

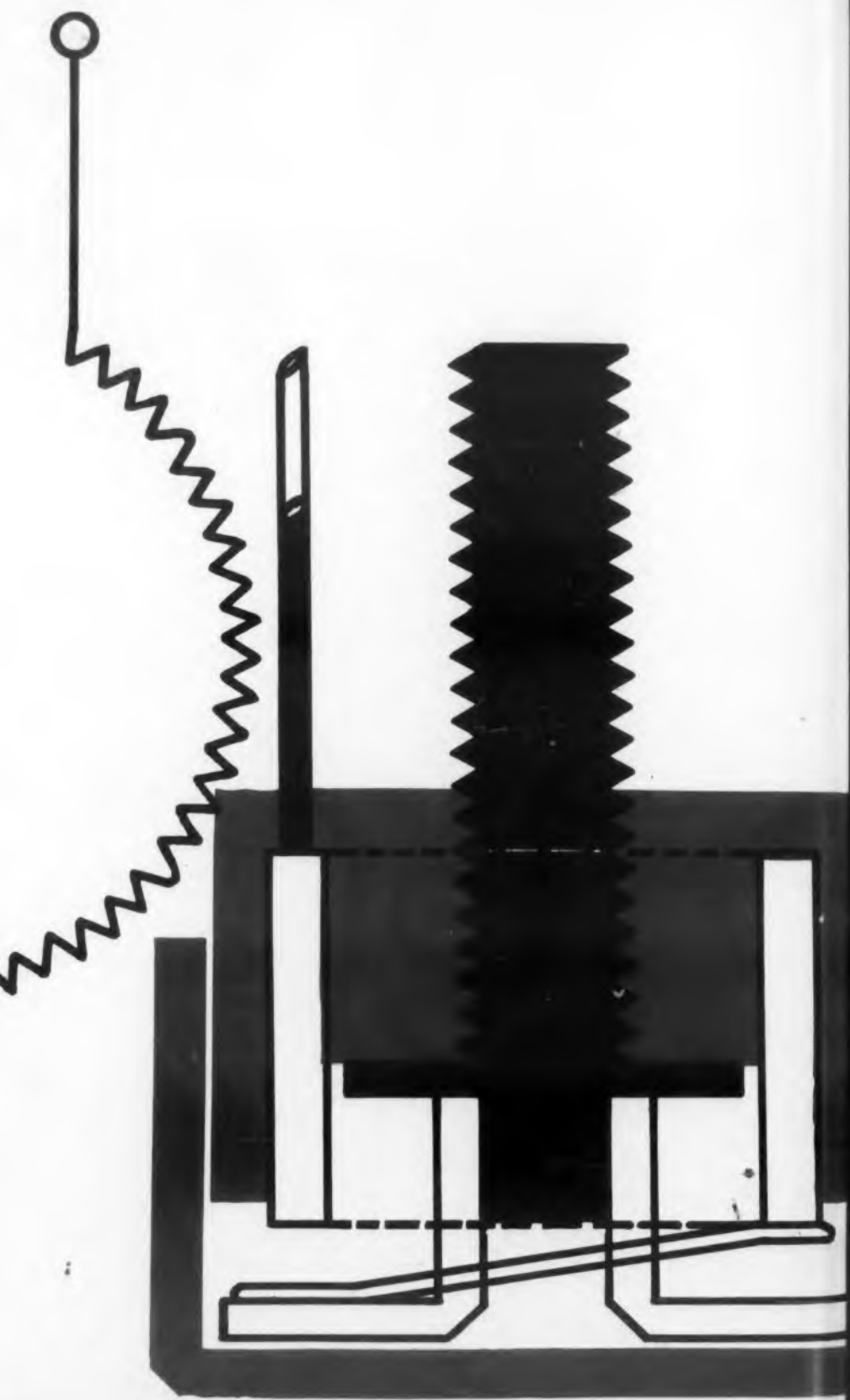
..... page 30

Submitriature Potentiometer



FROM SIGN

JAN 18 1957



D

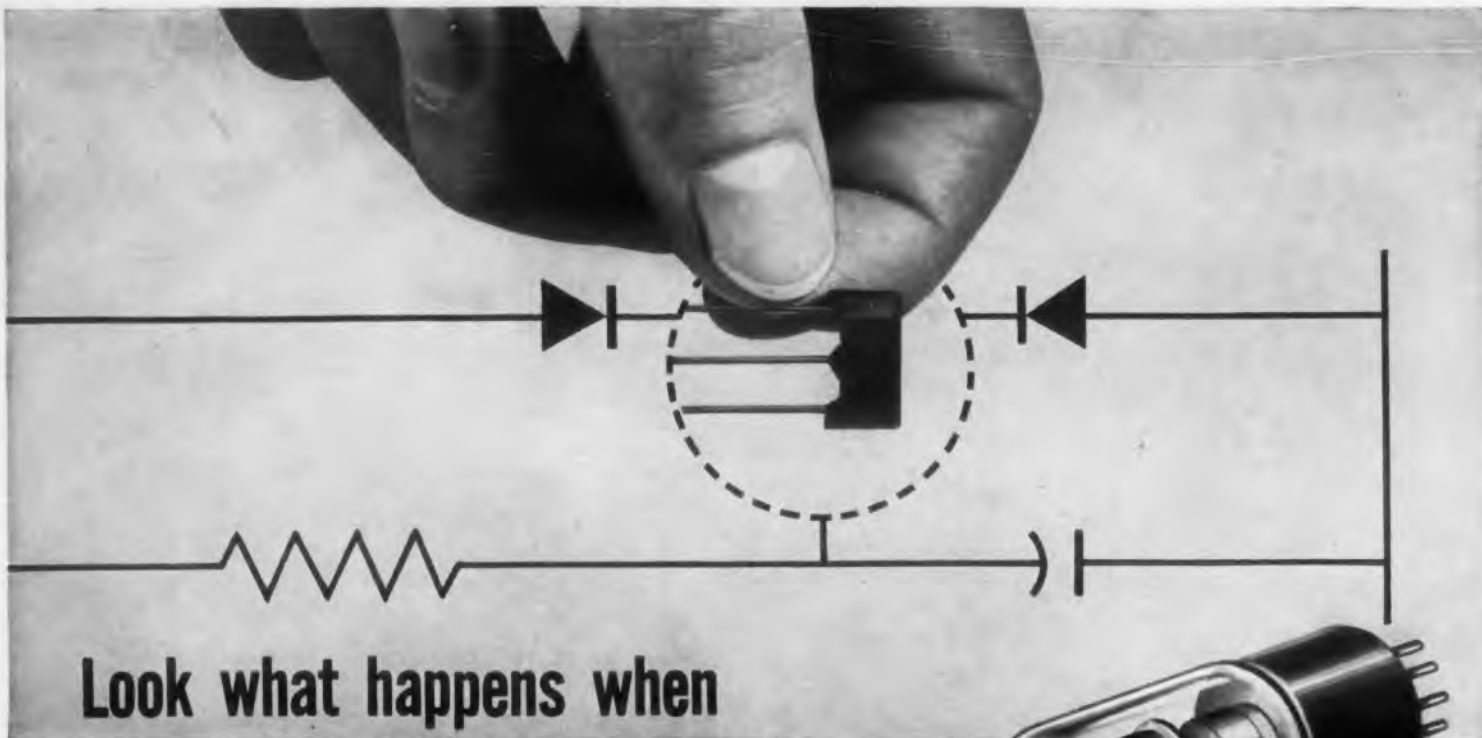
T

C

F

L

E



MICROSTAK diodes replace tubes

By replacing dual diode vacuum tubes with MICROSTAK Selenium Dual Diodes, you can now save space and money in many low current applications calling for high back resistance and low forward resistance. These IRC components not only eliminate all the added bulk, sockets, and assembly connected with tubes, but are also economical to buy and use.

MICROSTAK Selenium Dual Diodes cover a microampere to milliampere current range at voltages as high as several thousand volts. Furthermore, they are available in molded plastic, hermetically sealed glass, and other enclosures. As a result, MICROSTAK Selenium Diodes deliver the performance you want in power supplies, voltage regulators, balanced modulators, arc suppression, meter overload protection, logarithmic converters, magnetic amplifiers, and many other applications.

SEE NEW IRC COMPONENTS AT WESCON BOOTH 1023.



INTERNATIONAL RESISTANCE CO.

Dept. 262, 401 N. Broad St., Phila. 8, Pa.

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

Send bulletins on Selenium Diodes Varistors

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

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

Wherever the Circuit Says

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



CIRCLE 1 ON READER-SERVICE CARD FOR MORE INFORMATION

Staff

Editor	Edward E. Groze
Managing Editor (Acting)	J. A. Lippke
Associate Editor	E. T. Ebersol, Jr.
Assistant Editors	S. Dresner P. J. Lahey T. E. Mount D. S. Viebig
Washington Editor	H. H. Rosen National Press Bldg. 1346 F St., NW Washington, D.C. STerling 3-8912
West Coast Editor	H. C. Jordan 5720 Wilshire Blvd. Los Angeles, Calif. WEbster 5-5158
Contributing Editors	S. H. Hubelbank J. M. Monstream J. G. Adashko R. D. Thornton E. Brenner A. Nadell
Editorial Assistants	G. A. Schwartz F. Muehleck M. S. Buckley M. J. Madden
Art Director	S. Sussman
Asst. Art Director	R. A. Schulze
Production Manager	T. V. Sedita
Asst. Production Manager	M. W. Baron
Business Manager	P. L. Canfield
Circulation Manager	S. Buffinton
Reader Service	L. R. Wendt

Co-Publishers

T. Richard Gascoigne
James S. Mulholland, Jr.

Advertising Sales Manager

Bryce Gray, Jr.

Advertising Representatives

New York: Owen A. Kean
19 E. 62nd St.
TEmpleton 8-1940
Lawrence Conover
Robert W. Gascoigne

Chicago: Thomas P. Kavooras
664 N. Michigan Ave.
SUperior 7-8054
Berry Conner, Jr.
R. Nelson Jolliffe

Los Angeles: Robert E. Ahrensdorf
5720 Wilshire Blvd.
WEbster 8-3881
Earl W. Wilken
John Quillman

Subscription 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 subscription without charge provided you send us the following information on your company's letter head: 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, describe those responsibilities. Job changes require requalification.

Subscription rate for non-qualified subscribers — \$12.00 for 1 year only.

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

ELECTRONIC DESIGN

Contents

Vol. 5, No. 4

February 15, 1957

Subminiature Potentiometer (Cover)	30
Editorial	4
Engineering Review	5
Washington Report	15
Features	
Design for Molding Small Plastic Parts, G. A. Scherry	22
Series-String Tubes, R. M. Hughes	26
Subminiature Potentiometer	30
Printed Circuits for Military Equipment, J. K. Scott	32
Selecting Plastic Materials, R. R. Moyer	36
Oriented-Ceramic Permanent Magnet	38
Selection and Application of Precision Film Resistors, P. Nyul, C. Wellard	40
Closer Crystal Oven Temperature Control, M. D. McFarlane, R. B. Metz	44
Binary Code Indicator	48
Ideas for Design	
Triple Coincidence Thyatron, J. N. Higgins	112
Tube Pin Cleaning	114
Light Deflection-Yoke Cores	115
Rubber "Safety Glass" Interlayer	116
Glass-Filled Silicone	117
Acrylic Implosion Shields	118
Circuits for Low-Cost Transistors	119
Russian Translations	
What the Russians Are Writing	132
Abstracts	
Amplifier with 1 Cycle Bandwidth, E. Brenner	136
Heat Dissipation—Transistors Vs. Tubes	138
Departments	
Letters to the Editor	16
Meetings	18
New Products	50
Production Products	96
New Literature	100
Report Briefs	120
Patents	126
Books	130
Standards & Specs	139
Careers Section	141
Advertisers' Index	145

NBP

ELECTRONIC DESIGN is published semi-monthly by Hayden Publishing Company, Inc., 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Acceptance under section 34.64 P. L. & R. authorized. Copyrighted 1957 Hayden Publishing Company, Inc. 30,000 Copies this issue.

BPA



another NEW G-V relay

... designed for long life, low cost, dependable operation



RED • DOT thermal TIMING RELAYS

G-V RED DOT THERMAL TIMING RELAYS provide the dependability and long life previously available only in relays at much higher cost. They utilize G-V's sound design, sturdy construction and reliable operation in a form fully qualified for industrial control and yet still light and inexpensive enough for use in electronic and communication circuits.

FEATURES: Rugged stainless steel mechanism • Shatterproof—no glass • Steel encased heaters • Dust tight enclosure • Tamper proof • Delays of 2 seconds to 3 minutes • Energizing voltages—6.3 to 230 AC or DC

AVAILABLE FROM STOCK



AIR
CONDITIONING



ELECTRONIC
EQUIPMENT



HEATING
EQUIPMENT



COMMUNICATIONS
EQUIPMENT



INDUSTRIAL
CONTROL

Write for
publication 130

Leading the
Field in
Thermal Relays



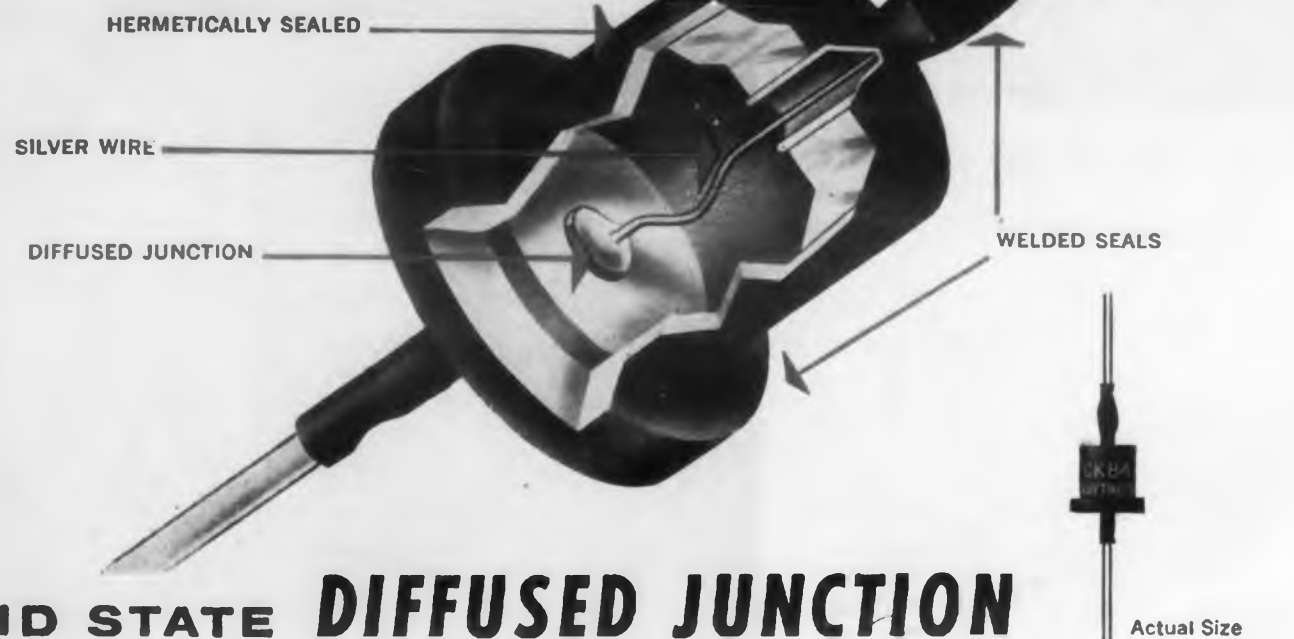
G-V CONTROLS INC.
18 HOLLYWOOD PLAZA, EAST ORANGE, N. J.

CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

another

RAYTHEON

first!



SOLID STATE **DIFFUSED JUNCTION** **SILICON RECTIFIERS** now in **QUANTITY PRODUCTION**

Uniform Characteristics — Uniformly High Quality

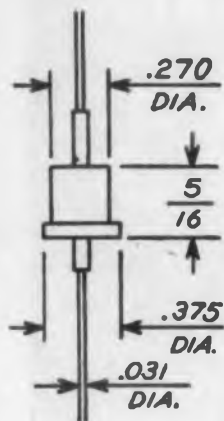
The Solid State Diffusion Process involves the formation of a junction by diffusing suitable gaseous materials into silicon at high temperatures. This process offers many advantages including:

1. Exact control of junction penetration.
2. Precise junction gradient for specific rectifier applications.
3. Flat junctions for uniformity and control of characteristics.

Operating Temperatures — minus 65°C to plus 165°C

Storage Temperature — up to 175°C

Hermetically Sealed — Welded



AVERAGE CHARACTERISTICS — **NEW**, IMPROVED RATINGS

Type	Peak Inverse Volts*	Forward Current**		Forward Volts at 300 mA _{DC} 25°C	Reverse Current (mA _{DC}) (max) at PIV 25°C
		100°C	150°C		
CK840 (1N537)	100	500	250	1.0	0.002
CK841 (1N538)	200	500	250	1.0	0.002
CK842 (1N539)	300	500	250	1.0	0.002
CK843 (1N540)	400	500	250	1.0	0.002
CK844	500	500	250	1.0	0.002
CK845	600	500	250	1.0	0.002

*PIV ratings apply from -65°C to +165°C

**Into inductive or resistive load



SEMICONDUCTOR DIVISION

Silicon and Germanium Diodes and Transistors • Silicon Power Rectifiers

NEWTON, MASS.: 150 California St. • DEcatur 2-7177
NEW YORK: 589 Fifth Ave. • PLaza 9-3900
CHICAGO: 9501 Grand Ave., Franklin Park • TUxedo 9-5400
LOS ANGELES: 5236 Santa Monica Blvd. • NOrmandy 5-4221

CIRCLE 3 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

More Clock Watchers Needed

To suggest that engineers be clock watchers may seem like a contradiction of what we've been "preaching" on using our available engineering manpower more efficiently. But, let's see!

The engineer who is oblivious to time—who never knows when it's time to go home for instance—may not be management's best candidate for a raise or promotion! If he never gets home on schedule to eat supper with his family, he most likely has formed similar habits in his work. He may fail to get his design assignments out on time. This doesn't necessarily mean he is unenthusiastic about his job and company—only that he may work in an unorganized fashion, possibly working furiously in every direction extraneous to the one producing the desired or prescribed result.

The engineer who is most valuable is the one who is punctual in all things—one who can organize his time, allowing only the amount of time for each project that the project deserves and then disciplining himself to produce an acceptable product in the allotted period. True, this involves judgment and perseverance; and good judgement often depends on experience. There will be errors; but, with experience, they will be less frequent and less costly—provided constant attention is given to this most vital element in the engineer's development.

How often we've heard the engineer say: "How can I estimate the design time for this (or that) project when I can't predict the troubles I'll have?" Where a design project takes an estimated 18 months or 2 years for instance, the law of averages on delays and good fortune should make it possible to come out on schedule, provided the estimate is based on good previous experience and reasonable suppositions. Yet, how often does a project finish on schedule? The delays seem to beset element after element of the project; but rarely is an element completed ahead of schedule! The law of averages should (on long-range projects, at least) produce an equal number of surprises that work *for* as well as against completion on schedule.

Self-discipline in clock watching by design engineers can produce dividends—greater output per unit time, greater company profits, greater peace of mind, and surprisingly enough, a higher quality product. It should also help relieve the engineering shortage. Try it, and see for yourself. Let's match our time on every project. Let's be better clock watchers!—ETE.

Engineering Review

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



Portable Dictating Machine: This book size, 4-1/2 lb. transistor dictating machine can operate on two self-contained batteries, as well as automobile and home voltage. Manufactured by Peirce Dictation Systems, Inc., Chicago, Ill., it holds 15 minutes of dictation on each magnetic-tape belt. It could be a valuable aid at conventions and conferences to the engineer who dislikes taking written notes.

IRE Opens Professional Groups

The Institute of Radio Engineers has announced that qualified non-IRE members may now join certain IRE professional groups *without* first having to join the IRE itself. Members of the Board of Directors regard this as one of the most important changes that has been made in the IRE structure in its 45 year history.

To be an affiliate of a Professional Group, a person must belong to an accredited organization approved by that Group and the IRE Executive Com-

mittee. Moreover, he shall not have been an IRE member during the five years prior to submitting his application.

The fee for Affiliates is to be the assessment fee of the Group, plus \$4.50. Affiliates cannot serve in an elective office, nor vote for candidates for these offices.

The Affiliate Plan is admittedly an experiment. So far as is known, no other society has ever tried a similar scheme. The Board of Directors feels strongly that the benefits afforded by the plan justify the risk that some persons who should join the IRE will instead become Affiliates. Participation in the plan is at the option of each Professional Group. It is not expected that all Professional Groups will adopt the plan.

High-Speed TV Office Duplicator

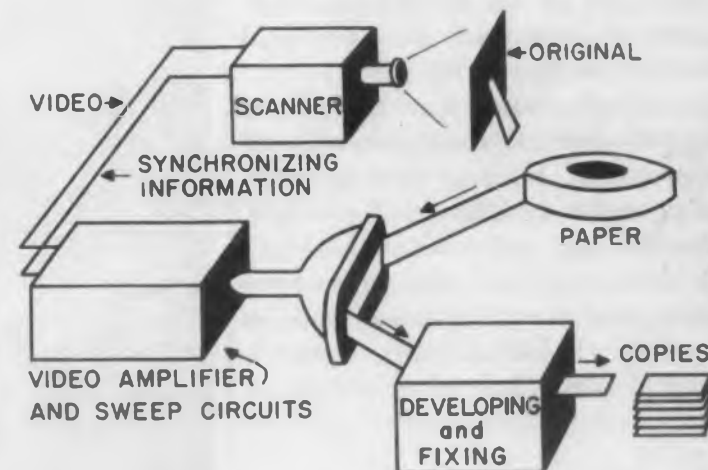
Original documents can be duplicated at the rate of 17,000 characters of elite type per second with a TV duplicating device developed by Stanford Research Institute, Menlo Park, Calif. A prototype, developed for A. B. Dick Co., prints the text from a 35 mm film on a 3/4 in. wide type. Proposed modifications will enable duplication on standard size letter paper.

At the point of transmission, a spot of light 0.006 in. in diameter scans the original document. Phototubes are positioned to receive light reflected from the document as it is scanned by the light beam. The tubes emit electrons proportional to the amount of light reflected to them.

At the receiver, the signal is amplified and ap-

plied to the grid of the cathode-ray tube. Whenever the transmitter beam strikes a dark spot, such as a portion of a language character, on a master document, the tube grid gets a greater positive electric charge. Immediately, a small dot of electric charge is deposited—by means of a wire array in the tube face-plate—on copy paper. After 1,700 successive scanings, a sufficient number of electrically charged dots is deposited on the paper to form a legible reproduction.

Because conventional TV cameras cannot adequately convey the fine detail found in typewritten documents, SRI is developing a special camera to transmit a signal of the sharpness desired for reproduction copies. A future use is seen for instantaneous transmission of documents from a central location to an unlimited number of printer units; in effect, a TV link counterpart of teletype, but without the necessity of phone circuits.



Flow Diagram—TV Office Duplicator

Now Up to 709

IBM 709, the latest addition to the International Business Machines Corporation's 700-series of electronic data processing machines is designed to help business management solve its problems scientifically. The 709 is the first equipment of its capacity that can work with equal facility on both commercial and scientific or engineering calculations.

It will vary considerably as to the number of units used, but a typical system will lease for around \$56,000 a month or sell for about \$3,000,000.

Union Carbide and Carbon Corporation has placed the first order for a 709 system. They plan to put it to work on scientific management problems such as sales forecasting and optimum distribution. One interesting application is the use of the 709 to pinpoint the best possible location for a new plant.

Mobile Smog Detective

"Silent Sam" the Franklin Institute's mobile smog detective that was sent to Los Angeles in August for on-the-spot studies of the Coast city's smog problem has given its first report. It is believed that ozone reacting with organic pollutants forms the as-yet-unidentified substances that damage plants and irritate eyes.

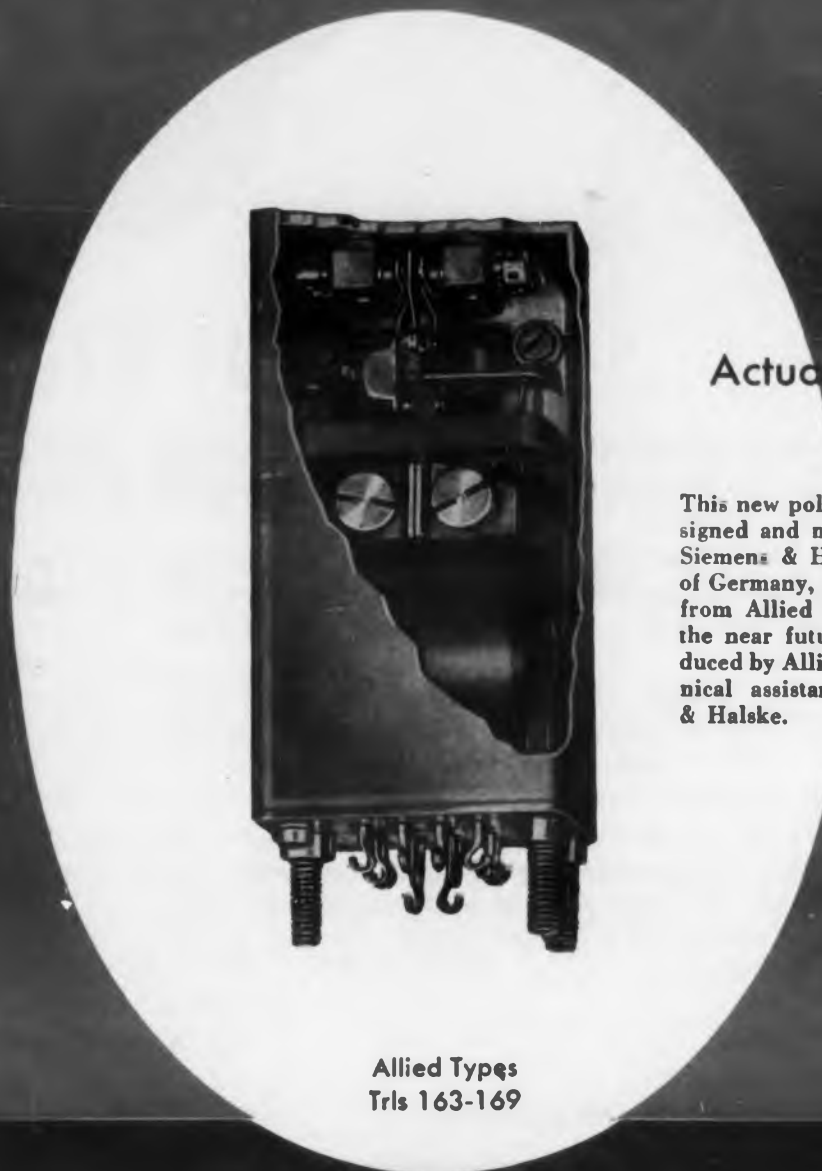
The fact that high concentrations of ozone are produced by reactions between nitrogen dioxide and organic compounds in the sunlit atmosphere is explained by the simultaneous formation of Compound X, a chemical identified as peracyl nitrate.

In scientific terms, Sam is an ultra-long-path infrared absorption cell and spectrometer. He is a very versatile and powerful analytical tool, and provides the only method for detecting and identifying the unsuspected or unknown gaseous constituents of smog as found in L.A.—especially unstable chemical compounds like the peracyl nitrate.

CIRCLE 4 ON READER-SERVICE CARD >

ALLIED'S

NEW



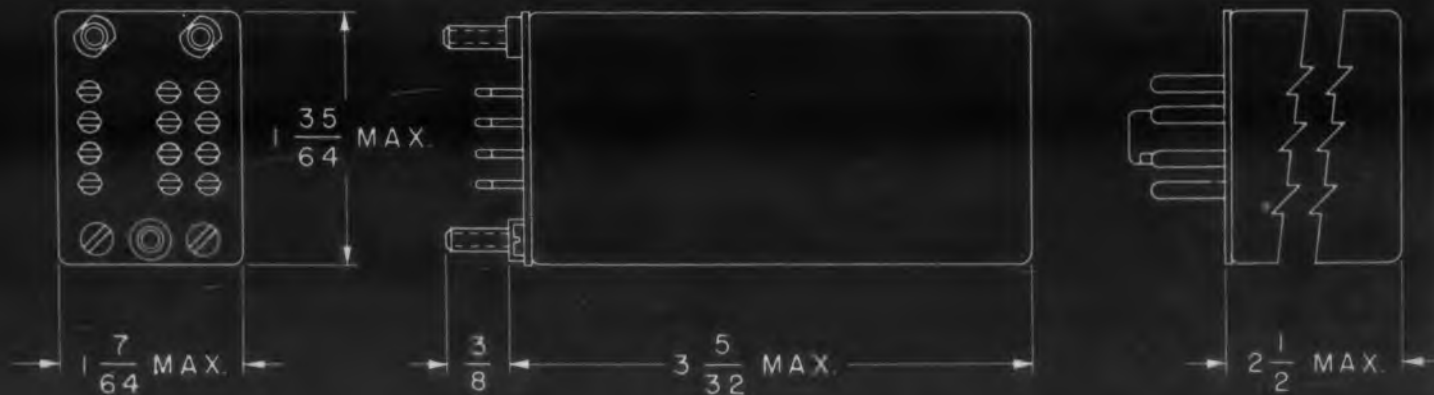
Allied Types
Trls 163-169

Actual Sizes

This new polarized relay, designed and manufactured by Siemens & Halske Company of Germany, is now available from Allied Control, and in the near future will be produced by Allied with the technical assistance of Siemens & Halske.



Allied Types
Trls 193-199



Trls 163-169 with SOLDER TERMINALS

Trls 193-199
with OCTAL BASE

Sealed POLARIZED RELAYS

Specifications for Allied's
Types Trls 163-169 and Trls 193-199

Type Number		Trls 163 Trls 193	Trls 164 Trls 194	Trls 165 Trls 195	Trls 166 Trls 196	Trls 167 Trls 197	Trls 168 Trls 198	Trls 169 Trls 199
Description	Positions	2		3	2	2	3	2
	Operation	Magnetic Latch		Null Center	Magnetic Latch	Spring Biased	Null Center	Spring Biased
High Contact Pressure		High Sensitivity						
Contact Arrangement		SPDT		SPDT	DPDT	SPDT	DPDT	DPDT
"Operate" Excitation (Std.)	Amp. Turns	7	2	2.2	5.5	5	4	15
"Operate" Power	Trls 163-169	500	40	50	300	250	160	2250
	Trls 193-199	610	49	61	375	300	195	2750
"Working" Excitation	Amp. Turns	15	4	6	10	10	10	25
"Release" Excitation	Amp. Turns			2.2		2.4	4	5
Max. Rate of Operation	Oper./Sec.	200	200	200	200	100	200	100

Shock and Vibration: The degree of shock and vibration resistance is related to the type of operation, the adjustment, the coil input power and the application. Contact Allied Control for ratings for your specific application.

Contacts:	Silver, General Purpose 2 amp., 28v d-c resistive load
	Platinum Alloy A. Low-Level Applications up to .5 amp.
	Platinum Alloy B. Heavy Duty Applications above .5 amp.
	Max. Continuous Current 5 amps.

Dielectric Test Voltage	Coil to Frame	500v rms.
	Contact to Contact	350v rms.
Standard Coils	Contact to Frame	500v rms.
	Winding to Winding	150-500v rms.
Temperature	Resistances from 1.1 to 18,000 ohms	
	Max. number of windings	3
	Max. Continuous Loading	1 watt
	Max. Ambient	85°C

Auxiliary Power For Radar

Emergency power is now being provided to gap-filler radar stations by an automatic diesel power plant. In the event the normal power supply from commercial lines fails, weakens, fluctuates or otherwise ceases to provide steady and sufficient power for radar operation, the automatic power plant turns itself on and provides power to the full load in less than 12 seconds.

The compactly packaged power units built by Consolidated Diesel Electric Corp., Stamford, Conn., operate without manpower in attendance. Gap-filler radar stations are those which cover gaps between main and auxiliary radar installations because of uneven terrain or for other reasons.

The control point for the Model 4000 may be many miles distant from the actual installation. The units constantly, through associated equipment, relay operational information back to the central control point.

As an extra precaution the power plant makes an automatic two-hour check of the commercial power supply voltage after this voltage has returned to the correct range. If the commercial voltage remains within established limits, the unit returns the radar equipment to commercial power, shuts itself off, and returns to standby condition.

Foamed-In-Place Materials

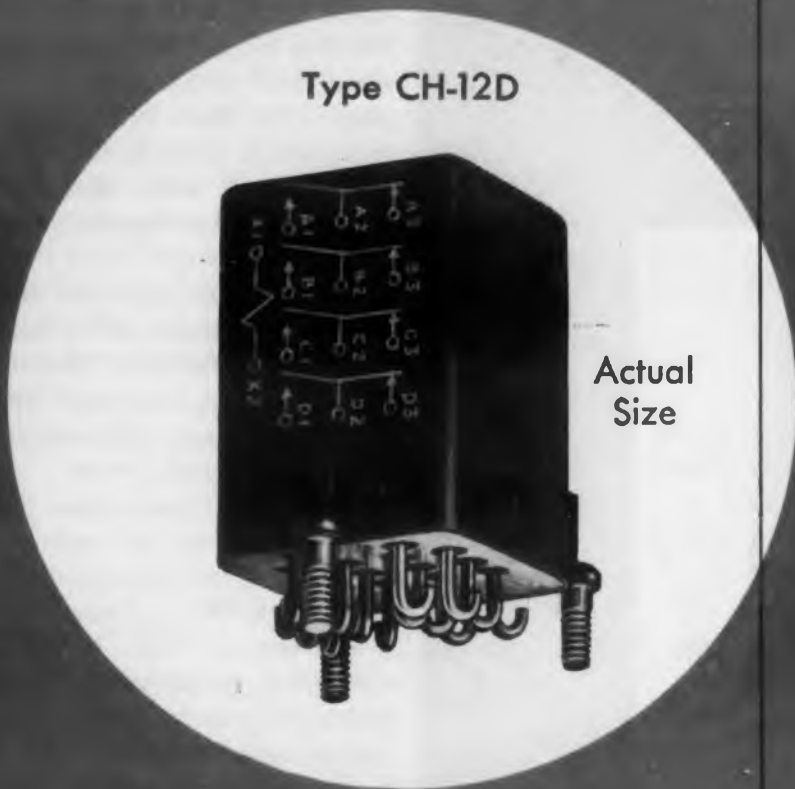
An improved formulation slows down normal foam reactions of 30 to 60 seconds to 100 to 180 seconds. This affords a safer handling margin and enables pouring into molds before the urethanes harden in the mixing vessels, a major problem up until now.

The new formulation was specifically designed by The Dayton Rubber Co., Dayton, Ohio, for rigid materials used in electronic components for aircraft, guided missiles, and torpedoes, among others. In addition to reducing waste, the new formulation gives a more uniform and finer pore structure.

◀ CIRCLE 4 ON READER-SERVICE CARD

NEW 10 Amp Relay

30g to 2000 cps 60 Amp Overload 80 Amp Rupture



Here are the facts:

Contact Rating: 10 amperes resistive at 30 volts d-c and 115 volts, 400 cps
Overload—60 amperes
Rupture test—80 amperes

Contact Arrangement: 4 PDT

Coils: 26.5 volts d-c, 170 ohms (other resistances are available)

Temperature: -65°C to +125°C

Vibration: 30 g to 2000 cps

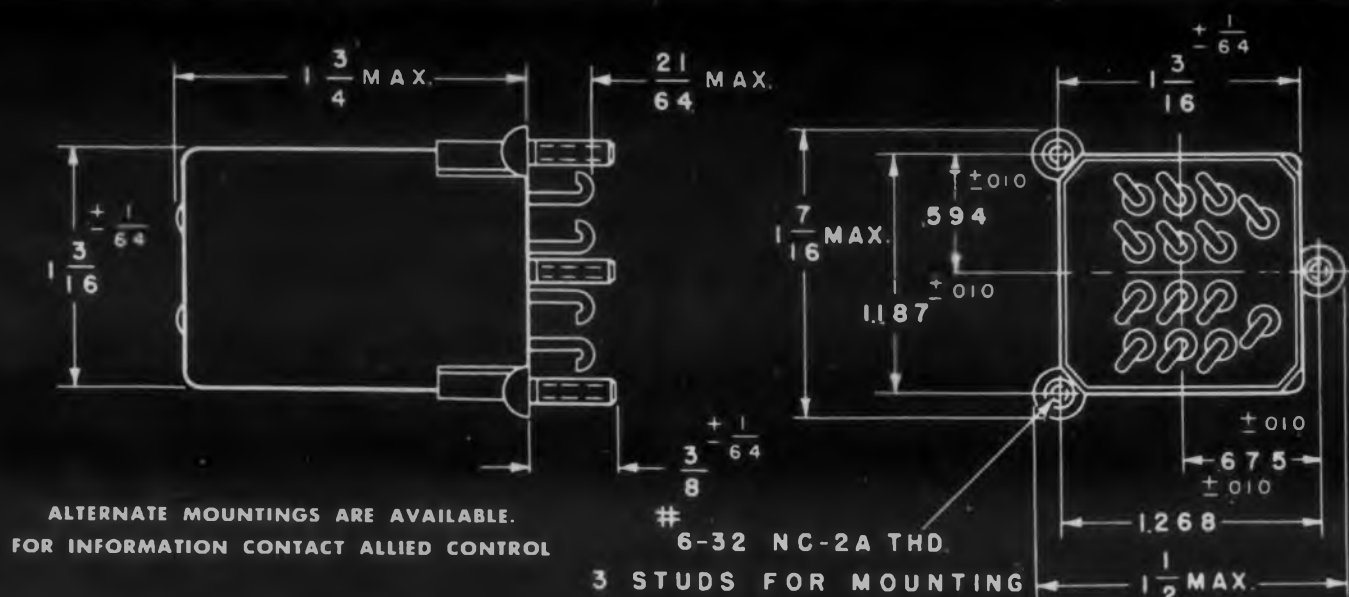
Operating Shock: 100 g.

Weight: 5 oz.

Military Specifications:

Meets test conditions of—
Mil-R-5757B • Mil-R-6106A • Mil-R-25018

For more information, write for Bulletin CH



Coasting-time Computer

A "coasting-time computer" will control the injection of the satellite Vanguard into its orbit around the earth at precisely the right moment. Developed by Air Associates, Inc., Teaneck, N.J., the computer will gather flight data up through the second stage's thrust period and, from that data, compute the correct coasting time between the end of this thrust period and the jettisoning of the second stage and firing of the third stage.

The first computer, after exhaustive tests have been performed, will be delivered to the Martin Company next month, it was announced.

Live Better—Electrically!

A General Electric Company executive has predicted that use of electricity in the average American home will increase 67 per cent by 1960. He cited other projected increases in electric power consumption on the farm, in industry and in the community, and cautioned that management must now plan years ahead "even an entire business generation in order to have a better perspective on the courses that should be taken today."

Extra-Power Hearing Aid

An extra-powering hearing aid to bring the softest sounds to persons with extreme hearing loss has been announced by the Beltone Hearing Aid Company, Chicago, Illinois. The maximum power, which reaches 110 decibels, is fitted only to extremely severe losses with high tolerance. The instrument is particularly suitable for bone conduction as well as for air.

Five Year Radio Guaranty

A five year guaranty, made possible by the use of transistors and printed wiring panels is being given by Philco Corporation on its "cordless" hot spot radio. The guaranty not only covers parts, but free service as well.

Philco dealers will replace, free of charge, the two ordinary flashlight cells which power the transistor radio if they wear out within one year.

◀ CIRCLE 5 ON READER-SERVICE CARD



ALLIED CONTROL



ALLIED CONTROL COMPANY, INC., 3 EAST END AVENUE, NEW YORK 31, N. Y.

Reliability

At the Third National Symposium on Reliability and Quality Control in Electronics, J. M. Bridges, Director of Electronics, Office of the Assistant Secretary of Defense (Engineering), spoke on the progress in reliability of Military Electronic Equipment during 1956.

In reviewing the progress made during 1956 in electronic equipment reliability improvement, several very important significant factors emerged. Here are some of the more important ones.

A fairly universal acceptance of mean-time-to-failure to express reliability has developed.

Policy has been established requiring that the design of a newly developed military electronic equipment be completed and thoroughly tested for reliability and producibility, as well as performance, before production for service use is started.

Equipment designers have become far more concerned about reliability and they are applying more effort to obtain it. Some of the newly designed equipments tested recently have demonstrated an inherent reliability perhaps an order of magnitude better than equipments now in service.

A definitive requirement for reliability, expressed in mean-time-to-failure, has been included in a contract specifications for the procurement of large quantities of a military electronic equipment.

The application of transistors to military equipments has started to expand.

With respect to reliability, the value of pilot production and reliability testing during the initial production period has been demonstrated.

Use of printed wiring has become more universal throughout military equipments, a potentially very significant step forward in reliability.

Specific and substantial advances have been made in obtaining more reliable electron tubes and component parts.

Management throughout industry has developed a far greater understanding of reliability and what is required to obtain and maintain it.

Comparable progress has not been made in improving the policies and practices of procurement. Emphasis on competitive cost in the procurement of both development and production is still a major deterrent to obtaining real reliability in military electronic equipment. It is improbable that a highly reliable equipment will ever be produced if the price has been forced so low that shortcuts in engineering or manufacturing are required.

Neither have we made much progress in convincing procurement people that substantial reliability improvements result from keeping the same contractor on the job through development and initial production.

In 1957 we hope to see these and other remaining barriers to reliability improvement broken by direct action or further education.



SUBMINIATURE FILTERS

- for I.F. amplifiers, printed circuit use
- temperature compensated to .15% from -55°C to $+85^{\circ}\text{C}$
- for operations above 1 mc
- dimensions: $13/16'' \times 2-1/2'' \times 2''$ high



ENCAPSULATED TOROIDS

- hermetically sealed
- high Q
- center-mounting permits stacking
- complete range of sizes and types
- dimensions: $21/32'' \times 3/8''$



TOM THUMB TELEMETERING FILTERS

- miniaturized for guided missiles
- high temperature stability
- designed to withstand shock and vibration
- hermetically sealed—wt. 1.5 oz.
- dimensions: $45/64'' \times 45/64'' \times 2''$ high



SUBMINIATURE ADJUSTORIDS

- precise continuous adjustment of inductance over a 10% range
- no external control current needed
- hermetically sealed
- low cost—wt. .83 oz.
- dimensions: $45/64'' \times 45/64'' \times 3/4''$ high



you're all set to roll..

... with a toroid, filter or related network by Burnell.

For Burnell *specializes* in these components; in manufacturing them *and* in delivering them on schedule — at competitive prices.

Today Burnell makes toroids, and the filters of which they are the basic components, small enough to meet a multitude of new purposes . . . in aircraft and guided missiles . . . in receivers, carrier and telemetering systems.

Very likely we already have the answer to your network needs among our extensive files. If not, we can swiftly find that answer for you. Try us and see.

Burnell & Co., Inc.



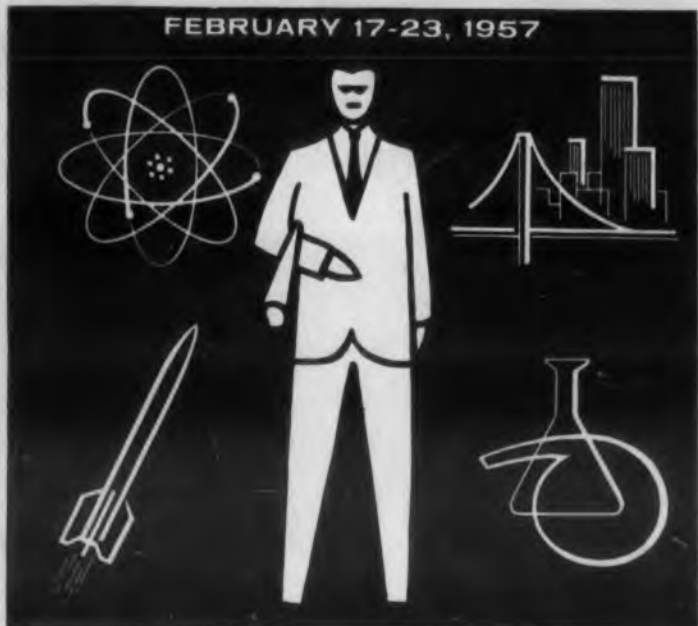
first in toroids, filters and related networks

Dept. ED-27 45 WARBURTON AVENUE, YONKERS 2, N. Y. TELEPHONE: YONkers 5-6800

PACIFIC DIVISION: 720 MISSION STREET, SOUTH PASADENA, CALIFORNIA TELETYPE: PASADENA 7578

CIRCLE 6 ON READER-SERVICE CARD FOR MORE INFORMATION

FEBRUARY 17-23, 1957



ENGINEERING... America's Great Resource

National Engineering Week: February 17-23, 1957, has been recognized by the President of the United States as an opportunity to stimulate a greater understanding of the contributions of the Engineering Profession.

During this week, Engineering Societies throughout the country will join with the National Society of Professional Engineers in the holding of special meetings and conferences, sponsoring guided tours for students through plants and laboratories, and in bringing the story of Engineering to the general public.



Probing of Thermal Barriers: A dilatometer made in Wetzlar, Germany by the E. Leitz Company, determines even the most minute coefficients of expansion of metals under heat. Dots shown in the insert upper right represent a distortion of one ten-millionth of an inch in the metal specimen. They were caused by gently blowing on the test specimen. The cylindrical portion (at extreme right) is an electronic furnace capable of heating test specimens to 2000 degrees Fahrenheit.

Where do you belong in IBM



Computer Circuit Design Engineers plan electronic circuitry for advanced airborne analog and digital computers . . . design linear and pulse circuits employing transistors, tubes, magnetic devices. Opportunities also exist in airborne power supply design, or to develop new techniques for marginally checking computer performance. *Do you belong on this team?*

Computer Logical Design Engineers determine the systems outline of a computer and its inter-connection with external equipment. Close liaison is maintained with mathematical support, circuit design, packaging and test engineers. Computer speed, memory size, configuration and arithmetic structure are tailored to requirements of weapons systems. *Do you belong on this team?*

Systems Evaluation Engineers test and evaluate electronic analog and transistorized digital computer systems design for aircraft. They evaluate new systems and improvements to insure compliance with specifications and Air Force requirements. Other assignments: liaison in testing of peripheral equipment, liaison with design, development and field engineering. *Do you belong on this team?*



Harry Branning (center): B.S.E.E. 1950, Syracuse. Design Engineer in circuit design, 1951; October, 1954, promoted to Associate Engineer; April, 1956, promoted to Staff Engineer, Systems Planning. In June, 1956, appointed Project Engineer and Manager of the 110 Computer Circuit Design Department; discussing the performance and packaging details of a transistorized read amplifier.

William Dunn (standing): M.E. 1950, M.S.E.E. 1952, Stevens Institute. Technical Engineer, 1955; April, 1956, promoted to Associate Engineer; August, 1956, transferred to Development Engineering in charge of Logical Design for digital computers in advanced weapons systems; here discussing Boolean Algebra method of optimizing the logical design of an airborne digital computer.

Eli Wood (left): B.S.E.E. 1950, Connecticut. IBM Customer Engineer, July, 1950; September, 1952, transferred to ACL Field Engineering. February, 1954, in charge of Field Engineering at Hunter AFB; May, 1955, Associate Engineer; appointed Project Engineer Manager of Systems Evaluation in August, 1956; here investigating a problem in radar data presentation set evaluation testing.

The brief records of the men cited above indicate only a few of the exciting activities right now in IBM Military Products. This division, organized 18 months ago, has grown enormously. A small-company atmosphere prevails. Men work in small teams . . . individual contributions are instantly recognized. Promotions occur frequently.

As a member of IBM Military Products, you'll enjoy physical surroundings and equipment second to none. Educa-

tional programs at IBM expense lead to advanced degrees. Salaries and benefits are excellent. Stability is guaranteed by IBM's history of consistent achievement—underlined by the fact that the rate of turnover at IBM is only one-sixth the national average.

Throughout the length and breadth of the United States IBM has built modern plants and laboratories. This map points out the various locations where you might live as an IBM em-

DATA PROCESSING
ELECTRIC TYPEWRITERS
TIME EQUIPMENT
MILITARY PRODUCTS

IBM

**MILITARY
PRODUCTS**

CIRCLE 560 ON READER-SERVICE CARD FOR MORE INFORMATION

IBM Military Products?



Systems Engineers oversee the engineering support provided by the Systems Coordination and Specification Group to the factory on the AN/ASB-4 Bombing-Navigational System. Air Force requirements are analyzed and the resulting engineering changes evaluated to determine effect on system performance and accuracy. Mathematical error analyses are run. *Do you belong on this team?*

Systems Analysts anticipate performance and recommend design criteria before and during development of equipment. Later, they compare dynamic performance accuracy and reliability characteristics with what has been anticipated. Other assignments include Digital Computer Systems Engineering, Input-Output and Analog-Digital Conversion Engineering. *Do you belong on this team?*



Quentin Marble (left): B.S.M.E. 1951, Syracuse. Joined IBM in 1951; promoted to Design Engineer in 1952; May, 1955, promoted to Associate Engineer, and then to Project Engineer, Manager of the Systems Coordination and Specification Group, Production Engineering Department, in February, 1956; shown here describing a unique cooling design to a new employee in his group.

Monroe Dickinson (left): B.S.E.E. 1952, W.P.I.; M.S.E.E. 1954, M.I.T. Technical Engineer in analog and alternate computer techniques for weapons systems, 1952; Associate Engineer responsible for systems design and analysis, 1954; December, 1955, Staff Engineer, responsible for research planning; here reviewing set-up on laboratory analog computer of a sampled data control problem.

Employee. IBM Military Products include the Airborne Computer Laboratories located in Owego, N. Y., and the Project SAGE installations directed from Kingston, New York.

Here is a real ground-floor opportunity that you can't afford to overlook. Without exaggeration, your potential in this dynamic young field of electronic computers is virtually unlimited. Get all the facts. Write, outlining your background and interests to:

A. A. Whitehorne
Manager of Engineering Recruitment, Dept. 902
International Business Machines Corp.
90 Madison Ave., New York 22, N. Y.



CIRCLE 560 ON READER-SERVICE CARD FOR MORE INFORMATION

Exceptional career opportunities are now open in IBM Military Products for E.E.'s, M.E.'s, physicists, and mathematicians, in the following fields:

SYSTEMS PLANNING AND ANALYSIS
DIGITAL AND ANALOG SYSTEMS
INERTIAL GUIDANCE
SERVO-MECHANISMS
ELECTRONICS
MECHANICAL DESIGN
ELECTRONIC PACKAGING
PROGRAMMING
FIELD ENGINEERING
RELIABILITY
COMPONENTS
PHYSICS
MATHEMATICS
HUMAN ENGINEERING
INSTALLATION
CIRCUIT DEVELOPMENT
POWER SUPPLIES
TRANSISTORS
HEAT TRANSFER
OPTICS
TEST EQUIPMENT
COST ESTIMATING
TECHNICAL PUBLICATIONS

\$300 Million Semiconductor Business by 1960

The semiconductor will jump from the present \$55 million to a \$300 million industry by 1960, according to Joseph S. O'Flaherty, manager of the semiconductor division of Hughes Aircraft.

This forecast of a 300 million dollar semiconductor industry by 1960 includes an estimate that, barring war, 85 per cent of this dollar volume will be sold to the civilian industrial and entertainment product industries, and only 15 per cent to the military.

One of the principal factors behind the growth is the development and introduction of new and improved products. Probably no industry is based so closely on initial discovery and research as is the semiconductor industry. Advanced research in solid state physics and the chemistry necessary to produce semiconductors has already passed into a realm of physics beyond the knowledge which produced the atom bomb, yet we have only scratched the surface. Literally thousands of scientists have a working knowledge of the physics of nuclear fission; only a relative handful have a comparable understanding of solid state physics.



Oscillograph Measures Force: Strain or force analyses, as well as speed, temperature and machine tool horsepower measurements can be determined with the use of a 4-channel electronic oscillograph recently developed by GE's Metallurgical Products Dept., Detroit. The picture shown is in the process of finding the three components of force on a lathe carbide cutting tool.

FOR THE THIRD CONSECUTIVE YEAR

ENGINEERS RATE LAMBDA FIRST

in all
**Power Supply
Surveys**

Every independent study of power supply preferences has shown an overwhelming vote for Lambda. In the most recent survey, made by a leading electronics publication, engineers who specify power supplies choose Lambda by more than 2½ times over the next identified manufacturer. This is the greatest margin of preference yet. Here is additional proof that the more opportunities users of power supplies have to try Lambda equipment for themselves, the more they recognize the superiority of these outstanding units.

We suggest that you inspect Lambda power supplies in use in your own area. We will be happy to provide names of nearby users. Ask the candid opinion of the men who work with this precision-engineered equipment daily.



QUALITY CONTROL assures you of long, dependable service from these assembly-line-produced power supplies.



HERMETIC SEALING PROCESS provides for complete quality control. Lambda makes all its own transformers.

MECHANICAL INSPECTION at every relevant point means trouble-free operation for you.



ELECTRONIC INSPECTION is designed to provide consistent quality and eliminate in-service down-time.

TYPICAL NEW LAMBDA "COM-PAK" MODEL (200-400-800 MA units) occupies a minimum amount of space, delivers maximum performance, is easy to service and maintain.



LAMBDA ELECTRONICS CORP.

The first name in power supplies

11-11 131 STREET • COLLEGE POINT 56, NEW YORK



SEND FOR NEW
CATALOG 57

Just off the presses. Illustrations and specifications for the complete line of Lambda Regulated D.C. Power Supplies.

Electric Delivery Truck

The electric delivery truck is back on the scene. One manufacturer, the Cleveland Vehicle Company, Cleveland, Ohio claims their electric truck costs up to fifty per cent less to operate. Because it starts and picks up more quickly and smoothly than a gasoline truck, the manufacturer claim it can save as much as an hour a day on a typical delivery route.

Batteries for the truck are supplied by the Electric Storage Battery Company, Philadelphia, Pa.

Heat Pumps In Home of the Future

Heat pumps have a definite place in the all-electric home of the future. "All-All-Electric Home", the dream and aspiration of many thoughtful men in the electric utility industry," said C. W. Bary of the Philadelphia Electric Company, "cannot be attained without electricity performing the job of providing comfort through heating and cooling of the home . . . the economic attainment of this goal is feasible through development by manufacturers of the heat pump."

Heat pumps, which are now widely used throughout the country and particularly in the South, use air, water or other media for the production of heat through compression and by a reverse process provide refrigeration.

Link Simulators for Commercial Jets

Preparing for the jet age in commercial aviation, KLM Royal Dutch Airlines has placed orders with Link Aviation, Inc., of Binghamton, N.Y. for two electronic flight simulators at a total cost of more than \$1,600,000.

The Link simulators will be used in training pilots and flight crews who will operate KLM's Lockheed Electric turboprop transports and giant Douglas DC-8 jet transports scheduled for delivery in 1959 and 1960, respectively. Without leaving the ground and at a fraction of the cost involved in flying an actual airplane, the crew will practice in-flight emergency procedures, normal flight routine, and approaches and landings.

◀ CIRCLE 8 ON READER-SERVICE CARD

Giant Telescope Tracks Missile 100 Miles Away

A giant telescope developed by the Army Signal Corps Engineering Laboratories at Fort Monmouth locates missiles in space, tracks and photographs high altitude meteorological balloons and evaluates radar systems. It has a 400-pound lens system developed by Fairchild Camera and Instrument Corporation which takes black and white photographs of rockets, jets and other flying objects automatically. The high degree of accuracy obtained by the lens system and associated equipment enable the photographs to reveal information not only as to the type of object but also its velocity, acceleration, elevation and azimuth.

The tracker is especially noted for its good telephotographic lens and camera system, precise coordination of target and time records, reliable target acquisition and fast and accurate tracking.

The optics include a turret of projection lens of 4X, 2X, 1X, and 1/2X magnification providing effective focal lengths of 160 in., 80 in., 30 in. and 15 in. respectively. The entire field of view of this optical system varies from 1.4 to 5 degrees depending on the projection lens in use.

Radio Noise Tests

Verification that rain causes increases in conducted radio influence voltage (RIV) of 15 to 20 times the fair weather value heads the list of conclusions drawn from "radio noise" field tests conducted by the Detroit Edison Company, Detroit, Mich. The test verifies previous reports from other sources.

RIV is the radio frequency line to ground voltage measured by direct coupling to the line using a radio noise meter as a two terminal voltmeter. Another important conclusion of the test was that a small change in relative air density causes a large increase change in RIV.

It appears that there may be an inverse relationship between RIV and relative humidity up to the dew point or the point of condensation on the conductor. Further work is being done in this area.

Rugged E-I Compression Seals are the industry's standard for superior performance in commercial and military service. Practically indestructible, they provide the maximum immunity to shock, vibration and temperature changes.

Available in miniature or sub-miniature types, these super-dependable hermetic seals are supplied in economical standard types to meet practically any sealing requirement.

**Keyed to
your electronic
future...**

E-I GLASS-TO-METAL SEALS

For complete information on the E-I line or recommendations on particular requirements, call or write:

ELECTRICAL INDUSTRIES

44 SUMMER AVENUE, NEWARK 4, N. J.



**Patents Pending—all rights reserved*



Single Lead Terminals—Available in standard or custom designs.



Plug-in Connectors—for vibrator, chopper, lock-in and noval sockets.



Transistor Closures—Standard sealed bases, cans and diode closures available.



Multiple Headers—for even hermetic sealing requirements.

CIRCLE 9 ON READER-SERVICE CARD ➤

Altitude, temperature, vibration and shock — application hazards aboard the high flying, high speed USAF Northrop Snark, intercontinental guided missile — are all in a day's work for tough Rheem Power Amplifiers.



RHEEM REL-09

*miniature RF
power amplifiers*

tough...and engineered to deliver

The REL-09, Miniature RF Power Amplifier, has widespread application in airborne telemetering systems.

To ensure reception of high quality signals, step up the power radiated from your airborne equipment.

Select the power amplifier which normally exceeds your requirements for vibration, shock, temperature and altitude. Use the Rheem REL-09 for consistent results. Power output—11 watts; Input Drive—1.4 watts. Detailed specification, price and delivery will be furnished promptly on request.

*
Get your 1957
Products File at
Rheem booth
no. 2811, I.R.E.
Show, Coliseum...
New York City,
March 18th
thru 21st.

RHEEM MANUFACTURING COMPANY



Electronics Laboratory

7777 INDUSTRY AVENUE • RIVERA, CALIFORNIA

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION



X-Ray Machine Traces Atomic-Changes

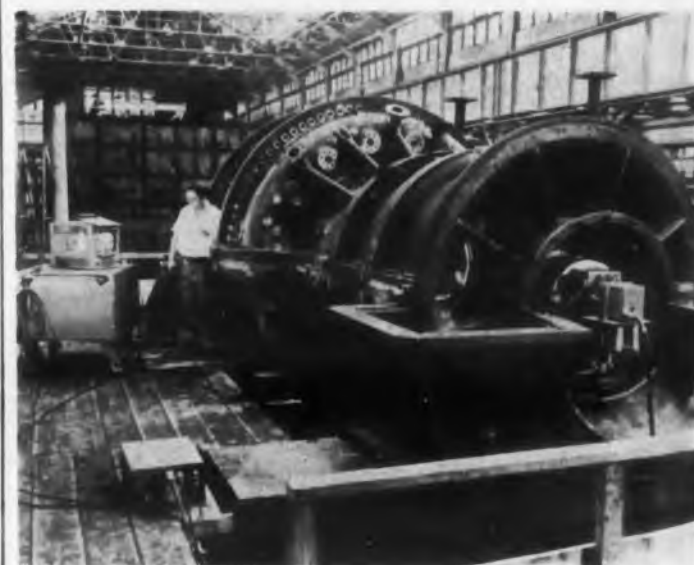
Hitherto unknown changes in the atomic arrangement of iron-aluminum alloys have been discovered through the use of the world's most powerful crystallographic x-ray machine.

The designer of the super-power x-ray, Dr. Abraham Taylor, a research scientist in the technology department of the Westinghouse Laboratories, said new information on the previously puzzling behavior of iron-aluminum would give metallurgists greater insight into these metals.

"Heretofore," said Dr. Taylor, "we were able to observe that at certain temperatures, iron-aluminum reacted in unexpected ways. We were aware of these changes but were unable to understand or explain them."

With the use of the new high intensity x-ray machine, it is possible to take x-ray photographs of these alloys during the precise moments when, due to temperature changes, the magnetic arrangement of atoms in the metal is undergoing transformation.

Valuable for their superior magnetic properties, iron-aluminum alloys may find wide application throughout the electrical industry for such apparatus as generators, transformers, circuit breakers, and similar electrical equipment.



TV Positions 5-Ton Gas Turbine: Correct and accurate positioning of turbine shells on a 5-Ton Gas Turbine at GE's Gas Turbine Department, Schenectady, N.Y. is accomplished by means of a closed circuit television camera. Previously the turbine shells were aligned by stretching a taut wire through the turbine and estimating when the shells were in position.

When lining up the turbine shells, the camera is bolted, leveled and centered on the first or master shell. When another shell is to be attached, a target is centered in the new shell and the camera lens focused to the known distance to the target.

By watching the monitor, the operator can note where the target lies in relation to the camera lens. Thus, he is able to carefully adjust the shell-connecting bolts and align the new shell.

Washington Report

Robert H. Rosen

President's Budget

With the writing of the Congressional inquisition of the Federal Budget will have begun. The question: why this amount? will be asked service by service and agency by agency. The President is asking for a record \$71.8 billion to operate the Federal Government from July 1, 1957 to June 30, 1958. He also wants the authority to obligate some \$73.3 billion. Over half of the \$71.8 billion is earmarked for the Department of Defense. The DOD has asked the authority to spend \$38 billion, to obligate \$38.5 billion, and to place contracts in FY '58 for \$40.6 billion.

In total figures, the expenditures the Defense Department plans to make, service by service, are as follows: Army \$9.170 B, Navy \$10.389 B, Air Force \$17.600 B.

Missile News

Two military missiles were recently revealed for the first time. Hughes Aircraft and the Air Force announced the existence of the GAR-1D, a super-sonic air-to-air version of the Falcon. The new missile is radar-guided, and will travel to altitudes in excess of interceptor capability. It is slightly longer than six feet, has an air-frame diameter of approximately six inches, and weighs less than an average man.

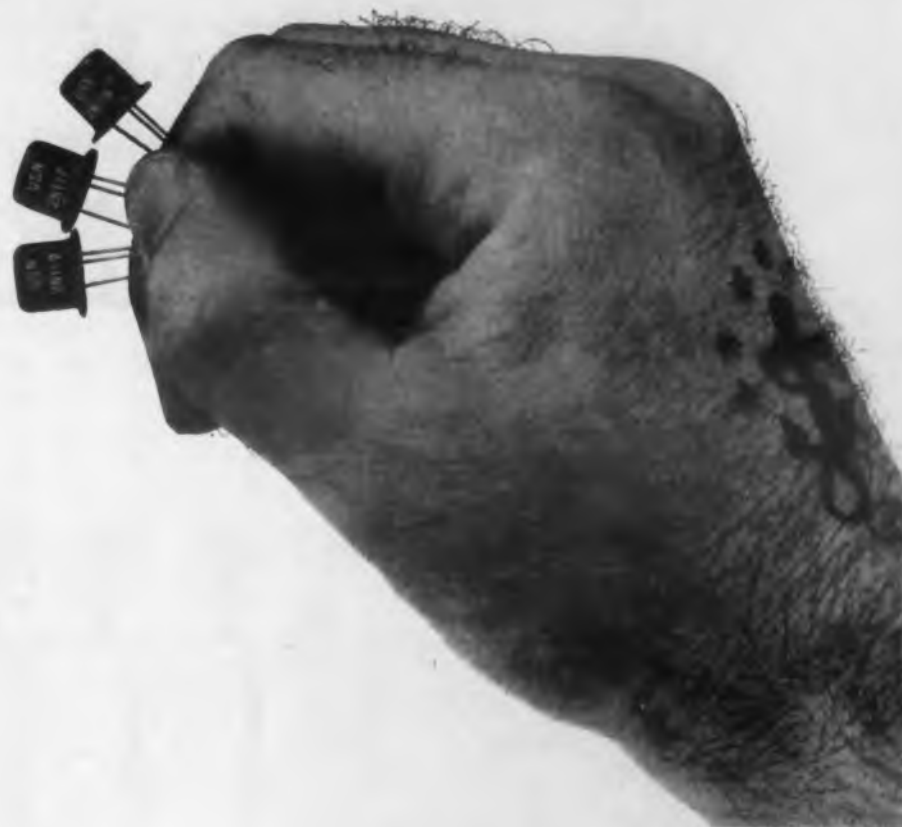
The other missile, disclosed by the Navy, is the Polaris. Unconfirmed reports have it that Polaris is designed for submarine launching and has a range of several hundred miles. Navy SINS (Shipboard Inertial Navigation System) will be an integral part of the Polaris system. Major contractor for Polaris is the Lockheed Aircraft Company.

ASO Meets

The first meeting of the year of the Television Allotment Study Group has ended with the adoption of a charter of operations and the naming of potential committee and panel chairmen. The five standing committees are: transmitters, receivers, field testing, propagation, and analysis and theory. People from industry, education, and Government will be asked to serve on these committees. A compilation of their reports will be presented to the FCC as a guide to the allocation of frequencies for vhf and uhf television.

ATASO is a nonprofit organization set up by five organizations having vital interests in TV broadcasting. The five are: Radio-Electronics-Television Manufacturers Association, National Association of Broadcasters, National Association of Educational TV, Committee for Competitive Television, and Association of Maximum Service Broadcasters, Inc.

FIRST silicon transistors meeting NAVY SPECS



For reliability under extreme conditions... design with TI's military silicon transistors... built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS), MIL-T-19502 (SHIPS), and MIL-T-19504 (SHIPS) — these welded case, grown junction devices furnish the tremendous savings in weight, space, and power you expect from tran-

sistorization... plus close parameter control that permits you to design your circuits with confidence.

All 20 Texas Instruments silicon transistor types have proved themselves in military use. First and largest producer of silicon transistors, TI is the country's major supplier of high temperature transistors to industry for use in military and commercial equipment.

degradation rate tests for TI's USN-2N117, USN-2N118, and USN-2N119

test	condition	duration	end point at 25°C
lead fatigue	three 90-degree arcs	—	no broken leads
vibration	100 to 1000 cps at 10 G	3 cycles, each x, y, and z plane	$I_{CO} = 2 \mu A$ maximum at 5V $h_{ob} = 2 \mu mhos$ maximum $h_{fb} = -0.88$ minimum (USN-2N117) $h_{fb} = -0.94$ minimum (USN-2N118) $h_{fb} = -0.97$ minimum (USN-2N119)
vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	
temperature cycle	-55°C to +150°C	10 cycles	
moisture resistance	MIL-STD-202	240 hours	
life, intermittent operation	$P_c = 150 mW$, $V_c = 30V$	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	
salt spray	MIL-STD-202	50 hours	no mechanical defects interfering with operation

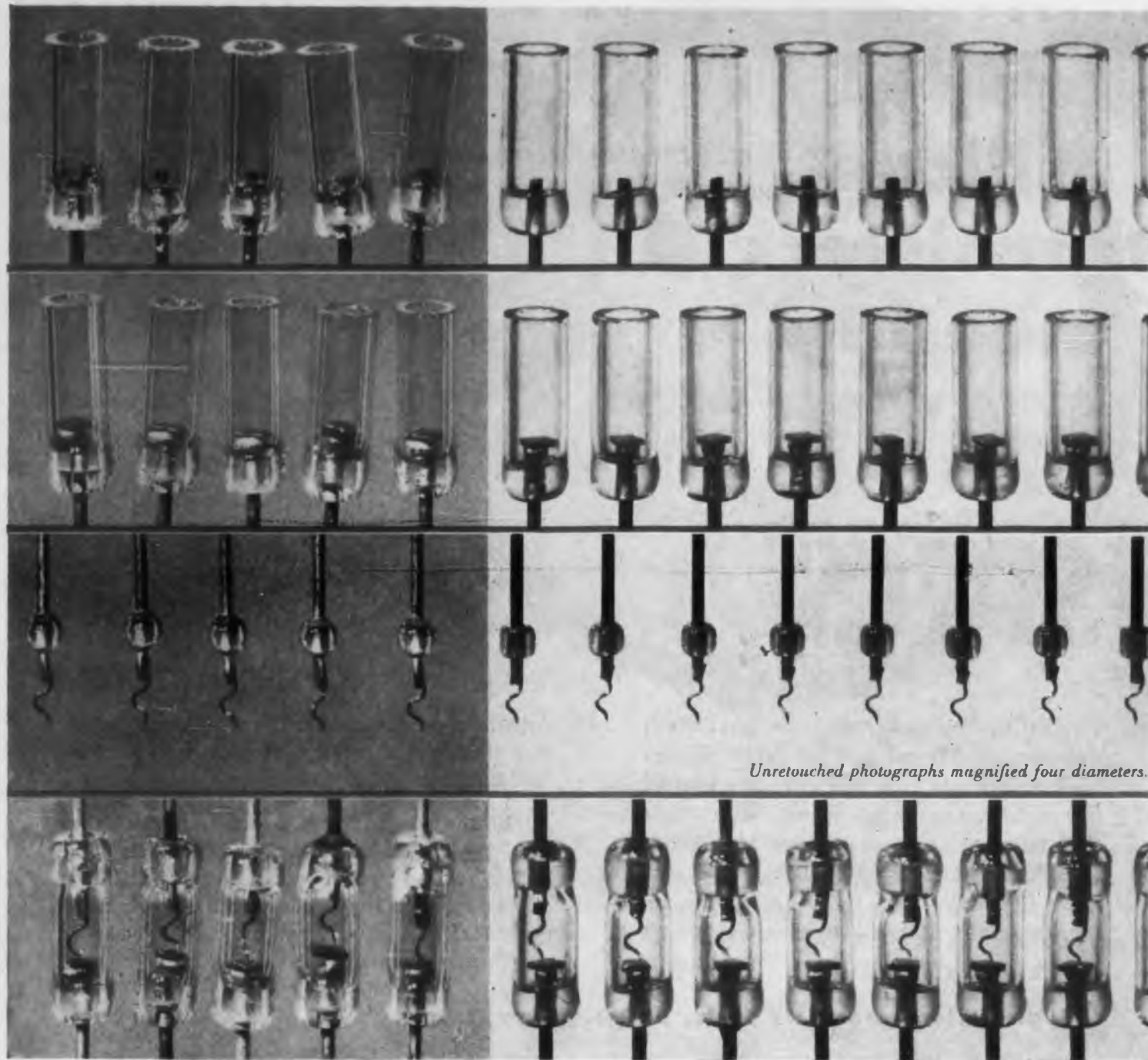
LOOK TO TI FOR: SILICON HF, MEDIUM POWER, POWER, AND SMALL SIGNAL TRANSISTORS
SILICON DIODES AND RECTIFIERS • GERMANIUM VHF, POWER, RADIO, AND GENERAL PURPOSE TRANSISTORS

pioneer producer of
silicon transistors



TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

CIRCLE 11 ON READER-SERVICE CARD FOR MORE INFORMATION



Hand assembled diodes ↑ COMPARE ↑ Automatically assembled CBS diodes

UNIFORMITY by and for automation

The increasingly automatic assembly of electronic equipment is placing serious limitations upon component manufacturers. Rigid, tight tolerances must be maintained to avoid jamming the automatic machines. This spells automation for components, too.

CBS has done something about it. On seven integrated machines, CBS glass diodes are automatically assembled, packaged, tested. The picture tells the story . . . compares the results of this automatic assembly with that of ordinary hand assembly. The controlled uniform quality is apparent. As you would expect, the uniformity is both mechanical and electrical.

Take advantage of CBS Advanced-Engineering. Specify CBS glass diodes for uniformity . . . for dependability . . . for automatically controlled quality.



semiconductors

Reliable products
through Advanced-Engineering

CBS-HYTRON

Semiconductor Operations, Lowell, Mass.
A Division of Columbia Broadcasting System, Inc.

CIRCLE 12 ON READER-SERVICE CARD FOR MORE INFORMATION

Letters to the Editor

Mica Status

Dear Sir:

We wish to comment on your editorial in the December 1 issue of *ELECTRONIC DESIGN*, giving the status of natural and synthetic mica. We feel that additional facts are needed.

The U.S. Bureau of Mines started, some years ago, to find sources for replacing mica mined in India. To this end, they initiated a program for making synthetic mica and found that the process was feasible. Thereupon, in order to expand the program, they released their technical data to anyone in industry who wanted to attempt commercial production.

Our company has been experimenting since 1953 using both Government data and our own research. As a result we have, to our knowledge, manufactured as large a crystal as has been produced yet in this country, during the past year. However, the major need of industry is for the larger playing card-sized pieces so far only found in the natural state; the small crystals are limited in use to small capacitors. We are using these small crystals in powder form in the manufacture of Mykroy, our glass bonded mica, thereby greatly improving its qualities.

We hesitate to agree that large crystals, synthetic will be available within a year or so to take care of the "90 per cent of the U.S. requirement." In reality, even with an adequate program of research it might take two to three years to work out the making of clear synthetic crystals large enough to meet the requirements of the industry.

In the opinion of this writer, who has spent long hours of research on this subject, there must be very real concern with establishing an adequate domestic supply of synthetic mica. Only the first elemental steps have yet been taken, and only a determined research program by all industry can actually supply our domestic needs. One deterrent is the large cost, which must be borne by the individual manufacturer.

D. E. Replogle, President
Electronic Mechanics, Inc.
Clifton, N.J.

► We appreciate having this comment relative to the mica picture and outlook. Other factual information bearing on this important subject will be welcome.



Correction

Dear Sir:

In my article titled "Attenuation and Phase Shift Changes in RC Sections from Curves," which appears on pages 38-39 of the December 1, 1956 issue, there are three errors. The first two are printing errors and the third is my error.

The fourth line from the bottom of the first paragraph on page 38 reads: "For a 0.5% change in amplifier gain for three stages the gain per stage is 0.167%." It should read: "For a 0.5% change in amplifier gain for three stages the gain change per stage is 0.167%."

The headings on the values for the curve on page 39 are incorrect. The column headed $\Delta G/\Delta f_0$ should be $\Delta G/G/\Delta f_0/f_0$ and the one headed $\Delta \theta/\Delta f_0$ should be $\Delta \theta/\theta/\Delta f_0/f_0$. The column headed $1 + f^2/f_0^2$ should be $1 + f^2/f_0^2$.

The horizontal axis of the curve on page 39 is labeled f/f_0 high pass, f_0/f low pass. The latter term should be f/f_0 low pass.

Sidney K. Benjamin

Can You Help?

Dear Sir:

As we see it, one of the aims of your publication is to serve as a clearing house through which development engineers can contact manufacturers in order to determine the availability of particular types of equipment. If it is not presumptuous, we would like to ask you to publish the following appeal:

We are looking for a zero speed tachometer pickup for use in the continuous process industries. The device must be capable of producing a number of electrical pulses proportional to input speed over the range from zero to 3000 rpm. Extreme reliability is important because of the high cost of down time in a continuous industrial process. There are no unusual environmental hazards other than dust and dirt and the possibility that explosion-proofing may be required in some applications.

Robert P. Einsel
Senior Engineer
Industrial Nucleonics Corp.
Columbus, Ohio.

In color tv, too

CRUCIBLE PERMANENT MAGNETS

for beam correctors, color purifiers and color equalizers
give maximum energy . . . minimum size

Designers of electronic and control equipment can count on a consistently higher energy product with Crucible alnico magnets. It means greater power from a minimum size magnet!

And they're available in practically any size you want—from a fraction of an ounce to several hundred pounds. What's more, Crucible alnico permanent magnets can be sand cast, shell molded, or investment cast to your exact size, shape, or tolerance requirements.

Crucible has been a leading producer of these permanent magnets ever since alnico alloys were developed. And their manufacture is backed by over a half century of fine steelmaking experience. That's why so many magnet applications begin at Crucible.

Crucible Steel Company of America,
The Oliver Building, Mellon Square,
Pittsburgh 22, Pa.



CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America

CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

Feb. 25-27: Special Conference on Electronics In Action

Statler Hotel, New York, N. Y. Several major companies will show electronic data-processing equipment in action through closed-circuit television. Sponsored by the American Management Association's Finance Division, 1515 Broadway, New York, N. Y.

Feb. 26-27: Third Conference on Radio-Interference Reduction

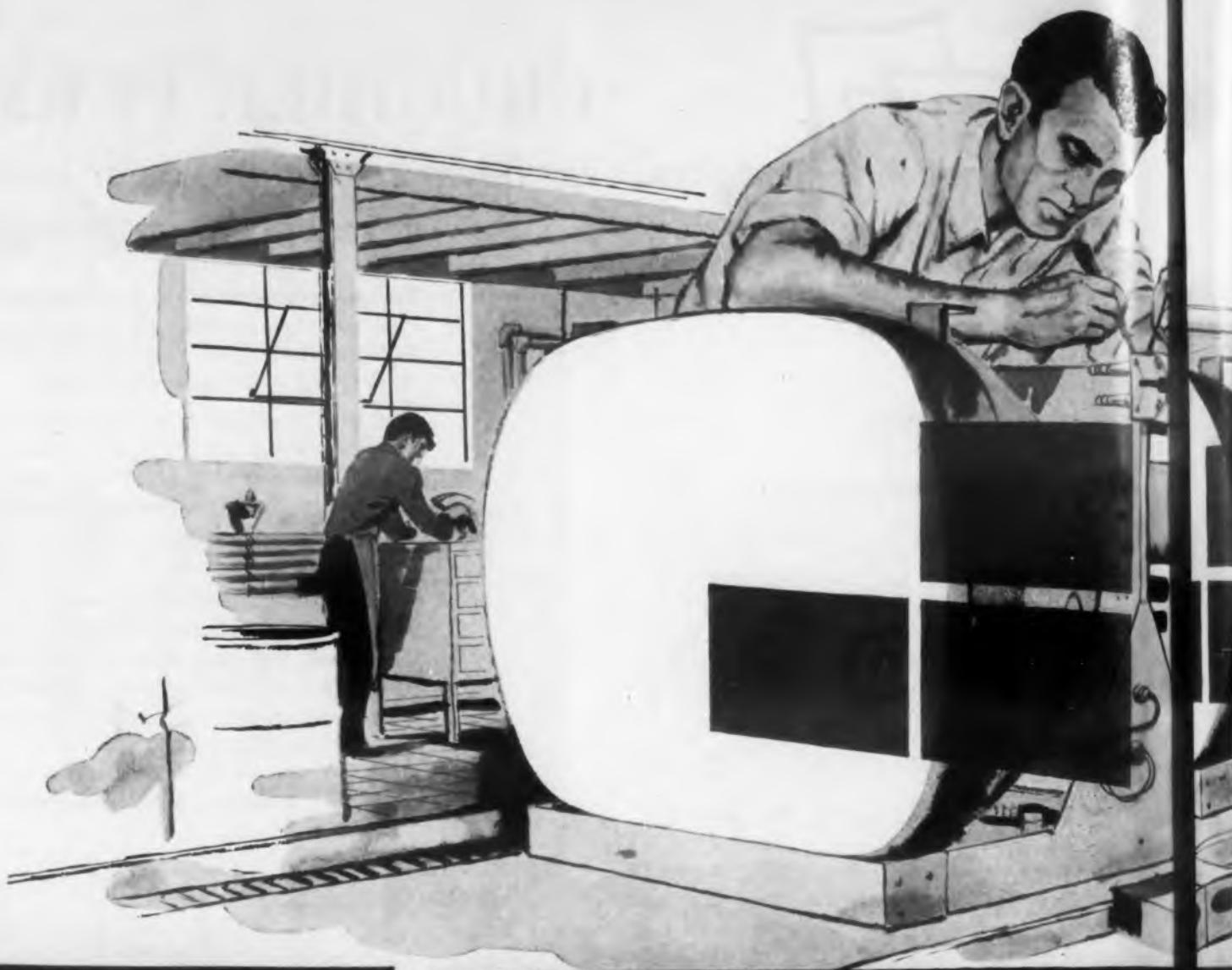
Chicago, Ill. Sessions include equipment design techniques, instrumentation and measurement techniques, practical interference reduction methods, and special suppression components. For further information contact Armour Research Foundation of Illinois Institute of Technology, Technology Center, 10 West 35th St., Chicago 16, Ill.

Feb. 26-28: Western Joint Computer Conference

Statler Hotel, Los Angeles, Calif. The Conference is under the joint sponsorship of the IRE, AIEE, and ACM. Theme of the meetings will be "Techniques For Reliability." For further information contact S. Dean Wanlass, Aeronutronic Systems, Inc., 13729 Victory Blvd., Van Nuys, Calif.

March 11-15: 1957 Nuclear Congress

Convention Hall, Philadelphia, Pa. Theme of the Congress is "For Mankind's Progress" and peacetime uses of atomic energy will be discussed. Included in the Congress are four major elements, including the Second Nuclear Engineering and Science Congress, coordinated by Engineers Joint Council on behalf of twenty engineering and scientific societies. This will include 130 technical papers during a four-day program. The National Industrial Conference Board will hold its Fifth Conference on Atomic Energy in Industry, featuring twelve round-table discussions. The International Atomic Exposition, sponsored by the American Institute of Chemical Engineers in cooperation with four other engineering societies, will display industry's latest items in the atomic field. The Fifth Hot Laboratories and Equipment Conference will take place March 14 and 15. For information, write to Engineer Joint Council, 33 W. 39th St., New York, N. Y.



new

Formica

Exceeds NEMA standards for XXP...meets UL requirements for printed circuitry... meets MIL SPEC 3115B for type PBE-P

New Formica Cirprint is far superior to any XXP ever made. The latest product of Formica-4 research, it is the first and only copper clad especially designed to meet the requirements of large volume manufacturers.

Check these Cirprint properties against your requirements: **High IR:** 250,000 megohms after 96 hours at 35° C and 90% relative humidity.

Cold punching: up to and including 1/16".

Low moisture absorption: 0.80% in 1" x 3" x 1/16" sample after 24 hours immersion.



subsidiary of

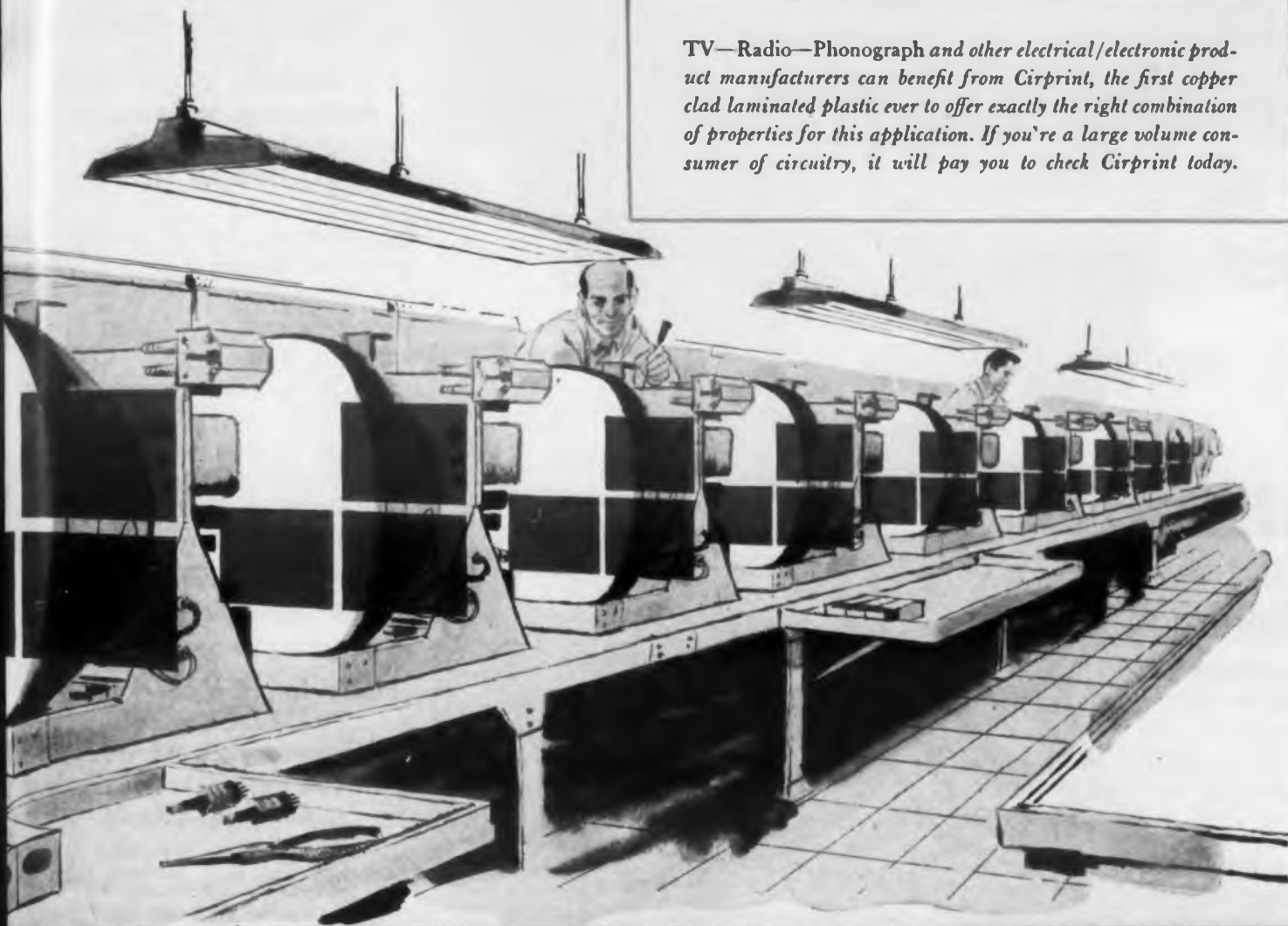
CYANAMID

1st choice in laminated plastics

Application engineering • Fabricating

CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

TV—Radio—Phonograph and other electrical/electronic product manufacturers can benefit from Cirprint, the first copper clad laminated plastic ever to offer exactly the right combination of properties for this application. If you're a large volume consumer of circuitry, it will pay you to check Cirprint today.



CIRPRINT

Cirprint watermarking gives you quick, positive, visual identification. Eliminates costly and ineffective factory records and marking systems.

You can see the quality because Cirprint is translucent. Its smooth structure is free of all impurities. Translucency also permits a visual check on the register of circuits printed on opposite sides of a sheet.

Enthusiastic reports from manufacturers who have tested Cirprint state it's the best XXP ever made . . . and that its outstanding properties are most useful.

Evaluate the contribution Cirprint can make to your electrical/electronic products. Send today for free bulletin 755. Use the handy coupon below, or write Formica Corporation, subsidiary of American Cyanamid, 4512-7 Spring Grove Ave., Cincinnati 32, Ohio.

Formica Corporation
4512-7 Spring Grove Ave., Cincinnati 32, Ohio
Please send me a copy of Cirprint bulletin 755.

FI-1345

Name _____
Company _____ Title _____
Address _____
City _____ Zone _____ State _____



CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

March 18-21: The 1957 SPI Annual National Conference and Pacific Coast Plastics Exposition

Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave., New York, N. Y.

March 18-21: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum, New York, N. Y. Twenty-three technical subjects such as Telemetry, Antennas and Propagation, Circuit Theory, Electron Devices and Receivers, Computers, Information Theory, Automatic Control Microwave and Instrumentation, Manufacturing Electronics, Audio and Broadcast, Aeronautical, Communication and Military Electronics, Ultrasonics, Medical and Nuclear Electronics will be presented at the convention. For further information on exhibits, contact Mr. William C. Copp, IRE Advertising Dept., 1475 Broadway, New York, N.Y. Contact the IRE, 1 East 79th St., New York, N.Y. for other information.

March 25-27: Special Conference on Research and Development

Palmer House, Chicago, Ill. Sponsored by the American Management Association. Subject will be "Product Development in Medium and Small Companies." For information, write American Management Association, 1515 Broadway, New York, N.Y.

April 4-5: Special Conference on Research and Development

Hotel Statler, New York, N.Y. Sponsored by the American Management Association. The conference will be an Engineering Forum. For information write to American Management Association, 1515 Broadway, New York, N.Y.

April 8-11: Fourth National Electrical Industries Show

71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

April 11-13: Southwestern IRE Conference and Electronics Show

Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.



Try this for size

**For guided missiles, airborne equipment,
portable and mobile ground equipment**

In these and related fields, where lack of space is the problem, manufacturers have turned to miniaturization. Daven's new ceramic switch occupies a panel area of less than 1½ square inches—incorporates features that ensure long life and trouble-free operation.

Despite its small size, this switch is extremely rugged and has been designed to withstand all types of field service. Coin silver contacts, rotors and slip rings are provided for low and uniform contact resistance and excellent electrical characteristics. Ceramic parts are silicone impregnated to function under extreme humidity. Sturdy solder terminals are supplied for wiring.

Single pole style has 18 shorting type contact positions available. 2 or 3 pole types may also be obtained. Several sections may be "ganged" by adding supplementary wafers. Flash-over voltage at 60 cycles is 1000 volts peak . . . current carrying capacity is 2 amperes.

This sturdy, high-quality switch is precision produced . . . will give years of service in fine commercial and military equipment. DAVEN's expert engineering staff is at your service for help with special problems or orders to your specifications. Write today for further information.

Miniature Ceramic Switch... Series M



THE **DAVEN** CO.

524 West Mt. Pleasant Avenue,
Route 10, Livingston, New Jersey

WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

**Nuclear Radiation Effects
on Semiconductor
Devices and Materials
Symposium**
February 27-28, 1957
Auditorium Western Union
Telegraph Co.
60 Hudson St., NYC

It is expected that all projects being sponsored by the Dept. of Defense and the AEC will be reported on. Among the reports, a survey of a 6 yr. transistor study by the AEC, Oakridge, Tenn. will be made. The symposium will be "UNCLASSIFIED," and security clearance will therefore be unnecessary. Registration will take place at the door, starting at 9 a.m. on February 27; there will be no registration fee. Sponsored by A.G.E.T.

**Radio Interference Reduction
Conference**
February 26-27, 1957
Armour Research Foundation
Chicago, Illinois

Tuesday, February 26
Radar Techniques

CALCULATION AND MEASUREMENT OF RADAR INTERFERENCE SIGNAL LEVELS. *Louis Valcik, Armour Research*
A SELF-CONTAINED INTERFERENCE BLANKER FOR RADAR RECEIVERS. *D. L. Hofmockel, Rome Air Center*
RF INTERFERENCE-FREE DESIGN TECHNIQUES IN RADAR SYSTEMS. *E. R. Radford, General Electric Co.*

Tuesday, February 26
Measurement Techniques

A NEW TECHNIQUE FOR EVALUATING RF LEAKAGE AND SUSCEPTIBILITY OF ELECTRONIC EQUIPMENT. *C. S. Vasaka, Naval Air Development Center*
HIGH POWER RADAR SPURIOUS FREQUENCY OUTPUTS. *Michael Marelli, Rome Air Development Center*
QUICKER AND SIMPLER MEANS FOR INTERFERENCE DETECTION AND SUPPRESSION. *P. B. Wilson, Interference Testing and Research Laboratory, Inc.*
INSERTION LOSS MEASUREMENTS OF RF

◀ CIRCLE 15 ON READER-SERVICE CARD

SUPPRESSION FILTERS WITH RATED CURRENT APPLIED. *J. A. Allen, SCEL*
SOME UNUSUAL ASPECTS OF MIL-I-181B RADIO INTERFERENCE MEASUREMENTS. *William Jarva, Filtron Co., Inc.*

Tuesday, February 26
Communications Systems Techniques

THE MEASUREMENT OF THE SUSCEPTIBILITY OF A RADIO RECEIVER TO INTERFERENCE. *B. T. Newman, General Electric Laboratories, Inc.*

DESIGN AND EVALUATION TECHNIQUES FOR REDUCING RADIO INTERFERENCE FROM UHF COMMUNICATION EQUIPMENT. *W. D. Wade and E. F. Swan, Magnavox Co.*

SUPPRESSION OF SPURIOUS OUTPUTS FROM PULSED TRANSMITTERS. *P. Varshkin, S. L. Brown, and F. J. Morris, Electro-Mechanics Co.*

3-DIMENSIONAL INTERFERENCE ANALYSIS. *N. H. Sheperd, General Electric*
PROBLEMS IN THE DEVELOPMENT OF AN AIRBORNE INTERFERENCE BLANKER. *H. R. Meadows, Farnsworth*

Wednesday, February 27
Aircraft Applications

NATURAL INTERFERENCE PARAMETERS IN THE AIRBORNE WEAPON SYSTEM DEVELOPMENT. *R. G. Stimmel, Wright Air Development Center*

RADIO INTERFERENCE STUDIES CONDUCTED ON TYPICAL USAF AIRCRAFT AND EQUIPMENT. *D. R. Meyer, T. Sugimoto, and D. S. Davis, Lockheed*
RESULTS OF UHF MUTUAL ENVIRONMENT TEST PROGRAM AT ROME AIR DEVELOPMENT CENTER. *J. Berliner and J. Augustine, Rome Air Center*

INTERFERENCE PROBLEM IN PULSE SYSTEMS. *S. B. Poritzky, ARINC*
PRECIPITATION STATIC NOISE GENERATION IN AIRCRAFT ANTENNAS NEAR DIELECTRIC SURFACES. *J. E. Nanevicz, Stanford Research Institute*

Wednesday, February 27
Practical Suppression Techniques

CONTROL OF INTERFERENCE THROUGH BASIC DESIGN. *L. W. Thomas, BuShips*
RADIO INTERFERENCE REDUCTION IN EXISTING EQUIPMENT. *C. F. Paluka, Remington Rand Univac*

Additional papers on practical suppression techniques, special suppression components, etc. will be delivered. For more information, contact H. M. Sachs, ARF.

CIRCLE 16 ON READER-SERVICE CARD

DU PONT

REG. U.S. PAT. OFF.
Better Things For Better Living
Through Chemistry

ELECTRONIC DESIGN

PROPERTY AND APPLICATION DATA
ON THIS VERSATILE ENGINEERING MATERIAL

TEFLON

NEWS

Du Pont TEFLON® provides new opportunities for miniaturization of electronic equipment

Because of its unusual combination of properties, Du Pont TEFLON tetrafluoroethylene resin provides new opportunities for the miniaturization of electronic components.

TEFLON has a low loss factor, low dielectric constant, and high volume resistivity. It maintains full electrical insulating characteristics, when flexed or bent during assembly and installation.

TEFLON also has good mechanical strength and an exceedingly low coefficient of friction. It is the only insulating material available today that is inert to nearly all chemicals and solvents normally used in commercial practice. An exception to this is metallic sodium and the other alkali metals. At elevated temperatures and pressures, halogens and certain halogenated chemicals and solvents may affect TEFLON.

Use of TEFLON can help cut production costs, too. The soldering iron will not burn or melt insulation of TEFLON. This saves time, labor, and materials.

The following applications are typical of the current uses of TEFLON tetrafluoroethylene resin.

MAGNET WIRE. Such wire, coated with TEFLON, is widely used on high-

temperature components for aircraft and guided missiles, transformers, relays and various types of motors.

HOOKUP WIRE AND LEAD WIRE. Insulation of TEFLON on hookup and lead wire proves advantageous on transformers, motors and harness assemblies for high-temperature applications. The chemical resistance of TEFLON is particularly valuable in gyros and other hermetically sealed components.

COAXIAL CABLE. Used as the dielectric medium of coaxial cable, TEFLON permits the design of miniature constructions which are the equivalent of coaxial cables using much thicker insulation of other materials.

TUBING. Insulation of TEFLON provides excellent protection for tubing used as bus wire and jumpers.

RESISTANCE WIRE. Insulation of TEFLON on small resistance wire facilitates miniaturization of heating equipment.

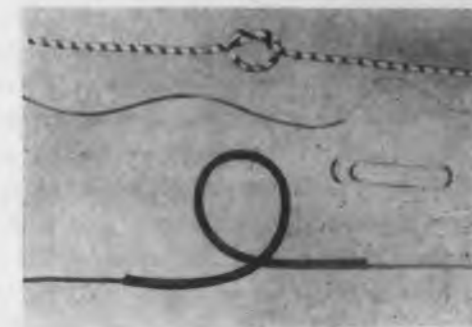
GLASS-FIBER PRODUCTS. Insulation of TEFLON is being applied currently to such glass-fiber products as lacing, tape and sewing thread. TEFLON provides excellent temperature resistance and withstands cutting action of glass fibers.



● Tubing of TEFLON serves as an insulator around two stainless-steel studs in miniature rotary tap switches used in military aircraft.



● The paper clip indicates the small size of these coils. The insulation of TEFLON is one important reason why they can be miniaturized.



● Here are shown a striped, wrapped lead wire (top) and two samples of miniaturized flexible sleeving — all insulated with TEFLON.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 182 Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada (1956) Limited, P.O. Box 660, Montreal, Quebec

NEED MORE INFORMATION?

Clip the coupon for additional data on the properties and applications of versatile Du Pont TEFLON tetrafluoroethylene resin.

Please send me complete property and application data on Du Pont TEFLON. I am interested in evaluating this material for

Name _____

Firm Name _____

Position _____

Type of Business _____

Street Address _____

City _____

Design For Molding Small Pl

George A. Scherry
Grayhill Co.
La Grange, Ill.



Prototype development and the obtaining of field samples of small, intricate plastic parts for electronic applications are now possible at low cost. This is because of a new plastic transfer molding machine based on an original development by Grayhill and now manufactured by Hull-Standard Corp. of Abington, Pa.

Featuring low mold cost and negligible tooling expense, the machine is designed to be used in conjunction with engineering development or for short- and medium-run production as well. Usually, up to 250,000 parts or more can be turned out before it pays to tool up for other larger volume production methods. Also, the parts produced in thermosetting plastics are exactly the same as would be produced on larger machines and are therefore entirely suitable for engineering analysis to determine tolerances, strength and other important characteristics in advance of irrecoverable tooling expense for large production quantities.

The Hull-Standard press was developed when the Grayhill Co.—manufacturers of miniature and sub-miniature electric and electronic components—was faced with the problem of buying small thermosetting plastic parts in quantities of 100 to 200,000. They also purchased several molded parts at the rate of 1000 to 5000 a year which, because of their nature, required permanent and accurate tools or molds. The expense of the tools made it very costly to make design alterations or to experiment with new products. Since these are exactly the problems faced by many other designers, this article should interest many engineers who are anxious to save dollars.

WITH the development of a unique small-part thermosetting plastic molding machine, engineers will find new instances where it is desirable to design in plastic instead of metal or other materials. However, a knowledge is necessary of the factors which will make it possible to take full advantage of the process, effect maximum economies, and possibly to design what has been a practical impossibility heretofore. Such considerations will be discussed here.

Basic Considerations

Thermosetting plastics differ from the thermoplastic compounds (acrylics, styrenes, butyrates, vinyls, etc.) in that the molding process brings about an irreversible chemical change (polymerization) in the material which results in a permanently hard part. The materials cannot be re-claimed; they are more heat resistant than thermoplastics; and they are dimensionally more stable. They have good appearance and can be readily molded into intricate shapes; they are fung-inert and therefore do not normally need a wax or varnish treatment for moisture and fungus protection because the filler is well impregnated with the resin.

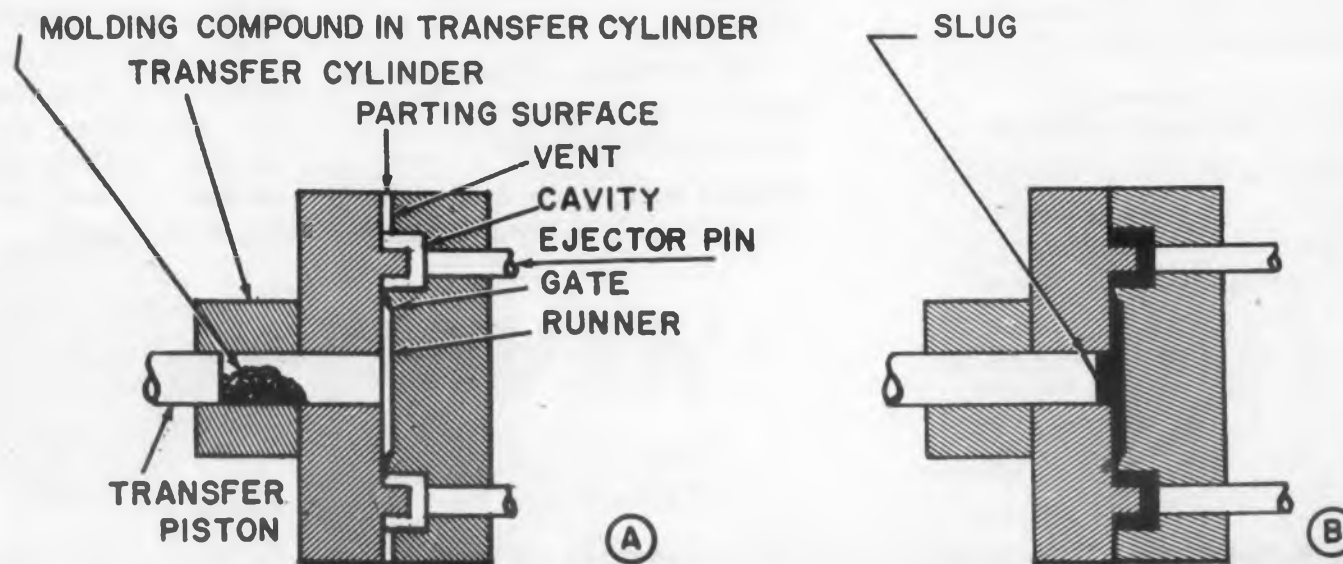
Mold Or Stamp?

Thermosetting plastic materials come in sheet, rod and tube as well as in powder form. Therefore, before deciding to mold a part, the designer should consider

whether it could be stamped or machined from stock. It might even be desirable to combine molding and other operations. A molded part may incorporate shapes and contours that would be impractical to machine or stamp from stock. Frequently one molded part can replace more than one stamping by combining all the features into one. Where the part can be made in several ways, the manner which proves least costly is normally best. For instance: A relay spacer can be stamped at a cost of about 0.1¢ each or less. A comparable molded part would probably cost 10 times as much. Yet, when it is necessary to use ten stamped spacers between contact arms, one molded part might be cheaper than ten spacers because of the reduction in handling one part in place of ten. Also, closer tolerances can be held on a single molded part than on a stack made up of several laminations.

Compound Characteristics

A large number of thermosetting plastic molding compounds are now on the market. With the variety of basic resins and fillers to choose from, it is possible to compound materials with a range of chemical, electrical and mechanical properties. For practical reasons, the compounds most generally used are compromises of physical properties and molding characteristics. As applied to small sized parts, the improved mechanical properties obtained from the use of the



Plastic Parts



Typical plastic parts molded by the process described, compared in size to a paper clip.

more fibrous fillers will fall far short of the anticipated values because of the thin sections usually involved and the inability to properly stratify the fibres. This is particularly true in transfer molding.

The designer should always identify the use and general requirements of the part or indicate an appropriate military specification. This will leave the molder some leeway as to actual compound and supplier. Suppliers catalog materials into compounds designed for general use, those with better than average electrical properties, those with the best attributes for mechanical properties (impact, strength, etc.) and those having the advantage of chemical resistance. Most common basic resins are phenolic, urea, melamine, alkyd, and diallyl phthalates. Some of the trade names are Bakelite, Durez, Beetle, Resinox, Durite, Plaskon and Melmac.

Each basic resin has its own peculiarities. The melamines have good arc resistance but leave something to be desired in their dimensional stability. The ureas, together with certain melamines, can be obtained in light colors only. The phenolics are relatively heat and water resistant and have good mechanical properties.

Fillers are used in these materials in order to decrease cost, add bulk, and provide special properties. Mica is added to enhance electrical properties; glass fillers add to the mechanical and heat resisting proper-

ties; rags add to the mechanical properties. Wood flour is the most common filler. Others in general use are cotton flock, asbestos, nylon and rubber.

In addition to the resins and fillers, plasticizers, lubricants and coloring agents are used. The plasticizers soften and improve the flowability of the compound during the short period in the molding cycle at which it is in the plastic state. The lubricants act as mold release agents and aid in preforming the material. Dyes and pigments are used to impart desired colors to the compound.

Most molding materials are available in several flow ranges. Softer flows are used for parts to be transfer molded, which is the case with this small sized equipment, and most generally is used for parts of intricate section and design. The harder flow materials are used in compression molds and usually result in a slightly higher production rate than with the softer materials. A fine adjustment of the flow period can be achieved by varying the temperature of the mold or the amount of pre-heating of the powder. A simple and easily filled cavity can be run relatively hot, thereby achieving a minimum flow period and somewhat higher production. An intricate cavity must be run relatively cool in order to obtain the maximum flow time, thus assuring a completely filled mold cavity and preventing the breakage of delicate core pins. In such cases, this may decrease the production rate as much as 30 per cent.

Transfer Molding

With transfer molding the mold is completely closed before the molding compound is injected into the cavities. The remainder of the cycle consists of cure time, opening of the mold, and ejection of the completed part. The complete cycle is illustrated in Fig. 1.

Prior to injection into the cavities, the molding compound is loaded into a transfer cylinder which is normally built as a part of the mold. A transfer piston forces the powder into the cavities at a pressure of from 4000 to 8000 lb per sq in. The amount of molding compound to be loaded into the transfer cylinder must be equal to the combined volumes of the cavities, multiplied by the bulk factor of the material, plus an appropriate allowance for the runners, slug, and flash.

"Setting" of the material is progressive. It commences in the first portion of the mold to be filled and ends at the slug, which acts as a reservoir of molding material until it has set. The gate is the point (or points) at which the material enters the cavity. It is designed to act as a nozzle in order to direct the flow and produce a cleaner break-off of the part from the runner. The mold is vented at one or more points (at the end points of material flow) to allow air and gasses formed during polymerization to escape. Sometimes the satisfactory molding of a part is entirely dependent on the proper positioning of the gates and vents in the mold.

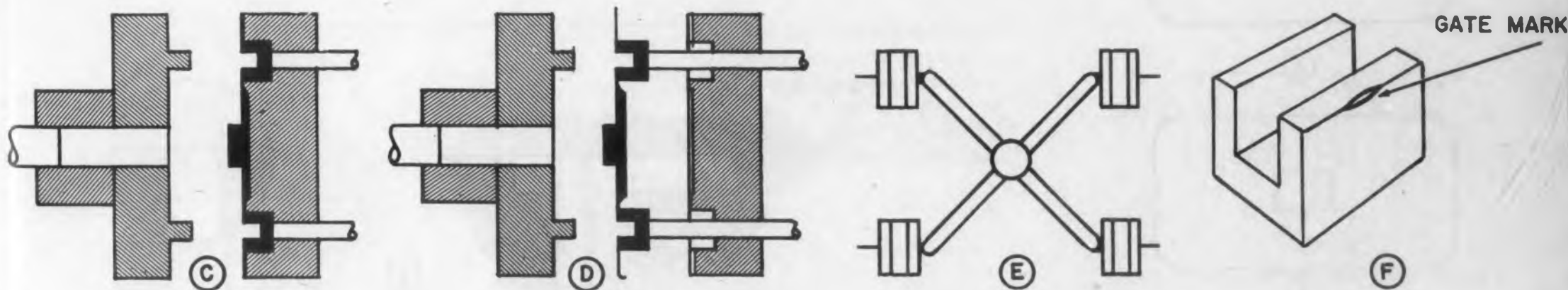


Fig. 1. Typical transfer mold. A—closed mold prior to transfer of molding compound; B—parts curing in mold after transfer of molding compound; C—mold open prior to ejection of cured parts; D—ejection of parts including slug, runners, etc.; E—typical "shot" before deflashing, and slug and runner removal; F—completed part after cleaning.

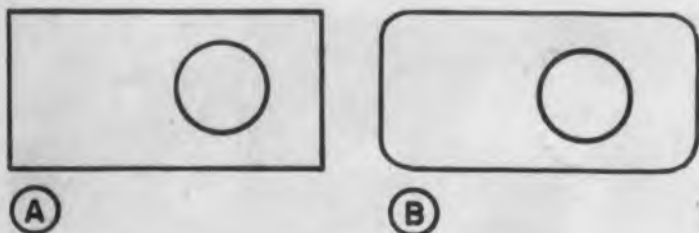


Fig. 2. Square-corner and round-corner molds, at A and B, respectively. The rounded corners are less expensive.

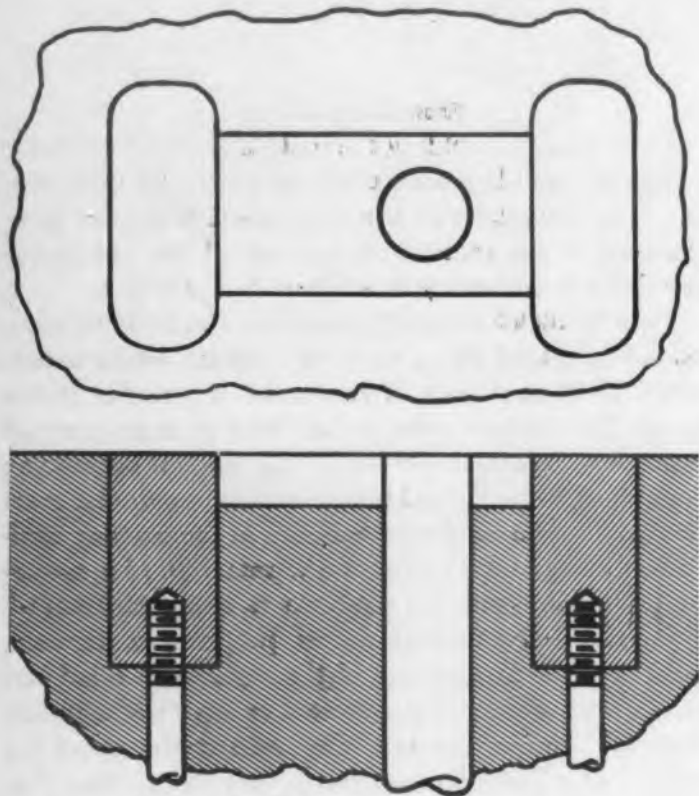


Fig. 3. Method of making a mold with square corners.

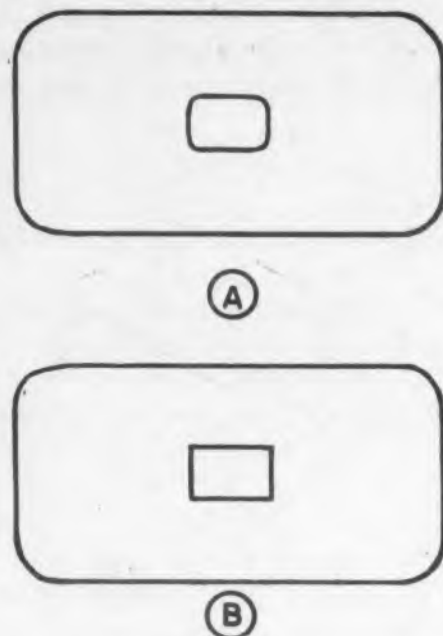


Fig. 4. Rounded and square hole corners at A and B, respectively, for mold core pin. The square hole is less expensive.

Part Design

Design of the part and mold design go hand-in-hand. Careful attention to part design based on mold considerations will keep costs at a minimum. Consider, for example, the simple spacer block shown in Fig. 2. At A the part is shown as originally designed, with square corners. At B it has been altered slightly with a small radius provided on each corner. As a result, four to eight hours of hand work and machining time per mold cavity has been eliminated. In this case the operations consist of end-milling the cavity, drilling one hole, and fitting one core pin. Formerly it was necessary to perform all of these operations plus hand working to make the corners sharp or milling slots at either end of the cavity and machine, fitting and securing the blocks into the slots to provide the square corners as in Fig. 3.

Corner Radius. Corner radius dimensions depend upon the cavity depth. Common practice calls for a radius of $1/16$ th the cavity depth, but not less than $1/32$ in. This dimension should be in multiples of $1/64$ in. so that a standard milling cutter can be used by the mold maker.

Tolerances. Cavities and cores alike are made oversize by an amount equal to the shrinkage of the part as it cools. For most thermosetting plastics, this allowance ranges from 0.004 to 0.010 in. per inch. The mold for a given part is designed for use with a particular material. Where close tolerances must be maintained, it is generally impossible to use another material and achieve the same results unless both materials have the same shrinkage characteristics. Other problems encountered in attempting to hold extremely close tolerances in molding are the variation of the materials from batch to batch, from one molding method to another, from part to part, and within a given production run if temperatures and molding pressures vary slightly. Generally, a tolerance of 0.002 is considered "close" as applied to small sized parts and therefore should be used only where absolutely necessary.

Coring. A rule-of-thumb in the design of cores is that the core pin should not be longer than three times its diameter to keep the pin from "floating" or encountering frequent breakage. If a rectangular-sectioned

core is required, it is less expensive to make if it has sharp corners. Thus, sharp-cornered holes should be specified wherever possible. See Fig. 4.

Ejection Marks. Ejector pins are needed to push the part out of the cavity after molding, and these will cause marks on the molded part. Therefore, the design should be such that the ejector pin marks will not occur on a critical surface. Such marks are usually from flush to 0.005 in. below the surrounding surface.

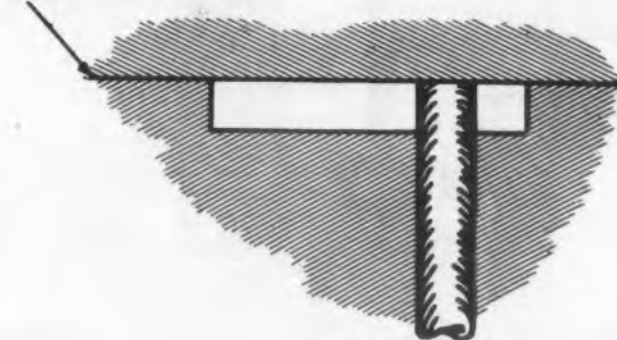
Parting Lines. The parting line, where the two halves of the mold separate, is particularly important as to location in transfer molding. The best parting line from the standpoint of mold construction is a flat plane without projecting elements which would prevent surface grinding for purposes of finishing.

Section Thickness. Section thickness or walls of a part should be kept as uniform as possible. Heavy sections require a longer cure time, increase the weight of the part, and increase the chance of porosity and warpage in the section. The first two add directly to the cost of the part. The latter also add to the cost of the part by causing high rejection rates and by creating a false impression of the strength of the section. No positive rule can be given on section thickness because of the many compromising factors involved; but it is not practical to mold as thin a wall with thermosetting plastic materials as has been done with thermoplastic grades.

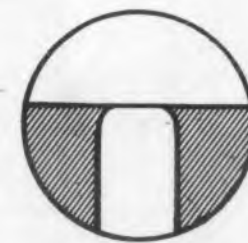
Cleaning. Parts not of extremely delicate section are generally tumbled as the first step in cleaning following molding. Additional cleaning operations are particularly costly and can be minimized by care in part and mold design and good mold maintenance. For example: In Fig. 5 the part has a hole molded in. At A the pin forming the hole is made in the simplest manner and shuts off all of the molding material except for a very thin flash. Most of this flash will tumble off except for a very thin "fin" which will usually remain on the circumference of the hole at the parting time.

An alternative means of molding the hole is shown at B in Fig. 5. Here the core pin is piloted through the mating half of the mold, leaving flash or a fin which is vertical to the parting surface and which will be com-

PARTING LINE



A



pletely removed in tumbling. The slight additional expense in building the mold in this manner can easily be offset by the elimination of hand cleaning. If, however, a loose fitting pin is to fit the hole in final assembly of the part, it would be unwise to go to any added expense in an effort to produce a hole entirely free of flash or fin. It is, therefore, important for the designer to advise the molder of all requirements of the molded part that might effect economies. With some intricate moldings, cleaning cost can be half the cost of the part. The amount of cleaning desired should always be specified to prevent "over-cleaning."

Inserts. Where metal inserts are required in a molded part, the designer should give careful consideration to which costs more—positioning the inserts in the mold before molding or mechanically inserting them later in the molded part. Automatic molding precludes inserting them in the mold; and, often the subsequent insertion by mechanical means is less costly than slowing down the molding operation to permit the inserts to be positioned during molding. When terminals are molded into a part, a very thin flash will often coat the projecting part of the insert. This necessitates extensive and costly cleaning operations, as well as a high percentage of scrap. Insertion by secondary operation leaves the insert clean and is often the best solution to such problems. Common methods of inserting are by using straight and spiral knurls, staking, riveting, spinning, and press-fitting.

Understanding The Machine

Two primary advantages accrue using the small-sized molding press available from Hull-Standard. One, and probably the most important to the designer, is the low tool cost which makes possible changes in design at minimum expense. The other advantage is the fact that the press operates automatically without an operator. One man tends a bank of six presses, including the changing of molds. The automatic operation also assures accurate control of temperatures, pressures, timing of the molding cycle, and volume of material injected into the mold. Accurate control of these factors is important to uniformity of finished parts.

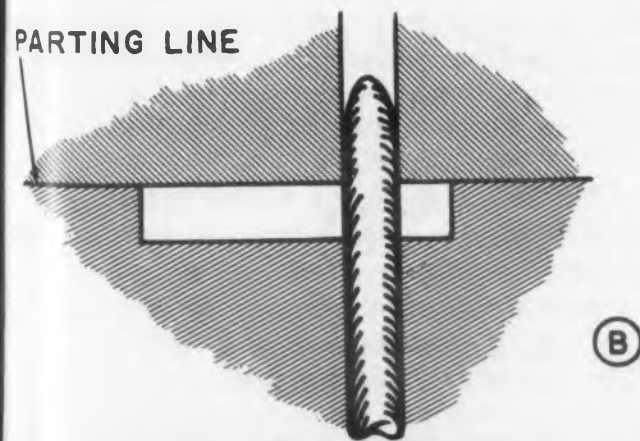


Fig. 5. A—Common and simple mold construction for molding in a hole, but results in a thin "fin." B—Simple method of modifying mold to eliminate "fin" and reduce cleaning cost.



Fig. 6. Hull-Standard mold. Note the simplicity.

The Mold. Contrasted with conventional molding presses, this press has built-in a method of loading the material, the basic ejection system, a system for positively removing the molded parts from the ejector pins, a mold heating system, and a mold retainer set. Thus, these functions are not part of the tool (mold) which must be purchased each time to make a different part.

The mold itself is illustrated in Fig. 6 and consists of one or two mold blocks (into which are machined the appropriate cavities), and a set of knock-out pins assembled to junction blocks. The mold blocks are made of air hardening or other suitable tool steels and are all of a standard size—about 2 x 5 x 1 in., and they are designed to fit into a standard mold-set which is part of the press.

Press Operation. An 8-hour supply of molding powder is contained in the hopper which feeds directly to the material loading mechanism. This mechanism feeds a measured volume of powder to the transfer cylinder which advances to force the material through the runners and gates in the mold and into the cavities. After the parts have cured, the mold opens and the ejector system advances the ejector pins which carry the part out of the mold. A set of fingers pick the pieces off the ejector pins and drops them into a chute. Safety measures are employed in the press to prevent re-cycling if a part has not been ejected.

Press power requirements are especially low: 115v ac, 60 cps, at 10 amp; and approximately 3/4 hp of compressed air at 80 psi.

Limitations

The press just described was designed to meet design and production requirements for comparatively small parts. The maximum sized part from materials with a bulk factor of 2.5 is approximately 0.25 cu in. for a two-cavity mold, 0.11 cu in. for a four-cavity mold, and 0.07 cu in. for a six-cavity mold. In special cases, more cavities can be accommodated if the part is small enough. The exact maximum volume varies inversely in accordance with the bulk factor of the material to be molded. The maximum depth in a part which can be accommodated is about 7/8 in., and the maximum size in parting plane about 1-1/8 in. (Fig. 7).

A secondary limitation is the daily production rate. An average part made from a two-cavity mold will have a rate of about 500 pieces per eight-hour day; from a four-cavity mold, about 1000 pieces per day; and from a six-cavity mold, 1500 pieces.

A third limitation, brought on by automation of the press, is the inability to mold in inserts. As pointed out, this can usually be converted to an advantage by setting up to properly install inserts as a secondary operation.

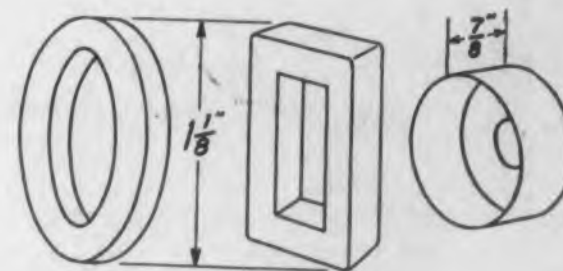


Fig. 7. Maximum part size. Mold capacity is limited to approx. 0.4 oz (or 0.5 cu in.) of molded material. This material is divided between 2, 4 or 6 cavities depending on size and quantity of the part to be molded.

Series-String Tubes

Robert M. Hughes
Design Engineer
General Electric Co.*

TUBES designed specifically for series-string heater operation make it often possible to reduce cost of electronic equipment with little or no reduction in performance or reliability. Discussed here are some of the problems to consider in switching over to, and specifying, series-string tubes.

Avoiding Burnouts

The main reasons for tube burnouts in series-string tube heater operation are: 1. Unequal heater current ratings, 2. Unequal heater warm-up time, and 3. Heater-cathode shorts in tubes. As a result of work by television receiver designers, a new line of tubes is available that makes it possible to simplify the design of heater circuitry. Since series-string circuits provide essentially a constant-current source of power for each tube instead of constant-voltage as in parallel-connected circuits, these new tubes are classified ac-

ording to heater current. Regardless of the application, all tubes in a line feature a uniform heater current, a controlled warm-up time, and an adequate heater-cathode voltage rating.

Tolerances

Series-string tube applications put a more rigid requirement on tolerances and allowable heater resistance variations for satisfactory tube operation than where parallel-tube operation is employed. With parallel-connected heaters, heater current varies only with changes in supply voltage; in circuits with series-connected heaters, heater current is dependent not only on changes in the supply voltage but also on the resistance of the heaters of the other tubes.

Temperature Coefficient

Tungsten, which is used for heaters in most tubes,

has a positive temperature coefficient of resistance. The heater thus regulates its own power input to some extent when the applied voltage changes. For example: Assume a heater in a steady-state temperature condition at a given voltage. If the voltage should drop, the heater current decreases, the heater cools down, and the resistance drops. The decrease in resistance of the heater causes the heater current to increase to a value above what it would have been if there had been no resistance change; and, therefore, the drop in heater power is less than what it would be with no resistance change.

This positive temperature coefficient minimizes difference in heater current due to dimensional differences in the heater wire. If a heater wire diameter is on the high side of tolerance, the current will be higher, which in turn increases the resistance and tends to lower the current. The heater current would

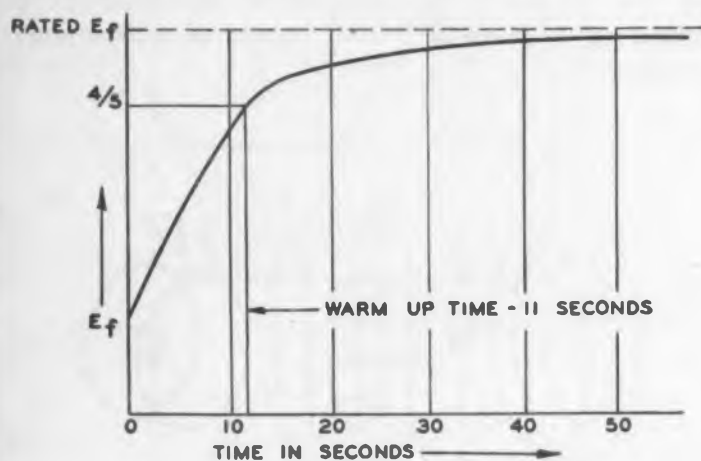


Fig. 1. Heater voltage vs time tube is energized in circuit of Fig. 2.

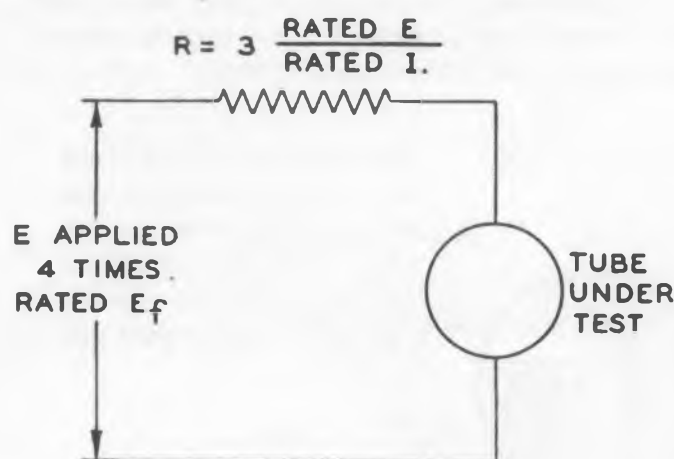


Fig. 2. "Warm-up time" test circuit.

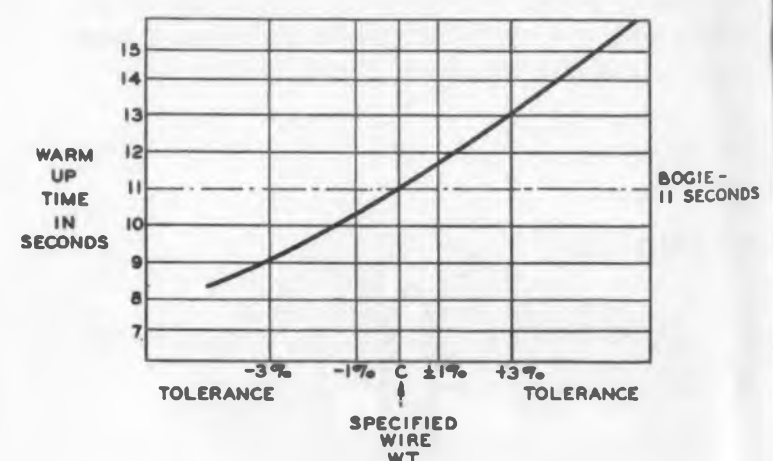


Fig. 3. Wire weight vs warm-up time for Type 12BQ6GA.

NEW!

LOWEST COST SCREEN ROOM IN THE INDUSTRY

MAKES IT UNPROFITABLE TO BUILD YOUR OWN!



ERIK A. LINDGREN

"Champion"

**DOUBLE ISOLATED
SCREEN ROOM**

(PATENTED CONSTRUCTION)

\$79500

(Standard 6'10" x 6'8" x 8' room — as illustrated)

Now, in the LINDGREN CHAMPION, you can receive all the advantages of a factory engineered and built portable screen room — and all at a lower price than it would cost to build your own. Positively offers more attenuation per dollar investment than any other room — costs approximately 1/2 as much as conventional copper screen rooms.



GUARANTEED HIGH ATTENUATION
MINIMUM 100 db from 200 kc to 1000 mc.

**EXCLUSIVE ROTO-LOCK
CONSTRUCTION FOR
PORTABILITY —
EASY ASSEMBLY**

Panels are held in contact with ROTO-LOCKS which supply a continuous pressure of 1,200 pounds, thus avoiding leaks between panels. ROTO-LOCKS are located in center of frames and apply equal pressure to both inner and outer screens.



SPECIAL NEW SCREEN MATERIAL — Lindgren engineers, in conjunction with one of America's foremost screen material manufacturers, developed a special screen which gives the low cost LINDGREN "Champion" sufficient attenuation for a wide range of commercial and military uses. The screen is woven of steel wire, then dipped in a special alloy that solders each mesh, giving it the same electrical characteristics as a solid piece of metal with perforations.

STANDARD LINDGREN DOOR — Same door as on Lindgren deluxe screen rooms. Strong contact fingers — single handle with 3-point pressure contact. Inside and outside handle electrically insulated from each other — inside and outside screen protected by birch plywood.

HEAVY DUTY FLOOR CONSTRUCTION — Extra-strong floor with cross beam every 12". Flooring is 3/4" plywood.

Write today for complete details,
specifications and performance charts



ERIK A. Lindgren & ASSOCIATES, INC.
4515 N. Ravenswood Ave., Dept. E2, Chicago 40, Ill., Phone: LOngbeach 1-0408

CIRCLE 17 ON READER-SERVICE CARD FOR MORE INFORMATION

Therefore not be as large as if there had been a zero temperature coefficient of resistance.

The positive temperature coefficient of resistance is still advantageous in a series string of heaters when looking at the operation of the string as a whole; but for any single tube in the string it is detrimental. For example: A tube which has a low resistance heater (and, therefore, a heater current above normal in a parallel heater circuit) draws above normal heater power when used in parallel connection. In a series-string circuit the current is fixed; thus, such a tube will have a lower voltage drop and consequently a lower heater-power input. In series connection, one tube's heater characteristics can have an effect on other tubes' operation as well as its own; therefore, heater current must be controlled to closer limits.

Warm-Up Factors

Tube warm-up time is considered to be the length of time it takes the voltage across a tube in a constant current circuit to rise to a certain proportion of its full operating value. Practical considerations dictate the applied voltage and series resistance. Voltage across the tube versus the length of time it is energized is shown in Fig. 1 for the circuit of Fig. 2. The RETMA definition of warm-up time is the length of time required for the voltage to reach 4/5 of its rated value when 4 times the tube's normal voltage is applied through a series resistor equal to 3 times the hot resistance of the tube. There is a definite relationship between warm-up time and surge voltage.

The warm-up time of a heater is dependent mainly upon the mass of material being heated. Since there is a time lag between the heating of the heater and the heating of the cathode, the warm-up time is dependent mainly upon the mass of the heater. The heater wire is a significant part of the heater mass,

*Receiving Tube Engineering, Owensboro, Ky.

HUBBELL Interlock PLUGS

TRADE MARK

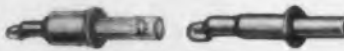






Stay Locked IN ACTION!

Won't Disconnect Accidentally . . .

Yet Disconnect Quickly When Intended

Today's engineers ask more of the connectors they use than simply that they make contact. Computers and modern, automatic machinery require constant, positive connections . . . aircraft wiring must be vibration proof and unaffected by temperature changes . . . printed circuits need sub-miniature connectors that will remain fixed. Hubbell *Interlock* Connectors are designed with all these features — and more! Whether they're used for connecting wire to wire, wires to panels, or wires to terminal strips, the combination of *Interlock* plugs and eyelets or plugs and jacks provides automatic locking, quick disconnect wiring that assures constant low contact resistance. Contact is maintained by a coil spring that adjusts for temperature and pressure changes and is part of the disconnect mechanism that permits fast rearrangement of circuitry and ease of maintenance.

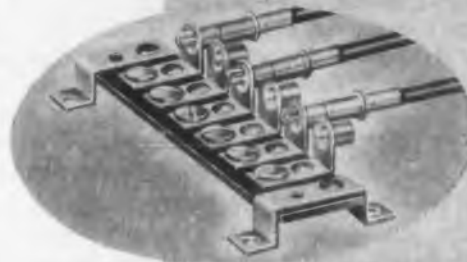
 <p>TYPE "A" PLUGS, JACKS AND EYELETS Nylon Insulated and Non-Insulated. Current Capacity: 10 amps. Wire Sizes: #14 to #18</p>	 <p>TYPE "B" PLUGS AND JACKS Nylon Insulated and Non-Insulated. Current Capacity: 5 amps. Wire Sizes: #18 to #22</p>
 <p>TYPE "A" ANGLE PLUGS AND DOUBLE ENDED JUMPER CORDS Current Capacity: 10 amps.</p>	 <p>TYPE "C" SUB-MINIATURE PLUGS AND EYELETS Current Capacity: 1 amp. Wire Sizes: #20 to #22 or smaller</p>
 <p>TYPE "S" PLUGS AND JACKS Nylon Insulated. Current Capacity: 15 amps. Wire Sizes: #14 to #18</p>	 <p>TYPES "A" AND "B" LAMINATED TERMINAL STRIPS AND TYPE "B" FLEXIBLE TERMINAL STRIPS</p>



Wire to Wire



Wire to Panel



Wire to Terminal Strip

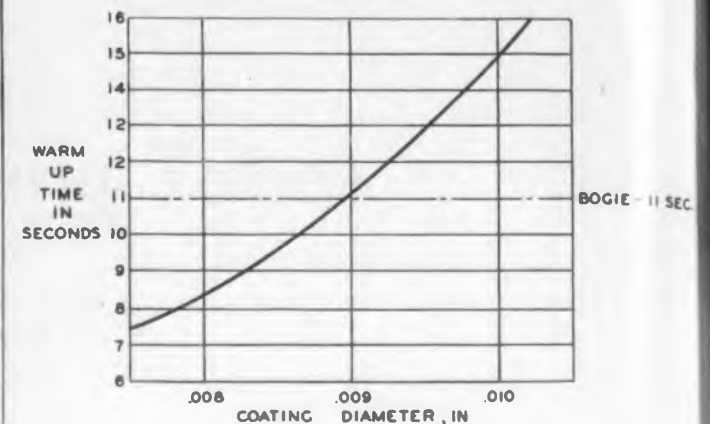


Fig. 4. Diameter of heater coating vs warm-up time, Type 12BQ6GA.

the rest of the mass being made up of the insulation coating; therefore, the heater wire weight, as well as the amount of coating, must be closely controlled.

The variation of warm-up time which can be expected with variations in heater wire weight for a typical series-strip tube is shown in Fig. 3. A wire weight tolerance of $\pm 3\%$, which has proven satisfactory for parallel heater tubes, would allow the warm-up time to vary approximately two thirds of its permissible variation. This would permit practically no variation in insulation coating thickness. From these data it is apparent that a closer tolerance on wire size is necessary if any manufacturing tolerance is incurred in the insulation coating thickness.

The variation in warm-up time experienced with heater coating diameter variations for a typical tube is shown in Fig. 4. It is obvious that the diameter must be controlled to ± 0.0005 in. to maintain warm-up time within acceptable limits.

Other factors which control warm-up time and therefore must be controlled are coating color and surface texture, since they change the heat-radiating properties of the heater.

One cause of heater-cathode breakdown during operation is high heater temperature. A tube can be made with several different heater wire sizes and still have the correct current if the length is adjusted accordingly. For a given heater current, the larger heater wire operates at a lower temperature than the smaller wire; therefore, to provide a tube with a greater safety factor in its heater-cathode rating, it is desirable to use the largest heater wire which can be inserted in the cathode.

Tubes designed for series-string operation must have heaters with the wire size closely controlled to provide satisfactory operation for all tubes in the string, and with insulation coating closely controlled in diameter to provide the correct warm-up time. The wire must be relatively large to operate cool enough to withstand a high heater-cathode voltage.



HARVEY HUBBELL, Inc.

Interlock Electronic Connector Dept.,

Bridgeport 2, Conn.



CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

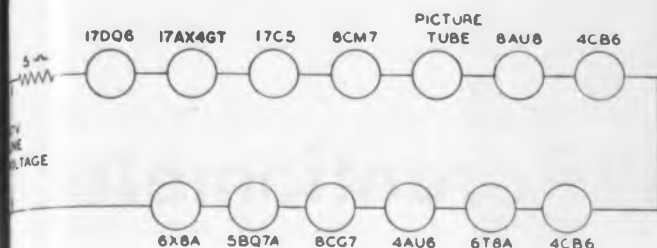


Fig. 5. Typical series-string circuit using tubes with 450 ma heaters.

Tubes Available

For any line of tubes to be practical, it must be possible to use them without any extra circuitry, as illustrated in Fig. 5. In TV receiver design, the heater power requirements are generally in proportion to the picture tube size. Therefore, the 600 ma line provides the necessary tubes for sweeping a 21 in. tube with little loss of power through a heater voltage dropping resistor. The 450 ma line provides the necessary tubes for the larger portables in the 14 to 17 in. sizes, and the 300 ma series provides the necessary tubes for the new 9 in. and smaller portables. By using the correct series, little or no resistance in series with the heater circuit will be needed, and consequently, there will be no wasted power to add heat to the cabinet.

These new 300, 450, and 600 ma tubes, designed for series-string operation, have aided designers of television receivers to produce a low cost, lightweight television receiver with no sacrifice in performance or reliability. Designers of other electronic equipment should find applications for these tubes as well.

Testing Series-String Tubes

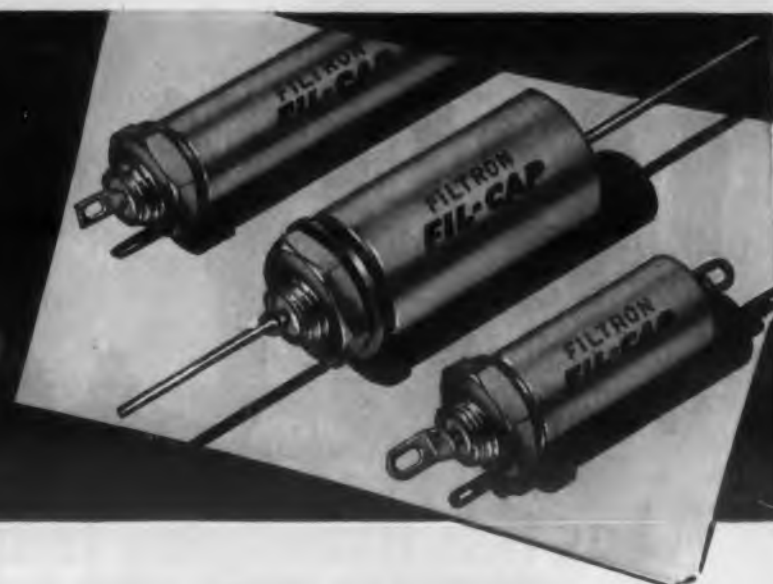
Tube characteristics are dependent upon emission and can vary with the method of energizing the heater. A poor emission tube with a low heater resistance would draw a high heater power if tested with a fixed voltage and would possibly test satisfactory; whereas, if tested with a fixed current it would draw low heater power, the poor emission would be noted, and the tube would be rejected. Tubes for series string application must, therefore, be tested with a fixed current.

Editor's Note:

For a more expanded treatise on the testing of series-string tubes and suggested testing circuits, see "Fixed Heater-Current Source For Testing Series-String Tubes" by W. Drummeter and R. E. Salzman, ED, May 1, 1956, page 28.

the Difference
is INSIDE the

FIL-CAP



FILTRON'S NEWEST SUBMINIATURE FEED-THRU CAPACITOR SETS A NEW STANDARD OF RF ATTENUATION PERFORMANCE

- 1 For the first time—a complete line, ratings for 5 AMPS & 10 AMPS, continuous duty
- 2 Advanced internal circuit design... specially processed impregnant
- 3 Meets Spec MIL-C-11693 (proposed) for suppression capacitors
- 4 Closely matches theoretically ideal attenuation characteristics

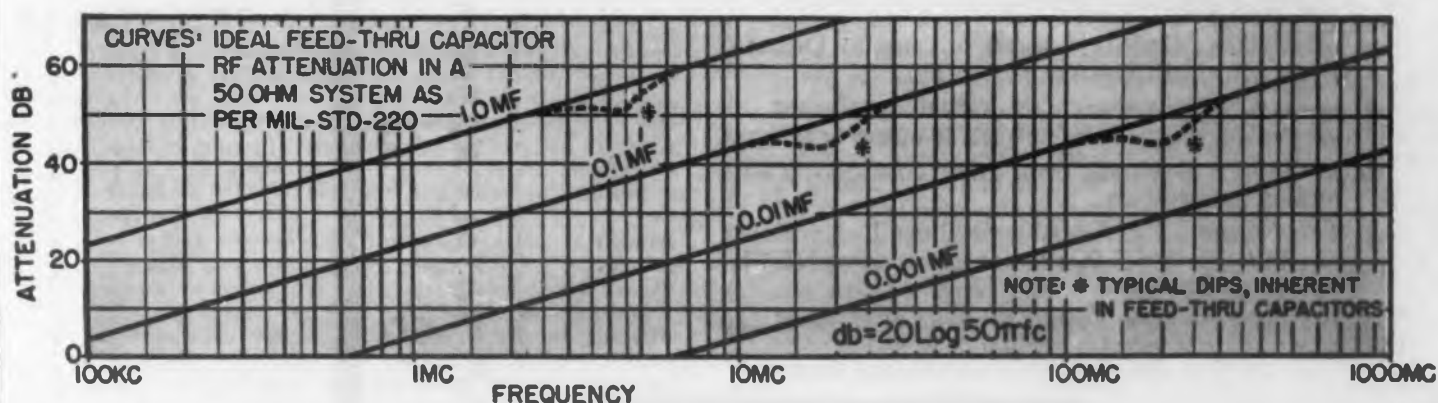
An unusual internal circuit arrangement, precision mechanical components, and a specially processed silicone impregnant combine to afford outstanding electrical characteristics and stability—unobtainable in conventional feed-thru capacitors ordinarily used for interference suppression in electronic equipment.

Basically, FIL-CAPS are a four-terminal network inserted in the current-carrying line. The power line to be filtered must be broken, and each end connected to an insulated terminal of the capacitor. The feed-thru ground-plane mounting prevents mutual impedances between input and output terminals. The FIL-CAP de-

sign includes compression glass insulated terminals, and milled flats on the threaded mounting neck, to prevent rotation during installation and under service conditions.

Type FV is rated for 5 amps AC-DC continuous operation, and Type FX is for 10 amps AC-DC continuous operation. Both types are available in operating voltages of 100, 200, 300, 400 and 600 volts DC; 125 and 250 volts AC; 0 to 400 cycles.

All FIL-CAP subminiature feed-thru capacitors are 100% tested and inspected before shipment.



If your requirements call for greater attenuation than is obtainable with feed-thru capacitors, Filtron also manufactures a complete line of RF interference filters. More than 5000 filter types are offered for military, industrial, nuclear and commercial applications. Filtron is the world's largest

manufacturer of RF interference filters. Details and literature furnished on request.

For complete engineering data and installation diagram, ask for Filtron Catalog FV, and FV Supplement for FIL-CAP equivalents to MIL-C-11693 military designations.

Main Plant, Flushing, New York



CIRCLE 19 ON READER-SERVICE CARD FOR MORE INFORMATION

WHY ...

has this time delay relay aroused such interest?



- May be ENERGIZED CONTINUOUSLY . . . does not require auxiliary lock-in circuits . . . a load carrier in itself
- SNAP-ACTION contact speed . . . up to DOUBLE-POLE, DOUBLE-THROW switching.
- SIMPLE HERMETICALLY-SEALED time element . . . long life stability. Not subject to aging or fatigue.
- Low Cost as a unit; even lower considering simplified installation.
- The NAME . . . *Silic-O-Netic* Time Delay Relay . . . MEANING: SILICone controlled, magNETIC flux variation.
- It's NEW . . . the Type "A" *Silic-O-Netic* Relay is a vastly improved model.

STRAIGHT FACTS

Time Delays . . . from $\frac{1}{2}$ to 120 seconds.
 Small size . . . Overall dimensions:
 $2\frac{1}{8}'' \times 2'' \times 1\frac{1}{8}''$. . . Weight 3 ozs.
 Operation . . . Hydraulic-magnetic principle
 providing positive contact operation, good
 contact pressure
 Contact capacity . . . 3 amp at 120 volts,
 AC (Non-inductive load) . . . D.P.D.T.

Write for Bulletin T-5002

HEINEMANN

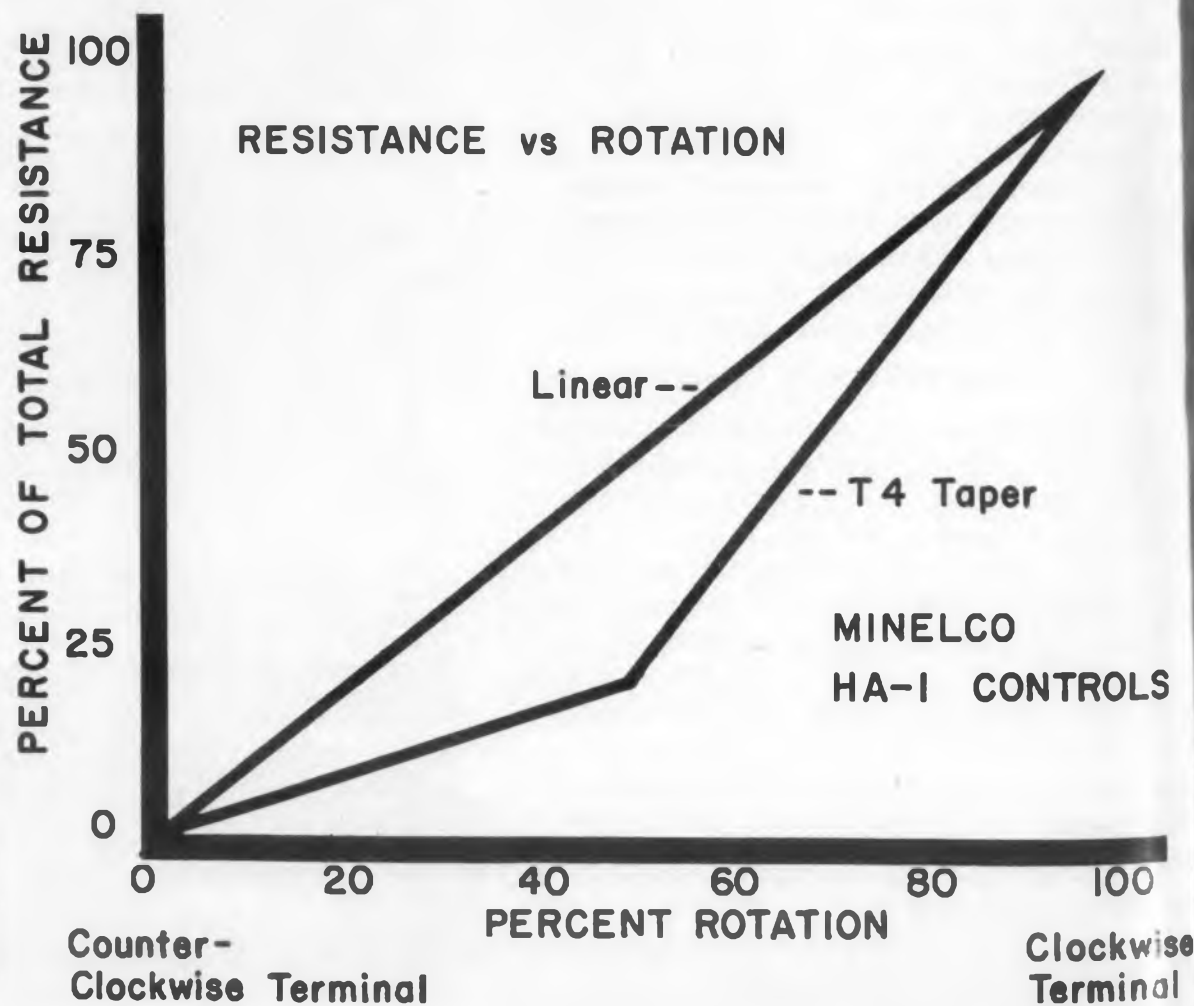
ELECTRIC COMPANY
 156 Plum St., Trenton 2, N. J.



CIRCLE 20 ON READER-SERVICE CARD FOR MORE INFORMATION



Subminiature Potentiometer



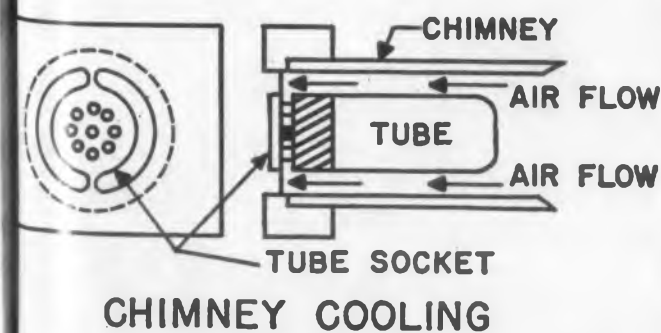
OCCUPYING less than a quarter-inch cub, this wire-wound potentiometer will dissipate a quarter watt and can be obtained in resistance values from 500 to 10,000 ohms. A unique design is employed where the resistance element is enclosed within the anodized aluminum knob, which forms the body of the control as shown. Believed to be the smallest unit of its kind, it can be obtained with linear and audio tapers and for knob or high-torque screwdriver adjustment.

This control, in spite of its small size, has 320 deg rotation for good resolution and is ruggedly constructed and reliable. Miniature Electronic Components Co. of Holbrook, Mass., is the manufacturer. Its type designation is the Minelco Model HA-1. The resistance element is wound with high precision resistance wire, mechanically bonded and soldered to the end terminals to insure positive electrical contact. The wiper material is a precious-metal alloy with low contact resistance and high fatigue strength.

The special-design feature of outside flush mounting has the advantage over conventional flush-mounted potentiometers in that no inside chassis or panel space is required except for the electrical contacts. The controls are single-stud mounted to readily fit most panels of varying thicknesses, thereby eliminating the measuring and cutting of shafts to proper length. The built-in knob construction eliminates the problems of knobs slipping or falling off, and there are no set screws to be tightened which might score the control shaft or mar the outside appearance of the knob. An index pin is provided on all models to prevent rotation of the control base as the knob is turned. Various colors are available.

The Model HA-1 controls can be readily mounted to printed-circuit boards. Only a 1/8 in. circle on the printed-circuit board is required for all three electrical contacts.

For additional information on this potentiometer, fill out the Reader's Service Card and circle 21.



TECHNIQUES and DEVELOPMENTS in oscillographic recording

PHASE SENSITIVE DEMODULATOR PRE-AMPLIFIER PROVIDES A DC VOLTAGE PROPORTIONAL TO AN INPHASE COMPONENT OF AN AC VOLTAGE WITH RESPECT TO A REFERENCE.

THE measurement of the amplitude of an AC voltage component is often necessary in performance studies of servo systems or of suppressed carrier signals over the carrier frequency range from 60 to 10,000 cps. In such cases the demodulator responds to inphase signals and rejects quadrature signals.



A circuit with these characteristics for use in an oscillographic recording system can be seen in the Model 150-1200 Servo Monitor (Demodulator) Preamplifier. It was developed by Sanborn as one of twelve interchangeable, plug-in front ends for "150" Series equipment,

to be used with the appropriate Driver Amplifier-Power unit in any channel of a "150" system. Elements comprising the circuit from input to output, include: compensated stepped attenuator and cathode follower input circuit, phase inverter, push-pull mixer and demodulator stages, differential DC output amplifier and low pass filter. In addition, the chassis contains a VTVM to facilitate accurate adjustment of the reference voltage, and an overload indicator which lights a warning lamp when excessive quadrature voltages exist.

Adaptability to a fairly wide variety of applications is accomplished through broad input voltage, reference voltage and frequency ranges. In order, these are 50 mv to 50 v (for full scale 5 cm deflection), 10 v to 125 v; 60 cps to 10kc. Rise time with low frequency plug-in demodulation filter is 0.1 seconds; with high frequency filter, 0.01 seconds. Quadrature rejection is better than 100:1; for carrier frequencies up to 5000 cycles.

Two representative uses of the Servo Monitor Preamplifier are in the design and adjustment of servo systems, and with instruments used in the design, development or adjustment of other apparatus. The first is illustrated by use of the Preamplifier and associated equipment in the recording of the output shaft amplitude and driving frequency of an AC positional servo; the second by recordings made with a similar setup of the difference between output signals from a gyroscopically-controlled stabilizing device and the "pitch" and "roll" signals generated by a "Scorsby Table" used for testing the device under dynamic conditions.

For a detailed discussion of the principles and design considerations involved in the Servo Monitor Preamplifier, refer to the February, 1955 issue of the Sanborn RIGHT ANGLE, for Dr. Arthur Miller's article on "Measurements with the Servo Monitor Preamplifier."

Technical literature and engineering assistance on specific problems are always available from our engineering department.

FROM SANBORN



BASIC FACTORS IN SELECTING OSCILLOGRAPHIC RECORDING EQUIPMENT

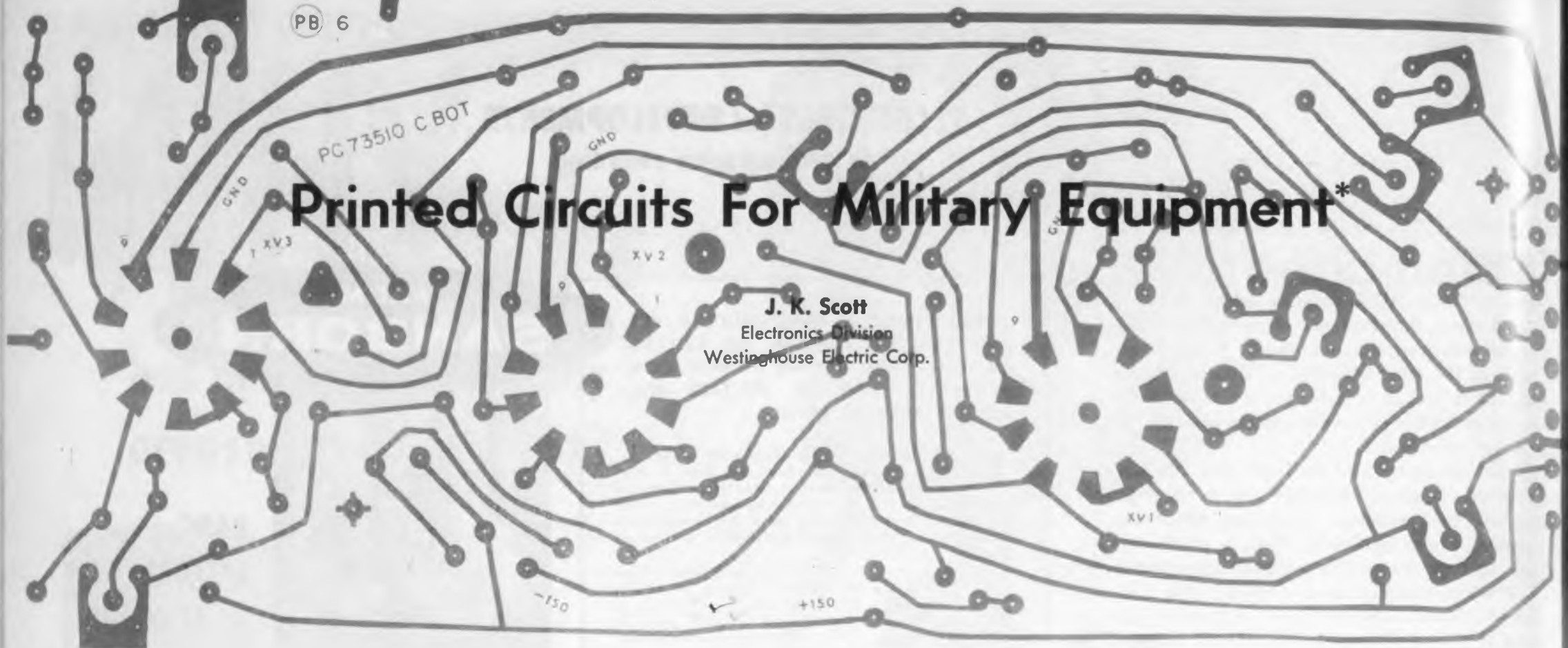
WHEN considering any oscillographic system or equipment for your application, three useful "yardsticks" to apply are (1) the recording method, (2) equipment adaptability, and (3) variety of equipment available. Here are the answers to the three, as they apply to Sanborn systems. In the record, rectangular coordinates accurately correlate multiple traces, simplify interpretation and eliminate errors. Permanent traces, produced by a hot ribbon stylus without ink, provide sharp peaks and notches, and clearly reveal all signal changes. One percent linearity results from current feedback driver amplifiers and high torque galvanometers of new design; maximum error is 1/4 mm in middle 4 cm of chart, 1/2 mm across entire chart. From the standpoints of "adaptability" and "variety", Sanborn "150" equipment offers the versatility of 13 different plug-in front ends for any basic system . . . the choice of one- to eight-channel systems . . . the variety of nine chart speeds, timing and coding controls, console or individual unit packaging . . . availability of equipment as either complete systems or individual amplifier or recorder units.

The purpose of the foregoing information is to better acquaint industry with typical oscillographic recording problems and their answers, design considerations in Sanborn equipment, and basic data on what Sanborn makes and how it is being used.



SANBORN COMPANY
INDUSTRIAL DIVISION
175 WYMAN STREET, WALTHAM 24, MASS.

CIRCLE 22 ON READER-SERVICE CARD FOR MORE INFORMATION



PRINTED circuits for military equipment require different layout techniques, materials, components, and packaging than for commercial applications. Drafting procedure, layout templates, and use of tape are discussed and illustrated here. Board material suitable for military work is considered; and newly developed components are described, as well as special packaging arrangements.

The techniques shown, the components illustrated, and the methods and materials used are, of course, not the only approach to the problems presented in the manufacture of printed circuits for military equipment, but they do represent a technique that is fast and efficient in its layout, advanced in its component use, and flexible enough to permit as little or as much mechanical bracing as required.

New Layout Technique

Several new developments have radically changed the procedure involved in converting a schematic into a finished board. Among them are the Xerox process, mylar film and glass cloth, and tape in strip and template form.

The Xerox process is best known as a means of duplicating or making large quantities of papers, prints, and the like. Its biggest drawback is its inability to reproduce large or heavily darkened areas with any detail and fidelity. It is this drawback which may prevent the use of the Xerox process for prototype or production boards. But, for breadboards it

Based on a paper presented by J. K. Scott at the 1956 National Electronic Conference.

holds real promise. The engineer needs only to draw the pattern or component layout he wants on any white or other high-contrast surface, and the Xerox process transfers the pattern to the copper-clad laminate in a few minutes. Although the plate necessary to transfer the pattern from paper to copper is not quite ready for industrial use, the ability to quickly prepare a printed circuit with this process makes its release to industry an eagerly awaited event.

Materials. Printed circuit layouts, whether commercial or military, require a dimensionally stable material. The availability of mylar film and glass cloth, two of the most dimensionally stable materials available, makes possible layouts that are easily handled and stored. Two different layouts, or top and bottom of the same layout, can be put on both sides of the mylar cloth, and photographed independently. The cloth is opaque enough to permit this, but transparent

enough to permit circuit checking through the cloth where two-sided circuits are used.

Tape can be supplied in rolls in various widths, bullseyes, and gum backed templates to locate holes for various connectors and components. The ease with which tape, component cutouts, and the template can be put on the mylar or glass cloth, or moved to correspond with design changes, makes the india ink ruling pen, and bristol board method of producing layouts as outdated as the Model T. To complete the layout, rolls of lettered tapes are available to make a very speedy process of labeling and identifying signals and components (Fig. 1). Component symbols and numbers are required by the Government, and so double-sided material is used. The numbers and jumpers are etched along with the circuitry, thus producing a much nicer and longer-lasting job than rubber stamping, spray stenciling, or silk screening.



Fig. 1. Use of tapes saves time in laying out printed circuit board.



Through-the-board connections. Eyelets are used in component and jumper holes (Fig. 2). A thin solder washer (0.003 in. thick) is placed under the head of the eyelets, which are installed from the component or jumper side of the board. These washers can be obtained with or without rosin. When the board is dip-soldered, heat is conducted through the eyelet to melt the solder washer and bond the eyelet to the board.

The boards are tin plated before etching to keep the bare copper from oxidizing. To keep any impurities from adhering to the etched board prior to dip-soldering, the boards are coated with an alcohol-flux paste, and flux-dipped again immediately before soldering. To insure proper electrical performance in service, it is necessary to remove flux residue from the board after soldering. This is accomplished by washing the board in any one of several solvents, one of the best being London Chem. Co. type HCR, which can be brushed, dipped, or sprayed. Some components were affected by this treatment by having their markings blurred or removed, but alcohol-resistant inks are now being used on such components to eliminate this difficulty.

Base Materials

Printed card materials commercially available range from phenolics such as XXX-P to high cost KEL-F. Between these two lie the most popular materials used in high-quality military equipment—epoglass (or epoxy-glass) and teflon-glass. For many applications XXX-P is not suitable. The extremely high Q and low moisture absorption rate of teflon-glass make its use mandatory in high-frequency or in high-contamination situations. The teflon material has its drawbacks, the main ones being poor punch-ability, low bond strength and lack of rigidity, resulting in ragged-edge holes, possible peeling of copper, and need for mechanical bracing of the printed boards. Epoglas, one fourth the cost of teflon-glass but still three times that of XXX-P, is among the best high quality materials available. Stiff but flexible, it has good bond strength, punches and drills cleanly, and has sufficient rigidity to meet most requirements. It is entirely satisfactory at frequencies up to 40 mc or higher, and is translucent enough to permit circuit checking and servicing with ease, as circuitry is visible through the material.

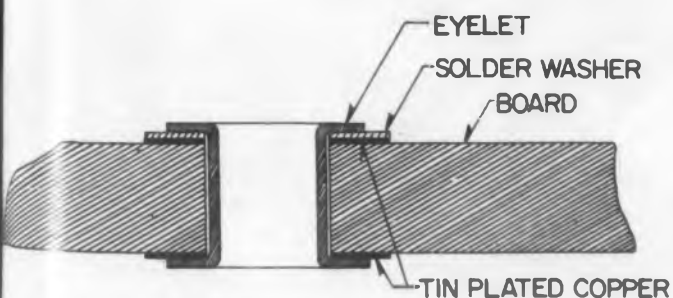


Fig. 2. Cross-section of component hole showing eyelet and washer installed.

Components

As the use of printed circuitry increased, the need for components especially designed for printed circuits became acute. Westinghouse has recently developed several special components. These included a test jack, a tube socket and a coaxial receptacle.

Test Jack. The test jack (Fig. 3), produced by Grayhill mounts in a 0.125 diam. hole and is riveted to the boards. The retaining ring at the top of the jack prevents spreading of the contacts. All metal parts are plated to withstand a minimum of 50 hours salt spray test. Thermosetting plastic snap-on sleeves of all colors are available, and are snapped in place before dip-soldering. The jack will accept and support in a vertical position a standard 3/32 in. probe.

Tube Socket. The easiest way to retain miniature tubes is by using the readily available JAN tube shield. The JAN shield can be used by making the shield base an integral part of the socket assembly (Fig. 4). The shield bases are JAN standard size, crimped over a molded socket, and plated for military use. One socket is for a snap-in application, with a phenolic insulating ring between shell and contacts



Fig. 3. Printed-circuit test jack.

to insure a minimum voltage breakdown. The other socket's pins insert into separate holes and crimp over on the opposite side of the board.

Coax Receptacle. Many circuits require that coax leads be brought directly to the printed circuit board, and so a dip-soldered receptacle was needed. Industrial Products Company developed the receptacles shown in Fig. 5—BNC, MB, and SM series. The pins are 0.040 diam, the insulator is teflon, and the finish conforms to applicable MIL specifications. Other manufacturers are now in production, as well.

Printed Card Connector. A new type printed circuit card connector has been designed to meet the most exacting military requirements (Fig. 6). The usual card insertion type has as its major faults no metal inserts for mounting screws (and so the brittle phenolic cracks), no provision for misalignment, unreliable pressure contacts, and a tendency to split down the middle if slightly oversize boards are inserted into the connector. The pin type is unsatisfactory because the pins are unprotected, there is no mechanical means of retaining the male piece to the board, no metal inserts in the female half, and no provision for misalignment and pin guidance.



Fig. 5. Types BNC, MB and SM printed-circuit receptacles (l to r) for dip-soldering.



Fig. 6. New printed-circuit connector. Either male or female half can be dip-soldered to the board.

The new connector is designed to have the male piece dip-soldered to the board, and the female receptacle to be fastened to a bracket or panel, although it too can be dip-soldered. The metal shell is shaped to polarize the connector, the pins are protected, and the aluminum shell is beveled to provide a guiding action for mating. The flange of the shell provides the mounting holes for #6 screws, on the male piece. Similar holes on the female half contain floating eyelets to provide 1/16 in. total misalignment.

The pins on the male plug that dip-solder to the board are 0.055 diam. and are available in three different lengths to accommodate 1/16, 1/8, and 1/4 in. boards, and the number of contacts available are 7, 11, 15, 19, and 23, and are rated at 7.5 amp.

A complete specification has been written for this connector, some major points of which are: 100 hour salt spray plating requirements, breakdown rating of 900 v rms at 50,000 ft, 4 to 12 oz insertion and withdrawal force, insert material conforms to MIL-P-14D



Fig. 7. Components described, assembled on board.

type MFE or MME or type MDG per MIL-P-4389, and may not be of hollow type construction. Plating of contacts is 30 millionths gold over silver. The solder cups will accept easily a 20 AWG wire. Tests have just been completed in accordance with the connector specification and no defects were encountered.

The connector design was coordinated through the Aircraft Industry Association, and then through the National Aircraft Standards Committee. This committee has assigned NAS numbers to the connector—NAS 713 to the specifications, 714 to the receptacle, and 715 to the plug. As more and more of these connectors are manufactured the price will drop, but even now they are approximately \$2.50 per pair in quantities of 1000.

Components Assembled. The printed board (Fig. 7) illustrates how all of the previously mentioned components look in service. They make for easy clamping and shielding of tubes, quick disconnecting of leads, and convenient signal tracing.



Fig. 8. A "packaged" printed-wiring assembly where complete shielding was required.

Packaging

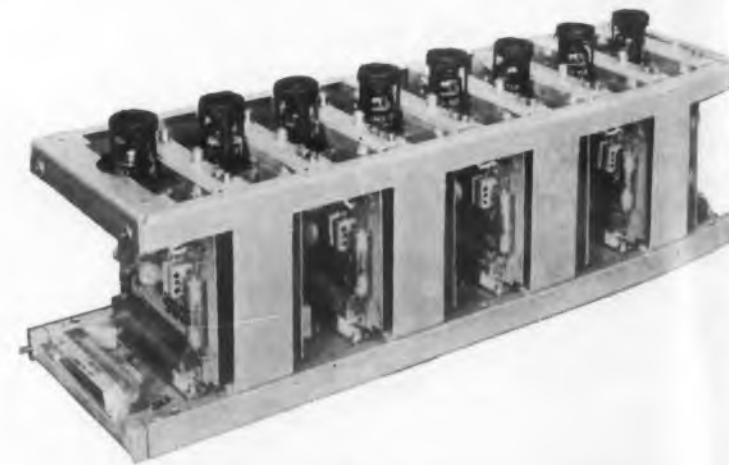
Packaging of the printed boards is a design function usually dependent on contract requirements and environmental problems. Among the things to consider in the packaging of a printed board are in-line or random mounting of the individual components, use of a grid pattern, coating of the boards, and supports or frames.

Component Placement. The in-line mounting versus random-mounting of components argument is one that never reaches a decisive conclusion. Boards laid out at Westinghouse seem to indicate that where space is not a premium and where circuitry is not too complex, the in-line arrangement is feasible if not preferable. Where crowded conditions are unavoidable, or where circuitry requires, random mounting has an advantage. Using components to bridge leads and run directly to tube sockets often saves space and lead lengths.

Fig. 9. 3-D construction. (a)—permanent construction. (b)—plug-in design.



(a)



(b)

Grid Pattern. One of the most discussed assembly concepts concerning printed circuits today is the use of a grid pattern. Much of the argument exists because there is a tremendous difference between the punching, drilling, and handling equipment now available and the equipment spoken of glowingly that will be available one of these days. The expected volume of production is important when considering a change to grid-pattern techniques. It will soon be possible to combine many separate operations of punching and the like into one machine set-up. Card indexed machines and programming devices are already under way. Components are becoming available with leads already on a fixed-pattern spacing thus saving pre-bending of leads. The way to take advantage of all these developments is by the adoption of a grid. Whether it be 0.025, 1/0, or 1/2 in., is best determined by each particular situation, but a fixed hole spacing, a grid, is the coming technique.

Coating of Boards. The decision to coat a printed board is usually based on the degree of moisture protection the board may need or on conditions imposed by a specific contract. Some equipments will always be in an enclosure or in an air-filtered cabinet. Others are tactical pieces subject to all the man-transportable, behind-the-front-lines service conditions. Still others are subject to sudden altitude changes and the frost and condensation that goes with it. Thus, the decision must be made to use or not use a coating. The coating material choice is difficult. Light varnishes will give some moisture protection and make replacing of components rather easy. Epoxy resins are better than varnishes moisture-wise, but hamper component repair. Thick coatings, commonly described as "gunk," are excellent for throw-away packaging designs but make component replacing almost impossible.

Board Supports. Support for the boards is another consideration that is dependent on many factors such as shock, vibration and the amount of handling involved. No specific rule can be given for this because too many factors are involved. For example, castings can be used at each end and extrusions on the side, as in Fig. 7. Special configurations are necessary where complete shielding is required (Fig. 8). A different casting is used at the plug end and different extrusions are used along the sides. The same cover plate arrangement along the bottom is used and a specially designed top cover and tube shield completes the assembly. Holes in the top cover provide access to test points where desired.

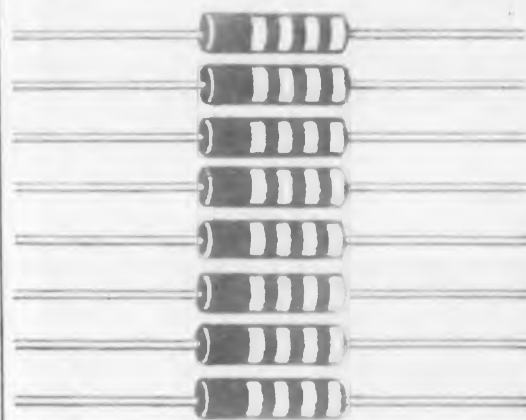
3-D Construction. Often, three-dimensional construction is desirable. Circuit boards can be assembled in a permanent fashion, such as is shown in Fig. 9a, or they can be assembled for replacement, Fig. 9b. A board laid out in this manner has a plug at one end for power and signals, and has receptacles dip-soldered at intervals along the board length. Boards are plugged into these receptacles and braced.



Meet or surpass today's critical performance requirements with

STACKPOLE fixed composition RESISTORS

Packaged for convenient assembly...
MANUAL or AUTOMATIC



Conservatively rated
at 70° C.

Low noise level.

Unsurpassed humidity
protection.

Easy-to-solder, firmly
anchored leads.

Drawings available
for detailed
packaging
specifications.



STACK-PACK

REEL-PACK

STRIP-PACK

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

Canada:
Canadian Stackpole Ltd.,
550 Evans Avenue, Etobicoke,
Toronto 14, Ont.

Stackpole Fixed Composition Resistors are stocked by leading parts distributors

CIRCLE 23 ON READER-SERVICE CARD FOR MORE INFORMATION

HARTWELL TEAMWORK



Research, Engineering and Development Services on Precision Mechanical Devices for aircraft and general industries. New fully equipped experimental machine shop and engineering test and development laboratory for HARTWELL'S engineering staff are "AT YOUR SERVICE!"

Over two decades of successful problem-solving ex-

perience in the fields of Flush Latches ■ Hinges; Fittings; Cable Terminals; Float Valves & Assemblies. HARTWELL'S highly developed skills and production abilities are "AT YOUR SERVICE!"

If you have a problem in one of our fields, or are beginning designs, HARTWELL TEAMWORK is "AT YOUR SERVICE!"



REQUEST NEW BROCHURE DESCRIBING OUR FACILITIES



9035 Menice Blvd., Los Angeles 34, California

BRANCH OFFICES:

Hackensack, New Jersey - Wichita, Kansas - Fort Worth, Texas
Seattle, Washington

CIRCLE 24 ON READER-SERVICE CARD FOR MORE INFORMATION

Selecting Plastic Materials

R. R. Moyer*

Monsanto Chemical Co.

THE PROPER choice of plastic material requires a knowledge of fairly exact performance specifications, consideration of assembly and end-use requirements, the experience or data on performance of molded or extruded sections which may be applied to design, and the consideration of one or several processing techniques for the plastic material. From the generation of the original idea to the approval of the prints which fix design and specify material, compromise is necessary.

Direct Selection Factors

■ Strength

Plastic strength is the ability of a fabricated shape to bear a load without abnormal and/or permanent distortion. Further, that energy absorption must be accommodated in the absence of rupture or physical breakdown.

■ Dimensional Stability

This is directly determined as the reaction of a fabricated mass to changes in temperature and humidity.

■ Aging Characteristics

This point of judgment deals with the factors of strength, dimensional stability, and chemical and temperature exposure. It acknowledges that the "as is" performance characteristics of a material may be adequate but that a particular type and length of use life is required.

■ Temperature Exposure

This is perhaps the most involved of all the factors. Performance values may be adequate for end product use but inadequate for assembly or transportation. Proper definition avoids the use of a substandard material with consequent failure, or the use of a premium compound with resultant excessive production cost.

■ Chemical Exposure

Swelling, dissolving surface crazing, discoloration, and physical degradation all reflect inadequate performance. It is important to note that apparently common solutions which differ minutely in content or process preparation can react with a marked difference on fabricated plastic articles.

■ Electrical Characteristics

These requirements are directly defined and can readily be applied to determine if a material in the "as is" state may suit the requirements. However, for applications in which current cycling, temperature and humidity extremes, or initial performance is ad-

judged borderline, practical testing of specimen samples must be conducted.

■ Color Stability

Natural sunlight, indirect sunlight, artificial light of specific sources, and high temperature conditions determine the color stability of a material as a condition of time. When previous performance is not known, practical evaluation must be made.

■ Processing Characteristics

This is a negative point of judgment since it determines if a facility may be adequate to use a specific material, or if a specific compound or plastic stock may be processed to a given design.

Related Factors

An initial choice of materials is based on the "direct factors." However, the final choice can be made only after considering related factors, as follows.

■ Material Cost

Take the case of a designer charged with preparing a part or a total assembly for which a set range of cost was allowed or a "not to be exceeded" value was established. Consideration of the direct factors enables the designer to roughly determine the wall section thicknesses which are to be used, and from this a direct cost of material may be calculated. Normally the material which is lowest in base cost will be the one which has the lowest total direct material cost. It is always possible that the use of a material which has higher initial cost but greater strength may allow a part of lesser mass to be designed which in turn will allow lower total direct material cost. The designer should never overlook this possibility.

■ Compromises

Since matters of cost, assembly technique, and total product performance must be judged, the necessity for compromise may arise. This would include a change in design either functional or aesthetic which might act to simplify assembly, improve total assembly performance, lower direct material cost, or allow the use of materials imparting greater toughness to the total assembly. Rules cannot be applied for this area of performance since the factors of design are specific for each product and defy generalities of interpretation.

■ Assembly

Assembly may involve the combination of the single plastic part with one or a series of metal parts, or with other plastic parts. The means of firmly affixing two or more components may include the use of fasteners, cement, or mechanical interlocking. The use of ce-

ments normally presents no problem as long as it has been predetermined that the cement, bodied or solvent type, will not adversely affect either of the components to be assembled. Where fasteners or interlocking are involved, normally the stress loading of a part or short time distortion are involved.

In the case of the former, materials satisfactory as separate components may subsequently be deemed to be unsatisfactory because the assembly method results in excessive stress or fatigue which ultimately causes the breakdown of the plastic components. Obviously, failure would require that tougher or stiffer materials then be considered for the job. In the case of the latter, deformation of a plastic molded component beyond the "yield" point normally does not cause rupture or failure of the part if the plastic has 15 per cent or higher elongation at failure characteristic. On occasion, multidirection distortion is required, and when the load is sharply applied, rupture of the plastic part may develop.

It is significant to note that once the assembly is completed, toughness may be adequate, but during the moment of assembly it may be inadequate. As a result, engineers with considerable experience in metal work will normally tend to request a tougher plastic. Since a move in this direction increases cost, the sound approach would be to review the assembly method to determine if a revised method of assembly fit or practice could be devised.

• Past Experience

Much of the data listed for designer guidance in handbooks for metals were developed after a long period of correlating actual design performance experience with laboratory tests. The plastics industry, with its rapid rate of introduction of new materials, has been unable to formalize design experience data for specific products in the form of handbook information. Consequently, experience as in the minds of men must be drawn upon. Both successes and failures will be the guide to be applied in the final choice of a plastic for a specific design.

• Tooling Costs Vs Volume

Normally the designer-engineer's knowledge of tooling costs for specific plastics which relates either the required inherent quality for tooling such as high-pressure type versus low-pressure type and relationship of plastic material to cycling rate are points of reference which are considered throughout the process of choosing a plastic material. Obviously, in the case of short-run requirements, the cost of the tooling can be equally as significant as the piece part price. Where long runs for several years of production are involved, higher tooling costs which allow higher production output rates, improved quality, and trouble-free performance would be considered an advantage rather than a detriment.

* Manager, Styrene Technical Service, Plastics Div., Springfield, Mass. This article has been adapted from a paper "Selecting the Proper Material" presented by Mr. Moyer at the Plastics Institute, sponsored by the University of Wisconsin Extension Division, Oct. 18 and 19, 1956, at Madison, Wis.



CONDENSE AND SAVE!

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

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

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

now after years of intense research and development of military requirements

 offers you **RC NETWORKS**

PITCH FILTERS INTEGRATOR NETWORKS

RC NETWORK as low as 1/2% capacitors and 1/2% resistors for reliable RC value of 1%.

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

PRECISION DECADE CAPACITORS with attached rotary switch or completely boxed!

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

CHECK THESE OUTSTANDING FEATURES:

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

**SOUTHERN
ELECTRONICS**
Corporation



For your most exacting requirements—

always specify S.E.C.

Wire, write or phone for a complete catalog today!

239 West Orange Grove Ave., Burbank, California

CIRCLE 25 ON READER-SERVICE CARD FOR MORE INFORMATION

RF LEAKAGE
CONTROLLED TO LESS
THAN 1/10 MICROVOLT!



ANOTHER PROBLEM SOLVED BY METEX!

This Type 240-A Sweep Signal Generator built by Boonton Radio Corp., Boonton, N. J., is designed to operate at controlled output levels down to 1/10 microvolt. To prevent RF leakage between the oscillator chassis and oscillator cover, Boonton engineers specified a METEX RF gasket at this critical joint. This METEX RF gasket, knitted of monel wire, prevents RF leakage so successfully that peak performance is obtained at minimum output levels where leakage was previously experienced.

METEX RF Shielding, knitted of monel, aluminum or silver plated brass wire, combines maximum *conductivity* for efficient performance with inherent *resiliency* that assures continuous line contact between imperfect mating surfaces. Interlocked loops, knitted of continuous wire strands, assure maximum *cohesion*.

If you have a problem involving RF shielding in electronics or related equipment, write METEX, today!

ELECTRONICS DIVISION
METAL TEXTILE CORPORATION

ROSELLE, NEW JERSEY

CIRCLE 26 ON READER-SERVICE CARD FOR MORE INFORMATION

Oriented-Ceramic

Permanent Magnet



Electromagnetic stator



Rotor

ORIENTED barium ferrite ceramic magnets, have a peak energy product 3½ times greater than conventional non-oriented ceramic magnets. These new high energy magnets can in many instances be substituted for Alnico. Feasible applications are: d-c motors, synchronous drives, travelling wave tubes, high fidelity loud speakers and magnetic clutches.

Called Indox V by the manufacturers, Indiana Steel Products Co., Valparaiso, Ind., oriented ceramic magnets utilize inexpensive, noncritical materials and are lighter than magnets made of metallic alloys. On an equivalent weight basis, ceramic Indox V has an energy product comparable to that of Alnico V—the strongest permanent magnet material commercially available. Because the energy product has a broad rather than a narrow maximum, it provides a wider high efficiency operating range than Alnico V. The length of Indox V is only 28% that of Alnico V at optimum operation, and the area is only 57% of conventional non-oriented ceramic magnets. In oriented magnets the crystalline

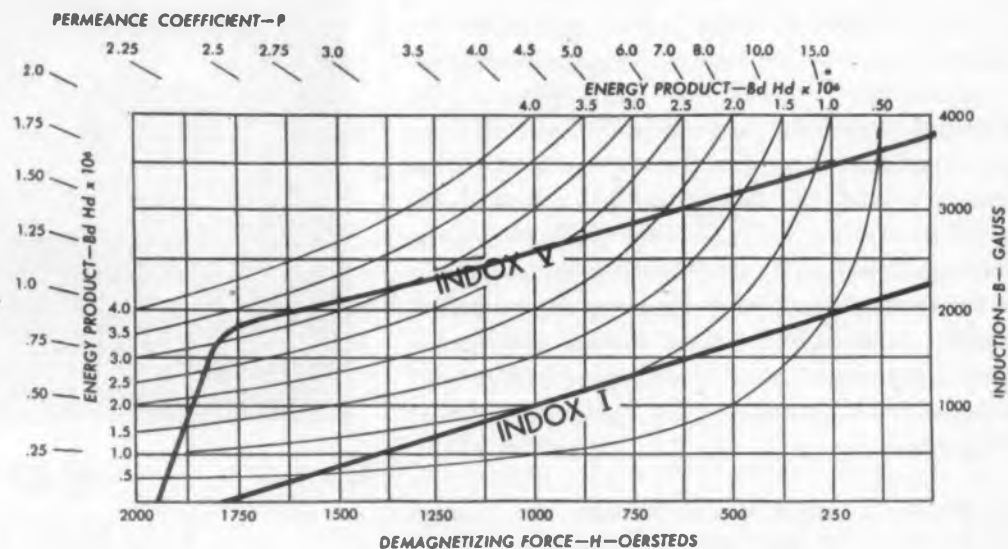


Fig. 1. Demagnetization and energy product for Indox I and Indox V

ANOTHER EXAMPLE OF HOFFMAN LEADERSHIP

TRACKING THE SUN TO POWER A ROBOT WEATHERMAN



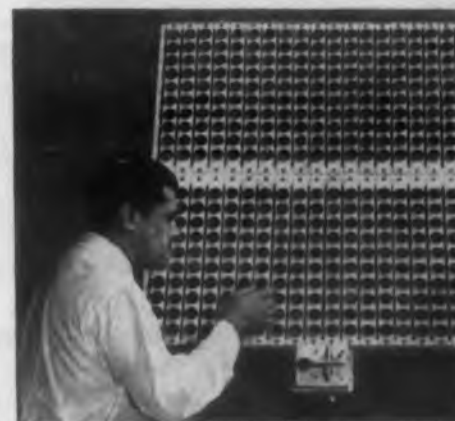
BIG BERTHA Solar Energy Converter Panels

Powering unmanned weather stations is just one of the many uses for Big Bertha—newest, most exciting product of Hoffman electronics research. Solar Energy Converter Panels like this can be installed wherever an economical and efficient source of electrical energy is needed to power transistorized signal, telemeter, communications and similar electronic equipment.

Hoffman silicon junction Solar Cells blanket the face of Big Bertha, convert sunlight directly into electricity to charge batteries and operate equipment—produce 80 watts of power output for each square yard of surface. Panels of almost any size or configuration can be built at modest cost.

Important potential applications for Hoffman Big Bertha Converter Panels include: untended telephone repeaters, unmanned radio relay stations, pipeline transmitters, Forestry Service radio units, telemetering equipment, railroad signaling apparatus, and all types of transistorized radio, TV, telephone and telegraph equipment.

Solar Energy Converter Panels can be supplied in tracking and non-tracking models, with special mounting stands or brackets designed to meet individual requirements. For additional technical information, please write the Applications Engineering Division, Hoffman Electronics Corporation, 3817 South Grand Avenue, Los Angeles 7, Calif.



BIG BERTHA consists of banks of Hoffman Solar Cells interconnected to attain specified power requirements—produces 80 watts per square yard of surface.



SUN TRACKER automatically turns Converter Panel to "follow" sun's transit across sky, assures maximum conversion efficiency throughout the daylight hours.

Hoffman

ELECTRONICS CORPORATION

CIRCLE 28 ON READER-SERVICE CARD FOR MORE INFORMATION



Indox V Stator

structure of the magnetic material is so arranged that individual crystallites are aligned with the preferred axis parallel to desired magnetization.

The reversible temperature coefficient is the same as nonoriented ceramic magnets. Because its coercive force drops with decreasing temperature, it has an irreversible flux drop when subjected to low temperatures and operated at or below the knee of the curve. To avoid this, it should be operated above the knee. For most applications, best results are obtained by magnetizing Indox V after assembly. This is especially true whenever the open circuit operating point would be below the knee of the demagnetization curve.

Properties include a coercive force (H_c) of 2000 oersteds, and a residual induction (B_r) of 3840 gauss. As shown in Fig. 1 the peak energy product is at a (B_H) of 1920 gauss and an (H_H) of 1820 oersteds. The resistance is 10,000 to 20,000 ohm-cm.

For further information on this ceramic permanent magnet, fill out the Reader Service Card and circle 27.

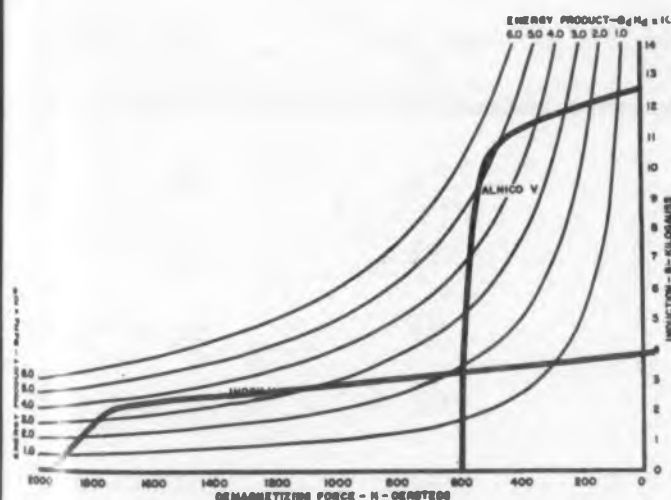


Fig. 2. Demagnetization and energy product for Indox V and Alnico V

Selection and Application of Precision Film Resistors

P. Nyul and C. Wellard

International Resistance Co.
Philadelphia, Pa.

PROPER selection and application of precision film resistors will enable the design engineer to use them to advantage where a wirewound resistor would be bulky, expensive, or cause undesirable inductive effects. There are available a large variety of insulated and uninsulated film resistors. To help the design engineer pick the proper type this article offers several convenient check-off lists. Specific application hints are also included.

Table 1 covers the more prominent uninsulated types. These are manufactured in wattage ratings from 1/8 w to several watts, but for brevity the table is limited to a 2 w maximum. Although range varies from manufacturer to manufacturer, this list gives an indication of what is available. Uninsulated types have the film applied on a ceramic base and are terminated with cap and lead assemblies. The term uninsulated is a relative one, since the resistors are usually covered with multiple layers of varnish or some other protective coating.

A tabulation of insulated types is given in Table 2. The more common varieties are molded, ceramic housed, glass housed, and glass sealed. Insulated resistors allow higher ambient temperatures than uninsulated resistors of the same wattage.

Molded units are made by taking the sub-assembly and molding it in a thermo-setting material. Ceramic and glass housed units have the sub-assembly inside a ceramic tube and the ends filled with insulating cement. A silver solder seal may be used instead of the insulating cement. Sealing is done at controlled room conditions, but the unit is usually not evacuated nor is an inert media put into the space immediately surrounding the sub-assembly. Glass sealed film resistors have a true hermetic seal with an inert media inserted prior to the final seal-off.

Table 3 contains a check-off list of important aspects governing the design engineer in his selection of the proper resistor. In addition, to the check-off list other considerations such as voltage coefficient temperature cycle, short-time overload, noise, insulation resistance, and effect on vibration should be made. These items vary in importance, depending upon the particular application; whereas items in the check-off list are important in practically every choice of component.

A listing of the more common types of film resistors in the order of increasing cost is given in Table 4. Specific values have been omitted because of the wide variation from manufacturer to manufacturer. The information is intended only to direct the reader to the proper category.

Application

Having made the selection of a precision film resistor that best fits the requirements of the circuit, the resistor must be applied in a way which will not detract from its performance.

Cases of failure because of misapplication, fall into one or more of the following categories: 1. Handling and Insertion, 2. Mounting and 3. Environment.

Handling—It is obvious that care must be exercised when dealing with the glass housed and glass-sealed units. During the insertion of uninsulated resistors, care should be taken not to damage the protective coating with a hot soldering iron, Fig. 1. This may result in permanent damage to the resistive film. Excessive bending of the leads and sharp bends ad-

Table 1 Uninsulated Deposited Carbon, Boron Carbon & Metal Film Nominal Specifications

Mil Style	Body Size-in.		Rating Watts 40 C Ambient	Volt. Max. DC	Res. ohms	
	L	D			Min.	Max.
RN 32 or RN 32M	9/32	5/64	1/8	250	50 —	1M
RN 10 or RN 10M	15/32	1/16	1/4	300	10 —	1M
RN 20X or RN 20R	9/16	5/32	1/2	350	50 —	25M
RN 25X or RN 25R	15/16	19/64	1	500	100 —	50M
RN 30X or RN 30R	2-1/16	19/64	2	750	200 —	100M

Table III—Considerations in Selecting Film Resistors

1. **Economy**—The most economical unit which will meet specifications with a reasonable safety factor should be chosen.
2. **Physical Dimensions**—Space requirements to mount or place the unit must be met.
3. **Load Characteristics**—What is the change in resistance of the component with continued load?
4. **Range of Resistance Coverage**—Not all ranges or resistance values are available in all wattages. As a general rule, the larger the wattage size, the greater the maximum resistance range. If the desired component is not available in a lower power rating it may be necessary to go to a higher wattage rating.
5. **Stability**—Long time stability in some applications is an absolute necessity. In others, initial tolerance may be chosen low to allow for a change in resistance with time.
6. **Low Temperature Coefficient**—If large fluctuations in temperature are to be expected components which have low temperature coefficients should be used. This will enable the individual components to remain fixed relative to one another through wide temperature variations.
7. **Humidity**—Special precautions should be taken in the selection of components for certain regions. Coastal tropic areas where humidity will fluctuate over wide ranges on a day-to-day basis is an example of such a region.
8. **Tolerance**—The tendency to be avoided is specifications of a high cost low tolerance unit in order to obtain an additional safety factor. Additional cost involved will seldom warrant such a selection.

Table IV—Types of Film Resistors In Order of Increasing Cost

1. **Uninsulated deposited carbon**—This is the most economical unit. It requires care in handling, and has limited mechanical strength and moisture protection.
2. **Uninsulated boron carbon**—Essentially the same as the foregoing but possesses a lower temperature coefficient and less range coverage.
3. **Molded deposited carbon**—An economical unit that can take rough handling. Environment performance is better than the unmolded types.
4. **Molded boron carbon**—Essentially the same as 3, but has improved temperature coefficient and less range coverings.
5. **Ceramic housed deposited carbon**—Has all the properties of molded deposited carbon resistors and is similar in characteristics.
6. **Uninsulated metal films**—Has a lower temperature coefficient and a higher operating temperature than first five components. Requires care in handling.
7. **Glass houses deposited carbons and metal films**—Deposited types are similar to 5 but are most susceptible to vibration failure. Glass housed metal films offer slightly higher operating temperatures and consistent temperature coefficients.
8. **Glass-to-metal sealed metal films**—Offer extremely high operating temperatures and very low temperature coefficients. Essentially unaffected by environmental conditions. They are however more susceptible to vibrations and breakage in handling than molded types.

Table II Insulated Deposited Carbon, Boron Carbon & Metal Film Nominal Specifications

Mil Style Proposed	Body size-in.		Rating Watts 70 C Ambient	Volt Max DC	Res. ohms		Type*
	L	D			Min.	Max.	
RN 60M or RN 60	13/32	1/8	1/8	250	50 —	1M	M
RN 65M or RN 65	5/8	3/16	1/4	300	10 —	1M	M,H
	3/4	1/4	1/3	300	5 —	1M	H
RN 70M or RN 70	23/32	1/4	1/2	350	10 —	25M	M,H
RN 75M or RN 75	1-1/8	13/32	1	500	100 —	50M	M,H,S
RN 80M or 80	2-1/4	13/32	2	750	200 —	100M	M,H,S

* M—Moulded; H—Housed; S—Sealed



announces
an unusually
precise

SERVOMOTOR- TACHOMETER GENERATOR



for
**INSTRUMENTATION
FIRE CONTROL
AUTOPILOTS
MISSILES
COMPUTERS**

FEATURES:

- Zero Speed Voltage (RMS) 8.0 mv in phase
15.0 mv quadrature
19.0 mv total
- Max Ambient Temp. 150°C
- Linearity 0.5% to 3600 rpm
- Output Gradient Phase Shift 0.5V/1000 rpm (min.) ± 10%
- Servo motor meets Bu. Ord. MK-14 specifications.
- Equipped with precision gearhead for lower backlash.
- Rugged, one-piece assembly.

WRITE for complete detailed information

EASTERN AIR DEVICES, INC.

SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD

391 CENTRAL AVENUE • DOVER, NEW HAMPSHIRE

CIRCLE 29 ON READER-SERVICE CARD FOR MORE INFORMATION

mounted on an insulated terminal strip may check out perfectly on insertion. After a period of time, the insulation material of the terminal strip absorbs enough moisture to cause a change in its insulation resistance from some relatively high value down to 5000 meg. This value of resistance shunting the 50 meg. resistor makes it appear as though the resistor had decreased in resistance by nearly 1%. This could very well put the resistance out of tolerance.

If the unit selected is to be applied in a surrounding media such as transformer oil, or silicon grease the choice of that media should be such that it will not attack the insulating material of the resistor. Certain gases can often destroy an otherwise perfect unit. Proper ventilation and careful selection of components will eliminate this problem.

Many times, the smaller sizes of resistors are encapsulated along with other components. Care must be exercised in the selection of encapsulated material since repeated and excessive contraction and/or expansion of the material used in encapsulation will permanently damage the resistive film.

Placement of components in equipment designed for high power uses requires special consideration. A resistor adjacent to a power element dissipating a large amount of heat, Fig. 2, will change in value well beyond the allowed tolerance limits.

The foregoing illustrations are but a few of the more common types of misapplications of precision film type resistors. Each component must be viewed with respect to its relationship to all other components making up the design. Because of its ability to fill so many of these requirements, applications for the precision film type resistor are on the increase.



Fig. 2: Precision resistor placed adjacent to a power dissipating unit will exceed temperature coefficient rating.

MICROWAVE PROGRESS

Frequency Measurement Devices

A couple of years back, it seemed to us that there were almost as many frequency measuring devices as frequencies. Anticipating that, sooner or later, some sort of definitive material would be needed, our engineer, Bob Lebowitz, consolidated the scattered, available information into his excellent report, "Frequency Measurement Devices"

This report provides a valuable summary of the various equipment types for measuring frequencies in the 300 to 40,000 mc/s range, and a succinct reference source for their respective design considerations and applications. It covers coaxial and cylindrical cavity wavemeters; crystal oscillator frequency standards; and use of stable reference spectral lines.

Most of the commercial requirements for precision are met by open circuited coaxial and right cylindrical waveguide cavities. Since the $\lambda/4$ and $3/4\lambda$ coaxial cavities can be made smaller than right cylindrical waveguide cavities, they are generally preferred for lower microwave frequency measurements. To overcome the critical design problem of contacting the movable plunger without introducing contact resistance in coaxial frequency meters, it has been found more satisfactory to use a non-contacting choke system rather than shorting fingers.

Broadband cavity frequency meters have accuracies that vary between .01 and 1%. For accuracies greater than .001%, low frequency quartz crystal standards are utilized. For microwave applications, multiplying and heterodyning means are required to compare the l.f. frequency oscillator signal with the signal of unknown frequency.

Although we've tried to cover most of the aspects of Bob Lebowitz' report in the preceding paragraphs, space has forced us to omit many of the important details. But, the full report on frequency measurement devices is available to you for the asking. Just request on your company letterhead, "PRD Report Vol. 2 No. 2A"



Polytechnic Research and Development Co., Inc.

202 Tillary Street • Brooklyn 1, N. Y. • Tel: UL 2-6800

Cable Address: MICROWAVE, NEW YORK



PRD Precision Heterodyne Frequency Meter

provides direct reading of any frequency from 100 to over 10,000 mc/s to an accuracy of <.03%!

This is the one unit that has all the features required for both laboratory measurements and production and field testing of transmitters and receivers. Completely self-contained and portable, the 504 Precision Heterodyne Frequency Meter gives you quick, simple operation with both CRT and aural presentation, and a new, exclusive direct interpolating dial. Consisting of a spiral scale fitted with an adjustable index, the dial permits direct interpolation to 0.1 mc/s at all settings. *No calibration charts needed* when you use the 504 Heterodyne Frequency Meter.

SPECIFICATIONS

Frequency Range: measures 100 to over 10,000 mc/s; generates 500 to 900 mc/s and harmonics
 Calibrator Accuracy: 0.002% at 5 mc/s crystal check points
 Interpolation: < 0.03% between 5 mc/s crystal check points
 Resetability: < 0.02%
 Input Sensitivity: at 500 mc/s and above—30 dbm; at 100 mc/s—5 dbm
 Heterodyne Oscillator: 500-900 mc/s
 Crystal Calibrator: Built-in 5 and 50 mc/s quartz crystal standards. The 5 mc/s crystal is temperature-controlled.
 Power Requirement: 115/230V, 50-60 cps, single phase, 125 watts
 Price: \$695 f.o.b. Brooklyn, N. Y.

For all the important details on PRD Heterodyne Frequency Meter, please request on your company letterhead, "PRD Technical Data Sheet 504A"

CIRCLE 31 ON READER-SERVICE CARD FOR MORE INFORMATION

Closer Crystal Oven Temperature Control

Maynard D. McFarlane and Ramey B. Metz

Robertshaw-Fulton Controls Co.
Aeronautical Div.
Anaheim, Calif.

THE change-of-state principle described here, used as an element in crystal oven design, extends the regulation possible in oven temperature control. Conductivity- and volume-sensed change-of-state ovens have the advantage of operation with no moving parts. Under controlled conditions, oven temperatures have been maintained for extended periods at ± 0.0025 C; and, with improved instrumentation, it is anticipated that this value will be materially improved.

To a greater or lesser degree, all crystalline materials exhibit a change in some physical characteristics in going from a solid to a liquid state, and in most cases the physical effect produced will be proportional to the liquid-solid ratio. Most materials exhibit more than one changing characteristic, and to determine the liquid-solid ratio it is necessary to select that characteristic or combination of characteristics which will best suit the practical requirements. Choice of a material is influenced by the melting point temperature, the latent heat of fusion, and by the suitability of the control characteristic.

Conventional Oven-Control Limitations

The commonly employed oven temperature control systems rely upon a change of temperature to control the application of heat. These systems usually incorporate a material of low thermal efficiency to smooth out the fluctuations of the control system; in effect, the unit is a low-pass thermal filter. Even the temperature-controlled heater amplifier, much more precise than the conventional thermostat, cannot perform its function until a sensible temperature occurs.

Change-of-State Ovens

The heat applied to the change-of-state oven is governed by the liquid-solid condition, and a change can be made in the liquid-solid ratio without any corresponding change in temperature. Departure from ideal

conditions occurs as a result of practical considerations. It is necessary to support a crystal cavity in the material; it is necessary to bring out wires from the cavity; there are practical limits to the volume of the material, and hence external effects from the container influence the heat rate; supporting and adjacent structures affect heat distribution; individual factors in many applications have an effect. For these and similar reasons the actual design of a crystal oven using a change-of-state principle involves many problems, many of which center about the selection of the proper material to use to surround the crystal cavity.

Since the temperature at which the crystal is to be held is that of the melting point of the material used, this selection is based primarily upon a melting-point determination; it has been found that some variations in composition of some materials may be made in order to modify the melting temperature. The mate-

rials which have been found suitable for use with change-of-state ovens include salts, metals, compounds, and mixtures, and as can be expected, the useable characteristics of the materials vary widely; organic salts have high electrical resistivity and poor thermal conductivity, while metals have low electrical resistivity and high thermal conductivity; organic salts exhibit a large volume change, metals a small volume difference. Some of the materials which exhibit useful properties are chemically active and require non-corrosive containers.

When a material is heated until it is completely melted and then allowed to cool under controlled conditions, its temperature vs time plot will exhibit a plateau, whose slope and duration are measures of the physical constants of the material. A plot of a theoretical cooling curve with a corresponding solid-liquid ratio is shown in Fig. 1.

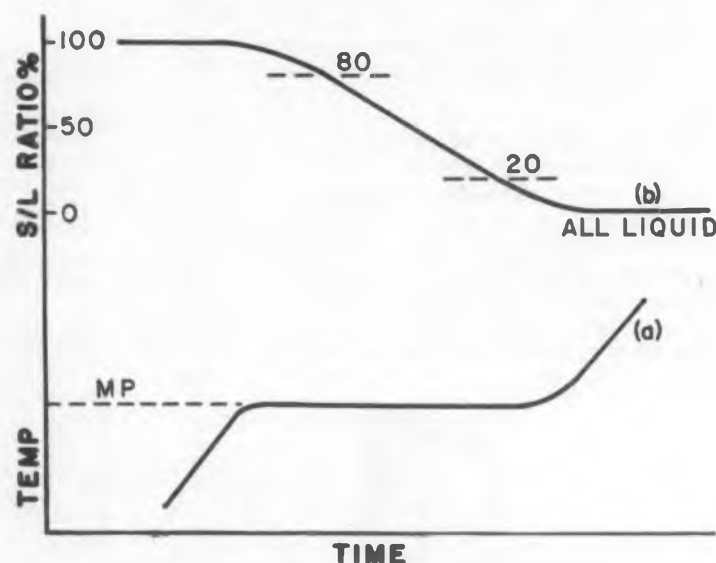


Fig. 1. Heating-time curve (a), and solid-liquid ratio curve (b).

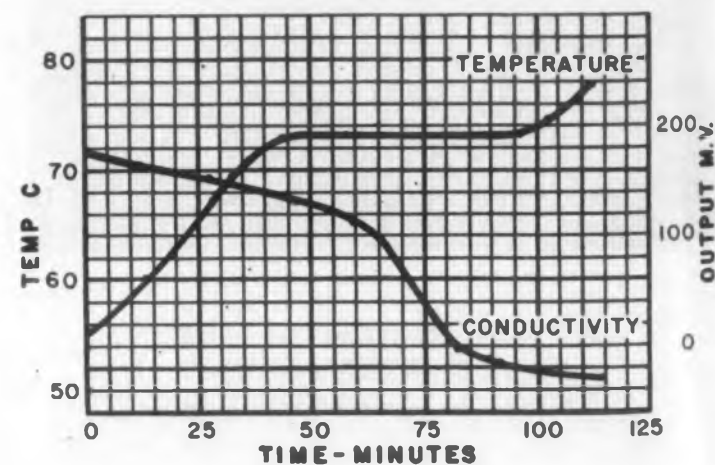


Fig. 2. Heating and conductivity curves.

Federal's NEW "V-M-D" PROCESS



produces **HI-DENSITY** Selenium Rectifiers
with **3 MAJOR SAVINGS...**



SPACE
... more than **42%**
WEIGHT
... averaging **23%**
COST
... as much as **24%**

FEDERAL'S NEW "V-M-D" CELLS HAVE 4 EXCEPTIONAL CHARACTERISTICS ...

- Longer life
- Higher temperature ratings ... up to 150° C. ambient.
- Higher voltage ratings ... up to 45V RMS.
- Higher efficiency ... 25% lower forward losses.

Federal



Federal Telephone and Radio Company

A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
COMPONENTS DIVISION • 100 KINGSLAND ROAD • CLIFTON, N. J.

In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., New York

CIRCLE 32 ON READER-SERVICE CARD FOR MORE INFORMATION

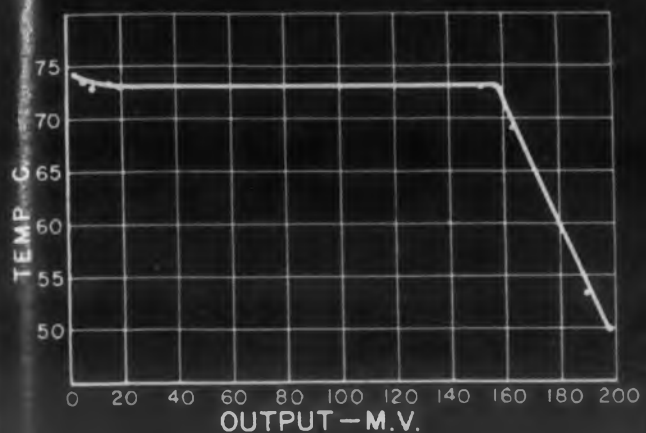


Fig. 3. Metallic conductivity control curve.

Sensing The Liquid-Solid Ratio

A sensing mechanism that can measure the liquid-solid ratio can be used to control external heat so as to maintain the material in a partially-liquefied state, and hence keep the temperature exactly constant. Some of the more important factors which can be used as sensing controls are changes in volume, density, viscosity, thermal conductivity, electrical resistance, dielectric constant, "Q," reactance, opacity, color, permeability, and elasticity of the body of the material; combinations of these variants are occasionally of use as ratio-sensing devices.

Conductivity Control

The cooling curve (Fig. 2) was run on a metallic eutectic mixture, showing temperature against time, and also conductivity against time. This shows the relation between the temperature plateau and the change in the slope of the conductivity curve. These same data are plotted in Fig. 3, as temperature vs conductivity; this plot eliminates the time variable and clearly shows the range of conductivity variation available for control purposes at a constant temperature. This temperature vs sensing condition curve is known as the "control curve" for the material and condition, and it provides an extremely reliable index of these parameters.

Volume Control

Certain organic salts have been used to control crystal oven temperature by a change-of-state principle, using volume change as the control element; amongst these are paradibromobenzene ($C_6H_4Br_2$) and paradiethoxybenzene ($C_6H_4(OC_2H_5)_2$), having

Based on a paper presented at the 1956 National Electronics Conference.

melting points at 87.0 and 70.5 C, respectively. These salts exhibit a constant temperature region, and their use has been exhaustively investigated. A volume-expansion chamber has been constructed in which the change in volume operates a bellows causing relative motion between the parts of a linear transducer, so that the output signal from the transducer (which is a function of displacement) is proportional to volume change. This output signal is amplified and applied to the heater windings on the outside of the unit, so that a self-regulating oven is secured. This unit, using para-dibromobenzene, exhibited control characteristics which maintained the oven temperature to within ± 0.015 C until shut off.

Illustrated in Fig. 4 are control curves for para-dibromobenzene and for para-diethoxybenzene. Both these curves show that a sensible degree of volume change is exhibited in the region of interest. There are a large number of suitable salts having melting points



Fig. 4. Organic salt control curves.

in the desired control range and having other attributes which make them suitable for use in equipment of this type. There are also a large number of metals and alloys which are suitable for use in precision crystal ovens. However, in order to concentrate effort on the essential features of the system, experimental work has been carried out with a limited number of materials; and for similar reasons, while measurements have been made on a number of different sensing arrangements, major effort has been concentrated on two methods, volume and conductivity variation.

Applying Heat

From the control curves, it can be seen that in all cases there is a relatively large swing in the control parameter with zero temperature change, which allows

a very precise control of heat application to be made on a proportional basis. This can be effected in several ways, but the method found most suitable up to the present is to apply the control signal to an amplifier whose output circuit includes the heating element; this method of control shows the same advantage over a cyclic (on-off) control as the temperature controlled heater amplifier shows over the conventional thermostat, and the further advantage that the control is exercised without any change of temperature. The curves taken from units having control proportional to the liquid-solid ratio do not show the cyclic ripple that is evident in thermostat control systems.

Control Circuits

A magnetic amplifier has been used successfully to exercise proportional control over a change-of-state crystal oven (Fig. 5). For use with the linear transducer used on a volume change sensing device, the

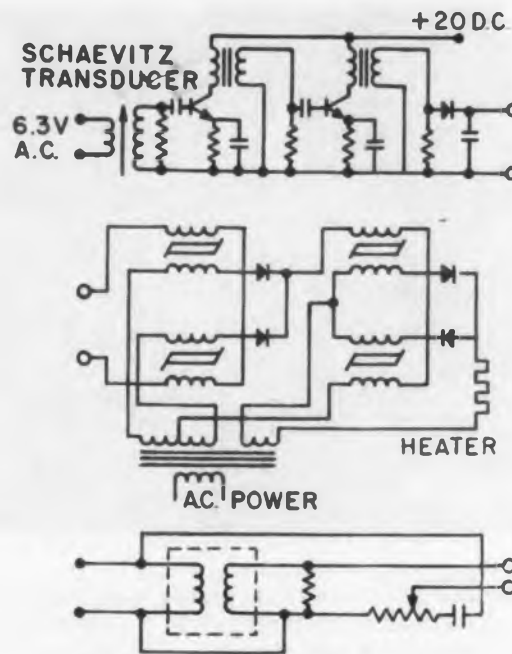


Fig. 5. Magnetic control amplifier.

magnetic amplifier is used with the transistor pre-amplifier shown at the top; when used with conductance control, the transistor unit is not required and the magnetic amplifier alone is required. The output of the magnetic amplifier is applied directly to the control heater winding, and exercises control of the oven over a 5 C range; a separate heater, thermostatically controlled, is used to bring ambient variations within this range. The magnetic amplifier operates on 400-cycle power, and requires 15 watts power input for maximum output.

At the lower portion of Fig. 5 is a patented circuit for conductivity measurements. Two toroids are wound and placed side-by-side. In air the coupling between the toroids is negligible, but when immersed in a conductive material, either liquid or solid, the material forms a shorter turn linking the two cores, and trans-

fer of energy takes place between them. In the circuit shown, the zero point of energy transfer can be offset to produce a maximum change of signal level for a definite increment of conductivity in the linkage material. A modification of this circuit uses a single toroid as a sensing element, and produces a voltage output which is proportional to the conductance of the material forming the shorted turn; the use of the single coil results in economy of space and material.

Temperature Measurement

One of the most difficult problems is the measurement of the very small temperature differences necessary to evaluate the results. Since the melting points are themselves the key to the temperature scale used, calibration procedures based upon established practice have to be re-examined in the light of the exact measurement required. Work with the precision constant-temperature oven has progressed to the point

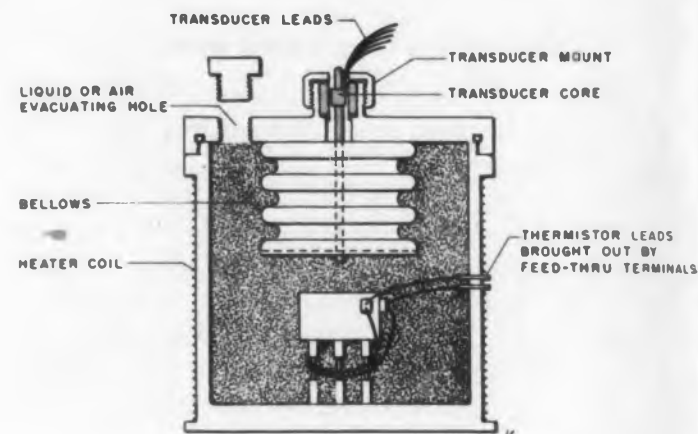


Fig. 6. Volume change oven.

where the accuracy of the measuring equipment becomes a factor in evaluating the results; there is reason to believe that the actual oven temperatures are more closely regulated than is apparent on measuring equipment subject to ambient variations.

The present method of measurement uses small bead-type thermistors whose resistance vs temperature calibration is periodically checked, and this apparatus is used to give data on relative temperature and rate of temperature change. With new equipment calibrated at the National Bureau of Standards, these relative temperatures will be referenced to an accurate standard. The thermistor is located in a silicone oil in a brass slug, so that its temperature is representative of the space occupied by the crystal cavity. The sensing element output voltage is also a measure of the temperature in the semi-molten material, and in

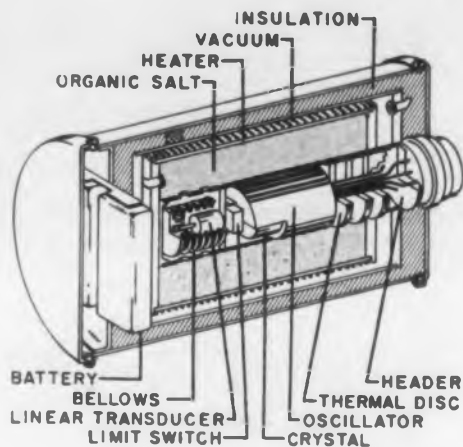


Fig. 7. Oscillator-oven assembly.

all test runs the thermistor bridge output, the sensing output voltage, and the ambient temperature are recorded on a chart recorder so that accurate comparisons can be made.

An experimental oven is shown in Fig. 6 for operation with paradibromobenzene, using volume change as the sensing element. This unit incorporates coarse and fine heater elements, and has operated for extended periods of time within its design limits of ± 0.1 C. A test run with ambient variation of 52 C has shown a total oven temperature variation in this unit of less than 0.07 C. Under controlled ambient conditions (air-conditioned laboratory) an oven temperature control within 0.01 C has been maintained with this unit.

An oven designed to incorporate a crystal and complete transistor oscillator is shown in Fig. 7. The temperature stabilization is applied to the transistors as well as the crystal itself. This unit has not yet been built, but the design calculations indicate a very high degree of stability for this standard.

Oven Construction

The change-of-state material forms one element in the construction of a precision oven. It has been found economical to use thermostatically controlled auxiliary heaters to bring the oven into a range of 0.5 to 1.0 C of the desired operating temperature, since this then requires only a small amplifier (one to three watts) to effect precise control. The heater required to meet military requirements of rapid warmup from -65 C draws a comparatively large amount of power, and would be wasteful of amplifier capacity, weight and size.

The external thermal insulation is also a factor in the power requirements and in the regulation. In the laboratory a Dewar flask is a useful insulator; however, in field units this can be replaced by other insulating material more suited to rough handling. Intelligent use of plastic materials in the fabrication of the unit can assist in the insulation protection.

For all wafering, dicing, slicing of QUARTZ, GERMANIUM, SILICON

FELKER DI-MET

Diamond Abrasive Blades and Ultra Precision Cut-Off Machines

FELKER TYPE DIT AND D1TR DIAMOND ABRASIVE BLADES

The outcome of long research and development to combine maximum cutting speed with smoothness of finish and greatest economy in terms of cuts per blade. Metal bonded diamond sections are unusually deep, giving a bonus in extra service. Numerous bond variations insure a most exacting and efficient blade selection for each material. Blade bodies are stiff, tempered alloy steel for high strength and freedom from deflection. D1T rims are flush with blade sides. D1TR blades are relieved on sides. Diameters: 2" through 14".

The standard of the Electronics Industry for a Decade and a Half!

PAPER THIN FOR EXTREME ACCURACY AND CONSERVATION OF MATERIAL

Investigate this Felker Type D1T Metal Bonded Abrasive Blade for your germanium cutting! 3" O.D. x .006" thickness, it is ideal for dicing operations where accuracy and conservation of material is of utmost importance! Ductile steel core guards against breakage.

**FELKER
DI-MET**
REG. U. S. PAT. OFF.

Over 15 years exclusive development for the electronics industry has proved the outstanding qualities of Felker's high-precision cut-off machines. Designed to fulfill every crystal cutting requirement with a choice of down or through-feeding methods, the most critical control is insured for every type of cutting. Smooth, velvety hydraulic retardant on downfeed; heavy, rugged construction; precision preloaded ball bearings in removable spindle quills; ball bearing arbor supports; choice of rolling tables or rotary tables with mechanical screw control on cross and through-feeds are a few of the many refinements that make Felker first choice in the nation.

Both Models 80BQ and 120B are available as basic units. Wide selection of table types enables exact adaptation of each unit to individual needs. Write for circular giving complete specifications!

MODEL 80BQ ILLUSTRATED—With type HVCT-12B Rotary Table. 360° rotational orientation and tilt adjustments accurate to 1 minute of arc, screw feeds to .001" on both cross and through motions.

ALSO AVAILABLE—Model HVC-12B Rotary Table. Same as above with cross-feed slide only. For use on rolling table.

MODEL 120B—similar to Model 80BQ but with increased vertical arbor lift and added work capacity.

FELKER MANUFACTURING COMPANY

Torrance, California



*First in Diamond
Cut-Off Blades!*

World's largest and oldest manufacturer of diamond abrasive cut-off wheels and machines.

CIRCLE 33 ON READER-SERVICE CARD FOR MORE INFORMATION

**DO
YOU
WANT
TO...**



GENERATE PULSES



DELAY PULSES



WIDEN PULSES



REGISTER PULSES



COUNT PULSES



SUM PULSES



DO BINARY LOGIC



DRIVE TRANSISTOR CIRCUITS

You can do all of these functions with the new integrated line of NAVCOR transistorized pulse programming equipment . . . available in miniaturized building blocks.

WRITE FOR COMPLETE DATA FOLDER!

Navcor

NAVIGATION COMPUTER CORP.

1621 SNYDER AVE., PHILADELPHIA 45, PENNA. / HOward 5-7700

CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION

Binary Code Indicator

DATA can be displayed, stored, or transferred with these Digital and Alpha-numerical indicators in accordance with a predetermined binary code. They are self-contained plug-in units which can be applied to the output of digital computers, teletype equipment, or telemetering systems. Operating on 20-30 v dc, the indicators can be used to accept data from a source, free the source for other programs, and disseminate the data as required.

Manufactured by the Union Switch and Signal division of the Westinghouse Air Brake Co., they store the displayed character mechanically and electrically for any length of time. While transmitting, the indicator does not move and the character displayed is retained until erased or a new character received. The same set of control wires is used to receive and transmit the position code, and a minimum number of control wires are employed. For each binary bit stored in the indicator, an external relay can be eliminated.

Digital Unit

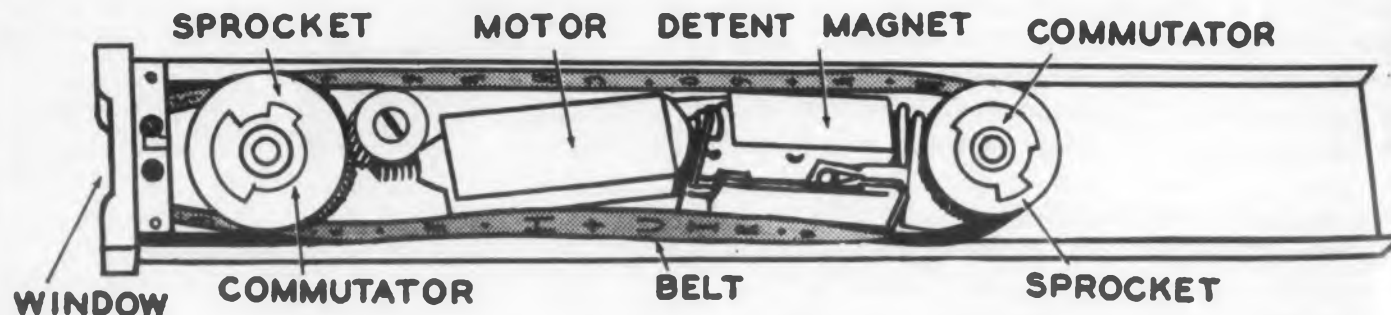
The digital indicator utilizes a four-bit binary code and ten character positions out of a possible

sixteen. The relation of the visible character to its code is the direct translation of binary coded decimal notation to decimal, although other combinations can be developed.

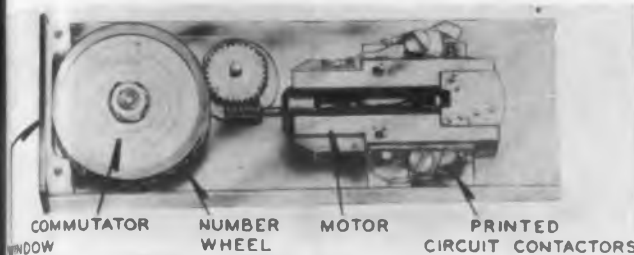
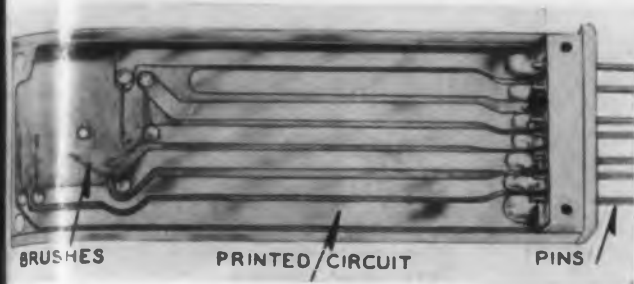
A single commutator and six brushes are used, which connect to a small d-c permanent magnet motor. A mismatch between the transmitted code and commutated code will complete the circuit, causing the motor to operate. The commutator is driven by the motor until the transmitted and commutated codes are coincident. At this instant the motor is de-energized and the indicator comes to rest, displaying the character whose code was transmitted. A maximum of 0.8 seconds is required to scan nine character positions. The average total running power is 3 w, and the steady-state drain is zero. The indicator is 5 in. long and weighs 7 oz.

Alpha-Numerical Unit

The Alpha-numerical indicator is based on a positioning system which uses a six-bit code on six wires and a differential belt and sprocket arrangement. The belt carries 72 displayed characters and is supported by two sprockets, eight and nine units



Construction of Alpha-numerical indicator. The belt is given half a twist so as to carry characters on "both sides" and shorten its length. Nominal running time for 71 belt spaces is 1.7 seconds.



Construction of digital indicator, showing printed circuit connector strips on cover. When the commutator code matches the input code, the motor is de-energized.

in circumference. For each combination of sprocket position there is a distinct belt position, making 72 possible combinations. In order to reduce the length of the belt it is formed into a Mobius-strip configuration, with characters "on both sides."

The commutators are made in such a way that there are eight different codes. One code is repeated on the nine unit wheel; so that the number of different codes is 64—the maximum with a six-wire system. Eight different characters appear twice.

The indicator is internally powered by a small d-c permanent-magnet motor. A detent magnet, when energized, withdraws the pawl from the detent wheel and closes the motor circuit. The detent magnet also closes a tell-tale circuit which is used by the external circuitry to determine whether any indicator is running. An internal relay is provided to switch the six code wires so that strap-wiring techniques can be used when the indicators are arranged in a rectilinear array.

The indicator is back-lighted with diffused light by a miniature aircraft bulb, or it may be lighted with phosphors which require black light.

The indicator will move from any position to any other position in less than 1.7 seconds. It is so constructed that it stores the positioned character, and can read it out into another indicator or into relays, over the same set of six wires. The overall length of the indicator is about 11 in., and weight is 16 ozs. The average total running power is 7.5 w and the steady state drain is zero.

Data entry into the indicators may be accomplished by push-buttons, switches, or storage-type relay contacts.

For further information on this binary indicator turn to the Reader's Service Card and circle 35.

OAK rotary solenoids*

*Mfd. under license from G. H. LELAND, INC.

built for you separately
or in remote-controlled
subassemblies



TYPICAL OAK SUBASSEMBLY WITH ROTARY SOLENOID (MT273E BASE BUILT FOR BENDIX RADIO DIV.)

Oak stamps, draws, welds, and etches the aluminum chassis . . . builds the rotary solenoid switch . . . manufactures the screw machine parts . . . makes the complicated cable harness . . . assembles all the parts . . . then runs life tests, heat and cold checks, and humidity chamber trials.

Oak can offer you complete engineering and manufacturing facilities for electro-mechanical subassemblies, plus a knack for making complicated devices producible. Time and again, Oak engineers have suggested changes that resulted in lower costs and better operation.



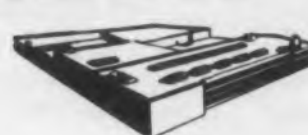
meet the most severe
MIL specifications

In converting a straight pull to rotary motion, Oak rotary solenoids give a high-torque, positive action, even under severe mechanical operating conditions. Oak rotary solenoids are compact, also, and help economize in wiring and mechanical linkage on remote-control devices. Three standard sizes in many variations cover a wide range of switching and light mechanical tasks. Oak also can supply any component needed to accompany rotary solenoids. Because Oak engineers know the application possibilities of rotary solenoids inside and out, consult them early in the design stage. They can save you valuable time. Write for a copy of Oak's rotary solenoid bulletin that includes time-saving layout sheets.



OAK MFG. CO., Dept. D, 1260 Clybourn Ave., Chicago 10, Ill.
Phone: MOhawk 4-2222

OAK MFG. CO. 



Chicago, Ill.



Chicago, Ill.



Crystal Lake, Ill.

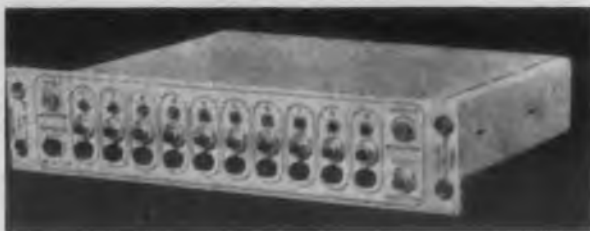


Elkhorn, Wis.

SWITCHES • CHOPPERS • SPECIAL ASSEMBLIES • VIBRATORS • TUNERS
CIRCLE 36 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Indicating Shift Register Transistorized



Complementary to the manufacturer's complete line of transistorized logic units, the Indicating Shift Register here shown, Type 108 C, affords increased versatility in parallel-to-serial and serial-to-parallel information transfers. It embodies provisions for push-button programming, number-of-bits selection and information indication. Amplified outputs are available to drive tape recording heads, relays, or memory units.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Panel-Mounting VTVM Reads 0-1000 V DC



This panel-mounting electronic d-c voltmeter occupies no more panel space than a conventional 6-in. meter. Its tube complement consists of a single Type 5814-A. Input impedance is 10 megohms, accuracy ± 3 per cent f.s.d., scale length 4-1/2 in., and weight 2.69 lb. Power required is 115 v., 50-400 cps, single phase, 3 w. There are seven models with scales calibrated respectively 0-1 v, 0-3 v, 0-10 v, 0-30 v, 0-100 v, 0-300 v and 0-1000 v; as well as a multimeter with scale calibrated in all seven of these ranges, and a selector switch. Each model, moreover, can be furnished with either end-zero scale or center-zero scale; the latter of course read plus or minus.

Pameco, Dept. ED, Mill Lane, Waterford, Conn.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

Loopstick Antennas For Transistor Circuits

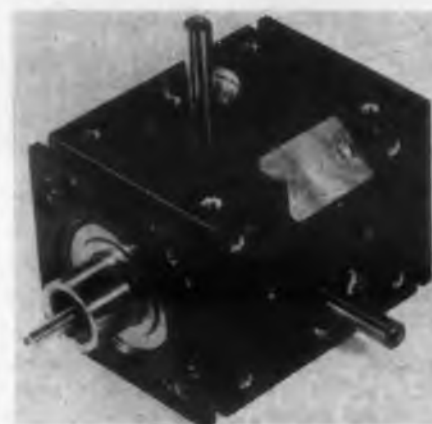


Packed with full installation instructions and 9 suggested receiver circuits, these transistor "loopsticks" combine complete electrical adjustability with maximum signal transfer, compactness, and increased sensitivity. They are currently available in eleven different sizes and models.

Superex Electronics Corp., Dept. ED, 4-6 Radford Pl., Yonkers, N.Y.

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniaturized Ball Resolver For Analog Computers



Weighing less than 3/4 lb, and measuring only 2-1/8 in. long x 1-1/2 in. square, this ball resolver has a rated accuracy of ± 0.5 per cent over the 360 deg range. The faces have precision mounting arrangements. The input shaft, 0.1248 in. in dia, is surrounded by a concentric 0.500 in. orientation shaft. The sine and cosine output shafts are 0.187 in. in dia. They extend 1/2 in. from their adjacent faces; the 0.5 in. orientation shaft extends 5/16 in. beyond the adjacent mounting surface and the input shaft protrudes an additional 5/16 in.

The input shaft may be driven up to 100 rpm. Less than 5 inch-ounces applied to the input (at 25 C) produces from 1 to 2 in.-oz. at the outputs.

Vectron, Inc., Dept. ED, 1600 Trapelo Rd., Waltham 54, Mass.

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

Jewel-Bearing Potentiometer Very Low Torque



Intended for sensitive instrument applications, or for servo, computer or selsyn use, this jewel bearing, subminiature, precision wire-wound potentiometer has a standard resistance range from 10 ohms to 250 k, and is available in other ranges on special order. Very high accuracy is maintained; the torque required to rotate the shaft being so slight that no appreciable error is introduced. Torque is 0.01 oz/in.; linearity ± 0.3 per cent; size 1/2 in. x 1/2 in.; weight 1/2 oz including lock washer and nut; power rating 2 w for 60 C temperature rise; temperature range -55 C to $+150$ C.

Ace Electronics Associates, Inc., Dept. ED, 103 Dover St., Somerville 44, Mass.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Insulated Terminals Silicone Impregnated Ceramic



Two models of rugged, miniaturized, insulated ceramic terminals have been developed, with cadmium plated mounting studs, and contact points gold flashed over silver for easier soldering. The insulation is grade L5 ceramic, silicone impregnated. Metal fittings, under their platings, are brass. The units measure 1/8 in. dia and 3/8 in. high when mounted.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Fluorescent Lamp Ballast

Smaller, Quieter

For operation of two F96T12 fluorescent lamps, at 430 ma, General Electric Company's ballast department has developed a new smaller, quieter ballast, designated 6G1010. It supersedes the former 89G596. Power consumption of the new ballast is only 26 w; while its reduced operating temperature will make it easier to use in enclosures and will give it longer life.

Lamination and case vibrations have been reduced, for quieter operation, by an exclusive core assembly, special push-on clamps, reduced core length, cemented gaps, special wedges and other provisions. Dielectric strength and life have been improved by use of non-hygroscopic polyester film insulation, DuPont's Mylar; and of an improved nylon enamel wire.

The new ballast measures 1-25/31 in. high, has a mounting length of 1-9/64 in. and an overall length of 1-3/4 in. It weighs 1-1/2 lb less than the model it supersedes.

General Electric Co., Dept. ED,
Schenectady 5, N.Y.

CIRCLE 43 ON READER-SERVICE CARD

Volume Control

For Use With Transistors

A printed circuit type volume control, with a special low-end resistance taper designed for use with transistors, have been developed.

The "hop-off" or zero rotation resistance is extremely low, to provide satisfactory minimum volume level in low impedance circuits. In addition, the low end taper gives gradual resistance rise from the zero point over the first 20 to 30 degrees of shaft rotation, thus providing smooth control throughout the entire volume range.

The new taper is available on controls of several styles, designed for mounting vertical to or horizontal to the printed circuit panel.

P. R. Mallory & Co. Inc., Dept. ED,
Indianapolis, Ind.

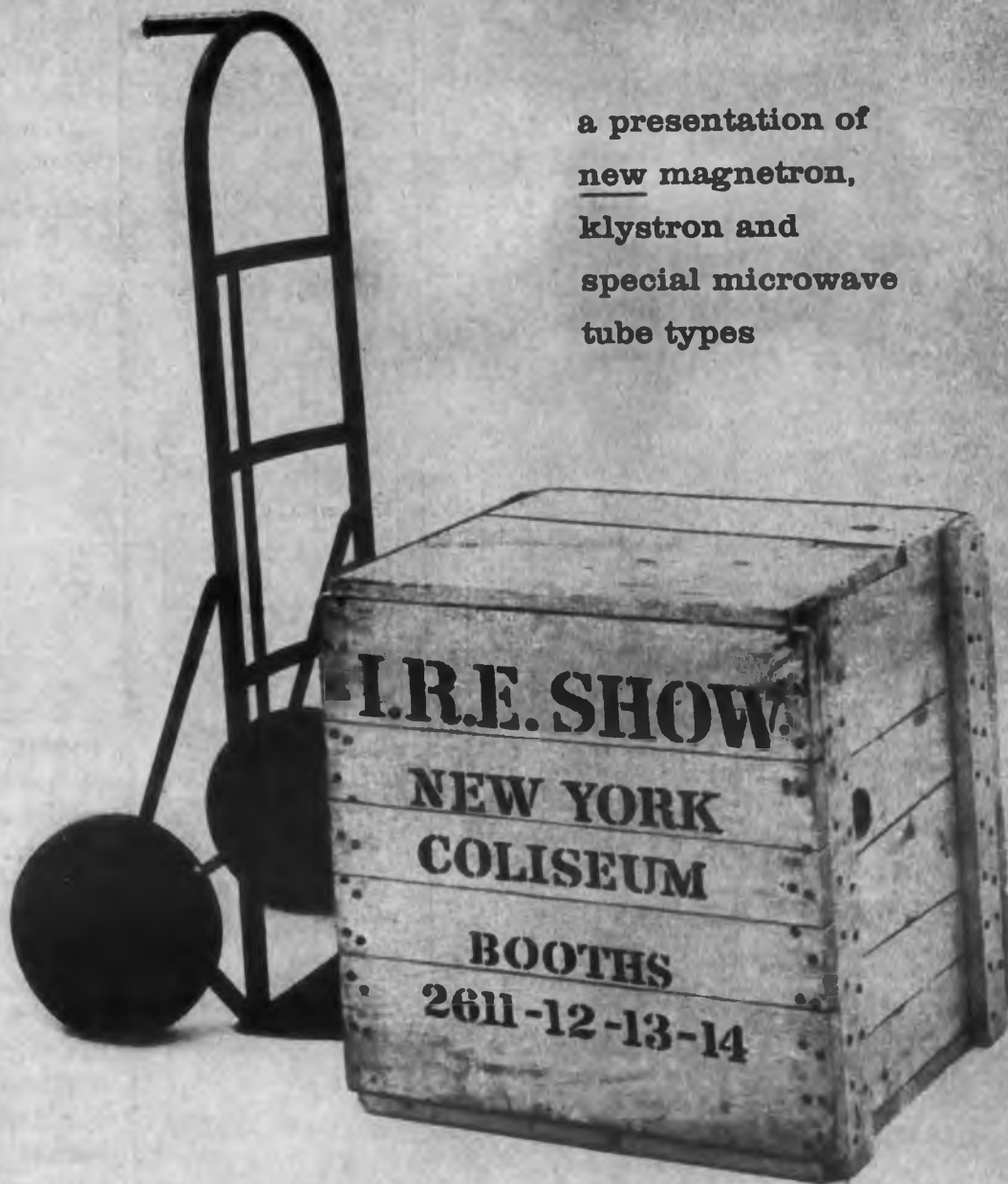
CIRCLE 44 ON READER-SERVICE CARD

CIRCLE 45 ON READER-SERVICE CARD >

Prize Package!



a presentation of
new magnetron,
klystron and
special microwave
tube types



RAYTHEON

MICROWAVE AND POWER TUBE OPERATIONS, WALTHAM 54, MASS.



Why Corning High-Power, High-Frequency Resistors meet your most exacting circuit requirements

You'll find Corning High-Power and High-Frequency Resistors designed for stable, long-life service—even under the most difficult operating conditions.

With Corning Resistors you get the highest resistance range for a given physical size compared to wire-wound resistors.

Their thin-film construction makes them inherently non-inductive. The noise level of these resistors is so low it's difficult to measure. The resistive film is a metallic oxide, fused to the PYREX glass core at red heat to form a permanent bond. This special glass insures highest core resistivity even at elevated temperatures, great resistance to chemical attack and to mechanical and thermal shock.

These Corning Resistors are remarkably stable regardless of moisture and humidity.

Other products for Electronics by Corning Components Department: Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Sub-miniature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traversal and Midget-Rotary Capacitors*, Metallized Glass Inductances, Attenuator Plates.

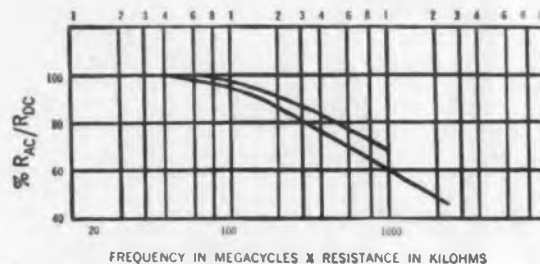
*Distributed by Erie Resistor Corporation

The chart in the next column gives you a quick idea of their exceptional frequency characteristics.

The ranges and ratings shown in the illustration are for our standard lines, but we can design and build resistors to match your own requirements for all usable frequencies. We've made specials with ratings up to 150 kw. and we can go higher.

Within the standard range of these resistors, we can give you wide variations in mounting hardware. You can get hardware for vertical or horizontal mountings and mountings to absorb mechanical shock and severe vibration. Ferrule-type terminals are available for use with standard fuse clips.

Our catalog sheets give far more complete details than we are able to here. We'll be glad to send you copies with current price lists.



Ask for information on these other Corning Resistors:

Low-Power—3-, 4-, 5-, and 7-watt sizes. Highest resistance range of any low-power resistor.

Type S—Stable performance to 200° C. Meet MIL-R-11804A specs. Values to 1 Megohm.

Type WC-5—5 KW water-cooled. Range, 35 to 300 ohms. Versatile, adaptable.

Type N—Accurate grade. Made to meet all requirements of MIL-R-10509A. Characteristics X and R.

Specials—To your specifications—Co-axial Line Elements, Dummy Loads, HF Elements, Peak Pulse Loads, High-Voltage Resistors.

Ten-Color Knobs For 1/4, 1/8 In. Shafts



The centers of these knobs are snap-in inserts that come in ten different colors for color coding and color matching. The knobs come in three sizes and each size in three styles. The largest knobs are for 1/4 in. shafts only, the smallest for 1/8 in. shafts only, and the middle size for either. Each size can be had without skirt, with plain skirt, or with skirt having an indicating line. Collet parts are non-ferrous, heavily nickel-plated; knobs and skirts are Tenite II in black matte finish.

Cambridge Thermionic Corp., Dept. ED, 44 Concord Ave., Cambridge 38, Mass.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier Power Manifold For Computers, Etc.



A manifold, consisting of a power supply unit and 10 amplifier units, Model HKR, is designed for use in association with plug-in computing modules, meters, oscilloscopes or pen-and-ink recorders. The ten amplifiers are of plug-in type and together with the power supply, constitute a single panel, rack-mounted array. Any of several of the manufacturer's plug-in amplifiers may be used; or any combination of them. The power supply provides plus and minus regulated 300 v dc at 0-100 ma, with 0-10 ma available for external use. Unregulated 6.3 v ac is also supplied. All input, output and ground connections are made through banana jacks on the front panel. The front panel also mounts the a-c and d-c operating switches, and the pilot lamps.

George A. Philbrick Researches, Inc., Dept. ED, 230 Congress St., Boston 10, Mass.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION



CORNING GLASS WORKS, 91-4 Crystal Street, CORNING, N. Y.

Electronic Components Department

Corning means research in Glass

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Sequential Sampling Switch For Component Testing



The multiple-throw sampling switch here shown, designated Tensor Model 6000, is intended for automatic sequential testing of large numbers of electronic components. Readouts can be taken at rates up to 3 per second and automatically recorded. Model 6000 can handle up to 1252 two-terminal components or 626 four-terminal components. Because the switching is multiple-throw, components to be tested can be kept on aging voltages at all times except when actually called on for readout. Automatic, 100 per cent component inspection can be carried out under suitable voltage and environmental conditions.

Tensor Electric Development Co., Dept. ED,
1873 Eastern Parkway, Brooklyn 33, N. Y.

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

Basic Round Meter High Sensitivity



The meter here shown is available, for the present, only to original equipment manufacturers. It is a basic device that can be supplied in all standard ranges of microammeters, milliammeters, ammeters and voltmeters. Its features include exceptionally high sensitivity, high torque-to-weight ratio, minimum number of parts, and a simplified pressure method of ruggedizing and sealing. Diameter is 2-1/2 in. The meters meet MIL-M-6A and MIL-M-10304A.

WacLine, Inc., Dept. ED, 35 So. St. Clair St.,
Dayton 2, Ohio.

CIRCLE 52 ON READER-SERVICE CARD FOR MORE INFORMATION



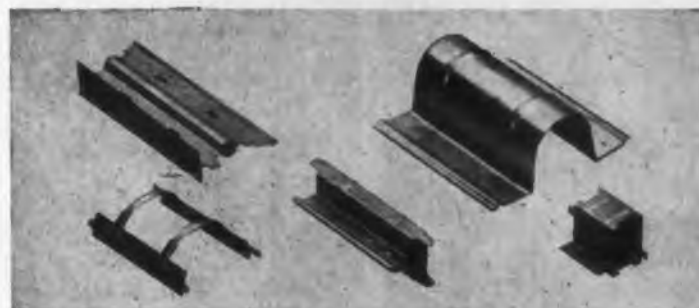
TWO METALS

are often better than one...

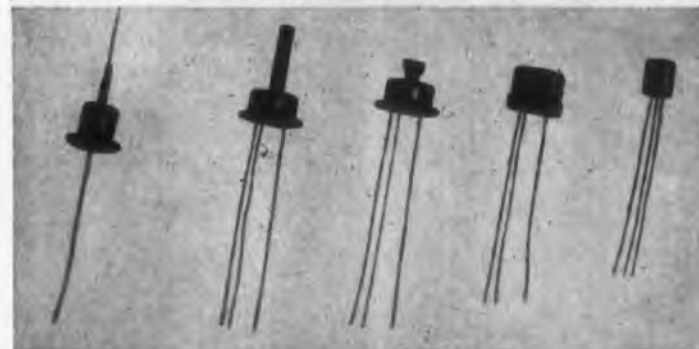
and

GENERAL PLATE Clad metals

for electronic uses are a case in point



Consider General Plate ALIRON®, ALNIFER®, and NIFER®, all preferred materials for vacuum tube plates. Offering improved performance with attractive cost savings, these General Plate Clad Metals are supplied in annealed coils ready to feed through your production tools. They form beautifully, conserving critical materials and producing more parts per pound. ALIRON and ALNIFER require no carbonizing — the matte finished aluminum blackens evenly during bombardment to provide a highly efficient radiating surface. For full details, write for Technical Data Bulletin 717C.



Or consider General Plate TIN CLAD NICKEL. Here's an improved material for transistor cradle supports. The layer of pure tin is unvarying in thickness and is bonded to a pure electronic grade nickel backing so completely that voids and contaminating inclusions are eliminated. This means perfect wetting during your transistor soldering operations — top transistor performance every time — lower soldering costs too! For full details, write for Technical Data Bulletin 708.



Or look to General Plate COPPER CORED 52 ALLOY WIRE for better glass-to-metal seals. With a 30% copper core you'll get up to three times the electrical and thermal conductivity over solid lead wires of the same size — or you can cut your solid lead wire sizes correspondingly, without reducing electrical ratings by using General Plate Copper Cored 52 Alloy Wire, and take a big step toward miniaturization in sealed terminal blocks and hermetic headers. For full details, write for Technical Data Bulletin 706.

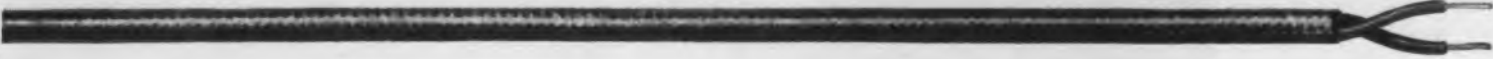
To get the whole General Plate Clad Metal Story, write for our new general catalog, PR-700A, covering many other combinations in both base and precious clad metals — composite electrical contacts — TRUFLEX Thermostat Metals.

Metals & Controls Corporation

GENERAL PLATE DIVISION
2102 FOREST STREET, ATTLEBORO, MASS.

You can profit by
using General Plate
Clad Metals

CIRCLE 53 ON READER-SERVICE CARD FOR MORE INFORMATION



If it's worth Engineers' time . . .



. . . It's worth Engineered Cable



Belden

**INTERCOMMUNICATING
AND
SOUND SYSTEM CABLES**

Indoor-outdoor, phones
or speakers—there is a
Belden engineered cable
to meet your needs for
a permanent, trouble-
free installation.

"Items from the
Complete Belden Line"

*Intercommunications systems in
the Statler Hilton in Dallas,
and other leading hotels
with intercommunications
systems, are wired by Belden.*

Belden

WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

Magnet Wire • Lead and Fixture Wire • Power Supply Cords, Cord Sets and Portable Cord • Aircraft Wires
Welding Cable • Electrical Household Cords • Electronic Wires • Automotive Wire and Cable

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION

Missing Pulse Counter

For Microwave Tubes



A device that checks the performance of pulse-modulated tubes such as klystrons and magnetrons, this Model PD11A Missing Pulse Detector records the absence of scheduled pulses of any width from 0.2 to 6.0 microseconds, at any repetition rate up to 5000 pps. Missing pulses are recorded on a counter. Energy threshold of the pulses to be detected can be preset in 10 per cent steps between 0 to 50 per cent of maximum pulse level. Any pulse of lesser amplitude than the preset value is considered missing. If the equipment undergoing test is operating properly the missing pulse detector delivers no output to the counter (which is not a part of the detector); for each r-f pulse missing the detector energizes the counter with a 15 v positive pulse. Input power required is 115 v, 60 cps, 20 w. The detector measures 10 in. deep and high, 14 in. wide.

Manson Laboratories, Dept. ED, 207 Greenwich Ave., Stamford, Conn.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION

Laboratory Vacuum Unit

for Metal Coating

For laboratory, pilot plant, and limited production use, a new vacuum system is now available. Packaged as a unit, it was designed primarily for laboratory coating of various materials with vaporized metals.

Known as the Type LC1-14A vacuum system, it features a high-capacity pumping system which reduces pumping time, and a complete line of standard accessories.

The standard pumping system consists of a 4 in. fractionating diffusion pump and a 5 cfm combination roughing and backing mechanical pump with vented exhaust.

Pump-down time with a clean, dry system is six mins. to 0.5 micron hg, with an ultimate pressure of 2×10^{-5} mm Hg. A liquid-nitrogen trap will reduce this still further by a factor of 10 (2×10^{-6}). Pressures in the forepressure lines and work chamber are indicated on a new discharge gauge and a new Pinani gauge from 0.75 mm to 1×10^{-7} mm Hg.

Consolidated Electrodynamics Corp., Dept. ED, 1775 Mt. Read Blvd. Rochester 3, N.Y.

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 15, 1957

Mirror Galvanometer

1-570 cps Movements



Intended to serve as components of electrical measuring instruments, H. & B. moving coil mirror galvanometers are manufactured abroad, but available in the U. S. in a wide variety of models. Oscillating frequencies available are from 1 to 570 cps. The instrument is silicon-oil-damped, but further damping can be achieved by an appropriate external resistance. A concave reflecting mirror, 7 mm in diam and having a focal distance of 75 mm, is standard equipment, but mirrors of other focal distance as well as flat mirrors, can be supplied. Sensitivities range from 0.0036 μ amp/mm to 252 μ amp/mm. An 8 in. flexible shaft is provided for zeroing. Different models differ in physical construction and mechanical facilities, as the illustration indicates.

Epic, Inc., Dept. ED, 154 Nassau St., New York 38, N. Y.

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Calendered Polyethylene Films

Greater Heat Resistance

A new series of calendered polyethylene films of the low pressure or linear type to supplement its existing Polyken Polyethylene Films, which have been limited to high pressure polymers, is announced.

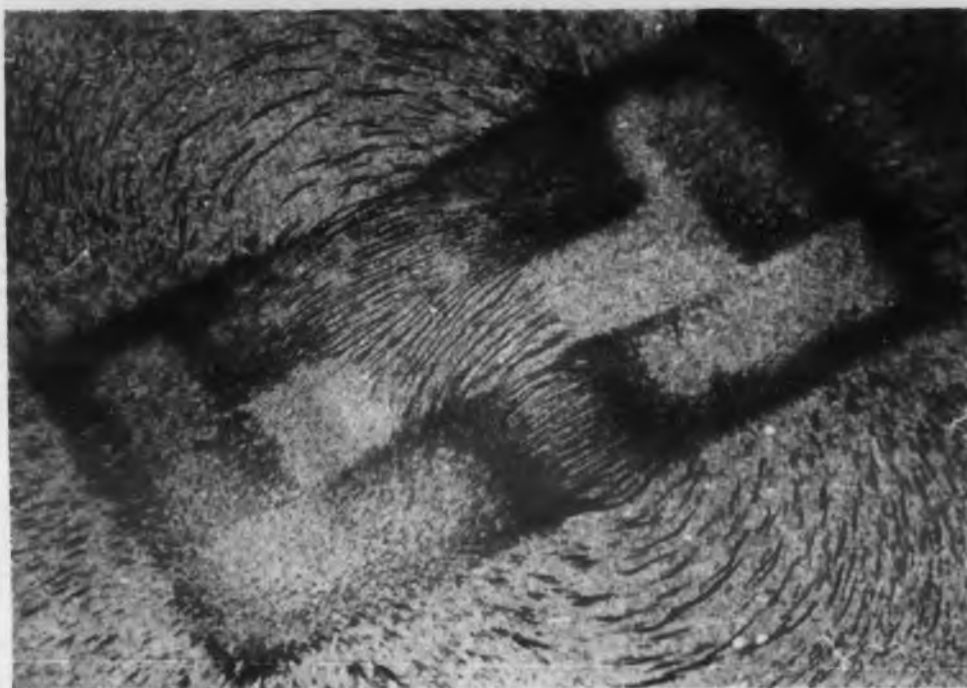
These new films offer the physical and chemical properties inherent to polyethylene with the additional characteristics of greater heat resistance, lower gas permeability and improved chemical resistance.

The films are available in gauges ranging from 0.004 to 0.025 in. and widths up to 32 in. The present films are limited to natural and black containing 100 per cent linear polyethylenes as well as blends of this material with regular polyethylenes. These offer the physical advantages of the linear polyethylenes with less rigidity, improved handling and greater yield per pound.

The Kendall Co., Dept. ED, 309 W. Jackson Blvd., Chicago 6, Ill.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 15, 1957



Flux pattern of experimental magnetic circuits

How location of magnets affects magnetic circuits

Adapted from an article by Charles A. Maynard, vice president, Research and Engineering, The Indiana Steel Products Company

The LOCATION of permanent magnets in a magnetic circuit is a definite factor in design. To determine the extent to which this is true, involved calculations are necessary.

A comparatively simple experiment, however, which shows the nature of the changes that take place when permanent magnets are placed in different positions in a magnetic circuit, was devised by Mr. Maynard. The material on which the following questions and answers are based was taken from a report, "An Experiment in Magnet Location," published in Vol. 3, No. 5, of Applied Magnetism. A copy of this issue is available on request to The Indiana Steel Products Co., Dept. M-2, Valparaiso, Ind.

Question: What effect does the location of permanent magnets have on a magnetic circuit?

Answer: It has a marked influence on the flux density in the various portions of the magnetic circuit.

Question: Is there a preferred location for magnets?

Answer: Yes, it is important to place the magnets as close to the air gap as possible.

Question: What is the benefit of their location?

Answer: The leakage flux is reduced, and the useful flux in the air gap is increased.

Question: How is this an important factor in design?

Answer: It minimizes the amount of magnet material required to produce a given flux in the air gap.

Question: Does this mean lower magnet costs?

THE INDIANA STEEL PRODUCTS COMPANY
VALPARAISO, INDIANA

THE WORLD'S LARGEST MANUFACTURER
OF PERMANENT MAGNETS

In Canada . . . The Indiana Steel Products Company of Canada, Limited, Kitchener, Ontario

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

Answer: Generally, this is true. However, structural considerations may prevent the placement of permanent magnets at preferred positions.

Question: Are there available quantitative data which indicate the degree to which magnet position influences the efficiency of a circuit?

Answer: A brief experiment was conducted on the nature and magnitude of the changes that occur when magnets are placed in various positions in a simple magnetic circuit. The results are discussed in *Applied Magnetism*, Vol. 3, No. 5.

World's largest permanent magnet separates electron particles

The largest and most powerful permanent magnet ever designed is an important part of a new Mass Spectrometer to be used for high molecular weight hydrocarbon

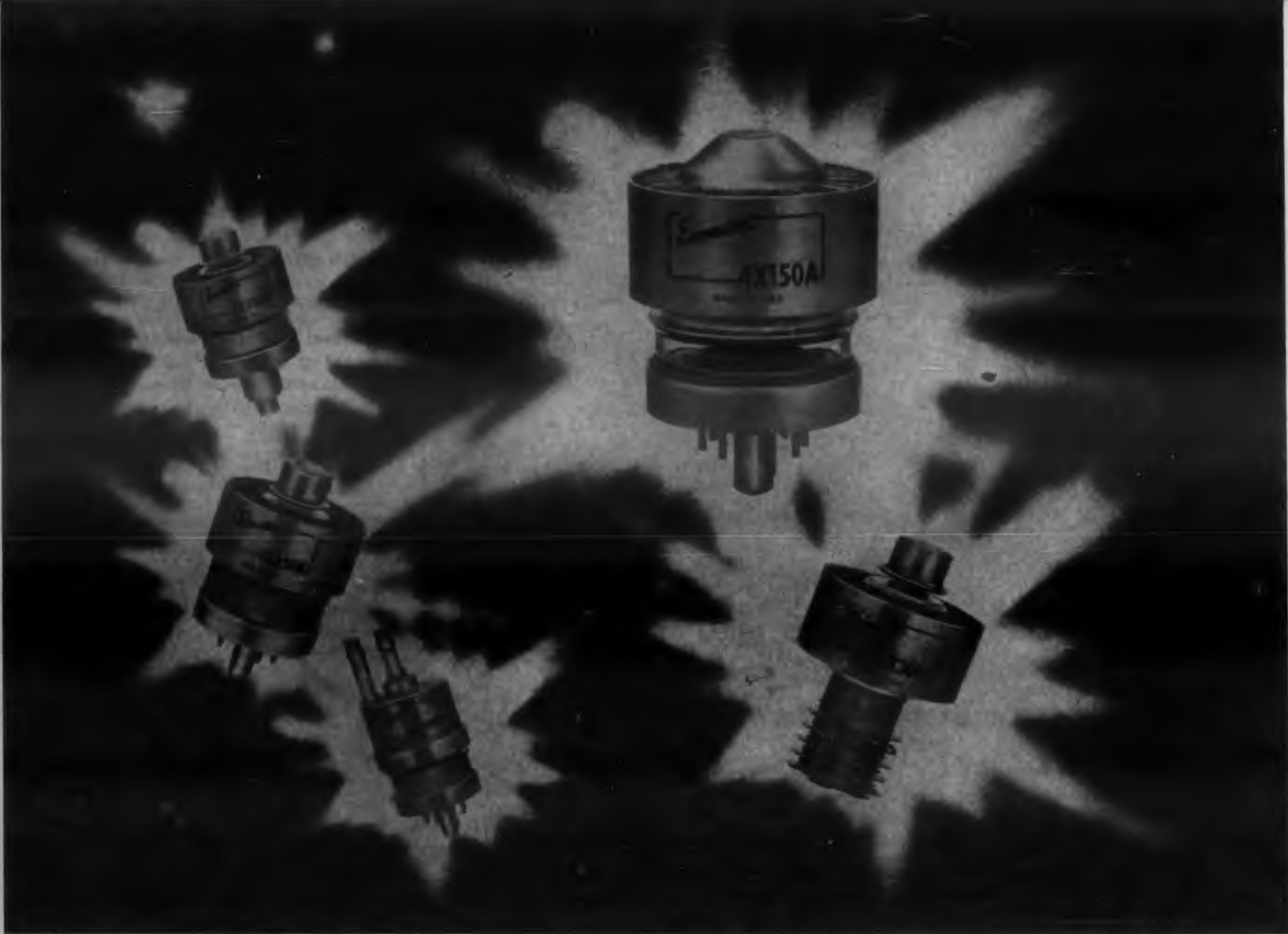


Indiana's C. A. Maynard inspects air gap of giant Alnico V magnet assembly

analysis at the Whiting, Indiana, research and development laboratories of a large Midwestern oil company. Function of the spectrometer is to establish a strong magnetic field that separates electron particles.

The Alnico V permanent magnet used in the assembly has a maximum field strength of 6,000 gauss . . . equal to 10 tons of magnetic holding force . . . and weighs 1,800 pounds. The complete assembly, which weighs approximately 4,700 pounds, was designed and fabricated by The Indiana Steel Products Company, Valparaiso, Indiana.

INDIANA
PERMANENT
MAGNETS



Evolution at Eimac

Back in 1946 Eimac developed and produced the 4X150A—a new concept in power tetrodes. Its immediate acceptance by the industry then, has led to even more popularity now.

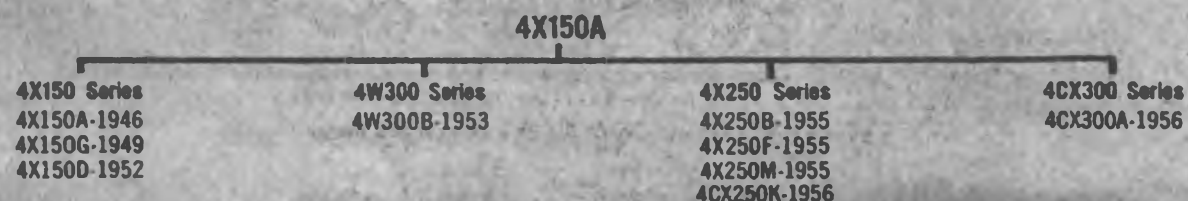
But today at Eimac the glass 4X150A is virtually obsolete.

Since 1946 Eimac has constantly improved the 4X150A to the point where it has evolved into a family of superior quality 250w and 300w tubes for operation to 500Mc. Small, compact structure has been retained. In fact, the 4X250 series is interchangeable with 4X150

tubes. Ceramic envelopes make possible greater mechanical strength, better production techniques, and higher temperature processing.

Because "good enough" has never been accepted at Eimac, however, this family of air cooled or water cooled, co-axial or conventional socketed tubes (2.5v, 6v, and 26.5v) is again accelerating the pace in quality, design, and performance, exactly as the 4X150A did a decade ago.

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



Flexible Circuit Kits

Make Package Units

To assist the design engineer (and his assistants) to lay out, set up, alter and take down electronic circuitry, Alden Products Co. has brought out its kit No. 37, consisting of chassis prepunched terminal cards, card mounting tube sockets, connectors and hardware.

Included are four basic chassis and a universal rack adapter. The chassis are without wiring. There are 36 prepunched terminal cards, 36 terminal card mounting brackets, and 18 terminal card mounting tracks. In addition (for printed circuitry) the kit embodies three prepunched terminal cards copper clad on one side and six copper clad on both sides; 25 printed circuit cross-over connectors and etchant, resist tape, resist circles and resist ink.

The kit further includes 24 planning sheets by means of which schematic diagrams can quickly be converted to terminal card layouts. Also provided with kit No. 37 are 72 connectors, 6 tell tale lamps, 30 test jacks, 3 fuseholders, 2500 assembly terminals, 72 tube sockets that mount on the terminal cards, 100 eyelets for the same, a staking tool, and an eye-letting tool.

Alden Products Co., Dept. ED, 117 N. Main St., Brockton 64, Mass.

CIRCLE 63 ON READER-SERVICE CARD

Stainless Steel Springs

Wide Range of Sizes

A complete line of experimental stainless steel springs in both open and closed wound types for development and research work are available from stock in 5 outside diameters and 5 wire sizes, ranging from O.D.'s of 3/32 to 3/8, wire diameters of 0.016 to 0.040 in. and lengths of 1-1/4 to 4 in.

The material is #302 stainless spring temper wire having a clear passivate finish.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., East Rockaway, L.I., N.Y.

CIRCLE 64 ON READER-SERVICE CARD

◀ CIRCLE 65 ON READER-SERVICE CARD

Ultrasonic Generators

For Industrial Processing

Designed to drive a wide variety of low-impedance ultrasonic transducers, ultrasonic generators have been announced. Accenting an untuned output system and featuring 800 w rf power output plus a varied range of frequency levels, these generators will be found useful for performing numerous electro-mechanical techniques such as cleaning, chemical processing, soldering and drilling.

The series of generators, designated Glennite U-405, are blower cooled and operate at a nominal fixed frequency of 40 kc or at any frequency between 30 kc and 2 mc, depending on model. Gulton Industries Inc., Dept. ED, 112 Durham Ave., Metuchen, N.J.

CIRCLE 67 ON READER-SERVICE CARD

Corrosion Resist Film

Withstands 2000 Hr. Salt Spray

Metal sprayed with a single coating of selinizing fluid, a silicone resin dispersion in compatible organic solvent, allowed to air dry, then baked for one hour at 480 F offers a strong protective corrosion resistant coating.

Selinized Process Co., Dept. ED, Houseman Bldg., Grand Rapids, Mich.

CIRCLE 68 ON READER-SERVICE CARD

Electric Cartridge Heaters

Low in Price

Suitable for a broad range of applications, the heaters are rated at 35 watts per square inch of effective heating length.

Diameters available are 1/2-in., lengths from 2-1/2 to 8 in.; 5/8-in., lengths from 2-1/2 to 16 in.; 3/4- and 1-in., lengths from 3 to 20 in.; and 1-1/4 in., lengths from 4 to 24 in. Wattages available vary from 100 to 2000. Heaters with diameters below one inch are equipped with 10-inch flexible leads; diameter sizes 1 in. and above have 1/2-in., 8-32 threaded solid stud terminals.

General Electric Co., Dept. ED, Schenectady 5, N.Y.

CIRCLE 69 ON READER-SERVICE CARD

CIRCLE 70 ON READER-SERVICE CARD >



MAURICE L. LEVY,
DIRECTOR OF
COMMERCIAL ENGINEERING

Emerson RADIO AND PHONOGRAPH CORP. IS ANOTHER OF THE
HUNDREDS OF IMPORTANT COMPANIES WHO DEPEND UPON PYRAMID
FOR A MAJOR SHARE OF THEIR CAPACITORS AND RECTIFIER COMPONENTS.

capacitors—rectifiers
for original equipment—
for replacement

PYRAMID ELECTRIC COMPANY

north bergen, new jersey



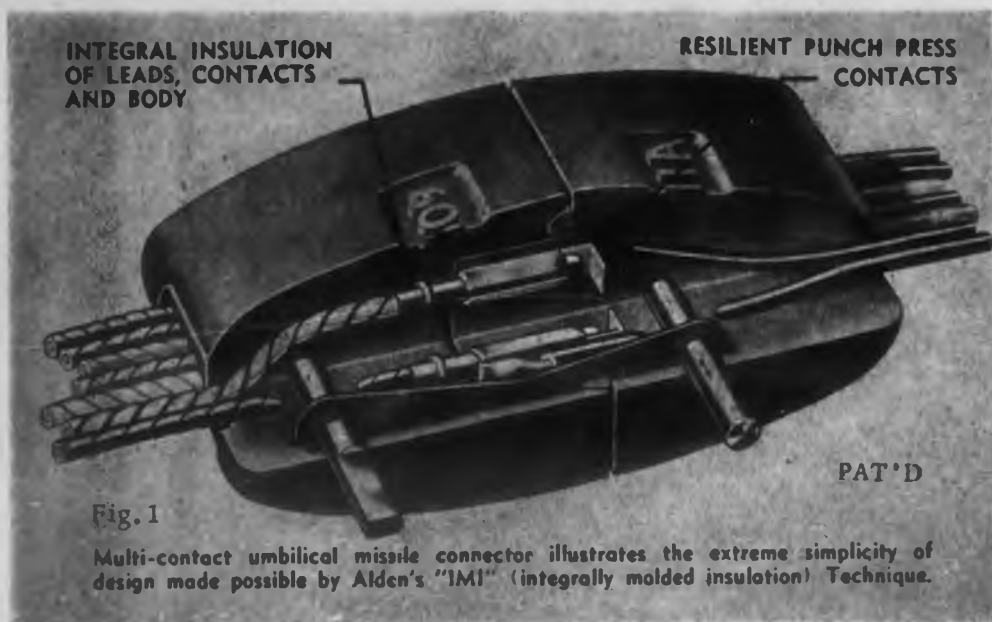


Fig. 1

Multi-contact umbilical missile connector illustrates the extreme simplicity of design made possible by Alden's "IMI" (integrally molded insulation) Technique.

First Breakthrough in Connector Reliability Since Potting

UNIT CONNECTORS INTEGRALLY MOLDED ON CABLES RAISE WHOLE LEVEL OF CONNECTOR RELIABILITY

A new approach to connector design—"unitizing"—offers a simple low cost and basic solution to connector problems.

Advantages of Unitized Connectors

"Unitized" connectors are plastic molding of the entire assembly—contacts, leads, even circuit components—integrally with the insulation forming the connector body itself.

History

The first approach to connector reliability was through heavy mechanical construction using several dielectric inserts, wire supports, and screw machine parts for contacts and structural members. For high voltage applications it was necessary to provide long leakage paths at wire entries, resulting in connectors of unusual length, bulk and weight. (See Fig. 2.)



Fig. 2 Conventional multi-contact connector.

Potting was the next development. Based on previous mechanical designs, it provided for special sealing compounds to be cast at the rear of the connectors around the wires and solder cups after assembly. An improved moisture seal, somewhat better electrical characteristics and greater overall reliability resulted. Mechanical complexity, weight, and bulk were reduced somewhat.

However, certain disadvantages were inherent in potting; it is messy and tedious. Temperature and humidity must be controlled and time allowed for curing. It is expensive and virtu-

ally impossible to put on a fast, efficient production basis.

Most Recent Advance

The recent development of advanced molding techniques and highly specialized production machinery by Alden Products Company has made possible the new Alden "IMI" (integrally molded insulation) process. This technique enhances connector reliability because the entire assembly is unitized. The connector elements are molded by a single hot shot of insulation into a finished assembly. Using insulation material compatible with the wire insulation effects a homogeneous bond between the wire and connector insulations forming a continuous seal against moisture, contaminants, and leakage. (See Fig. 1.) The insulation material used can be selected for characteristics pertinent to the application.

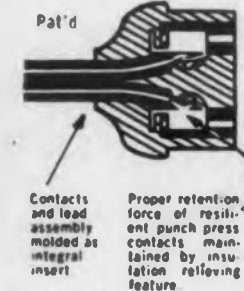


Fig. 3

Since the connector parts and lead wires are embedded in the plastic connector body, excellent strain relief is provided for the leads, minimizing wire and solder joint fatigue under vibration and shock. Alden's new patented technique, providing a relieving space around the contacts, permits the use of highly resilient, long-life punch press contacts which eliminate troublesome, inelastic screw machine parts. The result is a compact, lightweight, unitized connector—inherently tough, durable and strong.

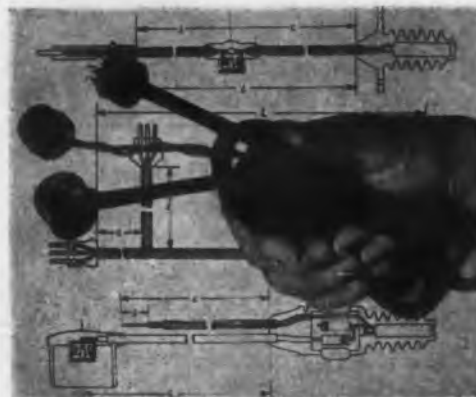
Electrically, advantages are numerous. Contacts are deep-seated in the connector openings and the long leakage path on the rear of the connector

eliminated. Protection against flash-over, dust and moisture is provided. Circuit components such as resistors, chokes and capacitors can be molded in, insulated and protected, and located near their operating elements. For high voltage corona suppression, shielding shells can be molded into the insulation.

Alden's "IMI" Technique offers equipment designers greater freedom in connector cabling because of its extreme flexibility. An infinite variety of connectors suitable for any electrical or electronic application becomes possible—limited only by the designer's imagination. Because of their inherent simplicity in design and construction, mass production, with speed, economy and reliability becomes possible for the first time with Alden "IMI" unitized connectors.

Standard Designs Available

Available right now are standard, mass produced Alden "IMI" Connectors that are solving these problems in fixed, mobile, marine and airborne application: Instantly replaceable, molded unit connector and cable assemblies in several insulation types for a variety of uses. Tube caps and high voltage disconnects for commercial and military electronic gear. Umbilical disconnects for missiles, (See Fig. 1).



Alden "IMI" unit molded connector-cable assembly. Fig. 4

Alden Custom Design Service

If you have an urgent need for volume quantities we will work with you to design custom connectors and unit cables to meet your specific requirements. We have the techniques and facilities to move fast from idea to production.

We design and build our molds, giving us close tooling control for quantity and speed. Flexible production planning, combined with tooling techniques and manufacturing know-how assure you of proper timing with your schedules.

To get started quickly, send us your sketches or prints so that we can begin working on proposals immediately. Or, better still, we cordially invite you to visit our plant, bring your connector problems, and sit down with our engineers and see for yourself how we are prepared to help you. Write, wire or phone our Connector Engineer, Mr. Malcolm Partridge, today. See us at the IRE Show: Booth 1614 and 1616, March 18-21, Coliseum, New York.

ALDEN PRODUCTS CO.

2139 N. Main St. Brockton, Mass.

Simplified Synchro Tester

Direct Scale Readings



Giving direct-scale readings of electrical error and null, this Model MST-1 Synchro Tester accurately measures phase shift, transformation ratio, null and electrical error in accordance with MIL-S-16892 and ARP-461. The instrument utilizes passive components only.

Electrical error is read by the bridge method, every 5 deg through 360 deg, and appears directly on the appropriate scale. Null is read every 90 deg in the case of resolver synchros, every 60 deg for other types, appearing directly on the appropriate scale. Transformation ratio can be measured at any angle, and appears in the form of direct digital readout to three decimal places. Phase shift also can be read at any angle.

The synchro shaft positioning reading is accurate to a maximum error, non-cumulative, of 15 sec of arc; synchro bridge reading maximum error is 10 sec of arc; null reading max error 5 per cent; transformation ratio reading max error 1 per cent; phase shift reading max error, 2 deg.

Theta Instrument Corp., Dept. ED, 204 Market St., East Paterson, N. J.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

28 V DC Adjustable Supply

Up to 5 Amps



Filtered, adjustable, 28 v power up to 5 amp is provided by this rectifier supply. The output is adjustable by means of transformer taps wired to a terminal board. Designated Model 28-5MX, the unit can be mounted in any position. It weighs 15 lbs, and measures 12-1/2 in. long, 4 in. wide and 4-3/4 in. high above the deck.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

Pirani Pressure Gauge

1-2000 Microns Hg



Direct, continuous pressure readings of vapors and permanent gases are obtainable by means of this Pirani vacuum gauge within the range 1-2000 microns Hg, and when the "range" knob is set to "leak detect" up to 10 mm Hg. The Type 2203-03 instrument features a new sensing tube which operates at the unusually low maximum temperature of 250 C, and greatly reduces zero drift. Deposits of carbon on its filament do not change its emissivity. Sensing and compensating tubes are enclosed in a single metal envelope to minimize the effect of changes in ambient temperature.

The 2203-03 incorporates a printed circuit. Automatic voltage regulation permits use of a 0-10 mv recorder without constant operator attention. Input power is 115 v, but the instrument can readily be adapted to 230 v operation. Size is 11 in. wide, 6 in. deep, 6-1/2 in. high; weight is 10 lb.

Consolidated Electrodynamics Corp., Dept. ED, Rochester Div., 1775 Mt. Read Blvd., Rochester, N. Y.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Tachometer Generator

Linearity ± 0.5 Per Cent



Consisting of an ac servo motor directly coupled to an induction generator, this unit is an unusually precise servomotor tachometer generator, with linearity of ± 0.5 per cent at 3600 rpm. Total null is 0.019 v rms; in phase null is 0.008 v rms and quadrature null 0.015 v rms. Size of the unit is No. 11; ambient temperature rating 150 C; applications include instrumentation, fire control, computers, missiles and autopilots. The unit conforms to Bu. Ord. MK-14.

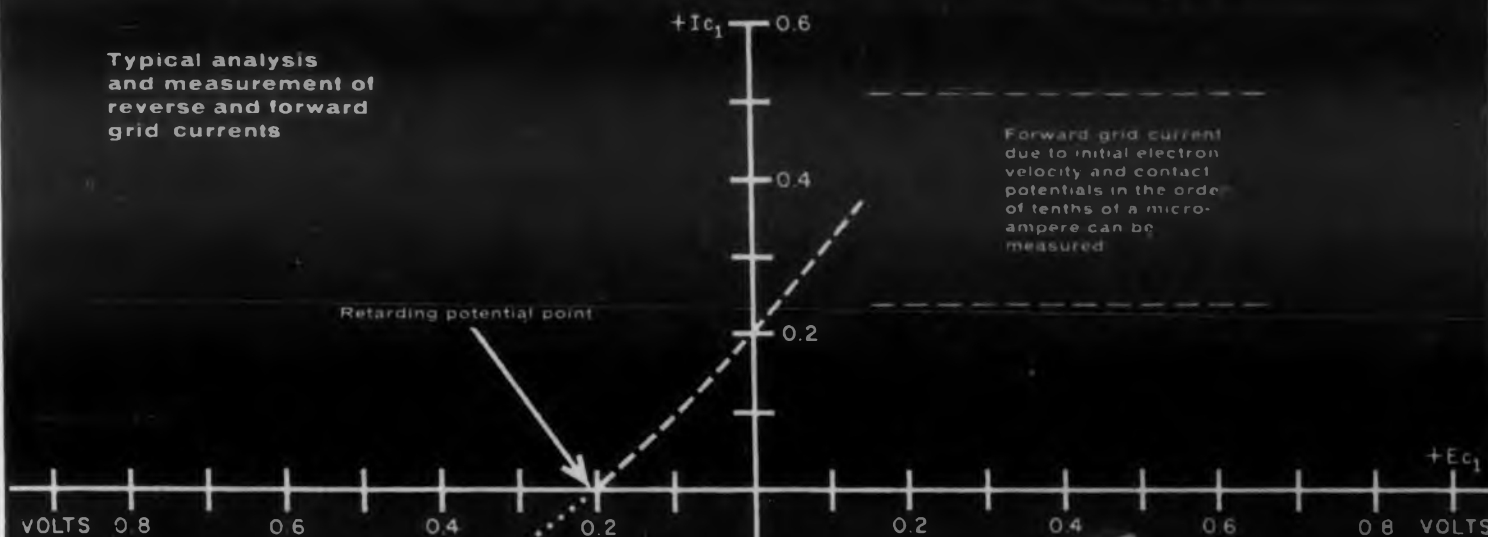
Eastern Air Devices, Inc., Dept. ED, 353 Central Ave., Dover, N. H.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

Electron-Tube Transconductance (gm) Tester measures Electrode Currents as low as 0.0000001 ampere!

RCA WT-100A MicroMhoMeter enables equipment design engineers to measure electron-tube grid and interelectrode-leakage currents for critical circuit applications

Typical analysis
and measurement of
reverse and forward
grid currents



Reverse grid currents
due to gas, grid emission,
and leakage in
the order of tenths of
a microampere can
be measured

Forward grid current
due to initial electron
velocity and contact
potentials in the order
of tenths of a micro-
ampere can be
measured



RCA WT-100A
MICROMHOMETER . . . \$785.00**

**User Price (optional)

- measures reverse grid currents (gas, grid emission, and leakage currents)
- measures forward grid currents (initial electron velocity and work-function currents)
- measures heater-cathode leakage currents (internal power supplies provide -100 to +300 volts for test)
- measures interelectrode leakage currents between any combination of electrodes (internal power supplies provide -100 to +300 volts for test)

RCA WT-100A Electron-Tube MicroMhoMeter is a laboratory-quality instrument which brings a reliable concept of tube-testing technique to users of tubes—on the production line, in the laboratory, and in circuit design. Uniquely designed, compact, and self-contained, the WT-100A offers versatility and accuracy comparable to that of more elaborate and complex laboratory equipment used for measuring transconductance and electrode currents. For detailed brochure, write RCA, Commercial Engineering, Section B18W, Harrison, N. J.



TEST EQUIPMENT

Radio Corporation of America
Components Division, Camden, N. J.

SPECIAL FEATURES OF THIS REMARKABLE INSTRUMENT

- Measures true transconductance with better than $\pm 3\%$ accuracy
- Built-in shorts test for any combination of tube elements
- Measures transconductance up to 100,000 μ mhos—in 6 ranges
- Measures transconductance of low-plate-resistance types and high-perveance types
- Measures control-grid-to-plate, screen-grid-to-plate, and suppressor-grid-to-plate transconductances
- Measures heater currents including 600-ma series-string TV types
- Built-in calibrating circuit—no null meters or extra devices required
- Has easy-to-read meter for all measurements
- VoltOhmyst[®]-type circuit for current measurements—has full-scale, reading of 3 μ amps on lowest current range
- Electronically protected burn-out-proof meter
- Regulated power supplies for all dc voltages
- 250-ma dc supply for filaments of battery operated tube types.

[®]Registered U.S. trademark

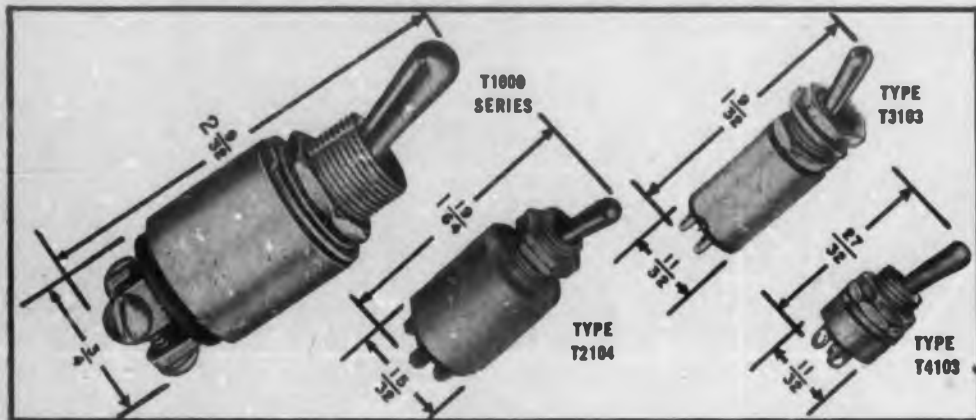
CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

HETHERINGTON

SWITCHES • INDICATOR LIGHTS • SPECIAL ASSEMBLIES

ENGINEERING NEWS #3

Say "WHEN" to Toggle SWITCH MINIATURIZATION



Few basic electrical components have been successfully miniaturized with such telling effect as the toggle switch. Hetherington has developed space- and weight-saving cylindrical types with ratings, dimensions, and performance tailored to the critical requirements of airborne and industrial electrical systems. And, thanks to Hetherington's positive cam-roller snap action, even the smallest types carry ratings far greater than their sizes would indicate.

Recent Hetherington developments such as the sub-miniature Type T4103 shown above approach the point where further miniaturization would seem to present more difficulties in mounting than in obtaining adequate switch performance. Although not quite ready for production, field tests of the T4103 have shown great promise for drastically cutting weight while assuring better performance in aviation's toughest jobs.

**8 AMP
U. L. RATING**
... 1/2 amp Size
and Price



Here's just the push-button switch to dress-up and improve that instrument, appliance or other "black box" now on the drawing table—and with attractive cost and space advantages in the bargain.

For the performance of these B-Series Switches comes mighty close to that of Hetherington's aviation-quality switches in terms of positive "feel," fast and audible snap-action. Normally-open or closed SP-ST types with 8-amp U.L. Approved ratings available with lugs or 6" leads. Send for Data Sheet S-4.

SWITCH PROTECTION "TAILORED"

to humidity
... moisture
... spray
... immersion

Although the mechanism of every Hetherington push-button and toggle switch is protected by the case against dust and moisture, some special requirements call for additional "climate-proofing." Where the perfect hermetic seal of a metal bellows is not needed, "O" rings, sleeves or boots of lightweight silicone rubber offer inexpensive solutions for most applications as shown by the typical types at right.



HETHERINGTON INC. 1200 ELMWOOD AVE., SHARON HILL, PA. • 139 Illinois St., El Segundo, Calif.

standard switches for the most specialized requirements

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Ten-Turn Precision Pots

7/8 in. Diameter



Two new ten-turn precision pots, Type 907 and Type 908, have cases 7/8 in. in diam 3600 deg electrical rotation, and resistance ranges from 100 to 100 k ohms. Both conform to MIL-E-5272A.

Type 908 is so constructed that the contact wiper is guided along the resistance element by a metal tab which slides in a helical groove parallel to the winding. The winding itself does not guide the wiper. Contact pressure is thus limited to that necessary for conductivity and the life of the winding, as well as its accuracy during life, are improved. Type 908 has a linearity range of 0.05 to 0.25 per cent, and is rated at 2-1/2 w at 40 C.

Type 907 is conventionally constructed; it has a linearity range of 0.1 to 0.5 per cent, and is rated at 2 w at 40 C.

Both units have an operating temperature range of -55 to +85 C. At 85 C their rated wattage is derated by 85 per cent.

Fairchild Controls Corp., Dept. ED, 225 Park Ave., Hicksville, L. I., N. Y.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Circuit Eyelets

For Solder or Solderless Leads



These miniature eyelets mount components on printed circuits. Connections may be either soldered or solderless. The latter are exceptionally strong, mechanically. Where soldering is used the capillarity of the eyelets assists the process. Standard eyelets are brass plated with tin-lead solder, but other finishes, such as silver and gold, are available. All eyelets are machined to close tolerances and intended to be fed and inserted into printed circuits by automatic equipment.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Servo Parts

For 400 Cy Airborne Systems



Where space is at a premium and low system inertias are required, a complete line of miniature servo parts provides all the mechanical components needed for assembly of servo systems. Included are miniature slotted mounting plates, hangers, dial assemblies, stop assemblies (mechanical and electrical), couplings differentials and gears. Gears are precision class II, in 64, 96 and 120 diametral pitches. Parts are designed for use with 1/8 in. shafting. Mounting of hangers to the slotted plates is facilitated by a "T" nut assembly which permits continuous adjustment in both directions for proper meshing. These miniature servo parts, which are intended primarily for airborne 400 cycle prototype or production applications may be bought individually, or in kits.

Reeves Instrument Corp., Dept. ED, 207 E. 91st St., New York 28, N.Y.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicone Sealed Resistors

Impervious to Moisture



A line of resistors between 2 watts and 10 watts, 68 k to 175 k, and in tolerances from ± 0.05 per cent to ± 3 per cent, has been announced. All are silicone sealed; totally impervious to moisture, including salt spray; wire wound, and with full wattage rating at 25 C ambient. The complete line has been designated RS. Typical are two sizes for three-watt application: RS-2, 1/4 in. diam x 5/8 in. long, and RS-2B, 3/16 in. diam x 9/16 in. long. These new resistors represent a revision of the line.

Dale Products, Inc., Dept. ED, Box 136, Columbus, Nebr.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

spoon at work...



A principle is at work, too! The same one by which a spoon creates a "silent cycle" of conduction, radiation and convection that cools the coffee—now, effectively applied, increases electronic equipment reliability.

Electronic reliability engineers are learning how to beat heat (the most frequent cause of electron tube failures and resultant equipment unreliability) with the "silent cycle" effectiveness of IERC Heat-dissipating tube shields. IERC's extensive research has resulted in the *only* Heat-dissipating tube shield that gives you maximum effectiveness in *all* three phases of the "silent cycle"—conduction, radiation and convection! Service in severe environmental conditions in many military and industrial equipments proves IERC shields reduce tube operating temperatures as much as 150° C—extend tube life up to *12 times longer! Excellent retention and shock and vibration protection is also provided.

IERC tube shields are available for miniature, sub-miniature, octal and power electron tubes.



IERC literature and latest Octal and Power tube shield Technical Bulletin available now — FREE!

*AIRC REPORT #DCA 56-1161.

IERC T-12 SHIELD AND BASE WITH 6080 TUBE ILLUSTRATED.

PATENTED OR PATS PEND. CROSS-LICENSED WITH NORTH AMERICAN AVIATION, INC.

International



electronic research corporation

145 West Magnolia Boulevard, Burbank, Calif.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

EFFICIENT
HEAT
TRANSFER
WITH



... an internal thermal gradient
of 1.2° C/watt or less!

Industry's Highest Power Transistors

Large area, thinness and intimacy of collector contact with large copper base provide the efficient thermal transfer.

Result—an unusually cool collector junction in the Delco Radio alloy-type germanium PNP power transistor. The Delco Radio 2N173 and 2N174 transistors not only have high power handling ability but also low distortion characteristics. Thus, they are ideal for audio as well as your general power applications.

Furthermore, these transistors are normalized to retain their performance characteristics regardless of age. Write for engineering data. Delco Radio transistors are produced by the thousands every day.

TYPICAL CHARACTERISTICS

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

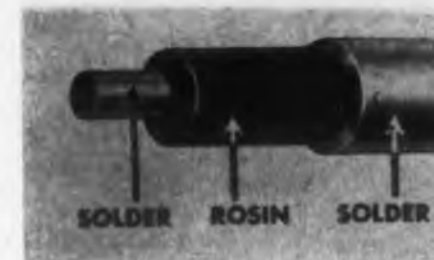
DELCO RADIO

DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

Low Temperature Solder

Eutectic 242-320 F



Where soldering with common 63 tin/37 lead alloys involves danger of damage to the materials (for example, in soldering ceramic feed-thru capacitors) low temperature alloys may be used. One such alloy, designated Alpha No. 238, has a eutectic of 242 to 320 F, considerably lower than the standard. The low temperature alloys also insure against silver scavenging. The effectiveness of the new alloys is further increased by the solder-rosin-solder sandwich construction, which eliminates flux skip spots. The entire line of alloys, of which Alpha No. 238 is one, is designated Cen-Tri-Core, and is available in the usual diameters and flux percentages, on 1, 5, and 25 lb spools.

Alpha Metals, Inc., Dept. ED, 56 Water St., Jersey City, N. J.

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulation Stripper

Uses Hot Wire



Using a heated nichrome filament to sever insulation instead of a blade, this insulation stripper cannot cut or nick even the finest wire strand. It strips large co-axial cables and extremely fine stranded wires without adjustment for wire type or size. It will remove most forms of plastic insulation, specifically nylon, vinyl and polyethylene. It will not strip teflon or rubber insulation. Power required is 115 v ac, which is stepped down through a transformer housed with an on-off switch in a metal box. An adjustable stop on the stripper predetermines the length of insulation to be removed.

Western Electronic Products Co., Dept. ED, 355 Colman St., Altadena, Calif.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Blocks For Solderless Connections



Taper receptacles of gold-plated brass over silver, molded into high impact glass-filled resin, are available in varying combinations. The taper receptacles accommodate AMP Series "53" taper pins. Pin and receptacle lock securely and positively. Terminal block Series 145-48 is fabricated in 20 rows of triple stacked contacts arranged in any desired shorting combination; and with perpendicular and right angle holes for mounting. Terminal block Series 145-58 is fabricated in a single row of 20 contacts, in 10 dual contacts and in 10 single contacts; and may be ordered in any pair or combination of shorted contacts. Molded or eyelet holes are provided for ease of stacking and assembly. The resin used in standard production is Alkyd, type 440A, but other molding materials may be specified.

Electronic Sales Division, DeJUR-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

X-Band Ferrite Load Isolator 8 Db Isolation 8600-9600 Mc



Simple and compact solution to magnetron loading problems caused by lengthy transmission lines or excessive VSWR's is offered by this Model H500 ferrite load isolator. It is intended to operate with RG51/U waveguide and to mate with UG52/U flanges. Insertion loss is 0.5 db or less; VSWR is 1.10 maximum, and the minimum isolation over the bandwidth of 8600-9600 mcs is 8 db.

Litton Industries, Component Div., Dept. ED, 5878 Rodeo Road, Los Angeles 16, Calif.

CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION



Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS

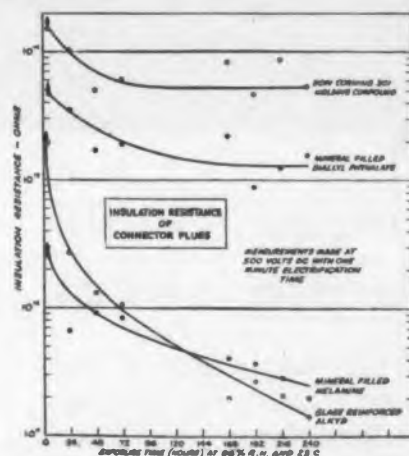
No. 10

Silicone Molding Compound Has Superior Insulation Resistance

While Dow Corning 301 Molding Compound is frequently specified for electrical parts because of its outstanding resistance to high temperatures, this versatile material also has electrical properties superior to comparable plastics at room temperature. Take insulation resistance, for example—

The accompanying graph traces a summary of tests run on four miniature 26-contact connectors molded by Continental Connector Corporation, Long Island City, N. Y. All plugs were identical in physical form, but each was molded from a different material as indicated on the graph.

Not only did the plugs made of 301 Molding Compound have the highest initial insulation resistance, but their margin of superiority broadened substantially after 240 hours at 96% RH. These tests were



conducted at room temperature; at elevated temperatures the superiority of the silicone molding compound is even more pronounced.

Performance like this is one of the reasons why Continental, among the world's largest producers of connectors, reports increasing interest in "301" molded units. Already undergoing tests in guided missiles, industrial ovens and even kitchen ranges, 301 Molding Compound is manufactured to meet Specification MIL-M-14E, Grade MSI-30. Continental has announced that its entire connector line will soon be available in 301 Molding Compound. No. 41

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C.
Canada: Dow Corning Silicones Ltd., Toronto; Great Britain: Midland Silicones Ltd., London; France: St. Gobain, Paris

Protect Current Transformer With Silastic Encapsulation

Encapsulation in Silastic*, Dow Corning's silicone rubber, has proved to be an ideal solution to the problem of protecting electrical and electronic components from vibration, heat, moisture and corrosive conditions. An excellent example is found in the new Type 5-kv current transformer made by Westinghouse.

A highly compact unit designed for indoor metering or relaying applications, the SM-5 transformer is the smallest, lightest and most durable 5-kv unit ever built. Silicone insulated throughout, the SM-5 easily meets all ASA and NEMA standards.

To further assure top dependability, the entire core-coil assembly is encapsulated in an attractive, one-piece silicone rubber jacket. This jacket remains resilient and



retains its original dielectric properties even in locations subject to extreme changes in temperature and humidity. The silicone rubber also expands and contracts with the coil. As Westinghouse aptly describes it, "transformer performance is sealed in to stay." *T. M. REG. U. S. PAT. OFF. No. 42

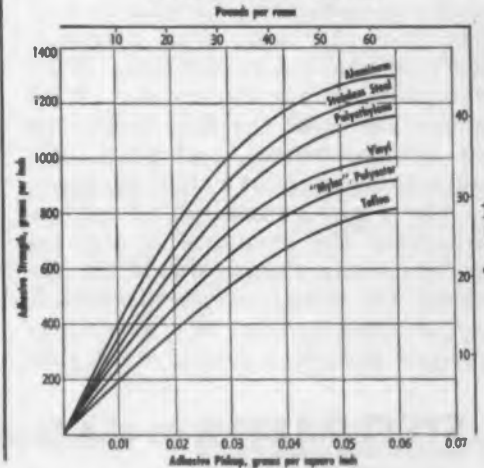
New Pressure Sensitive Tape Offers Outstanding Adhesion at -65 to 500 F

Designers looking for new ways to cut production costs or to improve product performance are certain to find many applications for Permacel EE-3621, a glass-cloth-reinforced tape coated with a pressure sensitive Dow Corning silicone adhesive.

Adhesion values for the new Permacel tape are exceptionally high at extreme temperatures. A 1-inch strip holds—

- 50 ounces at 150 F
- 30 ounces at room temperature
- 74 ounces at -65 F

TYPICAL ADHESIVE STRENGTH OF EE-3621 ON VARIOUS SURFACES



Send Coupon for More Information

DOW CORNING CORPORATION - Dept. 4714
Midland, Michigan

Please send me 41 42 43

NAME

TITLE

COMPANY

STREET

CITY ZONE STATE

CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

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

use **AL**

PERMENDUR



Write for
your copy

"MAGNETIC MATERIALS"

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

ADDRESS DEPT. ED-86

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

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

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

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

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

STEELMAKERS to the Electrical Industry

Allegheny Ludlum

WSW 6118



CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

Metal-Clad Power Resistors For Chassis Mounting



These miniature metal-clad chassis mounted precision power resistors have a low internal temperature rise. The reduced hot-spot temperature is achieved by the use of a filling material between the pre-coated resistor and the black anodized aluminum case. This material has exceptional ability to transfer heat, and forms a reliable seal against humidity hazards.

Available in nominal power ratings of 25 and 50 w, the resistors will dissipate 80 per cent of rated power at 40 C ambient while maintaining an internal hot-spot of only 260 C.

Recommended derating of the units is zero wattings at 260 C ambient. After 1000 cycled hours (1-1/2 hours on, 1/2 hours off) at recommended load, resistance shift averages 0.4 per cent.

The resistors offer dielectric strength obtainable up to 2500 v rms, and meet MIL-R-18546 (Ships) and MIL-R-26B.

Sage Electronics Corp., Dept. ED, 302 N. Goodman St., Rochester, N.Y.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

Please Note Corrections

The following necessary corrections have been called to our attention by the author of the article on page 32 of the December 15th issue—"E and I Regulation With Nonlinear Resistors":

1. In the equation preceding (3) $\frac{\lambda R}{4}$ should be $\frac{\lambda R^2}{4}$.

The second equation following (3) should read

$$E_{in} \frac{R}{R+r} = \sqrt{\lambda} R \sqrt{\frac{\lambda R^2}{4} + E_{in}} - \frac{\lambda R^2}{2}$$

3. Following equation (7), the statement: "Better Regulation . . ." should read "Less or smaller regulation. . . ."

4. In Fig 1, $R = r$ should read $R \neq r$.

Signal Converter For Telemetry



This instrument converts signals from 400 cps transducers to 0-5 v dc for telemetry inputs. Frequency and voltage regulated power is supplied to the transducers. Conversion is effected by a crystal diode demodulator. There are no amplifiers in the signal circuits, and gain and zero point are stabilized.* Linearity of the demodulated signal output is 0.5 per cent. The Model 4-1103, signal converter is a three-channel modification, designed for telemetry, of the same manufacturer's earlier, low level, device intended for oscillograph recording.

Dynalysis Development Laboratories, Inc., Dept. ED, 11941 Wilshire Blvd., Los Angeles 23, Calif.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Filament Supply Uses Silicon Rectifiers



This silicon rectifier filament supply unit requires an input of 6.3 v ac and delivers 6.3 v dc at 0.6 amp. Ripple is 600 mv; one input terminal is common to the negative output terminal. Construction is rugged, and the silicon units operate well below their ratings. The Model 226 is encapsulated in epoxy resin, and has an octal plug base. It measures 4-1/2 in. seated by 1-1/2 in. diam.

A companion unit, the Model 225, operates from 115 v ac and delivers 6.3 v dc at 2.0 amps, with ripple content less than 250 mv. Model 225 is supplied in a drawn enameled steel case, also with an octal base plug. The transformer isolates input and output circuits. Height is 3-3/4 in. seated, and chassis area 3 x 3-1/4 in.

C. J. Applegate & Co., Dept. ED, 1816 Grove St., Boulder, Colo.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION



New copper-clad MICARTA® takes dip solder bath without blistering!

New H-3032 copper-clad MICARTA® cuts costs and production time of printed circuits. Copper-clad MICARTA speeds up soldering, without the normal accompaniment of an increase in rejects and missed connections. It can be cold punched without cracking or chipping.

The laminate won't blister even when dip soldered for 10 seconds at 500°F! Examine the two close-up photographs. One shows an ordinary laminate after a laboratory test. Note the blistering, then look at the MICARTA dip soldered for the same length of time—and there is no blistering!

A special adhesive is used which has the same

high electrical properties, solvent resistance and low moisture absorption as the MICARTA laminate itself. Actually, adhesive strength is increased during soldering.

Because of a new adhesive process, copper-clad MICARTA keeps its high bond strength—from 10 to 13 pounds versus an industry standard of six pounds—even after heating and cooling is repeated many times. This is especially valuable for electronic circuits.

Copper-clad MICARTA may be the answer to your circuit assembly problem. Write for further information and technical data to Westinghouse Electric Corp., MICARTA Div., Hampton, S. C.,

J-06624-X

**YOU CAN BE SURE...IF IT'S
Westinghouse**

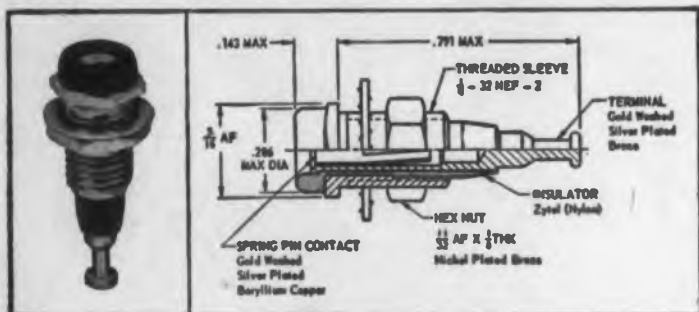
CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

new...from Raytheon

TEST JACKS

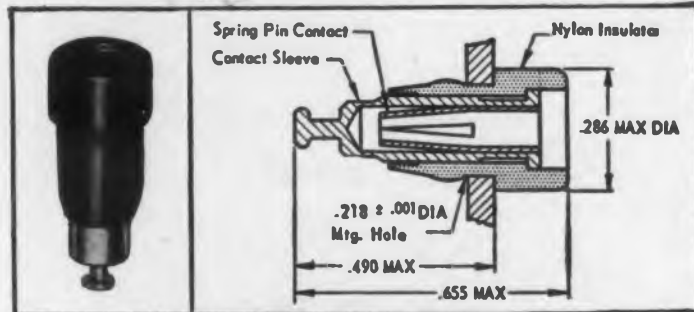
Now the most complete quality line in the industry . . .

All your test jack needs from one reliable source—Raytheon. These brand new components offer a unique combination of highly desired features. Nine colors. Nylon insulators. Beryllium-copper contacts with silver-plated gold-washed solder terminals. Designed for extreme salt spray, humidity, temperature conditions. For standard .080" prods. These jacks conform to military specs. and are competitively priced.

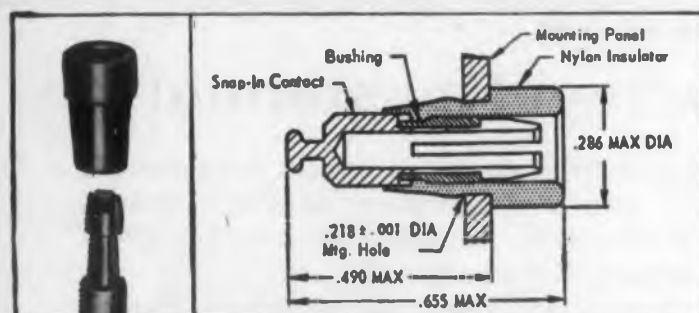


STANDARD TEST JACK

Rugged construction, superior design. Ideal for extreme shock and vibration conditions

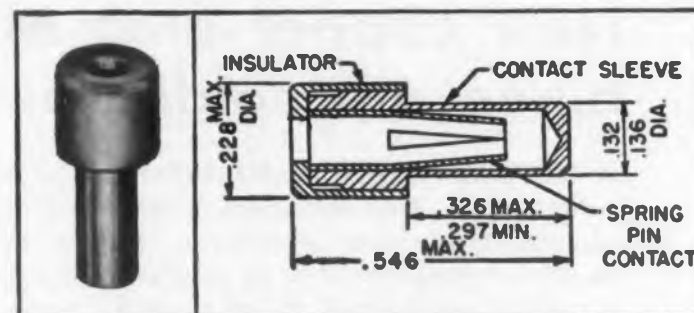


SUBMINIATURE FIXED-CONTACT TEST JACK
Fast, easy, press-fit assembly

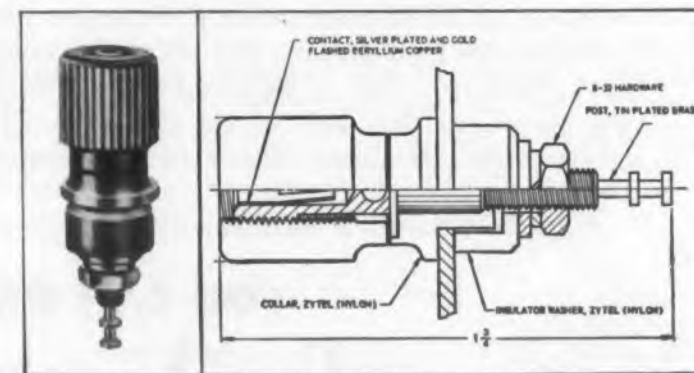


SUBMINIATURE SNAP-IN CONTACT JACKS

Snap-in contact can be soldered to cable before insertion in mounted jack



PRINTED CIRCUIT TEST JACKS
Mount on any panel to 1/4" thick



5-WAY BINDING POST

Compact, high strength. Incorporates jack for banana plug or standard .080" prod. Available in black or red

Solenoid Switch

Handles 3 Hp



An electromagnetic switch actuated by a solenoid, designated Powerloid, this unit can switch motor loads up to 3 hp at as high as 230 v ac, and heating loads up to 8400 w. Other ratings are: resistive load, 6000 w, tungsten lamp load, 500 w. The switch can be supplied with coil wound for standard ac voltages up to 230 v, 60 cps, or for dc up to 110 v. The switch is totally enclosed. Available combinations are spst, dual make, spst dual break; spdt, dual make and dual break; spst dual make with auxiliary switch outside the housing, and spst dual break with auxiliary switch outside the housing.

Guardian Electric Mfg. Co., Dept. ED, 1621 W. Walnut St., Chicago 12, Ill.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

VHF Band-Reject Filters

Sharp Cut-off



Series filters that remove adjacent-channel interference from color TV signals and improve band edge response are now available in two bandwidth ranges. Models HQT-26 and HQF-26 are tunable in the range of 50 to 100 mc; model HQT-73 covers the range 174 to 220 mc. The HQT models have a peak attenuation greater than 70 db and a 30 db bandwidth of 200 kc. The HQF model has a peak attenuation greater than 90 db and a 30 db bandwidth of 400 kc. The filters are stable, their bandwidths constant, and cutoffs sharp.

Entron, Inc., Dept. ED, 4902 Lawrence St., Bladensburg, Md.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

For complete information, please write Dept. 6120



RAYTHEON MANUFACTURING COMPANY
Commercial Equipment Division
Waltham 54, Mass.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION



Laboratory Testing Oven
Room Temperature to 100 C

Intended for laboratory tests of electrical equipment, plastics, metals, chemicals and insulation, this stainless steel oven affords a temperature range from room temperature up to 100 C, and controlled relative humidity variable from 20 per cent to 100 per cent. The viewing window is triple-paned; and the water used to increase relative humidity is first temperature-conditioned in its own completely sealed chamber to prevent condensation. The oven door is sealed with a replaceable gasket of silicone rubber. Automatic recording is provided via separate wet bulb and dry bulb pens. Other features include a quick-opening exhaust vent, adjustable air inlet, and automatic water inlet regulator. Temperature control is accurate within $\pm 1/2$ C; humidity control is accurate within ± 5 per cent. The Model No. 8091 oven is available for either 115 v or 230 v single phase current. External dimensions are 46 in. wide x 31-1/2 in. deep x 64-1/2 in. high. The chamber measures 24 in. wide x 20 in. deep x 30 in. high, and contains two adjustable stainless steel shelves.

Electric Hotpack Co., Dept. ED, Cottman and Melrose Sts., Philadelphia 25, Pa.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature-Stabilized Crystal

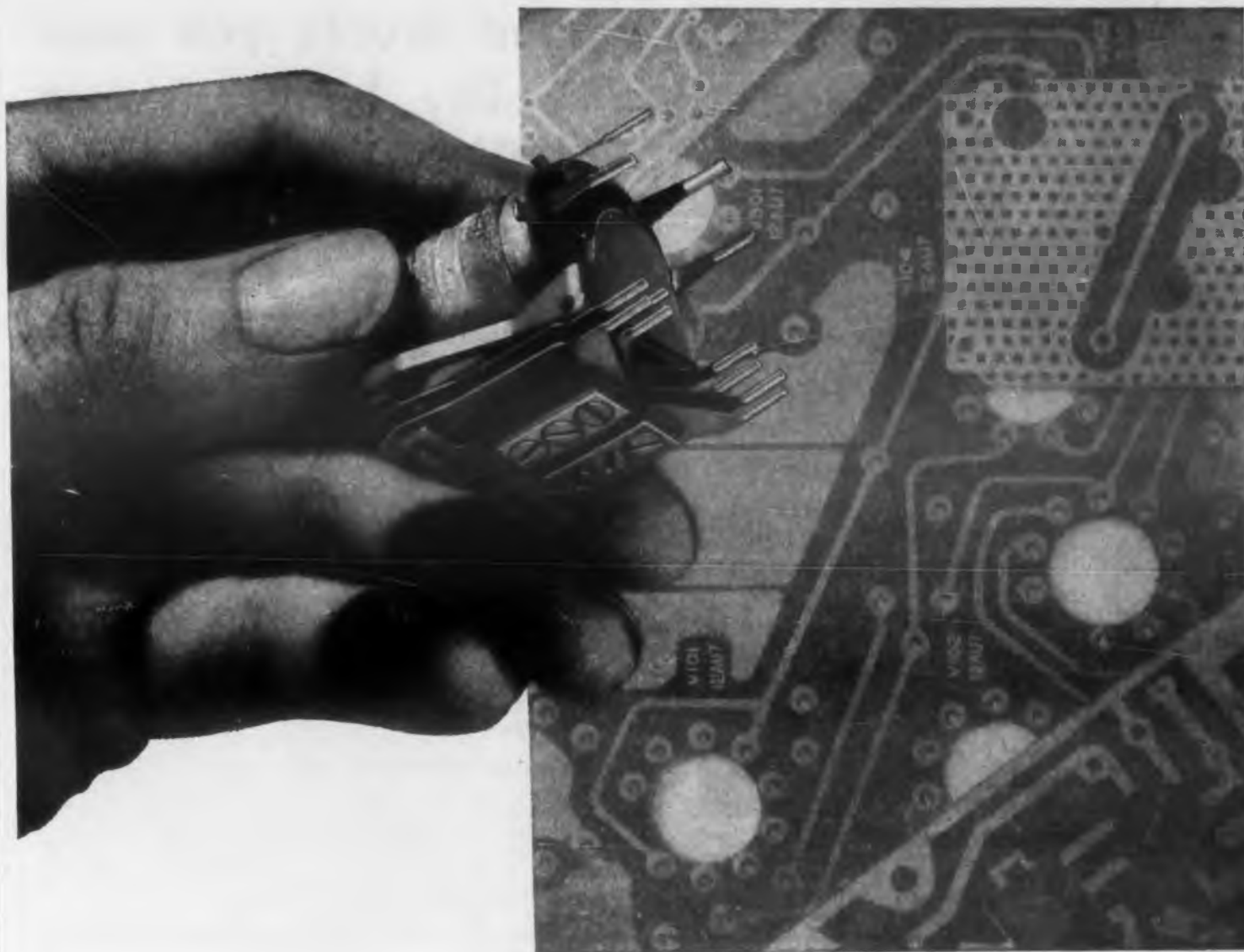
Subminiature

Integrally stabilized at a temperature of 75 C under **even extremes** of ambient temperature, this subminiature crystal package, designated BTC-1, is offered in the range 5 to 125 mc. It is a plug-in device, intended for applications where assembly space is limited, and measures only 1-7/8 in. high, including pins. The package is hermetically sealed.

Bliley Electric Co., Dept. ED, Union Station Bldg., Erie, Pa.



CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION



NOW!

dependable relays for printed circuits

Maybe you, too, have been awaiting availability of a *good* relay for direct insertion into printed circuits. Now Automatic Electric can solve your problem with a miniature relay that is just right.

120 million operations, without a single readjustment or relubrication! That's what you get from this rugged, improved Series SQPC Relay, because it features a special *heavy-duty* bearing and bearing pin. Also a recess in the bearing plate retains an adequate supply of lubricant for long-term lubrication of the bearing pin.

Consider these additional advantages:

1. The sections of the terminals that insert into the printed circuit board are NOT brazed or welded into place, but are integral parts of the coil terminals and contact springs—thus preventing internal loss in conductivity or continuity.
2. Terminal design permits direct plug-in of the relay into a printed circuit board, ready to be secured in place with any acceptable soldering technique.

Usually the desired contact spring combination, or pile-up, is sufficiently large so that additional mounting (support) of the relay is not necessary.

SQPC Miniature Printed Circuit Relays are available with many different contact spring arrangements, and for a multitude of applications. Springs can be made of phosphor-bronze, "Bronco" metal, or other special-purpose materials, as required.

Of course the long life, heavy-duty features of the improved SQPC Relay can be had in the conventional type of plug-in relay, if regular sockets are preferred for use, whether in printed circuitry or other applications.

To get complete details, write: Automatic Electric Sales Corporation, 1033 West Van Buren St., Chicago 7, Illinois. In Canada: Automatic Electric (Canada) Ltd., Toronto. Offices in principal cities.

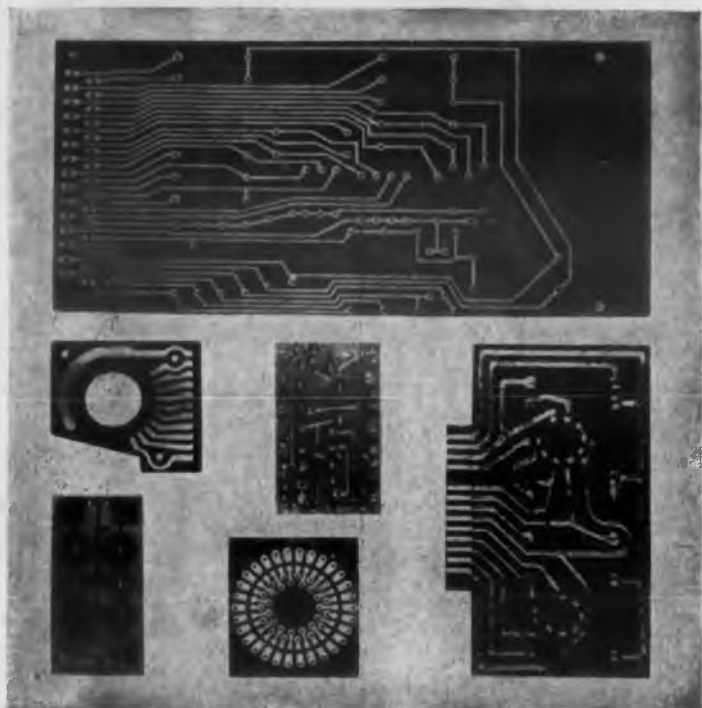
AUTOMATIC ELECTRIC

Originators of the dial telephone • Pioneers in automatic control



CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

For the most dependable printed circuits, you need the high bond strength, workability, heat-resistance of C-D-F DILECTO® METAL-CLAD LAMINATES



Printed circuits based on C-D-F materials are being used with great success in military electronic equipment, commercial television and radio sets, telephone switchboards—even sub-miniature radiosonde equipment and hearing aids.

Photos courtesy of Photocircuits, Inc., Glen Cove, N. Y.

HIGH BOND STRENGTH—C-D-F's special adhesive for metal-clad Dilecto bonds the copper foil to the plastic without affecting the laminate's superior electrical properties. Heat-resistance, dissipation factor, dielectric constant, dielectric strength, and insulation resistance of the Dilecto base remain unaffected. The closely-bonded foil can be etched cleanly and dipped in hot solder to 450°F. for ten seconds with a guarantee of no blistering or separating. Metal-Clad Dilecto can be punched or machined either before or after etching.

EXCELLENT WORKABILITY—On all four Dilecto metal-clad grades, you can solder, punch, saw, and assemble components either by hand or automatically. Thanks to the inherently superior workability of the plastics laminate over that of ceramic-type materials, Dilecto can be dropped, jammed into tight chassis, and otherwise treated roughly on the assembly line and in service.

HIGH HEAT-RESISTANCE—Metal-Clad Dilecto Laminates are made of phenolic, epoxy, or Teflon® resin for various conditions of service and assembly, and have either cellulosic paper or woven glass-fabric base. All are ideally suited to printed-circuit applications in which heat-dissipation is a major problem. Continuous exposure to high ambient operating temperatures in enclosed electronic equipment has no significant effects on Dilecto's electrical and physical properties.

UNLOAD YOUR HEADACHE HERE! C-D-F, a big, reliable source of supply, can help you get the most for your printed-circuit money by reducing rejects, lowering fabrication costs, assuring dependable quality every time. Send us your print or problem, and we'll gladly supply appropriate test samples free. See our catalog in the Product Design File (Sweet's) or send for the new 20-page Dilecto catalog. Let your nearby C-D-F sales engineer (listed in Sweet's) help you right from the design stage!

TYPICAL PROPERTY VALUES

	Copper-Clad PHENOLIC (Grade XXXP-26)	Copper-Clad PHENOLIC (Grade XXXP-28)	Copper-Clad EPOXY (Grade GB-181E)	Copper-Clad TEFLON® (Grade GB-112T)
BOND STRENGTH—0.0014" foil (Lbs. reqd. to separate 1" width of foil from laminate)	7 to 11	5 to 9	8 to 12	4 to 8
MAXIMUM CONTINUOUS OPERATING TEMP. (Deg. C.)	120	120	150	200
DIELECTRIC STRENGTH (Maximum voltage per mil.)	800	800	650	700
INSULATION RESISTANCE (Megohms) 96 hrs. at 35° C. & 90% RH	50,000	25,000	20,000	Over 10 ⁶ megohms
DIELECTRIC CONSTANT 10 ⁶ Cycles	4.20	4.20	4.54	2.85
DISSIPATION FACTOR 10 ⁶ Cycles	0.026	0.052	0.018	0.0006
ARC-RESISTANCE (Seconds)	10	5	120	180
TENSILE STRENGTH (psi.)	16,000 x 13,000	12,000 x 10,000	48,000 x 44,000	23,000 x 21,000
FLEXURAL STRENGTH (psi.)	21,000 x 18,000	18,000 x 16,000	65,000 x 55,000	13,000 x 11,000
IZOD IMPACT STRENGTH edgewise (ft. lbs. per inch of notch)	0.40 x 0.35	0.40 x 0.35	13.5 x 11.5	6.0 x 5.0
COMPRESSIVE STRENGTH flatwise (psi.)	28,000	22,000	62,000	20,000
BASE MATERIAL OF LAMINATE	Cotton rag paper	Cotton rag paper	Medium-weave, medium-weight glass cloth	Fine-weave, medium-weight glass cloth
COLOR OF UNCLAD LAMINATE	Natural greenish	Natural Brown	Natural	Natural

All these standard grades are available with 0.0014", 0.0028", 0.0042", or thicker electrolytic or rolled copper foil on one or both surfaces. Other metal foils and other resin-and-base combinations can be supplied on special order.

*duPont Trademark



CONTINENTAL DIAMOND FIBRE

CONTINENTAL-DIAMOND FIBRE DIVISION OF THE BUDD COMPANY, INC.
Dept. 107, NEWARK 16, DELAWARE

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

Component Holders 300 Variations



These component holders in 300 variations are light weight slotted holders for glass, paper and plastic envelopes. Some are cases for subminiature tubes and capacitors. There are silver plated beryllium-copper holders for applications requiring non-magnetic materials and heat-treatable silver alloy holders for applications requiring maximum heat dissipation. And so on. Their design automatically provides greater holding power as the metal flexes under heavy vibration or extreme temperature changes. They have been tested to 90 g's at 2000 cps without resonant frequencies, and tests show that their heat dissipating characteristics permit 2 to 10 w wirewound resistors to be upgraded by as much as 50 per cent. Diameters of these holders are from 1/8 in. to 1-1/2 in., and lengths from 3/16 in. to 4 in.

Atlas E-E Corp., Dept. ED, 47 Prospect St., Woburn, Mass.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

Wideband Amplifier 200 Kc to 220 Mc



Power output of this wideband amplifier is 0.75 w; voltage gain into a 185-ohm load is 19 db; into a 90-ohm load 16 db; rise time less than 3x10⁻⁸ seconds, input impedance 90 ohms, bandwidth 200 kc to 220 mc. The amplifier is equipped with gain control and self-contained power supply, and mounts in a standard 19-in. rack. The Model M-510 is intended to be cascaded between the company's voltage and power amplifiers. When so cascaded the overall result is a system with a rise time of 3x10⁻⁸ seconds, a voltage gain of 200, and an output voltage in excess of 20 v rms, suited to pulse applications or to amplifying cw signals over the bandwidth cited.

Instruments for Industry, Inc., Dept. ED, 150 Glen Cove Rd., Mineola, Long Island, N.Y.

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION

Fire Detector For Aircraft



This fire detector is currently being installed in Class D baggage compartments of new DC-6 and C-7 aircraft. It is recommended for installation in baggage compartments of aircraft now in the field. Weight is 4.3 oz; and the photograph shows its size in comparison with the size of a pack of matches. The unit is hermetically sealed. It is mounted on a metal cover plate which fits existing electrical terminals. Contacts close when the temperature rises above a set point. The adjustment range is 50 to 200 F; current ratings are 5 amp at 125 v ac, 2 amp at 28 v dc and 1 amp at 48 v dc. Ambient temperature range is -65 F indefinitely up to 2000 F flame for short periods. The detector can be furnished with modifications to permit its use in baggage compartments of most types of commercial aircraft. Designation is Model 27021-11.

Aviation Products Div., Fenwal, Inc., Dept. ED, Lowell, Mass.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

Oxygen-Free Copper Waveguides Reduce Losses in Long Lines



Microwave components made of high conductivity, oxygen-free copper have been made available in straight sections, circular bends and adapters in the WR-137 waveguide size. They are recommended, in combination with standard flexible waveguide components and windows, for microwave relay systems operating in the 6000 mc region. The maker notes that oxygen-free high conductivity copper has an attenuation between 2.0 and 2.4 db/100 ft, whereas standard brass WR-137 has a waveguide attenuation between 2.80 and 3.38 db/100 ft, and aluminum between 2.44 and 2.95 db/100 ft; and that the attenuation of silver-plated brass varies with the thickness and polish of the plating.

Airtron, Inc., Dept. ED, Linden, N.J.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION



Other Brown components for servo systems



Shielded low-level transformers,

for input or coupling circuits, faithfully handle low-frequency a-c, or chopper-modulated d-c signals from 0.0005 to 200 millivolts. Highly effective electrostatic and magnetic shielding. Wound for maximum cancellation of strays. Three models; impedances 1,300, 7,500 and 50,000 ohms input at 60 cycles. Prices from \$21.00.



Brown Servo Motors.

2-phase reversible motors with high torque at low speed. Totally enclosed. Permanently lubricated. 60-cycle models with no-load shaft speeds of 27, 54, 162, 333 and 1,620 rpm. 25-cycle models also available. Prices from \$42.00.



Brown Converters

put stable performance in
your measuring and servo loops

THESE synchronously-driven choppers convert d-c signals as low as 10^{-8} volt to ac, with freedom from pickup and exceptionally low thermal noise.

Ideal for radar, computers, servomechanisms and null balance circuits, Brown converters are built for long, dependable service. Thousands of them have been used for continuous duty for years in *ElectroniK* instruments.

In standard models, each contact closes for 55% of the cycle. Other closure cycles can be supplied. Output signal lags line voltage by $17^\circ \pm 5$. Power rating is 0.1 milliwatt.

Four standard models are available. In addition, many variations can be provided for special requirements.

• **ORDER NOW!** Prices from **\$36.00** (even more favorable depending on quantity).

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

Available in these ratings

Nominal frequency, cps	25	40	50-60	400
Synchronous range, cps	23-28	36-44	45-66	360-440
Driving coil	6.3 volts, 60 ma.			18 volts, 94 ma.



MINNEAPOLIS
Honeywell

BROWN INSTRUMENTS

First in Controls



what are the new Performance-Guaranteed laminations?

Whenever our tungsten-carbide dies have produced enough nickel-iron laminations of a new shape to permit stocking them for immediate delivery, we let you know, because we get so many requests for "what's new in Performance-Guaranteed laminations?"

It's rather sensible, the emphasis our customers put on this "Performance-Guarantee." They know it's a guarantee based upon our higher quality hydrogen annealing, vital for high permeability laminations.

You see, small percentages of impurities, particularly carbon, oxygen and sulphur, have a deleterious effect on magnetic properties—and they are present in every alloy at the beginning despite the most rigid control of the metallurgy of the heats. In this as-rolled state, the steel will develop as little as 5% of its ultimate permeability.

Now everyone "hydrogen" anneals—but not everyone dry-hydrogen anneals. You can't use bottled hydrogen, without leaving a surface oxide injurious to magnetic properties and making soldering virtually impossible. So we dry our hydrogen to a dewpoint of -60°C , removing

the water vapor which is produced by the reduction of hydrogen. Carbon reduces to methane, sulphur to sulphur dioxide, and both are removed by the continuous flow of dry hydrogen during the 24-hour cycle.

As a result of our superior annealing, we develop better magnetic properties and clean lamination surfaces, and you get that valued "Performance-Guarantee."

New Performance-Guaranteed shapes, in stock, immediately available: EE 28-29, UI-312, F-21, DU-1, DU-37, rotor, stator and head laminations. Why not write today for Catalog ML-201 and full information on these and all other clean, flat, burr-free laminations we manufacture. **Magnetics, Inc., Dept. 33-ED, Butler, Pennsylvania.**

MAGNETICS inc.

CABLE: MAGNETICS

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Micro Data Card Reader

Opaque Reading Screen



Accepting micro data cards up to 11 in. in one direction and of unlimited size in the other, the AO Micro Opaque Reading Reader accommodates every known type of micro data card. It utilizes an opaque reading screen for greater eye comfort than is possible with the conventional translucent screen. The screen measures 11 in. x 12-5/8 in., and is mounted at a reading angle of 15 degrees. There are three easily interchangeable objectives, 15X, 20X and 23X. Fan cooling eliminates any danger of heat damage to cards or desk top; finger switch and foot switch are provided; focus is accomplished by a conveniently located knurled knob. The cast steel frame is finished in two tone gray and charcoal baked-on wrinkle enamel, and the Reader is portable, weighing only 23 lbs.

American Optical Co., Instrument Div., Dept. ED, Buffalo 15, N. Y.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

Glass-Mica Insulation

Reinforced With Steel



Mycalex 410 is a molding grade glass bonded mica with excellent electrical and mechanical properties that make it an exceptionally efficient high-temperature, high-frequency insulator; Supramica 555 is a ceramoplas-

tic compounded of high temperature electrical glass and synthetic mica. Supramica 555 is capable under some circumstances of withstanding continuous operating temperatures up to 800 F. Reinforced Mycalex 410 fulfills all the requirements of the HI shock test specified by the U. S. Navy for shipboard components. Inasmuch as the expansion coefficient of these materials matches that of steel, steel reinforcement can be molded in, which increases the flexural strength of these materials by 50 per cent, their impact strength by 100 per cent. Mycalex Corp. of America, Dept. ED, Clifton, N.J.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Differential Gear

Stainless Steel



Shaft inputs to these differential gears are applied to two stainless steel end gears (not shown in the illustration) and

the output is taken from the differential shaft. When the two end gears rotate in contrary directions their effective output is half the difference of the inputs; when they rotate in the same direction their output is half the sum of the inputs. In either case the output is corrected by the ratio of the end gear used. Direction of rotation of the output shaft depends upon which of the two inputs is "positive" and which "negative."

Double ball bearings assure low breakaway and minimal backlash. All gears have a 14-1/2 deg mesh angle and 48 diameter pitch. Available end gears provide ratios of 1/1, 1/1.25, 1/1.5, 1/2, 1/2.5, 1/3.33 and 1/1.666.

Servo Corp. of Amer., Dept. ED, 20-20 Jericho Turnpike, New Hyde Park, Long Island, N.Y.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Servo

Immune to Single Phasing

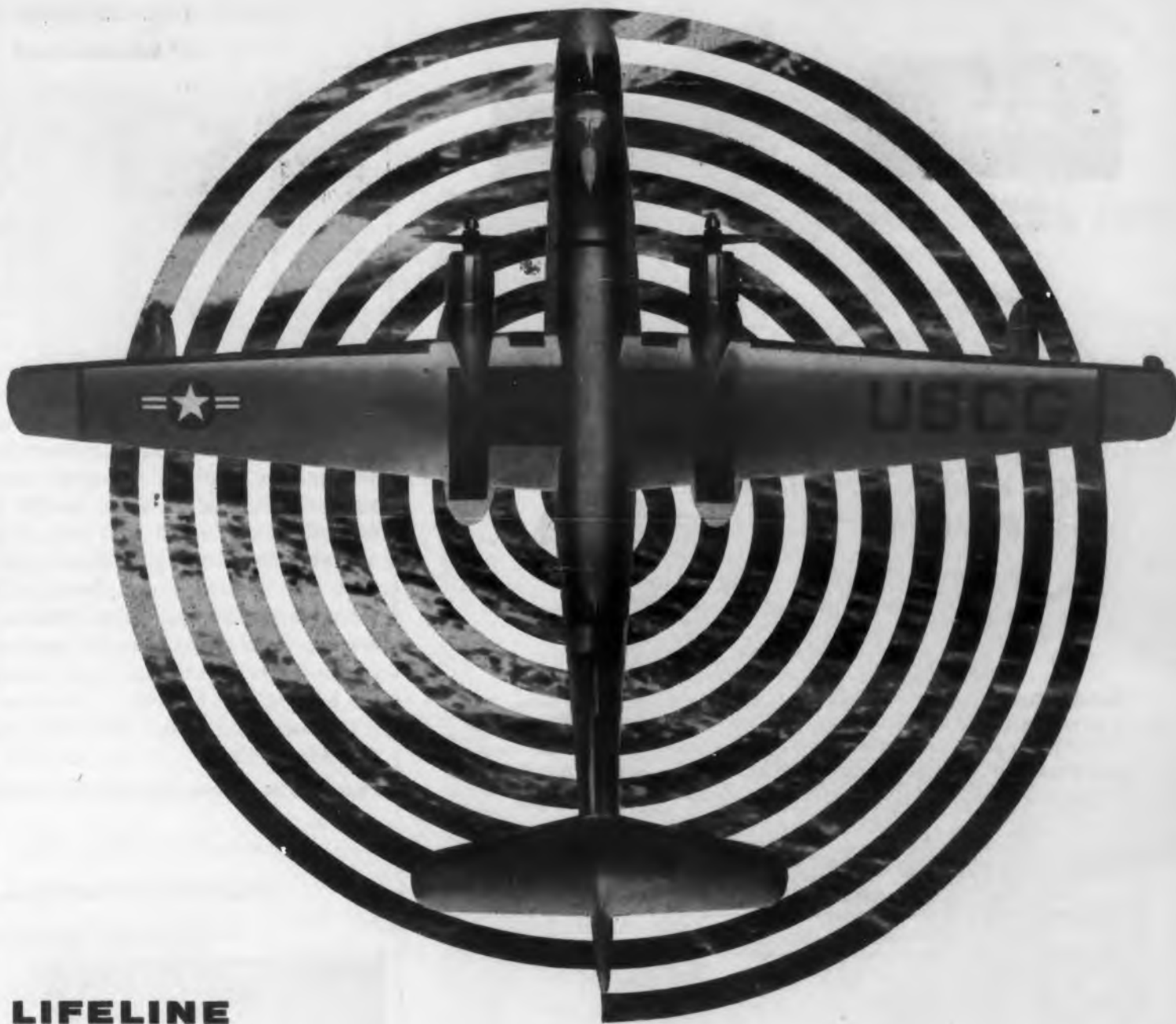


Intended for use with a companion transistorized amplifier now available from the same manufacturer, the servo here pictured is exceptionally im-

immune to single phasing. It will not single phase with the fixed phase winding energized; nor will it do so with a tuning capacitor even of excessive value connected across the control phase. The motor can be supplied with modifications to cover a wide variety of amplifier applications; and with such gear train, brake and environmental characteristics as may be specified; but basically it operates in the temperature range -65 C to +85 C, in 115 v fixed phase, 36 v control phase, 3 w per phase stalled, 0.26 in.-oz at stall minimum, and 1500 rpm at no load.

John Oster Mfg. Co., Avionic Division, Dept. ED, Racine, Wis.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION



LIFELINE

... --- ... These are the "call letters" of the U. S. Coast Guard. Watching over more than half a million square miles of our coastal waters, the rescue record of this famous organization is one of the great air-sea sagas of war and peacetime service. Helping to extend the Coast Guard's far-flung lifeline is the Martin P5M and the new P5M-2G, providing long-range sea reconnaissance for any emergency. Also, in active service with both the Atlantic and Pacific fleets of the U. S. Navy, ten squadrons of this famous seaplane—specially armored for anti-submarine warfare—are in operation today, from Norfolk to the Mediterranean and from Washington to the Orient.

MARTIN
BALTIMORE · DENVER · ORLANDO



*NEW
R 809



**SERVO
MOTOR-
GENERATORS
FOR EVERY
PURPOSE**

Kearfott Servo Motor-Generators are characterized by low rotor inertia, low time constants and high stall torque. Motor-Generator combinations provide 1/2 to 3.1 volts per 1000 R.P.M. with an extremely linear output over a speed range of 0—3600 R.P.M. and useful output up to 10,000 R.P.M.

*New Size 11 low cost, Servo Motor-Damping Generator Type R 809.

CHARACTERISTICS

TYPE	MOTOR		GENERATOR	
	STALL TORQUE	NO LOAD SPEED	OUTPUT FUND. NULL	LINEARITY
DAMPING				
SIZE 10	.35 OZ. IN.	6000	21/1	.5%
SIZE 10	.30 OZ. IN.	8500	23/1	.5%
NEW R 809	.63 OZ. IN.	5900	25/1	.5%
SIZE 15	1.5 OZ. IN.	5000	25/1	.5%
SIZE 18	2.4 OZ. IN.	5000	25/1	.5%
SIZE 18	3.0 OZ. IN.	9600	23/1	.5%
RATE				
SIZE 15	.45 OZ. IN.	10,500	170/1	.5%
SIZE 15	1.5 OZ. IN.	4700	350/1	.2%
SIZE 18	2.4 OZ. IN.	4700	350/1	.2%
SIZE 18	3.0 OZ. IN.	8400	350/1	.2%
*INTEGRATOR				
SIZE 15	.70 OZ. IN.	6300	400/1	.1%
SIZE 15	1.25 OZ. IN.	4500	400/1	.1%
SIZE 18	1.35 OZ. IN.	7200	400/1	.1%
SIZE 18	2.4 OZ. IN.	5200	333/1	.06%
SIZE 18	3.0 OZ. IN.	8000	333/1	.06%

*Integrator Tachometers are temperature stabilized

Kearfott components satisfy all requirements for high accuracy, light weight and small size.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, 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 Counters and other components of interest to you.

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

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION



**Tube Retainers
Of Stainless Steel**



Designed to secure electron tubes and other cylindrical components ranging in diameters from 7/8 in. to 2-5/16 in., this new line of retainers, designated Top-Tainers, conforms with the military-approved method of tube retention. The retainers are available in single and double post types. Post heights range, in 1/8 in. increments, from 7/8 in. to 5-1/2 in. The U shape of the post, and the broad mounting base, provide rigid support. The cap rides on a double rail which is serrated on the bearing edge, effectually preventing the cap from slipping up the post under vibration. It can be removed by a slight upward pressure on the locking tab. Material is stainless steel.

Birtcher Corp., Dept. ED, 4371 Valley Blvd., Los Angeles 32, Calif.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

**Photo Trace Oscillograph
For Lower A-F Spectrum**



Designated Lumiscrypt, this photo-trace instrument utilizes a pin-point of intense light and exceptionally sensitive photographic paper to trace curves that become instantly visible without development. Electrical, mechanical, pneumatic or hydraulic vibratory data in the lower audio spectrum can be displayed on the photographic charts thus made; and can be reproduced, or made permanent for filing, by a simple stabilizing process. Three different chart speeds are built in, and it is also possible to drive the feed shaft at still other speeds by mechanically coupling it to an external motor. Charts of three different widths can be used; and a paper-cutting device is built in for slitting the charts.

Epic, Inc., Dept. ED, 154 Nassau St., New York 38, N.Y.

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

**STRAITS
TIN
REPORT**

New developments in the production, marketing and uses of tin



The largest tin-producing country in world is the Federation of Malaya. It produces the most ore. It produces and exports most tin metal. In 1955, for instance, Malaya supplied nearly 75% of U.S. imports of pig tin. One of the most significant facts about Malaya's tin reserves is that more than 2% of the Federation's area has been set aside for tin mining.

★ ★ ★

The Malayan Tin Bureau in Washington was established by the tin producers of Malaya to provide accurate information about Straits Tin, one of the world's most useful metals. "Straits Tin Report," to be published at frequent intervals, will be factual and informative, helpful and interesting.

★ ★ ★

From A for aluminum to Z for zinc (and zirconium) tin is now being successfully alloyed for industrial applications with many other metals. Tin imparts properties to alloys obtainable from no other element.

★ ★ ★

New 20% tin-aluminum is a bearing metal with several times the fatigue strength of babbitt at working temperatures, and excellent antifriction properties. It is now producing outstanding results in actual performance tests.

★ ★ ★

Tin-zinc is a plating alloy which — thickness for thickness — gives greater protection against corrosion than either zinc or cadmium alone. And an alloy of tin and zirconium shows great practicability for water-cooled nuclear reactors.



Ask us to send you TIN NEWS, a monthly letter. It will keep you posted on tin supply, prices, new uses and applications.

The Malayan Tin Bureau
Dept. 13B, 1028 Connecticut Ave., Washington 6, D.C.

CIRCLE 130 ON READER-SERVICE CARD

PORTABLE

DC VTVM

has 200 microvolt sensitivity
and 10^{14} ohms input

THIS little instrument measures transistor and electrochemical potentials, voltages of charged capacitors and dc amplifiers, and voltages at the summing points of analog computers. It can be most useful in measuring low currents in semiconductors, ion chambers, and photocells. It also may be used to test insulation leakage and volume resistivity.



KEITHLEY
MODEL 200B
DC VTVM

BATTERY-OPERATED, the Model 200B has voltage ranges of 0.008, 0.02, 0.08, 0.2, 0.8, 2, 8 and 20 volts full scale of either polarity. Accuracy is within 2%. Accessories permit measuring currents as low as 5×10^{-14} ampere, resistances above 10^{16} ohms, and voltages up to 20 kv.

DESIGN FEATURES include excellent zero stability, a polarity reversing switch, 500 hours useful battery life, and a constant zero from range to range.

DETAILED DATA on the Model 200B is now available in Keithley Engineering Notes. Vol. 4 No. 1. Your copy will be sent promptly upon request on your company letterhead.

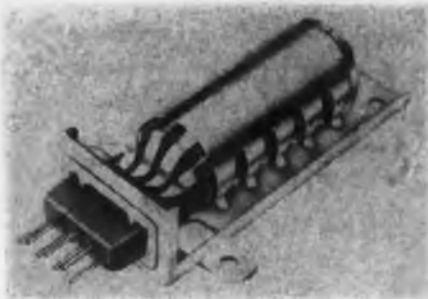
KEITHLEY
INSTRUMENTS, INC.

12415 Euclid Ave., Cleveland 6, Ohio

CIRCLE 132 ON READER-SERVICE CARD

Sub-Miniature Tube Mount

Dissipates Heat



This right angle sub-miniature tube shield mount provides engineers with a clamping mount that is highly adapted to use in confined spaces while

providing maximum access for service and replacement. Its integral socket accepts 3-, 4-, 5-, 6- and 7-pin flat press tubes. The manufacturer's patented metal-to-glass contact along the bulb, together with precision fit of the socket, provides cooling of the entire bulb surface, excellent electrostatic shielding, and maximum tube retention under severe shock and vibration. Shields are silver plated overall and have an inner wrap of pure silver for maximum heat conductivity; spring clip and right angle base are beryllium copper. Shields in other finishes, such as bright or black cadmium, also are available.

International Electronic Research Corp., Dept. ED, 145 W. Magnolia Blvd., Burbank, Calif.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

Ready-to-Use Multiplexers

Frequencies to 4000 Mcs



Three fully-engineered multiplexers, needing no further development work to meet any normal re-

quirements, are available in frequency ranges up to 4000 mcs. Each has 5 output channels, 4 filter elements, overall insertion loss of 2 db, and input and output impedances rated 50 ohms. Each is 19 in. wide for standard rack mounting. The Model RFM-102 covers the 100-200 mc range, has a bandwidth per channel of 20, and measures 8-3/4 in. high x 13-1/2 in. deep. Model RFM-510 covers the 500-1000 mcs range, with a channel bandwidth of 100, and measures 26-1/2 in. high x 9 in. deep. Model RFM-2040 embraces 2000-4000 mcs, with a bandwidth of 400 per channel, and measures 14 in. high x 10 in. deep. In all models, there are no dead spots in the spectrum covered; while cross-channel interference is minimized by use of four resonant circuits within each channel.

Applied Research, Inc., Dept. ED, 163-07 Depot Rd., Flushing, N.Y.

CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 135 ON READER-SERVICE CARD

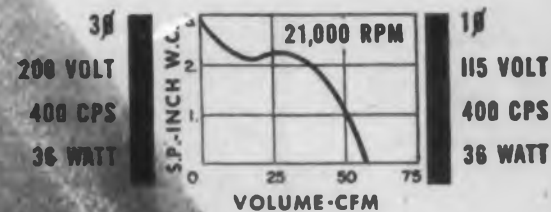
Aximax II Airborne Fan



FULL
SCALE

4 oz. net weight

2" DIAMETER • 1 1/2" LONG
PATENT PENDING



WRITE FOR ROTRON CATALOG SHEET #50201-1



ROTRON mfg. co., inc.

SCHOONMAKER PARK • WOODSTOCK • NEW YORK

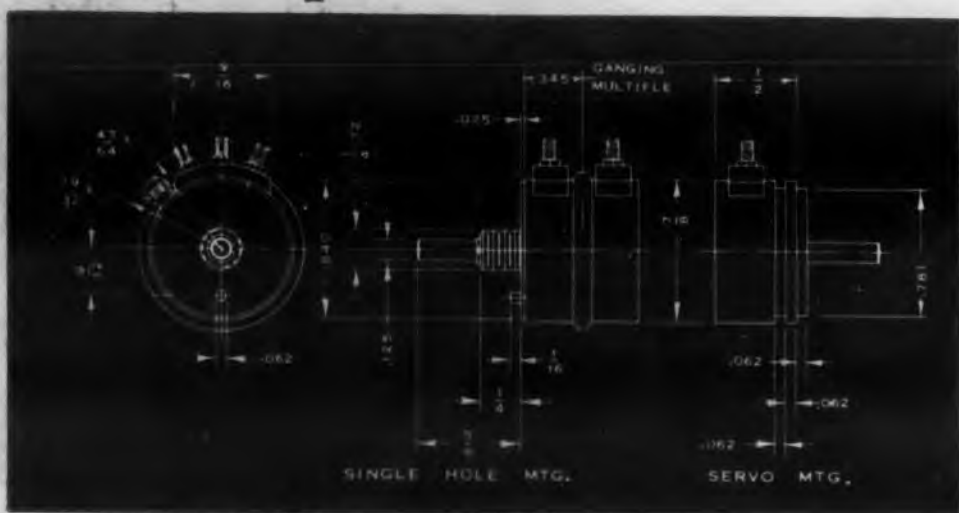


ACTUAL SIZE

DeJUR

7/8"

subminiature potentiometers



precision units solve weight and space problem in computers, portable and aircraft equipment

Now — the features of full-size potentiometers in a new series that's no larger than a penny! If your product is for computers, trimmers, guided missiles, or any portable or aircraft equipment, DeJUR's new subminiature potentiometers help you achieve substantial savings in weight and space.

FEATURES:

- Unit height only 3/8", weight only 1/2 oz.
- Single or multiple gangs
- Independently phased
- Completely enclosed
- 320° electrical and 326° mechanical rotation
- Gold collector for trouble-free contacts
- Multiple-finger precious metal contact brush
- Available with special torque ratings, ball-bearings, sealed housings, special tolerances and other requirements for any linear or non-linear function.

WRITE FOR COMPLETE TECHNICAL LITERATURE.

No obligation. Our engineering department can supply prototypes to meet unusual design specifications for tests and approval. Send us your specs for analysis. Electronic Sales Division, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

DeJUR

ELECTRONIC SALES DIVISION
DeJUR-Amsco Corporation
45-01 Northern Blvd.
Long Island City 1, N. Y.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Power Supplies

Save Space and Weight



Transistorized ac-to-dc power supplies featuring small size, light weight and high efficiency are available now for either 60 or 400 cps 105-125 v input; and with the following dc outputs: 5-10, 10-20, 20-30, 30-40, 40-50, 50-55 v at currents up to 200 ma; 100, 150, 200 and

300 v at currents up to 100 ma.

Line regulation and load regulation are better than 0.5 per cent; ripple content is less than 0.05 per cent. A typical 60 cycle unit measures 2-1/2 x 3 x 4 in. and a typical 400 cycle unit is 2-1/4 x 2-3/4 x 3-3/4 in. Units are potted, but the transistors and the voltage adjustment are accessible externally.

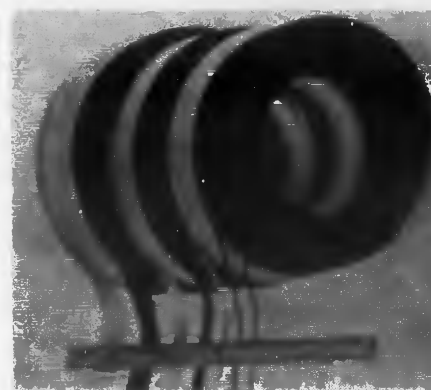
These miniaturized power packs, designated Transpac, are particularly intended to provide a rugged and reliable source of dc for reference applications, missiles and computers.

Electronic Research Associates, Inc., Dept. ED, 67 E. Centre St., Nutley 10, N.J.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

Black Photographic Tape

In Decimal Sizes



Masking operations can be simplified by using pressure-sensitive tape of the exact width needed for the area to be masked. A new slitting technique developed by By-Buk Co.

enables that manufacturer now to offer a complete line of black tape on standard 60 yard rolls, supplied from stock in 1/32 in., 1/16 in., 3/32 in., 1/8 in., 5/32 in., 3/16 in., 1/4 in., 3/8 in. and 1/2 in. widths. Decimal widths are produced on short notice. The new slitting process leaves smooth, clean edges, and assures uniform width throughout the roll. The tapes it produces are particularly recommended for printed-circuit master drawings.

By-Buk Company, Dept. ED, 4314 W. Pico Blvd., Los Angeles 19, Calif.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Want to save weight?

FINN lightweight mounting bases could save 7 3/4 lbs. on the B-52



FINN lightweight mounting bases could save 5 1/2 lbs. on the F-102



FINN lightweight mounting bases could save 5 lbs. on the F-100



What about your project? Finn engineers will be glad to show you how you can eliminate extra weight yet pass all JAN and MIL specs. Write today for evaluation.

FINN

Pioneers in lightweight shock and vibration control

T. R. FINN & CO., Inc.

ELECTRONICS DIVISION

200 Central Avenue
Hawthorne, N. J.

CIRCLE 140 ON READER-SERVICE CARD

CIRCLE 142 ON READER-SERVICE CARD

ELECTRONIC DESIGN • February 15, 1957

Electron Tube News

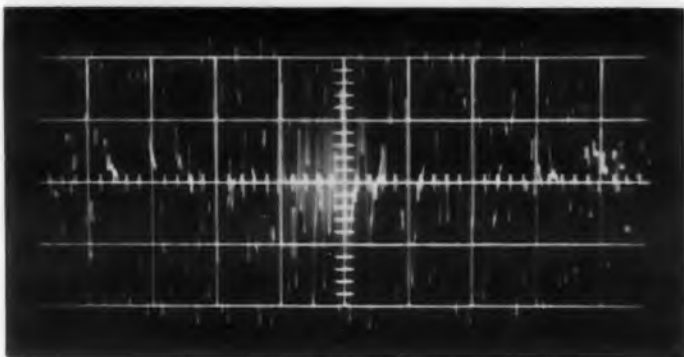
-from Sylvania

— contributing to equipment performance
everywhere in electronics

Sylvania adds its newest reliability factor to premium subminiature tubes

— “White noise” vibration test is worthy measure of the superior construction of the button-header subminiature.

A full line of Sylvania “gold brand” subminiature tubes is now being “white noise” tested on a pro-



This unretouched oscillogram demonstrates the wide spectrum of frequencies inherent in the “white noise” vibration test, which is applied to the tube.

duction basis. Thus a new measure of reliability has been added to the tubes already acknowledged as the world’s most reliable.

The “white noise” test presents a full range of frequencies over a broad spectrum at peak g-levels of 15 and provides a closer approximation of vibrational environment encountered in guided missile and other vehicular applications.

The ability of Sylvania subminiatures to submit to this more exacting test is dramatic proof of the superior construction of the button-header design. Stronger leads, vertical support in three rather than a single vertical plane, wider spacings — these and other features of the button-header have added considerable impetus to the accepted use of Sylvania “Gold Brand” subminiatures in guided missiles.



Here’s a simple comparison of the advantage of Sylvania’s “donut-ridge” button-header over ordinary types. When the leads are bent sharply as shown, ordinary headers will flake, chip, or crack; but leads bend cleanly around the “donut ridge” in Sylvania “Gold Brand” subminiatures.

— in
military
equipment



For the first time by any manufacturer, subminiature tubes are being given the “white noise” vibration test in addition to the currently used static-vibration tests at 40 cps and 15 g. Types listed are now being tested for “white noise.”

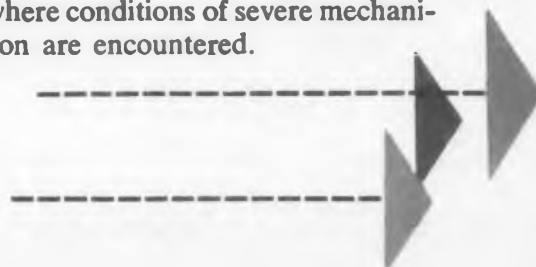
- Type 5636..... UHF pentode
- Type 5639..... Video pentode
- Type 5718.....UHF medium Mu triode
- Type 5719.....High Mu triode
- Type 5840.....UHF sharp cutoff pentode
- Type 5899..UHF semi-remote cutoff pentode
- Type 5902.....Audio Beam Power Pentode
- Type 5977.....Medium Mu Triode
- Type 6021.....Medium Mu Double Triode
- Type 6111.....Medium Mu Double Triode
- Type 6112.....High Mu Double Triode
- Type 6205.....UHF sharp cutoff pentode
- Type 6206..UHF semi-remote cutoff pentode
- Type 6788..... RF Pentode



New Subminiature RF Pentode is Tailor-made for Guided Missiles

The new Sylvania Type 6788 features high gain in the audio region and has exceptionally low vibrational noise, making it ideally suited for guided-missile application.

It is the first subminiature tube released from Sylvania’s guided-missile development program and is the only tube specifically designed for use as an amplifier where conditions of severe mechanical vibration are encountered.



—contributing to equipment performance,

—in
television

New Dual Triode developed for Vertical Deflection in 110° Systems



Anticipating the need for a new vertical deflection tube to complete the designer's needs in 110° deflection circuits, Sylvania developed the type 10DE7. The 10DE7 is a T6½ double triode with dissimilar sections — one triode for vertical deflection and the other suitable for vertical oscillator use. The type utilizes a 600 ma heater with warm-up time control for series string operation.

The high perveance type 10DE7 will deliver 80 ma peak plate current at lower supply voltages and at a plate dissipation up to 7 watts in the vertical deflection amplifier section.

The grid of the output section is connected to two external pins providing for additional cooling and greater circuit flexibility. The miniature construction of the type 10DE7 also makes it particularly adaptable to printed circuits and automation techniques.

The types 6DE7 and 13DE7 are also available for use in transformer circuits and 450 ma series string operations respectively.

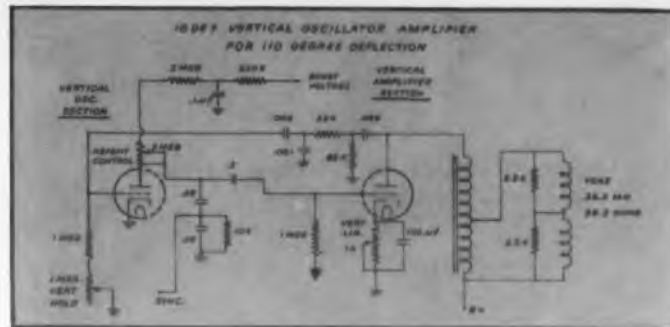
Average characteristics of the 10DE7 in a typical 110° deflection circuit

Amplifier Section

Cathode Current	29 ma
Peak Cathode Current	80 ma
Peak-to-Peak Grid Drive	103 V
Grid Bias	-11.5 V
Cathode Bias D.C.	21 V
Plate Voltage—Peak-to-Peak	577 V
Filament Voltage	10 V
High Voltage	16 KV @ 100 ma
B+ Voltage	250 V

Oscillator Section

Plate Voltage	65 V
Cathode Current—Peak	47 ma
Grid Voltage	-55 V
Grid Voltage—Peak-to-Peak	235 V



Design and performance capabilities of the 10DE7 have been checked out thoroughly in the typical 110° circuit shown. Characteristics reflect average characteristics measured.

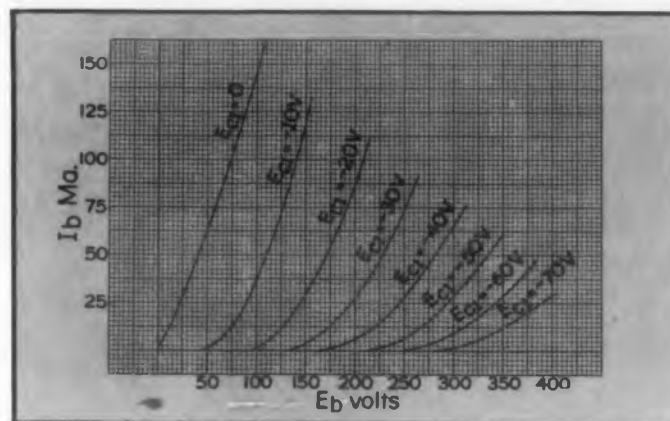


Plate family characteristic curves for the Type 10DE7

Beam Power Pentodes for 110° vertical deflection

For systems using pentodes for vertical deflection amplifier use Sylvania provides two basic important types, the type 6CM6 and type 6CZ5. Both are suited for 110° deflection—the 6CM6 for up to 17" picture sizes and the 6CZ5 for larger.

Characteristics — pentode connections

Type 6CM6	.....pentode conn.
Plate V	.....315 V Max.
Peak Pos. Plate Volt	.....2000 V Max.
Plate Diss.	.....8 Watts Max.
Grid 2 V	.....285 Volts Max.
Grid 2 Diss.	.....1.75 Watts Max.
Type 6CZ5	—
Plate V	.....315 V Max.
P.P.P. V.	.....2200 V absolute Max.
Plate Diss.	.....10 Watts Max.
Grid 2	.....285 volts Max.
Grid 2 Diss.	.....2 watts Max.

The types 6DQ6A and 6DN6 will meet horizontal deflection needs in 110° circuits and the proved type 6AU4GTA or 6AX4GTA will provide adequate damper service.

Completing the tube needs in 110° deflection systems, Sylvania offers the types 1B3GT and 1X2B for high voltage rectifier use.

everywhere in electronics

New 110-Degree Picture Tube offers more picture per cubic inch of TV set

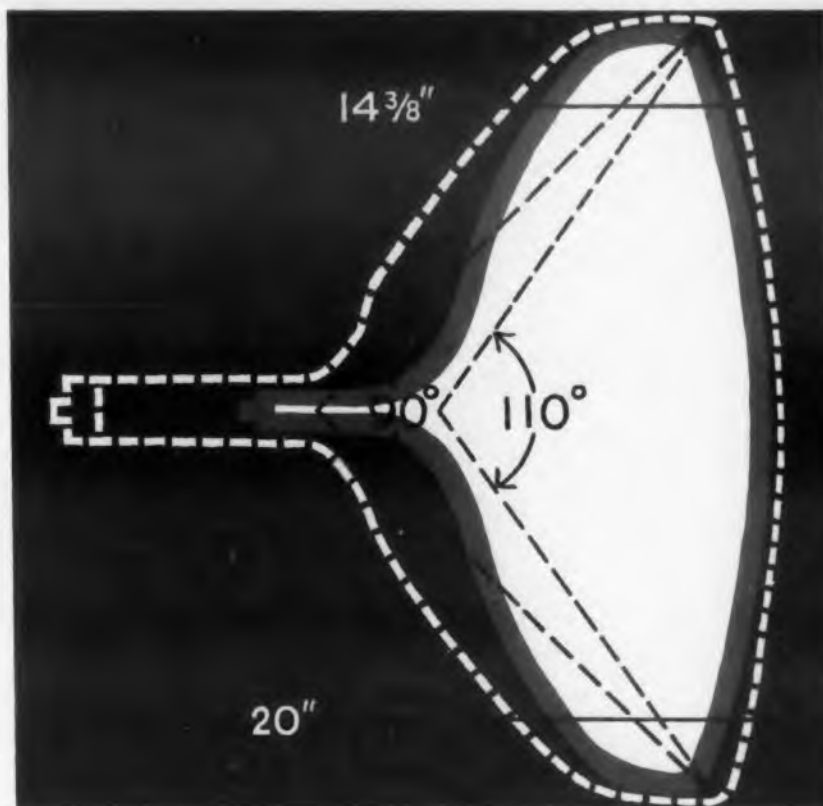
— other new tubes offered include 90° short-neck, non-ion trap types and a dramatic new development scheduled for early production.

New, shorter, lightweight, 110° deflection picture tubes will save as much as 20% in picture tube weight and will make it possible to design more compact, lighter TV consoles, as well as more portable TV sets.

Light weight and structural strength of the picture tube have been achieved in a new face-plate design. New trim set styling made possible by shorter lengths should provide new stimulus for the sale of black-and-white TV sets.

As a leading picture tube manufacturer, Sylvania is working closely with TV set makers to supply the industry's requirements for both 110° deflection types and 90° short-neck non-ion trap types. New developments will be made available early this year.

Compare a 21" bulb in 90° and the new 110° versions. New 110° offers considerable savings in depth per square inch of picture.



Sylvania offers new types in a complete line of 12-volt tubes for hybrid auto radio



Sylvania's line of 12-volt tubes for hybrid auto radio features an RF pentode with high transconductance, an IF pentode with high gain and a transistor driver designed to match the input characteristics of single-ended or push-pull transistor output stages.

These developments reflect the specific design requirements which have been brought about by the hybrid radio design, particularly the need for high performance with fluctuations in voltage-supply conditions.

All auto-radio types are produced under Sylvania's well-known "noise-free" tube program which exerts tighter limits and more rigid controls on all factors influencing microphonism.



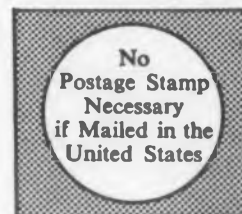
Type 12CY6 —
New T5½ IF Pentode
Heater Voltage — 12.6 volts
Heater Current — 200 ma.
Transconductance — 3250 uhms
Plate Resistance — 140K ohms
Plate Current — 1.6 ma.
Grid to Plate Capacitance — .18 uuf max.



Type 12CX6 —
New T5½ RF-IF Pentode
Heater Voltage — 12.6 volts
Heater Current — 150 ma.
Transconductance — 3100 uhms
Plate Resistance — 40K ohms
Plate Current — 3.0 ma.
Grid to Plate Capacitance — .05 uuf max.



Type 12J8 —
New T6½ Transistor Driver
Heater Voltage — 12.6 volts
Heater Current — 350 ma.
Transconductance — 5400 uhms
Plate Resistance — 4000 ohms
Power Output — 20 mw.
Total Harmonic Distortion — 5%



BUSINESS REPLY CARD
(First Class Permit No. 46687, New York 19, N.Y.)

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway
New York 19, N. Y.



-contributing to product performance,
everywhere in electronics

-in
computers



The Type 6888 is a dual control computer pentode designed for long life and low failure rate. It is especially designed for pulse amplifier use, core driver and coincidence circuits.

It is built to the highest standards of reliability established for commercially available tubes and is dynamically tested for pulse characteristics under pulse test conditions.

The type 6888 is just one of a full line of Sylvania tubes especially designed for computer applications.

Write for this complete brochure of Sylvania's
line of computer products



What every computer designer should know about Sylvania components is completely outlined in this 64-page book. Between these two covers is the complete story of Sylvania's stake in the computer field: its philosophy of reliability, its testing procedures, and its ability to develop the tube parameters required for computer applications.

-in test
equipment



Type 6D4 is specified for noise output

The type 6D4 has been redesigned to meet the requirements of test-equipment manufacturers and is specified to produce, in its output, a wide range of random noise frequencies.

It's the first commercial tube ever to be so specified and typifies the co-operation between Sylvania and equipment manufacturers to produce tubes for special applications.

-Advanced
Engineering
Series

Series on Electron
Tube Life and
Reliability is
published by Sylvania

As a service to the industry and in an attempt to explore the factors of design and application of reliable tubes, Sylvania is currently publishing a high-level technical discussion on tube reliability in chapter form.

This series is available to electronic engineering staffs through their chief engineer who may request it directly on company letterhead.



SYLVANIA

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

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

Please send additional information on the items checked below.

- | | |
|--|---|
| <input type="checkbox"/> "white noise" test | <input type="checkbox"/> premium subminiature tubes |
| <input type="checkbox"/> type 6788 | <input type="checkbox"/> miniature deflection package |
| <input type="checkbox"/> 110° deflection tubes | <input type="checkbox"/> hybrid auto-radio tubes |
| <input type="checkbox"/> type 6888 | <input type="checkbox"/> computer book |
| | <input type="checkbox"/> 6D4 |

Name _____

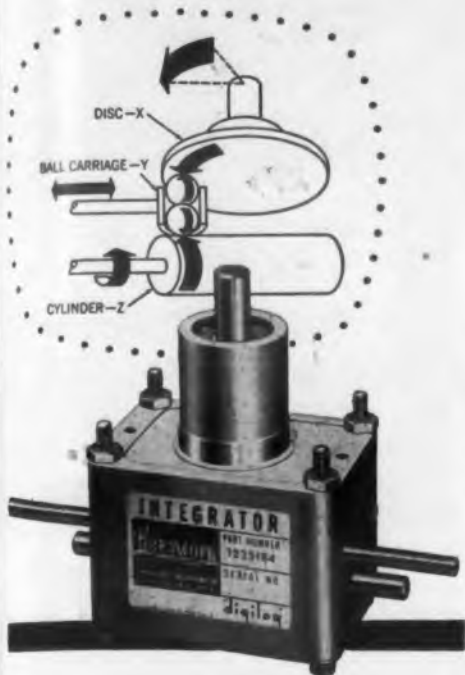
Address _____

Company _____

**Use this handy
business reply card
to request
additional information
on these new Sylvania
tube developments**



Primary parts of the Librascope Ball and Disc Integrator are a rotating input disc (X), two counter-rotating steel balls enclosed in a carriage (Y), and an output cylinder (Z). The cylinder speed is proportional to the product of the disc speed and the ball carriage position. The disc speed and ball carriage position can be continuously variable.



LIBRASCOPE BALL and DISC INTEGRATOR

A precise, instrument-size
mechanical integrating element or
variable speed drive

Useful as a mathematical tool for speed multiplying, speed ratio computing and flow rate totalizing. Also fire control and automatic feedback applications.

Size	1 7/8" x 2 3/4" x 3 3/4"
Weight	17 oz.
Starting torque, no load	2 in. oz.
Output torque	2 in. oz. max.
Carriage travel	± 3/4" from zero
Output ratio	2.4:1
Precision	As high as 0.01% at stated output torque

Write for Catalog



A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

808 WESTERN AVENUE • GLENDALE, CALIFORNIA
CIRCLE 143 ON READER-SERVICE CARD

← CIRCLE 142 ON READER-SERVICE CARD

Wide Field Stereo Microscope

Two-Lens Turret



For inspection, examination, counting, checking, assembling, dissecting and similar operations this stereo microscope presents an erect image, correct as to right and left, clear and sharp. Because of the stereo or binocular construction, the user sees a three-dimensional field, with excellent depth

perception. Two sets of objective lenses on a rotating turret provide 21x and 34x magnification, respectively, when used with the standard 8x oculars; other oculars are available for greater or lesser magnification. Interpupillary distance is adjustable. Focusing is effected by a helical rack and pinion, with a large control knob for fine adjustment. Working distance is up to 3 in.

Edmund Scientific Co., Dept. ED, Barrington 17, N.J.

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Shift Registers

For Computers, Radar



Magnetic shift registers ("memories") for use in computers, business machines, radar

and the like have been made available in a number of models by Magnetics Research Company. Where small physical size and ease of interchangeability are important models MSR 2, MSR 3, MSR 4 and MSR 5 are recommended. These are ten-bit units having a packing density of 1 cubic inch per bit. These registers may be connected serially. There are two cores to a bit; the frequency range is dc to 100 kc, peak advance current 300 ma.

Other registers available are the MSR 0 and MSR 1 units, each of eight-bit length, which may be connected to form a 16-bit register. Frequency range of these units is also dc to 100 kc, they have two cores per bit, and their peak advance current is 100 ma.

Complete details for both sets of units, and also for MSR D-2, are available in a manufacturer's brochure.

Magnetics Research Co., Dept. ED, 255 Grove St., White Plains, N.Y.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION



Use 'dag' Colloidal Graphite in CRT manufacture because . . .

1. A uniform, conductive film produced by a dispersion of colloidal graphite in de-ionized water on inside walls functions as a ray-focusing anode, retards secondary emission, absorbs gases.
2. A special 'dag' dispersion in lacquer used on outside walls dries in 2-3 minutes, forms an electrically-conductive graphite film which is opaque and tenacious.
3. 'dag' Colloidal Graphite produces films which adhere equally well to all types of glass.

Other ways in which 'dag' dispersions are used in electrical and electronic applications are described in a free bulletin. Ask for Bulletin 433-K-2.



*'dag' is a registered trademark
of Acheson Industries, Inc.*



ACHESON COLLOIDS COMPANY

PORT HURON, MICHIGAN

Offices in:

**BOSTON • CHICAGO • CLEVELAND • DAYTON • DETROIT • LOS ANGELES • MILWAUKEE
NEW YORK • PHILADELPHIA • PITTSBURGH • ROCHESTER • ST. LOUIS • TORONTO**

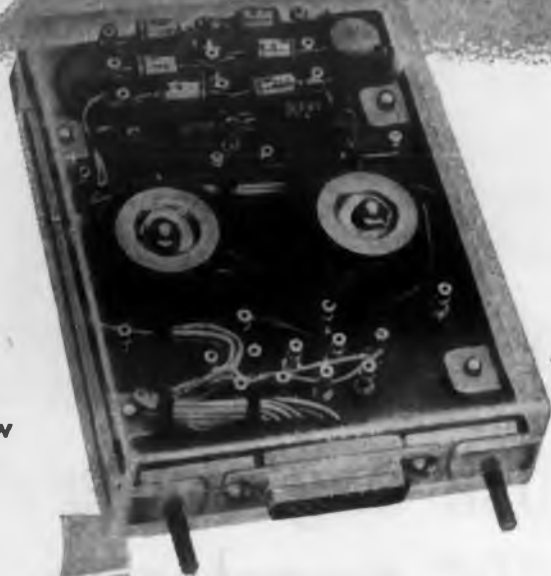
CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Lightweight!

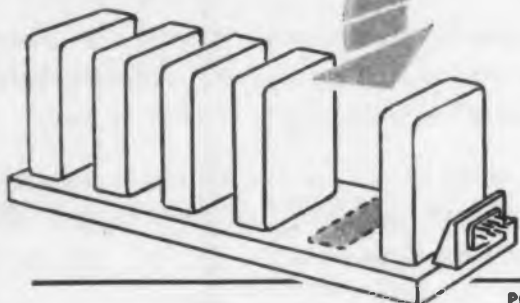
SERVO

Magnetic Amplifiers

The servo amplifiers illustrated are typical standard types. Other models, including higher power types, are available for systems engineering. The complete MA line offers the designer a choice of compact, low cost types, amplifiers featuring fast response at high gain and all-magnetic models providing highest performance.



In addition to standard types, custom designs can be produced for special applications, or complete servo and automatic control systems can be engineered to your requirements.



TYPE	SUPPLY	POWER OUTPUT	SENSI-TIVITY	RESPONSE TIME-SEC.
LIGHTWEIGHT SUB-MINIATURE MAGNETIC AMPLIFIER	115 volts 400 cps.	1/2, 3, 5, 10 watts	.02 volts	.003
MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS	115 volts 400 cps.	3, 5, 6, 10, 18 watts	1 volt AC	.03
MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 cps.	5, 10, 15, 20 watts	0.1 volt AC	.008 to .1
TRANSI-MAG*: TRANSISTOR + HIGH GAIN MAGNETIC AMPLIFIER	115 volts 400 or 60 cps.	2, 5, 10, 15, 20 watts	.08 volt AC into 10,000 ohms	.01

Call or write for new illustrated bulletins.

Magnetic Amplifiers • Inc

632 TINTON AVE., NEW YORK 55, N. Y.—CYpress 2-6610
West Coast Division

136 WASHINGTON ST., EL SEGUNDO, CALIF.—EAsgate 2-2056



CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

Non-Spill Storage Batteries

6 and 15 Amp-Hrs



Electronic Batteries, Inc., presents a line of plastic - case, lead-acid storage batteries comprising two basic types of cells. These are assembled into

twelve different batteries that offer voltages ranging from 2 to 28. The S-series cells are rated at 6 amp-hrs and the H-series at 15 amp-hrs. Batteries of S-cells offer 2, 6, 14, 18, 24 and 28 v. Batteries of H-cells offer 2, 4, 8, 12, 24 and 28 v. Battery chemistry of these units is conventional; for reasons of economy cadmium, silver, etc., have not been added. All the cells are of non-spill construction. Plates are constructed with internal vertical supports for additional length of life. Seamless plastic cases and other weight-saving features result in an average output of 13-1/2 w-hrs per pound of battery. Cycle life is rated at 100 cycles of charge and discharge, depending on service conditions. The batteries can be shipped charged and dry, for indefinite shelf life.

Electronic Batteries, Inc., Dept. ED, Bush Terminal Bldg. No. 4, 28-34 35th St., Brooklyn 32, N.Y.

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermostat Probes

For Power Supply Cords



A "probe" type thermostat for power supply cords is available for temperature-control of such equipment as plastic molding

machinery, vending machines, hospital apparatus, and for similar uses. Designated the Stemco Type H Thermostat, it is fully adjustable, and of fail-proof design. Rating is 1650 w at 115 v ac.

The long probe case is anodized aluminum. Several types of mountings are available from stock, and the so-called "nozzle" mounting used for liquid immersion can be supplied to order.

All units are precalibrated at the factory prior to shipment. The available range extends from open in low to 500 F in high.

Stevens Manufacturing Co., Inc., Dept. ED, Lexington, Ohio.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

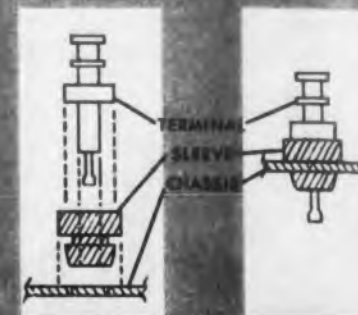
Lerco

electronic hardware

now...

TEFLON®
SNAP-LOCK terminals

ACTUAL SIZE



- new principle (patent pending) eliminates terminal boards
- terminals install directly in chassis
- provides ground ring for sensitive circuits

Lerco's new Teflon insulated terminals make possible new design methods which eliminate terminal boards. The terminals, individually insulated from the metal by Teflon, may be installed directly in the chassis. First, the Teflon sleeve is snapped through a hole in the chassis. Then the terminal is inserted and swaged over the insulator to lock the assembly solidly in place. Lerco Teflon insulated terminals will withstand severe shock and vibration conditions.

The Lerco terminals (patent pending) are now produced in sizes for .035, .050, and .062 thickness material. Illustrated above is Number 4075. For other variations now available and for further information, write for complete brochure.

® Dupont trade mark

ALWAYS CALL LERCO FOR

- Diode clips • Terminals
- Terminal boards
- Taper pin terminals
- Stand-offs • Plug assemblies
- Inserts • Sockets
- Receptacles • Bushings
- Printed circuit hardware

WRITE FOR
FREE CATALOG

Lerco

ELECTRONICS, Inc.
501 South Varney Street
Burbank, Calif. • Victoria 9 5556

CIRCLE 151 ON READER-SERVICE CARD



NOW
greater accuracy for
ANALOG COMPUTERS
with the
VERNISTAT®
a.c. potentiometer

In analog computer design, where system accuracy is directly related to the accuracy of the computing elements, the new VERNISTAT a.c. potentiometer meets the most exacting design requirements. The VERNISTAT overcomes the severe limitations placed on computer performance up to now by the use of conventional potentiometers. Errors introduced by loading, phase shift and wear are substantially reduced.

The VERNISTAT a.c. potentiometer represents a truly fundamental advance in precision potentiometer design. The combination of a tapped autotransformer and an interpolating resistance element overcomes the limitations of the purely resistive potentiometer. The VERNISTAT principle provides inherently high linearity, low output impedance, very small phase shift and long life. Relatively high output current capability and the ease with which nonlinear functions may be generated are plus features of the VERNISTAT. The unit is normally supplied as a ten-turn version and it may also be arranged for continuous rotation.

Use of the VERNISTAT potentiometer in analog systems results in a general improvement in performance characteristics. Greater simplicity, through elimination of isolation amplifiers is often an added dividend.

For further information write to:

vernistat®
division
PERKIN-ELMER CORPORATION
Norwalk, Connecticut

CIRCLE 153 ON READER-SERVICE CARD

High Frequency Resistors
For Circuits Up To 400 Mc



Characterized by the very low resistance, inductance, and skin effect that are desirable in pulse circuits and in any circuits involving steep wave fronts, these two

lines of resistors are usable to over 400 mc. Resistances range from 20 ohms to 100 megohms. Tolerances are from 5 per cent to 20 per cent.

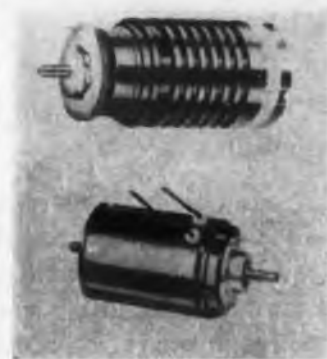
The type G high frequency resistors are characterized by band terminals or ferrules. They come in 6 sizes, from 4-1/2 in. long x 3/4 in. diameter, up to 18-1/2 in. long by 2 in. diameter, and in power ratings from 10 to 100 watts.

The type F high frequency resistors are characterized by lug or wire leads and come in 8 sizes from 9/16 in. long x 0.10 in. diameter up to 6-1/2 in. long by 9/16 in. diameter. Their power ratings are 1/4 w to 10 w.

Resistance Products Co., Dept. ED, 914 S. 13th St., Harrisburg, Pa.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Clutches
Miniatures



Miniature magnetic clutches, included in the breadboard parts line of this type are designed for electrical control of rotary mechanical functions, such as the remote setting or adjusting of potentiometers, synchros and other rotating components. They also may

be used as controlled loads or stops.

Model 583 is suitable for small space application since it is only 1-1/4 in. in diameter and 2-11/16 in. in length. It has a maximum combined braking and clutching torque of 8 oz in. Designed for more rugged duty, Model 543, is 1-3/4 in. in diameter and 4-1/8 in. in length. It has a maximum combined braking and clutching torque of 35 oz in. Both clutches are the solenoid-operated, dry-disc type requiring no slip rings. Backlash is eliminated. They are fixed-coil clutches designed for high cycling rates and operation at 24 and 48 v. Positioning does not affect their operation.

A 48-pitch, 14-1/2 degree pressure angle, stainless steel input gear is furnished with each clutch. Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

Got A Small
"Black Box"
Crammed full
of *Electronic
Equipment?*



*FITS RIGHT
INTO
THE PICTURE*



The **Model "M" ACRO** *micro-switch*

Unsurpassed in all these ways...

- REPEATABILITY
- FUNGUS PROOF
- VIBRATION RESISTANT
- LOW CONTACT RESISTANCE
- TEMPERATURE RANGE +165° F. to -90° F.
- DIMENSIONALLY STABLE AT ABOVE TEMPERATURES
- WIDE RANGE OF OPERATING FORCES
- CLOSE MOVEMENT DIFFERENTIALS

HELPFUL SWITCH APPLICATION GUIDE

Whether your problem is meeting rigid government specifications for weather and altitude or controlling circuits on sensitive electronic equipment, this data in charted form will greatly simplify your switch selection. Write for Data Sheet M-1.

"The Biggest Line of Little Switches"

ACRO
MANUFACTURING COMPANY

ACRO SWITCH
DIVISION

COLUMBUS 16, OHIO

Plants at Columbus and Hillsboro, Ohio

REPRESENTATIVES IN ALL PRINCIPAL CITIES

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

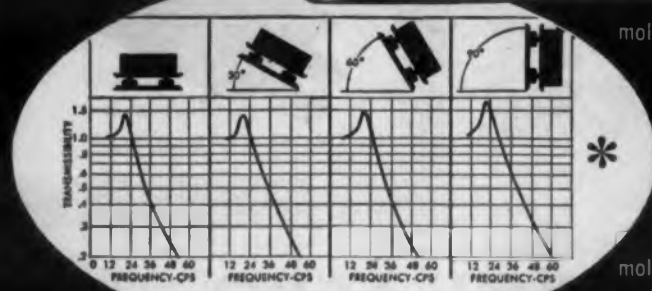
NEW

ALL-ANGL BARRY MOUNT

for Jets and Missiles



MIL SIZE 2
loads up to 40 lbs.
per mount



- 1 molded nylon spring seat and top snubber
- 2 stainless steel core
- 3 stainless steel cup
- 4 damper spring
- 5 phenolic damper
- 6 stainless steel load carrying springs
- 7 molded nylon spring seat and bottom snubber

NOW AVAILABLE in PRODUCTION QUANTITIES

Gives shock and vibration isolation where MIL-spec mounts won't work

- in every attitude of flight or launching
- under sustained high-g acceleration
- at high amplitudes of vibration input
- during severe shock conditions
- at high vibration frequencies

* These curves show why ALL-ANGL Barry Mounts really work through all attitudes. Data Sheet 57-02 gives detailed specifications. Write now for your copy.

ALL-ANGL BARRY MOUNTS are meeting the tougher requirements for shock and vibration isolation in such high-performance aircraft and missiles as North American Aviation's F-100 Super Sabre, Convair's supersonic F-102A, Martin's MATADOR, and in others still classified *top secret* — giving reliability protection where failure cannot be tolerated. "Only ALL-ANGL Barry Mounts gave effective isolation . . ." is the way their performance in one of today's hottest fighters is described.

When your problem is protection under the tough, complex requirements of jet and missile flight, your answer is ALL-ANGL Barry Mounts. For recommendations, call your nearest Barry Sales Representative.

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

BARRY
CONTROLS
INCORPORATED

BARRY B MOUNT

SALES REPRESENTATIVES
IN ALL PRINCIPAL CITIES

775 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS
CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

Telephone Industry Battery

Uses Silver and Antimony



Developed especially for telephone work and related industrial uses, the Exide batteries here shown have polystyrene plastic cases, spun glass separator retainers, and alloy composition plates of lead, antimony, silver and other metals. It is designated the EWA battery.

Elements are suspended from ledges molded within the jar walls. Molded ribs at the bottom of the jar help to support the separators and to position the negative plates. Retainers hold the active material firmly in place on the grids. Other constructional features include an explosion-proof gas baffle, a pilot cell hydrometer vent and plastic vent plug, and electrolyte level lines marked on all four sides of the jar.

The batteries are available charged and filled (C & W) or charged and dry (C & D), in two-cell or three-cell containers with capacities of 180 amp-hrs at the eight-hour discharge rate; or in single-cell assemblies with capacities ranging from 240 to 660 amp-hrs also at the 8-hr discharge rate.

Electric Storage Battery Co., Dept. ED, Box 8109, Philadelphia 1, Pa.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

TV Camera Tubes

Infra-Red and Miniature



Four new models of TV camera tubes are available. One, intended for infra-red light, is sensitive in the region 8000-22,000 Angstroms. A second, designated Type 235 and called the Mini-Resistron because of its size, is intended for miniature cameras and offers 300-line resolution; it is only 1/2 in. in diameter and 3-1/4 in. long. A standard-size tube, the Type 255, offers 600 line resolution, excellent sensitivity, good edge focus and very low flare. Type 350 is 1-3/8 in. in diameter and slightly longer than standard size, but is capable of 1000-line resolution. These tubes have very low image persistence.

Nucleonics Products Co., Dept. ED, Los Angeles, Calif.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

Protect Your Printed Circuits

against corrosion
BEFORE SOLDERING
DURING SOLDERING
AFTER SOLDERING



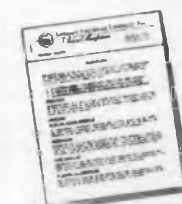
FLUXCOTE 21-XR

The liquid soldering flux with protective coating characteristics . . .

plus:

- Smooth, fast action
- High insulation resistance
- Light, tack-free, varnish-like protective film after soldering

Whatever your printed circuit production, dip . . . spot . . . or area soldering you get full three-way protection against corrosion with Lonco Fluxcote 21-XR.



REQUEST FREE TECHNICAL BULLETIN
"The Soldering of Printed Circuits"

Also request free samples and data on other Lonco Products used in printed circuit manufacture: INSULATING ROSIN FLUXES

SEALBRITE COATINGS • SOLDER RESIST • FLUX REMOVERS
FLUX THINNERS • OXIDE REMOVERS



LONDON CHEMICAL COMPANY, Inc.

1531 North 31st Avenue
Melrose Park, Illinois

CIRCLE 161 ON READER-SERVICE CARD

Shaped Wires and Rods In Many Alloys

A newly developed combination drawing and rolling process now makes available shaped wire and rods in Monel, Inconel X, nickel, stainless steel and other metals and alloys. Surfaces are smooth, no tool marks show and the shaped wire is strong and tough. The product can be supplied, as desired, in coils, spools or straight lengths. Minimum dimension may be as small as 0.002 in.; maximum dimension, however, may not be larger than 0.5 in. Manufacturing processes that involve expensive machining may be eliminated by these shaped rods and wires.

Techalloy Co., Inc., Dept. ED,
Rahns, Pa.

CIRCLE 163 ON READER-SERVICE CARD

Small Transformer Lamination

With 3/16-in. Center Leg

Designed to simplify coil construction by providing additional winding area a new small transformer lamination is offered in all grades of silicon steel and nickel alloys. For faster production handling the laminations are shipped in boxed, nested wire rows. Type T-18 lamination is intended for all miniature transformer applications, including transistor, audio, interstage and output transformers.

Tempel Mfg. Co., Dept. ED, Bryn Mawr at Damen, Chicago 26, Ill.

CIRCLE 164 ON READER-SERVICE CARD

Colored Epoxy Hardeners

For Coding and Safety

Colored hardeners for epoxy resins are now available to serve two purposes. One is assurance of effective hardening, since incomplete or improper mixing would be indicated at a glance by the resulting uneven color distribution, striations or streaks. The other purpose served by the new hardeners is of course color-coding of the hardened casting. Colors presently available are red, blue, yellow, green, orange and black.

Flurane Plastics, Inc., Dept. ED,
4516 Brazil St., Los Angeles 39, Calif.

CIRCLE 165 ON READER-SERVICE CARD

CIRCLE 166 ON READER-SERVICE CARD



Why your ceramic-to-metal seals need RAYTHEON R-95 HIGH-ALUMINA CERAMIC

Fundamental to the problem of reliable seals is a reproducible ceramic body. And equally basic to the quality of the ceramic body are these essential characteristics:

1. Vacuum tightness
2. Sure thermal shock resistance
3. Reliable mechanical properties
4. Dependable electrical properties
5. High temperature characteristics
6. Economical fabrication
7. Uniformity—from lot to lot—in each of the above

Raytheon's R-95 ceramic meets every one of these exacting demands, consistently!

Ceramic parts manufactured from Raytheon's R-95 high-alumina are available, either alone or as hermetic ceramic-to-metal assemblies, in accordance with your specifications. The assemblies can be soldered into your production in your own plant.

Send sketches or drawings outlining dimensions and tolerances, together with operational conditions. We will be pleased to supply information and help on any of your ceramic needs.

Write for complete specification sheet. No cost or obligation, of course.

RAYTHEON MANUFACTURING COMPANY

Ceramic Sales

Waltham 54, Massachusetts



Excellence
in Electronics

MARCONI ACCURACY



Model
791C

NEW FM DEVIATION MONITOR

WIDER modulation frequency range is a feature of Marconi Deviation Monitor Model 791C, 50 cps to 35 kc.

HIGHER carrier frequencies are covered, 4 to 540 Mc in 6 ranges.

LONGER life is not claimed. No Marconi Deviation Monitor has yet worn out.

LOWER price, yet still Marconi precision.

Brief Specification

Frequency Range 4 to 540 Mc
 Mod. Freq. Range 50 cps to 35 kc
 Deviation Ranges 0 to ± 5 , ± 25 , ± 75 , ± 125 kc
 Accuracy 3%, crystal standardized
 Harmonic Distortion Less than 0.2%
 Tubes 6AK5, 6C4, 6CD6, 5718, 6AL5, OB2, 5Z4G

Price \$720.00 Delivery Immediate

The Marconi range of FM test instruments includes:

- Signal Generator Model 1066/1 10 to 470 Mc
- Signal Generator Model 995A/2 1.5 to 220 Mc
- Signal Generator Model 913 22 to 176 Mc
- Deviation Monitor Model 928 for Telemetry
- Ruggedized Deviation Monitor Model 934 2.5 to 500 Mc
- Eddystone Receiver Model 770R 19 to 165 Mc
- Eddystone Receiver Model 770U 150 to 500 Mc

Illustrated brochures on request.



MARCONI instruments
 44 NEW STREET • NEW YORK 4, N. Y.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Servo Amplifier

Drives 6.1 Servo



This model 1800-0700 miniaturized, hermetically sealed, plug-in transistor amplifier receives signals from a synchro control transformer, and drives a size 15, 60 cycle, 6.1 w

motor or equivalent. It has a nominal input impedance of 10,000 ohms but can actually be supplied in a wide range of input values as required. Typical voltage gain is 550 at 2 w output. Carrier frequency is 60 cps. Input power requirement for maximum output is +28 v dc at 350 ma; 20 ma input gives zero output. Input impedance of motor is $97 + j 95$ ohms; effective resistance is 192 ohms. Maximum output at 60 cps, when used with Kearfott Type R 160-5 servo motor, is 28 v rms, 4.5 w, 2.25 oz in. Phase shift, internally adjusted, is essentially 90 deg.

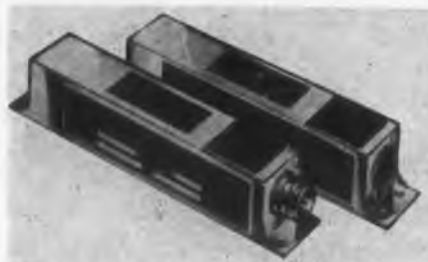
Weight is 6 oz, size 1,3/16 in. x 1-11/16 in.; 3-13/16 in. high. The unit is hermetically sealed with a 7-pin plug connector; turret head terminals are optionally available. The amplifier meets the requirements of MIL-E-5400.

M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

Small Accelerometer

For Missile Applications



A potentiometer-type accelerometer measures lateral accelerations in two mutually perpendicular planes, but occupies only 1-

1/8 in. square by 5-7/8 in. and weighs only 14 ounces. It contains two linear potentiometers internally mounted at right angles, and is available in ranges from ± 2 g to ± 30 g. Damping is accomplished by a silicone oil, and operation remains satisfactory throughout the temperature range -10 to +180 F. The accelerometer is encapsulated and hermetically sealed. Either a miniature Cannon receptacle or hermetically-sealed glass header can be supplied.

Genisco, Inc., Dept. ED, 2233 Federal Ave., Los Angeles 64, Calif.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Pressure Transducers

for operation to

+ 400° F.



Temperature compensated
over 465° F. interval

0.01% /° F. thermal coefficient of
sensitivity from -65° to +400° F.

0.01% fs /° F. thermal zero shift
from -65° to +400° F.

No cement or resin pressure seals

Homogeneous sensing diaphragm
surface

Statham unbonded strain gage
transduction

Minimum response to vibration
or acceleration

Pressure adapters for closed
line applications

Absolute Pressure Transducers
0-5 to 0-500 psia - Model PA260TC

Gage Pressure Transducers
0-5 to 0-500 psig - Model PG260TC

Differential Pressure Transducers
0-5 to 0-500 psid - Model PL260TC
 ± 2.5 to ± 25 psid - Model PM260TC

When the transducer is a
Statham, pressure
measurements at elevated
temperature are made with
accuracy and confidence.

Complete specifications available upon request.

Please wire or telephone us collect
whenever we may be of service.

Statham
LABORATORIES

12401 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE 171 ON READER-SERVICE CARD

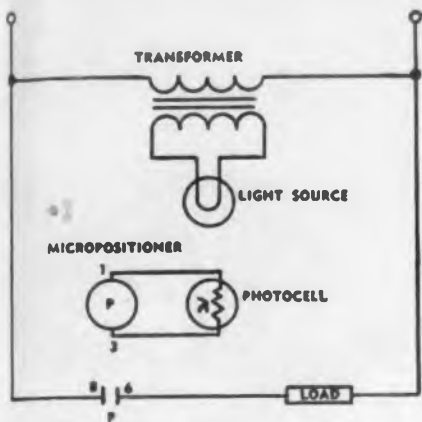


ultra-sensitive relays

HELPFUL DATA FOR YOUR CIRCUITRY IDEA FILE . . .

(No. 1 in a series by Barber-Colman Company)

The circuit drawing below indicates just one of the hundreds of ways many manufacturers are utilizing Barber-Colman Micropositioner ultra-sensitive relays to solve complex control problems. Could this be the answer to some of yours, too?



PHOTOELECTRICITY APPLICATION

Many stages of electronic amplification in photoelectric controls can be completely eliminated with a Barber-Colman Micropositioner, since a current generating photocell alone provides sufficient power to operate this relay directly.

A Micropositioner operating on 50 microwatt input (with fine silver contacts rated at 1 ampere, 110 volt 60 cycle, resistive load) is essentially a tubeless amplifier capable of two million times amplification.

Among the many applications for this simplified, non-electronic photocell control are: punch press safety controls . . . emergency lighting controls . . . door openers . . . burglar alarms . . . level controls . . . packaging, sorting, filling, and materials handling controls . . . plus many other automation functions.

If you are developing an application calling for photocell control, why not make a test with a Micropositioner designed for circuits similar to that shown above? Write for technical bulletins F7279 and F3961-5.



BARBER-COLMAN MICROPOSITIONER POLARIZED DC RELAYS

Various types...plug-in, solder-lug, screw terminal, hermetically sealed. Operate on input powers of 50 to 1,000 microwatts for use in photoelectric circuits, resistance bridge circuits, and electronic plate circuits. Send for data.

BARBER-COLMAN COMPANY
Dept. N, 1883 Rock Street, Rockford, Illinois

CIRCLE 173 ON READER-SERVICE CARD

Regulated Power Supply

Accuracy ± 0.01 Per Cent

Steady state regulation accuracy of ± 0.01 per cent, and output ripple less than 50 mv peak to peak in 200 v output line, feature this new power supply, which was



built primarily for computer applications. Input is 208-230 v, 3 phase, 60 cps, ± 15 per cent. Output is 200 v dc ± 10 per cent at 3 a. Dynamic regulation is ± 1 per cent for a ± 15 per cent step change in ac input; and ± 1 per cent for a 50 per cent change in load. Overall dimensions are 19-1/2 in. wide, 15 in. deep and 12-3/4 in. high.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermistor Radiometer

Reads Temperatures



Almost any temperature, including sky and ground temperatures, can be read with this improved model radiometer. Surface temperatures of liquids,

of human or animal skins, of moving objects or of operating equipment can be determined. Contact with the surface being measured is not necessary; readings can be taken at a distance by directing the radiometer at the object.

The instrument consists of a detecting head with a local aperture approximately 5/8 in. in diameter and a 20 deg field of view; an amplifier, and a black-body reference standard for ambient temperature compensation. Indications are given on a meter calibrated in degrees C. Full scale readings can be obtained on scales of 10, 30 and 100 deg C above or below ambient temperature; and differences as small as 0.1 deg C can be measured.

This new model has higher meter sensitivity, better stability, better damping characteristics and an improved and simplified radiometer head.

Williamson Development Co., Inc., Dept. ED, 317 Main St., West Concord, Mass.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION



*Reliability
Comparisons
Invited*

Shallcross

PRECISION WIREWOUND RESISTORS

This is your invitation to test and compare Shallcross precision resistors for that elusive quality known as reliability.

Statisticians tell us that component reliability and, subsequently, equipment reliability, can be predicted on a sound mathematical basis—assuming that environment is correctly predicted.

Unfortunately, most equipment manufacturers have divergent ideas of what component environments should be. Thus there are just as many interpretations of what constitutes a reliable component. In the absence of a common gage for reliability, Shallcross welcomes the opportunity of working with the standards and components groups now being established by many equipment manufacturers.

To save valuable testing time, Shallcross can supply qualified recipients with complete test data that shows to what extent MIL-R-93A is met or exceeded for any of eleven resistor styles. Data is also available on four of twelve Shallcross styles conforming to the 125°C MIL-R-9444 Specification. Data on remaining styles will be available as soon as testing is completed.

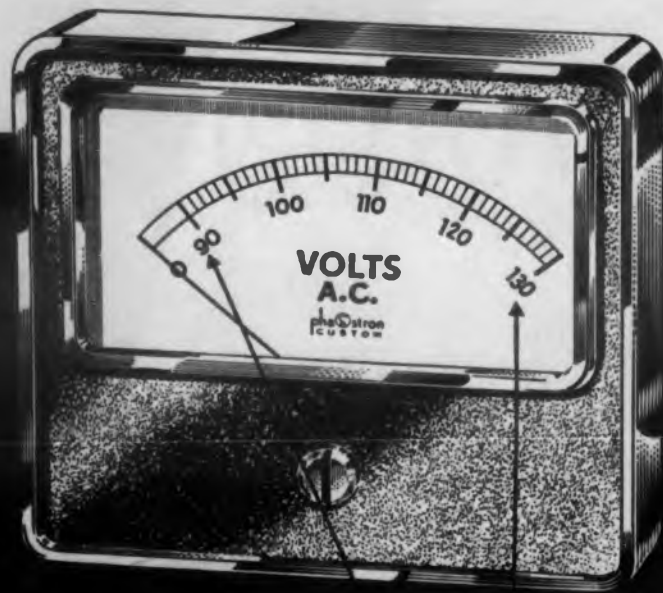
Details on Shallcross resistors designed to MIL Specifications as well as helpful application notes on encapsulated precision wirewound resistors are contained in newly-released Supplement to Bulletin L-30. For your copy write: SHALLCROSS MANUFACTURING CO., 528 Pusey Ave., Collingdale, Pennsylvania.

MIL-R-93A RESISTORS
... for 85°C
ambients

MIL-R-9444 RESISTORS
... for 125°C
ambients

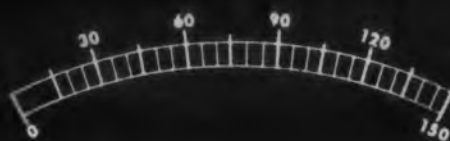
CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW PHAOSTRON EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range, AC Rectifier Type in all custom styles and sizes.

3½" and 4½" rectangular meter



NOW!... all the time-tested proven Phaotron features... PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaotron has squeezed down that under 90V portion of the scale, where you don't need it, and expanded the section where you need it most—between 90 and 130V. Precisely calibrated 1 volt scale increments provide greater reading accuracy. Wide frequency range—linearity—true rms reading and Phaotron craftsman construction.

Phaotron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.



2½" or 3½" square meter



6" rectangular meter



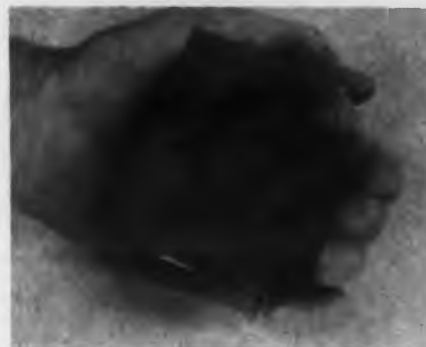
2½" or 3½" round meter

PHAOSTRON

PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relay Operates Electronically



Built to operate reliably under the conditions of vibration, shock, temperature and humidity normally specified for guided missile, aircraft and other military

applications, this electronic relay is supplied in order to meet a wide range of specified power supply and time requirements. Built-in, accurate time delays may be as low as 3 milliseconds or as high as 30 seconds. They are accomplished by charging a condenser through a resistance with voltage from a regulated source. The timing interval is not affected by line voltage variations. At the end of each charging process a gas-filled tube conducts, and operates the relay.

The relay is single pole double throw, with non-inductive contacts rated at 1 amp, and balanced armature construction.

The entire timer is hermetically sealed. It consumes 1/2 w in standing, 4 w operated, recycles instantly, needs no warm-up, and is rated to withstand 20G vibration and 50 g acceleration. It can be supplied for 105-125 v dc or ac, 60 cps or 360-1200 cps. Weight is 9 oz; dimensions 2-5/16 in x 2-1/16 in x 3-1/8 in.

G. C. Wilson & Co., Dept. ED, 1915 Eighth Ave., Huntington, W. Va.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

Soldering Iron Transformer

For 6-V Irons



Model 54203 soldering iron transformer is equipped with a-c cord and base holes for bench mounting. Its output is 6 v at 3 amps, and it is rated

for continuous operation. The transformer is primarily intended for use with all 6 v instruments produced by Oryx Electrical Laboratories, and is manufactured exclusively for Oryx by Triad Transformer Corp.

Oryx Company, Dept. ED, 9015 Wilshire Blvd., Beverly Hills, Calif.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

C.I.C.
SINE-COSINE
POT SPECS
begin
where others
stop



Infinite resolution and absolute dependability distinguish CIC ultra-precise Potentiometers. In the generation of the sine wave CIC Pots provide smooth, reliable performance, distortion free at all angles of rotation.

CIC carbon film Sine-Cosine Pots, the proven product of a unique research program, provide greater accuracy in smaller case sizes. Sizes range from 1" to 5" diameter with corresponding best conformities from .3% to .03%. Compensation for loading can be provided with no loss of performance.

At speeds in excess of 1,000 r.p.m. CIC guarantees life in excess of two million revolutions.

Many firms with critical specifications for industrial instrumentation, military fire control and flight guidance equipment rely only on CIC Potentiometers.

Our highly qualified engineers are ready to discuss your specific requirements with you. Call us today.

"For Precision Performance ... specify CIC"

cic

Detailed Technical Data Sheets available on request.

COMPUTER
INSTRUMENTS
CORPORATION

1 Vanhoo 3 8200

92 Madison Ave • Hempstead, Long Island, N.Y.

CIRCLE 181 ON READER-SERVICE CARD



The Curtiss-Wright "SNAPPER"

THERMAL TIME DELAY RELAYS
FOR COUNTLESS APPLICATIONS

- Eliminates chatter with snap action
- Single-pole, double throw contacts
- Wide ambient range (-65°C + 100°C)
- For military, commercial and industrial applications
- Metal envelope (7 or 9 pin) miniature or (8 pin) octal
- Glass envelope in 9 pin miniature
- Preset time delays in metal from 3 to 90 seconds, glass from 5 to 60 seconds

Write to Thermal Devices Department
for latest data sheets



Curtiss-Wright has career positions open for
qualified engineers and technicians.

CIRCLE 183 ON READER-SERVICE CARD

Rate of Turn Test Table

Tests Gyros and Switches



This yaw rate table tests gyros and gyroscopic switches by subjecting them to turning rates of from 0 degrees to 300 degrees per minute. Rate of fluctuation (wow) is less than 1.0 per cent. The table will test loads up to 10 lb. It can be used in a 20 in. x 20 in. chamber to simulate temperature conditions from -67°F to $+187^{\circ}\text{F}$, and altitude conditions from sea level to 60,000 ft. The control panel and amplifier can be remotely located; and can be mounted in a standard 19 in. rack if desired.

Micro Gee Products, Inc., Dept. ED, Box 1005,
6100 W. Slauson Ave., Culver City, Calif.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

Maximum-Minimum Thermometers

Stainless Steel Stems



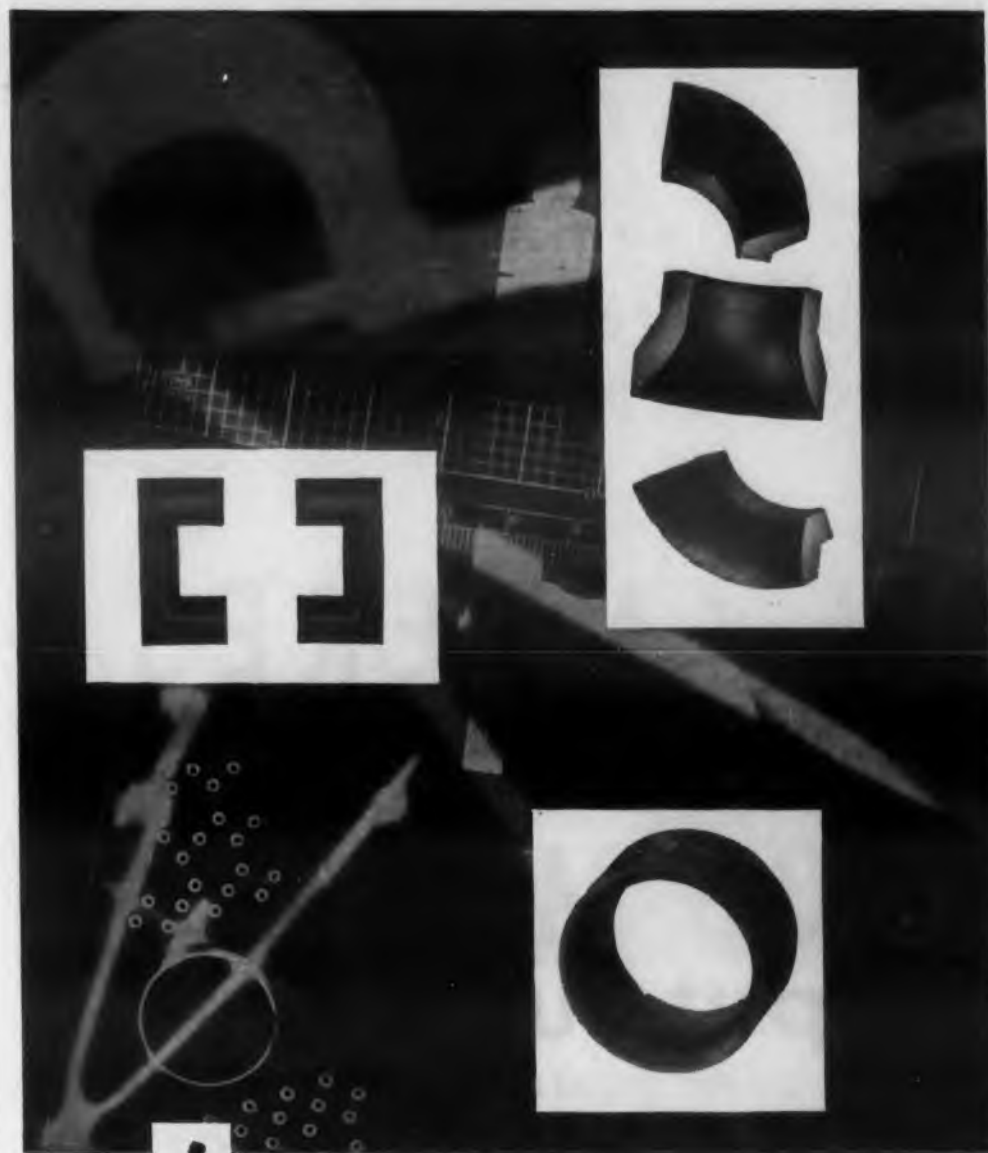
The center knob of this maximum-minimum thermometer is used to set the two ancillary indicators against the high and low sides of the indicating pointer. Thereafter the max and min hands move up and

down the scale with the pointer, remaining at the extreme temperatures reached until manually reset. Thus the dial indicates not only the present temperature, but the maximum and minimum temperatures since the last resetting.

These thermometers are supplied in seven ranges, both Fahrenheit and Centigrade, and are accurate to 1.0 per cent over the entire scale. They are of the direct drive bimetal type, without gears or linkage. They may be had with either 2 in. or 3 in. faces; and with stainless steel stems from 3 in. to 86 in. long. The stems do not require preheating for use in hot materials; they withstand corrosion and can be used in liquids and gases. The glass window and its center knob are hermetically sealed against fumes and moisture.

Pacific Transducer Corp., Dept. ED, 11836 W. Pico Blvd., Los Angeles 64, Calif.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION



*Imagination -
your only limit!*

FERRITE COMPONENTS

Imagination is your only limit in applying Ferrite Components, when you work with our resourceful custom engineering group—backed by the vast research facilities of General Electric. Beyond standard shapes such as the "C" Cores and Yoke Segments above, our engineers stand ready to work with you in bringing your particular Ferrite designs to rapid, economical and uniform quantity production—held to close physical and electrical tolerances, at an advantageous cost level. Whether it's general data on Ferrite Components, specifications on available parts, or design assistance for tomorrow's lines, write or wire General Electric Co., Specialty Electronic Components Department, Section 2327, Auburn, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION

transistor
measurements to—

15 AMPERES
sweep current

600 MA
input current

AMERICAN ELECTRONIC LABORATORIES INC.
IS PROUD TO ANNOUNCE THE

MODELS 126R and 126RT
TRANSISTOR CURVE TRACERS

To be available in
March - April
For orders placed now

AMERICAN ELECTRONIC LABORATORIES INC.
121 N 7th St. — Philadelphia 6, Pa.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION

Azimuth Alignment Theodolite For Precision Gyroscopes



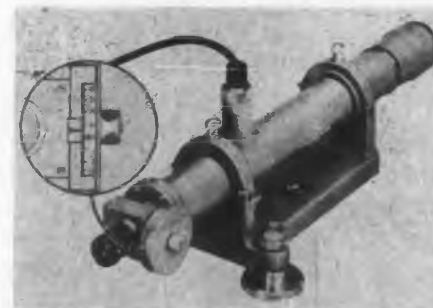
An azimuth alignment theodolite, permitting alignment of precision gyroscopes within an accuracy of 2 seconds of arc, has been developed. The instrument automatically detects discrepancies in the alignment of a precision gyroscope by continuous observation of the reflections from a mirror mounted on the monitored unit. Any such discrepancies produce error signals in the theodolite which are applied, automatically or manually, as corrective signals to the drive elements of the gyroscope.

The theodolite consists of three major components (optical, mount and electronic units). The upper optical unit is essentially a precision theodolite. The monitoring (lower) optical unit consists of two modulated light sources, a telephoto type objective, a beam dividing "Vee" mirror and a photomultiplier tube.

The telephoto lens is employed as the monitoring objective. Two glow discharge lamps, modulated in phase opposition, are used as sources.

Perkin-Elmer Corp., Dept. ED, Norwalk, Conn.
CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-Sensitive Collimator Reads to 0.1 Second of Arc



For engineering tests performed by optical methods, the Watts Microptic Auto-Collimator has now been improved by a new micrometer drum arrangement which permits direct reading to 0.1 second of arc, or 1/500,000th of an inch per inch. Applications include, among many others, testing of machine tools, testing of surface plates, control of ultra-precision gear cutting devices, control of test fixtures, control of guided missile units, measurement of diameter and of roundness of exceptionally fine wires, and so on.

Engis Equipment Co., Dept. ED, 431 S. Dearborn St., Chicago 5, Ill.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

PRECISION CAMS

from FORD INSTRUMENT



FLAT
CAMS

3D
CAMS

BARREL
CAMS

- offered in a variety of types
- with tolerances to $\pm 0.0005''$
- for wide range of computing and motion applications

Whatever your computing or motion application, Ford Instrument can make the cam to meet your exacting needs... 3-D Cams, grooved flat cams, external flat cams, grooved cylindrical cams. The Company's unique cam-production facility — and many years of experience — guarantee unmatched performance in this field.

FREE — Fully illustrated data bulletin gives specifications and performance information. Please address Dept. ED.



**FORD INSTRUMENT
COMPANY**

Division of Sperry Rand Corporation
31-10 Thomson Ave.
Long Island City 1, N. Y.

Ford Instrument's standard components



Rate
Generators



Differentials



Servo
Motors



Telosyn
Receivers



Integrators



Telosyn
Synchros

CIRCLE 191 ON READER-SERVICE CARD

surprise
another product from Helipot!



Beckman AC & DC Expanded Scale Voltmeters

What good's accuracy... if it takes a bug-eyed monster to detect it? That's why we've made our panel-mounting voltmeters as *readable* (by homo sap.) as they're *accurate* (as close as 0.3% of center-scale voltage). And we make them as small as 2½" dia.

Logical question: Are you kidding? That size, with those features?

Enthusiastic answer: S'true! The trick's in the expanded scale. Conventional meters have all the numbers and increments... from zero to full-scale voltage... jammed in with a shoe horn. Not ours. We took the meat part of the scale, expanded it, and made it linear... eliminating the fat and gristle. Now there's room enough for all you need to read... and boy, is it easy! So easy, it would take a conventional meter 12 times larger to achieve the same readability. (Can you imagine the damping factor you'd need for a 2-foot needle?)



Q. Who are they for?

A. They're as great for groundlings as they're fine for flyboys. The AC voltmeters, incidentally, provide true rms readings.

Q. How many models?

A. We've got eight basic models in a variety of shapes, sizes, standard scales and accuracies... to suit your mood and installation.

Interested? Write for data file 245.

Beckman® Helipot

Corporation

Newport Beach, California

Division of Beckman Instruments, Inc.

Engineering representatives

in principal cities

CIRCLE 193 ON READER-SERVICE CARD

Pulse Generator Fully Transistorized



The Model 502 pulse generator is a completely transistorized piece of test equipment using printed circuitry. This instrument is completely self-powered by a 22-1/2 v battery, providing a useful life of 450 hrs. It provides a pulse length from 0.5 to 3 μsecs in three steps with a 20 v peak into an 800 ohm load. The positive or negative pulses are continuously variable from zero to full amplitude and the instrument may be easily modified to accomplish external modulation. With negligible jitter, the pulse shape shows a rise and decay time of 0.1 μsec or less; tilt and overshoot is less than ±2 per cent over average amplitude at maximum pulse output. The repetition rate on internal sync is from 50 to 5000 pps, and on external sync from 0 to 5000 pps. The internal impedance is 100 ohms or less on either pulse polarity. Sync may be positive or negative at one volt minimum to 20 v peak to peak maximum. Sync output provides positive or negative 10 v peak into a 2000 ohm load with a duration of approximately 1.5 μsec at the half voltage point and a rise time of 0.5 μsec. Pulse position is available in two ranges: 0 to 20 and 0 to 200 μsec after sync output.

Cubic Corp., Dept. ED, 5575 Kearny Villa Rd., San Diego 11, Calif.

CIRCLE 194 ON READER-SERVICE CARD FOR MORE INFORMATION

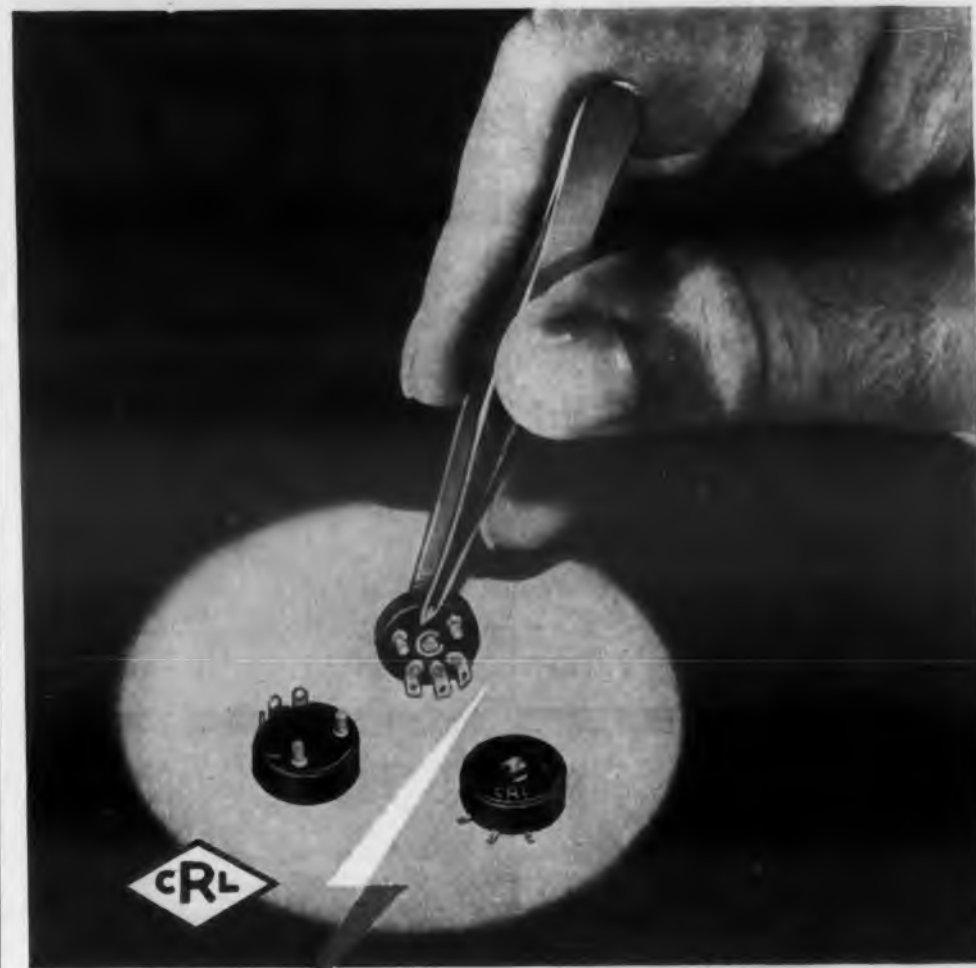
Fast Electronic Counters Capacities to 999,999,999



A new line of direct reading, high speed, electronic counters have absolute accuracy. Models are available from 1 to 4 decades. Capacities range from 999,999 to 999,999,999. Counts per second range from 0-150 to 0-100,000. Pulse pair resolution is 5 microseconds. Input requirement: 0.05 v rms. Two outputs, relay and pulse, are provided. The instruments can totalize any series of mechanical, optical, electrical or other events that can be converted into electrical impulses.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif.

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION








New, Ultra-Miniature Model 6 1/10-Watt Variable Resistor

Resistance range, 500 ohms to 10 megohms

For applications where small size and high quality are factors...

Hearing aids
Transistor radios
Telephone equipment
Military applications

-  Only ½ inch in diameter. Without switch, .127 thin. With switch, .200 thin.
-  On-off switch completely enclosed within control. Rated 2.5 amps at 2.0 v.d.c.; 0.1 amp. at 45 v.d.c.
-  Tested to a minimum of 25,000 complete cycles. Seven standard tapers.
-  Smooth, noise-free operation.
-  Variety of mountings available.

Technical Bulletin EP-77 gives complete engineering data. Write for it.

Centralab

B-2556

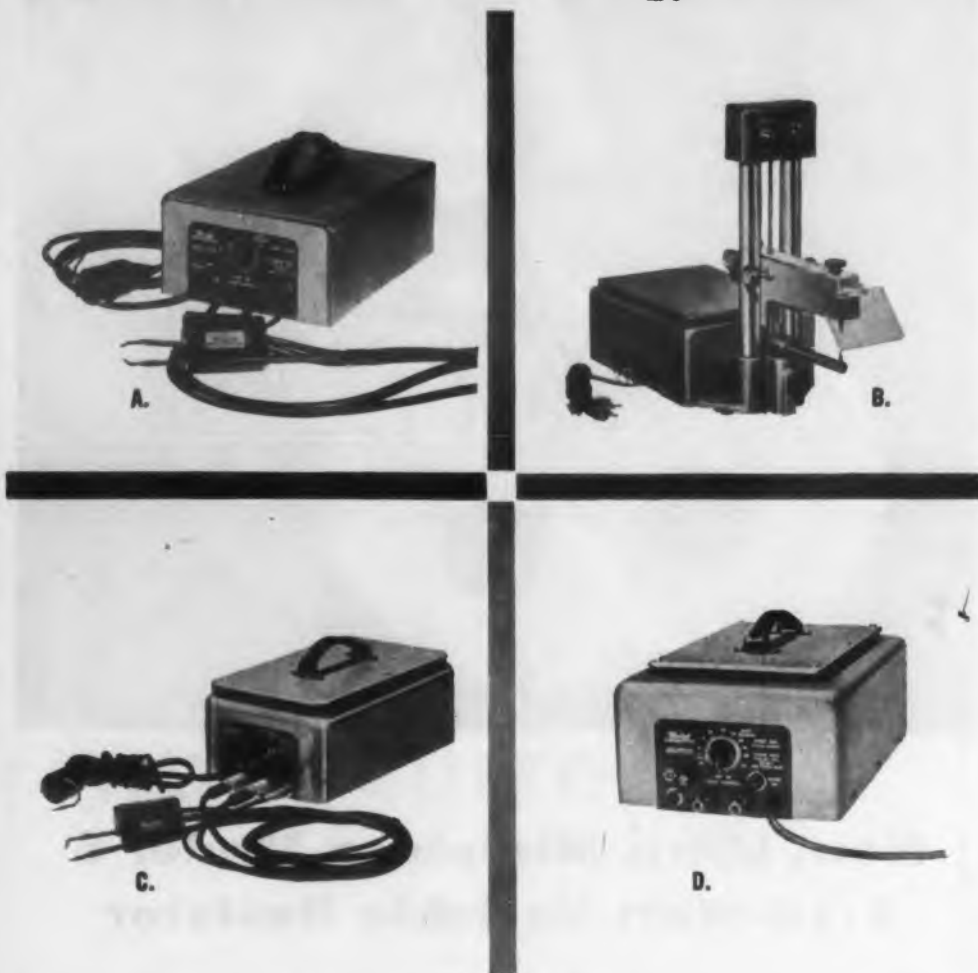
A DIVISION OF GLOBE-UNION INC.

960B East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada, 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

now—weld even
 “difficult” metals instantly
 with weldmatic stored-energy welders



Weld stainless steel, copper, silver, tungsten, molybdenum and other “problem” metals easily and in millisecond time. Weldmatic resistance welders speed precision metal-joining operations in electronic, instrument, aviation and general industrial work, displacing slower, costlier methods such as soldering, silver brazing, riveting and staking. Weldmatic-welded joints offer better mechanical performance, higher tensile strength, better fatigue resistance. Dissimilar metals and parts of widely varying thicknesses are joined with ease and require no preconditioning. Welds are strong and uniform—no discoloration or metallurgical change, no excessive deformation. Weldmatic welders are easy to set up and simple to operate.

there's a weldmatic for every precision assembly task

- A. weldmatic model 1012—Portable, Tweezer type handpiece. Extra-long leads.
 B. weldmatic model 1015—Bench mounted. Accommodates special-purpose electrodes and handpieces.
 C. weldmatic model 1016—Portable. Has two interchangeable handpieces, extra-long leads.
 D. weldmatic model 1026—Portable power unit with readily interchangeable handpieces.

APPROXIMATE WORK CAPACITY

MODEL NUMBER	LOW CONDUCTIVITY MATERIALS		HIGH CONDUCTIVITY MATERIALS	
	Sheet Thickness	Wire Diameter	Sheet Thickness	Wire Diameter
1012	.0005 to .010	.00015 to .030	.0003 to .005	.0001 to .015
1015	.0005 to .020	.0002 to .060	.0003 to .010	.0002 to .030
1016	.0005 to .015	.0001 to .045	.0003 to .008	.0001 to .020
1026	.0005 to .020	.0002 to .060	.0003 to .010	.0002 to .030

write for descriptive literature and details of sample welding service

WELDMATIC

a division of unitek corporation

260 NORTH HALSTEAD AVENUE • PASADENA, CALIFORNIA

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

Halogen Leak Standard

Calibrates Detectors



Called the Halogen Leak Standard, this inexpensive quantitative leak checker is a portable instrument for the precise calibration of halogen-type leak detectors.

The new equipment features accurate leak size determination of +10 per cent full

scale. Easy to use, the new leak standard is plugged in to a 110 to 120 v, 50 to 60 cps power supply. After power is turned on, the standard is adjusted to the desired leak rate value and the leak detector probe is inserted firmly into the gun fitting of the standard. The output indicator then shows the appropriate reading.

There are two scales on the leak rate indicator. The inner scale indicates the leak rate in ounces halogen per year. The outer scale, marked in arbitrary units from 0 to 100, is used only during the calibration of the standard.

A halogen vapor system and a filtered air system comprise the new leak standard. The halogen vapor system consists of a vapor tank, increase valve, manifold, decrease valve, ballast tank, gage, and standard leak assembly. Tanks supply halogen under pressure and valves control the pressure in the ballast tanks. A calibrated and adjustable leak is provided by the standard leak assembly.

General Electric Co., Dept. ED, Schenectady, N.Y.

CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Traveling Wave Solenoids

From 100 to 1000 Gauss



Traveling wave tube solenoids from 100 to 1000 gauss, 8-1/2 to 16 in. long, for use in 28, 90 and 225 v dc systems, are now offered by Menlo

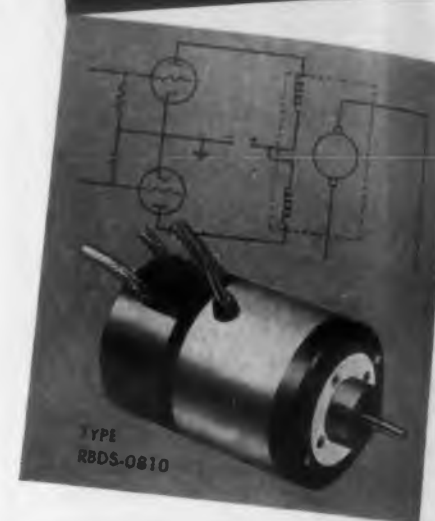
Park Engineering. They are currently in use with Huggins Laboratories' tubes. The units are carefully wound for minimum component of transverse magnetic field in order to provide optimum focusing of tube beams. Solenoids having fields greater than 600 gauss are provided with a built-in blower to cool both the winding and the tube.

Menlo Park Engineering, Dept. ED, 721 Hamilton Ave., Menlo Park, Calif.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

HOLTZER -CABOT

D. C. Miniature
 Servo-Motor



Holtzer-Cabot's Type 0810 is well known for its precision performance in gun fire control, radar navigation and radio tuning. It features immediate response to minimum input signal. The armature is designed for continuous excitation from a 24 to 29 volt D.C. source through a 28 ohm series resistor. The field has two 10,000 ohm sections: one for CW and the other for C.C.W. rotation. Full rated motor output is obtained by 6 ma. differential field current.

SPECIFICATIONS: Rating 0.3 oz. in., 6500 R.P.M., .002 H.P., Diameter: 1 1/4", Field Current 6.0 Milliamps; Armature Current 0.4 amp., Duty Cycle: 4 reversals per minute; Altitude: 50,000 feet; Amb. Temperature: -65° C to +72° C. Designed to meet MIL specs. Send coupon below for additional information.



HOLTZER-CABOT MOTOR DIVISION
 NATIONAL PNEUMATIC CO., INC.

125 Amory Street, Boston 19, Mass.

GENTLEMEN: Please send me data sheets on the Holtzer-Cabot Type RBDS-0810 servo motor.

Please have representative call on (date)

Name.....

Company.....

Street.....

City..... Zone... State.....

CIRCLE 201 ON READER-SERVICE CARD

NEW

magnetically
-controlled

COUNTER -DIVIDER

Magnivider

Using a "ladle-bucket" principle, magnetic cores in the unique Magnivider circuit set a new high of reliability and ruggedness wherever counting, scaling or frequency division is required.



Self-contained Magnivider plug-ins are ideal for your new equipment designs. Compared to conventional four-tube counters, one-tube Magnividers offer

- one-third the size
- 50% less power drain
- twice the reliability
- compatible scales of 9-10-11
- counting rates from 0 to 50 Kc.
- both low and high impedance outputs
- direct cascading without buffers

Magnividers have a wide range of applications

- Random counting
- Preset counting
- Cycle counting
- Frequency division
- Timing chains
- Synchronizing circuits
- Accumulators

Write for our Technical Bulletin 145 to obtain complete information and specifications.

Dept. ED-102

MAGNETICS
RESEARCH
COMPANY

255 GROVE STREET
WHITE PLAINS, N. Y.

CIRCLE 203 ON READER-SERVICE CARD

Holt Head Fasteners

Tamper Proof



The Holt head was originally designed for pan head screw which insures maximum driving power at the three points around the outside corner driving contours. They yield improved driving engagement and maintain maximum tamper-proof screw protection. Holt head screws are found in camera assemblies where it has become necessary to protect such units from tampering and also to insure return of the complete product in the same condition as originally shipped, for adjustment. The Holt

Head screw is also advantageous for enclosed factory-adjusted electronic and mechanical units which carry a warranty.

The angles of the screw slots and driver may be keyed exclusively to individual field applications by making a slight change in the 120 degree spacings which are normally provided in the 3-slot type, or in the 90 degree spacings in the 4-slot type. The Holt Head is obtainable for steel and brass machine screws, with 3 or 4 slots, also for types A and B sheet metal screws, type C thread forming screws and types 1, 23 and 25 thread cutting screws.

Central Screw Co., Dept. ED, 3501 S. Shields Ave., Chicago 9, Ill.

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

20 Amp Magnetic Relay

2 to 4 Pole Types



Useful for air conditioners, refrigerators, small power tools, fans, ovens, etc., this 20 amp magnetic relay is available with either 2, 3 or 4 poles, and for all standard voltages up to 300 v. It has silver cadmium oxide contacts, designed for minimum contact bounce, and its overall construction and

materials are such that it is expected to need no servicing or attention for the life of the air conditioning or other unit on which it is installed.

Arrow-Hart & Hegeman Electric Co., Dept. ED, Hartford 6, Conn.

CIRCLE 205 ON READER-SERVICE CARD FOR MORE INFORMATION

Giannini ROTOSTEPPER

Pulse-to-shaft Position Converter



Powerful, rapid, absolutely controllable shaft rotation in precise 2° increments... for DC pulse-to-analog shaft positioning in computers, sequence switching, algebraic counting, remote shaft positioning.

Pulsed DC from hand operated switches, choppers, or any similar manual or automatic pulsing devices controls the Gianni Rotostepper in precise 2° angles of rotation.... unlimited in either direction, at the rate of one step per pulse.

Optional control mechanisms available on the versatile Rotostepper provide homing to a fixed reference angle, automatic continuous stepping with a steady DC voltage, and/or potentiometric divided voltage functional to shaft position.

SPECIFICATIONS:

TORQUE: Up to 14 oz-in

SPEED: Up to 60 steps per second

ROTATION: Unlimited CW or CCW in 2° increments

LOCK: Spring detent locks shaft in a position accurate to $\pm 6'$

INPUT: 28 volts DC, 10 milliseconds minimum duration per step

Giannini

PRECISION INSTRUMENTS & CONTROLS

For further information write for Rotostepper Bulletin 8915

G. M. GIANNINI & CO., INC., 918 E. GREEN ST., PASADENA, CALIF.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

Molded RF Choke Coils

Complete & Standardized Series



150 RF COILS IN 6 SERIES STANDARDIZED TO SIMPLIFY YOUR ENGINEERING AND PRODUCTION PROBLEMS

- Inductance values range from .15 uh to 10,000 uh. Each coil is completely defined by physical size and related electrical parameters.
- A miniature series as small as a half-watt resistor.
- Hermetically encapsulated in molded alkyd plastic suitable for operation to 105°C.
- Conform to MIL-C-15305A.
- Quality controlled to 0.65 AQL on all shipments.
- Available for prompt delivery from stock and current production.
- Substantial savings possible by your use of standardized coils.
- Complete coil specifications in catalog form available upon request.
- Custom RF Coils developed and produced to solve your particular problems.

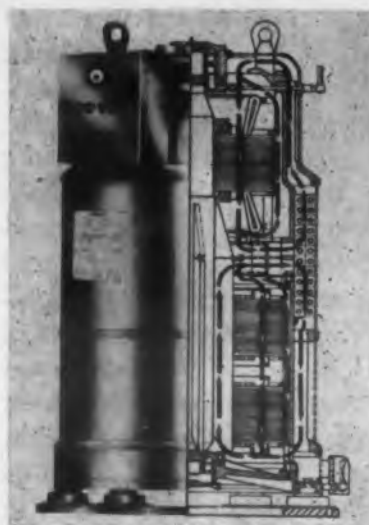
For full information write Dept. D-1



DELEVAN
Electronics
CORPORATION
EAST AURORA, NEW YORK

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

High Frequency Generators For Induction Heating



A new line of high frequency, vertical motor generators for induction heat treating applications such as smelting, forging, brazing, annealing and hardening has been introduced. Generator ratings from 10 to 250 kw outputs are available in frequencies of 1000, 3000, and 10,000 cps. Higher kw rated generators and other fre-

quencies are available on request.

Due to the short time constant inherent in the heteropolar designed generators, rapid changes of power output and improved regulations are important features. Also, the bearings are not subject to induced heating. Various voltages are obtained with tapped windings. Larger units are designed with separate generators for split output. Therefore, a 200 kw generator could at a future date become two 100 kw generators very easily.

Motor generators are totally enclosed and are cooled by fin type copper tube heat exchangers. Centrally located impeller fan distributes forced air cooling equally over motor and generator components.

Welduction Corp., Dept. ED, 10230 Capital Ave., Oak Park 37, Mich.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

Torque Transducers Low Range Models



Torque transducers, equally effective for measurement of static or dynamic torque, have been announced in two new models. Model TF-5-0.5

has a full torque range of 0.5 in.-lb and Model TF-5-0.05 a full torque range of 0.05 in.-in. The transducers operate without brushes and slip rings, and with no contact of any kind between torque shaft and pickup housing. Sensitivity and linearity are not affected by shaft speed. Full scale reading can be obtained at as little as 20 per cent of the transducer's full range.

Crescent Engineering and Research Co., Dept. ED, 5440 No. Peck Rd., El Monte, Calif.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Quality



that protects
your company's name...

There is no substitute for quality whether you are interested in the components, the workmanship or the end product you manufacture.

One of the basic components of almost every industry is fasteners. Successful operations that cash in on every opportunity for faster assembly utilizing maximum worker output with minimum loss of materials—find that quality fasteners such as Southern Screws form a dependable foundation for profitable production.

Although Southern has earned for itself an enviable reputation for fast service, and its stock of over One Billion fasteners—Quality is the benchmark of Southern products . . . Constant quality that has become synonymous only with U. S. A.-made fasteners produced by U. S. A. workers.

If yours is a quality product, protect your company's name with Southern fasteners. Southern makes every screw it sells! Wide variety of head styles, materials, and finishes . . .

Write for samples, Stock List and Regional Stock Guide, Box 1360-ED, Statesville, North Carolina



Wood Screws • Machine Screws & Nuts • A&B Tapping Screws • Stove Bolts • Roll Thread Carriage Bolts • Dowel Screws • Hanger Bolts • Wood & Type U Drive Screws

Warehouses:

NEW YORK • CHICAGO • DALLAS • LOS ANGELES
CIRCLE 211 ON READER-SERVICE CARD

High Power* Oscillator



200-2500 mc/s

Here is a proven source of dependable, high-level r-f power that provides complete coverage from 200 to 2500 mc/s with just one simple band change. The model M1141 provides exceptional frequency stability and choice of self-contained sinusoidal or square wave modulation. These features, plus reliable, trouble-free operation, make the M1141 the best general purpose oscillator available anywhere. Look at the specifications listed below.

MAXSON MAKES IT

Specifications

Frequency Range:

200 to 2500 mc* (in two bands, 200-1050 and 950-2500 mc/sec)
Coverage to 3000 mc/s upon special request.

*Power Output:

200- 400 mc—at least 40 WATTS
400-1050 mc—at least 25 WATTS
1000-2500 mc—at least 10 WATTS
(Power output variable by front panel control.)

Calibration Accuracy:

±1% or ±5 mc, whichever is greater

Resettability: < 0.1%

Output Impedance:

50 ohms (nominal)

Modulation:

1. External; 2. Internal square-wave, 400 & 1000 cps; 3. Internal sine-wave, 400 & 1000 cps; 4. CW

Power Requirement:

115V a-c, 50/60 cps, single-phase, 375-watt

Request "Maxson Instruments
Catalog Sheet 101B".



MAXSON INSTRUMENTS

47-37 Austell Place
Long Island City 1, New York

Division of the W. L. Maxson Corporation

CIRCLE 213 ON READER-SERVICE CARD

Time Interval Meter

Range 10 μSec to 1 Sec



The Model 250A time interval meter is designed for the precise measurement of elapsed time between two events occurring in the range of 10 μsec to 1 sec. Optional features include extension to 10 or 100,000 sec. Accuracy is ± 10 μsec. The measurement interval may be started and stopped by independent or common voltages representing optical, mechanical or

electrical events. Typical applications are: ballistics measurements, relay timing, photographic timing, testing of mechanical and electro-mechanical timing devices, etc.

Two independent, continuously adjustable trigger level controls permit full rated sensitivity, 0.07 v rms, at any voltage level between -50 and +50 v. Small increments of voltage which are ordinarily masked by attenuators are easily selected even though high voltage bias levels, voltage steps, square waves, are present. Provision for oscilloscope marker signals for trigger level adjustment of start and stop points for measurement of complex waveforms: Specifications include: range, 10 μsec to 1 second in 5 decades (optional: a 6th decade for extension to 10 seconds or a mechanical register for extension to 100,000 seconds); Accuracy, ± 10 μsec ± 1 part in 1,000,000. Stability, short term 1 part in 1,000,000, long term 5 parts in 1,000,000 per week; start and stop, 2 independent or common channels, positive or negative polarity; Input (each channel), 0 to 100,000 cps, direct or ac coupled; External standard, 0 to 100 kc; Secondary Frequency Standard, 100 kc, 60 v peak to peak, may be standardized against WWV.

Computer-Measurements Corp., Dept. ED, 5528
Vineland Ave., No. Hollywood, Calif.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

Marking Material Guards

Hydrogen Embrittlement

Tempa-Dot marking material tells-the-tale on hydrogen embrittlement hazard on every part.

Tempa-Dot is packaged in a handy spot applicator tube that cuts labor cost drastically. Tempa-Dot appears as a vivid red dot before baking and changes color after the proper hydrogen embrittlement bake. Tempa-Dot color reaction is accurate to tattletale a ±25 F deviation.

EverLube Corp., Dept. ED, 6940 Farmdale Ave.,
No. Hollywood, Calif.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

A New Broad Band



FERRITE ISOLATOR

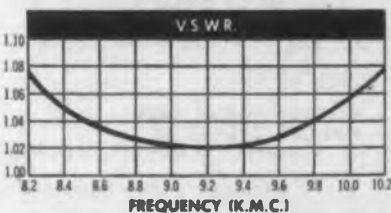
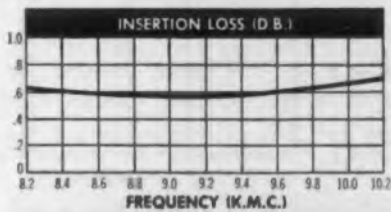
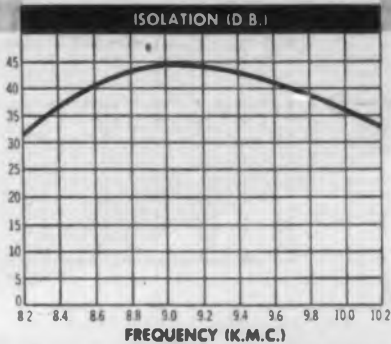
for Laboratory Test Bench Use



Model W177-2C-1

Use this Ferrite Isolator in your microwave setup for maximum frequency stability.

Typical Performance Curves



CHECK THESE FEATURES:

Broad Band—Usable from 8.2 to 10.2 KMC

High Isolation—A minimum of 25 db over the band

Insertion Loss—Less than 1 db

Small & Compact—Only 2½ inches long—weighs only 1½ lbs.

Flanges—Cover type. Mates with UG39/U flanges. Will absorb up to 10 watts reflected power

Price—\$135.00 each f.o.b., Van Nuys, Calif.

Delivery—From stock

Order—Model W177-2C-1

For custom-made isolators for specific radar & microwave application, you can depend on the skill of the Kearfott organization.

Kearfott, Western Division, has complete facilities for waveguide production, with qualified experts to assist in solving your problems. Let us help you.



For detailed information, ask for bulletins on new Ferrite Isolators and Radar Test sets.



Eastern Office:
1378 Main Ave.
Clifton, N.J.

Midwest Office:
188 W. Randolph St.
Chicago, Ill.

South Central Office:
6115 Denton Drive
Dallas, Texas

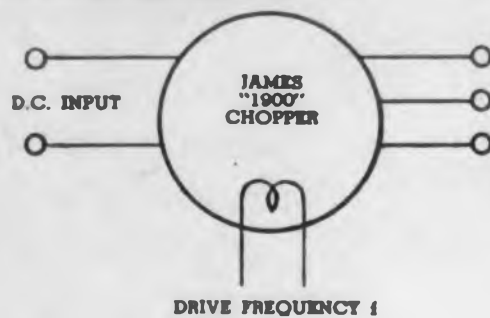
Western Area Office:
253 Vinedo Ave.
Pasadena, Calif.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

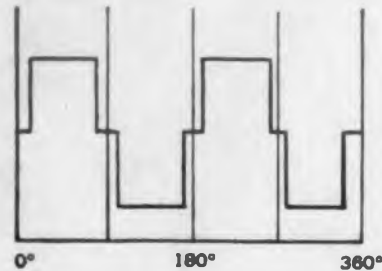
A NEW CHOPPER WITH FREQUENCY DOUBLER CHARACTERISTICS

Introducing the new JAMES "1900" Series Chopper with unique switching characteristics. Below are just two new circuit applications made possible by this component. It is polarized, non-resonant and capable of frequency doubling or providing two circuits 90° apart in phase.

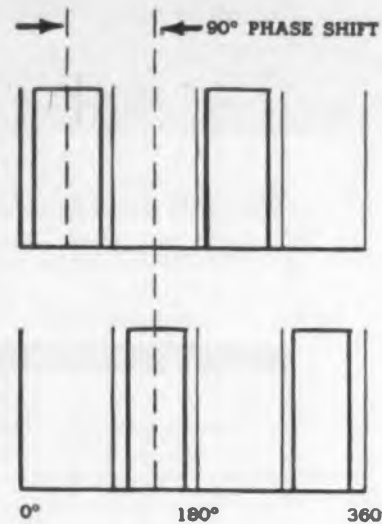
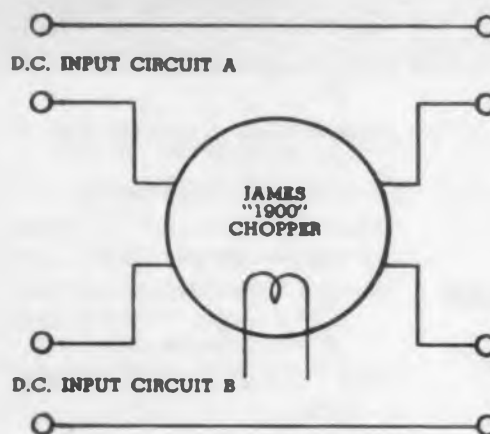
FREQUENCY DOUBLER



SWITCHING FREQUENCY 2 X 1



SERVO CONTROL



MODELS FOR 60 AND
400 CPS OPERATION

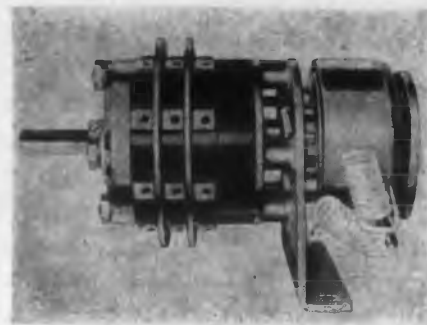
Write for Engineering Specifications

JAMES  **VIBRAPOWR COMPANY**
4036 N. Rockwell St. • Chicago 18, Ill.

CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION

Solenoid-Rotated Switches

Can be Custom-Built



Custom-built to the user's specifications, a varied line of solenoid-rotated multipole switches is available to suit a wide spectrum of needs. The

R-F Electronics M-12 sub-miniature switch has 12 contact positions 30 deg apart, up to three sections, and current capacity up to 3 amps, 115 v, ac. The type JR has 8 contact positions 45 deg apart, up to 10 sections, and is rated at 10 amps 125 v ac or 22-1/2 deg apart, up to 6 sections, and is rated at 5 amps, 125 v dc. Type HT has 16 contact positions may be closed by push button or by the mechanical action of the governed machine, as in automation.

Electro Switch Corp., Dept. ED, Weymouth 88, Mass.

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Pins Hold Nameplates

Low in Cost

Plastic pins, trimmed and heat sealed, are used for mounting new plastic nameplates called "Nameettes." Actually the pins are molded to the backs of the nameplates and are made long enough (up to 1 in.) so that the mounting may be on sheet metal, plastic, plywood or other body or panel material.

V. H. Swenson & Co., Inc., Dept. ED, 554-270 Elm St., Arlington, N.J.

CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION

Uniformly Illuminated Meter

Moving-Coil DC Instrument



FE 200 is a position distance indicator developed for a special application, and now available in all ranges

normal to dc moving-coil instruments. Its mechanism combines high performance stability and durability with very small size and light weight. It meets MIL-E-5272A Proc. III vibration requirements and has case dimensions conforming to MS33550 for 3-1/4 in. instruments.

Marion Electrical Instrument Co., Dept. ED, Grenier Field, Manchester, N.H.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

TELL YOUR PERSONNEL MANAGER ABOUT ELECTRONIC DESIGN'S "CAREER'S SECTION"

If your company is trying to attract skilled electronic design, development or research engineers, tell your Personnel Manager about ELECTRONIC DESIGN. Here is a concentrated audience of 25,000 engineers ready to read about the advantages offered by your plant.

Remember, more than 5,500 ELECTRONIC DESIGN readers inquire every issue—many of them will be interested in your job opportunities.

You can reach them in ELECTRONIC DESIGN'S "Career's Section," page 141 this issue.

THESE RUGGED JOHNSON VARIABLES WITHSTAND TERRIFIC VIBRATION and SHOCK!



Ceramic-soldered
for greater
strength!



Parts can't
break loose...
capacity can't
fluctuate!

These ceramic-soldered Johnson Type "L" capacitors are an ideal choice for applications requiring extreme stability and strength. Rotor bearings and stator support rods are actually soldered directly to the heavy $\frac{3}{16}$ " thick steatite ceramic end frames. Impervious to shock and vibration, parts can't break loose... capacity can't fluctuate.

SPECIFICATIONS

Plate spacing is .030" rated at 1500 volts peak at sea level; over 300 volts at 50,000 feet altitude. Plating is heavy nickel... other platings available on special order. Requires $1\frac{1}{2}$ " x $1\frac{3}{8}$ " panel mounting area.

• For complete information on Johnson Type "L" Air Variables or other quality Johnson components—write for your free copy of our newest catalog today!



Broadband Microwave Coupler 100 Through 3000 Mc

This high directivity, broadband microwave coupler is available in line sizes from Type N to 3-1/8 in., and will handle the full power rating of those line sizes.



Normally supplied for 30 db coupling, the device varies 3 db over a 2 to 1 frequency range. It has a minimum directivity of 23 db, which is independent of frequency. These couplers can be supplied either uni-directional or bi-directional. The vswr is less than 1.15 to 1 for main line.

Douglas Microwave Co., Inc., Dept. ED, 252 E. Third St., Mt. Vernon, N. Y.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

Color-Coded Plastic Gaskets Easy For Identification

Color-coded to indicate the twelve different available thicknesses, 0.001 to 0.030 in., a new plastic gasket and shim stock has been introduced. It is being marketed under the name of Color-Plast Gasket and Shim Stock.

Each gauge of the new material is identified by its own distinctive color.

General Gasket Co., Dept. ED, Industrial Rd., Clifton, N.J.

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

Panel Meters Clear-plastic Cases



Designed to make full use of room lighting, so that scales can be read without need for supplementary illumination, the GAR type PS-250 panel meters are furnished in transparent-plastic cases that conform to industry standards for size and mounting provisions.

Stock models, all of which use D'Arsonval-type movements, include dc microammeters, milliammeters, ammeters, millivoltmeters, and voltmeters, and a ac (rectifier-type) microammeters, milliammeters, and voltmeters. Standard accuracy is 2 per cent of full scale.

Waters Mfg. Inc., Dept. ED, P. O. Box 368, So. Sudbury, Mass.

CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

 **E. F. Johnson Company**
3409 SECOND AVE. S.W. • WASECA, MINN.

CIRCLE 223 ON READER-SERVICE CARD

when you
need

CUSTOM METERS

Yesterday!



CALL WATERS

Of course yesterday is a colloquial term, but we can and will give your order, whether large or small, extra fast attention and quick delivery. Custom meters will be made to your specifications regarding scales, graduations, ranges, colors, and trade names.

All meters have D'Arsonval-type movements with standard accuracy 2% of full scale. All a-c meters include internal rectifier.

The Waters line includes:

- A-c and d-c microam- ● 2½" and 3½" round cases.
meters, milliammeters, ● 2½" and 3½" square,
voltmeters, d-c millivolt- clear plastic cases.
meters and ammeters. ● 3½" and 4½" rectangular cases.

Hermetically-sealed meters are made to Military Specifications MIL-M-6A and JAN-1-6.

*Write today for further information,
or see your Waters representative.*

Waters
MANUFACTURING, Inc.

APPLICATION ENGINEERING OFFICES
IN PRINCIPAL CITIES

Wayland, Massachusetts
P. O. Box 368, So. Sudbury, Mass.



CIRCLE 227 ON READER-SERVICE CARD FOR MORE INFORMATION

Test for Electrical LEAKAGE • SHORTS • BREAKDOWN with "HYPOT" JUNIORS

HIGH POTENTIAL
TESTING
INSTRUMENTS



WRITE FOR
BULLETIN 4A

- ONLY ONE instrument necessary to make high potential tests for leakage, breakdown or shorts!
- PORTABLE, with rugged steel case...Operates in any position!
- SAFE to use, with rugged test leads, current limiting transformer, grounded case!
- SIMPLE—only three easy steps to make a complete test!
- VISUAL INDICATIONS from neon lights give positive test results. Audible test indication for leakage also available.
- RANGES 0-1500 to 0-10,000 V.A.C. output. Other "Hypots" to 100,000 V.A.C. output at 10 KVA.
- WRITE for complete data on "HYPOTS" for your jobs.

ASSOCIATED RESEARCH

Precision Instruments Since 1930

3769 West Belmont Avenue, Chicago 18, Illinois
Export Dept., 308 W. Washington Blvd., Chicago 6, Illinois

CIRCLE 228 ON READER-SERVICE CARD FOR MORE INFORMATION

GEE-LAR KURZ-KASCH KNOBS FOR EVERY USE!

A wide range of standard plastic knobs is available to you in the Gee-Lar Kurz-Kasch line. They meet all MIL and JAN specifications and are ideal for all kinds of instruments and communications applications.

AVAILABLE EXCLUSIVELY THROUGH
YOUR GEE-LAR ELECTRONICS
PARTS DISTRIBUTOR

INSTRUMENT
DIAL TYPE
CRANK HANDLE
SPINNER TYPE
POINTER AND BAR
... MANY OTHERS

WRITE TODAY for a complete Gee-Lar Catalog. FREE!

GEE-LAR MANUFACTURING COMPANY

Division of General Cement-Texton Inc.
400 South Wyman Street • Rockford, Illinois

Regulated Power Supply

0-50 V DC, 1 Amp



A low-voltage, high-current power supply unit for square wave loads, transistor work and other exacting applications, this

Model .5-IMB offers a dc output that can be varied continuously between 0-50 v with a maximum output current of 1 amp. A second output supplies 6.3 v ac at 10 amps. Regulation for 50 v/1000 ma output is rated at 80 mv change from no load to full load. Ripple and internal noise for the same output is below 3 mv rms. Recovery time from 0 to full load is 0.5 millisecond and from full to no load, 0.25 millisecond. Outputs may be pulsed with square wave load without affecting normal regulation. A 3-turn helipot provides accurate adjustment of output voltage. The power supply has a standard 7 x 19 in. rack-mounting panel, and measures 15 in. deep.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

Polyester Laminate

Low in Cost

Just released is a new Grade TS material, which meets the new NEMA GPO-1 standards for polyester glass-mat laminates.

Glastic Grade TS combines good physical properties with high electrical properties and heat resistance. Though it has better impact and punching characteristics, new Grade TS is low priced and available in thicknesses from 1/16 to 1-1/4 in. and in sheet sizes of 24 x 36 and 36 x 72 in.

The Glastic Corp., Dept. ED, 4321 Glen Ridge Rd., Cleveland 21, Ohio.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermocuring Adhesive

Passes Creep Test

Designed specifically for high temperature applications, Pliobond H. T., a new thermocuring adhesive, is being introduced. Having a curing temperature in the neighborhood of 350 F, Pliobond H. T. does not "creep" under load at high temperatures. Laboratory tests conducted at 400 F showed that 40 gauge samples of cold rolled steel bonded with the new adhesive exhibited no creep tendency under constant load. Many ordinary adhesives fail the creep test before reaching 150 F.

Goodyear Tire and Rubber Co., Chemical Div., Dept. ED, Akron 16, Ohio.

CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

RIFLE MAKER SAVES

86% with GRC DIE CASTING

Illustrated rifle part die cast in one piece by Gries not only costs 86% less than former 3-piece assembly, but is actually superior—more precise, better looking, with no assembled parts to loosen. By die casting in one piece, and in one automatic operation, substantial savings in time and money are realized. Designs can be simplified to reduce or eliminate machining and assembly.

NO MINIMUM SIZE!

Maximum length: 1 3/4"

Maximum weight: 1/2 oz.



Quick deliveries on quantities of 100,000 to many millions.

SEND TODAY FOR SAMPLES AND BULLETIN.

GRIES REPRODUCER CORP.

World's Foremost Producer of Small-Die Castings
40 Second St., New Rochelle, N. Y.
Phone: NEw Rochelle 3-8600

GRIES

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION

SCIENTIFIC ENCLOSURES QUICKLY ASSEMBLED!

Widney-DORLEG

Cabinet Component System

of pre-fabricated dural die-cast corners, extruded sections and parts... assemble into modern fully-radiused cabinets to any dimensions, with NO SPECIAL TOOLS, DIES OR JIGS.

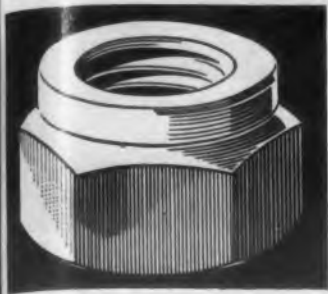
Used in Electronic applications, such as Control and Analysis, Computers, Mining, Spraying, Refining, Food Processing, etc. Also in many Government-approved installations.

For prices & data sheets write Dept. YB-887

BRITISH INDUSTRIES CORP., Port Washington, N. Y.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

Specify standard **FLEXLOC**
microsize locknuts



- One-piece, all-metal construction
- Resilient locking section
- Controlled locking torque
- Lock and stop nut in one
- Every thread carries its full share of the load
- Made to Class 3B fit

Smaller than regular FLEXLOCs of the same nominal diameter, FLEXLOC microsize locknuts make possible smaller mating joints and flanges. Standard materials are brass (plain or cadmium plated) and aluminum (plain or chemically treated), for temperatures to 250°F; alloy steel and 18-8 stainless steel, for temperatures to 550°F. They are available in sizes #0 through #4 at your industrial distributor's. See him for details. Or write for literature, samples, information on other materials. Flexloc Locknut Division, STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

STANDARD PRESSED STEEL CO.

FLEXLOC LOCKNUT DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

An industry-wide trade show featuring new materials... new methods... new equipment... and new applications from the plastics industry.

Send for your tickets now. Since there are no general public admissions, please make ticket requests on your company letterhead

VISIT THE
DYNAMIC
WORLD
OF
PLASTICS



Pacific Coast
Plastics
Exposition
March 18-21,
1957

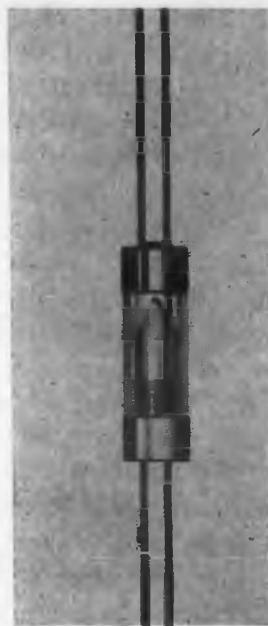
SHRINE EXPOSITION HALL
LOS ANGELES, CALIFORNIA

Sponsored by: The Society of the Plastics Industry, Inc.
250 Park Avenue • New York 17, New York

CIRCLE 236 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 15, 1957

Miniature Thermal Relays
Stand Extreme Conditions



This illustration shows the actual size of a line of miniature thermal relays currently used in missiles and available for rockets, aircraft, computers, and other specialized electronic devices. They withstand temperatures from -100 F to +450 F, can take shock up to 200 g's and vibration from 20 to 3000 cps; and their electrical characteristics are precise. Operating on the "fuse burnout" principle, these relays permit wide latitude in systems design. Metal headers bonded to glass tubing provide visibility of interior. Reliability is rated 99.99 per cent plus.

Networks Electronic Corp., Dept. ED, 14806 Oxnard St., Van Nuys, Calif.

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

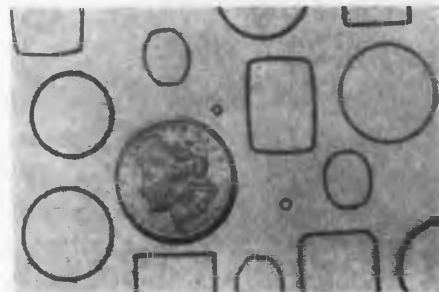
7-Oz Electro-Mechanical Filters
For Single Sideband Radio

Small, 7-oz. electro-mechanical filters which can reduce requirements for electron tubes and components, particularly single sideband types, have been developed. The new components, band-pass devices designed to provide the extreme selectivity required for single sideband operation, include a 250-kc upper sideband type (MFU-250-1) and a 250-kc lower sideband type (MFL-250-1).

Radio Corp. of America, Dept. ED, 30 Rockefeller Plaza, New York 20, N.Y.

CIRCLE 238 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Molded Rubber Parts
Natural and Synthetic



(such as the gaskets here shown) that have round cross sections as small as 0.02 in., and dimensional tolerances as close as ±0.001 in. Varying shapes can be produced in such dimensions and tolerances, some even with mitered corners.

Minnesota Rubber & Gasket Co., Dept. ED, 3630 Wooddale Ave., Minneapolis 16, Minn.

CIRCLE 239 ON READER-SERVICE CARD FOR MORE INFORMATION

True Hermetic Sealing
assures Maximum Stability in

AMPERITE
RELAYS and REGULATORS

Simplest • Most Compact • Most Economical



STANDARD

PROBLEM? Send for
Bulletin No. TR-81

**Thermostatic
DELAY RELAYS**

2 to 180 Seconds



MINIATURE

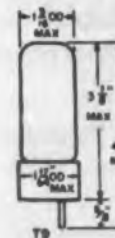
- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- Hermetically sealed. Not affected by altitude, moisture, or other climate changes.
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from -55° to +70°C. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!
TYPES: Standard Radio Octal, and 9-Pin Miniature.

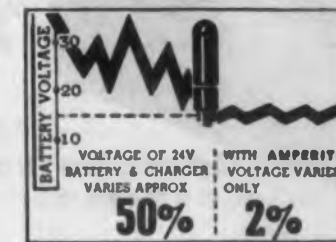
Also — Amperite Differential Relays: Used for automatic overload, under-voltage or under-current protection.

BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit automatically regulated at a definite value (for example, 0.5 amp.)
For currents of 60 ma. to 5 amps. Operate on A.C. D.C., Pulsating Current.



Hermetically sealed, they are not affected by changes in altitude, ambient temperature (-55° to +90° C.), or humidity. Rugged, light, compact, most inexpensive.



Write for 4-page Bulletin No. AB-51

AMPERITE CO., Inc.
561 Broadway, New York 12, N. Y.
Telephone: CAnal 6-1446

In Canada: Atlas Radio Corp., Ltd.
41 Wingate Ave., Toronto 10, Ont.



Individual inspection and double checking assures top quality of Amperite products.

CIRCLE 240 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 hold.

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 245 ON READER-SERVICE CARD FOR MORE INFORMATION

Industrial Preset Counter

Local or Remote Reset



MEK-2094-AG electronic counter was designed for all industrial counting applications and counts dependably from 0 to 5000 counts per second without special adjustment or circuit changes. The counter is extremely flexible and will operate with photoelectric, semiconductor, magnetic, or contact-

making pickups. At the end of the warning and final count, plug-in relays are energized for control purposes. The warning circuits can be used to slow down the process to insure accurate control or to provide notice that the preset number is about to be reached. After reaching the end of count, the counter can be reset to zero by either of several methods. The counter can be reset automatically either immediately or after the expiration of a built-in adjustable time delay (0.4 sec). It is also possible to have the counter reset immediately and at the same time to have the control relays remain energized until reset by one or the other of the above means. These are standard features and eliminate in most cases the need for a special counter to provide the desired operation.

Operating personnel will be interested in the unique enclosure design which provides visible observation without opening the dust-tight, oil-tight (NEMA 12) enclosure. When a change in setting is required, the enclosure can be opened by nonelectrical personnel as the unit is dead front (NEMA 1) with the door open.

Machinery Electrification, Inc., Dept. ED, Northboro, Mass.

CIRCLE 243 ON READER-SERVICE CARD FOR MORE INFORMATION

Serrated Lug

Resists Horizontal Pull



A serrated lug with a circular boss, combines greater resistance to horizontal pull with up to 11 per cent greater contact area than is afforded by cylindrical or hexagonal bodies. Intended to compete in the lowest price field, the PennLug is available in seven sizes.

Penn-Union Electric Corp., Dept. ED, Erie, Pa.

CIRCLE 244 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW MUCH AIR?
WHAT PRESSURE LOSS?
WHAT TYPE OF FILTER?
WHAT SIZE FILTER?
HOW MANY FILTERS?

How Are You Going To Solve Your Electronic Equipment Ventilation Problems?

Typical **FAR-AIR** filters now in use by major electronic manufacturers

Smaller components, critical heat effects and effective dirt removal make proper ventilation of electronic equipment most important. FARR COMPANY offers a new line of air filters for electronic components that can be specially designed to meet your needs... in any size, shape, material or capacity.

More important, Farr Engineers who are among the country's leading authorities on air filtration, offer you expert assistance in your ventilation design problems.

FARR
COMPANY

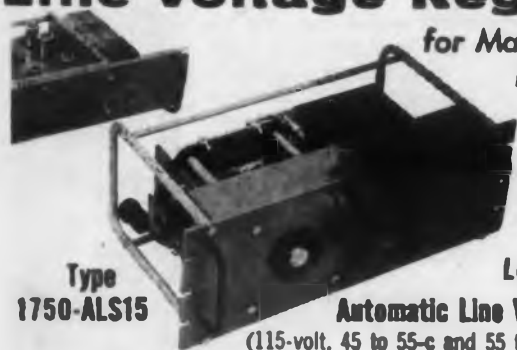
LOS ANGELES • NEW YORK • CHICAGO • NEW ORLEANS

Manufacturing Licensees:
Far Company (UK) Ltd.,
London, Canada
The Clift Engineering Co. Pty. Ltd.,
Sydney, Australia
Mitsubishi Ltd.,
Birmingham, England
Originators of **FARR-AIR** Certified Filter Service

WRITE OR WIRE FOR TECHNICAL INFORMATION OR THE SERVICES OF YOUR NEARBY FAR-AIR® FIELD ENGINEER

CIRCLE 241 ON READER-SERVICE CARD FOR MORE INFORMATION

Now **GR** Militarized! Automatic Line Voltage Regulator



for Maximum Flexibility
Simple Maintenance
Reliable Operation
Long Life

Type 1750-ALS15

Automatic Line Voltage Regulator
(115-volt, 45 to 55-c and 55 to 65-c line): \$625.

☆ Output Voltage constant within ±0.25%; adjustable over ±10% of 115-volt line

☆ Fast, 10-volts-per-second response ☆ 6 KVA Capacity

☆ No Waveform Distortion

☆ Regulator Unit and Control Circuits in separate Assemblies; latter removable for servicing without interrupting interim manual operation

Write for detailed information including quantity prices, data on 230-volt models, and units to control 400-c power.

GENERAL RADIO Company

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

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 920 S. Michigan Ave. CHICAGO 5

1150 York Road, Abington, Pa. PHILADELPHIA

3055 13th St., Silver Spring, Md. WASHINGTON, D. C. 1000 N. Seward St. LOS ANGELES 38

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

KESTER SOLDERFORMS®

BIG STEP in

Production Cost-Cutting!

Take a giant step forward in lowering assembly costs with Kester Solderforms. Labor costs are reduced, assembly operations speeded up. There's no solder waste, and the end result is a neater, more expertly finished product.

WRITE TODAY for complete Kester Solderforms information. Free!
KESTER SOLDER COMPANY

4266 Wrightwood Ave.
Chicago 39, Illinois
Newark 5, New Jersey
Brantford, Canada

CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION



**Here's real protection—
economical, and
simple to apply.**

◀ The corona inhibiting ring of this T-V fly-back coil is

PROXMELT®

Fusible plastic dipping and enveloping compound. Preferred for cells, capacitors, junctions, transformers, transistors, bases, coils. Easy to apply with simple economical equipment. Various Proxmelt are used as self-sufficient insulating compositions; as well as modifiers for waxes, resins, oils, etc. There is a Proxmelt for *your* product. Write or phone for details.

PYROXYLIN PRODUCTS, INC.

PHILADELPHIA, PENNA.

CHICAGO 32

Virginia 7-4800

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

SAVE COST ON PRINTED CIRCUIT DRAWINGS



Black Donuts . . . overlapping "KWIKY DOTS" . . . for fast and easy application. Sizes from 1/4" O.D. up. Any I.D. desired. Black discs from 1/8" dia. also available.

Narrow black pressure-sensitive tape in 60 yd. rolls from 1/32" width. Also . . . tear-drops and 90° corners in stock.

PROMPT DELIVERY

WRITE FOR SAMPLES

BY-BUK CO.

4314 W. Pico Blvd. • Los Angeles 19, Calif.

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 15, 1957

Hand Vibrograph Reads Machine Vibration



Mechanical vibration in aircraft, ships and vehicles, in machinery and its casings or bases, or in component parts such as shafts or springs, can be measured and recorded conveniently by this Askania Hand Vibrograph. With the help of accessories more elaborate measurements can be made and recorded.

Records are inscribed on moving waxed tape and can be seen and evaluated at once. The instrument senses in any direction through mere contact with its feeler tube. It needs no line power, only a flashlight battery for its time markers. During its running time of 2 min. per rewinding it advances the paper about 180 in., of 1-1/2 in. per second.

The frequency range is 0-250 cps; acceleration limit 100g max; magnification 50x max; smallest amplitude, 0.00001 in.; largest amplitude 3/8 in.; paper tape dimensions 1 in. x 30 ft.

Available accessories include 1:1, 5:1, 20:1 and 50:1 feeler tubes; clamping device for measuring low frequencies; extension rod for reaching difficult points; ball and socket joint for rigid connection to vibrating body and roller fork for measuring eccentricity of shafts.

The Hand Vibrograph measures 10-1/4 in. x 3-1/2 in. x 6 in. and weighs 3-3/4 lb.

Epic, Inc., Dept. ED, 154 Nassau St., New York 38, N.Y.

CIRCLE 250 ON READER-SERVICE CARD FOR MORE INFORMATION

Multi-Bias for TV Servicing

Four Simultaneous Biases



Designed for alignment and servicing of monochrome and color TV equipment, the Model 230 voltage-regulated multi-bias supply provides four simultaneous bias voltages to substitute for avc, agc, chroma, etc. biases. All outputs are from a well-filtered, voltage-regulated source. Each is individually adjustable; three of the controls being variable from 0 to -15 v and the fourth from 0 to -150 v. Price is \$27.50, net.

Precision Apparatus Co., Inc., Dept. ED, 70-31 84th St., Glendale 27, Long Island, N.Y.

CIRCLE 251 ON READER-SERVICE CARD FOR MORE INFORMATION

WIDE

FREQUENCY and
VOLTAGE COVERAGE



MV-45A TRVM

Introducing . . .

the NEW MV-02B VTVM and the MV-45A TRVM (TRANSISTOR VOLTMETER)

The addition of these high quality AC voltmeters to our line extends even further our unrivaled coverage of unusually high frequency and voltage measuring ranges.

TYPE	FREQUENCY	VOLTAGE	ACCURACY
MV-02B VTVM	2 cps — 250 kc	0.7 mV — 1 kV	2% through entire frequency range
MV-12B VTVM	20 cps — 250 kc	0.7 mV — 1 kV	2% through entire frequency range
MV-22B VTVM	20 cps — 10 mc	70 μV — 1 kV	3 1/2% through entire frequency range
MV-18C VTVM	1 mc — 2.5 kmc	1 mV — 1 kV	5% below 100 mc, 7% below 200 mc, rest 5% with calibration chart
MV-45A TRVM	20 cps — 150 kc	2 μV — 1 kV	2% below 100 kc, 5% above

TOMORROW IS OUR YESTERDAY

Millivac
Instrument Corp.

BOX 997, SCHENECTADY, NEW YORK

CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION

How KPR* helps you make etched circuits

*Kodak Photo Resist

If you manufacture etched circuits for electronic equipment, you'll like KPR. Fast and easy to use, stable, durable, it is an all-plastic, pre-sensitized, liquid surface coating. Here's how it works . . .

- (1) Clean metal thoroughly; a power brush saves time here.
- (2) Easiest way to get rid of oxides after scrubbing is with acid rinse.
- (3) Then, coating is easy with KPR. You can spray, dip, or use a whirler. KPR is so stable you can coat plates months in advance, without affecting exposure times.
- (4) Exposure times are short on any metal. Use arc lights, or ultraviolet. Your exposure time stays constant, even through atmospheric changes, protects you against makeovers.
- (5) Rapid, continuous processing can be done in vapor-spray degreaser for economy on large runs—in tanks or trays on shorter runs.
- (6) Use standard copper etching techniques with ferric chloride. KPR protects panel surface image during fabrication, then strips off clean when panel is "skated" on tin-lead solder, leaving excellent solder joints.

There's full information in a new booklet titled "Industrial Uses of Kodak Photo Resist"—yours free for the asking.

No statement or suggestion in this advertisement is to be considered a recommendation or inducement of any use, manufacture, or sale that may infringe any patents now or hereafter in existence.

EASTMAN KODAK COMPANY
Rochester 4, N. Y.

Kodak

CIRCLE 254 ON READER-SERVICE CARD FOR MORE INFORMATION



TEMP-R-TAPE®

pressure sensitive TEFLON tape
for Class H insulation, low friction facing

Temp-R-Tape, Teflon with a silicone polymer adhesive backing, provides 1500 vpm dielectric strength, low power factor, a temperature range of -100°F to 400°F (-75°C to 200°C), and a slippery, low friction surface. As an easy-to-apply dielectric or low friction facing, Temp-R-Tape is being designed into electrical and electronic units, aircraft and general industrial applications. $\frac{1}{4}$ " to 12" wide, .006" or .013" thick.

FREE SAMPLE and folder—write, phone or use inquiry service

A PRODUCT OF **CHR** THE CONNECTICUT HARD RUBBER CO., NEW HAVEN 9, CONN.

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Designers might find it profitable to redesign their present products, or to conceive of better products, to take advantage of the capabilities of these new production equipments.

Single Crystal Puller Silicon or Germanium



Designed for maximum production of single silicon or germanium crystals, the unit also may be adapted to laboratory work. Production rates of 300 grams of single crystal silicon and excesses of 1000 grams of single crystal germanium per 8 hr day have been reported.

The carbon pedestal which supports the crucible has been designed to provide maximum RF substances and minimum heat capacity. Precision construction of the pedestal and susceptor ring assures uniform heat distribution with absence of hot spots.

The top pressure plate of the crystal puller incorporates a unique silicone-rubber seal which permits positive, gas-tight sealing of the muffler and pull-rod without bending or distortion. Sealing of the top and bottom plates on the quartz muffler is accomplished under spring pressure, utilizing silicone-rubber gaskets between the plates and quartz tube. Both plates are internally and externally water cooled. The puller's induction coil support is mounted to the column of the machine. Up and down adjustment is made by a rack and pinion to facilitate positioning of the coil with respect to the crucible and susceptor.

Power requirements for the control cabinet are 115 v, 60 cps, single-phase, 15 amps. Other voltages and frequencies can be furnished. For the induction heater of 10 kw capacity, a supply of 220 v, 60 cps, 3-phase, 100 amps is required. Water requirements for the puller is 1 gpm minimum at 30 psi. For the induction heater, a supply of 6 gpm minimum at 40-80 psi is necessary. Inert gas requirements is approximately 6 liters per min during pull.

Precision Tool & Engineering Co., Dept. ED, 92-26 180 St., Jamaica 32, N.Y.

CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION



Assemble laminations 3 ways better with Rollpin

In this radio transformer, ROLLPIN® fasteners hold core laminations firmly in place and do two things a rivet can't do—ROLLPIN aligns the laminations and compensates for minor hole variations.

ROLLPIN fasteners offer an opportunity to cut assembly and maintenance costs in many spots where dowels, rivets, set screws or pins were previously used. These slotted tubular steel pins eliminate special machining, tapping, close tolerances. Driven into a hole drilled to normal production standards, ROLLPIN locks in place, yet can be readily drifted out and reused if necessary.



Want more information? Write Dept. B41-257

**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION



AT THE I R E SHOW Visit Electronic Design Booth No. 2401

Editorial Headquarters for Electronic Design, Electronic Week, and Electronic Daily, will be located at Booth No. 2401 at the Coliseum. Stop in to see our editors . . . bring us your suggestions for future articles . . . tell us about your plans . . . or, request an editor to meet your engineers to discuss your new programs and developments. Copies of all three Hayden publications will be available at the booth.

HAYDEN PUBLISHING COMPANY, INC.
New York • Chicago • Los Angeles

ELECTRONIC DESIGN • February 15, 1957

Berkeley NEWS NOTES



NEW IN-LINE, IN-PLANE READOUT

- One-plane presentation; easily read from any angle
- Reduces fatigue, reading error
- Speeds data observation
- High reliability, low maintenance

BRIEF SPECIFICATIONS:

No. digits: 4, 5 or 6
 Digit size: $\frac{3}{4}$ " to $1\frac{1}{4}$ "
 Operating speed: To 15 readouts per second
 Input: Binary voltages from counting instruments
 Overall dim.: $5\frac{1}{2}$ " H x $20\frac{3}{4}$ " W x 17" D; 35 lbs.
 Price: \$610.00 (4 digit) to \$775.00 (6 digit)
 (f.o.b. factory)

Write today for complete data;
 please address Dept. D-2.

Berkeley

division

105

BECKMAN INSTRUMENTS INC.

2200 Wright Avenue • Richmond 3, Calif.

CIRCLE 261 ON READER-SERVICE CARD FOR MORE INFORMATION

ALLIED the world's largest supplier of ELECTRON TUBES for industry

ALL BRANDS IN STOCK

AMPEREX
 EIMAC
 GE
 ELECTRONICS, INC.
 RCA
 RAYTHEON
 SYLVANIA
 TAYLOR
 TUNGSO
 WESTINGHOUSE
 and others

Immediate delivery from stock
 saves you time, effort and money

At ALLIED, we constantly stock for quick shipment the world's largest inventory of special-purpose electron tubes. We specialize in supplying the electron tube needs of industry, broadcast stations, laboratories, schools and government. Save time, effort and money on your electron tube orders—phone, wire or write us anytime for expert, immediate shipment from stock.

ALL TYPES IN STOCK

Power Transmitting Rectifier
 Phototube
 Radiation
 Sub-Miniature
 Oscillograph
 Ignitron
 Thyatron
 Image Orthicon
 Klystron
 and all others



Refer to your ALLIED Catalog for everything in electronic supplies. Copies of our latest 356-page 1957 edition are available FREE on request.

ALLIED RADIO

100 N. Western Ave.
 Dept. 69-B-7, Chicago 80, Ill.

EVERYTHING IN ELECTRONICS FROM ONE DEPENDABLE SOURCE

CIRCLE 262 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Materials Handling System

Lifts and Holds



An announcement has been made of a materials handling system, called VAC-U-LIFT, which incorporates the principle of induced vacuum in conjunction with a

single or combination of a number of VAC-U-PADS, which are then used for lifting and holding non-porous materials. A positive vacuum system creating vacuum to 28 in. Hg induces positive grip on the VAC-U-PADS. The system uses a vacuum "Power Pac" which utilizes an efficient compact rotary pump controlled by a 5-way solenoid valve.

The VAC-U-PADS are of metal construction in various shapes to fit particular applications. Positive sealing action is controlled through a special sealing ring attached to the perimeter of the VAC-U-PAD. No load is imposed on the sealing ring at any time. The VAC-U-PAD comes in direct contact with the material, the seal ring only acting to create the vacuum.

VAC-U-Lift Co., Dept. ED, Box 298, Salem, Ill.

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor Capping Machine

Fully Automatic



Designed for high production capping of resistor bodies with press fitted terminal caps, this machine may be tooled for a variety of resistor bodies ranging in size

from $1/16$ to $5/16$ in. diameters.

Machine features in vibratory hopper feeds which automatically maintain full chutes for uninterrupted operation. Caps are fed at 100 per min so that 3000 resistors are assembled per hour.

One machine may be tooled to handle several sizes by simple change procedure. Also available is machine to fit end leads internally, thereby making the entire OD of the body available for the resistance element.

Special Products Div., Halm Instrument Co., Inc., Dept. ED, Glen Head Rd., Glen Head, N.Y.

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

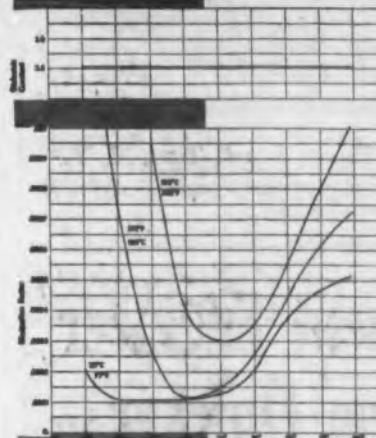
For Ultra High Frequency Insulation

REXOLITE 1422

In cast rods of diameters to 6" and plates up to 36" x 36", from .031" to $1\frac{1}{2}$ " thickness.



REXOLITE 1422 CHARACTERISTICS



• Withstands high temperatures — to 400° F.

• Does not exhibit cold flow.

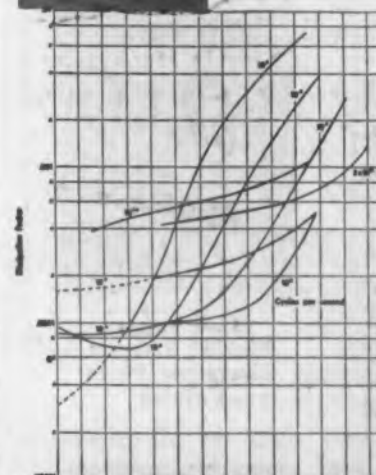
• Has low dielectric constant and power factor.

• Specific gravity of 1.045-1.050.

• Is strong and rigid with good tensile and impact strengths.

• Unusual chemical inertness permits its use where others fail.

• Readily machinable to close tolerances.



WHERE PERFORMANCE PLUS PRICE IS A FACTOR REXOLITE 2100

UHF insulation in thermosetting sheets 36" x 36", .031" - .125" thick

• Has good punching properties.

• High impact strength.

• Good machinability.

• Dielectric constant 10-10,000mc. 2.77.

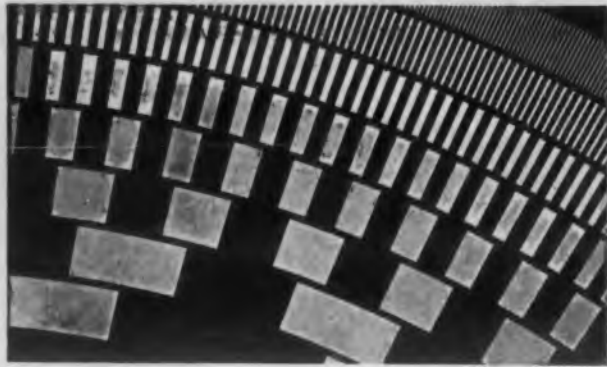
Send for complete technical data and samples

The **REX** CORPORATION
 Electronics Division

210 HAYWARD RD., WEST ACTON, MASS.

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

Gurley Standard Binary Code Discs
Now Available in Four Versions



Gurley, manufacturer of the standard binary code disc for the electronics industries, is now able to supply four versions for use in either photo-electric, magnetic or contact types of pickups.

Containing concentric zones of information in the gray (reflected) code, the Gurley discs contain alternate clear and opaque sectors. Thin annular rings separating adjacent zones are opaque. Varying patterns record up to 8192 bits of information (65,536 on special designs!).

Four coatings are available: "Type T"—photoengraver's glue with colloidal (black) silver, essentially grainless; "Type R" with etched metal coating, for reflectivity and transmission contrast; "Type M" with chemically deposited ferrous alloy possessing both magnetic and optical transmission contrast; and "Type C"—metal bonded on glass for electrical contact use as well as in contrast of optical transmission. WRITE FOR BULLETIN 7000.

W. & L. E. GURLEY • 525 Fulton Street, Troy, N. Y.

GURLEY since 1845

CIRCLE 267 ON READER-SERVICE CARD FOR MORE INFORMATION

Alert Development Engineer Solves Problem Quicker

Direct-from-the-
factory product
information
is the key . . .

he finds it faster
in The MASTER!



1546 pages
World's Largest
Electronic Parts
Catalog

Production, design, development engineers and PA's rely on The MASTER. It's the quickest, easiest way to get current, direct-from-the-factory data on all products needed in production and research applications. The MASTER describes, illustrates, lists specifications and prices of over 125,000 electronic items—all systematically arranged for speedy reference.

Get the NEW
1957 Radio-Electronic MASTER

21st edition

at your parts distributor today

ONLY \$295

The Radio-Electronic MASTER
60 Madison Avenue • Hempstead, N.Y.

CIRCLE 268 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Materials Properties Tester

Dynamic Hardness and Natural Lubricity



Contrasted with the commonly used hardness testers with stationary indentors, this Model 164 dyhedron tester works a standard shaped diamond penetrator into the surface of the material with a dynamic rotary oscillating motion under 2

kg pressure. The motion of the device also considers the material's natural lubricity, of importance in materials used for bearing or sliding parts. This natural lubricating factor is closely related to the material's resistance to abrasive wear.

Practically all materials below the diamond in hardness can be tested. Readings on abrasive wheels indicate the strength of bonding materials that hold the abrasive grain together and not the hardness of the abrasive grain itself.

Taber Instrument Corp., Dept. ED, 111 Goundry St., North Tonawanda, N.Y.

CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Blueprint Machine

Only 5-1/2 Pounds



Weighing only 5-1/2 lbs, measuring only 18 x 9-1/2 x 4 in. deep, the new PELprinter "60" is light and compact enough to be carried. Op-

erating on a dry vapor process, it reproduces any type of drawing or written matter up to 8-1/2 x 14 in. The entire operation takes less than 1-1/2 mins. The cost is approximately 1¢ per copy sheet. Price of the complete unit with 25 sheets of 8-1/2 x 11 in. PELpaper is \$60.00.

Contained in a luggage-type, unbreakable plastic carrying case, the PELprinter "60" requires only a 110 v outlet for operation. It can also be adapted for use in automobiles.

Product Engineering Labs. Co., Inc., Dept. ED, PELprinter Div., 314 Adams St., Newark 5, N.J.

CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

UNIPLUG DC FILAMENT Supplies



Model	Output	Input	Price
119	12.6v@0.9a	115 AC	\$36.00
125A	6.3v@1.2a	115 AC	\$39.50
*225	6.3v@2.0a	115 AC	\$69.00
*226	6.3v@0.6a	6.3 AC	\$29.00

*Silicon Rectifiers. Special units to your specs. Available on short delivery.

C. J. Applegate & Co.

Phone Hillcrest 2-8750

1840-24th St., Boulder, Colo.

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION



HEAT-CONTROL PROBLEMS
IN YOUR INDUSTRY,
MR. DESIGNER?

BEST ANSWER USUALLY COMPACT, TOUGH,
ACCURATE FENWAL THERMOSWITCH UNIT.

WE HAVE PROVED THAT TO DESIGNERS
IN ALMOST EVERY INDUSTRY,
INCLUDING, PROBABLY, YOURS.

VERY ADAPTABLE — 24,000 VARIATIONS
AVAILABLE ON BASIC THERMOSWITCH IDEA.

Designers — Write Fenwal Inc.,
172 Pleasant St., Ashland, Mass.,
for THERMOSWITCH Folder.

Fenwal

Controls Temperature
... Precisely

CIRCLE 272 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Resistance Welding Controls Assure Uniform Welds



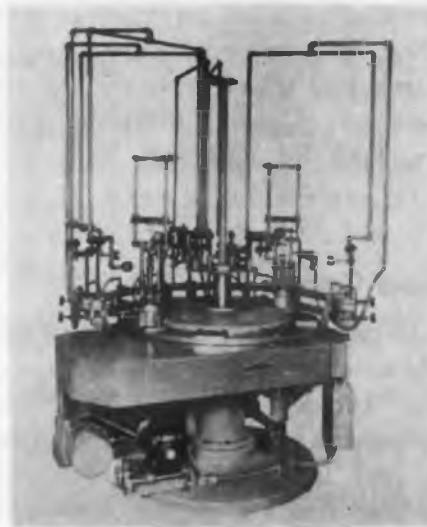
Designed to assure precise control of current duration and magnitude for accurate, uniform resistance welding, two new synchronous timers and two new thyatron contactors are available.

The synchronous timers are offered in two models, Model 2-152 single synchronous timer, and the Model 2-153 dual timer. The single synchronous model has two independent control knobs, one for heat adjustment and one for time. The dual unit has two independent controls for heat and two for time, permitting the use of two separate welding heads or a dual head. A transfer circuit for either foot or knee switch connection is provided on the dual synchronous timer.

Raytheon Mfg. Co., Dept. ED, Waltham, Mass.

CIRCLE 276 ON READER-SERVICE CARD FOR MORE INFORMATION

Seal Memory Tubes At High Speed



To fulfill the latest CRT requirements of elongated neck lengths, difficult envelope shapes increased numbers of components, and more exacting precision levels and to add production-rate manufacturing speeds an improved group of sealing

machines has been created. Machine No. 2815, accommodating neck lengths up to 40 in. precision indexes tubes by a very accurate mechanism that provides maximum product quality. Product speeds of up to 140 units per hour are easily maintained.

Kahle Engineering Co., Dept. ED, 1400 Seventh St., North Bergen, N.J.

CIRCLE 277 ON READER-SERVICE CARD FOR MORE INFORMATION

3 BASIC REASONS WHY DERINGER CONTACTS ARE YOUR BEST BUY

UNIFORM HIGH QUALITY

Modern facilities and equipment are designed for efficient precision manufacture. Skilled craftsmen specialize on just one product—the finest electrical contacts. Double check quality control plus 100% inspection assures uniform high quality.

ADVANTAGEOUSLY PRICED

in accordance with precious or base metal market. Substantial savings made possible by efficient operation are passed on to you in superior contacts and service.

UNUSUALLY QUICK DELIVERY

Deringer now offers the largest selection of standard sizes in the industry—300 flat and radius faced contacts and rivets. Delivery of small quantities for emergency or pilot runs can normally be made quickly, dependent chiefly on the supply of the particular metal specified. Delivery of larger quantities depends on your needs.

Write for our new catalog listing 300 standard contacts and rivets.

DERINGER

METALLURGICAL CORPORATION

8123 MONTICELLO AVE. • SKOKIE, ILLINOIS
PHONES: CHICAGO—KEystone 9-8502 SKOKIE—ORchard 5-1030

CIRCLE 278 ON READER-SERVICE CARD FOR MORE INFORMATION

HERMASEAL . . . Specialists in Glass-to-Metal Seals!

Hermaseal

CALL US ON STANDARD
AND SPECIAL TERMINALS.

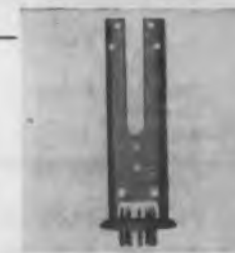
Hermaseal OCTAL Plug. ▶



Hermaseal

. . . A successful pioneer since 1943 in glass-to-metal seals, compression (cold rolled steel) and matched (Kovar), to meet your needs.

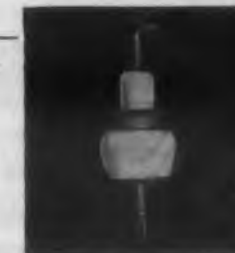
Hermaseal NOVAL Header
and Bracket Assembly. ▶



Hermaseal

. . . with its expert engineering staff and the latest in production equipment is ready to serve you.

Hermaseal 10M Volt TERMINAL. ▶



For further information,
phone 2-3773 or write.



THE HERMASEAL COMPANY, INC.
1010 N. Main, Elkhart, Indiana

CIRCLE 279 ON READER-SERVICE CARD FOR MORE INFORMATION

Plasti-Plugs

45 STANDARD SIZES

FASTEX® Plasti-Plugs® snap-in type plastic plugs—
are available for a wide range of applications, including:

- Ventilation Holes
- Access Holes
- Sealing Plugs
- Frictionless Glides
- Indicator Buttons
- Appliance Feet
- Spacer Buttons
- Conduit Holes

Available in several plastic materials. Plasti-Plugs can be color-matched to your product saving expensive rack painting, and they just snap in.

Write for FREE Plasti-Plug Folder



FASTEX

195 Algonquin Road, Des Plaines, Illinois

In Canada: SHAKEPROOF-FASTEX,

Division of Canada Illinois Tools Ltd., Toronto, Ont

A DIVISION OF ILLINOIS TOOL WORKS



CIRCLE 274 ON READER-SERVICE CARD FOR MORE INFORMATION

every day,
designers are
discovering
new ways to
make products
better, more
efficient...with

Precision manufactured
from DuPont Nylon Resin
to close tolerance of
±.001 on diameters
and .001 on sphericity.
Ace Nylon Balls give
design flexibility and
production economy.

Light in weight . . .
tough at low temperatures
stable at
high temperatures . . .
resistant to corroding
chemicals such as
sulphuric acid, etc. . . .
almost abrasionproof
these mass-produced
balls have hundreds of
industrial applications.

Come in 14 standard
sizes from 1/8" to 3/4".
Complete facilities
for fabrication of
plastic parts for all
industries. Estimates
submitted promptly
on receipt of blue-
prints or specifications.

Write for samples,
bulletin, price list
TODAY.

PRECISION
ACE NYLON BALLS

ACE PLASTIC COMPANY

Extrusion Molders
and Fabricators

91-58 Van Wyck Expressway, Jamaica 35, N. Y.

CIRCLE 275 ON READER-SERVICE CARD FOR MORE INFORMATION

ACEPOT*
ACETRIM*

Sub-Miniature Potentiometers and Trimmers

¹/₂ size, precision wire-wound,
up to 250K, $\pm 3\%$ linearity

setting new standards
for dependability
in sub-miniaturization

Let the facts speak for themselves! ACE Sub-Miniature Precision Wire-Wound Potentiometers and Potentiometer Trimmers are the result of 4 years development and over a year of successful use by leading electronic equipment manufacturers. Users have conclusively proved that ACEPOTS and ACETRIMS meet requirements for space and weight saving compactness, while at the same time meeting MIL specs' most stringent qualifications for performance and dependability. Why invite trouble with untested components when you can protect your reputation with ACEPOT and ACETRIM . . . the subminiature potentiometers and trimmers proved in actual use.

Condensed Engineering Data

	ACEPOT (potentiometer)	ACETRIM (trimmer)
Resistance Range	200 \sim to 250K $\pm 2\%$	10 \sim to 150K $\pm 3\%$
Linearity	$\pm 3\%$	$\pm 3\%$
Resolution	extremely high	excellent
Ambient Temperature	-55° C to 125° C*	-55° C to 125° C
Torque	low or high	low or high

The above specifications are standard — other values on special order.

Available in threaded bushing, servo, flush tapped hole or flange mounting, and ganged units. All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN specs and MIL-E-5272A standards.

*New X-500 ACEPOT operates to a new high of 150° C.

Expedited delivery on prototypes; prompt servicing of production orders.
Send for Fact File and application data sheets.

*trademarks applied for

ACEPOT*
ACETRIM*

ACE ELECTRONICS ASSOCIATES

Dept. ED, 101 Dover St. • Somerville 44, Massachusetts

CIRCLE 281 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Laboratory Instruments 282

Bulletin No. 83, just released, gives descriptions and photos of new and re-designed instruments and apparatus for laboratory use.

Among the instruments included in the booklet are: line of electric incubators with stainless steel inner liners; portable moisture determinator; vapor pressure apparatus for use in petroleum analyzers; new centrifuge with stainless steel bowl; microscopes; electric timers and others.

The booklet also contains a number of interesting articles on various topics including one on paper chromatography, a research tool which recently has grown in importance. Central Scientific Co., 1700 Irving Park Rd., Chicago, Ill.

Thread Gages 283

A 16-page primer on thread fit and gaging is now available.

The booklet is well illustrated and describes the basic principles of measuring high and low limits of pitch diameter tolerance; tips on gaging techniques including "Do's and Don'ts" to insure accurate readings; a method for setting gages that is more accurate than the one generally used; and reference data including Class 3A pitch diameter tolerances, best wire sizes for 3-wire thread gaging and a double sampling plan of inspection. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

Wire-Wrapping Tools 284

Pamphlet No. 5205 describes tools designed to speed electrical connections in radio, TV, and other electrical, electronic and electro-mechanical assemblies. The wire wrapper is a hand-held tool, powered either by air or electricity.

The pamphlet is illustrated and gives the specifications, and description of the model. The advantages are also given which include superior connections, compact assembly of carrying parts and greater uniformity. Ingersoll-Rand, 11 Broadway, New York 4, N.Y.

Oscillograph Paper Developer 285

Directed toward organizations faced with the problem of developing and drying records from recording oscillographs, a catalog mailer features a self-threading, motorized automatic record developer. In addition to the description of the Model SD-10 developer, the literature gives brief treatment to a number of oscillographs. Hamilton Watch Co., Hathaway Instrument Div., 5800 E. Jewell Ave., Denver 22, Colo.

Chemical Catalog 286

Over 4000 chemicals are enumerated in a 1957 catalog. Listed are fine organics, inorganic reagents, indicators and certified biological stains. Matheson, Coleman and Bell, East Rutherford, N.J.

Storage Systems 291

Twenty page catalog No. 505 provides comprehensive description of storage and handling systems for parts, tools and materials.

The booklet contains many product illustrations and installation photographs, including detailed facts and figures on dimensions and prices, of individual products.

Templates are provided to help users plan layouts and a system to fit your specific needs can be estimated through the use of the material included in this catalog. Stackbin Corp., 1339 Main St., Pawtucket, R.I.

TV Transmitters 292

Two TV transmitter specifications bulletins, describing the 500 W and 10 kw VHF television transmitters (high and low band) have been released.

The bulletins contain photographs of the transmitters, complete explanations of how the equipments operate, descriptions and illustrations of major design features, electrical and mechanical specifications, tube lists, and block diagrams of both aural and visual transmitters. Standard Electronics Corp., 285 Emmet St., Newark 5, N.J.

Cooling Fans 293

A 4-page catalog presents a full line of electronic cabinet cooling fans. Illustrated and described with detailed specifications, the fans are for standard 19 in. racks. The models cover a wide range of air deliveries and fit the popular panel heights. McLean Engineering Labs., P.O. Box 228, Princeton, N.J.

Standard FM Signal Generator 294

A booklet of 4 pages is devoted to the Model 95 standard FM signal generator. The instrument's specifications are detailed, and its operation explained. The form, 184-12-56, also lists advantages and applications for the unit. A photograph and a block diagram are provided as illustrations. Measurements Corp., Boonton, N.J.

Flat Belt Conveyor 295

To introduce an adjustable-length flat belt bag conveyor, Bulletin 0456 has been published. The prefabricated device coordinates packing and sewing into a single one-man operation. Its telescopic design affords a choice of conveying lengths from 7 to 12 feet. The 4-page brochure outlines the installation operation and special features of the conveyor and describes standard components. Richardson Scale Co., Van Houten Ave., Clifton, N.J.

Pinhole Detector 296

Bulletin No. 6520 describing the capabilities and operation of the pinhole detector is now available. This pinhole detector is used for automatically inspecting fast-moving opaque strips for small holes.

The illustrated four page bulletin includes a complete description of the detector with the advantages, operating notes, functional specifications and a block diagram. General Electric, Specialty Control Dept., Waynesboro, Va.

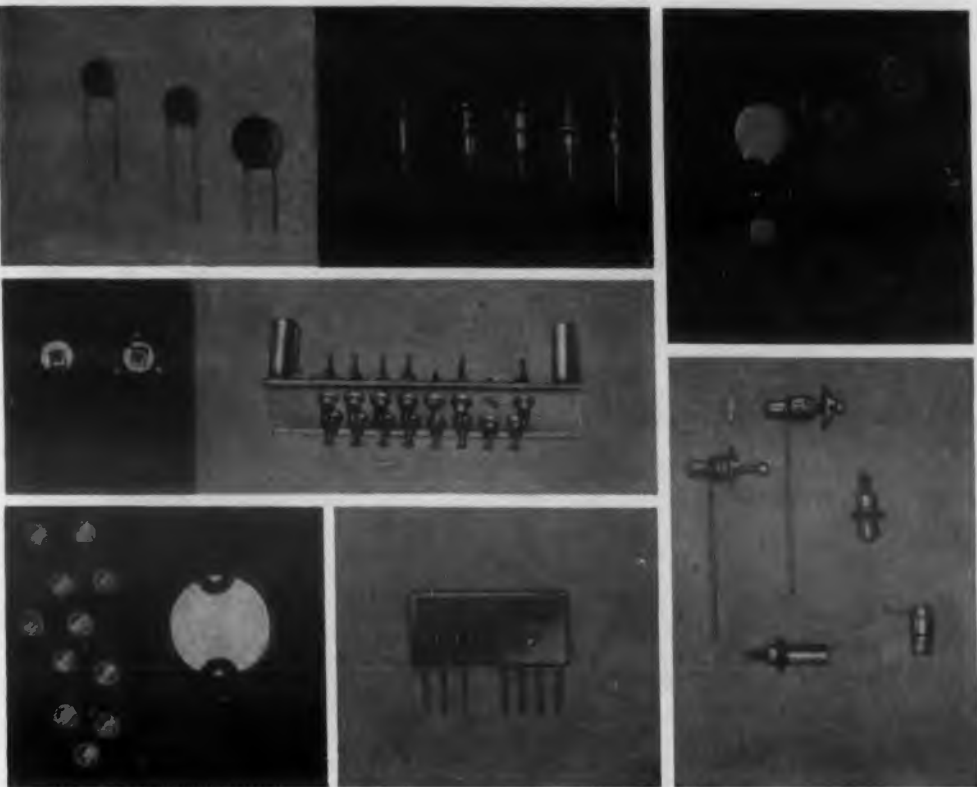
Coated Fabrics 297

Silicone rubber coated fabrics and nylon resin coated nylon fabrics which can stand temperatures ranging from -100 to $+500$ F are catalogued in a 4-page bulletin. Listed are many stock and standard fabric constructions. The booklet discusses briefly properties, applications, base fabrics and coatings. It will serve as a background on both standard and special coated fabric constructions. The Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.

Soldering Tips 298

Catalog No. 144 describes soldering tips of various sizes and special styles. Plug and screw tips are illustrated and data on tip diameter and length, style and size of tip point are given. Also shown are the soldering iron models each tip fits.

A description of the construction of the long-life tips is given including instructions on their use and care. Hexacon Electric Co., 299 W. Clay Ave., Roselle Park, N.J.



for plus values in ceramic capacitors — S O L A R

We go all out to bring you more than just a satisfactory unit. Our items save assembly time, as well as offer exceptional space-saving features. Solar pre-thinking gives you a terrific start in the right direction.

Note the variety of Solar capacitors. Many stock items are available, covering a tremendous range of needs. Here is an excellent basis for integrating your networks.

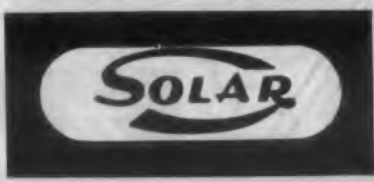
Quality? Reliability? You can be sure that Solar—the company that is organized to deliver plus service—keeps its quality and reliability high.

Streamlined production at Solar requires no expediting, and keeps prices attractive. And we really service your account—anytime... anywhere. Service includes calls at your plant to help design equipment for assembling our capacitors at lowest cost.

Write for the name of a nearby representative.


"QUALITY ALWAYS"

SOLAR MANUFACTURING CORP.
New York, N. Y.



SALES OFFICES: *46th & Seville, Los Angeles 58, Calif.*
4000 W. North Ave., Chicago 39, Ill.

CERAMIC CAPACITORS • PRINTED NETWORKS • PIEZO CERAMICS
CIRCLE 299 ON READER-SERVICE CARD FOR MORE INFORMATION





"I use  magnetic materials because..."



As a customer, I feel I'm a Very Important Person to my suppliers. That's why I deal exclusively with Thomas & Skinner. T&S treats me like a V. I. P. In a jam, I can pick up the phone and talk directly with T&S's top management people . . . people who can understand my problems . . . people who can give me personalized service . . . people I can depend upon regardless of how large, how small or how specialized my requirements . . . whether for permanent magnets, wound cores, laminations or silicon iron magnetic tapes.

It's nice to be a V. I. P. at Thomas & Skinner.

SPECIALISTS IN
MAGNETIC MATERIALS

Permanent Magnets  Magnetic Tapes 
Laminations  and Wound Cores 



Thomas & Skinner, Inc.

1157 East 23rd St.

Indianapolis 7, Ind.

CIRCLE 303 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Socket Screws 304

Consumer net prices for packaged and bulk quantities of self-locking socket screws are tabulated in Form 2194. The catalog's 31-pages cover a wide variety of configurations made from alloy or stainless steel. Listed are set screws with plain cup, cone, oval, half-dog, and flat points; socket, flat, and button head cap screws; shoulder screws; and Dryseal-Thread pressure plugs. Standard Pressed Steel Co., Jenkintown, Pa.

Electronic Test Equipment 305

There are 24 pages of information on electronic test equipment and components in a recent catalog. Photographs illustrate all units. The descriptions encompass construction and operating features along with technical specifications.

Covered are a series of decade counters, a frequency meter, a spectrum analyzer, an electronic multimeter, a radio receiving set, an electronic counter, and a signal generator. Northeastern Engineering, Inc., Manchester, N.H.

Laboratory, Office Equipment 306

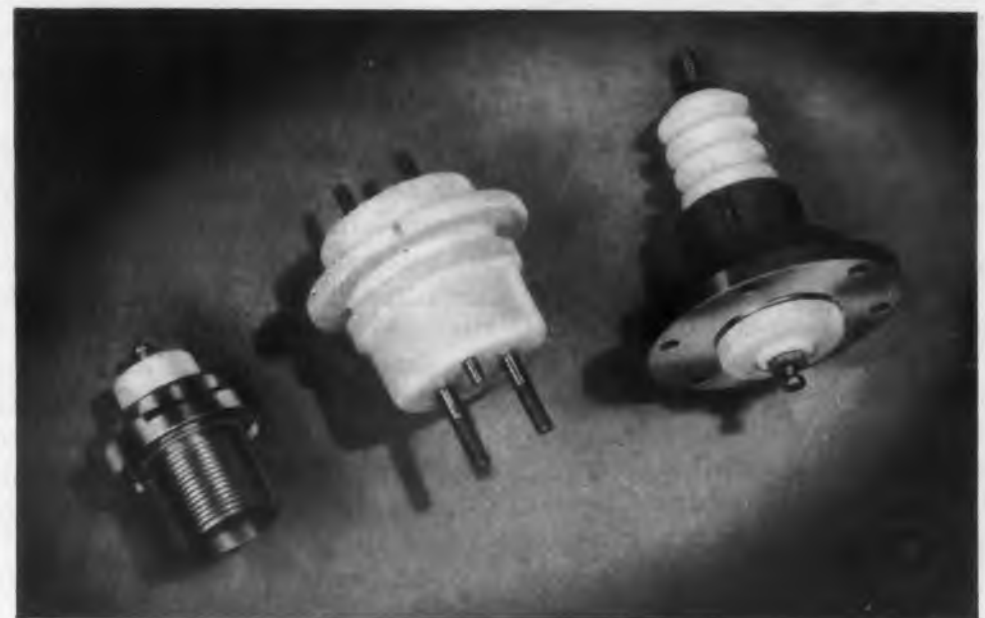
Equipment for office and laboratory is described in a catalog of 24 pages. Among the listings are industrial ovens, modern flow lockers, and safety ladders. All items are priced and illustrated. Precision Equipment Co., 3706A Milwaukee Ave., Chicago 41, Ill.

Cold Headed Fasteners 307

A catalog of 4 pages points out the design and manufacturing advantages of cold headed fasteners and parts. Text and illustrations show the design possibilities. John Hassall, Inc., Westbury, N.Y.

Digital Computer 308

The G-15D general purpose digital computer and its digital differential analyzer accessory are considered in a 6-page folder. A complete line of input and output equipment is also described. The illustrated text discusses new programming techniques and lists specifications. Bendix Aviation Corp., Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif.



Teflon connectors, hermetically sealed,

FOR TEMPERATURES FROM **-100** TO **+500 F**

No other material, natural or synthetic, compares with DuPont Teflon for toughness, chemical inertness, high dielectric strength. It will not char or carbonize from arcing; stands thumping shocks and vibration; will not warp or loosen at jet engine heats or sub-zero climates. Made by a revolutionary new molding process. Every manufacturer of high frequency radio, radar and other electronic equipment should write for details.

The **Joclin** manufacturing company 20 Lufbery Avenue
Wallingford, Connecticut

CIRCLE 309 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Converter 313

Form 185-12-56 describes the Model 275 intermediate frequency converter. The 4-page folder explains the unit's features and uses and its method of operation. Detailed specifications, a photograph, and a block diagram are also provided. Measurements Corp., Boonton, N.J.

Engineering News 314

The latest edition of the News is illustrated and features comprehensive articles on the theory and application of oscillograph galvanometers, the SD-10 automatic developer and on the MRC-21 strain gage control unit. Hatheway-Hamilton Engineering News, 5800 East Jewell Avenue, Denver 22, Col.

Clinch Nuts 315

Flush-mounted self-locking clinch nuts are listed with complete specifications in an 8-page booklet. Their temperature-resisting qualities and other advantages are described. Photographs and dimensional drawings illustrate the brochure. The Kaylock Co., Kaylock Div., Box 2001, Terminal Annex, Los Angeles 54, Calif.

Main Steam Piping Alloys 316

In his ASME report, "Metallurgical Considerations of Main Steam Piping for High Temperature, High Pressure Service," H. S. Blumberg discusses the potentialities of superstrength alloys. He also suggests piping materials for power plants designed to operate up to 1200 F and 5600 psi. Tempil Corp., 132 W. 22nd St., New York 11, N.Y.

Radio-TV, Electronics Catalog 317

Equipment for radio, electronics and television is presented in a 1957 catalog. In the 172 pages, hundreds of items are listed for the first time. The buying guide features 21 pages of low cost items. Burstein-Applebee Co., 1012-14 McGee St., Kansas City 6, Mo.

Test Set for Transistors 318

The Model 505 standard test set for transistors is featured in Form 176-12-56. The characteristics and uses of the instrument are outlined, and detailed specifications are listed. Circuit diagrams and a photograph illustrate the 4-page brochure. Measurements Corp., Boonton, N.J.

PAYS FOR ITSELF IN SAVINGS

• ELIMINATES DISADVANTAGES OF
MANUAL PRE-WEIGHING . . . INCOMPLETE OR
FROTHY MIXING . . . PRODUCT LOSS . . . INTER-
RUPTED PRODUCTION . . . MANUAL POURING



HARDMAN
TRIPLEMATIC MIXING-METERING
PUMP FOR TWO-PART
POURABLE EPOXY RESINS

CHOOSE FROM 8 MODELS-POTTING • CASTING
Can Be Modified To Meet Many Other Requirements

ACCURATE • FLEXIBLE • SIMPLE
ECONOMICAL • SAFE

Priced from \$1985. Call or Write

H. V. HARDMAN CO. INC.

BELLEVILLE 9, N. J.

PLYMOUTH 9-1242

Since 1906 . . . Formulating Dependable Potting Compounds

CIRCLE 319 ON READER-SERVICE CARD FOR MORE INFORMATION

Hycon's

OSCILLOSCOPE



*Adjustable vertical space-
-swept back-to-back for
additional test positions*

5 1/4" high

11" deep

for Standard

19"

Relay Rack



Rack Mounted Digital VTVM —
only 5 1/4" high. Model 615AR has a
broad range of testing
applications. Highly accurate and
easy to read. 3-digit display
reduces interpolation and parallax
errors. For visual readout or
printout applications.

"Where Accuracy Counts"
HYCON ELECTRONICS, INC.
Pasadena, California

**Send
TODAY
for latest
catalogs!**

HYCON ELECTRONICS, INC., Dept. B-10
P.O. Bin D
Pasadena, California

Send me the latest catalogs on Models 627R and 615AR.

Name _____
Address _____
City _____ State _____

CIRCLE 320 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL

STA

SOLID TANTALUM CAPACITORS



Here Are the Sizes Available:

	CATALOG NUMBER	CAPACITY IN MFD ¹	WORKING VOLTAGE	SURGE VOLTAGE
100 SERIES	STA-155	3.5	10	12
	STA-160	2.0	15	18
	STA-165	1.5	20	24
	STA-170	1.2	30	36
	STA-175	1.0	35	42
200 SERIES	STA-255	17	10	12
	STA-260	11	15	18
	STA-265	8	20	24
	STA-270	6	30	36
	STA-275	5	35	42
300 SERIES	STA-355	70	10	12
	STA-360	45	15	18
	STA-365	35	20	24
	STA-370	23	30	36
	STA-375	20	35	42

AND AVAILABLE IN PRODUCTION QUANTITIES

(Write for bulletin 6.112)

FANSTEEL METALLURGICAL CORPORATION

North Chicago, Illinois, U.S.A.

TANTALUM CAPACITORS . . . DEPENDABLE SINCE 1930

CIRCLE 323 ON READER-SERVICE CARD FOR MORE INFORMATION

Photo Slide Rule

324

A slide rule to aid professional and industrial motion picture photographers and data recording engineers is now available.

The slide rule permits easy conversion of feet of film to running time, or the reverse, for all frame rates and film sizes. It greatly speeds the calculation of camera operating conditions, especially for engineering photography where operating conditions vary. Flight Research Inc., Richmond, Va.

Transformers and Reactors

325

Miniaturized low-frequency transformers and reactors are described in an 8-page catalog No. 105 just released.

The illustrated bulletin features shielding, flexibility, and wide range of applications of these geophysical transformers.

The complete line of input, output, interstate, and AVC output transformers, as well as a listing of reactors and special reactors are given. Complete design and application information is shown, including mounting information and space requirements. Southwestern Industrial Electronics Co., P.O. Box 13058, Houston, Tex.

Air Compressors

326

Data sheet 653 R lists construction details, specifications and models of air compressors in the 1/4-20 H.P. range. The bulletin provides data in selecting the right compressor for a specific job in virtually every industry.

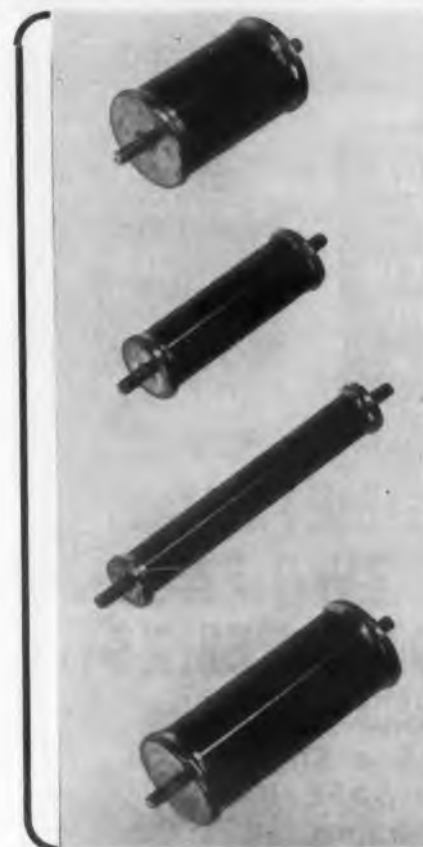
This useful guide features single and two stage air compressors which are available either for electric motor or gasoline engine drive as well as simple compressors, single or two stage with or without flywheel.

Also air outfits for continuous operation as used in paint spraying or laundry machinery are described. Brunner Manufacturing Co., 11 Fisher St., Utica, N.Y.

Panel Meters

327

Descriptions, specifications and prices for over 800 panel meter models are set forth in Bulletin 2057. The 6 pages are illustrated with photographs of meter styles and movements, dimensional drawings for mountings, and full-size scale reproductions. The folder also presents information on available shunts and current transformers. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.



NEW GLASSCAPS

Glasscaps TYPE of capacitors are manufactured with improved characteristics.

NEW TEMPERATURE RANGE with full rated voltage -55°C to 85°C .

NEW LOW POWER FACTOR at 60 cycles less than 0.9% over temperature range -40°C to -20°C less than 0.4% from -20°C to 100°C .

NEW LOW TEMPERATURE COEFFICIENT less than 4% change from room temperature to -55°C or 100°C .

NEW HIGH RESISTANCE at high temperature—greater than 100 megohms x mfg. at 100°C with FULL RATED VOLTAGE applied.

Write for FREE Glasscaps Information



Plastic Capacitors, Inc.

2620 N. CLYBOURN AVE., CHICAGO 14, ILL.

CIRCLE 328 ON READER-SERVICE CARD FOR MORE INFORMATION

Nickel-Cadmium Batteries 333

Bulletin No. 501 on sintered plate storage battery has been released. It is designed to help engineers evaluate the practicability of miniature nickel cadmium batteries for electronic, aircraft, and communications equipment.

The eight-page illustrated technical report gives the details of development, construction, and operation along with curves of discharge and charge characteristics. Nickel Cadmium Battery Corp., 66 Pleasant St., Easthampton, Mass.

Automatic Exposure Control 334

An electronic device for automatic exposure control in moving pictures is the subject of a 6-page folder. The accessory, which can be adapted to any motion picture camera, is fully described with attention to construction, operation, and performance. Illustrating the brochure are photographs of the unit, and filmstrip reproductions showing its capabilities. Flight Research, Inc., P.O. Box 1-F, Richmond 1, Va.

Color-Coded Gaskets and Shims 335

A shim and gasket plastic which shows its thickness by color is announced in a 4-page illustrated brochure. The advantages and applications of the material are described, and code colors are listed with their corresponding gages. Tables give dimensions and prices for a variety of shims. General Gasket Inc., Industrial Rd., Clifton, N.J.

Slotted Angle Storage System 336

A bulletin describes new approaches to storage and other construction problems. It explains some of the varied applications such as stock racks, production benches, stock carts, pallet racks, maintenance platforms, temporary partitions, movable billboards, mezzanine floors, ladders, conveyor frames, machine guards, pilot production setups, and switchgear racks.

The illustrated bulletin shows how rigid, fire resistant, space saving structures can be built without drilling, welding, or painting, and with a minimum of measuring. The reusability of the components and the ease of storage is also given. Flexangle Corp., 278 Park Road, W. Hartford 7, Conn.

PREFERRED!

Clary Numerical Data Printers

Clary is the printer preferred by many of America's top companies for data-handling work and automation. For example, in solving such problems as *shaft position* and *digital voltmeter* conversion, the Clary printer is now standardly used by more and more firms. Clary may well be the one printer able to answer your problem.

Gives you a permanent printed record, instead of a fleeting visual one. Both serial and parallel-type printers available. Choice of 4 models, 8 to 11 digit

capacity. Designed for use with any automation or data-processing system. Capable of taking input in various forms, manual or remote, and delivering it in equally diverse forms. And only Clary equipment is able to print, add and convert remote input to perforated tape or cards. Also a wide line of other data-handling units for industrial and scientific applications. Please write on your letterhead for facts. Clary Corporation, Dept. E27, San Gabriel, California.



**ELECTRONICS
DIVISION**

CLARY CORPORATION
San Gabriel, California

...manufacturer of business machines, electronic data-handling equipment,
aircraft and missile components...for America and the World

CIRCLE 337 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL

Silicon RECTIFIERS



Minimum Size.....

Maximum Performance...

Fansteel Dependability

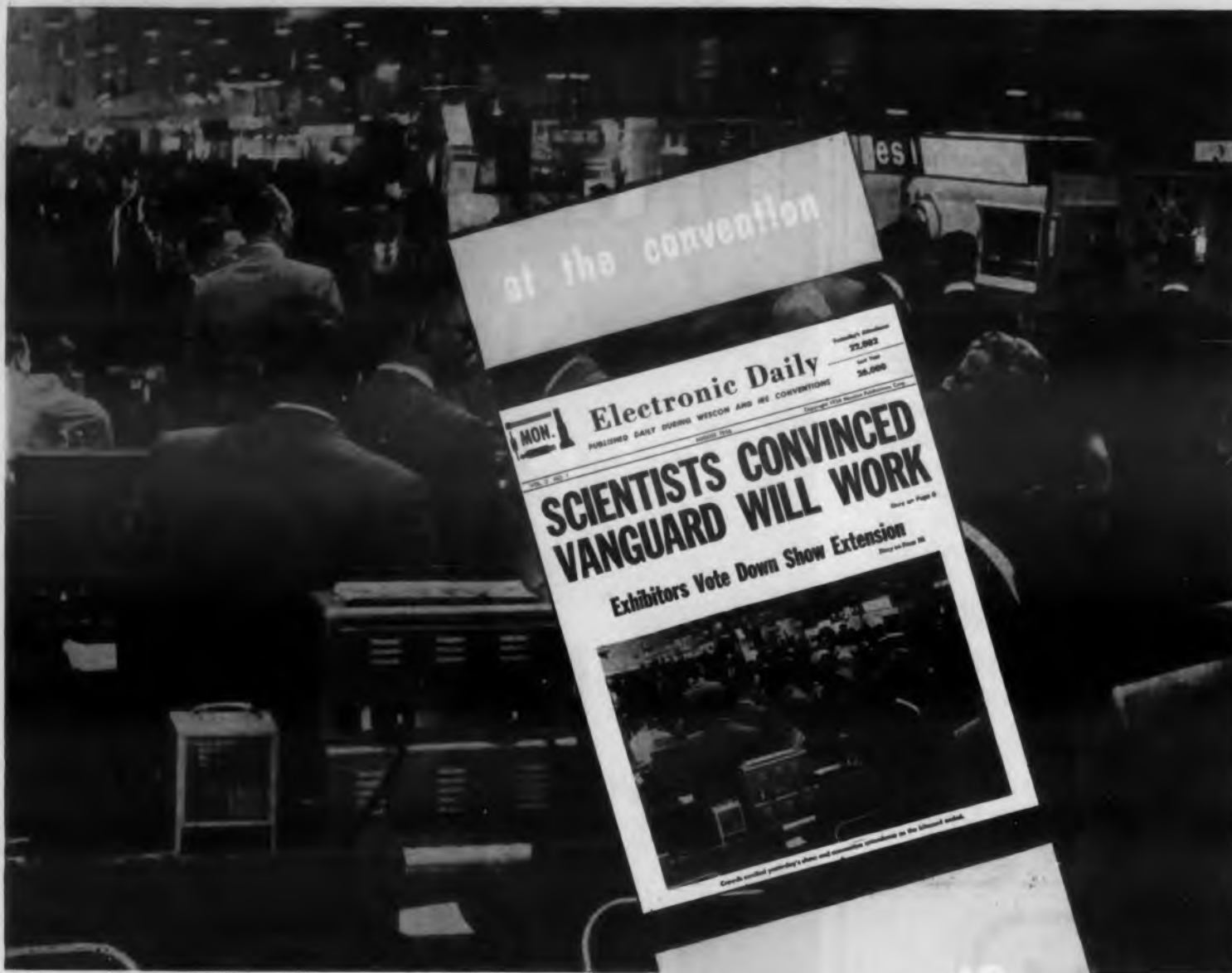


FANSTEEL METALLURGICAL CORPORATION

North Chicago, Illinois, U. S. A.

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 338 ON READER-SERVICE CARD FOR MORE INFORMATION



Electronic Daily will be your news source and guide at the Radio Engineering Show. Published each day during the convention, **ELECTRONIC DAILY** will give the news behind the news, list daily events, meetings, etc. Look for your copy ... available in major hotels or from **ELECTRONIC DAILY's** booth at the convention.

Electronic Daily

published each day at the IRE CONVENTION

HAYDEN PUBLICATIONS CORPORATION

19 East 62nd Street, New York 21, N.Y. • Telephone: TEmpleton 8-1940

CIRCLE 343 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultra-Thin Gages

344 CRT

A four-page data sheet on ultra-thin gages and extremely high-tolerance phosphor-bronze is now available.

The data sheet contains pertinent information on the physical characteristics, processing, and applications of phosphor-bronze in thicknesses as low as 0.0005 ± 0.0001 in. Phosphor-bronze has high strength, long fatigue life, good electrical conductivity, and excellent resistance to corrosion.

Applications for ultra-thin phosphor-bronze range from shims, current carrying springs, diaphragms, thermostat controls, bushings, bursting discs, to electronic computer tape. American Silver Co., 36-07 Prince Street, Flushing 54, N.Y.

Dynograph Recorders

345

A 12-page, two color catalog describing dynograph recorder models is now available. The dynograph, a high-speed direct writing oscillograph for the recording of a variety of dynamic and static variables, combines in one unit, three media of recording; ink, heat sensitive, or electric sensitive with either curvilinear or rectilinear coordinates.

Described in detail are the principles of operation, specifications, assemblies, and construction of the four units: Type M Console, Type MC computer Console, Type MR and MCR rack mounted, and Type P Portable.

A special selection chart shows the features available in the various types of assemblies and the alternate mountings. Single or multi-channel assemblies are obtainable in console, rack mounting and portable cases. For low gain applications such as telemetering and computer writer out, specially designed simplified assemblies are available. Ofner Electronics Inc., 5320 No. Kedzie Ave., Chicago 25, Ill.

High Speed Counter Tube

346

The G10/241E Nomotron, a cold-cathode gas-filled decade counter tube which doubles as a distributor, is the topic of a 12-page booklet. Discussed in detail are technical characteristics of the tube and its many possible uses. As a practical aid in applying the tube, special attention is given to circuit design information. Specifications and circuit information are also given for the G1/371K high-speed primed-trigger tube which is intended for use with the G10/241E. An additional section contains a short history on the development of multi-element counter tubes. The booklet is illustrated with a photograph and several circuit diagrams. International Standard Trading Corp., 22 Thames St., New York 6, N.Y.

Compiled in a catalog of 20 pages is a complete line of accessories and components for electronic circuitry and test equipment. More than 200 items associated with cathode-ray oscilloscopes, oscilloscope record cameras, and other test equipment are described. Among these items are knobs, test probes, magnetic shields, viewing hoods, photographic developing equipment, cathode-ray tube and multiplier phototube base clamps, base sockets and connectors, movable tables, and rack mounting adapters. Also covered are electronic circuit components such as pulse transformers and wide-band toroids. Photographic and written descriptions, catalog numbers, and prices accompany all listings. Requests for the "Du Mont Catalog of Components and Accessories" should be addressed on company letterhead to the Component Parts Sales Dept., Technical Products Div. Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N.J.

345 Tapping Linear Pots 354

Originally published in the August 1956 issue of Control Engineering, Jack Gilbert's "Use Taps to Compensate Potentiometer Loading Errors" has been reprinted as Tech Paper 804. The 5-page analysis graphically describes a method of tapping linear pots to reproduce a particular function. The procedure limits loading errors to the best resolution of a single-turn pot while using a minimum number of taps and resistors. Four, two, and five-tap pots are considered with illustrations and equations. The designs presented can reduce loading errors by factors up to 60:1. An addendum lists references and derivations. Helipot Corp., Newport Beach, Calif.

346 Gas Liquefier 355

Engineering data on a gas liquefier is contained in a 3-color folder of 6 pages. The bulletin is illustrated with photographs and drawings which show the operating cycle and construction of the machine. Technical details are given on speed, efficiency, yield, motor characteristics, cooling water consumption, weight and size; and information on liquid air applications is presented. Liquefying of gases from cylinders is discussed with respect to industrial problems. The folder also covers the economics and practicability of an in-plant source of liquid air when temperatures as low as -328 F must be produced. North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N.Y.

Another Hoffman
FIRST!

**SILICON
DIFFUSED
JUNCTION
FULL-WAVE
RECTIFIERS**

Replace
**Vacuum tubes 5R4-GY,
5U4G and others, in
most military applications**



... especially designed to replace, and exceeds the current ratings of full-wave vacuum rectifiers 5R4-GY, 5U4G and others, in critical electronic circuits.

Military applications and equipment (radar, aircraft, missiles) will benefit from the following features of HOFFMAN Silicon Diffused Junction Full-Wave Rectifiers:

- ★ High efficiency (see chart)
- ★ Long life
- ★ Maximum reliability
- ★ Long time stability
- ★ No energy loss in a hot filament
- ★ Small size—for compact design needs
- ★ No maintenance required in critical military circuits



Hoffman Semiconductor Division
formerly National Semiconductor Products
of Hoffman Electronics Corporation

930 Pitner Avenue, Evanston, Illinois

COMPARISON OF CHARACTERISTICS

	Peak Inverse Plate Voltage	Max. Average Output Current	Note 2	Typical Rectifier Efficiency *
Hoffman MFWR-1	2100 V	400 ma (2100V Note 1)	430 V 220 ma	98.3%
5R4-GY	2100 V	250 ma	400 V 200 ma	79.5%
5U4-G	1550 V	270 ma	400 V 200 ma	75.5%

Note 1—At 2100 V peak inverse plate voltage, 25°C ambient, with choke input to filter. Max. Avg. output current of 300 ma at 2100 V peak inverse with 12 mfd max. capacitor input to filter.

Note 2—DC output voltage and current when indicated type is substituted in a typical rectifier circuit with choke input to filter.

* Operated at 1414PIV into a 1650 ohm load.

We invite your inquiry

MANUFACTURERS:
silicon junction diodes
zener reference elements
medium and high power rectifiers
silicon solar cells

CIRCLE 356 ON READER-SERVICE CARD FOR MORE INFORMATION

The New 411A

From LFE's

Special

Products

Division-



What makes the difference in OSCILLOSCOPES?

Basically, oscilloscopes are much the same. Like LFE, several have the "Big 3"—wide bandwidth, fast rise time, excellent sensitivity—but extras make the difference!

\$1210.

without plug-ins
F.O.B. BOSTON

- Diversification of the X-Axis System through plug-in adapters—*an LFE exclusive.*
- Direct-reading, continuously variable sweep speeds, 0.1 us/cm to 0.1 s/cm, 5% accuracy. Calibration accuracy 1% with gated marker generator plug in.
- Simple operation—direct-reading, functionally-grouped controls throughout.

LFE's new 411A gives you ALL these plus:

Full DC to 10mc/s bandwidth @ 20 mv/cm sensitivity, 0.035 us rise time.

Clean, brilliant trace and DC amplifier stability.

Direct-reading, continuously-variable square-wave calibrating voltage from 0.1 to 100 volts, 5% accuracy.

Versatile triggering facilities—external, internal, recurrent 500 to 5,000 cps—trigger on any part of leading or trailing edge of signal.

Internal trigger and sweep gate outputs, Z-Axis input for intensity modulation.

Elevation rack for easy viewing.

Plug-in adapters now available:

- extended range trigger generator
- sweep delay generator
- 2-channel video switch
- gated marker generator
- TV trigger shaper
- long sweep generator

411A is a precision scope for advanced electronic research. For complete details, simply write Special Products Division, Laboratory for Electronics, 75 Pitts St., Boston, Mass.

An outstanding instrument welcomes comparison
LABORATORY FOR ELECTRONICS, INC.

75 PITTS STREET

BOSTON, MASSACHUSETTS

CIRCLE 363 ON READER-SERVICE CARD FOR MORE INFORMATION



Immediate Delivery

Chemical Laboratory Apparatus 364

Chemical Laboratory Apparatus Catalog 56S which contains some 700 pages of factual text has just been released.

The well illustrated catalog has over 20,000 items and covers the general chemical apparatus requirements of those in education, industry and research. Griffin & George Limited, Alperton, Middlesex.

Teflon Lined Steel Pipe 365

A 2-page Bulletin, T-100 describing a series of lined steel pipes, has been released. The bulletin gives the details of the application of "Teflon" as a liner for schedule 80 steel pipe, and the rugged assembly can solve the toughest corrosion problems in chemical, petroleum, and allied industries.

The illustrated bulletin shows that pipe lined with "Teflon" will withstand temperatures as high as 350 F; working pressures of this piping are limited by the flange strength. Standard flange strengths are available at 125, 250, and 300. Standard sizes are 1, 1-1/2, 2 and 4 in., standard lengths in 2, 5 and 10 in. sections. Halocarbon Division, Haveg Industries, Inc., 900 Greenbank Rd., Wilmington 8, Delaware.

Closed Circuit TV Survey 366

A closed circuit TV survey-questionnaire designed to help management of industry and institutions lower costs by pinpointing situations and company problems which can be improved or solved through closed circuit TV, was announced recently.

The survey is based on the premise that lower labor costs, increased safety and efficiency are inevitable if the range of vision from office or laboratory can be extended to encompass one or more remote, hazardous or inaccessible locations for: visual communication, data transmission, instruction or demonstration. Blonder-Tongue Laboratories, Inc., 9-25 Alling St., Newark 2, N.J.

Thermostats and Safety Switches

Thermostats for vaporizers, percolators, dryers and other appliances requiring low-cost temperature control are described in Bulletin 9000. The 2-page sheet is illustrated with photographs, dimensional sketches and schematics. It gives principles of operation, specification data and ratings. A tip-over safety switch is also illustrated and described. Stevens Mfg. Co., Inc., Lexington, Ohio.

CIRCLE 368 ON READER-SERVICE CARD FOR MORE INFORMATION

366
aire
stry
ing
uch
sed
hat
ef-
ion
l to
ous
m-
or
to-

High Pressure Gage Snubber 373

An improved high pressure gage snubber for the protection of pressure gauges and other pressure devices operating at extremes of pressure is described in a bulletin just released.

Protection of instruments against line surges and pulsations on systems having total pressure increments of as high as 60,000 psi is achieved. Chemiquip Co., 460 Broadway, New York 12, N.Y.

High Power Ultrasonic Generators 374

High power ultrasonic generators and transducers adaptable to almost any type of tank configuration and dimension are described in Bulletin DR-2000. The pamphlet details how two generators, Model DR-2000AL (low frequency) and Model DR-2000AH (high frequency), can be applied for powering large scale, high volume batch or automated ultrasonic cleaning, machining and liquid processing systems. Several typical tank arrays are illustrated to show the "building-block" flexibility of the ultrasonic systems. Specifications are also given for the Models AM-203B (magnetostriction) and AC-40 (Barium Titanate) transducers. Acoustica Associates, Inc., Glenwood Landing, N.Y.

Aircraft Hook-up Wires 375

A series of single-conductor, 600 volt, high-temperature aircraft hook-up wires, designed to meet applicable requirements of Military Specification MIL-W-7139, are described in Bulletin No. 1906, just released.

These wires possess outstanding dielectric characteristics over the continuous temperature operating range from -68 to +410 F. Silver plated copper conductors are available in sizes from 22 to 12 gauge, and are insulated to form a rugged insulation highly resistant to abrasion and corrosion.

The insulation can be readily stripped and will be impervious to most chemicals and solvents. Revere Corp. of America, Wallingford, Conn.

Infrared Weapons Systems 376

An eight-page brochure IR 9902 describing infrared detection systems has been released.

It explains the infrared detection system which finds its target without producing energy to betray its own position.

Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, N.Y.

do you use time delay relays?



Illustrated above are a few of the many environmental conditions which these compact timers are designed to withstand. More rigid requirements frequently can be met upon special consideration.

Do you require ADJUSTABILITY? No Problem!

Do you require HERMETIC SEALING? No Problem!

Do you require BOTH? NO PROBLEM for the

A. W. HAYDON Company

The A. W. Haydon Co. offers a complete line of

ADJUSTABLE — HERMETICALLY SEALED TIME DELAY RELAYS

for operation under adverse environmental conditions

Write for Bulletin AWH TD401
Bulletin AWH TD401 Describes
6400 Series — DC units
11400 Series — AC units
24300 Series — 400 cycle units
Nominal Range of Adjustment: 0-1
Timers supplied with:
AN connector
Hermetic Adjusting Knob
Glass Window and Calibrated Dial



Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE 377 ON READER-SERVICE CARD FOR MORE INFORMATION

VACUUM

PRESCRIBED FOR YOUR PRODUCT

**THE FOUR AREAS WHEREIN KINNEY
HIGH VACUUM OFFERS EXTRAS FOR YOU**

- ✓ **QUALITY OF PRODUCT**
- ✓ **UNIFORMITY**
- ✓ **INCREASED PRODUCTION**
- ✓ **SOUND ECONOMY**

Relatively few products require the ultimate in High Vacuum which KINNEY Equipment makes available . . . many requirements are as individual and unique as your appetite. That's why there's such a broad range of sizes and models in the KINNEY line . . . TO PROVIDE A PRESCRIPTION ANSWER TO YOUR VACUUM PROBLEM. Thus, you benefit with Pumps you can "custom tailor" to your needs . . . Pumps that assure the quality, uniformity and low cost of the product plus important savings of time in production.



HIGH VACUUM PUMPS

The range of sizes in KINNEY Oil Sealed Mechanical Pumps extends from small laboratory units developing pressures to 0.2 microns to large production two-stage Mechanical Booster Pumps providing ultimate pressures of 0.1 micron. Additionally, there is a full range of sizes in high performance Diffusion Pumps in both Fractionating and Non-Fractionating Types.

VACUUM SYSTEMS

Completely engineered High Vacuum Standard Systems for Coating, Metallizing, Cathodic Etching, Evaporating, Crystal Growing, Sputtering, Evacuating, Vacuum Molding, or other purposes. Special equipment, engineered to accommodate special production schedules or to handle individual processes, built to your specifications or developed jointly with our engineering staff.

GET THE FACTS

Write for full information on KINNEY High Vacuum Pumps and or KINNEY High Vacuum Systems.

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY

3561B WASHINGTON STREET • BOSTON 30 • MASS.



Kindly send me literature describing new developments in

KINNEY High Vacuum Pumps KINNEY High Vacuum Systems

Name _____

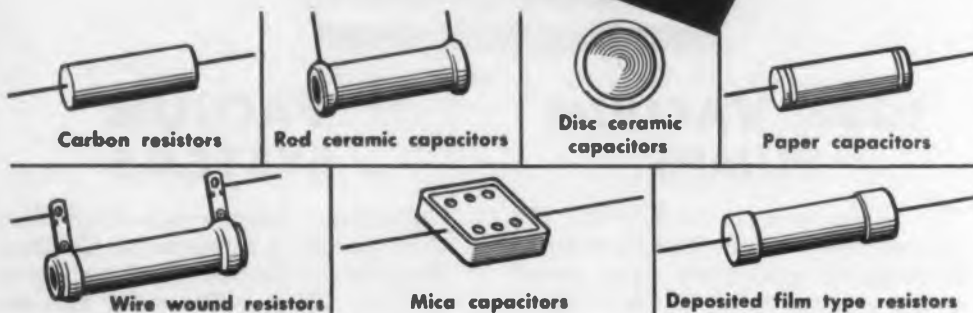
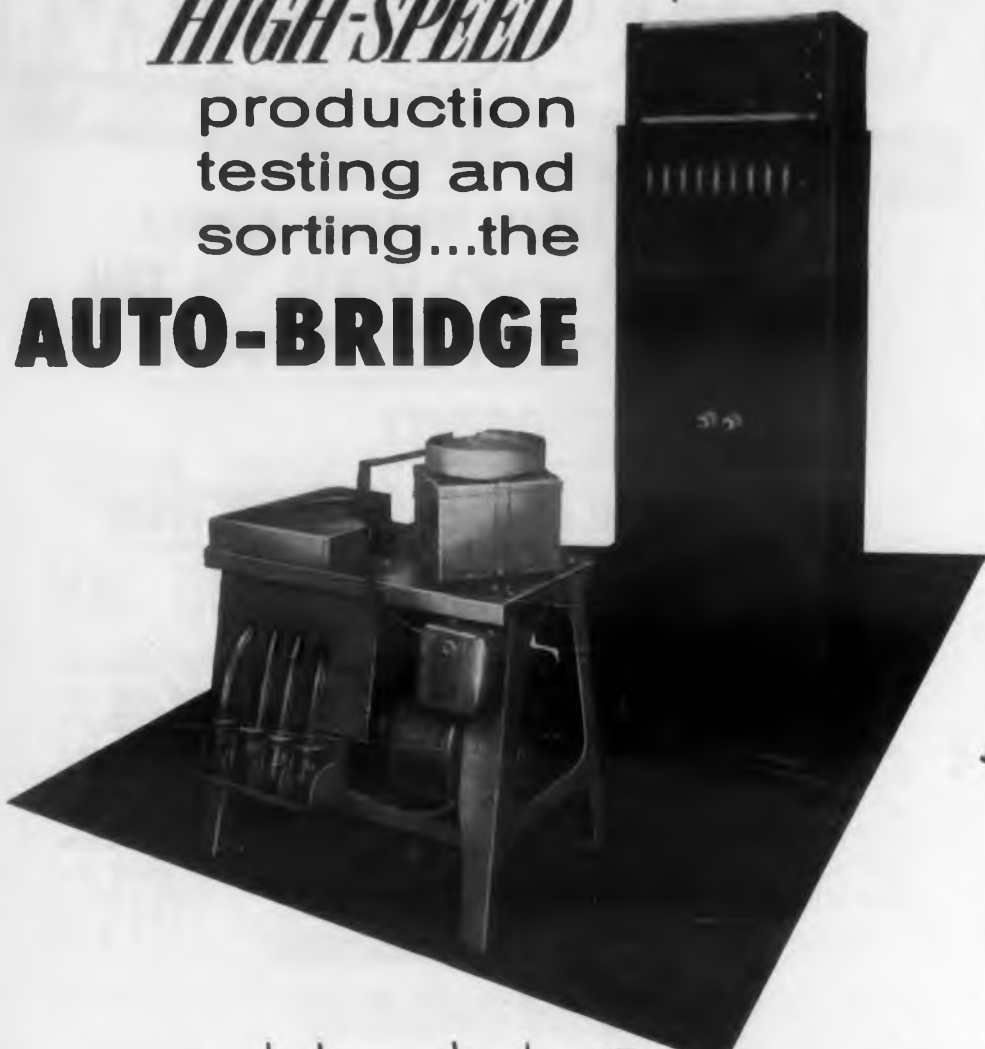
Company _____

Address _____

City _____ Zone _____ State _____

CIRCLE 378 ON READER-SERVICE CARD FOR MORE INFORMATION

for
HIGH-SPEED
production
testing and
sorting...the
AUTO-BRIDGE



Jigging designs available to accommodate practically any electronic component to be tested and sorted by the Auto-Bridge. Application shown is sorting disc ceramic capacitors.

An automatic device for high-speed testing and sorting of components. Used by leading manufacturers of components for final testing as well as stage-by-stage inspection. Also used extensively for incoming inspection by component users. Tests for go-no go or grouping into as many as 8 percentage tolerances by merely flicking a switch. Tests resistors, capacitors, inductors or impedance elements. Accuracy is $\pm 0.3\%$ in the range from 10 ohms to 5 megohms in impedance. Equipment may be used at resistances above 5 megohms. Speed of operation is entirely dependent upon components to be tested and type of jigging ordered.

Write for complete information on the Auto-Bridge today.



Industrial Instruments

89 COMMERCE ROAD, CEDAR GROVE, N. J.

CIRCLE 383 ON READER-SERVICE CARD FOR MORE INFORMATION

Scientific Journal

A scientific magazine, "Journal of Research and Development," which will be published quarterly, starting January 1, 1957, has been announced.

The purpose of the Journal is to publish original work by scientists and engineers for interested technical people, and help promote rapid dissemination of scientific and technical information.

The announcement indicates the new magazine will publish comprehensive articles on latest scientific and technical results from research and development laboratories here and abroad. Articles will come from such fields as solid state physics, chemistry, metallurgy, information theory, and electronics.

Among the features will be articles on the latest development in computers, data processing machines, and design of components such as magnetic core memories and semiconductor devices. It will be available by subscription at a cost of \$3.50 per year. IBM, 590 Madison Ave., New York 22, N.Y.

Tin-Plated Metal Strips

385

A data and specification sheet covering tin plating is now available showing a wide range of non-ferrous thin strip metals.

The illustrated information sheet includes a .002 in. thick sample, with tin coating of .00008 in. on two sides which meet the requirements of electronic and electrical manufacturers. Somers Brass Co., Inc., 94 Baldwin Ave., Waterbury, Conn.

Glass Electrical Insulating Tapes

386

Glass Electrical Insulating Tapes are shown and described in a bulletin just released. Woven of continuous filament glass yarns, the glass electrical insulating tapes have high tensile strength, dimensional stability and high resistance to deterioration. They can be used as coil wrappers, protective coverings, conductor insulating, mechanical reinforcements and similar applications in electrical apparatus. Russell Manufacturing Co., 107 E. Main St., Middletown, Conn.

WHY NOT FIND OUT

ALL



BEFORE YOU BUY BLINDLY

Remember the benefits promised by Circultry . . . savings in time, effort, and costs in your production. You will get them if your circuits are produced by economical mass production techniques. If they are uniform in quality. If they are delivered on schedule.

It makes sense to pick a supplier who promises these and more. CRONAME DOES. Mass production has tripled our production in one year. Our circuits are covered under Underwriters' Laboratories Recognition program for UL listed items. Specify CRONAME "printed circuitry processing" for your circuits.

CRONAME
INCORPORATED

1767 GRACE STREET CHICAGO 13, ILL.

other Croname products - 53 years of leadership

Nameplates, dials, panels, escutcheons, mechanisms, light assemblies, masks, bezels, cabinets, control panels; decorated glass, CroRoto embossed.



CIRCLE 387 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors—Rheostats

393

Bulletin No. 53 describes various types of rheostats and fixed or adjustable resistors which are now available.

The rheostats have been designed to meet with military specifications. The bulletin is well illustrated, and includes a complete description of each model with specifications, tables of size and ratings, and the uses to which they are being put. Hardwick-Hindle Inc., Newark, N.J.

Expanded Foam Polyethylene

394

Expanded foam polyethylene, a material having a uniform small-sized closed-cell structure, is detailed in a catalog sheet just published. It is offered in semi-finished molded components such as rings, blocks, rods and sheet, and can also be molded to meet individual specifications.

Applications include low-temperature insulations, sandwich cores, shock absorbers, packaging, buoys and radiation shielding. American Agile Corp., P. O. Box 168, Bedford, Ohio.

Power Conversion

395

General catalog on various models of power conversion and control equipment is now available.

Also covered is a travelling wave tube power supply ranging from 300 volts 1 ma to 550 volts dc at 5 amp. A controlled firing time inverter which controls the output power by controlling the conducting periods of the thyratron tubes is included. Lawn Electronics Co. Inc., Freehold, N.J.

Rectilinear Recorder

396

Three illustrated bulletins on rectilinear writing galvanometric recorder, the Recti/Riter, and accessories are now available. Bulletin R-501 is a six-page, two-color brochure giving the design, construction and operator techniques of the ink-writing, strip writing, strip chart recorder. Houston Technical Laboratories, 3609 Buffalo Speedway, Houston 6, Tex.



BIRTCHEE TOP-TAINERS

FOR THE MILITARY-APPROVED
METHOD OF SECURING TUBES
AND COMPONENTS AGAINST
SEVERE SHOCK AND VIBRATION

Even severe shock and vibration can't loosen the new stainless steel Birtcher TOP-TAINERS, yet they can be removed for maintenance with a slight upward pull on the locking tab. Available in a wide range of single and double post modifications for all tubes and cylindrical components ranging from 7/8" to 2-5/16" in diameter, and in post heights from 2-1/2" to 4-5/8". Write for catalog and specifications.

Write
for
catalog



THE BIRTCHEE CORPORATION

INDUSTRIAL
DIVISION

4371 Valley Blvd.,
Los Angeles 32, Calif.

CIRCLE 397 ON READER-SERVICE CARD FOR MORE INFORMATION



When it has to be heated rely on **Safeway** **Woven Heat** **Elements**

... and the "it" can be just about anything from a simple tray to the curing blankets for honeycomb structures.

Safeway Woven Heat Elements are custom tailored to fit specialized requirements of many applications. A single aircraft, for example, may need upwards of 80 different heating and de-icing elements, all of which are made by Safeway. Other applications are on helicopter rotors, rocket tubes, missile launchers, and on a wide variety of molds, dies, tanks, ovens and dryers in industry.

If you have a problem that requires heat, let Safeway engineers study your requirements and—without obligation to you—submit an appropriate recommendation.

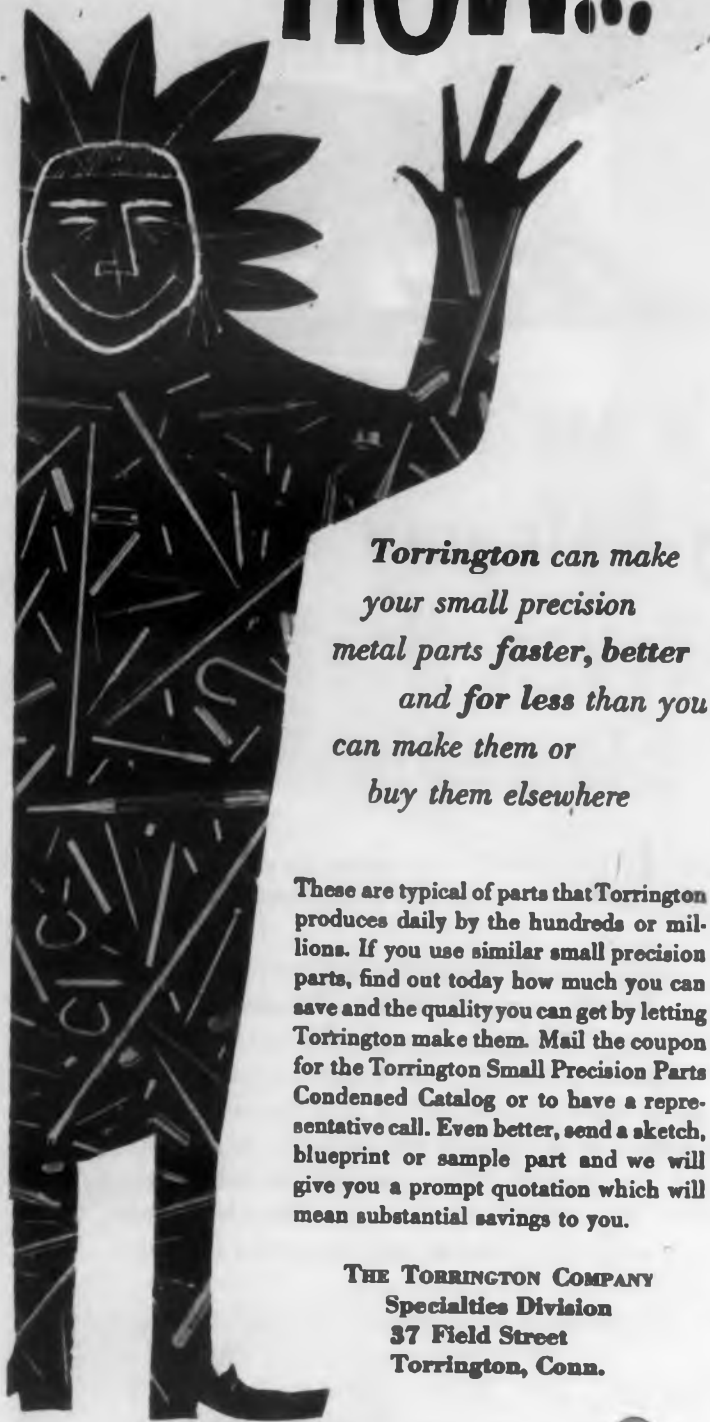
*For your copy
of a fact-filled folder,
write to:*

Safeway

**HEAT
ELEMENTS
INC.**

680 Newfield Street • Middletown, Connecticut
CIRCLE 398 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW...



Torrington can make your small precision metal parts faster, better and for less than you can make them or buy them elsewhere

These are typical of parts that Torrington produces daily by the hundreds or millions. If you use similar small precision parts, find out today how much you can save and the quality you can get by letting Torrington make them. Mail the coupon for the Torrington Small Precision Parts Condensed Catalog or to have a representative call. Even better, send a sketch, blueprint or sample part and we will give you a prompt quotation which will mean substantial savings to you.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street
Torrington, Conn.

TORRINGTON
SPECIAL METAL PARTS
Makers of Torrington Needle Bearings



The Torrington Company - Specialties Division
37 Field Street, Torrington, Conn.

- Please send the Torrington Small Precision Parts Condensed Catalog.
- Please have representative call.
- Please send a quotation on enclosed sketch, blueprint, part.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

CIRCLE 403 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Design

Triple Coincidence Thyratrons

John N. Higgins

Kip Electronics Corp.

Stamford, Conn.

A NEW class of thyratrons has recently been developed which greatly simplifies coincidence control circuitry. The tubes have three control electrodes which can provide double or triple control in circuits where a coincidence function is to be performed. In such a circuit one of these tubes can replace more than a dozen components, with considerable savings in cost and space. The coincidence tubes are finding application in computers, automation control apparatus, conveyor selector systems, coding and programming devices, counters, or wherever the coincidence of two or three signals should cause tube conduction and result in circuit operation.

Operating Conditions

Each coincidence thyatron has two symmetrical ion deflection electrodes (shown as grids) and a third ion-information electrode. In double coincidence circuits, only the two deflection electrodes are signalled. For triple coincidence functions, all three are signalled.

A typical circuit for two-signal double control is

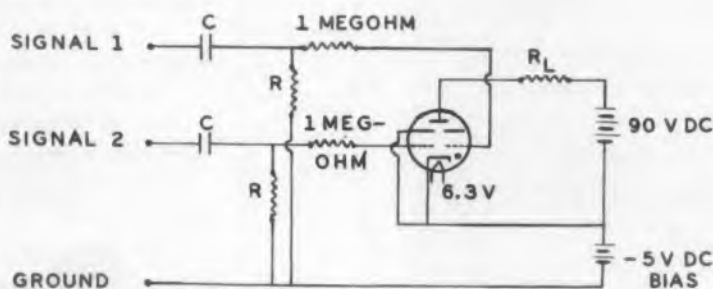


Fig. 1. Coincidence thyatron in circuit designed for two-signal operation. The two ion-deflection grids are signalled, and the third electrode is grounded.

shown in Fig. 1. Reference to Table 1 will reveal that no signal, up to 45 v positive, applied to one grid alone will fire the tube. However, small simultaneous signals (5 v) applied to both grids result in tube conduction.

A curve may be used to illustrate this two-signal coincidence operation. In Fig. 2, the shaded area within the L-shaped curve represents tube conduction. The axes are the supply voltages to the two grids. Point A is the selected bias. Positive signals, applied singly to either of the grids, are represented by the dotted lines extending from A to points B or C. Coincident 5 v signals applied to grids No. 1 and 2 are seen to be at point D, within the area of tube conduction. Two such coincident signals will then cause the tube to fire.

The circuit of Fig. 3 shows how grid No. 3 can be used as a third control electrode, allowing the tube to perform triple coincidence functions. Table 2 shows that no signal up to 20 v positive applied to any two of the three grids will cause conduction. However, small simultaneous signals applied to all three grids will fire the tube.

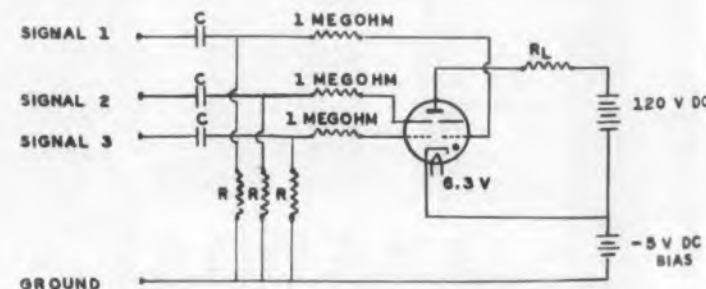
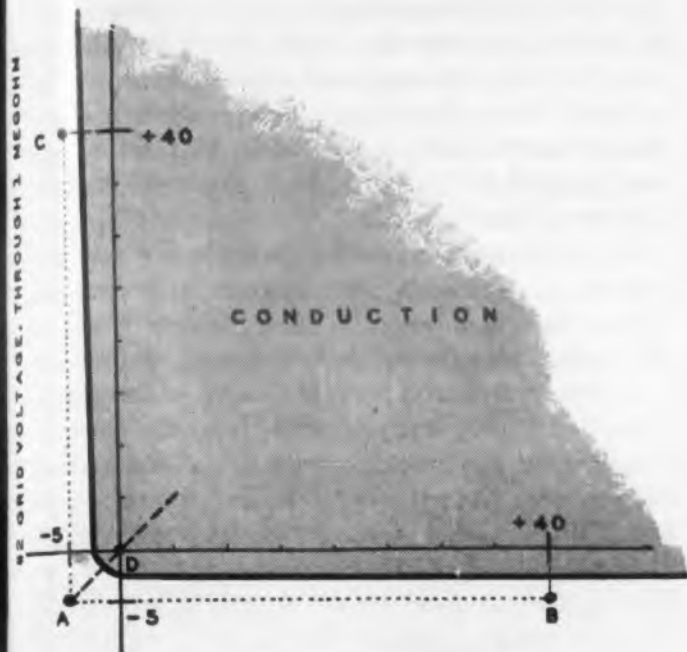


Fig. 2. Coincidence thyatron in circuit designed for three-signal operation. The ion-information electrode acts as a third control grid.

A new regular feature covering clever circuit and mechanical design ideas—Individual contributors will be paid \$10 for items published.



NO. 1 GRID VOLTAGE, THROUGH 1 MEGOHM

Fig. 3. Curve showing typical two-signal operation. All combinations of No. 1 and No. 2 Grid voltages which fall in the shaded area will cause tube conduction. A similar diagram for three-grid operation could be drawn in three dimensions.

Table 1 Two-Signal Coincidence

Volts Signal Applied To:		Tube Condition	Point on Curve in Figure 2
Grid #1	Grid #2		
0	0	Non Conduction	A
45	0	" "	B
0	45	" "	C
5	5	Conduction	D

Table 2 Three-Signal Coincidence

Volts Signal Applied To:			Tube Condition
Grid #1	Grid #2	Grid #3	
0	0	0	Non Conduction
20	0	0	" "
0	20	0	" "
0	0	20	" "
20	20	0	" "
0	20	20	" "
20	0	20	" "
5	5	5	Conduction

(Continued on following page)

SPECIAL OFFER FOR ELECTRONIC DESIGN READERS . . .



SAVES \$1.50

\$1.50—that's all it costs *Electronic Design* readers to subscribe to *Electronic Week*, during this special "combination offer."

52 issues of *Electronic Week* will be yours for only one-half the regular price. Qualification for subscription is based on job function. *Electronic Week* brings you all the news in the electronic field . . . new developments in design and research, exclusive interviews with leading personalities, financial, legislative and military developments, labor reports, taxwise tips, people and plants . . . written and reported from major electronic centers all over the world by men experienced in the electronic field.

Nowhere else will you find such information compiled into one publication; *Electronic Week* is the only single source of news in this field.

The electronic industries are the fastest growing business concerns today. The man who wants to get ahead must stay on top of this growth. Learn how *Electronic Week* will aid you in keeping abreast of the industries. Take advantage of this special "combination rate" and save \$1.50 over regular subscription price.

**TO TAKE ADVANTAGE OF THIS OFFER—
SIMPLY CIRCLE ED NO. 549 on READER SERVICE CARD**

Hayden Publications Corp., 19 East 62nd Street
New York, New York TEmpleton 8-1940

Another product surprise from Helipot!



Ideas for Design

The Ion Deflection Principle

In the coincidence thyratrons, deflection electrodes are placed between the anode region and the cathode to deflect the migrating ions away from or toward the cathode. Since these ions help neutralize the space charge surrounding the cathode, this action controls the firing of the tube. A third electrode controls the number of ions formed.

Multiple signal control is possible because the two deflection electrodes are separate and symmetrical. When the same potential is applied to both control electrodes, no ions are deflected; and, if the potential is sufficient, the tube fires. If a large positive potential is applied to only one electrode, both the electron current and the ion current increase, but the ions are deflected away from the cathode, and the tube does not fire. If the potential on the other electrode is increased, the deflection of the ions is diminished and tube fires. The ion-formation electrode is used as a third control for triple coincidence functions.

Applications

These tubes are being used in newly designed circuits to perform computer coincidence functions or for automatic product selection from conveyor lines.

Tube types available are KP-80, a 6.3 v, 150 ma heater-cathode version in a T-5-1/2 miniature envelope with a standard seven-pin base. Two subminiature versions of these coincidence tubes are made. The KP-106 is a T-2 subminiature with ratings similar to the KP-80. The KP-124, recently developed, has a 1 v, 50 ma hearing-aid type of filament and is intended for battery operated portable equipment applications. This tube is also a T-2 size subminiature and has flying leads, along with the KP-106. Anode voltages are between 90 and 150 v dc. The tubes are manufactured by Kip Electronics Corp., 29 Holly Place, Stamford, Conn.

Preliminary indications have suggested the use of these tubes in circuits where negative signals should cause conduction, and in single-signal fast-firing circuits. Their use to date has resulted in reduction in cost and space. The simplification of circuits and reduction in the number of components has also improved equipment reliability.

Tube Pin Cleaning

To assure good tube pin-to-socket contact in equipment using high reliability miniature tubes, General Electric has developed a pin scouring process.

Normally, in miniature tube production, an oxidation residue is formed on the nickel pins as a result of the 100 deg C heat of the button stem sealing process. This can now be cleaned with an abrasive

905



Here's health to your system . . . when you specify Helipot's series 7600 potentiometer.

Here's strength . . . and here's accuracy!

Here's how it's done. The robust housing of Resinox 10900 is molded in one shot, lathed in one set-up . . . gives you greater mechanical conformity and stability . . . corks up electrical leakage.

The rotor-and-slider-block design pours ruddy health into the 7600 . . . gives you 38-inch-pound stop-load strength, lowered torque and inertia . . . drains off every last drop of backlash.

Cheers for the 90° coil extension that improves end-coil linearity . . . for the internally expanding ring that emphatically clamps lid to housing, eliminates screws.

The full-bodied facts about the 10-turn, 1-13/16" diameter series 7600 are soberly presented in data file 225. Try one today!

Beckman®

Helipot Corporation

Newport Beach, California

a division of Beckman Instruments, Inc.

Engineering representatives in principal cities

CIRCLE 407 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Design

emulsion. The tubes are placed in a holder so that twin nozzles, revolving through 360 deg, subject each pin to the blasting force of abrasive emulsion jets from every angle. The pins then are rinsed in clear water and dried by heat lamp.

Once removed, the oxide coating will not reform in normal tube use, and the full surface area of every pin remains conductive. This lessens the chance of poor contact due to possible failure of the socket to grip the pin tightly, and in some cases precludes faulty contact as a result of chemical interaction of the oxide coating with atmospheric impurities.



Before Cleaning (left). After cleaning (right).

Light Deflection-Yoke Cores

A new method of molding full-round ferrite deflection yoke cores has led to a flared ferrite core for use with the new 100 deg TV picture tubes.

The new flared yokes make possible a weight reduction of 30 per cent over conventional cylindrical cores heretofore used for the 110 deg tubes. The reduction in material comes from shaping the outer surface so that the cross section is approximately uniform from top to bottom.



Allen-Bradley Company of Milwaukee, Wis. is producing these flared cores which are available in Class WO-1 ferrites, having uniform permeability and flux density. They are made as a full 360 deg ring, then "cracked" by a special process into two mated halves, which are rejoined and mechanically held together for shipping. The "full-round" construction also has the advantage that there is no need for grinding and matching, as is required when quarter sections are used.



POWER TRANSISTORS

- High power ratings
- High power gain
- Rugged, compact mechanical design
- Welded, hermetically sealed package for stability and long life
- Excellent heat dissipation characteristics

Now Clevite can supply you with power transistors that fit your needs for audio applications, portable power supplies, etc., from a full line of six types. All are available in production quantities. All are rated at 25 watts continuous operation with infinite heat sink — 15 watts with 36 sq. in. heat sink.

Clevite Power Transistor packaging is compact. Vacuum baking and hermetic sealing of the package insure stability and long life. Low thermal resistance between collector junction and large copper flange insures excellent heat conduction from the package to the heat sink.



CLEVITE TRANSISTOR PRODUCTS

241 Crescent St., Waltham 54, Mass. TWinbrook 4-9330



Clevite Power Transistors are used in leading auto radios.

OUTLINE SPECIFICATIONS

TYPE	2N268	CTP 1111	2N257	CTP 1104	CTP 1109	CTP 1108	Units
Instantaneous Collector-to-Base Voltage (absolute maximum)	-80	-80	-40	-40	-20	-20	Volts
Junction Temperature (absolute maximum)	85	85	85	85	85	85	°C
Average Total Power Dissipation (with inf. heat sink @ 25°C)	25	25	25	25	25	25	Watts
Average Total Power Dissipation (with 36 sq. in. heat sink @ 25°C)	15	15	15	15	15	15	Watts
Power Gain	28 ^a	23 ^a	30 ^a	23 ^a	27 ^b	20 ^b	db
Frequency Cutoff	6	4	7	4	6	4	kc/s

^a V_{cc} = -14V; I_c = 500 ma; R_L = 30 Ω (choke coupled); R_e = 10 Ω

^b V_{cc} = -7V; I_c = 500 ma; R_L = 15 Ω (choke coupled); R_e = 10 Ω

Write for Data Sheet B-211

Clevite Divisions: Brush Electronics Co. • Cleveland Graphite Bronze Co. • Clevite Harris Products Inc. • Clevite Research Center • Clevite Ltd.

CIRCLE 408 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Design

Rubber "Safety Glass" Interlayer

Silicone rubber is now being used as the center layer in "safety glass" windshields for supersonic aircraft. Identified as "Silastic Type K Interlayer," the new silicone rubber was developed by Dow Corning Corporation in conjunction with Wright Air Development Center.

This goes back over two years—ever since it became evident that plasticized polyvinyl butyral, the conventional safety glass interlayer, would not withstand the intense frictional heat generated by potential aircraft speeds.

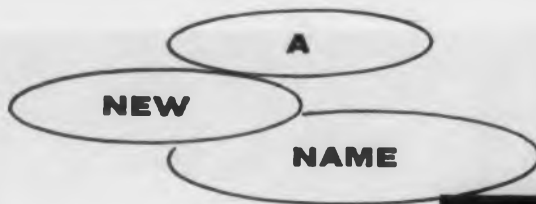
Above 180 F, for example, the conventional interlayer softens, evolves gas bubbles, and rapidly loses shear strength. Also, temperatures in the range of -65 F render it almost as brittle as glass itself. At either extreme, conventional interlayer material is unable to prevent glass from shattering if cracked.

Laminated windshields made with silicone rubber retain full strength and clarity at temperatures ranging from -65 to over 350 F. At up to 160 F, they have somewhat less shatter resistance than the conventional laminate, but the strength of the conventional plastic interlayer falls off so sharply above 160 F that at 200 F the new silicone is more than twice as strong.

In the uncured stage, Type K is a soft, plastic and extremely tacky sheet, calendered between layers of polyethylene-coated paper. Readily flowable under pressure, it requires no bonding adhesive. When laminated and cured under pressure in either flat or curved "glazings," it forms a tough, rubbery interlayer with excellent optical properties. Haze and distortion are minimized, and a high order of transmittance is obtained over the entire spectrum.



Fig. 1. After a few minutes at 375 F the plastic interlayer in conventional safety glass softens, bubbles and oozes out the panel edges, robbing the laminate of shatter-resistance. Panels based on Silastic Type K Interlayer, however, remains clear and shatterproof even after hours at 375 F.



KINTEL

for **KAY LAB** products



The same company, the same engineering and manufacturing facilities, the same world-wide staff of field engineers, but a new name more descriptive of the Company and its products.

LOOK FOR **KINTEL** ON:



UNIVERSAL DC
MICROVOLTMETERS



INDUSTRIAL TELEVISION
EQUIPMENT



MICROVOLT LEVEL
BROADBAND DC
AMPLIFIERS



BROADCAST TELEVISION
EQUIPMENT



ABSOLUTE DC POWER
SUPPLIES AND
METER CALIBRATORS

On these and many other electronic products the name **KINTEL** means outstanding instruments and television equipment.



Representatives in all major cities

Write, wire, phone today for demonstration

ELECTRONICS FOR COMMUNICATION • MEASUREMENT • CONTROL

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

KINTEL

[KAY LAB]

FOR DRIFT-FREE DC INSTRUMENTATION**AMPLIFY MICROVOLTS
with STABILITY**

The KINTEL Model 111 amplifier provides maximum stability and the lowest drift of any commercially available broadband d-c amplifier. It is the end result of years of research in the field of chopper stabilized broadband d-c amplifiers. Thousands of KINTEL amplifiers are in daily use. The Model 111 incorporates KINTEL's proven chopper amplifier circuitry and provides ten extremely precise, feedback controlled gain ranges. Several feedback loops assure high accuracy, stability and uniform frequency response. The completely new and unique circuit provides rapid recovery from severe overloading and unsurpassed dynamic performance - unaffected by load or gain changes. The Model 111 is available in a single unit cabinet or in a six-unit rack-mountable module. The amplifiers are extremely compact; the six unit module occupies only a 19-inch rack width.

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

SPECIFICATIONS

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

Power Requirements:
Amplifier 117 V - 60 cycles - 70 VA
Cabinet 117 V - 60 cycles - 15 VA
6 Unit Rack Adaptor 117 V - 60 cycles - 45 VA
Dimensions: Amplifier Unit 2 $\frac{1}{2}$ " wide, 7 $\frac{1}{2}$ " high, 14 $\frac{1}{2}$ " deep
Rack Adaptor for 6 Units 19" wide, 8 $\frac{3}{4}$ " high, 18 $\frac{1}{4}$ " deep
Net Weight - Amplifier 11 pounds
PRICE: Amplifier Unit \$550.00
19-inch Rack Adaptor for 6
amplifier (with fans and connectors) 200.00
Cabinet for single amplifier
(with fan and connector)
is available.

...the Standard in chopper-stabilized instruments

KINTEL

[KAY LAB]

Representatives in all major cities.

5725 KEARNY VILLA ROAD, SAN DIEGO 11, CALIFORNIA · BROWNING 7-6700.
CIRCLE 409 ON READER-SERVICE CARD FOR MORE INFORMATION**STABILITY***locked in!*

WITH CHOPPER AMPLIFIERS

Ideas for Design

Availability at present is limited, but larger scale manufacturing facilities are under construction at Dow Corning. Lamination of the material within windshield glass is being done by Libby-Owens-Ford Co., Toledo, Ohio and Pittsburgh Plate Glass Company, Pittsburgh, Pa.

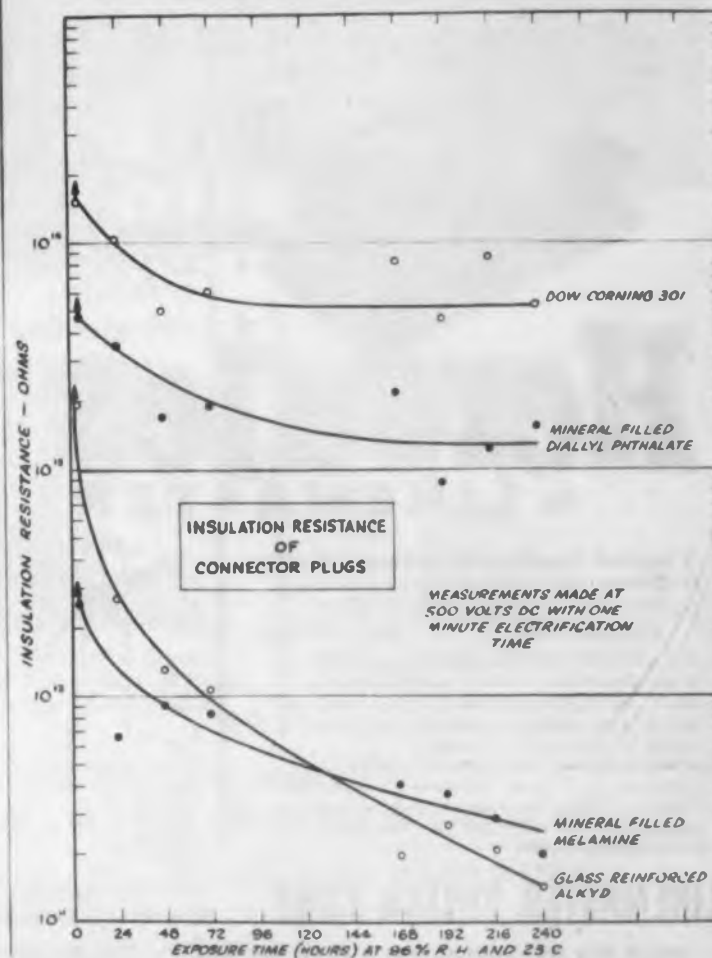
Glass-filled Silicone

Although glass-filled silicone molding compound is usually specified primarily for high temperature service, its insulation resistance at any temperature is reportedly superior to comparative materials.

In the figure are test results of insulation resistance run on four miniature 26-contact connectors molded by Continental Connector Corp. of Long Island City, N. Y. The plugs were identical in design but were fabricated from four different materials. These included mineral-filled melamine, glass reinforced alkyd, Orlon-filled diallyl phthalate, and glass-filled silicone (Dow Corning 301).

As shown, the silicone connectors have the highest insulation resistance. Most significant is the situation after 240 hours at 96 per cent relative humidity. The silicone-compound connector maintained a broader lead in insulation resistance over the others as exposure time increased.

The curves shown are for room temperature. At elevated temperatures, the superiority of the silicone compound would be even more marked.



PROBLEM

Design a charging reactor with an inductance of 4.85 henrys ($\pm 7\%$) at 150 ma, DC, and an inductance linearity of 20%. It should operate at 8000 volts DC, be tested at 14,000 RMS volts, and continuously useable in the frequency range up to 2000 cps. It should have a maximum temperature rise of 125 C in a standard ambient, also a maximum effective capacitance of only 60 micromicrofarads when measured in the frequency range between 20 and 25 megacycles. Other prime factors are minimum weight and dimension. Construction to be in strict accordance with the applicable requirements of MIL-T-27.

... SOLUTION

Inductance	4.85 henrys $\pm 5\%$ (@ 150 ma, DC)
Linearity	10%
Operating Voltage	DC = 8000
Test Voltage RMS	16,000
Useable at F up to	2000 cps
Maximum Temp. Rise	100° C
Ambient Temperature	25° C
Max. Effective Cap.	51 micromicrofarads (measured at 20-25 megacycles)
Weight	2-3/4 lbs
Dimensions, nominal	H — 3-1/2" + 3/8" terminal W — 2-7/8" L — 3-13/16"

The outstanding success of the Peerless engineering staff in the development of transformers to meet unique and difficult specifications has made Peerless transformers the first choice of engineers throughout the country. Custom production techniques and stringent quality control assure a dependable product.

Consult Peerless for the best solution to your quality transformer requirements.



PEERLESS
Electrical Products

A DIVISION OF



1515 S. Manchester Ave., Anaheim, Calif.
161 Sixth Avenue, New York 13, N.Y.

CIRCLE 404 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW from America's FOOTSWITCH leader A NEW HEAVY DUTY LINE



- * Rugged
- * Cast iron enclosure
- * Safety-guarded

Hercules

by LINEMASTER

2 Contact Types — 40 Different Models
4 Classes (all in single, two or three stage)
General Purpose Water-tight
Explosion-proof High DC rated

For use in the electrical and electronic fields (riveting machines, welders, motors, solenoids, relays, sound systems, presses, machine tools, etc.) and as pilot devices in connection with control circuits of contactors or starters.

Fitting companions for Linemaster's Lektro-Lok, Linemaster Jr., Clipper, Linemaster Sr., Compact, Treadlite, Cadet, The Executive and the completely waterproof Nautilus, models for every conceivable footswitch application!



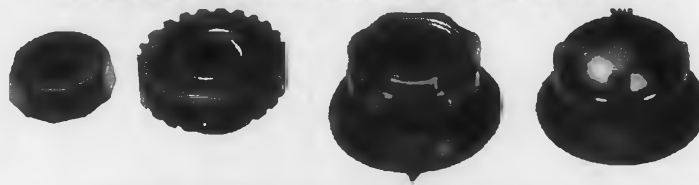
Let us quote on your specific problems or write TODAY for full catalog and price list.

LINEMASTER SWITCH CORP.

130 Putnam Rd.,
Woodstock, Conn.

CIRCLE 405 ON READER-SERVICE CARD FOR MORE INFORMATION

standard knobs



widest choice



fastest delivery



Variety and versatility in a complete standard line of thermosetting plastic knobs. Combinations, variations in types, sizes and colors delivered promptly. Send for catalog. Specialists in thermo-setting plastics for 41 years.

kurz-kasch

Kurz-Kasch, Inc., 1415 S. Broadway, Dayton 1, Ohio

CIRCLE 406 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Design

Acrylic Implosion Shields

RCA Victor has turned to molded acrylic implosion shields to help reduce the weight of the 8-1/2 and 14 in. models in its TV portable series. The new shields weigh 2/3 less, yet meet the same optical and safety standards as the tempered glass shield formerly used.

One of the big advantages of molding these shields is that the cutting and finishing operations which are necessary when the shields are made from cast acrylic or glass sheet, are eliminated. With molding, the 1/8 in. thick shields can be produced to exact size and with the required curved-edge contour with negligible trimming and waste. In addition, material costs for the acrylic molding powder used was lower than that of tempered or laminated glass in the thickness necessary to provide equivalent strength. These various economies reduced the unit cost of the molded shield, including die amortization, appreciably below that of the previously-used glass shields. Another advantage of molding is that thickness tolerances can be held within 0.005 in., closer than is commonly obtainable with sheet material.

The shields are presently produced for RCA by two injection molders—Sinko Manufacturing Company and Santay Corporation, both of Chicago. Plexiglas VM, a medium-flow grade of acrylic molding powder, manufactured by the Rohm & Haas Company of Philadelphia is used. The shields have a neutral gray tint, with 55 per cent light transmission, for glare control.

The acrylic shield has excellent color stability, will not yellow with age or be discolored by ultraviolet radiation when used outdoors. Furthermore, it provides the high impact and shatter resistance required for the application. Also, scratch-and-craze-resistance are used.

As presently used, shields are flat panels held in place with a conventional bezel. However, the traditionally separate implosion shield, bezel, metal



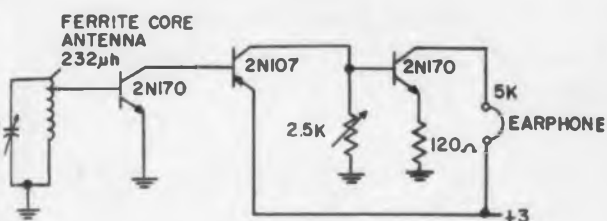
Ideas for Design

medallion, and control panel could be molded as a one piece decorated unit. Also, various curvatures can be molded into the shields for improved reflection control, and could be combined with integral knobs for curbing problems of sky reflection as portable TV sets get more outdoor use. Molding techniques can be adapted to produce beaded edges, lugs and holes for simpler mounting and installation. Similarly a return could be molded on the second surface of the shield with appropriate decorative effects to prevent seeing through the gap that is sometimes present between the decorated bezel and tube.

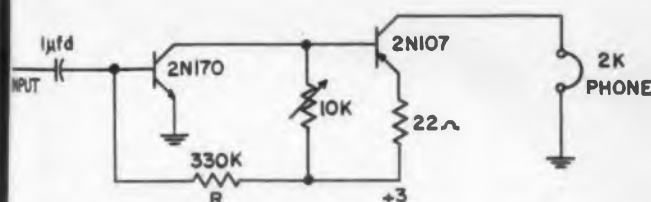
Circuits For Low-Cost Transistors

The transistor circuits shown were recently released by General Electric Company. They feature the use of low-cost transistors—the audio-frequency 2N107 and high-frequency 2N170.

DIRECT COUPLED VEST POCKET RADIO

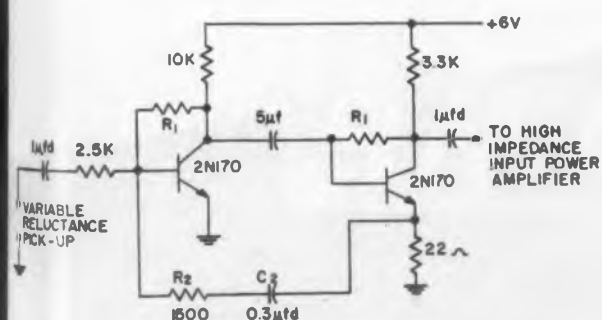


DIRECT COUPLED "BATTERY-SAVER" AMPLIFIER



R SHOULD BE ADJUSTED FOR OPTIMUM RESULTS

VARIABLE RELUCTANCE COMPENSATED PRE-AMPLIFIER



R1 (100K-500K) SHOULD BE CHOSEN TO MAKE COLLECTOR VOLTAGE 2.5 TO 3.5 VOLTS

CHANGING C2 AND R2 WILL VARY COMPENSATION CURVE. VALUES SHOWN GIVE APPROXIMATE COMPENSATION FOR R. I. A. A. RECORDING CHARACTERISTICS

INSTALL 'EM...



FORGET 'EM!



WIRE-WOUND POWER RESISTORS

You can count on Clarostat "Greenohm" power resistors — they won't let you down. "Greenohm" power resistors are used in the most expensive, critical electronic equipment where dependability is the prime requisite. You can have this same dependability, by insisting on "Greenohm" power resistors.



LOOK — Overload a "Greenohm" power resistor. Get it so hot you can light a cigarette from it...



THEN . . . plunge the over-heated "Greenohm" power resistor in cold water. No blisters, no cracks, in fact, it will work good as new.



* Reg. U.S. Pat. Off.

Write for literature. Let us quote on your needs.

CONTROLS AND RESISTORS

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE

In Canada: CANADIAN MARCONI CO., LTD., TORONTO 17, ONT.

CIRCLE 411 ON READER-SERVICE CARD FOR MORE INFORMATION

Report Briefs

Non-classified results of the growing volume of Government-financed scientific research, estimated at a \$2.7 billion level for the current fiscal year, are being turned over to American science and industry in increasing quantity through the Office of Technical Services, U.S. Department of Commerce. Increased length of the Report Briefs department in *ELECTRONIC DESIGN* reflects this.

OTS, operating under a special law passed by Congress in 1950, is responsible for collecting research reports from the Army, Navy, Air Force, Atomic Energy Commission, and other agencies, reproducing them, and selling them to the public at the cost of reproduction and handling. Last year approximately 182,000 printed or microfilmed copies of such reports were sold.

In addition to research reports, OTS also publishes abstracts of Government-owned patents that are now free for use by private firms on a non-exclusive basis.

To keep science and industry advised of new material released through OTS, the office issues news releases to the trade, business, and technical press and publishes two monthly periodicals. U.S. Government Research Reports, a bibliography, describes 300 to 600 new reports in each issue. Technical Reports Newsletter reviews 15 to 20 of the most widely useable reports collected by OTS each month. These publications may be ordered from Supt. Documents, U.S. Government Printing Office, Washington 25, D.C., at \$6 a year for the USGRR and \$1 a year for Technical Reports Newsletter. In addition subject catalogs have been prepared in some fields, and a list of these Catalogs of Technical Reports is available from OTS on request.

ELECTRONIC DESIGN scans these publications regularly and reports in these columns titles of subject of interest to electronic designers.

Test Methods For Solder Flux

A discussion of solder fluxes with particular emphasis on rosin-based fluxes. Several test methods are presented which were developed to measure the degree of corrosion and electrical leakage attributable to the use of various commercially available rosin-based fluxes. *PB 111843 Test Methods For Soldering Fluxes, F. Hockberg, Signal Corps, OTS, US Dept. of Commerce, Washington 25, D. C., Nov. 1954, 75 pp, \$2.00.*

AMP-EDGE

has the

Design-Engineered with Positive Wiping Contact and Frictional Grippage.

The new AMP-EDGE connector gives you...

... **greater flexibility**— your printed circuit area and completed unit are not limited by the size of connection, as found in alternate methods of edge connection.

... **greater design versatility**— they can be applied in any arrangement to any section of the perimeter of the printed circuit.

... **two-way cost reduction**— production time and labor costs are reduced through solderless termination of the connector to the wire (4,000 terminations per hour) and the ease of applying the Edge Connector to the printed circuit.

For more information on AMP-Edge Connectors, contact:

AMP INCORPORATED



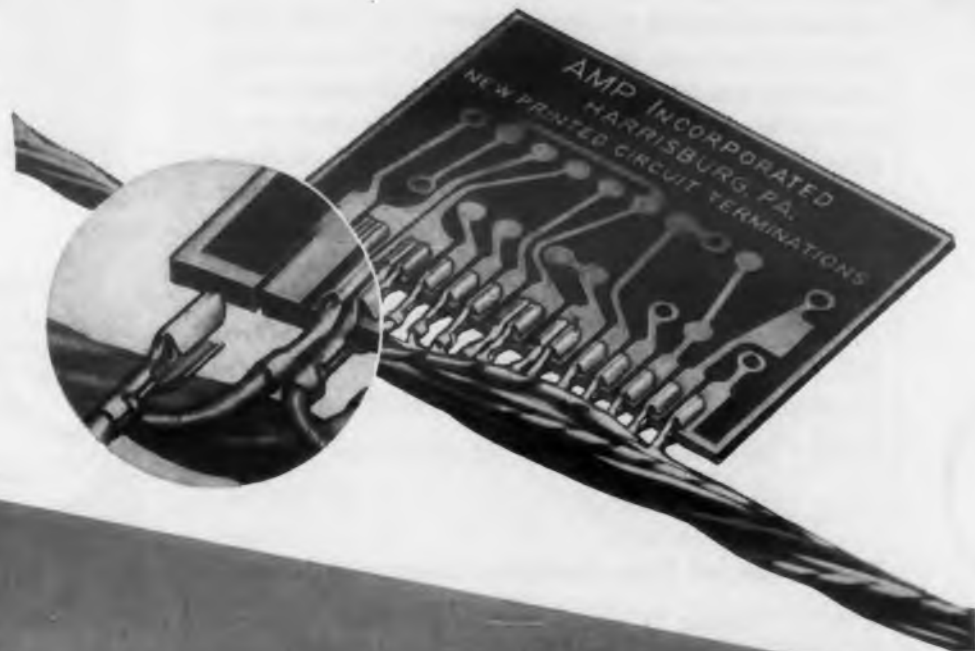
General Office: Harrisburg, Pa.

Wholly owned subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada • Aircraft-Marine Products (G.B.) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP-Holland N.V., Hertogenbosch, Holland

Japanese Distributors: Oriental Terminal Products Co., Ltd., Tokyo, Japan

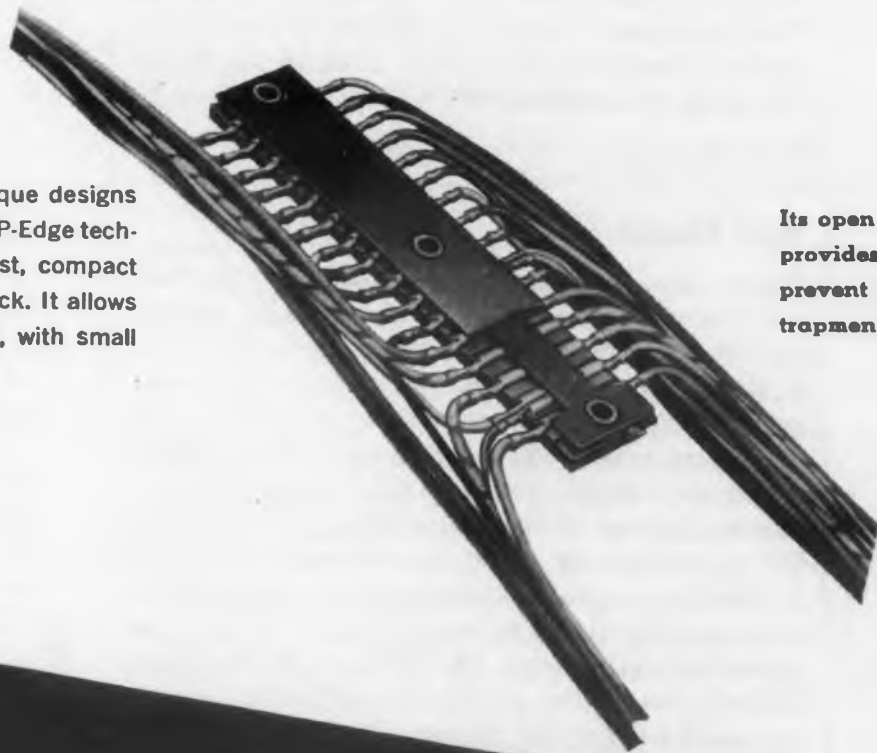
CIRCLE 412 ON READER-SERVICE CARD FOR MORE INFORMATION

EDGE ON PRINTED CIRCUITS



Amp's **C**reative **A**pproach
TO BETTER WIRING

Another of the many unique designs made available by the AMP-Edge technique is the new, low-cost, compact AMP-Edge Connector Block. It allows freedom of arrangement, with small area displacement.



Its open construction provides aeration to prevent moisture entrapment.

CIRCLE 412 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Data Reduction Devices

This catalog serves the purpose of summarizing the characteristics of devices useful in automatic data recording and reduction systems which are commercially available or under development. Included are analog voltage to digital converters, shaft position digitizers, digital plotters, digital to analog converters, digital voltmeters and special tape recorders. (For Part I, see PB 111927.) *PB 111928 Catalog of Devices Useful In Automatic Data Reduction, Part II, R. S. Hollitch and A. K. Hawkes, Armour Research Foundation, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Nov. 1954, 80 pp, \$2.00.*

Semi-Conductor Conductivity

The equations relating the photocurrent to field strength, intensity of illumination, quantum efficiency, and electron and hole mobilities and concentrations in semi-conductor crystals, are derived for the case when both holes and electrons are present. It is shown that in contrast to the case of induced conductivity in insulators, the measurement of time constant and of deviation from Ohm's Law does not yield sufficient information to determine either hole or electron mobility. *PB 120046 Photoelectric Conductivity in Semi-Conductors, J. N. Humphrey, NOL, Order from Library of Congress, Washington 25, D.C., July 1951, 19 pp, Microfilm \$2.40, Photocopy \$3.30.*

Delay Line Oscillators

A delay line oscillator is described, the frequency of which is controlled by varying the termination resistance of a delay line. The frequency of oscillation is linear within ± 1 per cent over a 22.8 per cent bandwidth with output voltage variations of ± 0.75 db at a center frequency of 212 kc. Similar performance should be attainable up to at least 20 mc. *PB 120896 Delay Line Oscillators, William S. Carley, U. S. Naval Ordnance Laboratory, Order from Library of Congress, Washington 25, D.C., Dec. 1954, 13 pp, Microfilm \$2.40, Photocopy \$3.30.*

Feedback Amplifiers

A docile amplifier is one that remains stable when connected to an arbitrary passive network of a specified type. Docility criteria are developed for end-loading, for ideal-transformer feedback, and for an arbitrary passive feedback network. *PB 122849 Criteria for Docile Behavior of Feedback Amplifiers, Samuel J. Mason, MIT, Order from Library of Congress, Washington 25, D.C., June 1954, 10 pp, Microfilm \$1.80, Photocopy \$1.80.*

Transistor Evaluation at a glance



TRANSISTOR CURVE TRACER

- EIGHT-CURVE FAMILY PRESENTATION
- SINGLE CURVE SELECTIVITY
- DUAL INPUTS FOR RAPID MATCHING
- FOR PNP & NPN JUNCTION TRANSISTORS

FULLY TRANSISTORIZED • SELF-POWERED • PORTABLE
(Weights only five pounds)

A must for circuit design, production test, and receiving inspection, the 504 makes possible immediate visual indication of GAIN, LEAKAGE CURRENT, LINEARITY, BREAKDOWN, COLLECTOR RESISTANCE, and ALL PERFORMANCE ANOMALIES.

CUBIC CORPORATION

5575 KEARNY VILLA ROAD • SAN DIEGO 11, CALIFORNIA
CIRCLE 413 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Microwave Systems

The results of a theoretical and experimental investigation of the free modes that propagate on the strip transmission line are reported. A Fourier integral solution is obtained for the free modes. In the course of the discussion, it is proved that the only free modes that may exist on any n-conductor system of arbitrary but constant cross section in homogeneous and simple connected space are TEM modes. Previously known methods for the determination of the guide wavelength and attenuation required that the standing waves of the strip transmission line be known. It was found that these could not be measured directly. Since precedent measuring methods were found to be inadequate, a new simple method for measuring the attenuation of any transmission line through a junction is presented. PB 122851 Printed Microwave Systems, Martin Schetzen, MIT, Order from Library of Congress, Washington 25, D.C., Sept. 1954, 41 pp, Microfilm \$3.30, Photocopy \$7.80.

Properties of Non-Metallic Compounds

A brief resume is given of the progress made in collecting and analyzing data on the magnetic properties of non-metallic compounds. The greater part of the data collected is on the simple compounds of the iron group, especially the oxides and halides. Particular attention has been given to compounds suspected of being antiferromagnetic and to those with the spinel structure. Existing data on ferrites is offered. PB 123582 Collected Data on the Magnetic Properties of Non-Metallic Compounds, J. S. Smart, NOL M 10496, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Sept. 1949, 16 pp, Microfilm \$2.40, Photocopy \$3.30.

High Resolution CRT

To give results of experimental tests using the General Electric Z4300, Z4303, Z4309 and Z4335 cathode ray tubes in comparison to the present CRT used in Radar Set AN/CPN-18. This improved indicator program is designed to provide techniques and equipment which will increase the radar information content appearing on the CRT scope. The military application of high information content radar PPI is twofold; the ability to more accurately predict the appearance of a selected target on the radar scope and the ability to recognize a selected target appearing on the scope. PB 122471 High Resolution Cathode Ray Tubes Applicable for Traffic Control, Approach and Landing Systems, William G. Stryker, USAF, Order from Library of Congress, Washington 25, D.C., Feb. 1956, 15 pp, Microfilm \$2.40, Photocopy \$3.30.



Cancer can't strike me,
I'm hiding.



What I don't know
won't hurt me.



Cancer?

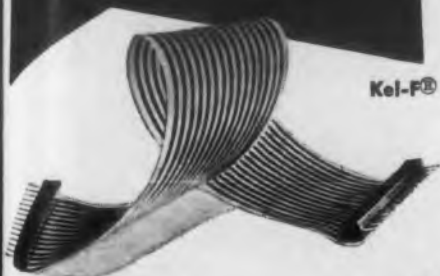
Lots of people die of it,
I know... but the
American Cancer Society
says a great many deaths
from cancer are NEEDLESS
deaths. That's why I do
what they tell me. I have
an annual medical
checkup however well
I feel. I know the seven
danger signals. And
when I want sound
information, I get it from
my Unit of the

AMERICAN
CANCER
SOCIETY



NOW!

Flexible Kel-F PRINTED CIRCUIT CABLES



developed by
Sanders Associates, Inc.

By means of an exclusive Sanders process, the versatile plastic Kel-F can now be laminated with copper in thin sheets to provide a flexible printed circuit cable. This unique development introduces an entirely new concept in the fabrication of multi-conductor cables or wiring harnesses. Excellent electrical and mechanical properties are supplied for operation over a wide range of environmental conditions. The complete encapsulation of the conductors in Kel-F ensures maximum protection against moisture. Glass cloth can also be included in the laminations for increased strength and high temperature stability.

FEATURES

- Excellent dielectric strength
- High degree of flexibility
- Lighter, thinner than many cables
- Maximum environmental protection
- Adaptable to many connectors
- Multi-layer construction available
- Suitable for chassis harnesses
- Wiring errors are eliminated
- Easily mounted

Write for engineering bulletin to Dept. ED-15



CIRCLE 415 ON READER-SERVICE CARD

CRT Displays

This report summarizes the results of a series of eleven studies of the feasibility of several different types of symbols for the coding of information on cathode ray tubes (CRT) and similar displays for use in future air traffic control and related systems. The report is divided into two sections. Section I contains specifications and recommendations for engineering applications to CRT-type displays. Section II contains the detailed results of the laboratory investigations, on which the recommendations of Section I are based. *PB 121468 Symbolic Coding of Information on Cathode Ray Tubes and Similar Displays, Muller, Sidorsky, Slivinske, Alluisi and Fitts, Ohio State University, OTS, U. S. Dept. of Commerce, Washington 25, D.C., Oct. 1955, 134 pp., \$3.50.*

Power Capacity of Transmission Line

An expression is obtained for the maximum power which can be carried by a strip transmission line having an inner conductor with rounded edges without breakdown. For a typical transmission line of half-inch plate separation and 50 ohm impedance, the result is of the order of 0.25 Mw/mm of inner conductor thickness. *PB 122377 Power Handling Capacity of Strip Transmission Lines Having Rectangular Inner Conductors With Semi-Circularly Rounded Edges, R. L. Pease, Tufts College, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Mar. 1955, 14 pp, Microfilm \$2.40, Photocopy \$3.30.*

Trimode Turnstile Waveguide

The microwave junction whose study is extended in this report is a seven port variation of a turnstile waveguide junction with a coaxial arm axially opposing the circular waveguide.

With the assumptions that all waveguide characteristic impedances that normalized, that the junction is lossless, that only TE_{10} , TE_{11} and TEM modes are propagated respectively in the rectangular, circular and coaxial arms, and that all sources and terminations are matched, the scattering matrix of the junction is determined explicitly for each of the three possible combinations of two different types of matched ports. These three different scattering matrices are then used to determine the amplitude and phase relationships of the output voltages at each port as the junction is excited by a number of different rectangular arm TE_{10} modes. *PB 121040 Multiple Mode Excitation Of The Trimode Turnstile Waveguide Junction, R. S. Potter, NRL Report 4802, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Aug. 1958, 16 pp, \$0.50.*



HERE'S THE RELAY
THEY'RE TALKING ABOUT

ELGIN'S NEOMITE

Designers are excited about the unique advantages of Elgin's new **NEOMITE** Relay. It's the world's smallest, weighing just .09 ounces, and requires only 100 milliwatts of power to open and close electrical circuits. *There's nothing like it for size or performance . . . and now they're available from leading distributors.*



SPECIFICATIONS

Relay Type	NMIC 50	NMIC 200	NMIC 500	NMIC 1K	NMIC 2K
D. C. Coil Resistance ($\pm 10\%$ @ 20°C)	50 Ohms	200 Ohms	500 Ohms	1000 Ohms	2000 Ohms
Coil Voltage	3-5 V.D.C.	6-10 V.D.C.	9-15 V.D.C.	12-21 V.D.C.	18-30 V.D.C.
Pickup	44 MA Max.	22 MA Max.	14 MA Max.	10 MA Max.	7 MA Max.

Duty: Continuous
Dropout: 30 to 60% of pickup
Contact Rating: .25 AMP at 28 V.D.C. resistive load
Operation Time: 4 milliseconds max. @ rated voltage
Dielectric Strength: Sea level: 500 V RMS. High altitude: 500 V RMS

Shock: Shock test: 50 G. without damage
Vibration: 10 G to 500 cps
Contact Arrangement: SPDT Form C
Ambient Temperature Range: -55°C to $+85^{\circ}\text{C}$
Life: 1,000,000 operations at rated load
Contact Resistance: .05 Ohms

YOU'LL FIND WHAT YOU WANT IN ELGIN'S ADVANCE RELAY LINE



. . . it's the most complete line of relays to meet almost every need. And they're available from stock at leading distributors all over the country. Write today for catalog information.



ELECTRONICS DIVISION
ELGIN NATIONAL WATCH COMPANY
Elgin, Illinois

CIRCLE 416 ON READER-SERVICE CARD FOR MORE INFORMATION



TELL US

And We'll Tell 25,000 Others

You're coming to the Show and Convention to pick up some ideas. You're bound to get plenty as you visit some of the 800 plus exhibits and catch part of all the papers being read.

Why not get your design ideas published in **ELECTRONIC DESIGN**. If you stop to think about it, **ED** is the only technical magazine devoted exclusively to passing along practical ideas for design engineers. It reaches more strictly design engineers than any other publication.

The code of the scientist is to publish his findings. Research engineers and scientists who use the Proceedings and Transactions of the IRE for this purpose are to be congratulated. But what about you, the practicing engineer who learned how to do something better than before. Are you passing along your knowledge as you can?

WHAT ARE YOU GOING TO DO IN RETURN?

You'll no doubt bump into old friends and associates and tell them about your latest brainstorm. They'll probably congratulate you. But in reality, you're as communicative as a clam. Only about 0.0005 per cent of your available audience will hear you. (Even if you read a convention paper, you will expose, orally and in print, only 0.05 per cent of the available audience to your idea.)

An editor will be on hand at Booth 1401 at all times. We will have an Author's Guide and a list of suggested topics for you.

STOP IN AND SEE US

HAYDEN PUBLISHING COMPANY, INC.

New York • Chicago • Los Angeles

CIRCLE 548 ON READER-SERVICE CARD FOR MORE INFORMATION

Development to Production

This report considers the process through which a new device is advanced from the stage of a requirement to the stage of mass production. For developments which take place within the framework of cooperation between a Navy operated laboratory and a capable industrial manufacturer, these phases are identified and defined. *PB 121170 Transition from Development To Production, D. E. Marlowe, NAVORD 3627, OTS, U.S. Dept. of Commerce, Washington 25, DC, Feb. 1954, 10 pp, \$5.00.*

Photoconductive Cells

Transient and frequency methods used to study the response of lead telluride photoconductive cells to infrared radiation. Both methods are used to study the dependence on the wave length and intensity of the radiation, and the voltage across the cell. The experiment indicated that both monomolecular and bimolecular decay mechanisms are present. Dependence on wave length intensity and bias is evident. The data are fitted by an empirical equation which combines two exponential and one hyperbolic time processes. *PB 120945 Response Time Studies In Lead Telluride Photoconductive Cells, Lummis and Scanlon, NAVORD 1899, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., May 1954, 36 pp, Microfilm \$3.00, Photocopy \$6.30.*

Rocket Instrumentation

A general discussion of the operating characteristics and experience with the Airpax 400 cy, dc to ac power inverter, is presented. Performance curves for the inverter and circuit diagrams of an electronically regulated power supply and flexible remote-control system suitable for rocket-borne use are included. Power supply reliability is discussed. *PB 122376 Power Supplies and a Remote-Control System Suitable for Aerobee Rocket Instrumentation, H. F. Schulte, Michigan University, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Dec. 1955, 18 pp, Microfilm \$2.40, Photocopy \$3.30.*

Design of Feedback Systems

The purpose of this study is to examine the relationship between system configuration and system performance with the objective of establishing practical guides to aid in choosing the configuration to be used. *PB 123159 Design of Feedback Systems, Edward J. Angelo, Jr., Polytechnic Institute of Brooklyn, Order from Library of Congress, Washington 25, D.C., Jan. 1956, 25 pp, Microfilm \$2.70, Photocopy \$4.80.*

BIG NEWS ABOUT A LITTLE PRODUCT

(ACTUAL SIZE)



Bendix "PYGMY" Electrical Connectors

Gold Plated Contacts	Can be pressurized to current MIL-C-5015 specification
Closed Entry Sockets	
Resilient Scinflex Insert	High Strength Aluminum Shells
Alumilite or Cadmium Plate Finish	Variety of Styles Available—General Duty, Environmental Resisting, Potting Types, Jam Nut Receptacles, Hermetically Sealed Receptacles
Two Quick Disconnect Couplings—Double Stub Quick Action Thread or Three-Point Bayonet Lock	
Light Weight	Wide Choice of Insert Patterns (1 to 55 contacts)
Small Envelope Size	
Maximum Serviceability	Designed especially for miniaturized Electronic Equipment

New "PYGMY" Connectors for Miniaturized Electronic Equipment Installations

Although the newly developed "Pygmy" line of miniature electrical connectors is approximately one third smaller in size and weight than the standard Bendix AN connector, they provide the same outstanding qualities of serviceability, ruggedness, reliability and resistance to vibration, moisture and corrosion for which all Bendix connectors have become world famous.

If you have an application for miniaturized electronic equipment requiring lighter and smaller connectors than standard AN types, you'll find Bendix "Pygmy" connectors the best possible solution. Write for complete detailed information. SCINTILLA DIVISION OF BENDIX AVIATION CORP., SIDNEY, N. Y.



*REG. U.S. PAT. OFF.

Scintilla Division

SIDNEY, NEW YORK



CIRCLE 418 ON READER-SERVICE CARD FOR MORE INFORMATION



COMAR is your best source for TELEPHONE TYPE RELAYS

Standards and Specials for All Applications

When you need telephone type relays, Comar is the place to get them. We have the engineering know-how and manufacturing facilities to serve you best. Send for details.

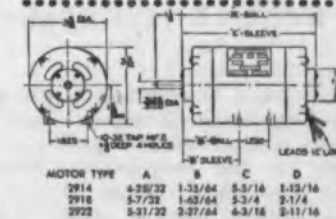
Comar ELECTRIC COMPANY
3349 ADDISON STREET, CHICAGO 18, ILLINOIS

RELAYS • SOLENOIDS • COILS • SWITCHES • HERMETIC SEALING

CIRCLE 419 ON READER-SERVICE CARD FOR MORE INFORMATION

THIS HOWARD INDUCTION MOTOR

Rated
1/100 to 1/15 H. P.



FITS A WIDE RANGE OF APPLICATIONS

Available in several models, Howard 2900 capacitor type motors are used for applications requiring quiet operation, minimum vibration, minimum maintenance, long life and overall uniform performance.

DESCRIPTIONS & APPLICATIONS

- (1) Non-Synchronous Capacitor Motors (Types RBC and RWC)—For laboratory equipment, vending machines and general service.
- (2) Standard Synchronous Capacitor Motors (Types SBC and SWC)—For tape pulling, sound cameras, telegraph-terminal equipment and other applications requiring a constant speed motor.
- (3) Hysteresis Synchronous Capacitor Motors (Types HBC and HWC)—Ideal for recording and facsimile equipment. When equipped with sleeve bearings, these motors are the ultimate in quiet operation and low rumble level. Can be supplied as 2 or 3 speed synchronous motors.
- (4) Torque Motors—high resistance rotors (Types RBH and RWH)—For take-up reels and use where high starting loads are encountered. The speed varies with load changes.

Howard 2900 Motors are available as: 1, 2, or 3 phase capacitor; split-phase (synchronous and non-synchronous). Available with gear heads with a wide range of gear ratios. Write today for complete data.

HOWARD INDUSTRIES, INC., 1725 STATE ST., RACINE, WIS.
Divisions: Electric Motor Corp. • Cyclohm Motor Corp. • Gasline Electric Products
CIRCLE 420 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW PRODUCTS . . . BROADER ENGINEERING HORIZONS FROM SORENSEN

MR3215 5-36 VDC AT 0-15 AMPS
new, tubeless, magnetic amplifier

WIDE RANGE REGULATED DC POWER SUPPLY

for versatile, trouble-free performance
in countless design & test applications

Different outside . . . and inside! The latest design in magnetic amplifier regulation. A silicon diode is used as reference element and a transistor amplifier provides the control current for the magnetic amplifier. Wide range, continuously adjustable voltage at high current. Regulation $\pm 0.5\%$ against line or load, *ripple 1% RMS. Versatile, dependable, rugged, economical.

*5-32 VDC; regulation $\pm 1.0\%$ over extended range.

Write today for detailed specifications, performance data,
and quotations.

SORENSEN & COMPANY, INC. • 375 FAIRFIELD AVENUE • STAMFORD, CONNECTICUT
In Europe, contact Sorensen-Ardag, Eichstrasse 29, Zurich, Switzerland, for all products including 50 cycle, 220 volt equipment.

CIRCLE 421 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents

Variable Pulse Delay Circuit

Patent No. 2,745,004. Yeo Pay Yu. (Assigned to Allen B. Du Mont Laboratories, Inc.)

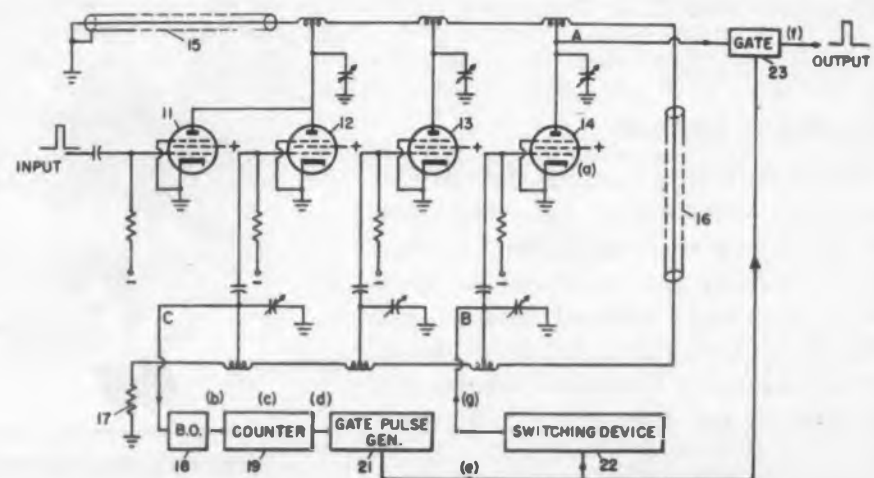
High-speed oscillographs require a variable delay circuit in their operation which are accurate as to the time of delay. Such circuits also find usefulness in determining the time between transmitted and received signals in radar and loran devices. There are a number of factors which can affect the accuracy of a circuit. The circuit of the patent has the required high degree of accuracy without being effected by the factors which commonly introduce disturbances.

The circuit of the figure uses two connected transmission lines 15 and 16, the far end of line 15 being grounded and the far end of the line 16 being grounded through a signal absorbing resistor 17. The delay circuit of tubes 12, 13 and 14 is connected between the connected ends of the transmission lines and the transmission line 16 and its resistor 17.

A positive input signal is applied to the control grid of the tube 11 and because of phase reversal in the plate circuit, a negative pulse is transmitted to the lines 15 and 16. The negative pulse passing through the line 16 is absorbed by the resistor 17. Since the tubes 12, 13 and 14 are biased beyond cut-off this negative pulse has no effect on these tubes. The negative pulse passing through transmission line 15 is reflected as

a positive pulse through transmission line 15 and 16. This positive reflected pulse renders each of the tubes 12, 13 and 14 conducting and generates a negative pulse in the plate circuits of each of the tubes which augment or are additive with respect to each other. This second pulse passes in one direction through line 16 and is absorbed by the resistor 17. The negative pulse passing through transmission line 15 is reflected as a positive pulse which continues through transmission line 16. The tubes 12, 13, 14 are biased to conducting condition in the manner previously described. This operation continues until a pulse is applied to the delay circuit of sufficient length of time to stop the recycling of the pulse.

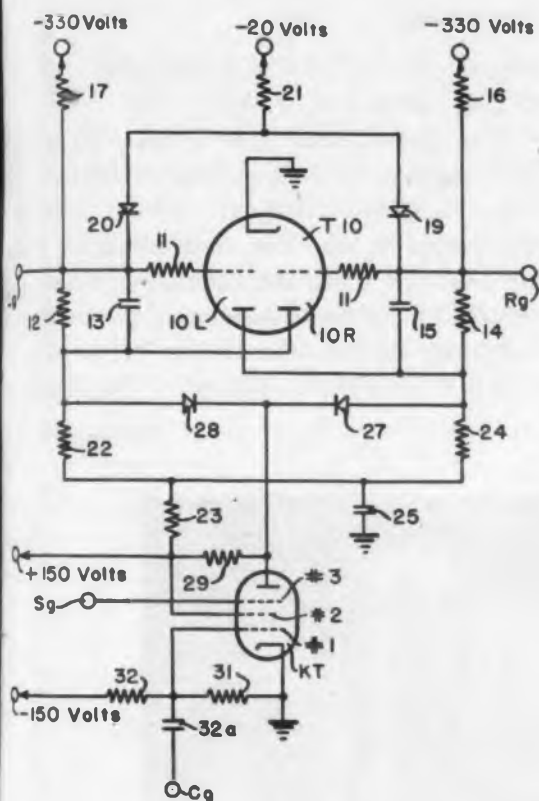
The reflected positive signal also triggers the blocking oscillator 18 which generates a signal stored by the counter 19. Upon a predetermined number of pulses, the gate pulse generator 21 is triggered to generate a gating pulse which controls the gate 23 and an output pulse passes to the output circuit. The gating pulse also triggers the switching device 22 which generates a negative pulse of sufficient amplitude and duration to bias the tube 14 below cut-off so that recycling of the pulse is halted. It requires a second input pulse to again set the circuit in operation. The patent illustrates several modifications which can be made to the basic circuit of the figure.



Multivibrator Trigger Circuit

Patent No. 2,745,955. B. L. Havens (Assigned to International Business Machines Corp.)

Trigger circuits of the Eccles-Jordan type are commonly used but these circuits are not as rapid in their operation as a similar multivibrator. Multivibrators are not ordinarily used as trigger circuits because they are free running whereas trigger circuits are required to be controlled to selectively assume one of its two stable conditions. The trigger circuit shown in the figure is believed to be faster than the presently known trigger circuits and this factor increases the usefulness of this particular circuit.



The trigger circuit shows a double triode T10 providing a pair of triode trigger tubes. The application of a positive potential to one of the control grids or to a terminal Lg or Rg will set the condition of stability. A control or keying tube KT is connected in the manner of the circuit to the multivibrator triodes. Assume that the triode section 10L is conducting with anode potential being supplied from the 150 v source through resistors 23 and 24. The potential at the junction of resistors 14 and 24 will then be relatively low whereas the potential at the junction of resistors 12 and 22 or upon the anode of triode section 10R is relatively high. A suitable triggering signal is applied to the control tube at the terminals SG and CG whereupon the control tube becomes

conducting. This lowers the potential on the anode of the control tube and at the junction of the two rectifiers 27 and 28. Because the initial potential across the rectifier 28 is less than that across the rectifier 27, the effect of the control tube becoming conducting is to reduce the potential on the control grid of the conducting triode section 10L and the potential on the control grid of the triode section 10R is unchanged. Conduction decreases through triode section 10L resulting in an increased potential at the junction of the resistors 14 and 24 which raises the potential on the control grid of the triode section 10R so that this section begins to conduct. Upon the tube section 10R becoming conductive the potential at the junction of resistors 12 and 22 decreases which is transmitted to the control grid of the triode section 10L through resistor 12 and condenser 13. This cumulative action quickly transfers the triode section 10L to non-conducting condition and the triode section 10R becomes conducting. Conduction continues through the triode section 10R until a second positive pulse is applied to the control tube terminals SG and CG to again render this tube conducting whereupon the same sequence of operation occurs to render the triode section 10R non-conducting and the triode section 10L conducting.

Increased speed of operation of the circuit is secured by applying a negative potential such as -20 v through rectifiers 19 and 20 to the control grids of the triode sections 10R and 10L respectively. This provision reduces the potential variation necessary to trigger the triode sections and hence speeds up the operation of the trigger circuit. The patent shows a more complex circuit which, however, uses the basic circuit illustrated.

Linear Pulse Integrator

Patent No. 2,750,500. W. R. Aiken. (Assigned to U. S. Atomic Energy Commission.)

A linear pulse integrator is described which produces a voltage proportional to input pulse frequency over a wide frequency range. Standard integrating elements are employed in this simple circuit which provides for double integration so that the unavoidable error of the first integration is integrated to produce the correct integrator signal.

DEMICON TYPE	MAX. OPERATING TEMP
TWT	-206°C
TWM	-160°C
TWU	-125°C
TWP	-85°C
TWH	
TWC	

if it's a capacitor...

C-D makes it...

and makes it better!

For Highest Dependability, specify C-D Demicons

The most adaptable miniature capacitor style ever developed. DEMICONs are available with innumerable combinations of electrical characteristics to meet your most stringent circuit requirements.

Specify C-D DEMICONs when your capacitor applications require:

- **Small size with big-capacitor performance.** DEMICONs fill the bill with smallest size and lightest weight per capacitor volume, rating and characteristics.
- **High capacitance stability and operation at temperatures to 200°C .** DEMICONs are readily available in a large variety of impregnants and dielectrics: wax compounds, Dykanol* liquid and solid impregnants; also paper dielectrics, metallized paper, and films including Polystyrene, Mylar** and Teflon.
- **Efficient circuit layout, chassis space conservation, economical assembly.** DEMICON styles allow: upright or inverted, horizontal, through-the-chassis grounded, or insulated mounting. Many terminal styles, too, including special termination for Automation.
- **All-around quality and reliability, dependable performance and long life.** DEMICONs are hermetically sealed, equipped with glass-to-metal solder seals; designed to meet all applicable military specifications and tests including shock, vibration, corrosion and moisture.

The C-D field engineer in your vicinity will gladly help you with your capacitor problems. Engineering Bulletin on request. Write to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

*CORNELL-DUBILIER TRADE MARK

**DUPONT TRADE MARK



CONSISTENT HI-DEPENDABILITY
CORNELL-DUBILIER CAPACITORS

SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER & CAMBRIDGE, MASS.; PROVIDENCE & HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD, FUGUAY SPRINGS & VARINA, N. C.; VENICE, CALIF.; & SUBSIDIARY, THE RADIART CORPORATION, CLEVELAND, OHIO; CORNELL-DUBILIER ELECTRIC INTERNATIONAL, N. Y.

CIRCLE 422 ON READER-SERVICE CARD FOR MORE INFORMATION

WHATEVER YOUR UHF ATTENUATION NEEDS...

AT-104: 12 POSITION STEP ATTENUATOR USING AT-50 ELEMENTS. DC TO 4000 MC.



**A COAXIAL UNIT FROM
EMPIRE DEVICES
WILL MEET
YOUR REQUIREMENTS**

Empire's UHF attenuators are resistive coaxial networks for the frequency range from DC to 4000 MC.

Accuracy is held to $\pm 1/2$ DB, VSWR is better than 1.2 to 1. Any attenuation values up to 60 DB are available. Deposited carbon elements are used for stability and operations at higher pulse levels. Standard impedance is 50 ohms, other values upon request. These units have excellent temperature characteristics and are vibration and shock resistant. Standard connectors are type "N", attenuator pads are also available with type "C".

The attenuators may be obtained as individual pads (AT-50, AT-60), or as multi-position step attenuators AT-103 (six positions) and AT-104 (twelve positions). For even greater flexibility, several step attenuators may be series connected.

For complete technical information about attenuators for your laboratory or production needs, write for free catalog.

AT-103: 6 POSITION STEP ATTENUATOR USING AT-50 ELEMENTS. DC TO 4000 MC.



AT-50: ATTENUATOR PAD, DC TO 4000 MC. 1 W AVERAGE, 1 KW PEAK.



AT-60: ATTENUATOR PAD, DC TO 3000 MC. 2 W AVERAGE, 2 KW PEAK.



NEW YORK—Dixby 9-1240 • SYRACUSE—SYRACUSE 2-6253 • PHILADELPHIA—Sherwood 7-9080 • PITTSBURGH—Atlantic 1-9248 • BOSTON—Twinbrook 4-1955 • WASHINGTON, D.C.—Decenter 2-8000 • ATLANTA—Exchange 7801 • ORLANDO, FLA.—3-3524 • DETROIT—Broadway 3-2900 • CLEVELAND—Evergreen 2-4114 • DAYTON—Fulton 8794 • CHICAGO—Estbrook 9-2700 • ST. LOUIS—Evergreen 5-7728 • DENVER—Main 3-0343 • FORT WORTH—Walnut 3-8811 • ALBUQUERQUE—Albuquerque 5-9632 • LOS ANGELES—Republic 2-8103 • PALO ALTO—Davensport 3-4455 • PORTLAND—Capital 7-3830 • STITTSVILLE, ONT., CAN.—Hazeldean 56 • EXPORT: NEW YORK—MUrray Hill 2-3760

**EMPIRE DEVICES
PRODUCTS CORPORATION**

38-15 BELL BOULEVARD • BAYSIDE 61 • NEW YORK
manufacturers of

FIELD INTENSITY METERS • DISTORTION ANALYZERS • IMPULSE GENERATORS • COAXIAL ATTENUATORS • CRYSTAL MIXERS
CIRCLE 423 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Patents Released For Public Use by AEC

Descriptions of some electronic patents owned by the U.S. Government and held by the Atomic Energy Commission have been released by the Commission. These patents were issued during the period of Sept.-Nov. 1956!

The Commission will grant nonexclusive, royalty-free licenses on the listed patents, as part of its program to make nonsecret technological information available for use by industry. Commission-held patents and patent applications released for licensing now total 1093.

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D.C., identifying the subject matter by patent number and title. Copies of these patents may be obtained from the U.S. Patent Office.

Pulsed Oscillator

Patent No. 2,764,689. (Inventor, W. C. Struven, AEC)

This patent relates to a pulse oscillator that delivers a constant frequency alternating current output whenever there is a trig-

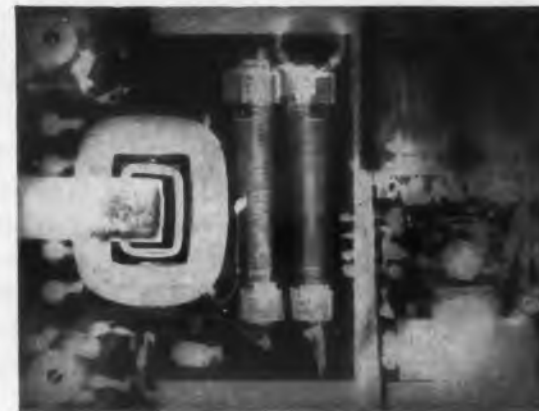
gering voltage at the controlling terminal. The oscillator circuit comprises a pentode vacuum tube having its first and second grids tied into a crystal oscillator circuit so that there is a continual oscillating frequency between these two grids. A load resistor is used between the cathode and the first grid for grid bias, and there is a variable capacitor between the cathode and the second grid so that there is a continual oscillating current discharge between the cathode and the second grid. The third grid is connected to the control terminal so that a negative voltage will isolate the signal from the plate, but a positive voltage will result in a high frequency oscillating current output.

Spark Gap

Patent No. 2,763,816. (Inventor, W. R. Baker, AEC)

This patent relates to a relay that may be triggered by an overload condition in a radio frequency line to isolate valuable equipment on the line that could be damaged by the overload condition. Two concentric electrodes are connected in unidirectional circuit, the inner electrode of which is connected through a capacitor to

**how to get
more volts
per pound
at high
altitudes**



PROBLEM: Design a regulated high-voltage dc power supply for operation at high altitudes. Specifications:

- Input voltage—400 cps $\pm 10\%$
- Output—dual: 4 KV at 2.5 ma; 8 KV at .3 ma
- Regulation—no load to full load within 1%
- 105 cubic inches maximum
- Light as possible.

SOLUTION: We designed a vacuum tube regulator circuit, with the regulator tubes kept at low voltage. Result: The tubes could be mounted externally—for easy replacement.

For compactness and to protect high-voltage components against the hazards of moisture or rarefied air, we cast the rest of the unit in epoxy resin.

The assembly weighs only 6 1/2 lbs., occupies 96 cu. in., plus terminals.

This sort of engineering can be at your service too. When you need electronic assemblies—by hundreds or thousands—straightforward or special design—make use of our production and design experience and facilities.

CALEDONIA ELECTRONICS AND TRANSFORMER CORP.

Dept. ED-2, CALEDONIA, NEW YORK

In Canada: Hackbusch Electronics, Ltd., 23 Primrose Ave., Toronto 4

CIRCLE 424 ON READER-SERVICE CARD FOR MORE INFORMATION



ground. Slightly removed from these electrodes is a third button electrode connected to the transmission line. When the overload voltage occurs a spark jumps from the button electrode to the inner electrode and returns to ground. This spark sufficiently ionizes the atmosphere that a spark may jump between the concentric electrode thereby completing the unidirectional circuit and activating cutoff controls for the equipment to be protected, thus, in the minimum amount of time, protecting the equipment.

Leak Detection Apparatus

Patent No. 2,766,442. (Inventor, W. H. Meyer, Jr., AEC)

This patent describes a heat exchanger design and apparatus that will permit prompt detection of a leak in the exchanger. A double tube sheet is provided that creates a void between the primary tube sheet header and the shell containing the secondary fluid, the tubes passing through both tube sheets. This design creates a double barrier through which any leaking fluid must pass. A conduit leads from this void to a chamber containing an electrode electrically isolated from the chamber body

which is grounded. Any liquid leaking through the tube to tube sheet seal welds will flow through the conduit to this chamber and complete an electrical circuit activating some suitable alarm device or control, thereby preventing extensive damage that may occur from undetected fluid leakage.

Phase Meter

Patent No. 2,771,582. (Inventors, C. N. Winningstad et al, AEC)

This patent relates to a phase meter that may be applicable to either amplitude modulated or frequency modulated phase measurements. Heretofore, the phase meters required the radio frequency source to be a continuous wave and with a stable frequency. This phase meter measures the phase difference of amplitude modulated radio frequencies, continuous wave or pulsed, when the frequency of the source is not stable. This is accomplished by having a frequency determining tank circuit and developing a voltage at a frequency equal to the difference between the input voltage and that of the tank circuit which may be measured by suitable means to indicate the desired result.



Fairchild FilmPot® trimmers are high quality potentiometers offering operating characteristics of infinite resolution, precision adjustment, and stability of performance over a temperature range from -55 to +175°C. The Nobl-Ohm® metallic film resistance elements are evaporated continuous films of precious metal alloys.

METALLIC FILM TRIMMERS

The Types 768 and 769 FilmPot trimmers feature the exclusive Fairchild Nobl-Ohm resistance element in two small size, light weight units. Resistance range 50 to 25,000 ohms $\pm 10\%$; infinite resolution; linearity $\pm 5\%$; -55°C to +175°C operating temperature. Type 769 measures $1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{3}{4}$ and the smaller type 768 is $\frac{1}{4} \times \frac{3}{8} \times 1\frac{1}{4}$ inches. Both types permit close stacking, and adjustment is obtained by a $28\frac{1}{2}$ turn screw.

The answer to all your precision potentiometer problems can be found at Fairchild. For information write: Dept. 140-78NI, Fairchild Controls Corporation, Components Division, 225 Park Ave., Hicksville, L.I., N.Y.

WEST COAST ADDRESS:
6111 E. Washington Blvd.
Los Angeles, Calif.

FAIRCHILD
PRECISION POTENTIOMETERS
and COMPONENTS

CIRCLE 425 ON READER-SERVICE CARD FOR MORE INFORMATION

INCOMPARABLE ACCURACY IN THE SMALLEST SPACE

Specify **TIC** linear and non-linear potentiometers



RVP1 $\frac{3}{4}$ Actual Size

It's true!
TIC's general line of linear and non-linear potentiometers provide more accuracy per unit area than any other potentiometers on the market.

ST18 $\frac{3}{4}$ Actual Size

Compare

ST20 $\frac{3}{4}$ Actual Size

ST09 $\frac{7}{8}$ " diam. Linearity of 0.25%

RVP1 1" diam. Linearity of 0.15%

ST18 $1\frac{3}{4}$ " diam. Linearity of 0.15%

ST20 2" diam. Linearity of 0.12%

NEW
EXPANDED
PRODUCTION
FACILITIES
(doubled)
ASSURES
PROMPT
DELIVERY!

These are not laboratory or model shop curiosities! . . . They have been delivered in substantial production quantities to our customers.

The high accuracy of TIC precision potentiometers are the result of a combination of unique design features . . . high standards of quality control . . . and construction of watchlike precision. Years of experience in supplying precision potentiometers for operational equipment designed to meet military specifications assure high accuracy throughout the long life of the unit . . . and under all types of adverse environmental conditions.

An added advantage of specifying TIC potentiometers is the tremendous production facilities and the wide selection of sizes that permits custom-like design in your application. Whether it be high accuracy linear potentiometers, standard function or empirical non-linear potentiometers, you can depend on TIC to provide greater accuracy throughout the long life of the potentiometer. Complete specs on request!

TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass. COlonial 3-7711
West Coast Mail Address, Box 3941, No. Hollywood, Calif. POplar 5-8620

CIRCLE 426 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW 750 WATT

Custom



DC to AC

CONVERTERS

In answer to a demand for larger capacity DC to AC Rotary Converters, Carter now adds this 750 Watt model to its famous "Custom" line.

Like Carter 300, 400 and 500 watt Converters, this new 750 watt job incorporates the latest technological advances in Converter engineering.

Carter "Seven-Fifty" Converters are available for input voltages of 24, 28, 32, 64, 115 and 230 volt DC and deliver clean 115v. 60 cycle AC.

"Seven-Fifty" Carter Custom Converters deliver full 115 volts AC under full load conditions while operating at their greatest efficiency. To overcome heavy starting load on major appliances, these converters actually deliver a surge of nearly 1000 watts at 110 volts, 1200 watts at 102v. AC. The full normal 750 watt load being obtained at 115v. AC output. Here is considerable overload capacity available without sacrifice of efficiency, without overheating or damage.

Carter Motor Co. 2764 W. George St., Chicago 18.

Please send Bulletin 1156A showing New Carter "Seven-Fifty" Converters, with performance chart and complete specifications.

Name _____

Firm _____

Address _____

750 WATT DYNAMOTORS ALSO AVAILABLE FOR DC TO DC VOLTAGE CONVERSION.

Carter Motor Co.

2764 W. GEORGE ST., CHICAGO 18, ILLINOIS

CIRCLE 428 ON READER-SERVICE CARD FOR MORE INFORMATION

NEY'S SMALL PARTS PLAY A BIG PART IN PRECISION INSTRUMENTS • NEY'S SMALL PARTS



PRECIOUS METAL

ENGINEERED CONTACTS, SLIP RINGS & ALLOYS

Ney designs and makes to customers' specifications sliding contacts, slip rings and assemblies, commutator segments and assemblies, brush and brush holder assemblies, and precious metal resistance wire. Consult Ney's Engineering Dept. and find out how precious metals can improve your products.

THE J. M. NEY COMPANY, P.O. BOX 990, DEPT. D, HARTFORD 1, CONN.
Specialists in Precious Metal Metallurgy since 1812



Ney has just built this modern new plant to give you even better products and better service.

NEY'S SMALL PARTS PLAY A BIG PART IN PRECISION INSTRUMENTS • NEY'S SMALL PARTS

CIRCLE 427 ON READER-SERVICE CARD FOR MORE INFORMATION

Books

A Handbook of Magnesium-Organic Compounds

S. T. Yoffe and A. N. Nesmeyanow. Pergamon Press, Inc., 122 E. 55th St., New York 22, N.Y., 3 Volumes, 2052 p. \$72.00.

The vast range of investigations on organic compounds of magnesium, including alkyl and aryl halides, are summarized in these volumes. All the chemical reactions since Girard (1899), together with work not heretofore described, are collected and systematized. In all, 13,395 reactions are listed, cross-indexed and arranged according to Chemical Abstracts indexing. The 3 volumes are divided into 5 sections covering a summary of total reactions, a formula-index of end-products of the reactions, a list of separate magnesium-organic compounds, literature sources and a supplementary index of co-authors.

Engineering Inspection, Measurement and Testing

H. C. Town and R. Colebourne. Philosophical Library, 15 E. 40th St., New York 16, N.Y., 192 p. \$2.90.

This book will be of interest to design engineers because it indicates the accuracy to which mechanical measurements can commonly be made in production. This knowledge can have a decided influence in specifying tolerances.

The book explains the function of the modern factory inspection department, and deals with the principles and practice of precision measurement and with comparators and other measuring and inspection machines. Attention is given to measurement during machining and automatic sizing operations, and to screw-thread measurement.



PRM 123
Rotary type, single gang,
1-5/16" dia., bushing
mounted, sleeve bearing.

General Controls, famous for 25 years as a supplier of mechanical and electro-mechanical controls for home, industry and the military... proudly announces a new product of its Potentiometer Division...

FEATURES...

- Variations from 100 to 50,000 ohms resistance.
- Standard tolerances $\pm 3\%$ resistance, $\pm 0.3\%$ independent linearity.
- Exceeds MIL-R-12934, -E-5272A Specs.
- Explosion-proof, or dust-tight seals.
- Operating temperatures are -65°F. to 275°F.
- Special Spec. Models Available.

Write for 1956 Catalog!



GENERAL CONTROLS

POTENTIOMETER DIVISION
Glendale 1, California

Factory branch offices serving all principal cities of the United States and Canada

CIRCLE 429 ON READER-SERVICE CARD FOR MORE INFORMATION

Proceedings of the High Temperature Symposium, June, 1956

Stanford Research Institute, Menlo Park, Calif., 218 pages, \$5.00

Collected in this volume are papers by 36 internationally recognized authorities in high temperature. The major subjects cover "Methods for Reaching High Temperatures," and "Materials for Containing High Temperatures." Written discussions of panel questions and a general treatment of the fundamentals of temperature by Dr. Carsten Steffens have been added to the proceedings. Also included is the keynote address on aerodynamic heating.

Induction Heating Practice

D. Warburton-Brown. Philosophical Library, 15 E. 40th St., New York 16, N.Y. 192 pages. Price: \$10.00.

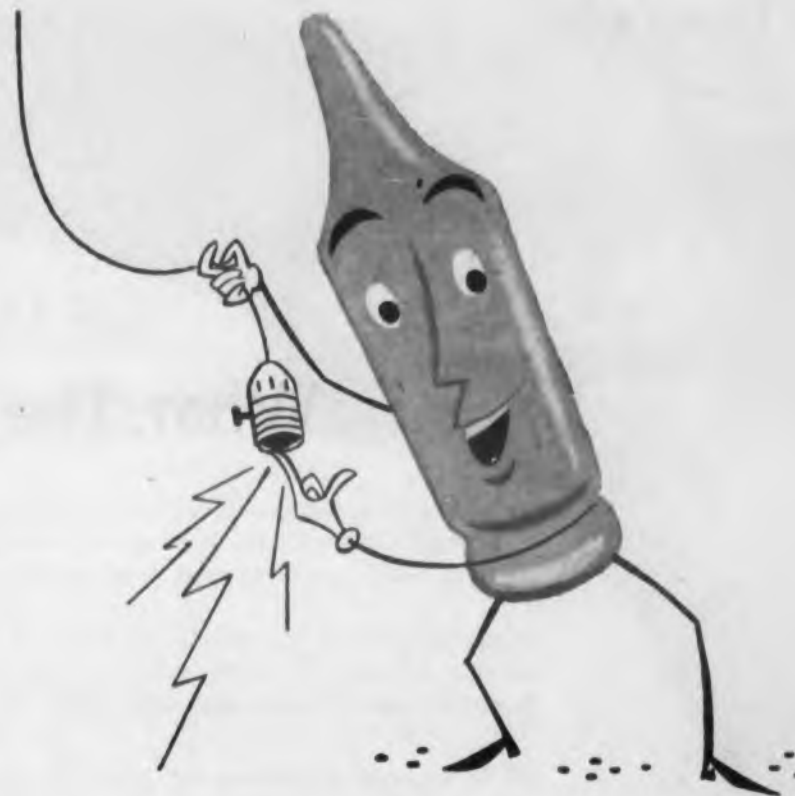
In this book, a leading British expert presents a detailed, up-to-date study of high-frequency induction heating. It is intended for the production engineer interested in the possibilities of installing or extending induction-heating equipment and all others

concerned with heat treatment in engineering production. Information is given on the design of work-coils and inductors, on modifying the design of components or assemblies to facilitate use of the process, and on jigs or handling mechanisms. The remainder of the book deals with various applications, first giving general notes on each and then going on to specific examples, with full production data. The examples cover a wide range, from motors and motor accessories to typewriters, gold-melting, electrical components and precision instruments. A complete chapter is devoted to the special problems of gear hardening.

Arcs in Inert Atmospheres and Vacuum

Edited by W. E. Kuhn. John Wiley & Sons, Inc., 440 Fourth Ave., New York, N.Y., 188 pages. \$7.50.

This volume presents the collected papers from a symposium on The Electric Arc in Inert Atmospheres and Vacuum. The contents are divided into four sections: The past and present status of high current arc technology, arc melting fundamentals, design and operation of arc melting furnaces, and chemical applications of arcs.



G-E GLOW LAMPS OBEY THE IMPULSE ... TO SERVE AS INDICATORS

Every live circuit should have an indicator—and with radio-type resistors, G-E Glow Lamps become simple indicators that give long, uninterrupted service. Only glow lamps offer small size, low wattage, long life, wide voltage tolerance, and rugged construction—for as little as 3½¢ each! They don't fail suddenly, so there's almost no chance of false indications. All these features help make General Electric Glow Lamps the ideal choice for hundreds of applications as indicators in the electrical and electronics industries.



If you'd like more information on the amazing G-E Glow Lamps, send today for your free copy of the folder, "G-E Glow Lamps for Pilot and Indicator Use". Write: General Electric Co., Miniature Lamp Dept. ED-2, Nela Park, Cleveland 12, Ohio.

A Single G-E Glow Lamp May Serve As A:
RELAXATION OSCILLATOR • LEAKAGE INDICATOR
SWITCH • VOLTAGE REGULATOR • VOLTAGE INDICATOR

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE 431 ON READER-SERVICE CARD FOR MORE INFORMATION

THE SHORTEST WAY

FROM

HERE TO HERE



BUD SHEET METAL FABRICATION

Whether your needs are for small or large quantities—simple or intricate designs—in steel or aluminum you can save time and money by consulting with Bud on all your requirements.

Bud makes over 500 different styles and sizes of sheet metal products as standard items. This enables us to meet your needs economically for a single part or for a specially designed and fabricated production run. Often a slight change in one of our standard models will give you exactly what you want without requiring production equipment.

Bud products are sold through distributors, we'll be glad to send you the name of your nearest one. Complete information about our products and services is contained in our Sheet Metal Products Catalog. Write us for a copy.



BUD RADIO, INC.

2118 East 55th St. Dept. ECD Cleveland 3, Ohio

CIRCLE 430 ON READER-SERVICE CARD FOR MORE INFORMATION

What The Russians Are Writing

J. George Adashko

Contents of *Elektrosviaz'* No. 8, 1956

Use of Tapped Inductance Coils in Electric Filters, Kh. I. Cherne, (8 pp, 10 figs, 3 tables).

Shows that replacing some two-terminal reactance filter elements with equivalent auto-transformer elements, employing high-grade core material and having almost zero leakage, results in many cases in simpler or better filters. For example, the filter of Fig. 1 can be replaced by that of Fig. 2, in which all the capacitors are the same, or by that of Fig. 3, in which all the inductances have the same values.

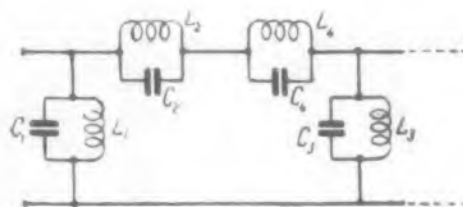


Fig. 1

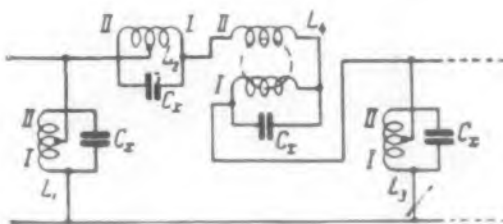


Fig. 2

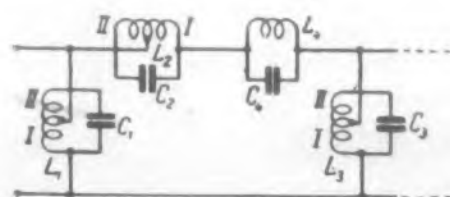


Fig. 3

Suppression of Pulse Noise by Compensation (Balancing) Methods, V. A. Kliaznik, (11 pp, 9 figs).

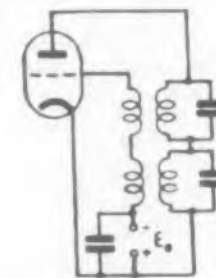
The compensation method is quite old, dating back to J. R. Carson's article in the IRE Proceedings, No. 7, 1928. The method consists essentially of incorporating two channels in the receiver, one for the signal plus noise, the other for the noise alone. The two voltages are separately detected and subtracted from each other. The article investigates the effect of pulsed noise on such a system and suggests several improvements for the scheme. The author also shows a way of realizing practically complete suppression of the harmful effect of pulsed noise prior to detection of the signal.

Narrow-Band Crystal Filters, E. V. Zeliakh, Ia. I. Velikin, (11 pp, 9 figs).

Gives theory and procedures for design of differential-type filters. This article will be abstracted in a future issue of *ELECTRONIC DESIGN*.

New Methods of Controlling the Frequencies of a Self-Oscillator, G. M. Utkin, (3 pp, 2 figs).

Describes a self-oscillator circuit (see figure) in which the bias voltage is changed (and the frequency controlled) with an added tank circuit, tuned approximately to a harmonic of the fundamental, and incorporated into the feedback loop. The carrier frequency can be varied 5-10 per cent in this manner. Experimental results are cited.

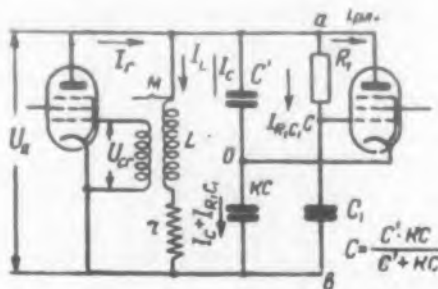


Effect of Non-Linearity of Tube Characteristics on Transients in an Amplifier Stage with Cathode Load, S. N. Krize, (7 pp, 5 figs).

The usual analysis of cathode followers does not take into account such non-linear effects as plate-current cutoff, even though the cathode follower is frequently used in output stages, where the signal level is high and operation is essentially non-linear. In this article the tube characteristic is approximated by a second-degree polynomial, and integration of the resultant non-linear equation leads to simple design equations, which give results that are in good agreement with experimental data.

Use of Reactance Tube to Control Frequency of Vacuum-Tube Oscillators, G. A. Levin, Z. P. Vazhenina, (15 pp, 12 figs).

Discussion of the maximum frequency deviation obtainable with a reactance tube. A relationship is established between the frequency deviation and the depth of parasitic amplitude modulation. A circuit is proposed (see figure for equivalent diagram) in which this parasitic am is substantially reduced. Operational equations are derived and checked against experimental data.



Estimate of Noise Stability of Wireless Facsimile Transmission, B. Z. Kisel'gof, (9 pp, 2 figs, 1 table).

Statistical study of the effect of noise on the clarity, contrast, and definition of the transmitted images. The estimate is based on measuring the average area of the blank picture that is damaged by the recorded noise.

Other Articles in this Issue:

"Optimum Qualitative Indices of Subscriber's Teletype Lines," V. I. Grigor'ev (5 pp, 3 figs); "Equivalent Circuit of Isolating Bridge used in Automatic Telephone Stations," Ia. G. Koblenz (3 pp, 3 figs, 2 tables).

Contents of Radiotekhnika No 8, 1956

Frequency Multiplication and Division of Modulated and Unmodulated Waves, I. T. Turbovich, (11 pp, 7 figs.)

Discussion of distortionless spectrum division; the spectrum so divided is transmitted over a narrow-band channel. Specifically covered is the transmission of speech over an 800-1200 cps channel.

Calculation of Parasitic Capacitance in Printed Circuitry, L. M. Kononovich, (7 pp, 14 figs.)

Conformal mapping is used to transform the printed-circuit lines and elements into a concentric long line. Design equations for the parasitic capacitances are derived on this basis. To be abstracted in a future issue of ELECTRONIC DESIGN.

The Transitor Generator as a Feedback Device, A. A. Kulikovski, (3 pp, 2 figs.)

Straightforward network-theoretical discussion.

Selected MINIATURES for TRANSISTOR and PRINTED CIRCUIT APPLICATIONS

Good-All
capacitors

Design and component engineers are invited to acquaint themselves with the wide variety of miniature low voltage capacitors developed by Good-All Electric. These compact new designs are ideal companion items for use with transistors and other printed circuit components.

Many space-saving Good-All types are as useful for military as for civilian applications. This is particularly true of the molded-in-Epoxy types. It has also proven to be the case with "wrapped" mylar designs which lend themselves to use in potted subassemblies.

Mylar* dielectric is frequently selected for Good-All miniatures because of its superior electrical characteristics — high I.R., low power factor and excellent stability with life. The space-saving it offers in low voltage designs is also an attractive feature.

Good-All offers a wide selection in 50 Volt miniature designs

	REPRESENTATIVE TYPES	TYPICAL SIZE COMPARISONS		
		Cap.	Volts	Diam. Lgth.
AXIAL LEAD	600UE . . . Mylar dielectric winding molded in dense, moisture-resisting Epoxy.	.01	50	.312 x 15/16
		.1	50	.438 x 1-3/16
		.47	50	.562 x 1-15/16
	663UW . . . Mylar dielectric winding with tough plastic film case and thermo-setting end seals.	.01	50	.188 x 11/16
		.1	50	.281 x 15/16
		.47	50	.437 x 1-15/16
613G . . . Mylar dielectric winding, extended foil construction, hermetically-sealed metal housing.	.01	50	.173 x 23/32	
	.1	50	.313 x 27/32	
	.47	50	.50 x 1-3/16	
RADIAL LEAD	600RE . . . This novel design combines features of conventional tubular capacitors and upright mounting types. The mylar dielectric winding is completely encapsulated in Epoxy. In addition to its attractive glossy red appearance the Epoxy formulation developed by Good-All yields a tough, durable coating with excellent dielectric strength.	.01	50	.250 x 11/16
		.1	50	.375 x 15/16
		.47	50	.50 x 1-3/4
UPRIGHT MOUNTING	600UPE . . . Mylar dielectric winding molded in dense, moisture-resisting Epoxy.	.01	50	.438 x 15/16
		.1	50	.562 x 1-3/16
		.47	50	.688 x 1-15/16
	620UPB . . . Mylar dielectric winding with molded bakelite housing and thermo-setting plastic end seal.	.01	50	.375 x 1
		.1	50	.375 x 1-1/4
		.47	50	.625 x 1-7/8
620PM . . . Mylar dielectric winding encapsulated in a plastic impregnated paper tube.	.01	50	.343 x 15/16	
	.1	50	.410 x 1	
	.47	50	.562 x 1-3/4	
EPOXY COATED CERAMIC DISCS	These Epoxy coated discs are ideal for use on printed circuit boards that are to be dip soldered, since no wax coating is necessary. The available types of ceramic discs are too numerous to describe in detail. A complete brochure with specifications on each type will be mailed to you upon request.	Dimensional information is contained in the Good-All ceramic disc brochure.		
		*DuPont's trademark for polyester film.		

Write or phone for consultation on specific design problems or to secure detailed specifications on the various capacitor types shown.



GOOD-ALL ELECTRIC MFG. CO.

OGALLALA, NEBRASKA A leading manufacturer of Tubular and Ceramic Disc Capacitors

CIRCLE 432 ON READER-SERVICE CARD FOR MORE INFORMATION

In Modern Design

Koiled Kords

play an important part

The use of KOILED KORDS retractile cords on more and more communications and industrial equipment in the past ten years has proved their claim of safety and convenience.

Designers have found KOILED KORDS invaluable in solving many wiring problems.

CAN YOU USE
KOILED KORDS?

Our years of experience with KOILED KORDS is available to you, without obligation, for help in solving your wiring problems.

Write for catalog today.



KOILED KORDS, THE ORIGINAL RETRACTILE CORDS, ARE THE RESULT OF 17 YEARS OF RESEARCH, DEVELOPMENT AND USE.

KOILED KORDS is a trade mark of Koiled Kords, Inc.

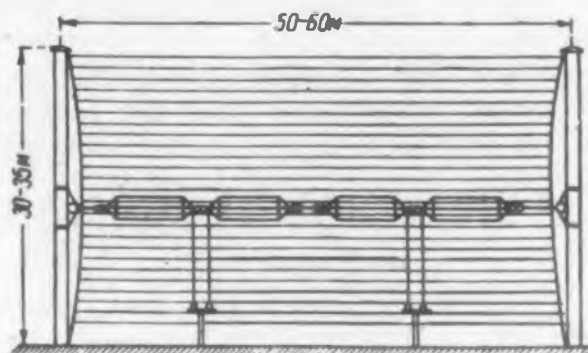
CIRCLE 433 ON READER-SERVICE CARD FOR MORE INFORMATION

Noise Stability and Effectiveness of Wireless Facsimile Transmission in the Presence of Fluctuation Noise. A. G. Ziuko, (11 pp, 2 tables.)

Statistical analysis of the following four types of facsimile transmission: frequency-modulated carrier; fm subcarrier and am carrier; both subcarrier and carrier frequency-modulated; fm subcarrier and am carrier with single-sideband transmission. In all these systems the signal-to-noise ratio is assumed higher than the threshold value.

Ways of Increasing the Effectiveness of Simple Waveband Antennas. S. I. Nadenenko, (6 pp, 9 figs.)

A "waveband" antenna is one with enough broad-band characteristics to cover effectively a relatively large frequency range. The antenna analyzed in this article is shown in figure and is designed for the 20-meter band. Its rating is 15-60 kw and its SWR not less than 0.4 at a wavelength ratio 2.5:1.

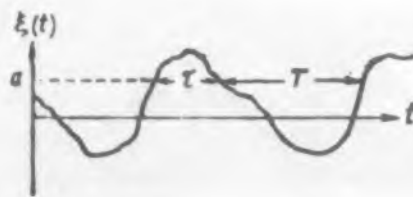


On the Problem of Establishing Decimeter-Wave Oscillations in Self-Excited Generators. N. F. Alekseev, (12 pp, 12 figs, 3 tables.)

The steady-state and transient behavior of microwave pulse oscillators has not been thoroughly analyzed in the literature, in the opinion of the author. This article is an attempt to determine the oscillation starting time, the initial amplitude, and the pre-oscillation noise. An effort is also made to find methods of reducing the average delay due to the leading edge of the hf pulse as well as to minimize the "dispersion" of the delays. The author indicates that it is possible to generate hf pulses of 0.1 microsecond duration without the necessity for sharpening the supply pulse.

Experimental Investigation of the Distribution of the Durations of Fluctuation Deviations. V. I. Tikhonov, (5 pp, 6 figs, 1 table.)

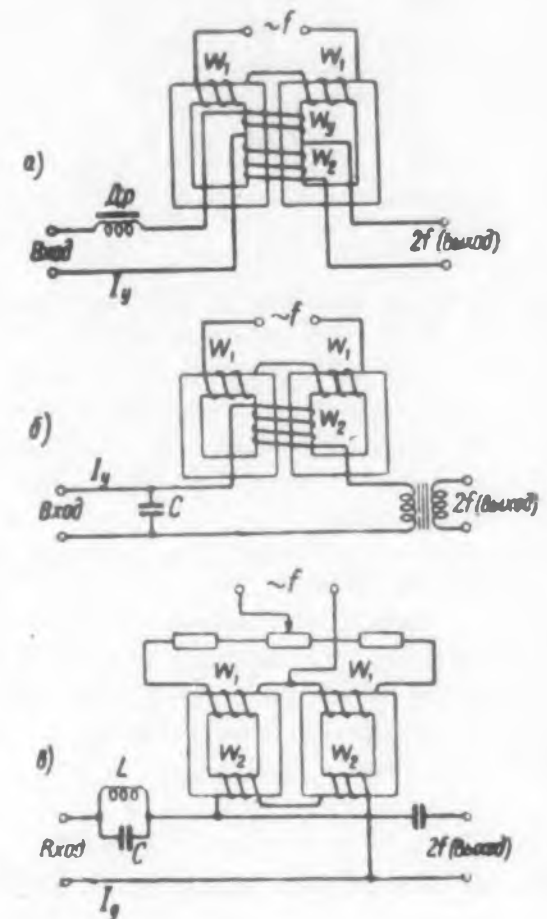
The term "deviation" denotes here an event in which the value of a random function exceeds a predetermined level. The article essentially discusses an experimental determination of the statistical values of t and T in figure.



Theory and Analysis of Magnetic Modulator Operating on the Frequency-Doubling Principle. M. A. Rozenblat, (16 pp, 11 figs.)

Magnetic modulators, Fig. 1, are frequently used to permit ac amplification of dc or slowly-varying signals. The use of frequency doubling makes such devices insensitive to external influences such as supply-line voltage and frequency changes, ambient-temperature fluctuations, and variations in magnetic core properties.

The article analyzes the modulator under no-load and full-load conditions. The principal factors that determine the modulator lower sensitivity threshold are explained. Data are given on the magnetic noise level of various alloys. Optimum design notes are made.



New Russian Magazine

"Pribori i Tekhnika Eksperimenta"
(Instruments and Experimental Techniques)

This recent arrival of interest to the readers of ELECTRONIC DESIGN is a quarterly publication published by the USSR Academy of Sciences. According to its editorial policy as stated on its title page it will publish the following:

1. Reviews dealing with various phases of physical measurements.
2. Original articles devoted to description of principles of operation, construction, methods of application, or analysis of operation of various physical instruments, as well as research procedures in all

fields of experimental physics.

3. Brief notes, devoted to improvement of laboratory instruments or to procedural and technological laboratory activities.

4. Short description of physical instruments produced by the industry, and data on new materials used in instrument building and in laboratory practice.

The scope of "Pribori i Tekhnika Eksperimenta" is roughly the same as that of the "Review of Scientific Instruments" and its many descriptions of various electronic circuits are slanted toward the experimental physicist rather than the electronic designer. It does, however, contain some interesting design items, which will be abstracted in ELECTRONIC DESIGN from time to time.

Complete Translations

ELECTRONIC DESIGN policy has been to review all principal electronic journals in order to give our readers an overall picture of Russian activity in the electronics field. To give complete coverage we have of necessity condensed or abstracted most articles. Complete translations of Automation and Remote Control (Automatika i Telemekhanika) are now available from Consultants Bureau, Inc., Dept. B, 227 West 17th Street N.Y. 11, N.Y. These translations begin with the January 1956 issue; 12 issues per year. All schematics are reproduced integral with the text. Price of a year subscription is \$185. Individual issues may also be purchased.

Complete translation of the Soviet Journal of Acoustics (Akusticheskii Zhurnal), four issues each year, are also available. The 1955 issues (Volume 1 of this journal) will be published in two issues. The 1956 and subsequent volumes will be published quarterly.

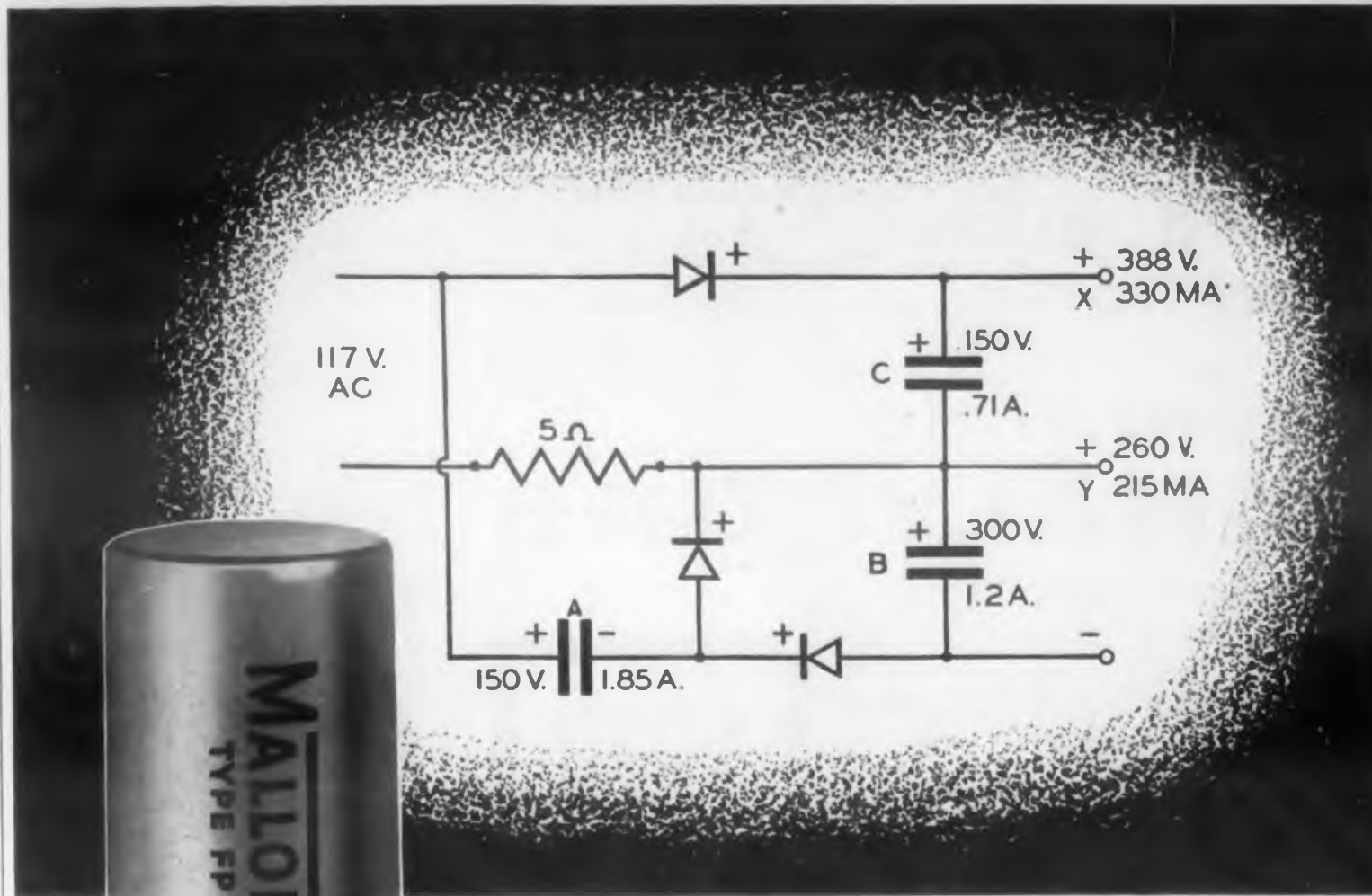
Translation on SSB Receiver

We received many inquiries about the Russian Dual Channel Single Sideband Receiver described in the Aug. 15 issue of ELECTRONIC DESIGN (p 108). Richard E. Daniel, who has reviewed several books published in the U.S.S.R for ELECTRONIC DESIGN, offered to do a complete translation on this timely subject.

Free copies of this translation may be obtained by writing to:

Richard E. Daniel, Sr. Engineer
Hoffman Laboratories, Inc.
Box 2471, Terminal Annex
Los Angeles 54, Calif.

The design of the dual channel single sideband receiver described is a further improvement of Soviet single sideband receivers. The use of wideband crystal filters for separation of sidebands; a new and more simple AFC system allowing tuning of the first heterodyne oscillator in relation to the suppressed carrier within a fraction of a cycle; elimination of dual reception, an unsatisfactory method; favorably distinguish this new receiver circuitry from its predecessors.



Solve the Voltage Tripler Ripple Current Problem with Mallory FP Capacitors

In the voltage tripler circuit above, the capacitor must handle extremely high ripple currents—and at 60 cycles.

For instance the ripple current in—

Capacitor A is $3\frac{1}{2}$ times the total load current

Capacitor B is $2\frac{1}{4}$ times the total load current

Capacitor C is $1\frac{1}{3}$ times the load at "X"

These ratios are approximate but give some idea for rule of thumb use when selecting capacitor ratings in voltage tripler circuits.

Remember also that silicon rectifiers produce different conditions than those encountered with sele-

nium rectifiers. They are tougher on the capacitors. Large values of capacity are needed to handle such ripple currents and engineering attention is needed here if good field performance is to be expected.

The unique ability of Mallory FP Capacitors to handle these severe ripple current values, even at 85°C ambient temperatures, is due to the use of fabricated anode construction.

If you do not have a copy of the new Mallory FP Technical Information Bulletin showing revised ripple current values—write for a copy—or better still let us help you in the initial design by asking for our engineering service.

Expect more . . . get more from



Serving Industry with These Products:
Electromechanical — Resistors • Switches • Tuning Devices • Vibrators
Electrochemical — Capacitors • Mercury and Zinc-Carbon Batteries
Metallurgical — Contacts • Special Metals • Welding Materials

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

CIRCLE 434 ON READER-SERVICE CARD FOR MORE INFORMATION

laboratory
tool or
production
workhorse...

Panoramic PANALYZORS

have tremendous
flexibility... many uses

3 models • 9 types

Actually automatic scanning superheterodyne receivers,
these widely used instruments—

- permit visual observation and analysis of one or more signals simultaneously
- are unique in that they offer all the advantages of wide scan spectrum presentations, yet enable examination of signals so closely adjacent in frequency that their corresponding deflections normally tend to merge together or even completely mask one another in wide scan displays
- can be used to observe signals anywhere in the spectrum up to 1,000 mc by means of an external signal generator and an internal aperiodic mixer which translate the spectrum segment to be analyzed down to the input band of the Panalyzer
- have a sweepwidth up to 10 mc
- and many special features dependent upon the model selected, such as

variable resolution . . . variable scan rates
long or short persistence display
linear or log amplitude scales

Panoramic Panalyzers provide a measuring tool of utmost simplicity, tremendous flexibility and many uses. 3 models in 9 different types fulfill almost every need from low-cost general purpose instruments to those for highly special applications:

Model No.	Type	Maximum Sweepwidth	Scan Rate	Resolution Range
SB-12	T-100	100 kc	1/10-30 cps (in steps)	3.2 kc—10 cps
SB-8b	T-200	200 kc	1—60 cps (variable)	4.5 kc—50 cps
	T-1000	1 mc		10.0 kc—200 cps
	T-10,000	10 mc		100.0 kc—9.0 kc
SB-3	T-50	50 kc	30 cps	2.5 kc—1.9 kc
	T-200	200 kc		4.4 kc—3.8 kc
	T-1000	1 mc		11.0 kc—9.0 kc
	T-3000	3 mc		25.0 kc—20.0 kc
	T-6000	6 mc		50.0 kc—40.0 kc

Write, wire, phone TODAY for more information on how a Panoramic Panalyzer can help you!
A Panoramic Application Engineer is always available to discuss specific problems. Special instruments made to order.

Proved Performers:
PANORAMIC SPECTRUM ANALYZERS
(Sub-Sonic through Microwave)
PANORAMIC SWEEP GENERATORS
PANORAMIC FREQUENCY GENERATORS

PANORAMIC RADIO PRODUCTS, Inc., 15 South Second Avenue, Mt. Vernon, N. Y.

Telephone: MOUNT VERNON 4-3970 — Cables: Panoramic, Mount Vernon, New York State

CIRCLE 435 ON READER-SERVICE CARD FOR MORE INFORMATION

For

- ▷ investigating pulsed RF signals
- ▷ analyzing AM and FM transmitters
- ▷ spotting spurious oscillations and modulation
- ▷ monitoring communications bands especially for signals very closely adjacent in frequency
- ▷ testing industrial RF equipment, diathermy and electrosurgical instruments



Model SB-12



Model SB-8b



Model SB-3

the pioneer
is the leader

PANORAMIC
RADIO PRODUCTS, INC.

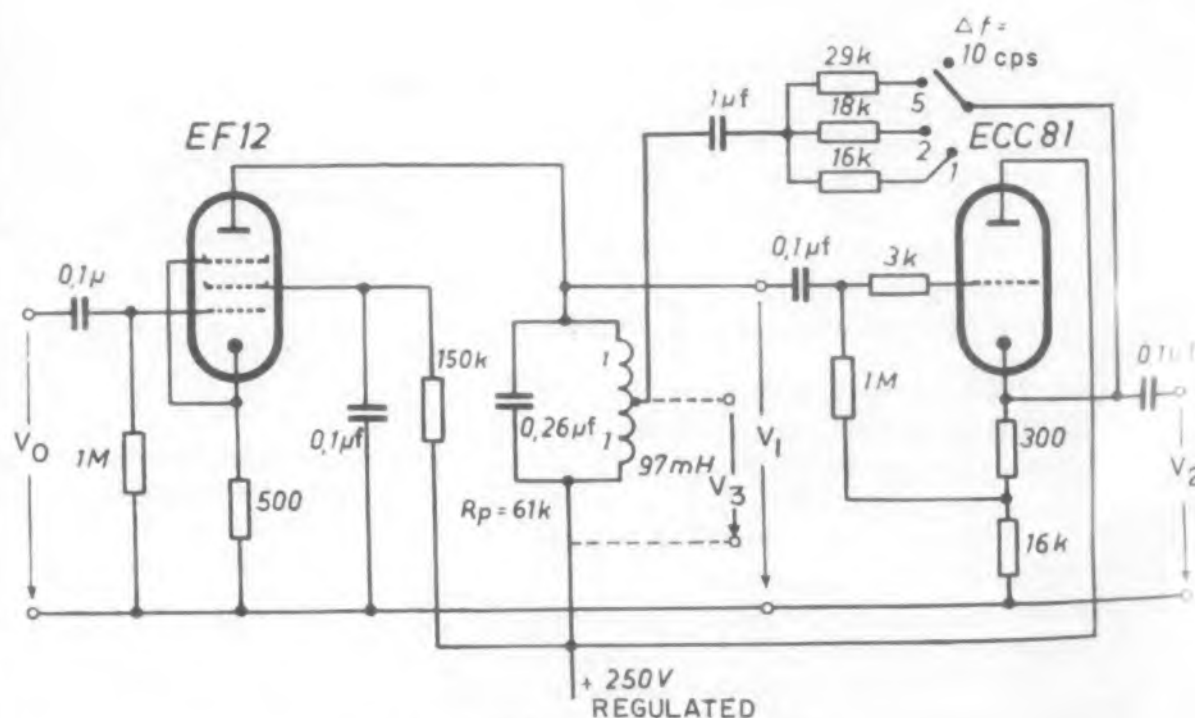
Abstracts—German

Amplifier with 1 Cycle

UNUSUALLY high selectivity has been incorporated in the final stage of an amplifier designed for noise spectroscopy applications. In this stage a cathode follower is used to increase the "Q" of a tuned circuit by employment of positive feedback. This arrangement enabled the designer to obtain both the Q improvement due to the positive feedback and the (tube parameter) stability of negative feedback. The circuit is based on the "Q-multiplier" of H. E. Harris (*Electronics*, Vol. 25, No. 5, p 131).

The basic circuit is shown in the figure. The switching arrangement in the feedback loop is adjustable so that when the loop is open the bandwidth is 10 cps and for the three other switch positions shown, the bandwidth is five, two or one cps.

Since the portion of the frequency spectrum which is under analysis is heterodyned to 1000 cps the pentode stage shown is tuned to that frequency. The tuned circuit consists of a high quality capacitance and a ferromagnetic-core coil (with air gap) so that



Circuit of frequency selective amplifier stage with adjustable bandwidth.

Bandwidth

E. Brenner

an uncompensated Q of 100 and a corresponding bandwidth of 10 cps results. The resonant conductance of the tank circuit, $G_p (= 1/R_p = 1/\omega_0 Q_0 L)$ is 16.4 micromhos. It is shown in the paper that the positive feedback through the resistance R_f (which appears in the diagram as 29K, 18K or 16K) to the tap on the tank coil results in an effective tank conductance G'_p :

$$G'_p = G_p + G_n \quad (1)$$

where G_n is a negative value given by

$$G_n = - \frac{a (K_0 - a)}{R_f + R'_o} \quad (2)$$

In Eq. 2 " a " is the turns ratio of the autotransformer formed by the tapped tank coil (i.e. the ratio of V_s to V_p , 0.5 in the example); K_0 is the (open circuit) gain of the cathode follower, nominally unity; R'_o is the output resistance of the cathode follower and R_f is the feedback resistance.

In order to maintain absolute stability G_p must remain positive so that the value of R_f must exceed the critical value $a(1-a)/G_p$. Within this limitation a value Q' is obtained (with feedback) which is related to R_f (if K_0 is unity) by

$$R_f = \omega_0 L \frac{a(1-a)}{\frac{1}{Q_0} - \frac{1}{Q'}} \quad (3)$$

where Q_0 is the uncompensated Q of the tank circuit.

While the circuit shown here results in the improved bandwidth as stated, the rejection of frequencies more than 10 c.p.s. off resonance is not improved. This defect may be overcome by bandpass filters such as those used in the i-f stages of radio receivers. In that case it is possible to use sufficient positive feedback to give negative conductance for the secondary as long as the total conductance of the primary and secondary combined remains positive. For switching of bandwidth both the feedback resistance R_f and a series feedback capacitance must be changed. In addition it is necessary to readjust the tuned circuit coupling for each bandwidth setting.

Abstracted from an article by W. Nonnenmacher, Elektronische Rundschau, Vol. 10, May 1956, pp 125.

Looking for germanium

... for transistors?

... for diodes?



Sylvania is your source!

If you manufacture transistors or diodes of any type, you will find that Sylvania can supply the kind of germanium you need.

The following Sylvania germanium products are available: spectrographically pure dioxide; polycrystalline as-reduced ingots; polycrystalline purified ingots; and vertically grown, undoped single crystals. All Sylvania germanium is n-type, and, in the purified ingot or single crystal form, has a minimum resistivity of 40 ohm cm.

Manufacturers of diodes and transistors report important benefits gained through using Sylvania germanium. They report they can use the same doping schedule from ship-

ment to shipment. They report higher yield in the growth of doped single crystals. And for those who grow doped crystals horizontally, Sylvania germanium ingots are purified in five standard boats to fit single crystal boats in popular use.

Whether you prefer germanium in the form of dioxide, as-reduced ingots, purified ingots, or undoped single crystals, Sylvania can fulfill your requirements. Send for a technical bulletin on all forms of Sylvania germanium. Write to:

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

TUNGSTEN • MOLYBDENUM • CHEMICALS • PHOSPHORS • SEMICONDUCTORS

SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY
CIRCLE 436 ON READER-SERVICE CARD FOR MORE INFORMATION

why companies find it
GOOD BUSINESS
 to specify panel instruments
 by **Simpson...**



... **QUICK SERVICE** from **HUGE STOCKS!**

Over 50,000 stock units, in 800 sizes and types are available through 1,500 electronic distributors. Wherever you are located, Simpson instruments are obtainable promptly.

CORE MAGNET METER MOVEMENT



EXTERNAL MAGNET METER MOVEMENT

... **EXACT NEEDS CUSTOM BUILT!**

Many meters quickly built from *standing tools*, or designed to your exact specifications. Firm delivery schedules. Movements include the superb, *self shielded* Core Magnet Meter Movement.

• Simpson instruments have established a reputation for laboratory accuracy... yet they have the ruggedness to stand up under years of service and severe shocks. Write for new catalog.

SIMPSON ELECTRIC COMPANY

5200 W. Kinzie St., Chicago 44, Illinois

Phone: EStebrook 9-1121

In Canada: Bach-Simpson Ltd., London, Ont.



Instruments that stay accurate

CIRCLE 437 ON READER-SERVICE CARD FOR MORE INFORMATION

Now... a low cost, reliable
SUPERSENSITIVE RELAY



NEW!
Simpson
METER RELAYS
of improved design and reliability

**Less than 50 Millimicrowatts
 Control Up to One Watt!**

Here is a line of improved Meter Relays that offers lower costs, plus circuit simplification for many alarm, control, and limit setting applications. The new design features platinum alloy contacts and increased contact force which minimizes sticking and provides extreme reliability. Simpson Meter Relays are a nonlocking type, currently available in 2" DC and 3" AC and DC models. Write for new Technical Bulletin No. 17, today.

SIMPSON ELECTRIC CO.

5200 W. Kinzie St.

Chicago 44, Illinois

Phone: EStebrook 9-1121

In Canada:

Bach-Simpson Ltd., London, Ont.



INSTRUMENTS THAT STAY ACCURATE

Abstract

**Heat Dissipation—
 Transistors Vs. Tubes**

A SINGLE output stage using electron tubes and having the same effective cooling area as an output stage using transistors can dissipate 1-1/4 to 4 times as many watts and still not have excessive temperatures. Temperatures associated with electron tubes may be 20 to 40 F above room temperature, but equipment associated with transistors are usually limited to 15 F above room temperature. This difference is maintained to ensure that the germanium transistor bead does not exceed 175 F for any operating situation. Electron tubes, on the other hand, operate at temperatures measured in the hundreds of degrees. Efficiencies of electron tube and transistor equipment also vary markedly. Cathode-type electron tubes seldom attain more than 10 per cent efficiency, and usually less than 5 per cent. Transistors can attain more than 50 per cent efficiency, but a conservative estimate of 33 per cent is used in these calculations.

Based on the above considerations and efficiency characteristics of tubes and transistors, it has been found that the area of transistor equipment should be 33.3 per cent larger than the area of equipment associated with the electron tube, on a one transistor vs. one electron tube comparison. Practically speaking, it has been found that transistorized equipment has an outstanding space advantage over electron-tube equipment where the output power required is less than 10 mw. The net efficiency of a complete equipment unit containing many active stages is different from that of the single output stage because only a few of the active stages are required to deliver large signal power. Here, transistors exhibit considerable advantages over electron tubes because low level stages can be operated at significantly higher efficiencies than are possible in tube circuits.

In general, there are significant differences in the problem of removing heat from transistorized equipment and electron tube equipment. When the signal level is small, less than 100 mw, transistors permit considerable space saving. Where the required signal level is large, more than 1 w, tubes possess a space saving advantage. In a room filled to capacity with either transistor or electron tube equipment, there is no significant difference in the over-all heat problem, forced cooling is required. Abstracted from *Heat Dissipation From Electronic Equipment*, E. K. Van Tassel, Bell Laboratories Record, Dec. 1956, pp. 456-460.

Standards and Specs

Sherman H. Hubelbank

Dielectric Tests

AIEE No. 62, PROPOSED RECOMMENDED GUIDE FOR MAKING DIELECTRIC MEASUREMENTS IN THE FIELD, NOVEMBER, 1956

The present state of the art of making various dielectric measurements and testing the electrical insulation of power apparatus in the field is summarized in this guide. This guide is intended to serve as an aid in obtaining reliable and accurate data. The interpretation of data as it relates to the quality or serviceability of insulation is beyond the scope of this publication. Also considered in this guide are the special conditions encountered in field testing, and their effect on instruments, methods, and procedures for making tests on the electrical insulation of power apparatus. Copies of this guide may be obtained without charge from the American Institute of Electrical Engineers, 33 West 39th St., New York 18, N.Y.

Preparing Specs

MIL-I-26036 (USAF), INSTRUCTIONS FOR PREPARATION OF CONTRACTOR-PREPARED SPECIFICATIONS FOR ASSEMBLY-TYPE GROUND SUPPORT EQUIPMENT, 22 AUGUST 1956 . . . Instructions to be followed by AF contractors in the preparation of contractor specs for assembly-type ground equipment are established by this spec. These instructions are to govern the spec written and to establish the format of the spec, but are not to be construed as requirements applicable to the design of the equipment.

Maintenance Drawings

MIL-M-19562 (SHIPS), INSTRUCTIONS FOR PREPARATION OF MAINTENANCE PRINTS FOR ELECTRONIC EQUIPMENT, 18 SEPTEMBER 1956 . . . The preparation and format of maintenance prints which are to be supplied with the electronic equipment to facilitate maintenance and servicing are covered in this spec. To aid the technician in troubleshooting, certain information from the technical manual and from other sources is condensed to form maintenance prints which will enable the service technician to perform his task more efficiently. This spec replaces Navy Department spec RE 9349A, entitled "Instruction for Preparing Servicing-Block Diagrams and Supplementary Material" and RE 9543A, entitled "Instructions for Preparing Radar Maintenance Prints."

New

Allen-Bradley developments

GREATER COLOR PURITY—BETTER CONVERGENCE

1.

FULL ROUND YOKE CORES

FOR COLOR TV

ALSO BLACK AND WHITE

Allen-Bradley has developed a method of producing ferrite deflection yoke cores as a full 360° ring! Unlike cores made from quarter rounds, the new full round cores are perfectly concentric and have parallel inner surfaces. They require no grinding. The round rings are "cracked" into halves and taped for shipment. Assembly is quick and economical. The tape is rolled back, the core is slipped over the coils, and the tape put back in place. The core's concentricity assures better convergence and greater color purity.



These ferrite yoke cores are produced as full rounds, and are "cracked" into halves and taped, as shown, for easy assembly.

2.

FLARED YOKE FERRITE CORES

FOR NEW 110° TUBE . . . SAVES WEIGHT

For the new 110° picture tube, Allen-Bradley has developed a flared yoke ferrite core whose outer surface is also shaped to reduce the amount of material required. This makes possible a weight reduction of approximately 30% over conventional cylindrical cores.

The new flared yoke is produced as a solid piece but, with the Allen-Bradley method, the yoke is "cracked" into halves, yet a perfect ring is maintained. Available in Allen-Bradley Class WO-1 ferrites which are to be preferred because of their uniform magnetic characteristics.

Allen-Bradley Co.
1344 S. Second St.
Milwaukee 4, Wis.

In Canada—
Allen-Bradley Canada Ltd., Galt, Ont.

FERRITE SAVED
BY CURVED SHAPE



ALLEN - BRADLEY

RADIO, ELECTRONIC, AND TELEVISION COMPONENTS

QUALITY

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Westinghouse **IGNITRON TUBES** still the industry standard.



Westinghouse invented the Ignitron tube and has maintained a record of improvements that are today the accepted industry standards:

- kovar seals to permit use of steel envelopes • improved ignitors to assure accurate ignition.
- thermostatic control for overload protection and water savings.

For highest quality Industrial and Special Purpose tubes—always specify Westinghouse.

YOU CAN BE SURE...IF IT'S Westinghouse

Cables

MIL-C-18329B (SHIPS), CABLE ASSEMBLY, POWER, ELECTRICAL, WITH 3-WIRE 3-PRONG, GROUNDED PLUG CONNECTOR, FOR 115-VOLT EQUIPMENT . . . Electrical cable assemblies, having three-prong grounded plug connector connected to one end, are covered in this spec. It also covers the requirements for connecting the other end of the cable assembly to a piece of portable equipment such as electronic test equipment. Grounding is accomplished by a conductor having a green tracer or green-colored insulation.

MIL-C-3885, CABLE ASSEMBLIES AND CORD ASSEMBLIES, ELECTRICAL (FOR USE IN ELECTRONIC, COMMUNICATION, AND ASSOCIATED ELECTRICAL EQUIPMENT), AMENDMENT NO. 2, 16 APRIL 1956 . . . The scope of this spec has been changed to cover the minimum requirements for power and audio-frequency cable and cord assemblies for voltage up to and including 600 volts ac or corresponding dc. The ends of a cable assembly that terminate in a molded connector or a molded crotch need not be treated with a mildew-inhibiting agent.

Antennas

MIL-006224B (USAF), ANTENNAE FOR UHF AIRBORNE COMMUNICATIONS EQUIPMENT, GENERAL SPECIFICATION FOR THE DESIGN OF, 6 AUGUST 1956 . . . The design, performance, and flight test requirements of an antennae system used with UHF communication systems are established by this spec. Also included are the requirements for the furnishing of engineering reports. The requirements of spec MIL-A-7772 apply as requirements of this spec. If the requirements of the two specs conflict, those of this spec shall govern.

MIL-A-7772B (ASG), GENERAL SPECIFICATION FOR THE DESIGN, LOCATION, AND INSTALLATION OF AIRBORNE ANTENNA SYSTEMS, 27 JUNE 1956 . . . The general mechanical and electrical requirements for design, and for the location and installation in military aircraft, of antennas for electronic equipment are covered by this spec. It is intended primarily for the use of aircraft manufacturers.

Resistors

MIL-R-19518 (SHIPS), PRECISION VARIABLE WIREWOUND RESISTORS, 31 AUGUST 1956 . . . Precision variable wirewound resistors capable of producing an output voltage (in terms of percent of applied voltage) proportional to the angle of shaft rotation are covered by this spec. It includes linear and non-linear, single turn and multi-turn, single section, and ganged assemblies of variable resistors. The resistors are capable of full-load operation at ambient temperatures of 40 to 100 C. A typical type designation for a resistor meeting this spec is RK09AEKM203P.

7ET-4103

CIRCLE 439 ON READER-SERVICE CARD FOR MORE INFORMATION

electronic engineers

SENIOR and JUNIOR

*Continued Expansion
Opens Up New Opportunities with*



Greenwich, Connecticut

Excellent positions are available with the General Engineering Laboratories of American Machine & Foundry Company, a recognized leader in the design, development and manufacture of atomic, electronic and mechanical equipment for the consumer, industry and defense.

If you qualify in any of the fields listed below, investigate these opportunities now:

- *High power radar system development*
- *Tropospheric scatter systems*
- *Microwave theory & component design*
- *Electronic packaging*
- *Missile control and handling systems*
- *Antenna design*
- *Electronic countermeasures*
- *Telemetry*
- *Data handling*
- *Circuit theory*
- *Navigation systems*
- *Instruments*



Good opportunities for advancement through advanced education on the premises as well as at nearby graduate schools in addition to a liberal tuition reimbursement plan, excellent employee benefits and an ideal location in Connecticut, surrounded by fine suburban communities. Relocation expenses paid.

Advanced electronic equipment
recently designed by **AMF**

*Please send your resume to Mr. J. F. Weigandt
OR for additional technical information,
contact Mr. D. R. Barker or Mr. H. R. Holloway
NOrmandy 1-7400*

General Engineering Laboratories

American Machine & Foundry Company

Fawcett Bldg. • Fawcett Place
Greenwich, Connecticut

CAREERS

CIRCLE 551 ON READER-SERVICE CARD FOR MORE INFORMATION



“My Dad’s with EMERSON ELECTRIC!”

...and there’s lots of room for your Dad, too!

- Electronic Engineers (radar, computer, servo)
- Electronic Packaging Engineers
- Electronic Test Equipment Designers
- Electrical Engineers
- Liaison Engineers (electronics background)
- and Recent Graduates

Big, new developments in our tremendous long range expansion program have created excellent career opportunities. Your position will be highly important and advancement rapid due to the dynamic pace of our growth.

Emerson Electric is medium sized (5000 employees, 850 engineers). Our Electronics and Avionics Division is a leader nationally, since 1940, in design, development and production of electronic fire control systems, missiles, supersonic airframe structures, radar assemblies and aircraft components.

Our Commercial Division, established 1890, produces comprehensive lines of fans, motors, air conditioners and power tools. The perfect balance of electronic, aircraft and consumer production assures stability and security.

Advanced education, undergraduate and graduate, is worked out to fit individual needs. Benefits range from unusual salary arrangements, group insurance and pension to fully paid moving expenses. We’re ideally located in a suburban St. Louis residential area with shopping centers and no traffic congestion. St. Louis combines four seasons with a delightful ‘national climate’ averaging extremes of 32.5° in January and 80° in July.

WRITE TODAY to R. L. Middleton, Employment Manager, for more details.

EMERSON ELECTRIC

**Electronics and
Avionics Division**



**8100 W. Florissant
St. Louis 21, Mo.**

Name _____

Address _____

Years of Experience _____ Degree _____

Assignment Desired _____

CIRCLE 552 ON READER-SERVICE CARD FOR MORE INFORMATION

If you're seeking a top career in a **UNIQUE** location—

**Look to FTL . . . where you work, live and relax
in beautiful suburban New Jersey . . . only minutes
away from New York City's wealth of scientific,
cultural and entertainment facilities**

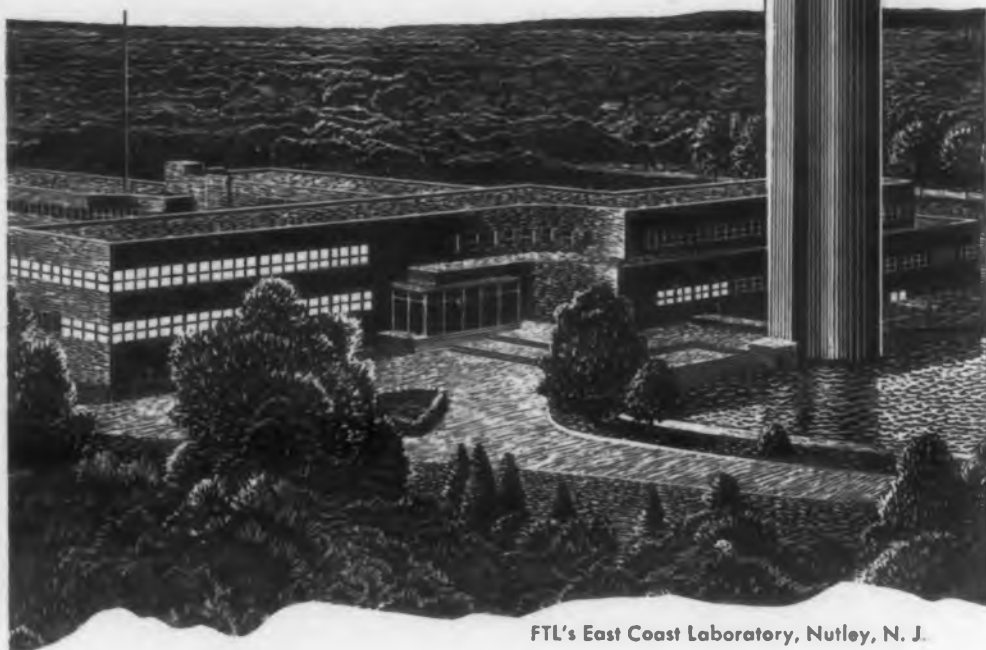
Mountains, lakes, ocean beaches, fishing, boating, golf—
all the things a man and his family enjoy—are within easy
reach of the "FTL Community."

At FTL you work in country-like atmosphere . . . in one
of America's great research and development centers . . .
with leaders in electronics . . . with every opportunity to
build a stable and rewarding career . . . as a member of
the world-wide I T & T Engineering Team.

FTL provides group insurance, company-paid medical
and pension plans, tuition refund and many other em-
ployee benefits.

Write today for information on any of the following
interesting assignments now open at Federal Telecommu-
nication Laboratories, Nutley, New Jersey:

Radio Communication Systems • Traveling Wave Tubes
Electronic Countermeasures • Air Navigation Systems
Antennas • Missile Guidance • Computers
Transistors and other Semiconductor Devices
Telephone and Wire Transmission Systems



FTL's East Coast Laboratory, Nutley, N. J.
—only 28 minutes from New York City

If you prefer **CALIFORNIA—**

• Opportunities for relaxed living
and career-building also available at
FTL's West Coast Laboratory . . . with
openings in Digital Computers, Iner-
tial Navigation Systems and Infra-
Red Systems. Write to 15191 Bledsoe
St., San Fernando, Cal.



MAIL THIS COUPON TODAY ED

Federal Telecommunication Laboratories
500 Washington Avenue, Nutley, N. J.
Please send literature describing opportunities
and benefits at FTL, in Nutley, New Jersey.

Name _____

Address _____

City _____ Zone _____ State _____

Federal Telecommunication Laboratories
A Division of INTERNATIONAL TELEPHONE
AND TELEGRAPH CORPORATION

CIRCLE 553 ON READER-SERVICE CARD FOR MORE INFORMATION

To the *forward-looking* engineer...

CAREERS



STICK-FORCE REVERSAL problems at sonic speeds are solved by this sensitive, accurate AiResearch air data system incorporating transducer, computer and actuator

Garrett Corporation engineers are constantly called upon to provide solutions for seemingly insurmountable problems. The high degree of respect in which the Garrett engineer is held by his profession is a tribute to the accomplishments of our team.

If you qualify to join us, stimulating assignments in the work you like best are only part of what we offer. We pay a premium for ability. You'll work with the finest research and laboratory facilities at your disposal...live in the most desirable areas in America—California, Arizona, the East Coast.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer equipment, electro-mechanical equipment, electronic computers and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley

THE GARRETT CORPORATION

9851 S. SEPULVEDA BLVD., LOS ANGELES 45, CALIFORNIA

DIVISIONS:

AIRESEARCH MANUFACTURING, LOS ANGELES • AIRESEARCH MANUFACTURING, PHOENIX

AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING

AIRSUPPLY • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

CIRCLE 554 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 15, 1957

*Electronics
Packaging
Engineer*

with unusual
advancement
potential

The Missile & Ordnance Systems Department of General Electric, prime contractor for the ICBM and IRBM nose cones; has a responsible position in the Instrumentation Engineering Operation.

Duties include: Solving unique packaging problems for airborne electronic equipment used in instrumentation transducer systems; developing testing techniques for laboratory evaluation under simulated conditions; acting as a consultant to design and development engineers.

Position requirements: Degree in Mechanical or Electrical Engineering plus several years' experience in packaging small electronic assemblies.

Desired: Experience or knowledge of military specifications, potting methods, and printed circuit techniques for transistor, semi-conductor, and sub-miniature vacuum tube circuits.

We are a research and development laboratory affiliated with one of the world's largest, most diversified and progressive industrial organizations. The environment is completely technical and professional. We hold prime contracts of a long-term nature with all of the armed services. Salary and benefits are liberal. Excellent facilities and equipment.

Our Manager of Airborne Instrumentation Engineering will be pleased to review your confidential resume. He will invite you to Philadelphia for a personal interview if your qualifications are appropriate. If you prefer, you need not reveal the name of your present employer.

Please send resume to:

MR. JOHN WATT

Technical Recruiting, Room 572-1



CIRCLE 555 ON READER-SERVICE CARD FOR MORE INFORMATION



**RAYTHEON'S WAYLAND LAB
OFFERS**

CHALLENGING WORK

Our success in obtaining prime, long-range contracts for Aircraft Weapons Systems, major Defense Radars, Fire Control Systems and many others provides lasting and challenging opportunities for good Design Engineers who are ready, willing and able to work on some of the most advanced radar and weapons systems being designed today.

PLEASANT LIVING

Wayland and the surrounding territory constitute a select residential area where an acre-per-house is the rule. History records these towns—Lexington, Concord, Sudbury, etc.—as having famous beginnings; just the right amount of modern progress blended with this background renders them ideal for relaxed and pleasant New England living.



Excellence in Electronics

WAYLAND LAB

Please send resume to: **Radar Professional Personnel
Box 242-H
Raytheon Manufacturing Company
Wayland, Massachusetts**

CIRCLE 556 ON READER-SERVICE CARD FOR MORE INFORMATION

engineers . . . physicists

BIG opportunities at **MOTOROLA** in the **WEST**

PHOENIX, Arizona—and RIVERSIDE, California



WORK IN A VACATIONLAND
(your family will love year-round outdoor living)
WHILE YOU ADVANCE YOUR CAREER



Here are the country's newest and most complete Electronic Laboratories, offering outstanding career advantages (see listing below). And here you'll get in on the ground floor of a swiftly expanding company. You'll enjoy working in air conditioned comfort in the most modern and well instrumented laboratories . . . with liberal employee benefits, including an attractive profit sharing plan and association with men of the highest technical competence.

To top it off, you'll be moving to a spot where there's room to grow (moving and travelling expenses paid for family) . . . where there are planned communities, with modern shopping centers, advanced schools, and many fine buys in homes available. Living will be easier, more relaxed and more fun in Phoenix or Riverside. "Go West" never had greater appeal (or greater rewards) than it does TODAY!



PHOENIX NEEDS:

Electronic Engineers, Mechanical Engineers,
Physicists, Metallurgists and Chemists.

RESEARCH LABORATORY

Microwave Antennas
Pulse and Video Circuitry
Radar Systems Design
Circuit Design
Electro-Mechanical Devices
Systems Test
Transistor Applications

SEMI-CONDUCTOR DIVISION

Transistor Application
Transistor Devices
Solid State Physics
Physical Chemistry
Metallurgical Engineering
Production Engineering

For above positions write:

For above positions write:

Mr. R. Coulter
3107 N. 56th St., Dept. J.
Phoenix, Ariz.

Mr. V. Sorenson
5005 E. McDowell Rd., Dept. J.
Phoenix, Ariz.

RIVERSIDE NEEDS:

Electronic Engineers, Mechanical Engineers, Physicists and
Mathematicians.

RESEARCH LABORATORY

Military Operation Analysis • Analog
Computer Flight Simulation • Digital
Computer Analysis • Digital Com-
puter Design • Dynamics Analysis •
Microwave Systems • Missile Sys-
tems • Circuit Design • Servo Mech-
anisms • Aerophysics.

For above positions write:

Mr. C. Koziol Dept. J.
8330 Indiana Ave., Riverside, Calif.

EXCELLENT OPPORTUNITIES IN CHICAGO, TOO

Challenging positions in Two-Way Com-
munications, Microwave, Radar and Mil-
itary equipment, Television (Color), Radio
Engineering and Field Engineering.

write to:

Mr. L. B. Wrenn,
4501 Augusta Blvd. Dept. J.
Chicago 51, Ill.



MOTOROLA

CIRCLE 557 ON READER-SERVICE CARD FOR MORE INFORMATION

COMMUNICATIONS SYSTEMS ENGINEERS

The expanding scope of advanced communications projects has created several unique positions in fields related to VHF, UHF, microwave transmission and reception, forward scatter and single sideband applications at Hoffman. Electronics engineers with appropriate backgrounds will find these new assignments professionally stimulating and financially rewarding. Please address Vice President of Engineering:

Hoffman LABORATORIES, INC.

A SUBSIDIARY OF HOFFMAN ELECTRONICS CORP.
3761 South Hill St., Los Angeles 7, Calif.
Telephone: Richmond 9-4831.

CIRCLE 558 ON READER-SERVICE CARD FOR MORE INFORMATION

AVIONICS OPPORTUNITIES

*In Sunny, Tropical
San Diego, California*



SYSTEMS ENGINEERS

SYSTEMS ANALYSTS
(engineering and mathematics)

CIRCUITRY DESIGN ENGINEERS

SERVO DESIGN ENGINEERS

COMPONENT PACKAGING ENGINEERS
(mechanical and electrical)

ETCHED CIRCUIT DRAFTSMEN

MICROWAVE TECHNICIANS

FOR **NEW**
AIRBORNE
NAVIGATIONAL
SYSTEMS

MISSILE
GUIDANCE
SYSTEMS

HELICOPTER
INSTRUMENTATION

AIRCRAFT
CONTROL
SYSTEMS

Work on these challenging projects at RYAN
Live in beautiful San Diego — a year-round playground

WRITE TO ENGINEERING PROFESSIONAL PLACEMENT



RYAN AERONAUTICAL COMPANY
2704 Harbor Drive, San Diego 12, California

CIRCLE 559 ON READER-SERVICE CARD FOR MORE INFORMATION

ADVERTISING INDEX

February 15, 1957

Advertiser	Page
AMP, Inc.	120, 121
Ace Electronics Assoc.	100
Ace Plastic Company	99
Acheson Colloids Company	75
Aero Mfg. Company	77
Airpax Products Co.	108
Alden Products Co.	58
Allegheny Ludlum Steel Corp.	64
Allen-Bradley Co.	139
Allied Control Co.	6, 7, 8
Allied Radio Corp.	97
American Electronic Laboratories Inc.	84
American Machine & Foundry	141
Amperite Company	93
Applegate, C. J. & Company	98
Associated Research, Inc.	92
Automatic Electric Company	67
Barber-Colman Company	81
Barry Controls Inc.	78
Belden Manufacturing Co.	54
Bendix Aviation Corp., Scintilla Div.	125
Berkley Div. of Beckman Instruments Inc.	97
Birtcher Corp.	111
British Industries Corp.	92
Bud Radio, Inc.	131
Burnell & Company, Inc.	9
By-Buk Company	95
CBS-Hytron	16
Caledonia Electronics & Transformer Corp.	128
Carter Motor Co.	130
Centralab Div., of Globe Union Inc.	85
Clarostat Manufacturing Co., Inc.	119
Clary Corp.	105
Clevite Transistor Products	115
Comar Electric Company	125
Computer Instruments Corp.	82
Computer-Measurements Corp.	42
Connecticut Hard Rubber Co., The	96
Continental Diamond Fibre Co.	68
Cornell-Dubilier Electric Corp.	127
Corning-Glass Works	52
Croname, Inc.	110
Crucible Steel Co. of America	17
Cubic Corp.	122
Curtiss-Wright Corp.	83
Daven Company, The	20
DeJur Amsco Corp.	74
Delco Radio Div. General Motors Corp.	62
Delavan Electronics Corp.	88
Deringer Metallurgical Corp.	99
Dow Corning Corp.	63
du Pont, E. I. de Nemours & Co.	21
Eastern Air Devices, Inc.	41
Eastman Kodak Company, Graphics Arts Div.	96
Etel-MacCullough Inc.	56
Elastic Stop Nut Corp.	96
Electrical Industries	13



Lockheed F-94C Starfire and the Hughes radar fire control system with which it is equipped.

Hughes has been the leader from the beginning in applying electronic computers to airborne fire control equipment. Today every U.S. Air Force and Canadian continental defense interceptor uses Hughes-developed and Hughes-manufactured systems.

Product Design at
HUGHES WEAPON SYSTEMS DEVELOPMENT LABORATORIES

As the intercept problem becomes more and more automatic, additional equipment such as new-type computers, control surface tie-in (CSTI), autopilots, and other units must be integrated into the system. Faster speed and heavier engines dictate more streamlining—and hence less space for electronic gear. The result is even more miniaturization and compact packaging, evolved from special techniques.

This all means that now the product design engineer is more important than ever before. In the Product Design Laboratory he is a vital part of the formal link between the Research and Development activity and the optimum configuration and installation arrangements for the systems "black boxes."

HUGHES Scientific Staff Relations

RESEARCH AND DEVELOPMENT LABORATORIES

HUGHES AIRCRAFT COMPANY

Culver City, Los Angeles County, California

CIRCLE 440 ON READER-SERVICE CARD FOR MORE INFORMATION

These positions in the Product Design Laboratory are open now in the Weapon Systems Development Laboratories:

IN THE GUIDED MISSILE AREA

ENGINEERS

to work on design and construction of microwave components.

ENGINEERS

to engage in the design and fabrication of airborne telemetering equipment for guided missiles.

ENGINEERS

to participate in development, design and prototype construction of electrical and electrohydraulic power supplies.

IN THE RADAR FIRE CONTROL AREA

ENGINEERS

to do equipment development and circuit design on special military field test equipment for support of fire control radar, fighter identification, and armament auxiliary equipment.

ENGINEERS

for circuit and equipment development in the field of airborne communication and navigation circuits.

ENGINEERS

experienced in computer or related fields to develop military field tests and auxiliary equipment for support of airborne computers.

You are invited to send resumes of your education and experience to the address at left.



SPEED NUTS® WITH A HANDLE eliminate fastener fumbling!

Multiple-unit strips of Tinnerman Flat-Type SPEED NUTS permit cost-cutting, split-second fastening. That's how Reznor Mfg. Co., Mercer, Pa., saves up to 40% in the assembly of louvers for its Suspended Gas Unit Heaters!

With strip in hand, the operator drives a screw into the end SPEED NUT, easily snaps off the tightened fastener from the strip and quickly places the next SPEED NUT in screw-receiving position. No lost motion feeling or fumbling for single fasteners, spanner or lock washers. Louvers are securely fastened, and are easily adjusted to control air distribution.

This is an example of the versatility of SPEED NUTS. It is also an example of the assembly advantages of SPEED NUT brand fasteners. Over 8000 types give you an answer to almost every

fastening problem. See your Tinnerman representative or write for complete details.

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



Canada: Dominion Fasteners, Limited, Hamilton, Ontario, Great Britain: Simmonds Aerocessories, Limited, Ffriforest, Wales, France: Simmonds, S. A., 3 rue Salomon de Rothschild, Suresnes (Seine), Germany: Hans Sichelinger GmbH "MECANO", Lemgo, I. Lippo.

CIRCLE 441 ON READER-SERVICE CARD FOR MORE INFORMATION

Advertiser	Page
Elgin National Watch Co., Electronics Div.	121
Emerson Electric Mfg. Co.	141
Empire Devices Products Corp.	128
Fairchild Controls Corp., Components Div.	129
Fansteel Metallurgical Corp.	104, 105
Farr Company	94
Fastex Div., Illinois Tool Works	99
Federal Telecommunication Laboratories	142
Federal Telephone & Radio Corp.	45
Felker Manufacturing Co.	47
Fenwal, Inc.	98
Filtron Company, Inc.	29
Finn, T. R. & Company	74
Ford Instrument Co., Inc.	84
Formica Corp.	18, 19
G-V Controls, Inc.	5
Garrett Corp.	142
Gee Lar Manufacturing Co.	92
General Controls	130
General Electric Company, Electronic Components Dept.	88
General Electric Company, Lamp Div.	131
General Electric Company, Missile & Ordnance Systems Dept.	143
General Plate Company	53
General Radio Company	94
Giannini, G. M. & Company	87
Good-All Electric Mfg. Company	133
Gries Reproducer Corp.	92
Gurley, W. & L. E.	98
Hardman Co., H. V.	103
Hartwell Company	36
Haydon Company, Inc., A. W.	109
Heinemann Electric Company	30
Helipot Corp., Div. of Beckman Instruments Inc.	85, 114
Hennaseal Company, Inc.	99
Hetherington, Inc.	60
Hewlett-Packard Company	147
Hoffman Electronics Corp.	39, 144
Hoffman Semi-Conductor Div. of Hoffman Electronics Corp.	107
Holtzer-Cabot Div. National Pneumatic Co.	86
Howard Industries, Inc.	125
Hubbell, Harvey, Inc.	28
Hughes Aircraft Co., Research & Development Div.	145
Hycon Mfg. Co.	103
Indiana Steel Products Co.	55
Industrial Instruments, Inc.	110
International Business Machines Corp.	10, 71
International Electronic Research Corp.	61
International Resistance Co.	2
James Vibrapowr Co.	91
Joelin Manufacturing Co.	102
Johnson, E. F. Co.	91
Kintel (Kay Lab)	116, 117
Kearfott Co., Inc., Little Falls Div.	72
Kearfott Co., Inc., Western Div.	81
Keithley Instrument Co.	7
Kester Solder Company	9
Kinney Manufacturing Division, New York Air Brake Co.	101
Koiled Kords, Inc.	13
Kurz-Kasch, Inc.	11
Laboratory for Electronics, Inc.	10
Lambda Electronics Corp.	1
Lercro Electronics, Inc. Div. Lynn-Deatrick	71
Librascope, Inc.	75

Page	Advertiser	Page
12	Lindgren, Erik A. & Associates	27
141	Lindmaster Switch Corp.	118
128	Little Falls Alloys, Inc.	94
	London Chemical Company	78
129	Magnetic Amplifiers, Inc.	76
105	Magnetics Inc. Components Div.	70
94	Magnetics Research Company	87
99	Mahayan Tin Bureau, The	72
142	Malory, P. R. & Company	135
45	Mason Instrument Company	80
47	Martin, Glenn L. Company	71
98	Mason Instruments	89
29	Metal Textile Corp.	38
74	Milivac Instrument Corp.	95
84	Minneapolis-Honeywell Regulator Co., Industrial Div.	69
3, 19	Motorola, Inc.	144
	Navigation Computer Corp.	48
142	New York Air Brake Co., Kinney Mfg. Div.	109
92	Ney, J. M. Co.	130
130		
88	Oak Manufacturing Co.	49
131		
148	Panoramic Radio Products, Inc.	136
53	Peerless Div. of Altec Lansing Corp.	118
94	Perkin-Elmer Corp., Vernistat Div.	77
87	Phaostron Company	82
133	Plastic Capacitors Corp.	104
92	Polytechnic Research & Development Co.	43
98	Pyramid Electric Company	57
	Pyroxylin Products	95
105		
36	Radio Corp. of America	59, 148
109	Radio Electronic Master	98
30	Raytheon Manufacturing Co., Equipment Marketing Div.	66
114	Raytheon Manufacturing Co., Microwave Div.	51, 79
99	Raytheon Manufacturing Co., Personnel Div.	143
60	Raytheon Manufacturing Co., Semi-Conductor Div.	4
147	Rex Corp., The	97
144	Rheem Manufacturing Co.	14
	Rotron Manufacturing Co.	73
107	Ryan Aeronautical Company	144
86		
125	Safeway Heat Elements, Inc.	111
38	Sanborn Company	81
145	Sanders Associates, Inc.	123
105	Shalleross Manufacturing Co.	81
	Simpson Electric Co.	138
55	Society of Plastics Industry, Pacific Div.	93
110	Solar Manufacturing Co.	101
11	Sorensen & Company, Inc.	126
91	Southern Electronics Company	37
	Southern Screw Company	88
90	Stackpole Carbon Co., Electronic Components Div.	35
102	Standard Pressed Steel Company	93
91	Statham Laboratories, Inc.	80
	Sylvania Electric Products, Equipment Div.	74, 75
117	Sylvania Electric Products, Tungsten & Chemical Div.	137
72		
80	Technology Instrument Corp.	129
7	Thomas Instruments, Inc.	15
9	Thomas & Skinner Steel Products	102
10	Therman Products, Inc.	146
15	Trington Company, Specialties Div.	112
11		
	Utek Corp.	86
10		
1	Vaters, Manufacturing Co.	91
7	Westinghouse Electric Corp., Industrial Tubes Div.	140
7	Westinghouse Electric Corp., Industrial Micarta Div.	65

Just announced!



-hp- X365A Isolator

Broadband X-band ISOLATOR

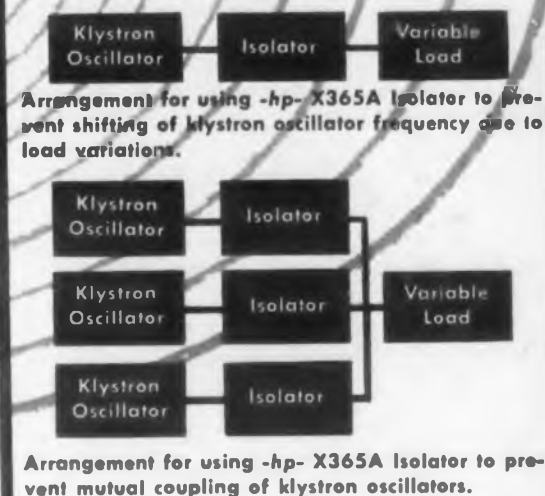
covers 8.2 to 12.4 KMC

One Isolator for entire X-band! Maximum forward attenuation 1.5 db; at least 25 db reverse attenuation! Low 1.2 SWR! Models for other bands coming soon!

No longer must you buy expensive narrow-band Isolators for every frequency band you work with. The new *-hp-* X365A is a true broadband Isolator—one precision instrument giving you almost flat rejection over the entire X-band. *-hp-* X365A employs the Faraday principle of field rotation. Two axially magnetized ferrite rods mounted inside a round, vaned waveguide, rotate the planes of polarization 45° each. This rotation, in combination with precisely located attenuator cards, permits forward power to pass almost without loss, while reverse power is virtually cancelled out.

-hp- X365A Isolators are precisely machined and finished, yet ruggedly constructed of top quality materials. *-hp-* 365A series Isolators for other waveguide bands will be announced soon.

TYPICAL APPLICATIONS



BRIEF SPECIFICATIONS

Frequency Range:	8.2 to 12.4 KMC
Minimum Reverse Attenuation:	25 db
Maximum Forward Attenuation:	1.5 db
Maximum SWR (either end):	1.2
Maximum Power Dissipation:	5 watts
Overall Length:	9 3/4"
Price:	\$225.00

*Specifications subject to change without notice.
Price f.o.b. factory.*

Get Details from Your *-hp-* Representative, or Write Direct!

HEWLETT-PACKARD COMPANY

3808K Page Mill Road, Palo Alto, Calif., U.S.A.
Cable "HEWPACK" DAVenport 5-4451

Field engineers in all principal areas



Complete coverage in waveguide equipment, too!

CIRCLE 442 ON READER-SERVICE CARD FOR MORE INFORMATION



FIRST TWIN DIODE...

Designed especially for computers

RCA-6887 Cuts Heater Power



Combining exceptional dependability, small size, and a low-wattage heater (1.26 watts)... the new RCA-6887 performs with high efficiency on *one third less heater power* than conventional twin diodes. This new tube offers up-to-date advantages for compact, medium-speed switching circuits.

Among the many design features of the RCA-6887 contributing to long life and high dependability are a pure-tungsten heater, special-alloy cathodes which retard interface, high-purity nickel plates, plus a protective shield to minimize interelectrode leakage. Each cathode utilizes a separate base pin to permit flexibility of circuit arrangement.

Strict production controls based on typical electronic computer conditions, extreme care in selection and inspection of materials, and rigorous tests for shorts and leakage—assure uniformity of electrical characteristics and stability initially and throughout life.



RADIO CORPORATION OF AMERICA

Tube Division Harrison, N. J.

Investigate the many advantages RCA-6887 offers your medium-speed electronic computer designs. Contact your RCA Field Representative at the RCA District Office nearest you.

EAST: Humboldt 5-3900
744 Broad Street
Newark 2, N. J.

MIDWEST: Whitehall 4-2900
Suite 1181
Merchandise Mart Plaza
Chicago 54, Ill.

WEST: RAymond 3-8361
6355 East Washington Blvd.
Los Angeles 22, Calif.

For technical data on RCA-6887, write RCA Commercial Engineering, Section 818Q-2, Harrison, N. J.

HAYDEN PUBLISHING COMPANY, INC.
19 East 62nd Street, New York 21, N. Y.

ELECTRONIC
DESIGN

◀ CIRCLE 443 ON READER-SERVICE CARD