-SERVICE CARD FOR MORE INFORMATION

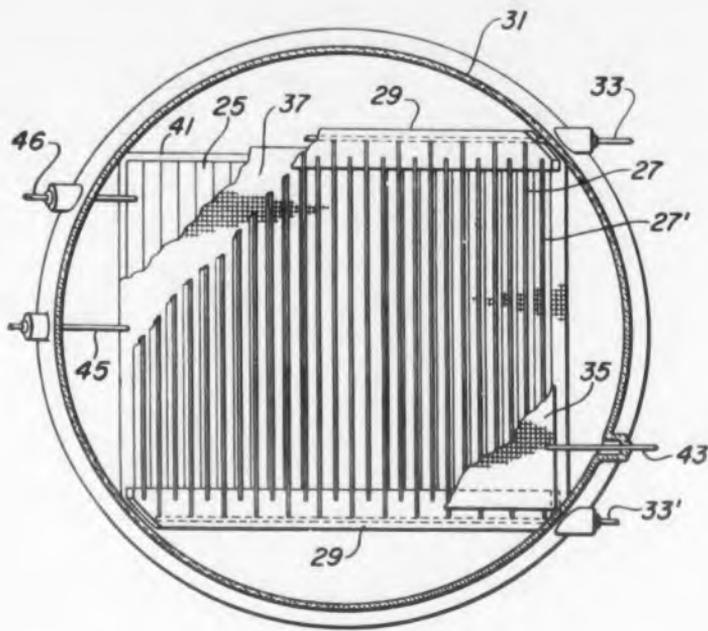


Fig. 5. The construction of the grid-like electron lens of the Lawrence tube.

the same or a higher potential is applied to electrode 37 through the connection 47. Lens grid 27, 27' have a negative potential of about 700v applied to them through connection 33 and 33'. This secondary lens is adjacent to the target so that the electron beam from the gun is focused by the lens structure into an elongated or line

beam of narrower width than the color strips (53). For a tube of high brilliance a potential of about 50,000v may be applied to the metallic coating (49, Fig. 4).

In order to give the beam a secondary deflection at the lens to direct the beam to the red or blue strip, metal plates 27 and 27' have stepped negative control po

Fig. 6
tential
plates
beam
so tha

A. R. C. CERAMIC INSULATED TERMINAL BOARDS



Resist Arcing, End Flash-Over Damage

These high performance components were developed to insure reliability in our own airborne equipment. They have a wide variety of other electronic applications.

Made of special ceramic material and silicone coated, they are extremely resistant to moisture and heat and are fungus-proof. Because

they furnish no continuous path for a short, arcing is minimized. Even in the event of a flash-over, there is no permanent damage to the part, as with phenolic boards. Longer life and fewer replacements mean lower true cost. Their type of construction permits positive, neat connections at terminals. Write for detailed literature.

Dependable Airborne Electronic Equipment Since 1928

AIRCRAFT RADIO CORPORATION
BOONTON, NEW JERSEY



CIRCLE ED-381 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • January 1955

ELECTR

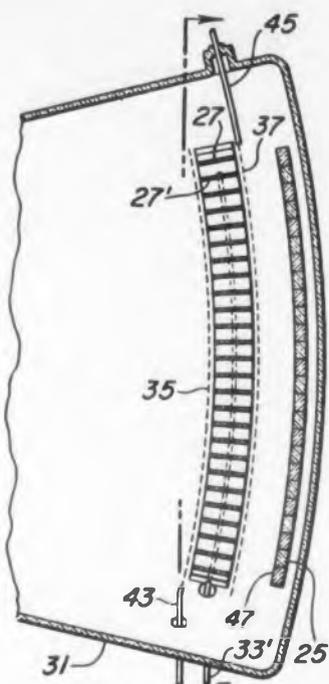


Fig. 6. Cross-section of the electron lens.

tentials applied to them. When one set of plates has a higher negative potential the beam is deflected towards the other plate so that the beam impinges on the opposite

color strip and vice versa. By using a stepped lens control potential of the proper frequency the picture tube and lens structure described may be used for a frame, line, or dot sequential system. With the tube described, the deflection of the beam for color selection may be made at low potentials.

The patentee has disclosed many variations in the lens structure some for simplifying the structure and others to illustrate the variations which may be made. Other refinements in the form of the tube are also explained in the patent for securing improved results.

Displaced Person

On p. 90 of the September, 1954, issue of *ELECTRONIC DESIGN*, it was incorrectly stated that Milton D. Rubín, inventor of a "Method of Manufacturing a Conductive Coated Sheet" (Patent No. 2,680,699) resides in *Rochester, Mass.* At the time the patent was issued, Mr. Rubín resided in *Dorchester, Mass.*, but now resides in *Newton, Mass.*

Finest
CLOSELY-REGULATED
PRECISION
DC POWER SUPPLIES
HIGH VOLTAGE—HIGH CURRENT



CONTROL: Magnetic Amplifier.
OUTPUT: 6 to 500 VDC at 5 to 200 Amps. continuous.
RIPPLE: As low as 0.01% RMS.—or to customer's specification.
REGULATION—Steady State. $\pm 0.15\%$ no load to full load.
Dynamic. $\pm 0.2\%$ under extreme load or line change.
PRECISE REGULATION . . . for Laboratory or Production work.

Designed to meet the most exacting requirements of the Electronics industry, INET Precision Power Supplies combine the long-life performance of selenium rectifiers with the rugged dependability of magnetic amplifier controls.

PROTECTED . . . Engineered for long, trouble-free operation, Units are fully protected against overloads and static elements eliminate maintenance.

COMPACT—Simple to Install and Operate . . .

Requires minimum space, housed in steel cabinets with meters and controls mounted for quick visibility and operation. Available in wall, floor-standing or caster mounted models.

Write for Technical Bulletin—Contains Complete Engineering Specifications

Phone L^Ogan 8-4771

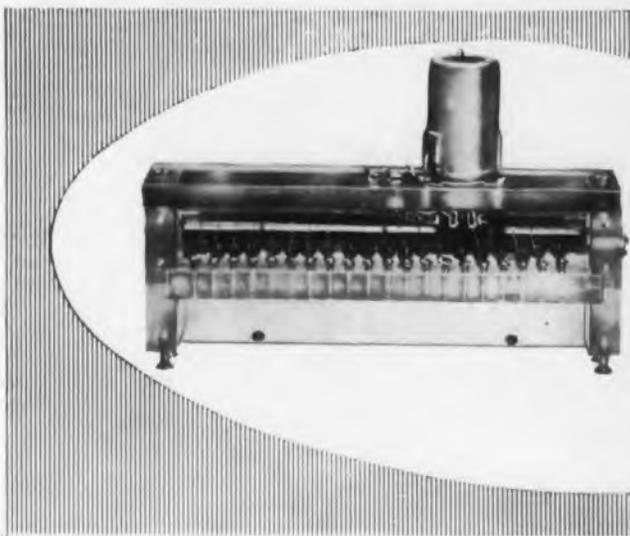
CIRCLE ED-386 ON READER-SERVICE CARD FOR MORE INFORMATION



Division of
LEACH CORPORATION

4441 Santa Fe Avenue
Los Angeles 58,
California

**this is a
custom-
made*
sub-assembly
by ESC**



*Custom-made to meet the most precise specifications through years of research and production experience. Our facilities are organized for design, development and production of delay lines, networks, pulse transformers, etc., incorporated into precision electronic sub-assemblies.

Brochure Available Upon Request



C O R P O R A T I O N

534 Bergen Blvd., Palisades Park, New Jersey

CIRCLE ED-387 ON READER-SERVICE CARD FOR MORE INFORMATION

GOLD INLAY KNOBS

IN ANY QUANTITY!

... and Never a Tool Charge

NEW GEE-LAR GOLD INLAY KNOBS

You can get beautiful gold inlay knobs, pointers, instrument controls . . . thousands of styles and varieties . . . in any quantity from GEE-LAR—The House of Knobs. They're available in both knurled and spring types, in either walnut or ivory backgrounds. For faster service and lower cost . . . plus the widest selection . . . get your Gold Inlay Knobs from GEE-LAR!

**WRITE TODAY
for GEE-LAR Catalog
IT'S FREE!**



THE HOUSE OF KNOBS

GEE-LAR MANUFACTURING COMPANY

824 Elm Street •



CIRCLE ED-388 ON READER-SERVICE CARD FOR MORE INFORMATION

Consider the tinker:

he spread himself too thin...

One early example of the non-specialist was the Traveling Tinker. Unlike the blacksmith, the gunsmith or other engineering-minded specialists of that day, the Tinker did everything. His work was just good enough to last his pioneering customers until someone better equipped came along. Sooner or later someone always did . . . and the Tinker lost his customers. Then he drifted on. Finally progress overtook him completely and we see him no more.

We have seen similar changes in our times too. Before specialized component manufacturers came on the scene a few years ago, leading engineers had to spread themselves pretty thin . . . the designer of complex new equipment had to devise from scratch on the tiniest details. Designing a hermetic seal, say, was part and parcel of developing a sensitive relay. This is no longer so.

Like many in the electronics industry, Hermetic Seal Products Co. has specialized in a particular product and related service. Our concentrated effort has resulted in producing, for other engineers' use, hermetic seals with performance characteristics undreamed of a few years ago. This specialized attention continually brings forth new advances in our products and those of our customers.

Hermetic's specialized engineering of VAC-TITE* and matched glass seals can be applied to your particular problems, too. Why not write today for particular information and for our latest addition to the "Encyclopedia Hermetica"? . . . Sent free when requested on company letterhead.



Hermetic Seal Products Company

33 South Sixth Street • Newark 7, New Jersey

F I R S T & F O R E M O S T I N M I N I A T U R I Z A T I O N

CIRCLE ED-423 ON READER-SERVICE CARD FOR MORE INFORMATION



Advertising Index

January 1955

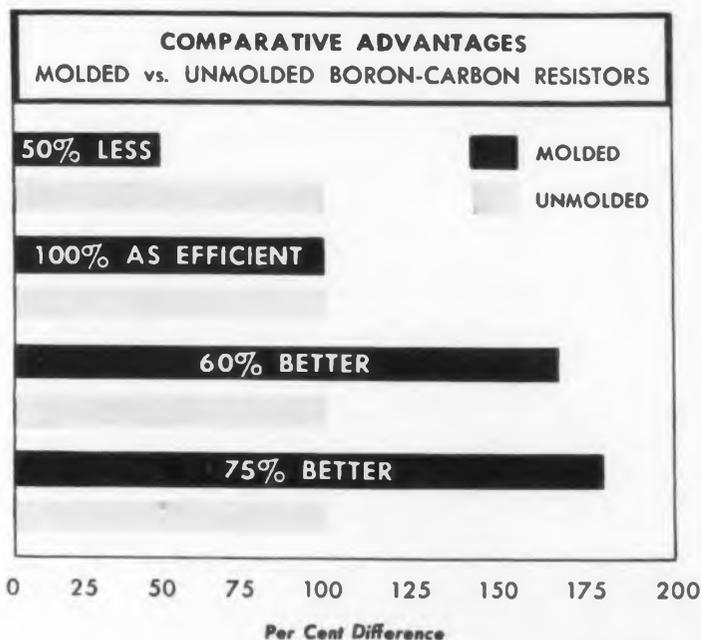
Advertiser	Page
Aircraft-Marine Products, Inc.	62
Aircraft Radio Corp.	120
Alpha Metals, Inc.	95
Allen-Bradley Co.	29
Allied Control Co., Inc.	75
Allied Radio Corp.	93
Amerac, Inc.	35
American Lava Corp.	71
American Phenolic Corp.	84
American Relay & Controls, Inc.	67
Arga, Div. of Beckman Instruments, Inc.	80
Arnold Engineering Co., The	44
Assembly products, Inc.	87
Astron Corp.	39
Atlas Engineering Co., Inc.	108
Avion Instrument Corp.	113
Baker & Co., Inc.	67
Baird Associates, Inc.	93
Barry Corp., The	109
Bead Chain Mfg. Co., The	116
Bendix Aviation Corp., Eclipse-Pioneer Div.	90
Bennett Mfg. Co.	113
Berkeley, Div. of Beckman Instruments, Inc.	56
Biddle, James G. Co.	88
Birtcher Corp., The	94
Bliley Electric Co.	83
Bomac Laboratories, Inc.	10
Bourns Laboratories	87
Bradley Laboratories, Inc.	98
Bruno-New York Industries Corp.	96
Brush Electronics Co.	115
Burndy Engineering Co.	70
Burnell & Co., Inc.	36
Cambridge Thermionic Corp.	67
Cannon Electric Co.	107
Chatham Electronics Corp.	118
Chicago Standard Transformer Corp.	30
Computer Co. of America, Div. of Bruno-N. Y. Ind. Corp.	80
Constantin, L. L. & Co.	57
Convair, Div. of General Dynamics Corp.	78
Cords Limited, Div. of Essex Wire Corp.	107
Corning Glass Works	98
Coto-Coil Co.	94
Curtis Development & Mfg. Co.	74
Dale Products, Inc.	115
Daven Co., The	4
DeJur Amsco Corp.	82
Dectron Corp., The	87
Donner Scientific Co.	111
Dow Corning Corp., The	51
Du Mont, Allen B., Laboratories, Inc.	6
Durant Mfg. Co.	99
ESC Corp.	121
Eastern Air Devices, Inc.	99
Eitel-McCullough, Inc.	64
Elastic Stop Nut Corp. of America	87
Electrical Industries	73
Electrical Products Corp.	83
Electro-Mechanical Specialties Co., Inc.	115
Electro-Mec Laboratory, Inc.	83
Electro-Motive Mfg. Co., Inc.	106
Electronic Fabricators, Inc.	118
Electronic Parts Mfg. Co., Inc.	103
Elgin-Neomatic, Inc.	117
Fairchild Camera & Instrument Corp.	99
Federal Tool & Mfg. Co.	111
Ford Instrument Co.	78
Freed Transformer Co., Inc.	2
G-M Laboratories, Inc.	83
G-V Controls, Inc.	34
Gee-Lar Mfg. Co.	121
General Electric Co., Apparatus Sales	84
General Electric Co., Apparatus Sales	49
General Electric Co., Electronics Div.	12
General Precision Equipment Corp.	109
General Radio Co.	105
General Transformer Co.	103
Genisco, Inc.	110
Globe Industries, Inc.	79
Green Instrument Co., Inc.	106
Gries Reproducer Corp.	104
Grieve-Hendry Co., Inc.	85
Gudeman Co., The	74
Hartwell Co.	70
Haydon, The A. W. Co.	104
Helipot Corp.	110
Heminway & Bartlett Mfg. Co., The	122
Hermetic Seal Products Co.	46
Hoffman Laboratories, Inc.	120
Hopkins Engineering Co.	58
Hughes Aircraft Co.	90
Hughes Research & Development Labs.	108
Hycor Co., Inc.	101
Imtra Corp., G. E. Co., Ltd.	101

Page	Company Name	Page
62	Div. of Leach Corp.	121
120	International Rectifier Corp.	117
95	International Resistance Co.	123
29	FD Mfg. Co., Inc.	114
75	Jennings Radio Mfg. Corp.	92
93	Johnson, E. F. Co.	98
35	Jones, Howard B., Div. of Cinch Mfg. Corp.	105
71	Kearfoot Co., Inc.	95
86	Kearfoot Co., Inc., Western Mfg. Div.	50
47	Kellogg, The M. W. Co.	77
80	Kellogg Switchboard & Supply Co.	74
44	Kenyon Transformer Co., Inc.	61
87	Leeco Laboratories	17
39	Lester Solder Co.	109
108	Metron Instrument Corp.	11
113	Knights, James Co.	116
67	Landis & Gyr, Inc.	101
93	Librascope, Inc.	116
109	Lindgren, Erik A. & Associates	113
116	Little Falls Alloys, Inc.	108
90	Litton Industries	23
113	Lockheed Aircraft Corp., Missile Systems Div.	91
67	Lucas Mfg. Co.	33
93	Magnetics, Inc.	54
109	Malayan Tin Bureau, The	104
116	Malco Tool & Mfg. Co.	105
90	Merit Coil & Transformer Corp.	82
113	Metron Instrument Co.	66
56	Metron Instrument Co.	107
88	Micro Switch, Div. of Minneapolis-Honeywell Regulator Co.	47
94	Microwave Associates, Inc.	100
83	Milwaukee Resistor Co.	111
10	Moloney Electric Co.	8
87	MOR Mfg. & Engineering Co.	119
98	National Semi-Conductor Products	85
96	Newark Electric Co.	110
115	Norris-Thermador Corp.	100
70	Olympic Metal Products Co., Inc.	97
36	Oster, John Mfg. Co., Avionic Div.	31
67	Pacific Relay Co.	106
107	Pacific Scientific Co.	56
118	Pacific Scientific Co.	80
30	Perkin-Elmer Corp., Vernistat Div.	76
88	Perkin Engineering Corp.	53
57	Phalo Plastics Corp.	110
78	Phillips Control Corp.	108
107	Photocircuits Corp.	69
98	Pike, E. W., & Co., Inc.	108
94	Plastic Capacitors, Inc.	96
76	Polytechnic Research & Dev. Co., Inc.	92
115	Potter Instrument Co., Inc.	3
82	Preco, Inc.	66
87	Pyramid Electric Co.	16
111	R-B-M, Div. of Essex Wire Corp.	112
51	Radio Cores, Inc.	72
6	Radio Corp. of America, Tube Dept.	124
99	Radio Materials Corp.	81
121	Ram Meter, Inc.	68
99	Rapi Design, Inc.	92
64	Ratheon Mfg. Co.	18
87	Raytheon Mfg. Co.	32
73	Raytheon Mfg. Co.	118
83	Resinite Corp., Div. of Precision Paper Tube Co.	92
115	Resistance Products Co.	112
83	Rotron Mfg. Co.	97
106	Servomechanisms, Inc.	107
118	Shakeproof, Div. of Illinois Tool Works	92
103	Shallcross Mfg. Co.	109
117	Shallcross Mfg. Co.	61
99	Sigma Instruments, Inc.	107
111	Simmons Fastener Corp.	68
70	Southern Electronics Corp.	104
83	Speer Carbon Co., Jeffers Electronics Div.	14
60	Sprague Electric Co.	111
94	Star Stainless Screw Co.	37
121	Stackpole Carbon Co.	74
60	Staedtler, J. S., Inc.	109
94	Standard Pressed Steel Co.	59
104	Statham Development Corp.	7
122	Stevens Mfg. Co., Inc.	104
45	Superior Tube Co.	89
103	Sylvania Electric Products, Inc.	55
110	Sylvania Electric Products, Inc., Tube Dept.	119
70	Technitrol Engineering Co.	15
104	Tektronix, Inc.	72
65	Texas Instruments, Inc.	101
74	Tarrington Co., The	79
93	Transitron Electronic Corp.	91
104	Tung-Sol Electric, Inc.	70
110	Uniform Tubes, Inc.	93
122	Unimac Switch, Div. of The W. L. Maxson Corp.	28
45	United States Gasket Co.	102
120	United States Radium Corp.	100
90	Valpo Crystal Corp.	114
108	Victor Instrument Co., The	59
101	Victory Engineering Corp.	86
	Vokar Corp.	106
	Warc Leonard Electric Co.	64
	Waters Mfg. Co.	30
	Westinghouse Electric Corp.	119
	Whitcomb, S. S. Dental Mfg. Co.	102
	Wincor Electronics, Inc.	

NOW

a *molded* boron-carbon resistor

The inherent superiority of a boron-carbon resistor is now available with added advantages of a fully insulated unit. The IRC Type MBC 1/2 watt, 1% resistor offers significantly better characteristics plus protection against damage during assembly. Send coupon for detailed information.



**Eliminates Danger
Of Mechanical Damage**

**Improves Electrical
Characteristics**

**Costs No More
Than IRC Unmolded Type
With Protective Sleeve**

Wherever the Circuit Says

IRC

INTERNATIONAL RESISTANCE CO.
Philadelphia 8, Penna.

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

INTERNATIONAL RESISTANCE COMPANY

Dept. D, 401 N. Broad Street, Philadelphia 8, Pa.

Please send Technical Bulletin describing Type MBC resistors:

Name

Title

Company

Address

City State

CIRCLE ED-424 ON READER-SERVICE CARD FOR MORE INFORMATION

Another **RCA** "First!"



NEW
"WORKHORSE"

FOR TV

RCA-6CG7..Miniature Version of the Popular 6SN7-GT

- New miniature design
- Same ratings as RCA-6SN7-GT
- 600 ma heater with controlled warm-up time (for "series-string" operation)
- New isolating shield between triode units

Designed with the same ratings as the 6SN7-GT, RCA-6CG7 is another product of RCA's basic program to anticipate and develop tubes to meet designers' tube requirements today—and in the future.

Engineered for modern TV circuitry including "series string" designs, RCA-6CG7 is

particularly useful as a deflection oscillator. It employs a 600-milliamperere heater having controlled warm-up time to insure dependable performance in television receivers employing a single series-connected heater string. Then too, it has an internal shield to prevent electrical coupling between the triode units.

The 6CG7 is also well-suited for use as a phase inverter, multivibrator, synchronizing separator and amplifier, and resistance-coupled amplifier in electronic equipment.

For technical information, call your local RCA Field Representative. Or write RCA, Section A18Q, 415 S. Fifth St., Harrison, N. J.

CIRCLE ED-425
READER-SERVICE
CARD FOR MORE
INFORMATION



RADIO CORPORATION of AMERICA
ELECTRON TUBES
HARRISON, N. J.