

FEBRUARY 13, 1959

electronics

A McGRAW-HILL PUBLICATION

VOL. 32, No. 7

PRICE SEVENTY-FIVE CENTS



**Thyratron
Controlled
Heater**

What Air Force Planning Means to Business

Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASS., Vol. 1, No. 2

NEW ONE-WATT COMMUNICATION KLYSTRONS COVER GOVERNMENT AND COMMON CARRIER BANDS

Designed primarily for use in microwave relay links, the QK-661 and the QK-754, one-watt transmitter klystrons, operate at frequencies of 7,125 to 8,500 Mc and 5,925 to 6,425 Mc, respectively. The QK-661 is the first tube of its kind to cover the entire government band. The QK-754 is the first of a planned series of tubes to cover the entire communications band.

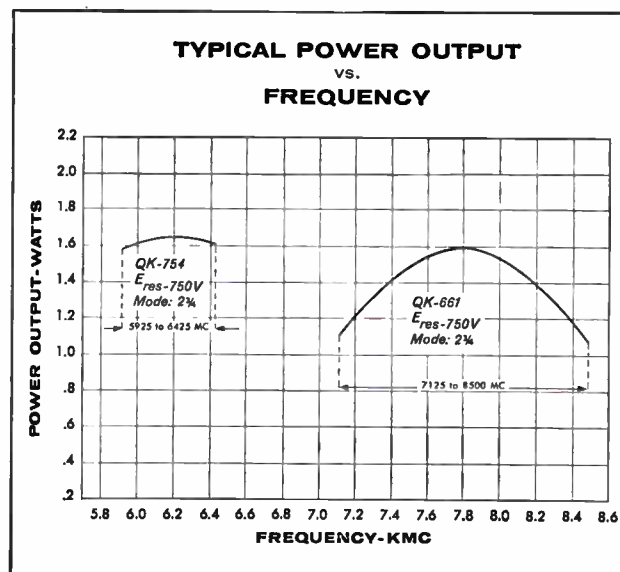
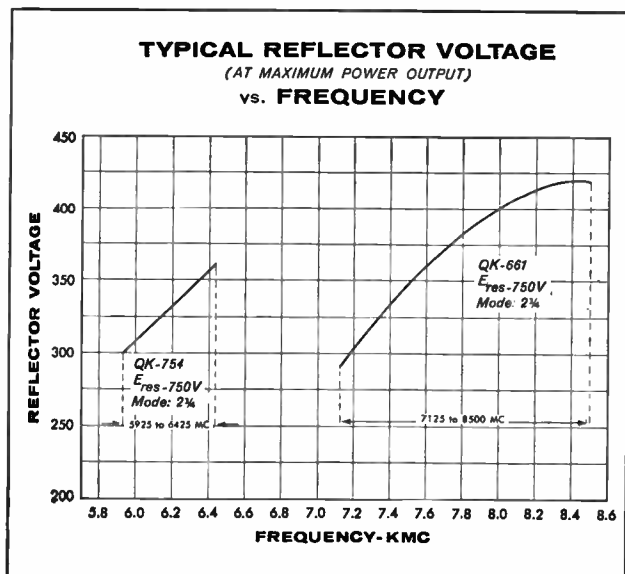
Both are mechanically tuned, integral-cavity, long-life, reflex-type tubes. The QK-754 uses a coaxial output; the QK-661, a waveguide output.

To insure efficient operation the tubes are available with integral cooling fins or with a heat-sink attachment suitable for connection to the chassis.



Typical operating characteristics

	QK-754	QK-661
Frequency Range	5925 to 6425 Mc	7125 to 8500 Mc
Power Output	1.5 watts	1.6 watts
Electronic Tuning (to half-power pts)	50 Mc	25 Mc
Modulation		
Sensitivity	1 Mc/V	600 Kc/V
(10 V pk-to-pk mod volt)		
Temp. Coefficient	± 0.1 Mc/°C	± 0.1 Mc/°C



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A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

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Vol. 32 No. 7

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THE DIVISIONS OF THOMPSON RAMO WOOLDRIDGE INC.



RAMO-WOOLDRIDGE

While it is now a division of **Thompson Ramo Wooldridge Inc.** instead of a separate corporation, **Ramo-Wooldridge** remains an integrated organization for research, development, and manufacture of electronic systems for military and commercial applications. R-W's military work is covered by thirty-four contracts with the Army, Navy, Air Force, and other government and industrial organizations. These support a broad technical and—in some cases—manufacturing program in such varied fields as Electronic Reconnaissance and Countermeasures; Microwave Techniques; Infrared; Analog and Digital Computers; Air Navigation and Traffic Control; Antisubmarine Warfare; Electronic Language Translation; and advanced Radio and Wireline Communication.

In the commercial field, the well-known RW-300 industrial process control computer and associated equipment—the basis of the expanding business that **The Thompson-Ramo-Wooldridge Products Company** is doing with process industries—was developed and is manufactured by the Ramo-Wooldridge division.

Men, machines, and manufacturing know-how from other TRW divisions will be added as needed to build up the growing production strength of the Ramo-Wooldridge division. In other ways, too, the availability of the special skills and facilities of the rest of the corporate family will broaden the services R-W can offer to its customers. However, R-W's major systems work will continue to be done in an organizational framework that brings the engineering and manufacturing groups into close-knit project teams in the division's own integrated development and manufacturing facilities in both Los Angeles and Denver.

Ramo-Wooldridge is production-oriented in the sense that its end objective is the manufacture and sale of equipment. However, because of the highly technical nature of its product lines, the R-W division will continue to give unusual emphasis to maintaining a high degree of professional scientific and engineering competence.



The completely transistorized RW-30 airborne digital computer has a volume of 4.19 cu. ft. and weighs only 203 lbs., including power supply



Ramo-Wooldridge is responsible for advanced electronic sub-systems development for application with both current and projected missile programs



Important infrared "search and track" equipment is now being developed by Ramo-Wooldridge for applications in modern U.S. Military aircraft



R-W is one of the major participants working with the Boeing Airplane Co. Systems Management Office on the U.S. Air Force Dyna-Soar project



New type of radar data processing system developed by R-W materially increases the capabilities of ground defense radar



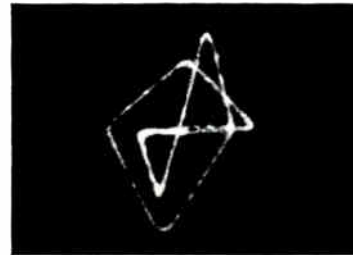
The RW-300 digital control computer has broad applications in automatic process control, data reduction and test facility operation



Systems are being developed for the ground processing and interpretation of photographic and other data collected by aerial reconnaissance devices



The Military and Ramo-Wooldridge are studying the use of automatic data processing techniques

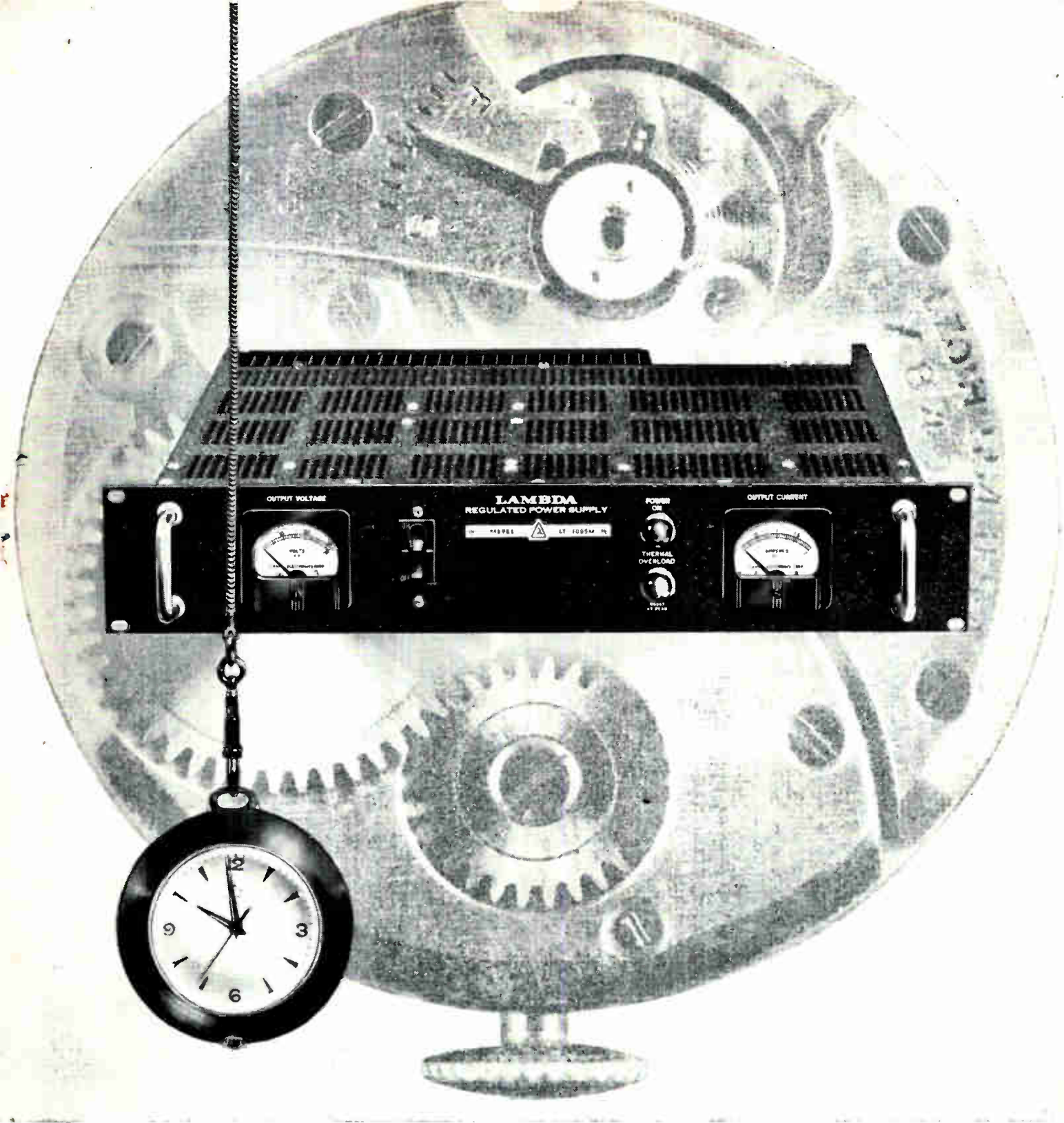


In research laboratory studies at Ramo-Wooldridge, electrically-charged particles are contained and supported in a vacuum by an alternating electric field



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BUSINESS AND A BLUEPRINT. Directly and indirectly the Air Force's Strategic Air Command is one of our industry's very best customers. What SAC plans today will have a direct and far-ranging effect on tomorrow's market.

To find out what SAC is up to electronically, Associate Editor Mason made a trip to the Command's underground headquarters near Omaha, Neb., by Air Force plane. His article, "SAC Prepares for Missiles," first of a three-part series, begins on p 30.

Mason has been following military electronics closely since he joined our staff late in 1956. He is especially well suited to the job. An Air Force navigator in World War II, Mason headed up an early Loran school. An alumnus of University of Mississippi and Mexico City College, he has traveled widely in Mexico, Spain, Germany and North Africa. His experience also includes a stint with the Voice of America.

NEWS SOURCES. We hear a lot these days about reporters and editors fighting to keep their news sources confidential.

Here's one extremely fruitful news source ELECTRONICS does not want to keep secret. It is the advertising pages in our own issues.

Like many other engineers and businessmen in our industry, ELECTRONICS editors follow these pages closely. We often find there tipoffs leading to top-notch engineering and business stories. Perhaps you too have noticed the newsyness of our advertising. It tells the "with what" in our business, complementing the "how to" given in our engineering and business articles.

EDITORIAL INDEX. If you are a typical reader, you can take the annual index, or leave it alone. Like a telephone book, its handy to have around, but it's hardly choice reading matter for a winter's evening.

Actually, getting the index together is a chore, but one that we do gladly to increase the permanent reference value of this magazine. It took Associate Editor Bushor, Mrs. Bushor and half a dozen full, part-time and casual girls better than six weeks to put together our 1958 index. The end product, as we shipped it to the printer, was a 2 x 1½ x 1-ft crate of 5 x 7 file cards, 4,500 cards all told.

For readers who may require additional copies of our editorial indexes: we still have some copies of our 1958, 1957 and 1956 indexes available at 10¢ a copy. We have a few copies of our 1955, 1954, 1953 and 1952 indexes, same price. In fact, we still have 67 copies of our 1930-to-1949 cumulative index at \$1 a copy.

Coming In Our February 20 Issue . . .

MICROWAVE HAZARDS. With average power output of radar, radio and countermeasures transmitting equipment continuing to increase, the hazards to humans from focused concentrations of r-f energy call for new and special precautions against possible biological damage. Within the last two years, massive research sponsored by the Defense Department has attempted to enlarge understanding of the biological effects of microwave exposure.

Next week, Associate Editor Leary describes the results emerging from this program. His article points up safety criteria to the electronics industry and indicates several paths for additional research.

PULSE POSITION DEMODULATOR. For a telemetry system to be useful, linearity must be of a high order, in the region of one percent or better. Linearity of the system must be preserved in the demodulator lest transmitted accuracy be negated.

L. Weisman and E. Teltscher of Ford Instrument Co., have devised a highly linear ten-channel demodulator made extremely compact by extensive use of solid-state components. Input circuit is a modified semiconductor diode AND gate.

F-M SOUND DETECTOR. Design of a transistorized television receiver requires an efficient, low-cost sound strip. Marvin Meth of CCNY's electrical engineering department discusses a unique oscillating linear-slope detector injection-locked by a one-stage audio amplifier. Device is highly sensitive, exhibits excellent a-m rejection.

TAKE YOUR CHOICE... of these two dependable wirewound resistors

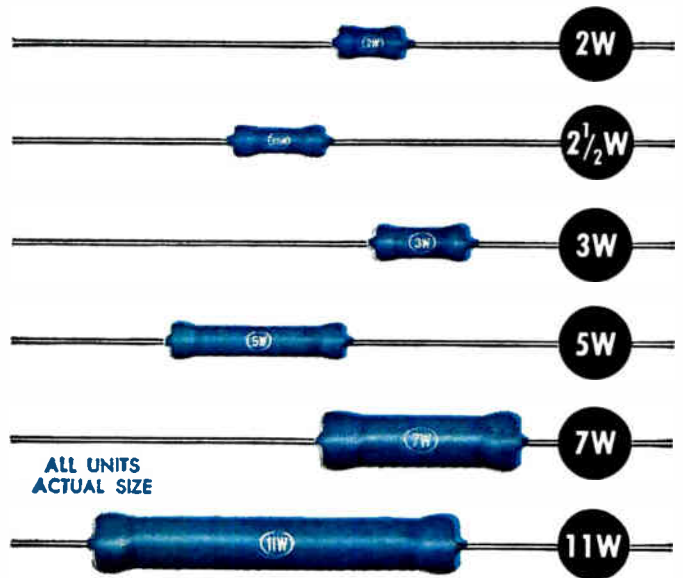
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VITREOUS-ENAMEL POWER RESISTORS

Sprague's new improved construction gives even greater reliability and higher wattage ratings to famous Blue Jacket miniature axial lead resistors.

A look at the small *actual sizes* illustrated, emphasizes how ideal they are for use in miniature electronic equipment with either conventional wiring or printed wiring boards.

Get complete data on these dependable minified resistors, write for **Engineering Bulletin 7410**.

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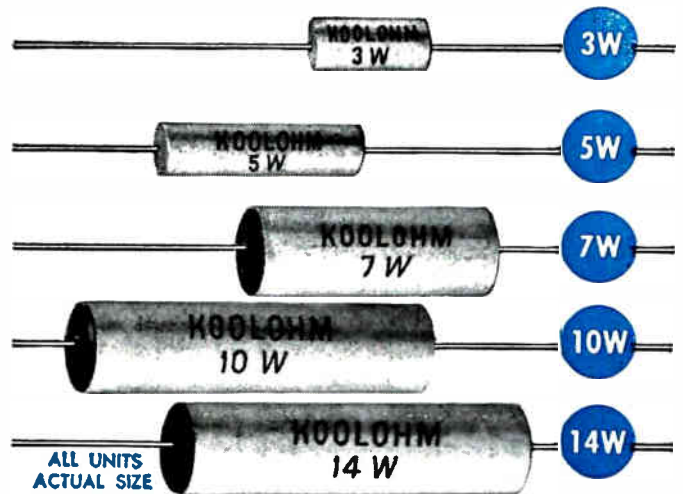


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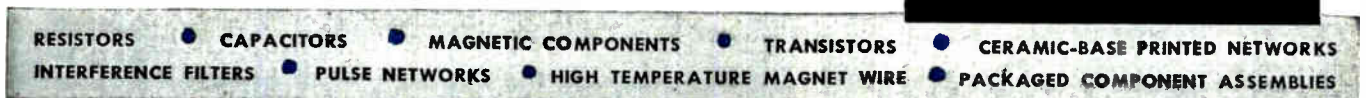
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Send for **Engineering Bulletin 7300** for complete technical data.

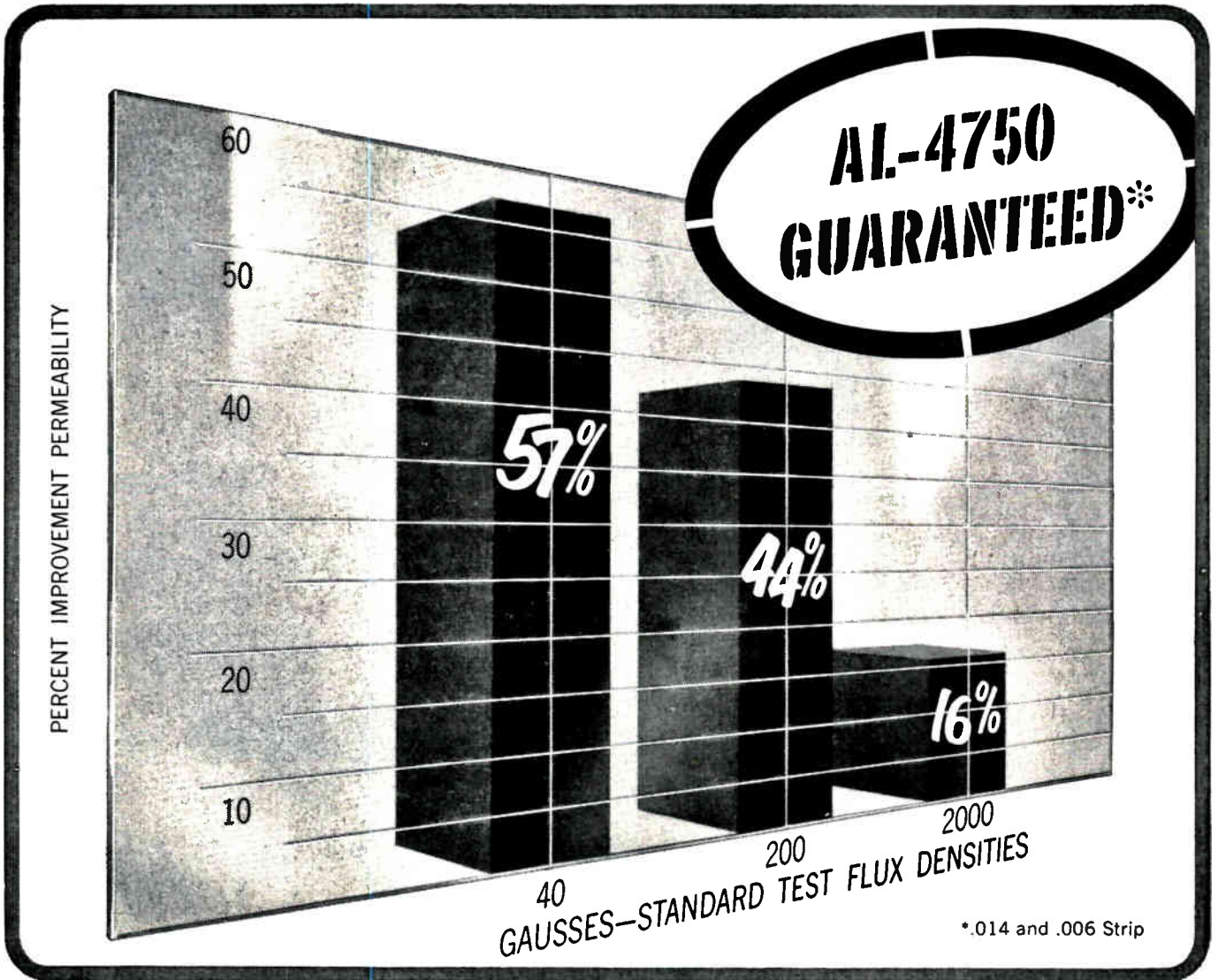


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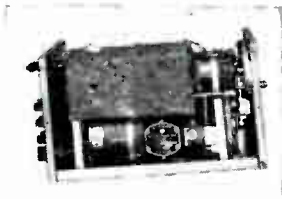
MISSILE PERFORMANCE

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HIGHER . . . Eastern electronic tube cooling units and systems permit avionic operation at altitudes which rule out air cooling. The cooling pack shown easily handles 1000 watts at altitudes to 60,000 ft.



FASTER . . . sustained supersonic speeds will call for advanced refrigeration-type cooling units for temperature control within close limits. This system, which relies on Coolanol 45, protects entire electronic systems.



FARTHER . . . miniaturized pump space and weight—extends missile range. This unit, an integral part of an APU system, helps provide hydraulic power to a cruise missile.



COOLER . . . much cooler electronic equipment, and new performance concepts—this is the promise of Coolanol 45. For the characteristics and applications of this new Monsanto product, write for Monsanto Technical Bulletin Number AV-3.

Smaller components pay off in higher performance . . . savings in inches and ounces add up to hundreds of additional miles per hour — or miles in range.

Eastern Industries' missile components and systems are miniaturized to meet the most rigorous requirements in space and weight. Through the use of Monsanto Coolanol* 45 and miniaturization concepts, Eastern now makes it possible to design more power, more performance into less and less volume and weight.

Avionic Cooling with Coolanol 45: This Monsanto-produced fluid is the answer to heat problems associated with miniaturized electronics . . . extends operations to altitudes where air cooling is impractical. Having a high boiling point, Coolanol 45 permits "hotter," smaller systems than with water cooling; low foaming tendency guards against circulation troubles. Heat transfer characteristics and dielectric properties of Coolanol 45 are excellent over its —65° to 400°F. temperature range.

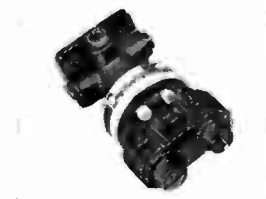
Hydraulic Pumps and Coolanol 45: Eastern puts Coolanol 45 to double use—as a hydraulic fluid as well as a coolant. The higher pump speeds possible (up to 24,000 rpm) mean more efficiency, result in smaller units for any given job . . . and prolonged pump life is the result of the fluid's excellent lubricity.

For deep forays into the thermal thicket — for problems in system redesign or miniaturization — for imaginative solutions — turn to Eastern Industries.

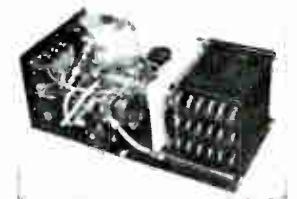
*Coolanol: Monsanto Trademark.



SMALLER . . . high operating speeds of this Eastern hydraulic power unit (to 24,000 rpm) results in modest dimensions and weight: 7³/₄" x 2¹/₂" x 7¹/₂", 4 pounds, 12 ounces.



LONGER . . . long life and reliability is typified in this Eastern high pressure hydraulic pump. Reliable performance under extreme environmental conditions is an Eastern tradition.



HOTTER . . . this unit protects electronic components of high performance aircraft from heat — delivers Monsanto Coolanol 45 coolant at 1.3 gpm flow rate and 60 psi pressure.



MORE . . . much more information on these and other accessories and systems is contained in this new complete brochure. It contains latest developments in hydraulic power, cooling and pressurization. Send for your free copy of Bulletin 360 today.



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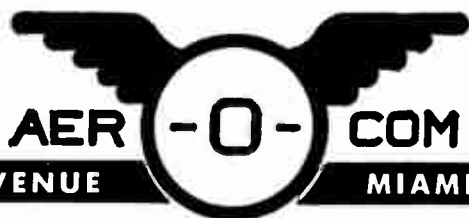


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ELECTRONICS NEWSLETTER

NUCLEAR THERMIONIC CONVERTER has produced electricity under gamma radiation conditions from a radioisotope in an eight-day experiment recently conducted by GE's atomic power equipment department. GE says demonstration showed the system has the potential to produce an extremely high ratio of power to weight for space vehicle auxiliary power use. Experiment simulated space conditions such as vacuum, temperatures from 800 F to 1,700 F, and gamma radiation. Gold strip was used as radioisotope. Firm says multihundred watt radioisotope thermionic converter could be developed in one to two years; for higher ranges, where small reactors might be substituted for radioisotopes as heat sources, GE adds, suitable systems could be developed in three to five years.

Ultrasonic gage that simplifies measurement of thousandths-of-an-inch variations in cylinder wall thickness is reported by General Motors for quality control of automotive engine castings.

HIGH-POWER SEARCH RADAR on Boston Hill in Andover, Mass., is believed ready to play an important role in ballistic missile defense experiments to be carried out by MIT's Lincoln Laboratory. Reflector is 120 ft wide, 30 ft high; rotatable antenna assembly weighs 50 tons. Ten-foot klystron was developed for transmitter output. Pulses lasting a few millionths of a second can be directed into space by antenna or, for test purposes, into dummy load. Special argon-filled tube protects highly sensitive receiver from pulse damage; gas ionizes when pulse strikes it and prevents all but one-millionth of the energy from passing to receiver.

Materials which have thus far received little attention for thermoelectric device applications are now under study at Battelle Memorial Institute. Two-year study is sponsored by 16 firms.

FLYING WEATHER LABORATORY described at Bendix Aviation symposium in Frankfurt, West Germany, will soon test a variety of electronic gear for USAF. Weather will be probed from 55,000 ft by (1) expendable dropsondes that transmit data back to the plane, a Boeing 707 jet transport, for recording, computing and relay to ground stations, and (2) by rockets that will rise nearly 10 miles before parachuting with their instruments. Also, C and K band radar will measure storm distance and clouds. All raw and processed data will go on magnetic tape for later ground computations.

EAGLE, Navy's long-range air-to-air fleet air defense and intercept missile, will use "new secret guidance devices." Sanders Associates, Nashua, N. H., says it will design and develop part of Eagle's guidance under subcontract to Bendix.

Soviet scientists are reportedly experimenting with electronic controls to boost cotton production. These include an automatic seed separator and a remotely controlled cotton picker.

TRANSISTORIZED COMPUTER for both business and scientific use features automatically controlled parallel processing of up to eight different jobs at once. Manufacturer, Minneapolis-Honeywell Regulator Co., making a bid for share of the medium-sized computer market, said such a unit would rent for about \$22,300 monthly, sell for about \$950,000; minimum system rents for about \$11,000, sells for \$500,000 to \$600,000.

ATRAN GUIDANCE built for USAF's surface-to-surface Mace missile has been used to fly a C-47 over hundreds of miles of prescribed courses in West Germany. Radar from the missile guidance system made by Goodyear Aircraft Corp. guided the plane; its position was checked against a previously unused synthetic film of the terrain. Firm says synthetic film can be made quickly from existing topographical maps for desired courses, permitting missiles or planes to be guided electronically.

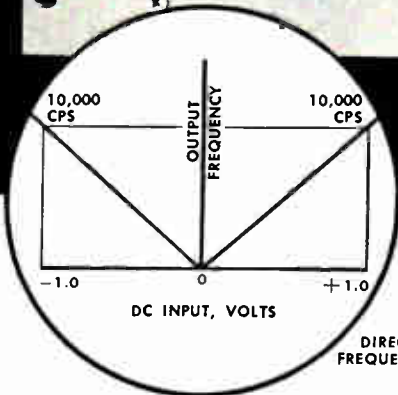
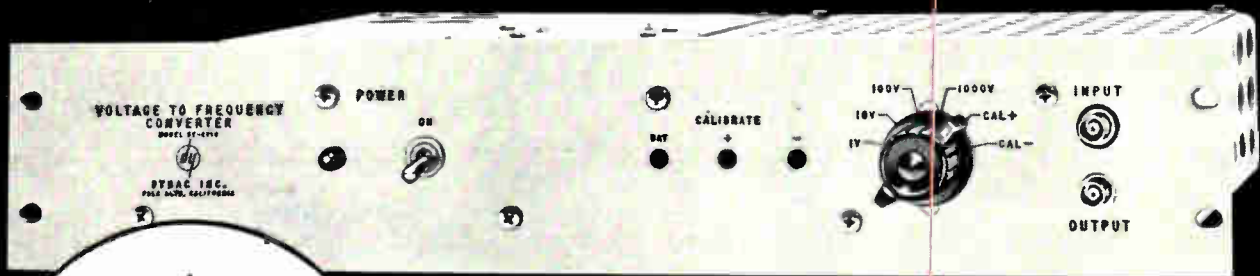
NEW CARD PROGRAMMED AUTOMATIC MILL installations show that the steel industry has accepted electronically controlled systems. That's the view of Westinghouse Electric's industrial control department. Firm reports that by the end of 1958 four of its systems were controlling steel or aluminum rolling in reversing hot mills, and that three more installations are near, including one in Japan.

NASA Administrator T. Keith Glennan says more than \$200 million has already been committed to the space vehicle systems that industry will be asked to develop and build.

COUNTERBATTERY RADAR and computer system is being considered for inclusion in Army equipment requirements. Emerson Electric Mfg. Co. and Litton Industries say they are competing as a team in a competition for such a system; Emerson Electric is working on radar and system integration, Litton on computer design.

NOW!

Use your electronic counter as an accurate digital voltmeter and integrator



New

Dymec Voltage-to-Frequency Converter

- Multiple input ranges, either polarity
- Inherent noise-averaging characteristics
- Output frequency 0 cps to 10 KC
- 1 megohm input impedance
- 0.1% accuracy
- Easily used in remote and automatic programming applications

CONDENSED SPECIFICATIONS

Input Voltage Ranges: 0 to 1, 10, 100 and 1,000 v dc; manual selection.
Input Impedance: 1 megohm, 200 μ f shunt, all ranges.
Input Polarity: Positive or negative. Polarity automatically sensed.
Output Frequency: Zero to 10,000 cps.
Accuracy: Within 0.1% full scale.
Calibration: Against internal mercury cell or external voltage standard.
Power: 115 v \pm 10%, 60 cps, 35 watts.
Dimensions: Cabinet model, 7 $\frac{1}{4}$ " wide, 11 $\frac{1}{4}$ " high, 10 $\frac{1}{4}$ " deep. Rack mount model, 19" wide, 3 $\frac{1}{2}$ " high, 10 $\frac{3}{4}$ " deep.
Price: \$650.00 (Rack) \$660.00 (Cabinet).
Data subject to change without notice. Prices f.o.b. factory.

See us at I. R. E. Booth 3019-3020.

Here is a compact new instrument which embodies a truly unique approach to the analog-to-digital conversion problem. You can now make accurate, dependable voltage measurements with your standard electronic counter, viewing results in direct, digital form on the counter. The instrument and its associated counter also serve as an electronic integrator permitting direct measurement of the time integral of dc voltages and other variables without time-consuming manual data reduction and analysis. These characteristics make the DY-2210 an ideal basic component for data handling systems.

The new DY-2210 converter generates output pulses at a rate proportional to the dc signal voltage. This renders the instrument virtually insensitive to noise, and makes possible average measurements of pulsating voltages and currents. The voltage measuring interval is determined by the associated counter. Either positive or negative voltages can be measured without reversing leads or switching.

Immediate shipment from stock. For complete details or demonstration see your Dymec representative or write direct for information.



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FAST! — up to 200 cps
SENSITIVE! low as ± 2.5 milliwatts

NEW CLARE Type HGS Mercury-Wetted Contact Relay

IDEALLY SUITED TO HIGH SPEED SWITCHING DEVICES

The Type HGS Relay is a new variety of CLARE Mercury-Wetted Contact Relay, developed to meet the needs of modern design engineers for faster and more sensitive relays. The HGS Relay is especially suited to all types of high-speed switching devices, over-voltage and overload protection devices and high-power chopper applications.

Operating speeds may be up to 200 cps or more. Sensitivity may be as low as ± 2.5 milliwatts for a bi-stable adjustment, as low as 5 milliwatts for a single-side-stable adjustment. Contact rating is 2 amperes, 500 volts, with a limit of 100 volt-amperes.

Supplements Clare HG and HGP Relays

The new CLARE Type HGS Relay will not supplant the revolutionary Types HG and HGP. It will supplement these relays in applications which require higher speed or greater sensitivity.

The Clare Type HGS is similar to the Types HG and HGP except that the HGS is always biased with permanent magnets. These are adjusted to single-side-stable or bi-stable operation.



Cutaway view of a CLARE Type HGS Relay. Mercury-wetted contact switch is sealed in glass and surrounded by the operating coil. Biasing magnets are attached to the upper ends of the side plates.

ELECTRICAL FEATURES

Long Life: Over one billion operations at rated load.

Operation Speed: Up to 200 cps with consistent performance. Higher if some variation is tolerable.

High Sensitivity: 5 milliwatts for single-side-stable adjustment; ± 2.5 milliwatts for bi-stable adjustments.

Stable Operation: 0.1 millisecond maximum operating time variation.

Freedom from Chatter: Absolutely NO CONTACT BOUNCE.

Low, Stable Contact Resistance: Initial contact resistance, 25 to 50 milliohms, does not vary by more than 1 or 2 milliohms during life of contacts.

Low Ratio Coil Inductance: Low inductance-to-resistance ratio of coil suits relay well for transistor-drive applications.

MECHANICAL FEATURES

Conveniences: Small, light-weight; plugs in like vacuum tube; completely protected from atmospheric conditions; contacts cannot wear, weld, stick or chatter; tamper-proof; requires no maintenance.

Durability: Easily withstands normal handling and transportation shocks.

Send for CLARE Sales Engineering Bulletin No. 125 for complete information on the new Type HGS Relay. Bulletins 120 and 122 describe HG and HGP Relays. Write: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 2700 Jane Street, Toronto 15. Cable Address: CLARELAY.

CLARE RELAYS

FIRST in the industrial field

for **PRECISION MEASUREMENTS**

from **50** to **10,500 MCS**

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100% Square Wave MODULATED RF SOURCES Offer High Amplitude and Frequency Stability



Model MS-6

Output Amplitude Independent of Load

Feedback circuit maintains constant incident power, allowing use of full generator output without power consuming impedance masking.

Amplitude Stability

After one hour warm-up and without feedback circuit: ± 0.1 db/hr. With regulator and external directional coupler, the incident power will change less than 0.2 db for a change in load of from 25 to 150 ohms. With a voltage probe, the voltage variation is reduced by 10:1 by feedback.

Model No.	Frequency MCS	Minimum Peak Power Output (100% Sq. Wave Modulated)
MS-1	50-250	80MW
MS-2	250-920	200MW
MS-3	900-2000	100MW
MS-4	2000-4200	60MW
MS-5	4000-7300	40MW
MS-6	7200-10,500	30MW

Write for complete specifications.

Weinschel Fixed Coaxial Attenuators cover the frequency range of DC to 12 KMC.

Write for complete catalog, specifying frequency range of interest.

Weinschel Engineering
KENSINGTON, MARYLAND

CIRCLE 11 READERS SERVICE CARD

WASHINGTON OUTLOOK

ELECTRONICS PRODUCERS can do nothing but gain from the current hassle over the Eisenhower defense budget.

The Democrats will keep hammering at our alleged ICBM lag behind the Soviets. They'll be getting support from some top Pentagon officials. Already, Roy Johnson, head of the Pentagon's Advanced Research Projects Agency, has said he could use at least \$300 million more than the \$445 million the president's budget allows him for next year. Similarly, the Air Force missile chief, Gen. Schriever, says he should have more money.

Eisenhower isn't likely to change his overall plan to hold down production of the liquid-propelled first-generation ICBM's—Convair's Atlas and Martin's Titan. But the Democrats will vote more money for these and other missile and space programs. Eisenhower then will probably expand his programs a notch or two.

At this moment, the ICBM program calls for about 20 squadrons of Atlases and Titans—around 200 missiles in all. Rough guess on the cost of these (excluding R&D): About \$2 billion. (The 1960 estimated spending is about \$4 billion for all missiles.)

More Titans and Atlases may be produced, depending on how quickly the solid-fueled, second-generation missile—the Minuteman—comes along.

- One area of electronic procurement is shaping up very big in the defense budget picture. That's spending for electronic countermeasures, early warning systems, antimissile missiles, decoy missiles to fool Soviet detection systems, reconnaissance satellites, and the like.

Here's a run-down on what's involved in this area:

BMEWS—Ballistic Missile Early Warning System—calls for gigantic radar stations in Alaska and Greenland, at a total cost of some \$800 million. A third station—in Scotland—may be added later.

Antimissile missile programs include Army's Nike-Zeus and Air Force electronic R&D that's very secret.

Basic research for advanced early warning techniques is being financed by ARPA. Again, it's highly secret lab research.

Being planned is a satellite whose orbit would make it hang over one spot on earth. Its infrared equipment would detect and report ballistic missile launchings. Again, it's still on paper.

The Quail, a decoy missile to be launched from a bomber distant from an enemy target, would look like a bomber on enemy radar.

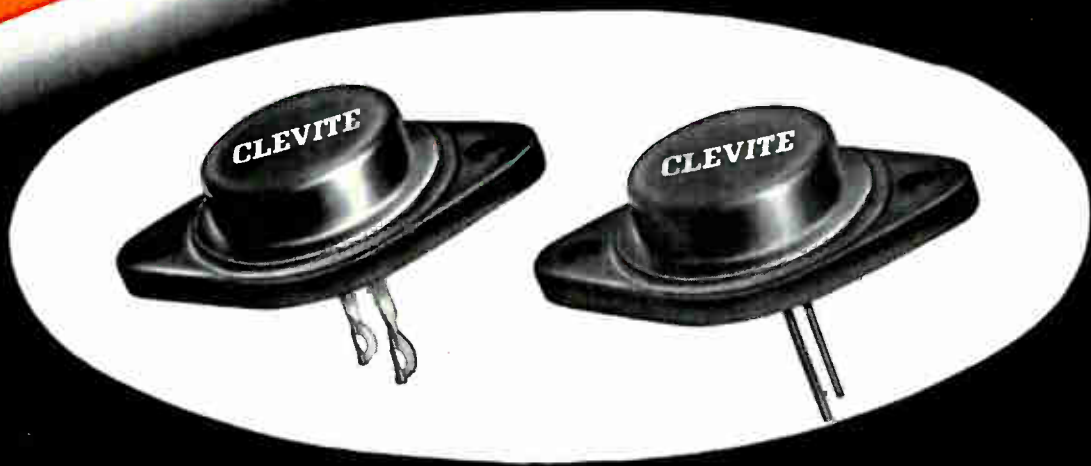
- First experimental stations of the military's multimillion dollar satellite detection system have started operating. The project—dubbed a Minitrack-Doploc fence—is aimed at detecting Soviet satellites that may be sent across the U.S. to ferret out military information.

All three military services are participating in the project under the Pentagon's Advanced Research Projects Agency (ARPA). The Naval Research Laboratory has responsibility for Minitrack stations on the east and west coasts. The Army's Ballistic Research Laboratory will set up Doploc stations—one is reportedly established in Oklahoma; the Air Force's Cambridge Research Center will be the computing and filtering center.

Eventually there will be "several" listening stations across the U.S. Details are highly classified. ARPA chief Roy Johnson, however, recently told a Congressional committee that construction of the listening posts was "essentially complete."

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HIGH POWER TRANSISTORS



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EIA REGISTERED TYPES WITH:

- Improved seal for long life.
- Saturation voltage less than 1 Volt at increased maximum rated current of 15 amperes.
- Average thermal resistance 0.7°C per watt.
- Current gain controls: 60-150 at 5 amperes.
- 100% test for resistance to transient burn out.
- Either standard pins or solder lugs.

TECHNICAL DATA

Typical Electrical Characteristics at 25°C

	2N1147 2N1146	2N1147A 2N1146A	2N1147B 2N1146B	2N1147C 2N1146C
Collector to Emitter Voltage Shorted Base (I _C = 1 amp)	30V (Min)	40V (Min)	60V (Min)	75V (Min)
Saturation Voltage (I _C = 15 amps)	1.0V (Max)	1.0V (Max)	1.0V (Max)	1.0V (Max)
DC Current Gain (I _C = 5 amps)	60-150	60-150	60-150	60-150
DC Current Gain (I _C = 15 amps)	35	35	35	35
Absolute Maximum Ratings				
Collector Current	15 amps	15 amps	15 amps	15 amps
Collector to Base Voltage	40V	60V	80V	100V
Collector to Emitter Voltage	40V	60V	80V	100V
Power Dissipation at 70°C	25W	25W	25W	25W
Case Temperature	95°C	95°C	95°C	95°C
Junction Temperature	95°C	95°C	95°C	95°C

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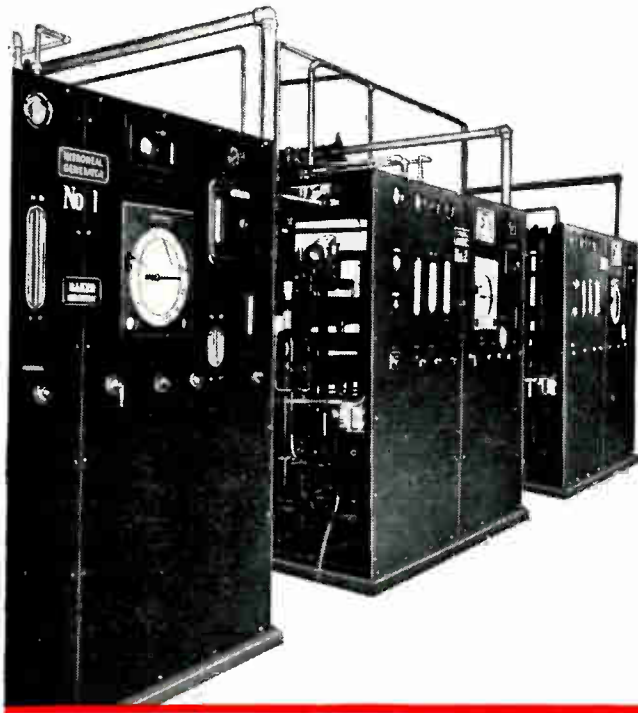
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The Nitroneal Generator is automatic except for startup, with no need for operating personnel. The unit performs instantly, efficiently anywhere in the range of from 25% to 100% of rated capacity. Installation requires only a 110 volt line, water, air, ammonia lines and drain facilities. Units can be supplied in capacities of 100 cfh to 10,000 cfh. . . . The catalyst lasts indefinitely—maintenance costs are practically nil. Write for complete catalog material and data.

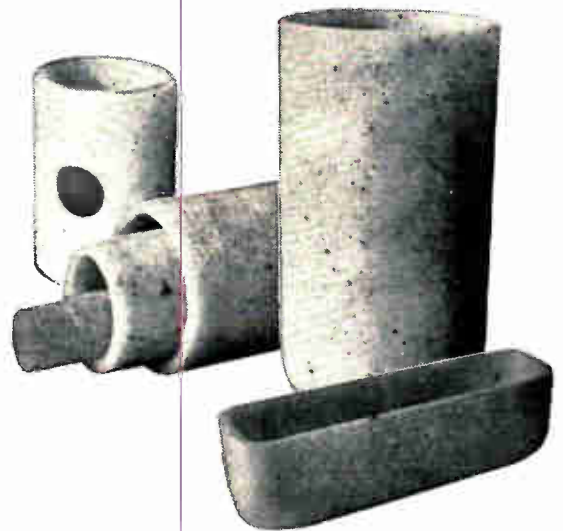
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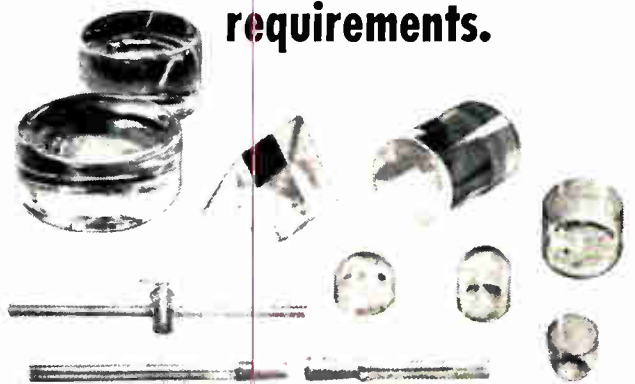
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a simplified mirror-bright silver plating process



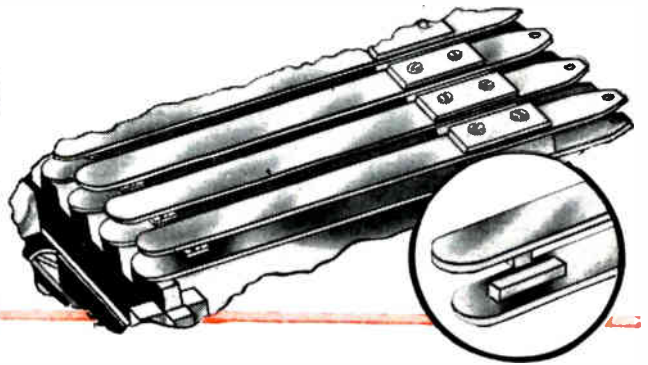
Here is the most efficient, simple procedure to protect electrical electronic and lamp components with a mirror-bright silver finish—through a complete range from flash to heavy deposit. The procedure is easy, economical and non-critical—with little or no polishing required. Silva-Brite is a clear, water-white solution, enabling the operator to observe work as it is being plated. Uniformly good results are attained with current densities ranging from 10 to 40 amperes per square foot. Normal room temperature operation minimizes fumes and tendency toward bath decomposition. Send for descriptive data together with detailed plating procedures.

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ECONOTAPE crossbar contacts are most efficient for electrical relays

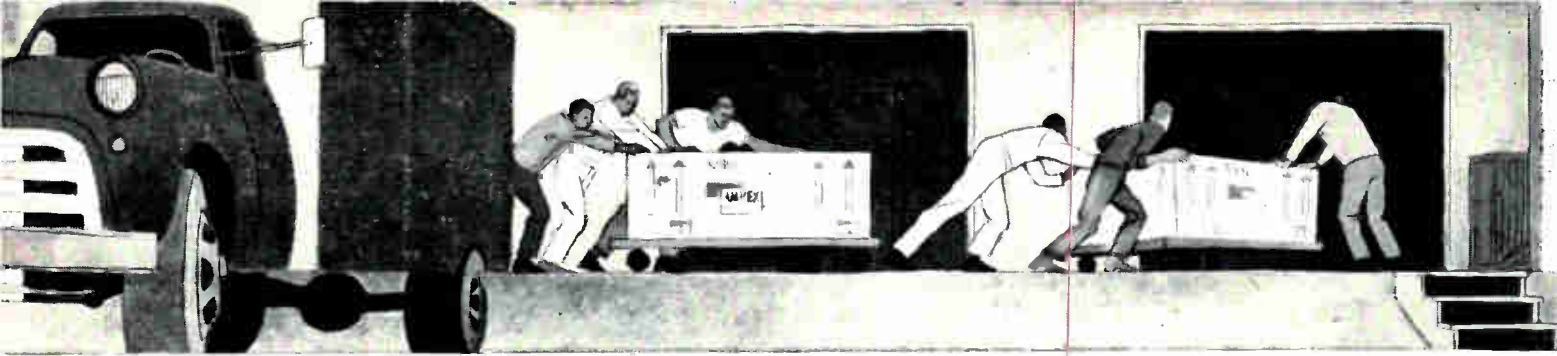
You can now get ideally efficient crossbar contacts for your electrical relays—with as many contacts as you need, where you need them—with positive assurance of full, contact surface. This has been made possible through the development of Makepeace's new ECONOTAPE, a precision-drawn shaped or rectangular contact wire in either solid precious metal or in laminated metal—in your choice of gold, platinum, palladium, silver and their various alloys.

Econotape crossbar contacts are supplied complete, attached to Makepeace blades . . . attached to blades supplied by you . . . or Econotape for your own attaching.

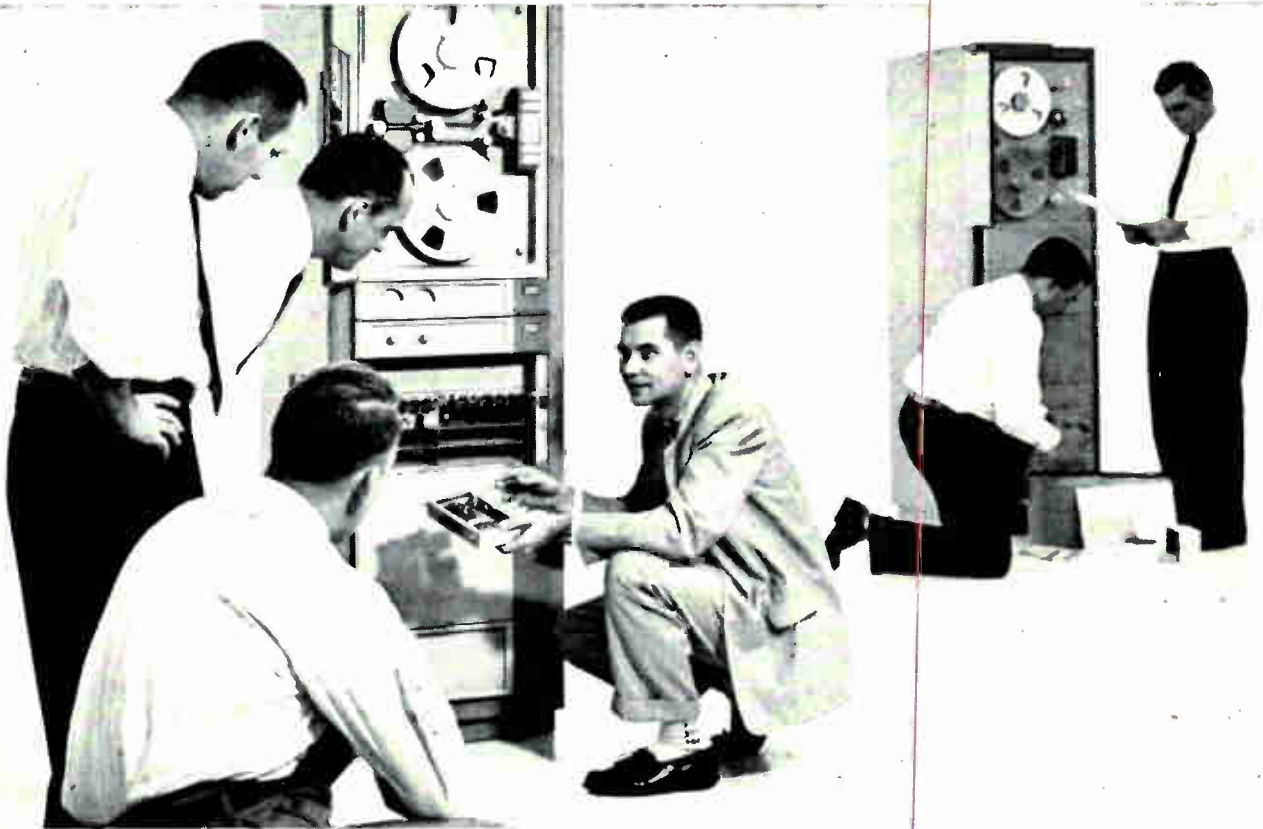
Econotape is cut off and welded to the blade in one operation. It is no longer necessary to handle and attach individual button type contacts. Positioning of Econotape on the blade is done automatically as the tape is cut off and welded. Permanent attachment is assured by a homogenous metallurgical bond that is undisturbed by expansion and contraction caused by temperature changes.

If you are designing a new relay or trying to cut the cost of your present mechanism, send for Econotape Crossbar Contact literature.

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Throughout your warranty period—and afterwards—Ampex Field Service is instantly available for modifications or *fast* replacements, avoiding costly down time.

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Available are Field Service programs ranging from scheduled preventive maintenance calls or time and materials contracts, to the services of a full-time resident Ampex engineer. With your purchase, an Ampex data specialist will discuss a service and spare-parts plan tailor-made to suit your magnetic tape instrumentation needs.

First in magnetic tape instrumentation



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CIRCLE 15 READERS SERVICE CARD

Firms Plan New Securities

NEW SECURITIES offerings by several electronics firms have been announced this month. In some issue plans, stock offerings are aimed at employee purchase programs, while others are intended for the open market.

• **Royal McBee Corp.**, Port Chester, N. Y., filed with the Securities and Exchange Commission on Jan. 6 a statement which seeks permission to register 94,726 shares of common stock to be offered under its employee stock option and savings plan.

• The following week, **Electro-Voice, Inc.**, Buchanan, Mich., filed a registration statement covering 150,000 shares of its capital stock for contemplated offering this month. Half of the stock will be sold publicly to augment the firm's working capital, and half will be offered to present stockholders. A prospectus for the offering states the stock earned \$1.04 a share for the firm in the nine-month period ended Nov. 30 last year.

• **Perkin-Elmer Corp.**, Norwalk, Conn., registered with SEC to offer 20,000 shares of common stock to employees pursuant to its employee stock purchase plan of 1959. P-E also plans to offer 49,875 common shares in its restricted stock option plan for key employees.

• A private stock transaction plan for future expansion has been announced by **Magnetic Research Corp.**, Hawthorne, Calif., manufacturer of specialized magnetic components and magnetic systems. The New York firm of **J. Barth & Co.**, New York Stock Exchange investment brokers, has purchased 2,500 shares of preferred stock and 24,250 shares of common stock. MRC statement says total consideration for the transaction exceeds \$½ million.

• **Smith-Corona Marchant Inc.**, owner of **Kleinschmidt Laboratories**, Deerfield, Ill., has filed registration of \$7,443,100 of converti-

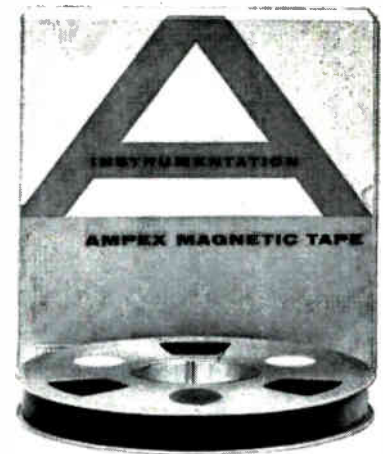
ble subordinated debentures due in 20 years. The company proposes to offer the bonds for subscription by its common stockholders. Basis will be \$100 in bonds for each 25 common shares.

• **Avco Manufacturing Corp.**, Cincinnati, plans to offer common stockholders subscription rights to \$15 million in convertible subordinated debentures at the rate of \$100 for each 64 shares of common stock.

OVER THE COUNTER

1958 LOW	BIDS HIGH	COMMON STOCKS	WEEK ENDING	
			Jan. 23 BID	Jan. 30 BID ASKED
33¼	20½	Acoustica Assocs	20	20¾ 28¼
15%	3	Advance Industries	3½	3¾ 4¾
3½	6½	Aerovox	6½	7½ 9
20½	33	Amer Res & Dev	37½	37¾ 40
16¾	24¼	AMP Inc	23¼	23¼ 26¾
5½	15	Appl'd Sci Princet	9¼	9 10½
1½	8½	Avien, A	10¾	9¾ 11¼
6¾	24	Baird-Atomic	26¾	25¼ 28½
9¾	13¾	Burndy	14¾	14 15¾
6¾	9	Cohu Electronics	6¾	7¼ 7½
11	22½	Collins Radio, A	25¼	23 27¾
10¼	22¼	Collins Radio, B	25¼	23 28
4	7	Craig Systems	6¾	7½ 8½
30	50½	Dictaphone	48	47½ 51½
17½	25¾	Eastern Industries	20½	20¼ 22¾
10½	21	Electro Instr	26¼	24¼ 28¼
34	49	Electronic Assocs	51	48 55
5	11	Electronic Res'rch	12¼	12 13¾
8½	12¾	Electronic Spec Co	14½	13 15
15¼	49½	Epsco, Inc	41	40½ 48¼
5½	9¾	Eric Resistor	10¾	10½ 12
10	17½	Fischer & Porter	16	15½ 17¾
36¾	50	Foxboro	49½	49 53½
5½	10½	G-L Electronics	11¼	13½ 15¾
12	27	Giannini	31	28 33½
23¼	48	Hewlett-Packard	42½	40½ 45½
13¼	3	High Voltage Eng	57	54 62
1½	5½	Hycon Mfg	3¾	3¾ 3¾
1½	4¾	Industro Trans'tor	2¾	2¾ 3¾
21	30	Jerrold	4½	4¾ 5¼
3¾	29	D. S. Kennedy	33¼	32½ 41¾
19¼	28	Lab For El'tronics	23¾	25¼ 28¾
2	3½	Leeds & Northrup	29½	30¼ 33½
16	18¾	Leetronics	2	2 2½
3½	20½	Ling Electronics	10¾	18½ 20
27½	4½	Machlett Labs	21¾	24½ 29¾
4¾	12	Magnetic Amplifiers	8	7¾ 8¼
10½	29	Magnetics, Inc	3¾	3¾ 4
5¼	11¾	W. L. Maxson	13½	13¾ 15¾
1½	7	Microwave Assocs	34	33½ 37¾
3½	7¼	Midwestern Instr	13¼	12¾ 14¼
9¾	16	Monogram Preci'sn	8¼	8½ 9¼
14¼	56	Narda Microwave	6½	7¼ 8½
14½	29¾	National Company	18¼	18½ 21¾
4½	7¾	Nuclear Chicago	30½	28½ 33
10½	27½	Orradio Industries	28¾	29 32½
4¼	9¾	Pacific Mercury, A	9¼	9¼ 10½
21	53¾	Packard-Bell	30½	31 36¾
11¾	19½	Panelit, Inc	6¾	6¾ 7½
2½	7¾	Perkin-Elmer	52¾	47 54¾
13	32½	Radiation, A	17¾	18 22
7	12	Reeves Soundcraft	7½	7½ 8½
22¾	40	Sanders Associates	33	32 35¾
26	35	SoundScriber	15	18 21
5½	15	Sprague Electric	41¾	41½ 45¾
5½	15¾	Taylor Instruments	34½	33 36¾
3¼	7¾	Technical Operat'ns	16¼	16¾ 19¾
1½	2¾	Telechrome Mfg	16	18 21½
8¾	16¼	Telecomputing	8½	8¼ 9
3¾	10¾	Tel-Instrument	2¾	2¾ 3½
14¼	40	Topp Industries	14¾	14¼ 16½
12½	18½	Tracerlab	12¼	11¼ 13¾
		Universal Trans'tor	2½	1 2½
		Varian Associates	50	42 53
		Vitro Corp. Amer	16¼	16¾ 18½

The above "bid" and "asked" prices prepared by the NATIONAL ASSOCIATION OF SECURITIES DEALERS, INC., do not represent actual transactions. They are a guide to the range within which these securities could have been sold (the "BID" price) or bought (the "ASKED" price) during preceding week.



why AMPEX squares the hysteresis loop

Ampex Instrumentation Tape inherits the same versatility and quality which make Ampex first in magnetic tape instrumentation.

Coercivity and retentivity are carefully balanced to square the hysteresis loop for uniformly higher output over the entire frequency spectrum. This optimized B-H curve suits Ampex tape to any recording mode: direct, FM-carrier, PDM or NRZ-digital.

The exclusive Ferro-Sheen process makes Ampex the smoothest of magnetic tapes. Improved head contact means consistently higher output and less noise from the very first run, unlike other tapes which get "hotter" as they wear smooth.

Smoothness means uniformity of output, too, within a range of 0.25 db on each reel for low frequencies, a 1.5 db range for the highs. And regardless of base type or thickness, Ampex tapes are interchangeable without equalization or bias adjustment.

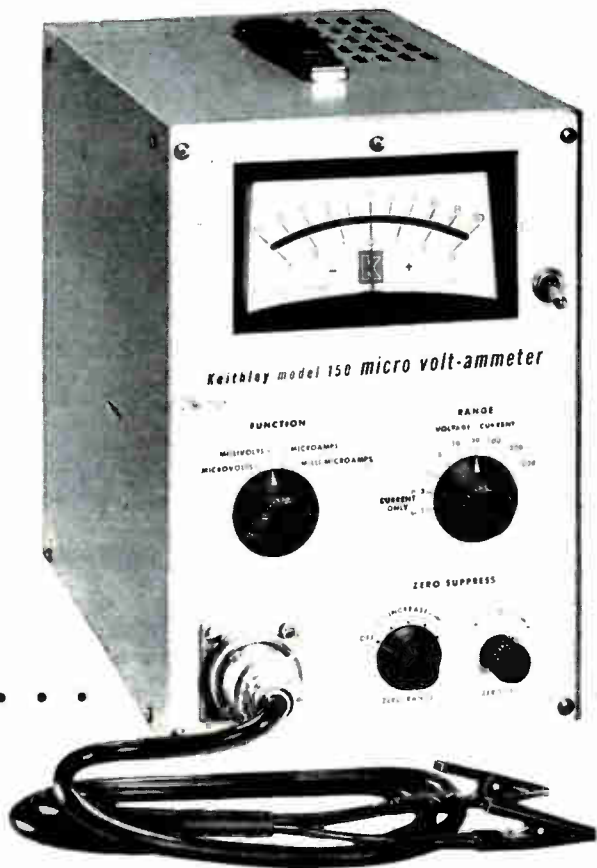
Ampex Instrumentation and General-Purpose Tapes are available on hubs, NAB-type or die-cast magnesium-alloy Precision Reels. Widths of ¼, ½ and 1" are standard on either Mylar* or acetate base, in the following lengths, reel diameters, and base thicknesses:

REEL DIAMETER	BASE THICKNESS (mills)	LENGTH (feet)
7"	1.0	1800
	1.5	1250
	1.5	2500
10½"	1.0	3600
14"	1.0	7200
14"	1.5	5000

* DU PONT TRADEMARK
For complete specifications or additional tape literature, write

AMPEX MAGNETIC TAPE

934 CHARTER STREET, REOWOOD CITY, CALIF.



KEITHLEY MODEL 150 MICRO VOLT-AMMETER

MEASURES
DOWN TO

0.03 μ v

AND 2×10^{-12} AMPERE

The Keithley 150 sets new standards in sensitivity, stability and noise figure for dc micro-voltmeters. It also serves as an amplifier, null detector, micro-microammeter, and (with an external voltage supply) meg-megohmmeter. Functions and measurement spans include:

- DC Voltmeter, 1 microvolt to 1 volt full scale**
- Ammeter, 10^{-10} to 10^{-3} ampere full scale**
- DC Amplifier, gains of 10 to 10,000,000**
- Null Detector, with 0.5 to 2 second period.**

OTHER FEATURES of the 150 include zero suppression of up to 100 times full scale; optional floating or grounded input; high input resistance; zero stability as a voltmeter within ± 0.1 microvolt per day, and within $\pm 2 \times 10^{-11}$

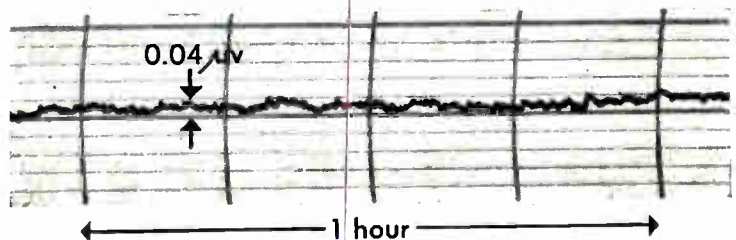
ampere per day as an ammeter; short term noise within 0.03 microvolt peak to peak (0.006 microvolt RMS). The 150 is rugged, relatively insensitive to vibration, 60-cycle fields, or thermal EMF's. It is available in either rack or cabinet packaging.

USES of the 150 encompass nearly every branch of research and engineering. Examples include measuring the outputs from strain gages, thermopiles, thermocouples, bolometers, phototubes, ionization chambers, scintillation counters, and barrier layer cells. Other applications are found in cell studies, electrochemical potentials, corrosion work, molecular-weight analysis, Hall effect studies.

DETAILED DATA about the 150 Micro Volt-ammeter are now available in Keithley Engineering Notes, Vol. 7 No 1. A request will bring your copy promptly.

BRIEF SPECIFICATIONS

- dc voltage:** 13 ranges in 1X and 3X steps from ± 1 microvolt to ± 1 volt full scale.
- current:** 17 ranges in 1X and 3X steps from $\pm 10^{-10}$ to $\pm 10^{-3}$ ampere full scale.
- zero stability:** within 0.1 microvolt per day, or 2×10^{-11} ampere per day.
- noise:** less than 0.006 microvolt RMS as a voltmeter; less than 2×10^{-12} ampere as an ammeter.
- accuracy:** voltage, $\pm 2\%$ of full scale on all ranges; current, $\pm 3\%$ on all ranges.
- zero suppression:** up to 100 times full scale.
- response speed:** 0.5 to 2 seconds.
- gain:** 10,000,000 maximum.
- output:** ± 10 v and 5 ma for full scale deflections.
- price:** \$675.00

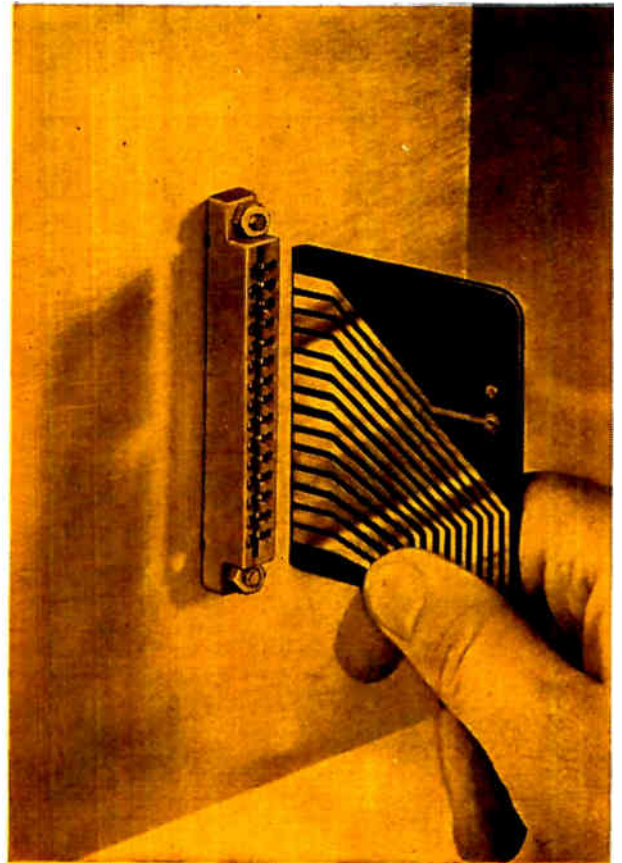
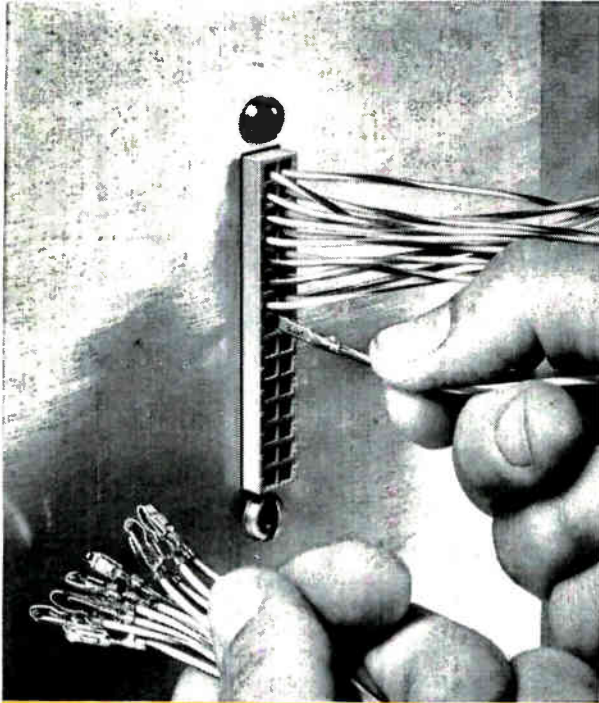


Long-term drift of the Model 150 is shown in the above recording. A 1000-ohm resistance was connected across the input. Note the very low peak to peak noise, even at this slow paper speed.



KEITHLEY INSTRUMENTS, INC.

12415 EUCLID AVENUE CLEVELAND 6, OHIO



SNAP IN

CLIP IN

THE NEW **AMP** PRINTED CIRCUIT EDGE CONNECTOR

This A-MP unit is more than new—it is the only *solderless, direct-contact* connector on the market. Designed for both commercial and military requirements, it means faster assembly, greater reliability and versatility to you—at lower cost!

You get construction of unmatched close tolerances in both the contact and the one-piece molded housing. And—because each contact is wholly enclosed within its own housing barriers, there's no need for post insulation. Contacts feature spring-lock design which assures positive contact with board—yet will not cause damage to board paths, even after repeated insertions.

Assembly is easy: An A-MP high speed machine crimps contacts to circuit wires. Contacts are quickly and completely snapped into housing, locked in place with a lance to eliminate damage from shorts, bending or strain. The printed circuit board is then inserted for unlimited circuit combinations.

Snap in . . . clip in—it's that simple to save time, money and increase quality.

Send for full product information today.

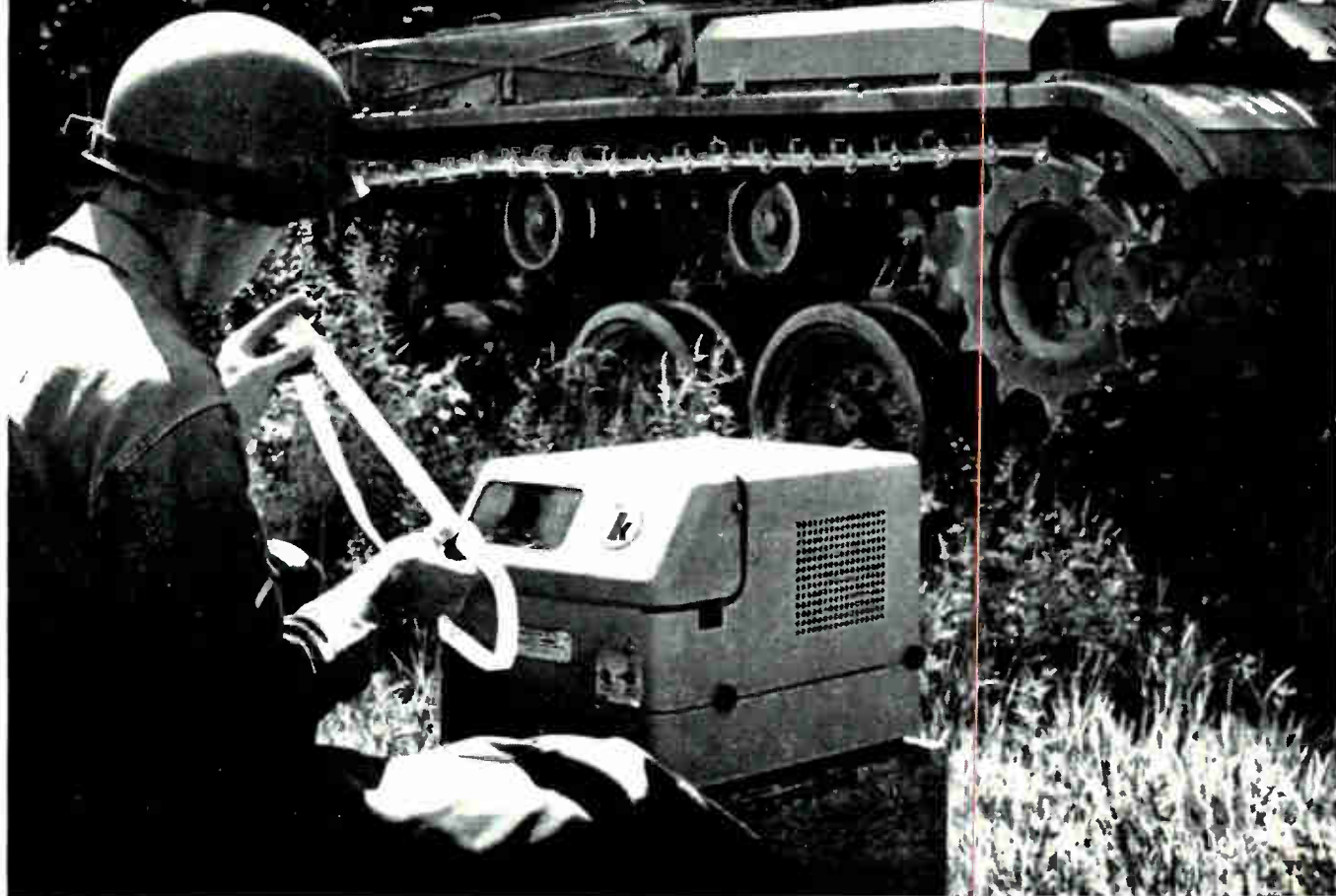
AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Canada • England • France • Holland • Japan

TANK TACTICS

on teletypewriter tape

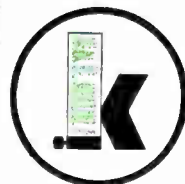


Capable of reception at speeds of 750 words a minute, new Kleinschmidt unit is world's fastest message printer and code puncher

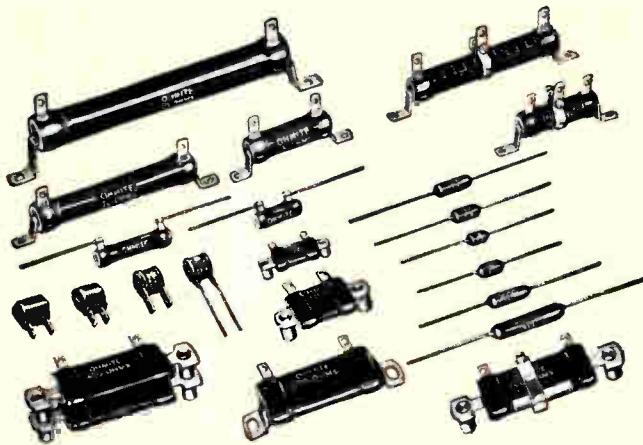
A major breakthrough in mechanical printing! Developed in cooperation with the U.S. Army Signal Corps, this new super-speed teletypewriter is ten times faster than "standard" equipment, five times faster than normal conversation. In future commercial use it could speed operations such as the

transmission of telegrams, stock market quotations, and weather reports. It has important applications in the field of integrated data processing. In recognition of its quality, Kleinschmidt equipment is manufactured for the U.S. Army under the Reduced Inspection Quality Assurance Plan.

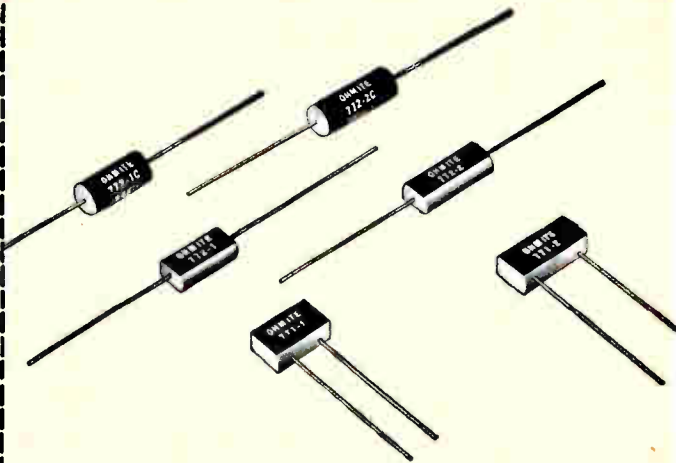
KLEINSCHMIDT



DIVISION OF SMITH-CORONA MERCHANT INC., DEERFIELD, ILLINOIS
Pioneer in teleprinted communications systems and equipment since 1911



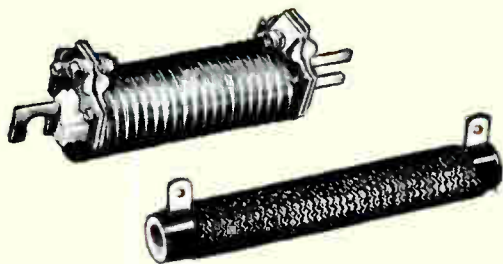
VITREOUS-ENAMELED RESISTORS Tremendous variety of types and sizes. Fixed, adjustable, tapped, noninductive, thin, and precision resistors available in a wide range of wattages and resistances. Also available to meet MIL-R-26C requirements.



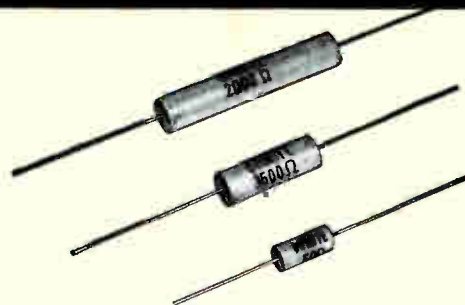
METAL FILM RESISTORS Riteohm® metal film precision resistors feature full ¼-watt rating at 150°C ambient; excellent high frequency characteristics; low temperature coefficient of resistance. Long-term load and shelf stability.

OHMITE® INDUSTRY'S MOST COMPLETE LINE OF QUALITY

WIRE-WOUND RESISTORS



POWER RESISTORS Power-type resistors for high-current, low-resistance applications. Vitreous-enameled, edge-wound, corrugated ribbon Corrib® units and open-type, edge-wound ribbon or round-wire Powr-Rib® units handle a wide range of power resistor needs. Available in fixed or adjustable "DIVIDOHM®" types.



MOLDED PRECISION WIRE-WOUND POWER RESISTORS Insulated units with Silicone-Type molded covering. Available in 3-, 5-, and 10-watt sizes. Tolerances: 0.1%, 0.25%, 0.5%, 1%, and 3%. Maximum resistance: 3-watt, 10,000 ohms; 5-watt, 25,000 ohms; 10-watt, 50,000 ohms.

OHMITE HAS EXACTLY THE RESISTOR YOU NEED

Ohmite offers the most complete line of high quality resistors on the market . . . fixed, adjustable, tapped, noninductive, and precision resistors in many sizes and types of terminals . . . in a wide range of wattages and resistances. All-welded construction. Ohmite application engineers will be pleased to help you in selecting the resistors for your job.

Write on company letterhead for Catalog 58.

NONINDUCTIVE

Tubular vitreous-enameled resistors with special winding. Dummy antennas consist of assemblies of several resistors. Watts, 5 to 1000; ohms, 1 to 5000.

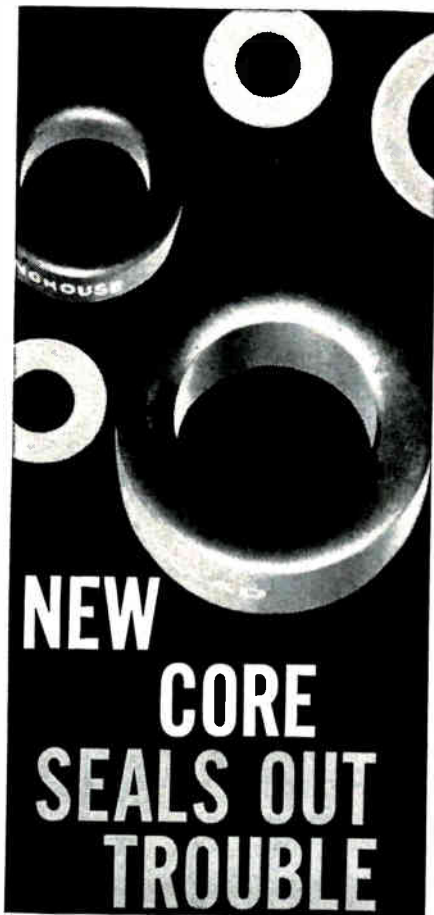
SPECIAL VARIETIES

Ohmite can provide toroids, flat strips, plaques, special-sized tubes, or tubes with mixed terminals, etc. Watt ratings and resistances available as required.

OHMITE® Manufacturing Company
QUALITY COMPONENTS

3610 Howard Street
Skokie, Illinois

RHEOSTATS RESISTORS RELAYS TAP SWITCHES TANTALUM CAPACITORS
R. F. CHOKES VARIABLE TRANSFORMERS DIODES



The Westinghouse hermetically sealed, Polyclad Hipermag core is the newest development in cores for magnetic amplifier applications. Applied over a new specially designed aluminum box housing the core, Polyclad insulation hermetically seals the core and allows encapsulating, casting or impregnating without altering magnetic properties. This special core:

- Stops magnetic amplifier rejects caused by changed magnetic values.
- Is suitable for all environmental conditions — high temperatures, humidity and high-voltage stress.
- Eliminates costly core taping.
- Is tested by Roberts constant-current, flux reset technique, or to your specification.

Available in production lots with normal delivery, these cores are supplied in special sizes or in standard AIEE sizes.

For more information about these or other Hipermag or Hipersil® cores, call your Westinghouse representative . . . or write Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pennsylvania. J-70855

YOU CAN BE SURE...IF IT'S

Westinghouse

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CBS TV MONDAYS

CIRCLE 21 READERS SERVICE CARD

MARKET RESEARCH

Test Chamber Gear Sales Up

ENVIRONMENTAL TEST EQUIPMENT sales are expected to benefit from today's drive to conquer space. Such equipment pretests electronic and other equipment by exposing it to environmental conditions it will encounter in use. Present annual sales are roughly about \$10 to \$20 million, says Monroe Seligman, president of **Tenney Engineering**, one of the largest manufacturers in the field.

Annual sales are expected to reach somewhere between \$50 and \$100 million in the next five years. Cost of electronic gear used with environmental test chambers is believed to presently average 10 percent; range is from five to 20 percent. Percentage of electronic equipment is on the way up.

• Bankers have cleared the decks for sale of electronic check-sorting equipment to nation's 14,000 commercial banks. Committee of the **American Bankers Association** has made the final decision needed for establishment of a compatible magnetic character check-sorting system. Bankers are expected to buy about \$200 million of electronic sorting equipment in coming years.

Manufacturers will deliver some sorting equipment this year, a lot next year. Computer and other electronic equipment sales are also expected to increase. Some estimate commercial bank market for all electronic equipment in next 10 years at \$1 billion. Most of the well-known manufacturers of electronic office equipment have been working with banks on problem of developing sorting and related equipment for number of years. However, because production until recently has been limited to prototypes, there may still be considerable opportunities for component and sub-assembly manufacturers.

• **Raytheon** is aiming for a big expansion of its commercial products business. Commercial products division has been split into two parts: one concentrating on

systems, other on components and equipment. Plans are to build commercial sales by adding to sales of old products; by developing new ones; through acquisition of some firms and through arrangements to market products made by other manufacturers.

• **Consolidated Electroynamics Corp.** institutes price increases averaging five percent on standard lines of data-processing, magnetic tape, transducer, analytical and control and high vacuum equipment.

• **Baldwin - Lima - Hamilton's Electronics & Instrumentation Division** announces that national distribution of its SR-4R strain gages will be transferred from local corporation sales offices to industrial sales representatives. Move was made to obtain better overall national sales coverage and give better service to customers. Unusual feature of the new distribution plan is that each of the reps selected will maintain a complete stock of standard strain gages in at least one location in his territory, company claims.

• **Bureau of the Census, U.S. Department of Commerce**, starts mailing its questionnaires for its Censuses of Manufactures, Mineral Industries and Business. Last similar Census Dept. enumeration was conducted in 1955 when the census covered 1954 activities. Electronic processing equipment will be used to process results. Preliminary reports will be released in the fall and winter of this year.

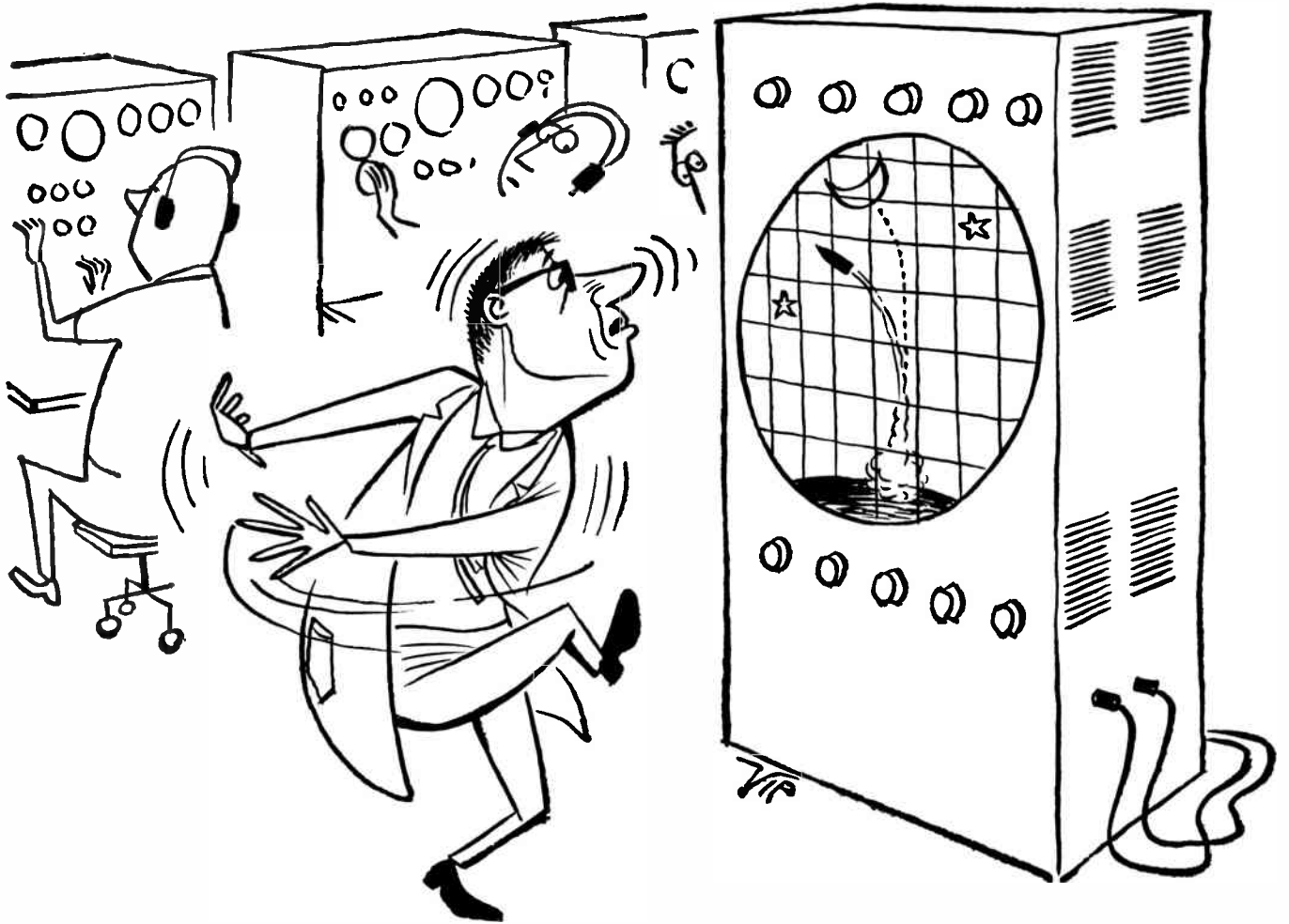
FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

(Source: EIA)	Jan. 23, 1959	Dec. 26, 1958	Change From One Year Ago
Television sets	112,762	55,804	+9.0%
Radio sets (ex. auto)	293,721	206,932	+26.1%
Auto sets	108,359	88,112	+35.4%

STOCK PRICE AVERAGES

(Standard & Poor's)	Jan. 28, 1959	Dec. 30, 1958	Change From One Year Ago
Electronics mfrs.	73.04	74.37	+34.1%
Radio & tv mfrs.	79.08	81.07	+71.4%
Broadcasters	81.24	79.88	+37.5%



Missile Guidance—*Body English*

Contortions of the human body have not, as yet, proven themselves acceptable means for overcoming component failures in missile guidance systems. While you may be able to "will" a golf ball into a cup, no one has ever "willed" a missile back on course. We at Hughes Products feel that missile component reliability can take a more scientific form. The tight quality control procedures at Hughes Products insure you component reliability that can be counted upon, even under the most severe environmental conditions.

On the following three pages you will find specific examples of reliable Hughes Products components—Gold Bonded Germanium Diodes,

TONOTRON* storage tubes, and High Frequency Crystal Filters.

In addition to these, other Hughes Products devices which provide you with this "built-in" reliability include: Special-purpose oscilloscopes...Rotary Switches...Thermal Relays...MEMOTRON® and TYPOTRON® display storage tubes...Diodes, Transistors and Rectifiers with uniform performance...and Industrial Systems which automate a complete and integrated line of machine tools.

*Trademark of H.A.C.

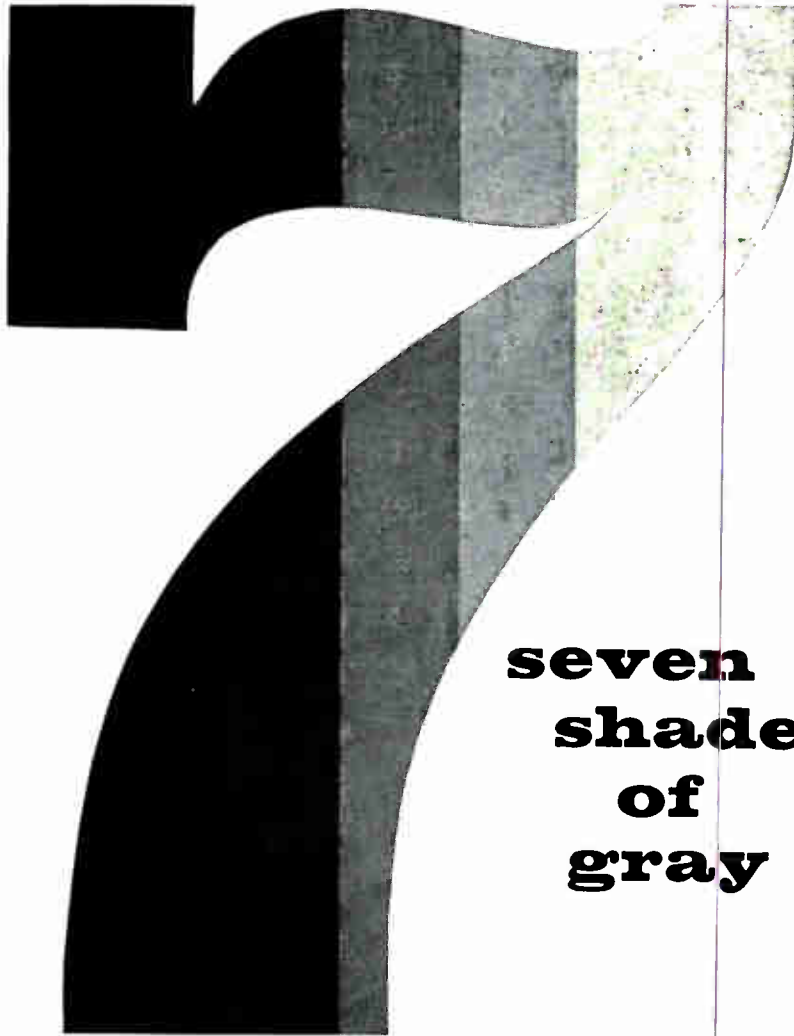
For additional information regarding any component or system please write: Hughes Products, Marketing Dept., International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

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SEMICONDUCTOR DEVICES • STORAGE AND MICROWAVE TUBES • CRYSTAL FILTERS • OSCILLOSCOPES • RELAYS • SWITCHES • INDUSTRIAL CONTROL SYSTEMS



seven shades of gray

with the Hughes TONOTRON* Storage Tube

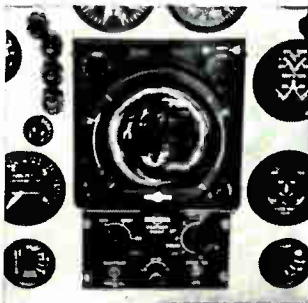
Able to present as many as seven shades of gray, the Hughes TONOTRON* cathode-ray storage tube now provides you with high-fidelity picture reproduction.

In addition, the Hughes TONOTRON* tube features high picture brightness (in excess of 1500 foot lamberts with full half-tone range) and controllable persistence.



Other Hughes electron tubes include the MEMOTRON® storage tube, the TYPOTRON® storage tube, and a family of microwave tubes. With a wide variety of reliable tubes designed to meet your strictest requirements, Hughes continues to maintain leadership in the field of storage and microwave tubes.

Collins Airborne Weather Radar System WP-101 incorporates the Hughes Type 7033 Magnetic Deflection TONOTRON* tube. This system provides the pilot with a continuous high-fidelity picture of weather conditions within a radius of 150 miles. Ground mapping — a secondary function — shows the location of cities, lakes, rivers, mountains, and shorelines, and dangerous obstacles. *Even in direct sunlight, no viewing hood is required.*



Typical installation in a commercial aircraft.

For additional information regarding any of the Hughes electron tubes please write: Hughes Products, Marketing Dept.—ELECTRON TUBES, International Airport Station, Los Angeles 45, California.

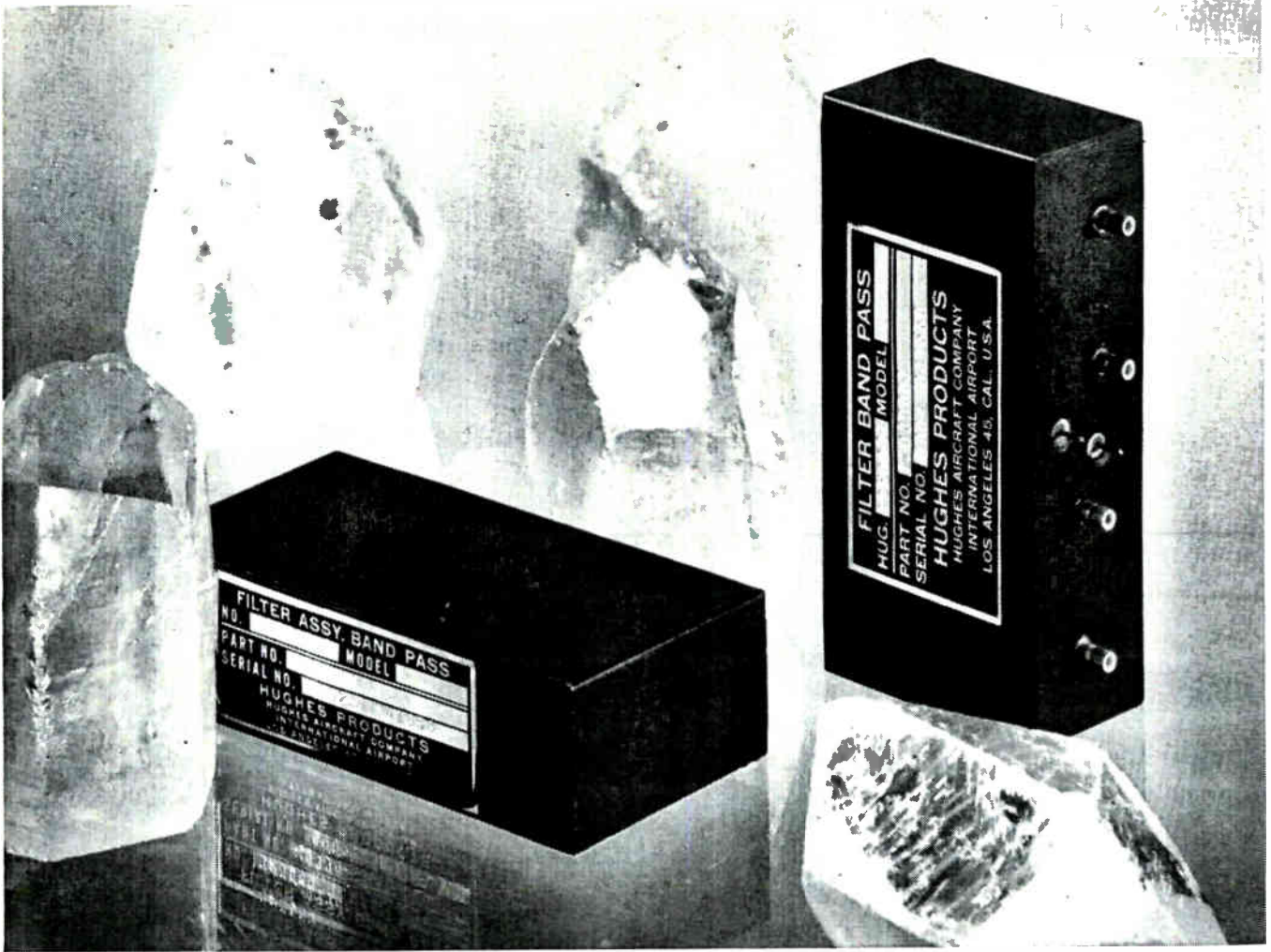
*TRADE-MARK OF H. A. C.

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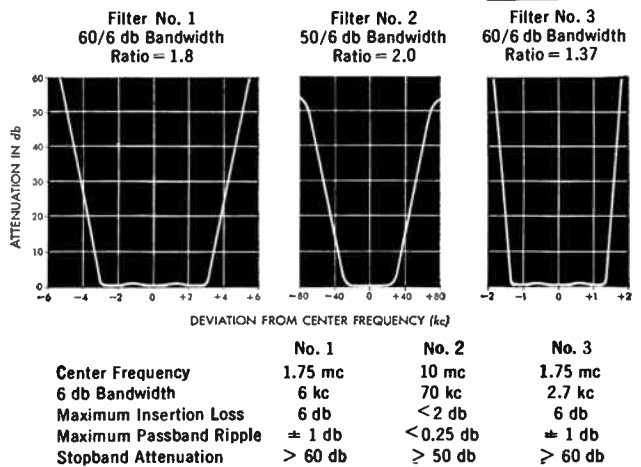
precision performance levels set by Hughes Crystal Filters

Hughes Products now offers high performance crystal filters previously available only for special military developmental contracts and Hughes-built systems. Utilizing unique design and advanced manufacturing techniques, these Hughes crystal filters provide a degree of performance previously unattainable.

With center frequencies of 30 kc to 30 mc and fractional bandwidths of 0.01% to 6%, these crystal filters have seven distinct advantages:

1. High frequency filtering
2. High selectivity
3. Low passband ripple
4. Low insertion loss
5. Small size and weight
6. Excellent temperature stability
7. Excellent shock and vibration stability

SPECIFIC PERFORMANCE CHARACTERISTICS FOR TYPICAL FILTERS



For further information please write HUGHES PRODUCTS, Crystal Filters, International Airport Station, Los Angeles 45, Calif.

Creating a new world with *ELECTRONICS*

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GOLD BONDED

HUGHES GERMANIUM DIODES

first of all for reliability.

Typical performance levels: @ 25°C. unless otherwise stated

	Forward Current @ +1V (mA min.)	Inverse Current @ Specified Voltage (μ A max.)	Maximum Inverse Voltage (Volts)
1N270	200	100 @ -50V	100
1N276	40	100 @ -50V 100 @ -10V*	60
1N277	100	250 @ -50V* 75 @ -10V*	125

*Measured @ 75°C.

*For additional information write: Hughes Products,
Marketing Dept.—Semiconductors, International
Airport Station, Los Angeles 45, California.*

Hughes gold bonded diodes exhibit fast recovery together with high forward conductance, low reverse leakage and high peak inverse voltage. They are fusion sealed in a subminiature one-piece glass envelope. This assures you complete isolation from damage or contamination.

Under varied and severe environmental and operating conditions, Hughes Gold Bonded diodes exhibit outstanding performance. You can be assured of reliable performance, since Hughes diodes exhibit the following characteristics: shock resistance... vibration resistance... thermal stability... electrical stability.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

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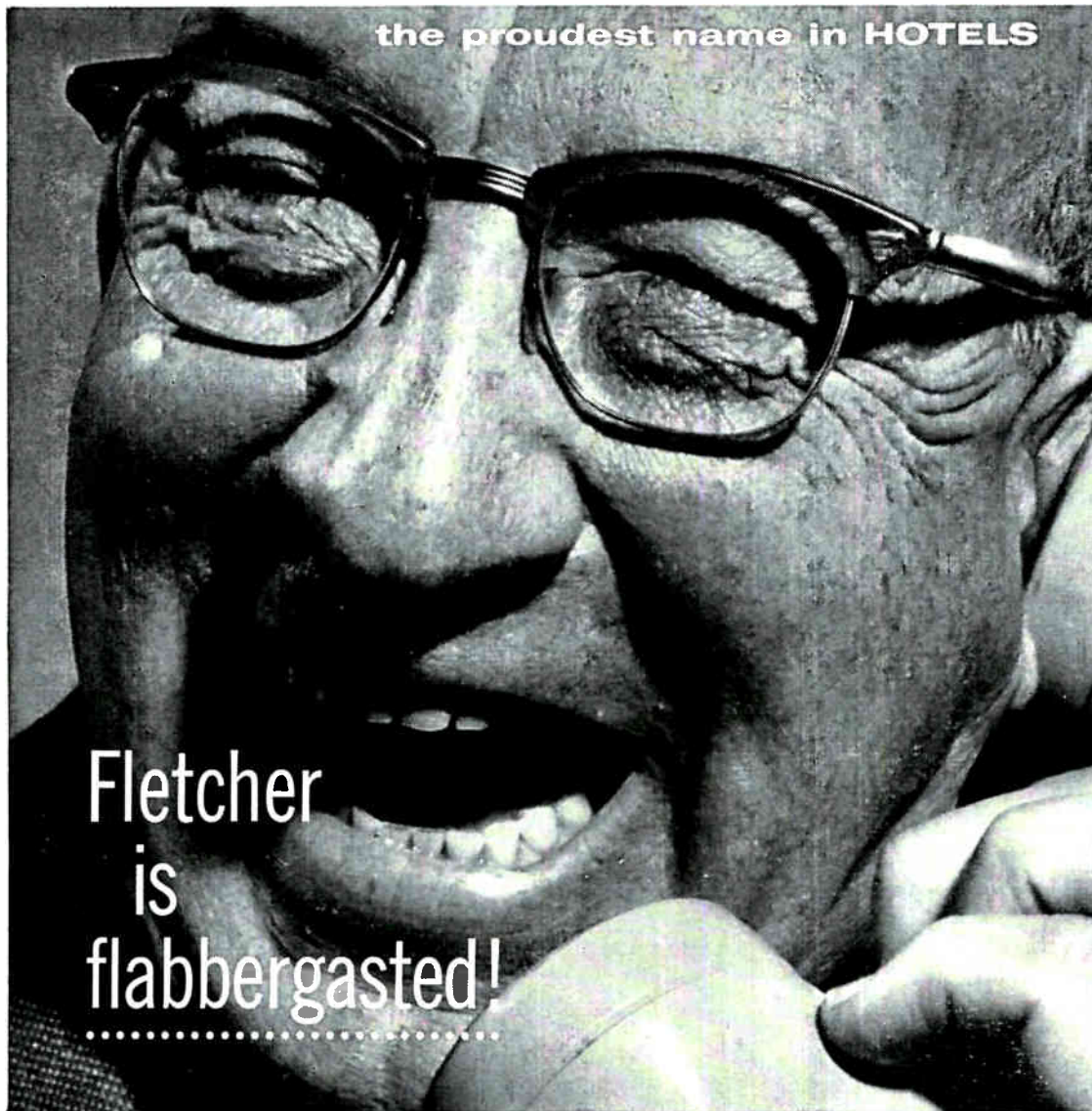
SEMICONDUCTOR DEVICES • STORAGE AND MICROWAVE TUBES • CRYSTAL FILTERS • OSCILLOSCOPES • RELAYS • SWITCHES • INDUSTRIAL CONTROL SYSTEMS

SHERATON



Which of these 39 cities is your next stop?

the proudest name in HOTELS



Fletcher
is
flabbergasted!

- EAST**
- NEW YORK
- BOSTON
- WASHINGTON
- PITTSBURGH
- BALTIMORE
- PHILADELPHIA
- PROVIDENCE
- ATLANTIC CITY
- SPRINGFIELD, Mass.
- ALBANY
- ROCHESTER
- BUFFALO
- SYRACUSE
- BINGHAMTON, N.Y.
- (opens early 1959)
- MIDWEST**
- CHICAGO
- DETROIT
- CLEVELAND
- CINCINNATI
- ST. LOUIS
- OMAHA
- AKRON
- INDIANAPOLIS
- FRENCH LICK, Ind.
- RAPID CITY, S. D.
- SIoux CITY, Iowa
- SIoux FALLS, S. D.
- CEDAR RAPIDS, Iowa
- SOUTH**
- LOUISVILLE
- DALLAS
- (opens early 1959)
- AUSTIN
- MOBILE
- WEST COAST**
- SAN FRANCISCO
- LOS ANGELES
- PASADENA
- PORTLAND, Oregon
- (opens fall 1959)
- CANADA**
- MONTREAL
- TORONTO
- NIAGARA FALLS, Ont.
- HAMILTON, Ont.

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RESERVATRON got
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A call to the nearest Sheraton Hotel sets in motion the world's fastest hotel reservation service. **RESERVATRON**, new electronic marvel, reserves and confirms your room in any Sheraton Hotel coast to coast in split seconds!
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FREE BOOKLET to help you plan trips, sales and business meetings, conventions. 96 pages, describing Sheraton facilities in 39 major cities. **MEMBERSHIP APPLICATION** for the Sheraton Hotel Division of the DINERS' CLUB. This card is an invaluable convenience for the traveler — honored for all Sheraton Hotel services.
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Please send me, without obligation: Sheraton facilities booklet
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Address

City.....Zone.....State.....



Over \$900 million is earmarked for B-52 bomber (left) and KC-135 Stratotanker in fiscal year 1960

SAC Prepares for Missiles

Electronics industry gets at least 25 percent of the \$2 billion spent annually on Air Force ballistic missiles for Strategic Air Command

OFFUTT AFB, NEB.—Judgments and decisions made here today at the Strategic Air Command headquarters result in tomorrow's needs from the electronics industry.

On-the-spot talks with top brass here at the brain and nerve center of one of the most complex and efficiently run operations in the world, indicate there'll be increased buying of existing, as well as brand new, electronic devices in fiscal year 1960.

SAC's current projects—all of which involve heavy electronic buying—include:

- Building up inventory of existing aircraft models.
- R&D on future aircraft—the B-70.
- Retrofitting operational B-47's, B-52's and tankers with new electronic gear.
- Continued dispersal of bases (to avoid concentration of planes and to provide more runways for simultaneous take-off). This will require additional electronic test, checkout, communications gear.
- Improvement of world-wide communication systems (single sideband will be operational in all SAC planes by June, 1960, operating in connection with four new ground-to-air stations).
- Acquisition of a new electronic combat control system—a stepped-up communications, computer and display complex.
- Preparation for blending in

SAC's missile force with manned planes.

Planes Always Flying

Controlled and directed by its underground headquarters here as tightly as a single infantry squad, the Command currently consists of about 2,100 bombers and 900 tankers and support planes, operating from 70 bases scattered over four continents. Approximately 211 planes are flying training missions at any given moment, day and night. About a third of the striking force is constantly on runway alert, set to fly in 15 minutes.

Manned aircraft striking force consists of:

- 28 wings of B-47's containing 45 planes each. Though no new planes are due, those already operational are constantly being updated with new electronic gear.
- B-52 force consists of six wings of 45 planes each. Four more wings will be operational by July. New 1960 fiscal money provides \$579 million for new B-52's. Hound Dog, air-to-surface, inertially guided supersonic missile to be launched from the B-52G, will be operational in 1960. First guidance system was delivered by Autonetics to North American's missile div. last month. Both the B-47 and B-52 can carry the air-launched Quail, short range decoy missile giving a bomber-like return on enemy radar.
- KC-135 jet Stratotankers will

get \$322 million in new money in fiscal 1960. SAC planning calls for one tanker for every two B-52's.

- Seven B-58's are now flying. Although still undergoing tests by ARDC, they are also training SAC crews. On order: 66 more.

- B-70 Valkyrie, Mach 3 long-range bomber that will carry an air-launched ballistic missile, will get \$355 million in fiscal 1960 for continued development. Martin and a Lockheed-Convair team are said to be working on the missile.

Business Better

Though new figures are not available, bomb-nav systems for SAC's B-47, B-52, B-58 and B-70 passed the \$1-billion mark a year ago (ELECTRONICS, p 15, Feb. 21, 1958). This business is even better now.

- KC-97 tankers, now out of production, total 888 operational planes. They are still being equipped with new electronic gear.

SAC missiles: Though the first SAC operational missile site will not be ready until July, SAC personnel have been receiving maintenance and operation training by manufacturers and military units for the past 15 months. SAC's missile strength now consists of 12 training wings and/or squadrons in the U. S. and United Kingdom.

- ICCM Snark (Intercontinental Cruise Missile), nearsonic pilotless aircraft, will be operational at Presque Isle, Me., in July. Current

\$50-million contract with Northrop covers production of the missile through December, 1960.

• IRBM's: Five Thor squadrons have been authorized, four to go to England and one still uninvited. Four Jupiters are authorized, though to date there have been no European takers. Possibilities are Italy, Greece, Turkey, France.

• ICBM Atlas: Nine sites are authorized. First two are now under construction at Vandenberg AFB, Calif., and at Warren AFB, Wyo. The third and fourth, to begin this year, will be here and at Fairchild AFB, Wash. Though to what extent the Atlas missile program is being accelerated is not disclosed, President Eisenhower says Atlas will be operational by June 30. Last month, GE received three contracts for radio-command guidance systems from Air Materiel Command totaling \$110 million.

• ICBM Titan appropriations will be increased 50 percent in fiscal 1960. First site will be at Denver. Three more are authorized. Request for seven additional sites, according to rumor, is in 1960 budget.

• Solid propellant ICBM Minuteman will get a \$251-million boost in fiscal 1960. Minuteman has not yet been officially assigned to SAC.

\$2 Billion for Missiles

Cost per year for USAF ballistic missiles, according to Gen. Ben I. Funk, Commander, Ballistic Missiles Center, amounts to \$2 billion—at least \$½ billion for electronics.

SAC's combined aircraft and missile striking force will present a formidable picture to a potential aggressor: B-47's approaching at 40,000 ft, releasing diversionary Quails; B-52's at 50,000 ft, launching air-to-ground Hound Dog missiles over 300 miles from target. B-58's will be coming in at 70,000 ft, and B-70's, even higher, will be launching long range missiles.

With operational surface-to-surface missiles, this picture is filled in by ICCM Snarks, coming in from high altitudes; ICBM's Atlas and Titan, launched from the U. S., appearing from "outer space"; and IRBM's Thor and Jupiter launched from Europe.

(Part II of this series will describe SAC's communications systems, internal and external.)

SMACK ON THE BUTTON!!

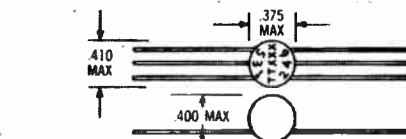
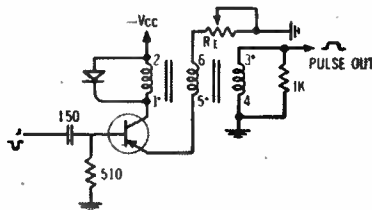
MIL-T-27A AND MIL-T-21038

specifications with

TRANSISTOR TRANSFORMERS by **PCA**

available from stock

TRANSISTORIZED BLOCKING OSCILLATOR CIRCUIT



TYPICAL NOMENCLATURE

TT331-0.2
 PRI. OCL IN MH
 TERTIARY RATIO
 SECONDARY RATIO
 PRIMARY RATIO



TYPICAL UNITS AVAILABLE FROM STOCK

PULSE WIDTH USEC	PULSE VOLTS	RISE TIME USEC	% DROOP	Vcc VOLTS	TRIGGER VOLTS	TRANSISTOR	PCA TRANSFORMER
.12	6	.04	30	-6	-1	2N240	TT331-0.1
.22	3	.02	30	-6	-1	2N240	TT421-0.2
.3	6	.06	20	-6	-1	2N240	TT331-0.2
.5	6	.05	25	-6	-1	2N240	TT221-0.5
.6	6	.05	15	-6	-1	2N240	TT331-0.5
.9	6	.06	10	-6	-1	2N240	TT661-1
1.2	6	.04	20	-6	-1	2N240	TT331-1
1.5	6	.2	20	-6	-1	2N240	TT221-1.5
2.2	10	.09	50	-12	-1	2N247	TT661-1
12	5	.05	50	-12	-1	2N247	TT521-6
13	2.5	.03	25	-6	-1	2N240	TT521-6

HUNDREDS OF OTHER TRANSFORMERS AVAILABLE FROM STOCK

1. All above data with $R_E = 0$
2. Insertion of feedback R_E narrows pulse width to circuit needs.
3. The transformer dash number approximates Pw.
4. Free run PRF can be controlled by ΔV_a on base.

- Temperature -55°C to 125°C .
- Insulation resistance at least 30,000 Megohm at 200 VDC
- Low leakage inductance
- Epoxy vacuum impregnated
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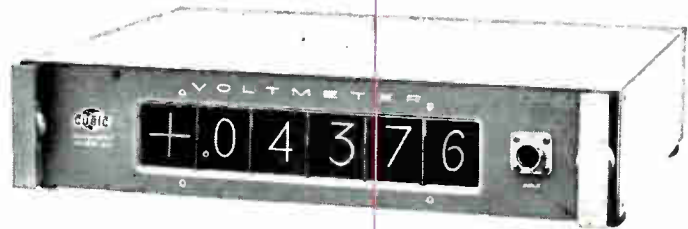
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. . . this superior Cubic instrument can measure with great accuracy every phenomenon of science which can be converted to a usable DC voltage level . . . pressure, temperature, depth, volume, salinity, etc. Great economy can be effected through use of the Digital Voltmeter in applications which require precise, legible readings to the unskilled worker without danger of costly operator error. Outstanding engineering and design talents have been combined to produce this fine DC Voltmeter, the most reliable Digital instrumentation available today.

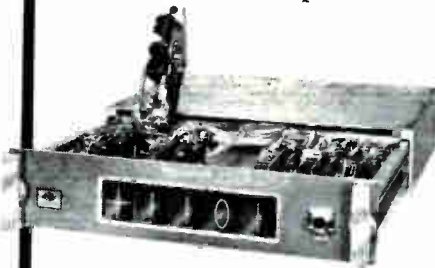
SPECIFICATIONS

Available with 4 digit (Model V-41) or 5 digit (Model V-51) display, the Digital Voltmeter is powered by Control Unit Model C-1, which includes a power supply, precision reference and differential amplifier, and which, separately housed, supplies power to as many units as are required in a Digital System. The Cubic Voltmeter provides an accuracy of .01% plus or minus 1 digit, between $\pm .0001V$ and $\pm 999.9V$ (Model V-41) and $\pm 0.0001V$ and $\pm 999.99V$ (Model V-51). Low level voltages ± 10 microvolts may be measured by the addition of the Pre-amplifier unit, Model PA-1.



THE SUPERIOR DIGITAL INSTRUMENT

Space Age know-how that goes into Cubic Corporation's missile tracking systems is also an important engineering and production component of Cubic DC Voltage instrumentation. The 4-digit and 5-digit Voltmeters, powered by the Cubic Control Unit, offer such quality features as unit plug-in construction, a precise two-part filter that eliminates the effect of AC ripple on DC readings, shock-mounted stepping switches with "controlled drive," in which the switch turns off the drive circuit part way through its cycle, ending overdrive and eliminating impact wear. Clear visual display is provided by an ultra-brilliant, edge-lighted read-out containing in-line numerals one inch high. Transistorization ends warm-up time, lengthens instrument life. Cubic's attention to fine detail increases the precision, reliability and functional capability of each instrument and at the same time provides such outstanding features of standardization as printed circuit boards that are interchangeable



and stepping switches that swing up and out for ease of routine maintenance. Cubic quality is your guarantee of truly fine instrumentation.

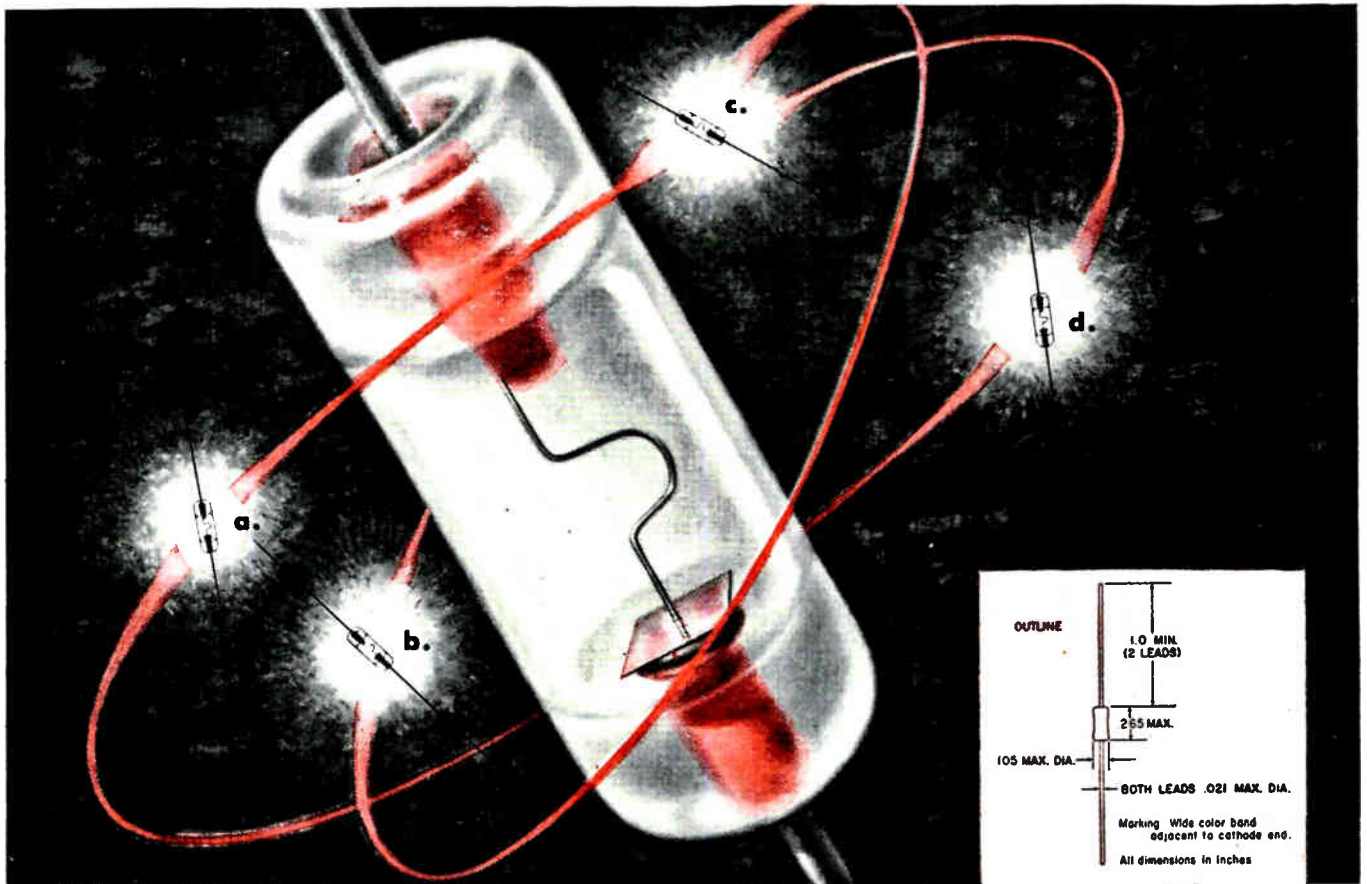
Unit construction of the Cubic Voltmeter and other Digital instruments provides maximum flexibility in creating "systems that design themselves." Inter-case wiring and standard-size plug-in units make every Cubic System a customized system using standard units. "Building Block" units which can be added easily to increase systems capabilities are the DC Pre-amplifier, AC-DC Converter, Digital Ohmmeter, Ratiometer, Master and Auxiliary Scanners and Printer Control Units. Write today for further information.



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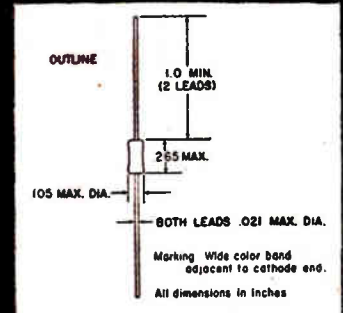


a. Computer Types

b. Gold Bonded Types

c. Point Contact Types

d. Silicon Junction Types



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Bonded series. Silicon junction types offer temperature operation up to 150°C with fast recovery time and high reverse resistance.

Wide reverse resistance and voltage ranges are found in the Germanium point contact types.

For further information on any or all of these diodes, contact your Sylvania representative, or write. Of course, Sylvania all-glass diodes, like all Sylvania semiconductors, can be purchased in small quantities directly from your nearby Sylvania Distributor.

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Computer Types:	Gold Bonded Types:	Point Contact Types:	Silicon Junction Types:
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1N192	1N276	1N127A	1N252
1N198	1N279	1N128	1N456-1N464
	1N281		1N625-1N629
	1N283		



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Inside Man-in-Space Capsule

One of Project Mercury's key electronic features will be a closed loop attitude control system. Total contract exceeds \$15 million

CLOSED LOOP attitude control system will be one of the principal electronic features of the Project Mercury man-in-space capsule (ELECTRONICS, p 9, Jan. 23).

National Aeronautics and Space Administration has disclosed that the system will consist of an attitude sensor with reaction controls. The reaction controls will keep the capsule at desired orbital attitude, and will establish the proper angle for retro-firing, reentry or an abort maneuver.

NASA says pilot will have the option of manual or automatic reaction control while orbiting. With manual control, optical displays will permit him to see portions of the earth and sky so he can position the capsule to desired orbital attitude.

Minneapolis - Honeywell Regu-

lator Co. says its aeronautical division will build the "inner ear" stabilizing and control system for the capsule under subcontract to McDonnell Aircraft. Firm explains that the system will inform the man inside, who will be in a state of weightlessness, when he's tipping over or hanging upside down.

In case of launching failure, firm says, the Honeywell system will automatically eject the capsule from the missile and control safety features such as parachutes, balloons and signalling devices. M-H says it's making systems for a dozen or more capsules.

McDonnell Aircraft's proposal for a manned capsule was the one NASA accepted last month. Collins Radio has subcontract for instrumentation and communications

systems. Total cost of about 12 Mercury capsules is expected to top \$15 million.

Retrograde System

Other important roles to be played by electronics in Project Mercury include:

- Control of the retrograde system. Retro-rockets will be fired upon a signal either initiated by ground control command link or by the man himself. This control over atmosphere reentry allows predetermined impact area.

- Instrumentation will measure and monitor internal and external capsule environment; medical instrumentation will obtain pilot's reactions. Data from both will be recorded, then telemetered to ground recorders.

- Radar chaff will be used to pinpoint capsule after it reenters the atmosphere and slows to the speed of sound. Tracking beacons and two-way voice radio will aid recovery after capsule lands.

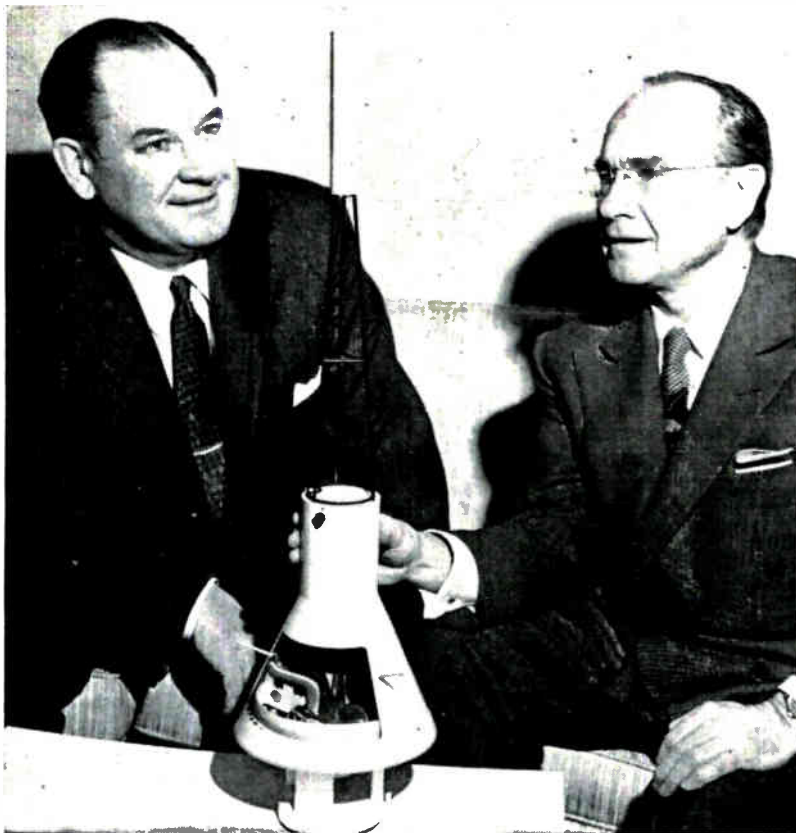
- Two-way communication between pilot and ground station will be maintained throughout flight.

Circular Orbit

NASA says the space capsule will be launched by an Atlas-D missile booster and guided from the ground into a near circular orbit between 100 and 150 miles into space. It's expected to make three or four orbits before being returned to earth. But launching of manned capsule from Cape Canaveral may be two or three years away.

Tracking of Mercury will be done by existing Minitrack and Microlock stations, says NASA, although some other stations may be added.

Tests on the escape system start in a few weeks at Wallops Island, Va. About six test shoots now planned will carry animals, probably monkeys, NASA says, and an animal will be put into orbit and returned before a manned capsule is launched.



Model of space capsule to carry man into orbit is examined by T. Keith Glennan (left), NASA administrator, and James S. McDonnell, president, McDonnell Aircraft Corp., prime contractor for project

How You Can Cut Product Costs With Indox V Ceramic Magnets

Experience in the design and production of Indox V, for such products as the loudspeaker below, points the way to substantial savings in manufacturing costs for other products using permanent magnets.

WHAT IS INDOX V

Indox V is a highly oriented barium ferrite material. Its energy is comparable, on an equivalent weight basis, to that of Alnico V—the most

powerful permanent magnet material available. Indox V magnets possess unique advantages — light weight, high-electrical resistivity,

great resistance to demagnetization, and inexpensive, non-critical raw materials — plus an energy product over three times that of non-oriented ceramic magnets.

APPLICATIONS

Indox V's excellent magnetic qualities and special properties suggest wide usage in many applications.

Among them:

D. C. Motors of Medium Size with Indox V fields have a high efficiency and show high starting and stall torques characteristic of series wound motors.

Holding Devices can take advantage of Indox V's total potential energy which, per pound of magnet weight, is appreciably higher than that of Alnico V.

Torque Drives using Indox V discs can be magnetized with multiple-pole faces.

The list of other promising applications is growing.

WHO MAKES INDOX V

Only Indiana Steel Products makes this oriented ceramic magnet, with an energy product of 3.5 million B_aH_a. And, because Indiana also produces Alnico and all other permanent magnet materials, it is uniquely qualified to recommend the one best material for your design. You are invited to consult with Indiana's design engineers for expert help on any application involving permanent magnets.

SEND FOR FREE LITERATURE

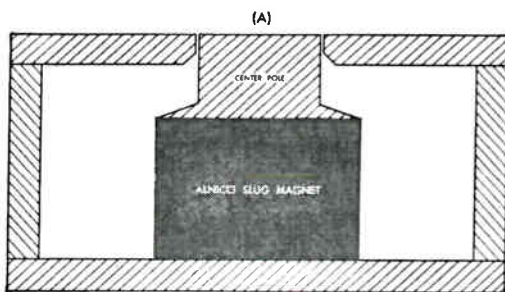
Write for your copy of the bulletin "Indox V Ceramic Permanent Magnets," describing magnetic properties, design considerations, and sizes and shapes available from stock for experimental work. Ask for Bulletin No. 18-A2.



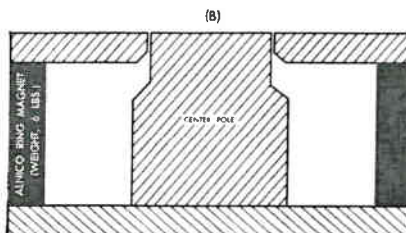
NEW INDOX V LOUDSPEAKER DESIGN...

- Cuts magnet cost 20%
- Saves 25% on weight
- Reduces length 46%

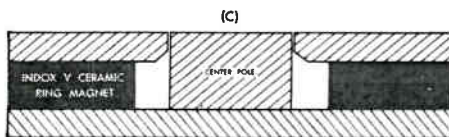
High fidelity, permanent magnet loudspeakers normally use an Alnico slug (A) or ring (B) magnet. Assembly (C) illustrates how one loudspeaker was redesigned to use Indox V, with the results indicated. Assemblies shown in proportion.



TOTAL WEIGHT (MAGNET, POT. CENTER POLE) = 26 LBS.



TOTAL WEIGHT (MAGNET, POT. CENTER POLE) = 20 LBS.



TOTAL WEIGHT (MAGNET, POT. CENTER POLE) = 15 LBS.

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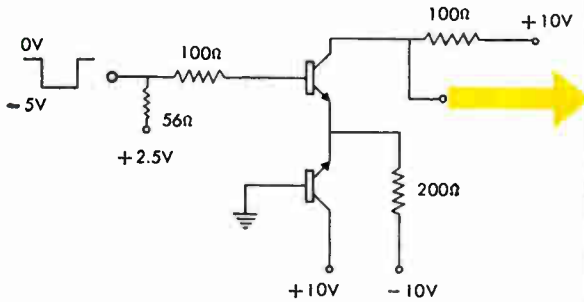
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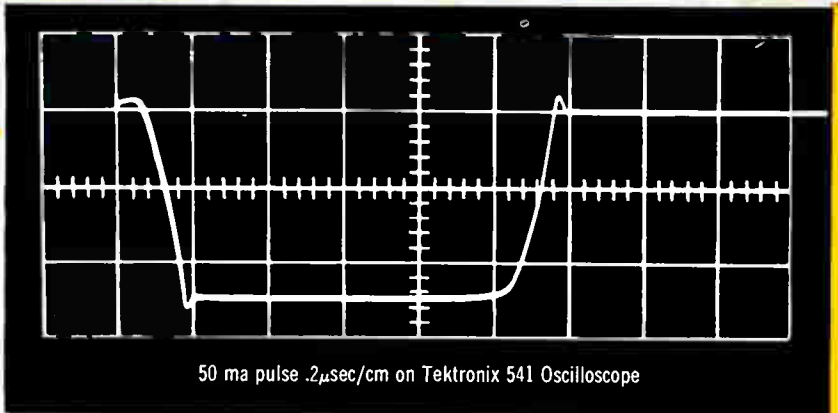
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Additional new types ST4080 and ST4081, because of their Beta linearity and superior bottoming, offer many advantages over types 2N339, 2N342 and 2N343.

For further information, write for Bulletin *TE-1355*.

ABSOLUTE MAXIMUM RATINGS

	2N1140	ST4080	ST4081	2N339	2N342	2N343
V _{ce}	40	60	60	55	60	60 Volts
V _{eb}	5	3	3	1	1	1 Volts
Power Dissipation 100°C amb.	0.5	0.5	0.5	0.4	0.4	0.4 Watts
100°C case	1.2	1.2	1.2			Watts

SPECIFICATIONS AND TYPICAL CHARACTERISTICS AT 25°C

h _{fe} at 1Kc I _c = 10 ma, V _c = 10 Volts	50	20-50	30-90	9-90*	9-32*	29-90*
I _{co} at Max. rated voltage	15	25	25	50	50	50 μa
Max R _{cs} at I _c = 20 ma, I _b = 5 ma	50**	100	100	300	350	350 ohm
h _{fe} at 10 mc typical	5					
C _c at V _{cb} = 10 volts, I _e = 0	16					μf.
h _{fe} at I _c = 50 ma, V _{ce} = 6V	50					
Rise time	.13					μsec.
Fall time	.10					μsec.

*at I_c = 5 ma
V_c = 10 Volts

**at I_c = 50 ma
I_b = 5 ma

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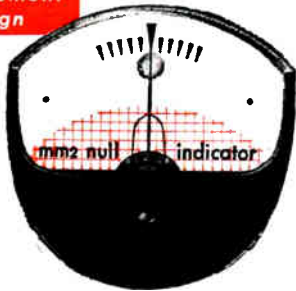
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CIRCLE 30 READERS SERVICE CARD

Japan Acts to Slow

Research subsidies aim at reducing dependence of electronics industry on U. S. licenses, now at high mark. Capital tie-ins also substantial

TOKYO—PATENT licensing agreements and capital tie-ins between American and Japanese electronics firms today are at a record level. But a plateau may have been reached, at least in the number of licensing agreements, ELECTRONICS learned this week.

Here's the picture, as described by a number of industry and government sources:

The Japanese electronics industry currently pays \$11.1 million a year in royalties to U. S. and other foreign electronics firms. It likes to compare its research spending to this royalty total. Ratio jumped to 2:1 last year from 1:1 the year before as the second government-subsidized, five-year electronics development program started.

Subsidy Increasing

Observers believe that with the Ministry of International Trade and Industry (MITI) sinking more money into electronics each year, the government will discourage new large-scale import of foreign patent knowhow. MITI's subsidy to the

Japanese electronics industry climbed from \$375,000 in 1957 to \$448,000 last year. This year the Ministry expects to hand out \$600,000 for research.

Today, there are 101 MITI-approved patent licensing agreements in electronics between Japanese and foreign firms, mostly American. So prized have these licenses been in recent years that some 200 other electronics firms are believed to have sought approval to enter into foreign licensing arrangements.

Reason for the great demand: Electrical and communications equipment manufacturers rushed to obtain foreign patents and technical knowhow after World War II when they realized they lagged 20 to 30 years behind the U. S.

Licensing and technical assistance agreements, and later a resurgence of Japanese research, has steadily narrowed this gap. Now the government can afford a more cautious attitude on licensing.

In the transistor field, for example, the government has shown concern about large volume produc-

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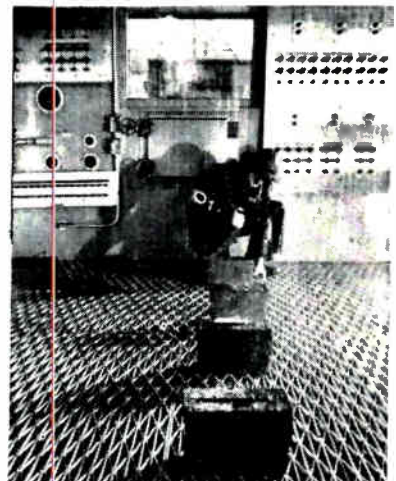
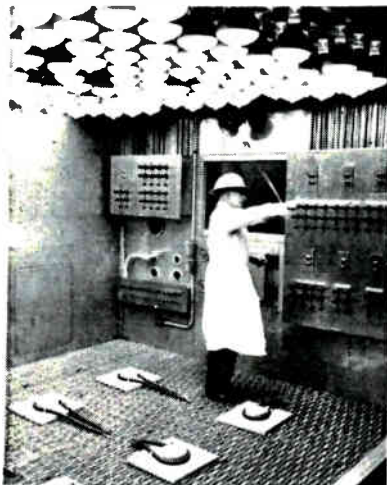
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CIRCLE 33 READERS SERVICE CARD

'Sun and Rain' Test Chamber



"You name it, we have it," might well be nickname for new rain and sunshine test chamber for electronic components, other items. Tenney Engineering, Inc., made equipment for Frankford Arsenal in Philadelphia. Technician tests power cables on wooden holders in "sun" (left), then prepares to test ammunition boxes under rainfall conditions

Licensing

tion. Recent bid by Hitachi for a new transistor license was turned down by MITI; firm already makes transistors under other license agreements. Toshiba, Nippon Electric, Sony, Kobe Industrial and Matshishita are among other Japanese firms manufacturing transistors under U. S. licenses.

Links to U. S. Firms

Here are some of the U. S.-Japanese capital tie-ins involving large American electronics firms:

Westinghouse owns 4 percent of the stock of the Mitsubishi Electric Mfg. Co. However, Mitsubishi manufactures radio and tv sets under RCA license and transistors under Western Electric license. Mitsubishi also manufactures radio gear for F-86 jet planes with technical assistance from Collins Radio.

Nippon Electric Co., which manufactures mostly communications equipment, is 21 percent owned by International Standard Electric Corp., ITT subsidiary. Total capitalization: about \$11.1 million.

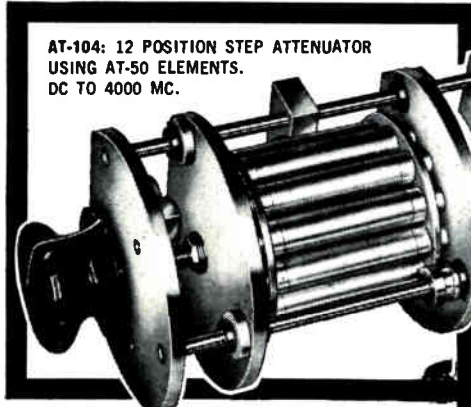
Shin (for New) Nippon Electric Co., a subsidiary of Nippon Electric with capitalization of \$555,000, is 10 percent owned by Sylvania which licenses it to make vacuum tubes and other products in return for a 2.5-percent royalty payment on total sales. Firm said none of these products was exported to the U. S. last year.

ISE owns 13 percent of Sumitomo Electric Industries and has a 10-year license agreement with the Japanese firm running to 1960. Under it Sumitomo makes l-f toll cable, plastic insulated wire and cable, carrier and coaxial cable.

Nippon Remington Univac Kaisha entered the Japanese computer market last April as a joint venture involving Remington Rand Univac, Daiichi Bussan and Toshiba. Firm expects early MITI approval of its application to produce Univac computers.

Minneapolis-Honeywell Regulator Co. holds 50 percent of the shares of the \$600,000 Yamatake-Honeywell Instrument Co.

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AT-104: 12 POSITION STEP ATTENUATOR USING AT-50 ELEMENTS. DC TO 4000 MC.

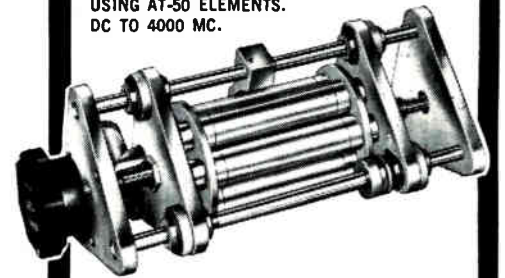
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Empire's UHF attenuators are resistive coaxial networks for the frequency range from DC to 4000 MC.

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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, Attenuator Panels, Model AT-106 (two or three step attenuators in series connected) are recommended.

For complete technical information about attenuators for your laboratory or production needs, write for free catalog.



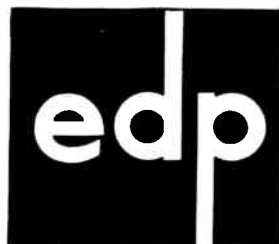
AT-103: 6 POSITION STEP ATTENUATOR USING AT-50 ELEMENTS. DC TO 4000 MC.

ATTENUATOR PADS.
DC TO 4000 MC.

AT-50: 1 W AVERAGE, 1 KW PEAK.
AT-60: 2 W AVERAGE, 2 KW PEAK.



AT-106: ATTENUATOR PANEL. TYPICAL COMBINATION: AT-106H, 0-120 DB IN 1 DB STEPS.



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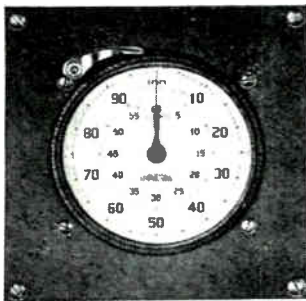
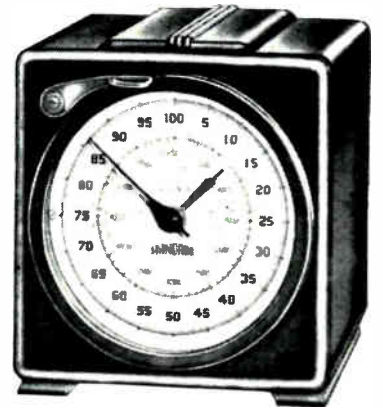
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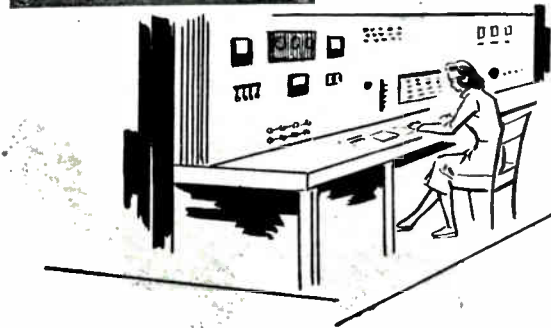


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MODEL	SCALE DIVISIONS	TOTALIZES	ACCURACY
S-100	1/5 sec.	6000 sec.	±.1 sec.
S-60	1/5 sec.	60 min.	±.1 sec.
SM-60	1/100 min.	60 min.	±.002 min.
S-10	1/10 sec.	1000 sec.	±.02 sec.
S-6	1/1000 min.	10 min.	±.0002 min.
S-1	1/100 sec.	60 sec.	±.01 sec.
MST	1/1000 sec.	.360 sec.	±.001 sec.
MST-500	1/1000 sec.	30 sec.	±.002 sec.

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So, when the need arises for a slim, *very compact* TV-set design, contact your RCA Field Representative. Your pass words are RCA "VC" 110° Picture Tubes. For technical data, write RCA Commercial Engineering, Section B-19-Q2, Harrison, N. J.



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PILOT
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PRESSURE

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1/2 SEC.

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WATER FLOW PERFORMANCE TEST
CHART SPEED 5"/SEC.
5"/SEC.

This is a record

REFERENCE

STATIC

STATIC REFERENCE

Unretouched Visicorder Record—actual size

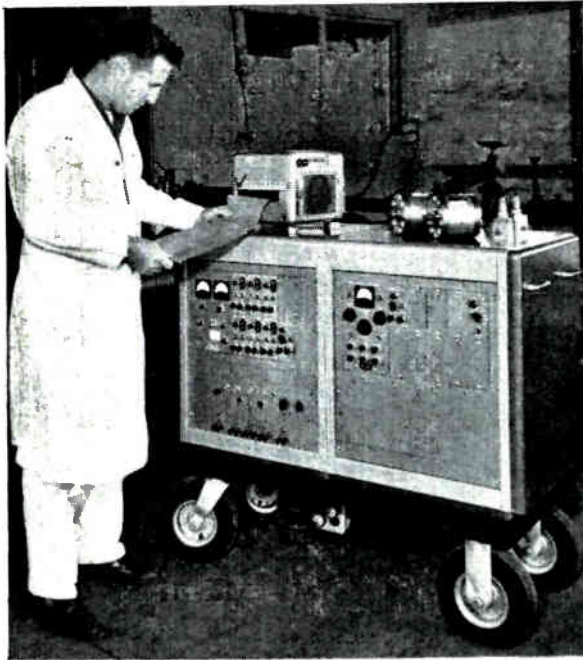


Wyle Laboratories in El Segundo, California, have used a battery of four Visicorder consoles like the one shown below to run a series of tests on a vital missile component. In the Wyle test project the unique Visicorder consoles are easy to operate. Most parameters are low frequency, requiring response on the order of 5 to 60 cycles.

The two calibrator control panels in each of the Visicorder consoles accommodate 10 plug-in balance and matching units—designed to match tachometer generators, pressure transducers, thermocouples, expanded-scale voltmeters, etc., to the Heiland galvanometers.

Dick Johnson, Instrumentation Branch Head at Wyle Laboratories, says. "This system, I feel, is one of the most efficient instrumentation consoles in operation. Set up and calibration time has been reduced by the use of Visicorders by approximately fifty percent. This is due to the simplicity of operation and trouble-free performance. There are no inking pens to clean, high-gain amplifier maintenance, and so on, and we can also use these consoles together to form systems of more than six channels."

of a missile component



Tom Jackson, Wyle engineer, examines Visicorder record

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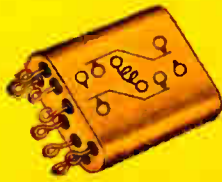
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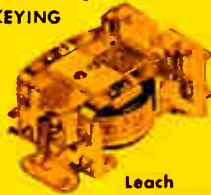
C. P. Clare

M E R



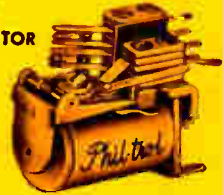
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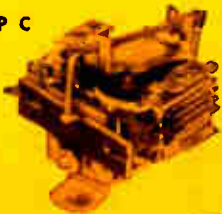


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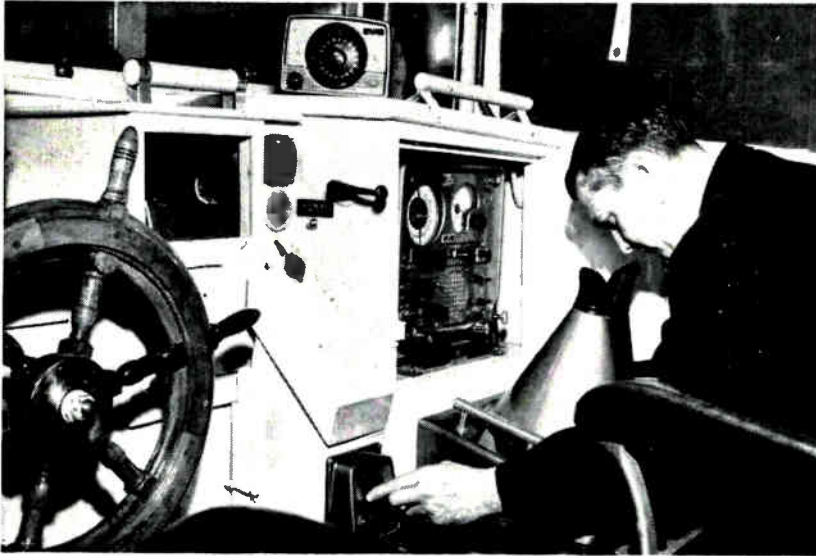
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How New Boat Units Work

More transistors and printed circuits are in electronic devices now on market

TODAY THERE are 3,620,000 cruisers, runabouts and utility outboard boats in the U.S. And this year electronics firms are wooing this market more than ever—with advanced designing, more transistors and printed circuits in new equipment.

One new marine radiotelephone using transistors draws only 6.5 amps from a 12-volt battery. The unit radiates 20 watts.

Big Market

Direction finders, constituting one of the larger segments of the small boat market, come in two classifications: manual and automatic. Typical manually operated units cost \$150 and up. Automatic units fall into the \$1,200 to \$1,500 range. One manually-operated d-f, selling for \$300, features eight transistors and printed circuitry throughout, self-contained batteries, distortion-free three-band reception—beacon, marine and broadcast.

A more sophisticated automatic d-f presents course and bearings on the face of a cathode-ray tube, requires no null meter, indicates on-station tuning by appearance of a propeller-shaped signal pattern.

Radar is still comparatively in the luxury class. Sets cost around \$3,500, and to date, commercial fishermen have constituted a fatter market than yachtsmen. Last year, which was a good fishing year, \$12-million worth of electronic equipment was delivered to the Gulf shrimp-boat fleet alone. (Most of this was primarily for radar, but also for fishfinders and highpower radiotelephones.)

Several reasonably priced automatic pilots are on today's market, directed largely at fishermen who like to troll. One firm is coming out with a specially designed unit costing between \$200 and \$300. Current models utilize a narrow beam of light projected through a compass card onto a photoelectric cell. Slightest course deviation causes change in intensity of light beam, hence in cell output. Amplified output of cell operates steering mechanism to control rudder.

Other electronic items recently introduced include a transistorized megaphone which can double as a foghorn, gas detectors for bilges, a 24-faceted aluminum radar target which will reflect over seven miles and facilitate spotting by larger ships.

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Model 867

FREQUENCY RANGE: 15 kc to 30 mc on 15-ft high-discrimination full-vision scale.
CRYSTAL ACCURACY: 0.01% with built-in 1-mc harmonic source.

OUTPUT RANGE: 4 μ v to 4 volts at 75 ohms. 0.4 μ v to 0.4 volt at 13 ohms. Automatic level control for good stability.

AMPLITUDE MODULATION: Monitored and variable up to 100%; high quality assured by envelope negative feedback. Modulation frequencies, 400 and 1,000 cps. Less than 200 c/s spurious FM.

F.M. SIGNAL GENERATOR

Model 1066A

FREQUENCY RANGE: 10 to 470 mc, on fundamentals throughout. 0.0025% short-term stability.

DIRECT-READING INCREMENTAL TUNING: Stepped control up to 15 kc; continuously variable from 0 to 20 and 0 to 100 kc.

OUTPUT RANGE: 0.2 μ v to 200 mv at 50 ohms.

MODULATION: FM deviation continuously variable and monitored from 0 to 20 and 0 to 100 kc. Also AM up to 40%. Modulation frequencies, 1 and 5 kc.

CARRIER DEVIATION METER

Model 791D

MEASURES DEVIATION: 200 cps to 125 kc in four ranges; measures down to 10 cps using external readout.

CARRIER FREQUENCY RANGE: 4 to 1,024 mc, directly calibrated.

MODULATION FREQUENCY RANGE: 50 cps to 35 kc.

CRYSTAL LOCKING: ensures freedom from microphony, allows measurement of FM hum and noise in VHF and UHF communication and broadcast transmitters.



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MEETINGS AHEAD

Feb. 12-13: Transistor & Solid-State Circuit Conf., AIEE, PGCT of IRE, Univ. of Penn., Philadelphia.

Feb. 12-13: Electronics Conference, AIEE, IRE, ISA, CPS, Eng. Soc. Bldg., Cleveland.

Feb. 16-20: Western Audio Convention, Audio Eng. Soc., Biltmore Hotel, Los Angeles.

Mar. 3-5: Western Joint Computer Conf., AIEE, ACM, IRE, Fairmont Hotel, Los Angeles.

Mar. 5-7: Western Space Age Conf. and Exhibit, L. A. Chamber of Commerce, Great Western Exhibit Center, Los Angeles.

Mar. 15-18: National Assoc. of Broadcasters, Annual Convention, Conrad Hilton Hotel, Chicago.

Mar. 23-25: Flight Testing Conf., American Rocket Society, Daytona Beach, Fla.

Mar. 23-26: Institute of Radio Engineers, IRE National Convention, Coliseum & Waldorf-Astoria Hotel, New York City.

Mar. 26: Quality Control Clinic, ASQC, Univ. of Rochester, Rochester, N. Y.

Mar. 31-Apr. 2: Millimeter Waves Symposium, Polytechnic Inst. of Brooklyn, USAF, ONR, IRE, USA Signal Research, Engineering Societies Bldg., N.Y.C.

Apr. 5-10: Nuclear Congress, sponsored by over 25 major engineering and scientific societies, Public Auditorium, Cleveland.

Apr. 6-7: Astronautics Symposium, Air Force Office of Scientific Research, Sheraton-Park Hotel, Washington, D.C.

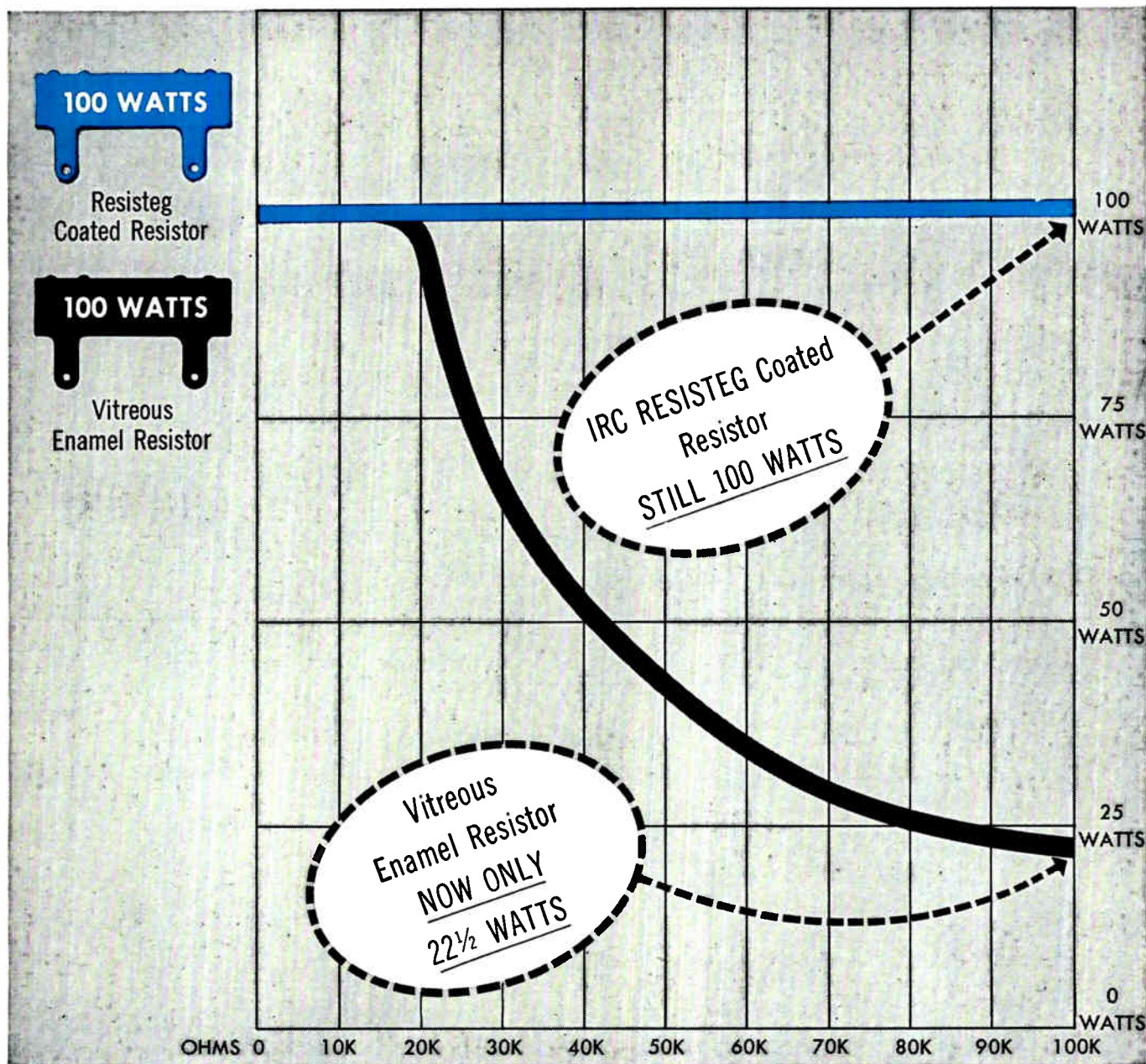
Apr. 6-9: British Radio and Electronic Components Show, Great Hall, Grosvenor House, Park Lane, London W.1.

Apr. 13-15: Protective Relay Conf., A & M College of Texas, College Station, Tex.

Apr. 14-15: Industrial Instrumentation & Control Conf., PGIE of IRE, Armour Research Foundation, Illinois Inst. of Tech., Chicago.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 86.

The "Inside Story" of Power Wire Wound Resistors



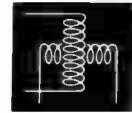
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seconds of arc in accuracy, from 8 to 25 in size. All Kearfott resolvers feature stainless housing, shafts and bearings and corrosion-resistant lamination materials for maximum environmental resistance. Optional designs available for operation at 200°C and in environment of 2000 cps vibration at 30 g's.

Computing Resolvers

Available with integral compensating windings. Can be provided with trimming networks to match existing isolation amplifiers or Kearfott-designed transistorized amplifiers.

Size 11

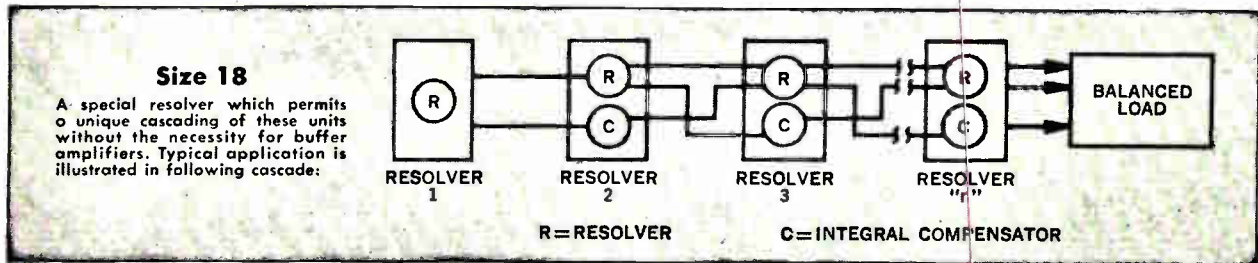
For applications where size and good functional accuracy are of paramount importance. Functional accuracy as good as .05% and bridge errors of 3 minutes of arc are in production.

Size 15

A 2:1 improvement in functional accuracy and bridge error obtained in this configuration. Unit tabulated is the direct equivalent of standard Navy BuOrd Mark 4 Mod 3 and contains necessary trimming network for standard buffer amplifiers. Transformation ratio is 1.000 ± .0001, phase shift 0° ± 1 minute. Functional accuracy of .025% and bridge error of 1.5 minutes of arc are standard.

Size 25

For applications demanding the highest order of accuracy. Close attention has been paid to design parameters.



Size 18

A special resolver which permits a unique cascading of these units without the necessity for buffer amplifiers. Typical application is illustrated in following cascade:

COMPENSATED RESOLVERS FOR PRECISE COMPUTER APPLICATIONS

SIZE	11		15	18	25
PART NUMBER	R980-01	R980-41	T980-51	V980-004	425506-1
Excitation Volts—(Max.)	60	60	26	26	25
Frequency—(cps)	400	400	400	400	400
Primary Impedance	629 + j2510	450 + j2200	220 + j1000	3000 + j (0 ± 40)	1630 / 78.5°
Secondary Impedance	695 + j2750	500 + j2300	240 + j1100	3000 + j (0 ± 40)	1620 / 80°
Transformation Ratio (Primary to Secondary)	.980	.980	.980	.775	.980
Transformation Ratio (Compensator to Rotor)	.985	.985	.950	.775	.985
Phase Shift (Lead)	8.5°	7.5°	8.5°	0° ± 10°	1°
Fundamental Null (MV)	15	15	8	15	15
Bridge Error From E.Z. (Max.) Primary	7 mins. Stator	5 mins. Stator	3 mins. Stator	3 mins. Stator	20 Seconds Stator

Non-Compensated Resolvers

Basically for application in precise data transmission systems. These synchro resolvers permit system designer to achieve system errors of better than 1 minute of arc without using 2-speed servos and elaborate electronics. By proper impedance matches up to 64 resolver control transformers can also operate from one resolver transmitter.

Size 11

Where size is important. These units have a maximum unit error of 3 minutes of arc.

Size 25

Where highest accuracy is required. These units have a maximum error as low as 20 seconds of arc.

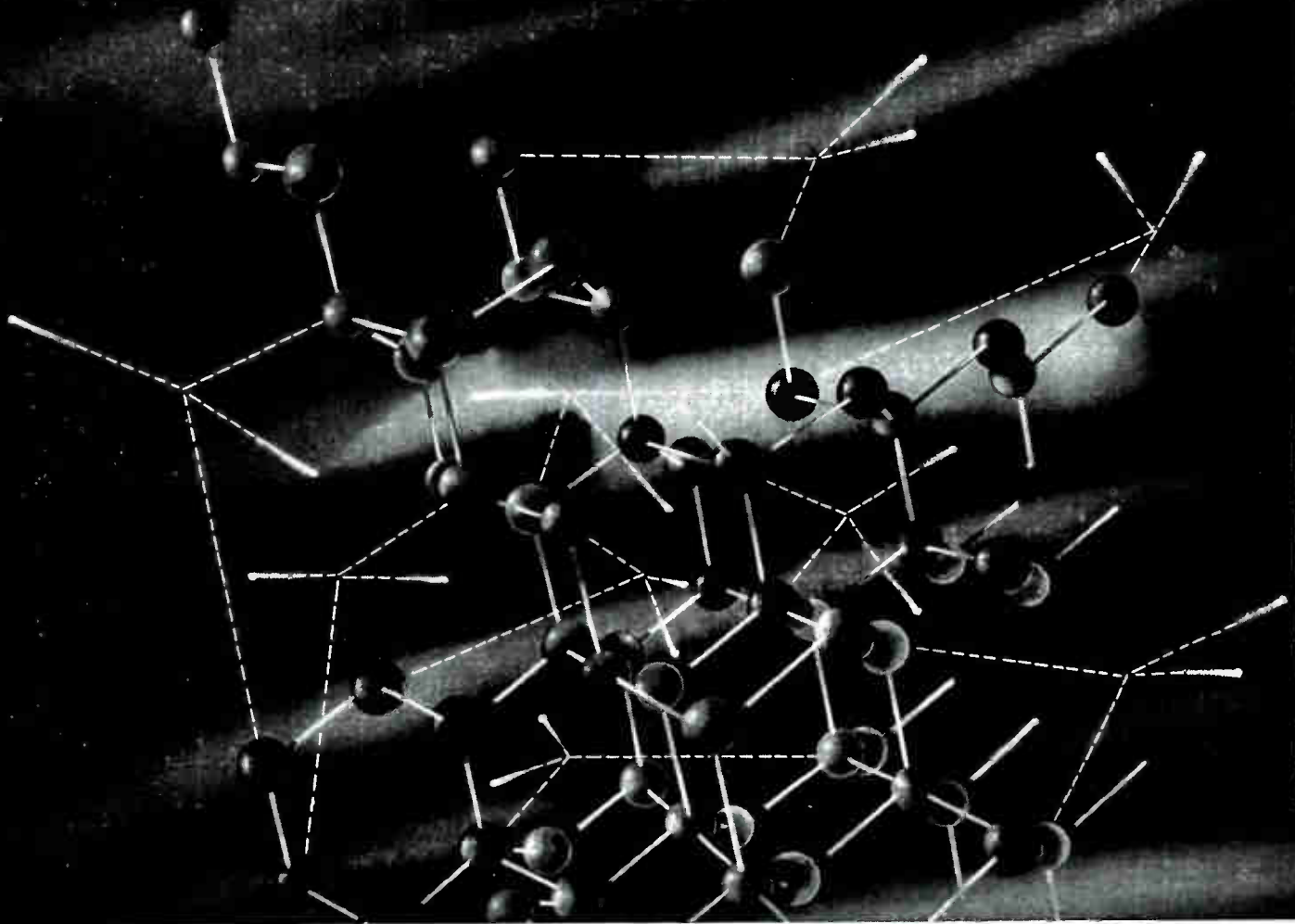
NON-COMPENSATED RESOLVERS FOR PRECISE DATA TRANSMISSION

	SIZE 11			SIZE 25		
	Transmitter	Differential	Control Transformer	Transmitter	Differential	Control Transformer
Type Resolver	R982-004	R982-011	R982-012	Z5161-001	Z5191-001	Z5151-003
Part Number	26	11.8	11.8	115	90	90
Excitation Volts (Max.)	400	400	400	400	400	400
Frequency (cps)	170 / 77°	850 / 80°	2000 / 80°	400 / 80°	800 / 80°	8500 / 80°
Primary Impedance	42 / 80.5°	1000 / 79°	8000 / 76°	260 / 80°	900 / 80°	14000 / 80°
Secondary Impedance	.454	1.000	1.906	.7826	1.000	1.278
Transformation Ratio	3 mins.	3 mins.	3 mins.	20 seconds	20 seconds	20 seconds
Max. Error from E.Z. Primary	Rotor	Stator	Stator	Rotor	Stator	Stator

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The nature of electron transport in a solid

An active program is under way at IBM to investigate various mechanisms that influence the conduction of electrons in solids. One project of interest is the work being done by Dr. Seymour H. Koenig of the Watson Research Laboratory at Columbia University, involving the behavior of electrons when their mean energy is greater than would be indicated by the temperature of the solid.

At a few degrees above absolute zero, the application of even a small electric field to a sample of germanium will grossly affect equilibrium of the conduction electrons and increase their average energy by a factor of twenty-five or more. The characteristics of these "hot" electrons

are being studied to determine the processes that occur as they move through the lattice, "cool," and return to equilibrium. By measuring the detailed behavior of the electrical conductivity, often in time intervals measured in milli-microseconds, important information relating to the interaction of electrons with the germanium lattice can be obtained.

These investigations at the Watson Research Laboratory in New York City are adding to our understanding of basic solid state phenomena at low temperatures as well as yielding some interesting and unexpected device possibilities.

IBM

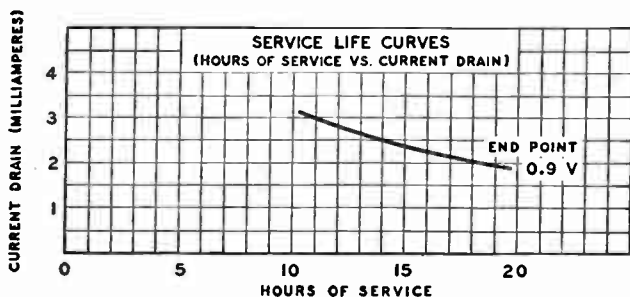
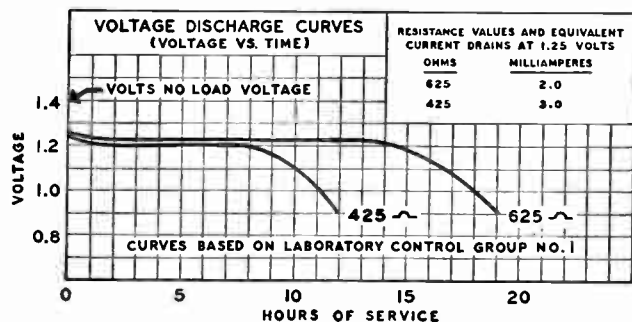
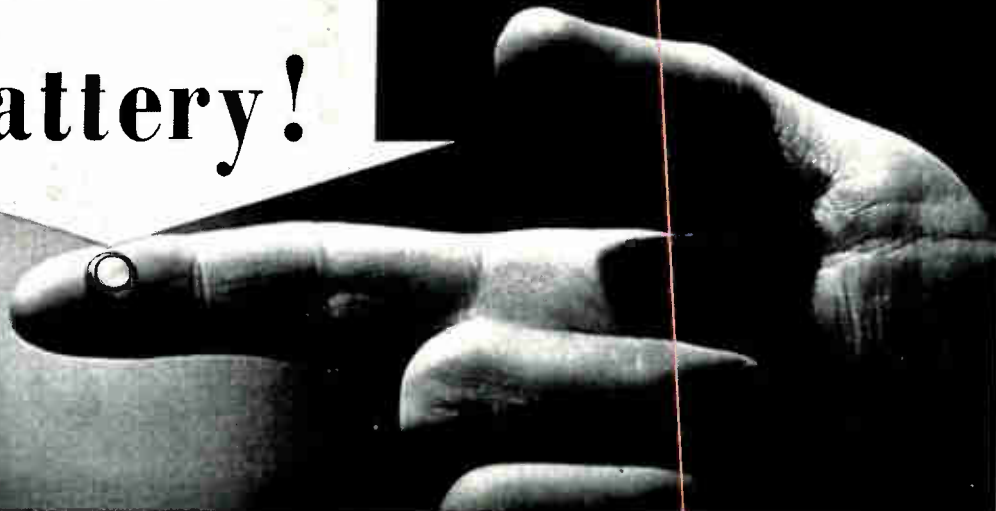
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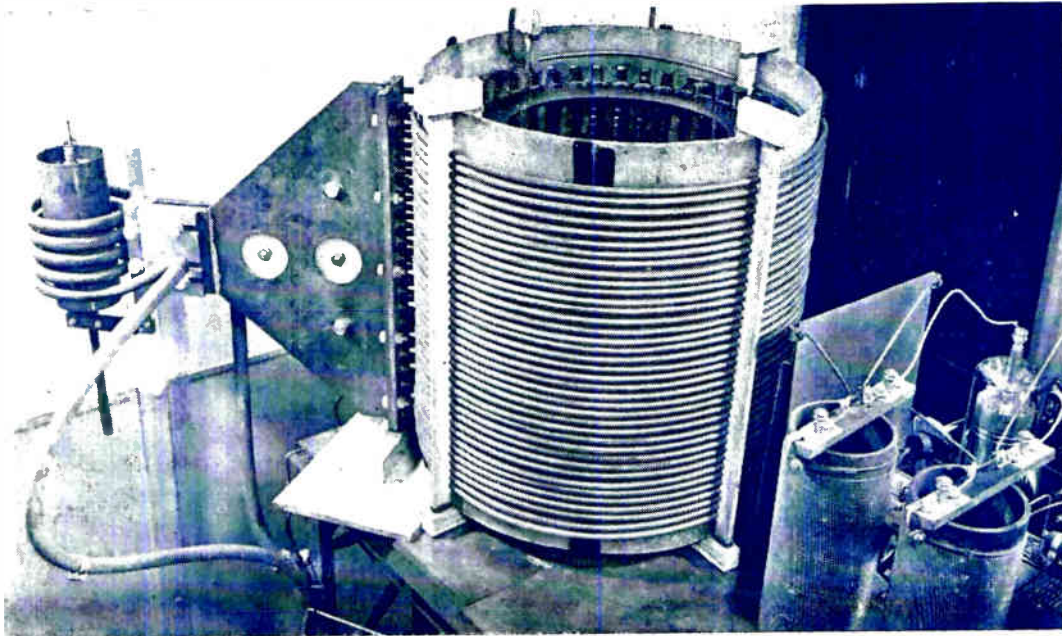
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Prototype high-frequency induction heater. Output transformer (center) has high-voltage coil and ring of Ferroxcube rods inside polyester cylinder; low voltage coil outside. Also shown are heat inductor (left), one thyatron and the anode series impedance coils (right)

How Radar Techniques Improve Induction Heating

Induction heating generator operating on spark-gap principle uses hydrogen thyratrons as rapid switches. Short ionization time and high current carrying capacity of thyratrons enable generator to develop 12 kv up to 10 kc

By **H. L. VAN DER HORST,**

Application Laboratory for Gaseous Discharge Tubes, N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands

INDUCTION HEATING is used industrially to harden, cast, solder, melt and temper metal. The heating generator described here develops 12 kw at frequencies up to 10 kc in the workpiece by using hydrogen

thyratrons as rapid switching elements.

ADVANTAGES OF HYDROGEN—The process of introducing gas or metal vapor into a vacuum tube changes many of its properties. Presence of positive gas ions neutralize the negative space charge of the electrons thereby reducing the internal losses. Thus, heavy currents can flow through the tube at a comparatively low anode voltage. Also, since the efficiency of these tubes is high, forced cooling is not required.

Because hydrogen is light gas, the ionization and

THE FRONT COVER—Operational induction heating generator uses four hydrogen thyratrons to switch power. The tubes are operated sequentially thereby increasing repetition rate and power by a factor of four. Since one tube fires at a time, only one anode series impedance coil is used.

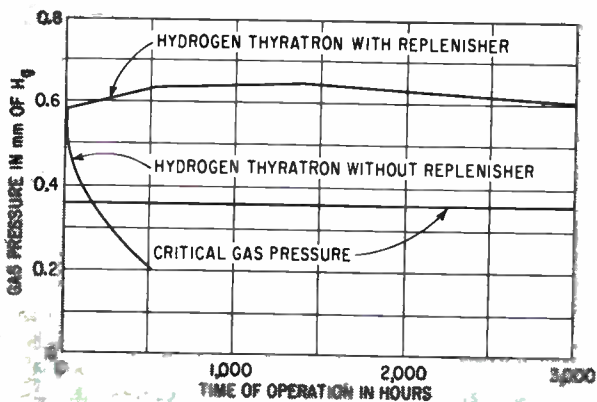


FIG. 1—Variation of gas pressure for hydrogen thyratron with replenisher and for random hydrogen thyratron without replenisher

deionization times of hydrogen thyratrons is short. This characteristic permits an oscillator equipped with such tubes to operate at frequencies up to 10 kc.

The simplest way of reaching a considerable power output is to raise the anode voltage to a high value. Maximum peak anode voltage of the 5949 thyratron is 25 kv; maximum peak emission current delivered by the indirectly heated cathode is 500 amp.

Since the ignition characteristic of a 5949 thyratron is positive, a positive grid pulse is necessary to fire the tube. This requirement holds even for positive anode voltages.

CLEAN-UP PROBLEM—A disadvantage of hydrogen thyratrons is the gas clean-up resulting from hydrogen being absorbed. This effect is counteracted by incorporating a replenisher in the tube envelope which consists of a specially processed wire capable of retaining the hydrogen and of acting as a gas reservoir.

When the temperature of the wire is raised, hydrogen is liberated. This process ensures that equilibrium is established between freed and absorbed gas and that there is a well-defined gas pressure at any temperature. Curves in Fig. 1 show variation of gas pressure with time for thyratrons both with and without replenishers.

HIGH-FREQUENCY GENERATOR—Characteristics of the 5949 hydrogen thyratron make it possible to construct a high-frequency generator operating on the principle of the spark-gap oscillator as shown in Fig. 2. In this circuit the thyratron simply acts as a rapid switch. Oscillations in the tank circuit, L_2C_2 , are of a more or less damped character depending on the nature of the load.

Correct choice of the ratio of C_1 to C_2 is of prime importance. Only when this capacitance ratio, denoted k , equals unity is the charge identical to the discharge taking place during each cycle. This relationship implies that no transient phenomena occur during the starting cycles.

At the beginning of the oscillations of the tank

circuit, the maximum voltage $V_{c_2} k$ across C_2 is the same for all values of k and is equal to $2V_0$. A requirement imposed on the thyratron is that the voltage between anode and cathode is always equal to $V_{c_1} + V_{c_2}$. Voltage V_{c_2} rapidly changes polarity during the oscillation of the tank circuit.

Voltages $V_{c_1} + V_{c_2}$ occurring across the thyratron as a function of k are shown in Fig. 3. This graph shows that immediately after discharge the voltage across C_2 drops to $-2V_0$, independent of k .

Oscillograms of the voltage across the thyratron for different values of k are shown in Fig. 4. It can be seen that either the positive tube voltage or the negative tube voltage resulting from the oscillations will exceed twice the value of the supply voltage V_0 , unless k equals unity and the oscillatory circuit is sufficiently damped. The highest peak inverse voltage decreases as k becomes larger, while the highest peak positive voltage is at a minimum when k equals unity. This phenomena is particularly noticeable during the first few cycles.

To prevent either the positive or negative voltages from becoming considerably higher than $2V_0$, the ratio k should be roughly equal to unity. In practice, however, thyratrons operate slightly better if k is chosen somewhat lower, for example 0.75. An oscilloscope trace would then be similar to the oscillogram shown in Fig. 4C.

Improvement obtained by making k slightly smaller than unity probably results from the fact that point B does not actually reach the excessively low value indicated on Fig. 4C. This limiting occurs because the thyratron, being in a conductive condition, is already opposed by the start of tank circuit oscillation. Since the residual charge of C_1 is negative as shown by point D on Fig. 4C, the discharge is immediately extinguished.

If k is greater than unity, as shown in Fig. 4B,

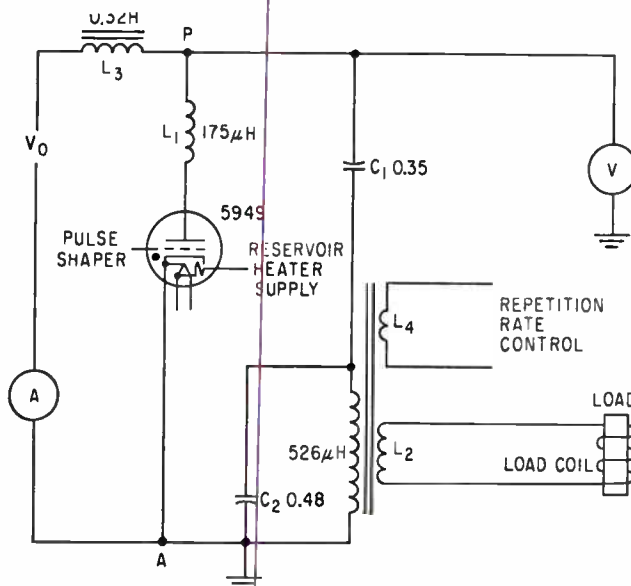


FIG. 2—Basic heating generator circuit. Voltage induced in small coil L_1 , coupled with tank coil L_2 is applied to the control circuit (Fig. 5) and used to make repetition rate of control circuit dependent on tank circuit damping

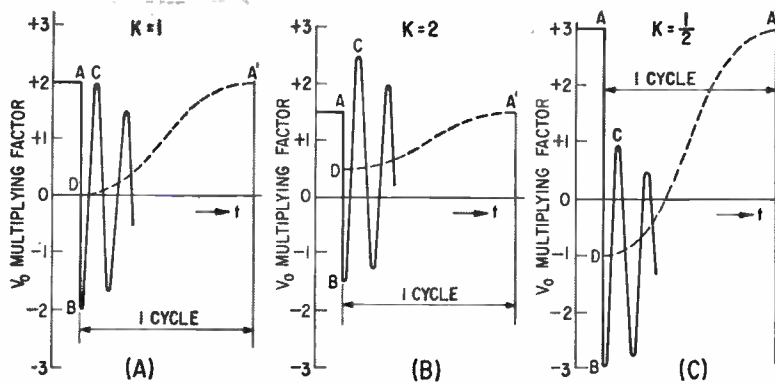
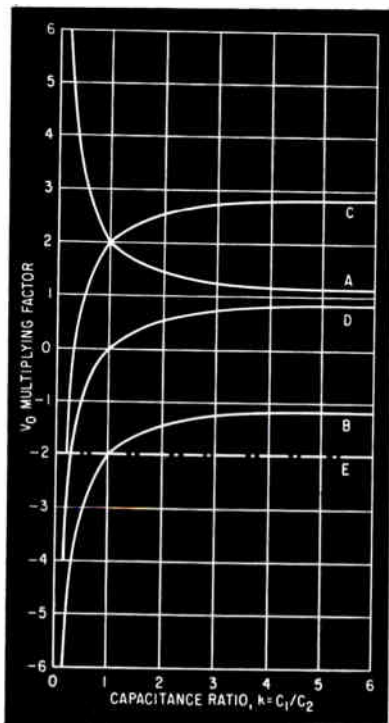


FIG. 4—Oscillograms of voltage across thyatron for different values of k

FIG. 3—Variation of voltage across hydrogen thyatron as function of k . Curve A applies to the instant before C_1 has discharged into C_2 , curve B to the instant after the charge has been transferred to C_2 and curve C to condition after a time $t = \pi (L_2 C_2)^{1/2}$ has elapsed. Line D represents voltage across C_1 and line E voltage across C_2 immediately after discharge

the polarity of the charge C_1 is positive and the tube works satisfactorily. However, point C then becomes particularly high and can lead to disturbing phenomena. In the generator described here, $C_1 = 0.35 \mu\text{f}$ and $C_2 = 0.48 \mu\text{f}$, therefore $k = 0.73$.

MAGNITUDE OF INDUCTANCE—Required inductance of tank coil L_2 is closely related to the desired generator frequency f . With a relatively small tube load it is possible to raise f to approximately 14 kc, while with a high tube load, good results can still be obtained at 10 kc. Since L_2 represents the stray self-inductance of the loaded transformer, the various couplings play an important part. Capacitor C_2 and total inductance L_1 should form a tuned circuit complying with the condition

$$\omega^2 L_1 C_2 = 1$$

where $\omega/2\pi = f = 10 \text{ kc}$.

Prime consideration with regard to L_1 is that the charge from C_1 be transferred to C_2 as quickly as possible without the maximum peak current rating of the 5949 thyatron being exceeded. Ratio L_1/L_2 , however, can not be chosen as some arbitrarily large value to avoid risk of hampering the extinction of the thyatron. Therefore, it is necessary that the instantaneous value of circuit current determined by L_1 and series-connected C_1 and C_2 can drop to zero. Calculation shows this will be the case when $L_1/L_2 \leq 0.217$. With components valued as shown in Fig. 2 and with $V_0 = 10 \text{ kv}$, the peak current flowing through the 5949 thyatron is about 340 amperes.

In determining the proper inductance for L_2 , it is assumed that the oscillations in tank circuit $L_2 C_2$ die out after 10 cycles, that is, after a time lapse of one millisecond. During this interval capacitor C_1 will be recharged through L_2 if the repetition rate is

1,000 cps. For reasons explained later, the repetition rate must be reduced to accommodate the circuit. This condition imposes an upper limit on the inductance of L_2 .

Too low a value of L_2 causes V_{c1} to reach its final value before tank circuit $L_2 C_2$ has ceased to oscillate. This situation causes the oscillating voltage superimposed on the load curve for C_1 to produce an excessively high value of peak forward voltage across the thyatron. Also, the energy stored in L_2 might flow to ground through the thyatron thereby effectively short-circuiting the power supply.

REPETITION RATE—The number of times per second the periodical charge and discharge of C_1 can be repeated depends on maximum average current I_{av} of the tube. In the circuit described, the current averaged over a half cycle is $i/1.57 = 216$ amperes and the time required to transfer the charge from C_1 to C_2 is $18.6 \mu\text{sec}$. The repetition rate should be chosen so that the current averaged over a long period does not exceed 0.5 ampere at which point the repetition frequency is 124 cps.

CONTROL CIRCUIT—Hydrogen thyatron 5949 must be controlled by a pulse voltage having a duration of approximately $2 \mu\text{sec}$. Output power of the generator is controlled by adjusting the repetition rate of the pulse with the three-part control circuit shown in Fig. 5.

The pulse generator produces voltage pulses of adjustable frequency for grid excitation of thyatron V_2 in the pulse shaper. When excited the pulse shaper produces, through an artificial cable circuit, square pulses of sufficient amplitude (about 400 v) and duration ($2 \mu\text{sec}$) to ignite thyatrons V_1 and V_3 .

The rate-control circuit controls the repetition rate of the pulses formed in the pulse generator in ac-

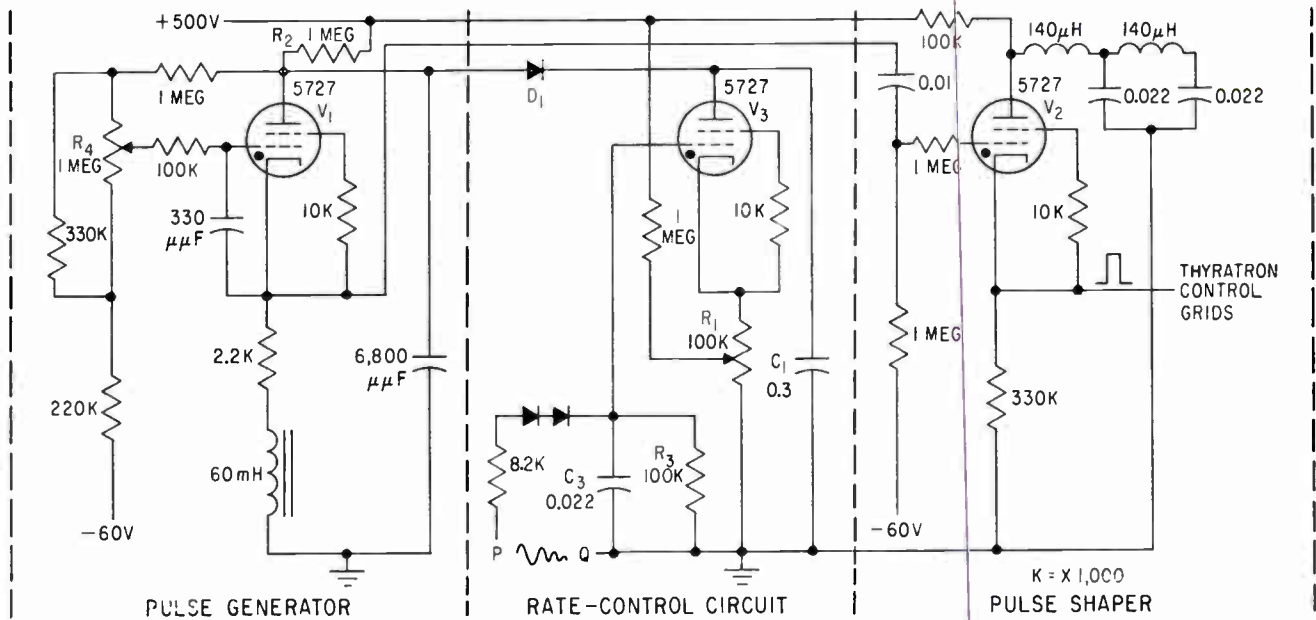


FIG. 5—Control circuit for heating generator. Pulse-generator controls tube V_2 in pulse shaper which drives hydrogen thyratrons. Rate control circuit regulates repetition rate of pulses formed by generator

cordance with the rate of damping of the tank circuit oscillations. Thyatron V_3 acts as a switch which, when conducting, allows C_1 to discharge rapidly through R_1 . Conduction takes place as soon as the control grid voltage is sufficiently positive. Thyatron V_3 is eventually extinguished because of the high value of R_2 .

Capacitor C_1 is charged through selenium rectifier D_1 to the same voltage as C_2 and remains charged until V_3 becomes conductive again at which time the voltage across C_1 and C_2 decreases then both capacitors must again be charged through R_2 . This phenomena results in a longer R-C time since R_2C_2 increases to $R_2(C_2 + C_1)$. As a result the time between ignitions of V_1 increases and the pulse repetition rate decreases. The greater the value of C_1 , the more the repetition rate will be reduced.

Ignition of V_3 is initiated as follows. Two voltages are applied to the control grid of V_3 ; a negative bias developed across the lower part of R_1 , and a positive voltage from capacitor C_3 and its leak resistor R_3 . The latter voltage originates from the alternating voltage induced in a small coil L_1 coupled to tank coil L_2 (Fig. 2) and is applied to terminals P and Q. Capacitor C_3 is charged to an extent depending on the rate of damping of the tank circuit. This damping is heavy when the generator is loaded; therefore, the positive voltage at C_3 is insufficient to ignite thyatron V_3 .

When the load is removed the damping is greatly reduced. This action makes the positive charge of C_3 high enough to ignite V_3 causing a lower pulse repetition rate. Damping can be adjusted by potentiometer R_1 .

It is possible to choose the value of C_1 and to adjust R_1 so that V_1 ignites only once a second at no-load. As soon as the generator is loaded, the damping increases, the voltage at C_3 decreases and V_3 no longer

ignites. The repetition rate is then normal.

SYNCHRONIZING CIRCUITS—Repetition rate of the 5949 hydrogen thyatron can rise to such a value or the damping of the tank circuit can be so small that an ignition pulse is applied before the tank circuit oscillations have died out. Hence, the instant at which the charge is transferred from C_1 to C_2 (Fig. 2) must be chosen with care. The most favorable instant approximates a point at which the voltage at C_2 passes through a minimum, for example at the charge transfer point shown in Fig. 6.

The correct time relationship may be insured by additions to the electronic control circuit shown in Fig. 7. A ripple voltage induced in coil L_1 is superimposed on the control grid voltage of V_1 , which increases according to an exponential function. The resulting driving voltage has the waveform shown in Fig. 8A. Ignition takes place periodically at instants t_1, t_2 and so on, that is, almost at the peaks of the oscillatory voltage.

It follows from Fig. 8 that when the damping of the tank circuit oscillations increases, the ignition

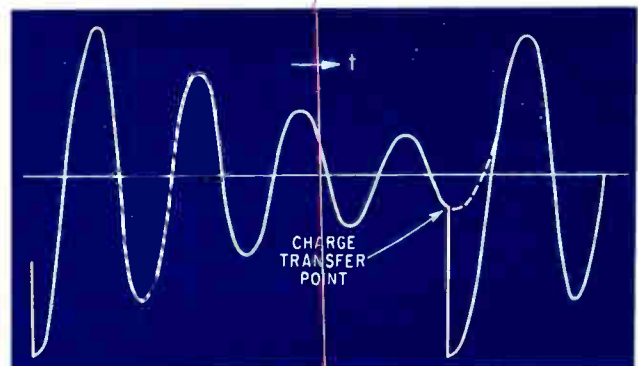


FIG. 6—Damping oscillation diagram showing point at which charge transfer from C_1 to C_2 (Fig. 2) should preferably take place

Sorting Components By

Speedier and more accurate determination of voltage and current waveform characteristics are obtained using time-sample detector. Amplitude of sampling trigger pulse is compared with combined amplitudes of trigger pulse and of unknown waveform at sample time to get proportional amplitude pulse

By **BENJAMIN AGUSTA,**

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AUTOMATIC WAVEFORM DETECTION makes possible high speed testing of ferrite cores, transistors, transformers or any other electronic components that require waveform measurement. This method not only eliminates the inherent disadvantages of the oscilloscope-operator method, but also achieves greater sorting speed and accuracy.

Waveform Detection System

The automatic waveform detection system operates on the premise that the time-dependent voltage or current waveforms of a network response, being limited by a maximum frequency component, can be defined if their amplitude is known at a series of discrete points spaced in time. For a single-pulse wave-

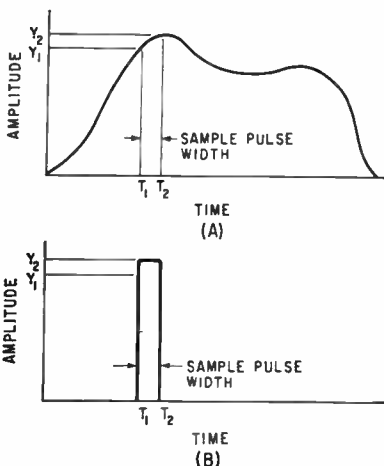


FIG. 1—Amplitude of unknown waveform (A) at time T_2 determines amplitude of sample pulse (B)

form, the number of samples required for waveform definition is equal to twice the product of the pulse width and maximum frequency component.

Thus, the detector, which measures the amplitude of a pulse for the required number of samples, can determine any physically realizable waveform.

A true impulse cannot be generated or handled electronically. However, by compromising and using a sampling pulse whose width is negligible compared to that of the unknown input waveform, as shown in Fig. 1, a close approximation to a true impulse can be obtained. This compromise is effective for engineering purposes provided the unknown waveform does not change magnitude too rapidly during the sample time interval.

A block diagram of the system is shown in Fig. 2. The waveform detector unit performs the sampling, and pulse-stretching and shaping operations. An unknown waveform is sampled and the intelligence derived is transformed into a reading that can be handled by a conventional analog-to-digital converter. A synchronization unit is used to provide the timing pulses.

Waveform Detector Unit

A block diagram of the waveform detector unit is shown in Fig. 3. A 50-v, 1- μ sec sample-pulse trigger from the synchronization unit causes the blocking oscillator trigger circuit to generate a special

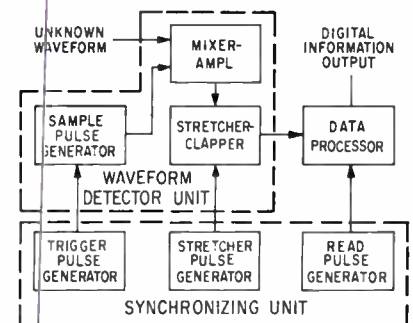


FIG. 2—Automatic waveform detection system samples unknown waveform and converts measurements to digital output reading

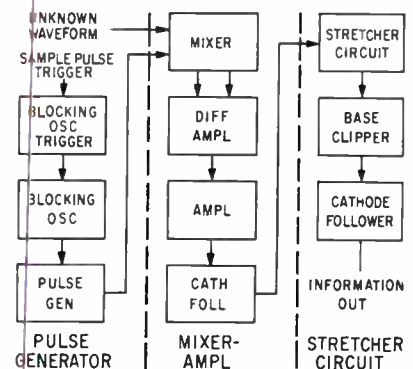


FIG. 3—Waveform detector unit changes amplitude of unknown waveform at sample time into square-shaped output pulse of proportional amplitude

pulse activating the blocking oscillator. The positive output pulse generated is fed to the pulse generator which produces the sampling pulse required by the mixer.

The mixer circuit accepts the sampling pulse from the pulse gen-

Measuring Waveforms

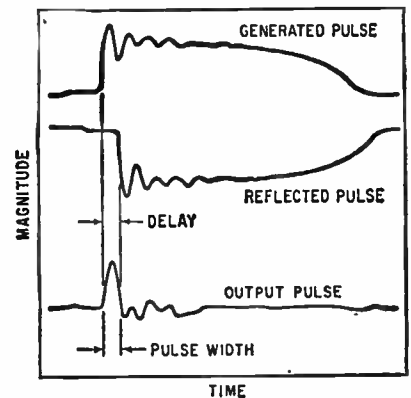
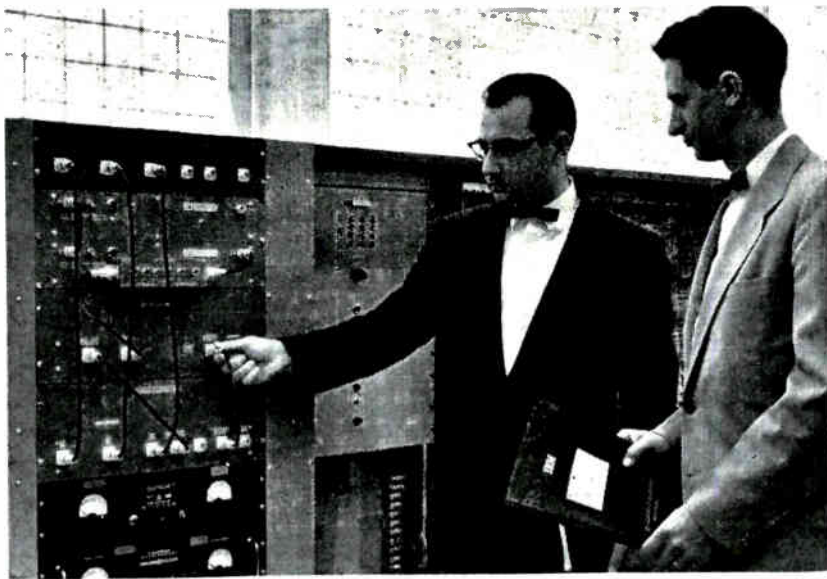


FIG. 5—Generation of sampling pulse for waveform detector unit

Automatic waveform detection system fits into common rack panel mounts

erator and an unknown waveform, and converts them into two outputs. One is proportional in amplitude to the sampling pulse; the other is a proportional combination of the sampling pulse amplitude and the unknown waveform amplitude at the sample time.

To compensate for various gain losses inherent in the mixer-amplifier section, an amplifier stage is used to drive the parallel set of cathode followers feeding the stretcher circuit. The stretcher circuit increases the width of the a-m pulse by the required amount

through use of a stretcher pulse from the synchronizer unit. This stretched pulse then passes through a base-clipper and a cathode follower. Final output of the cathode-follower is a square-shaped pulse whose duration is established by the synchronization unit. The amplitude of this pulse is proportional to the amplitude of the unknown pulse at the sample time. A schematic of the waveform detector unit is given in Fig. 4.

The sampling pulse generator is mounted together with the detector unit to place the generated sam-

pling pulse as close as possible to the mixer circuit. This arrangement minimizes lead inductance and stray capacitance.

The pulse generator circuit uses a delay line made of a length of RG-62/U coaxial cable in a network configuration. By shorting the end of the coaxial cable, a negative reflection of the generated pulse is provided after a fixed delay. The reflection pulse is used to cut off the pulse initially generated which results in an output pulse of short duration, and with sharp rise and fall times as shown in Fig. 5. How-

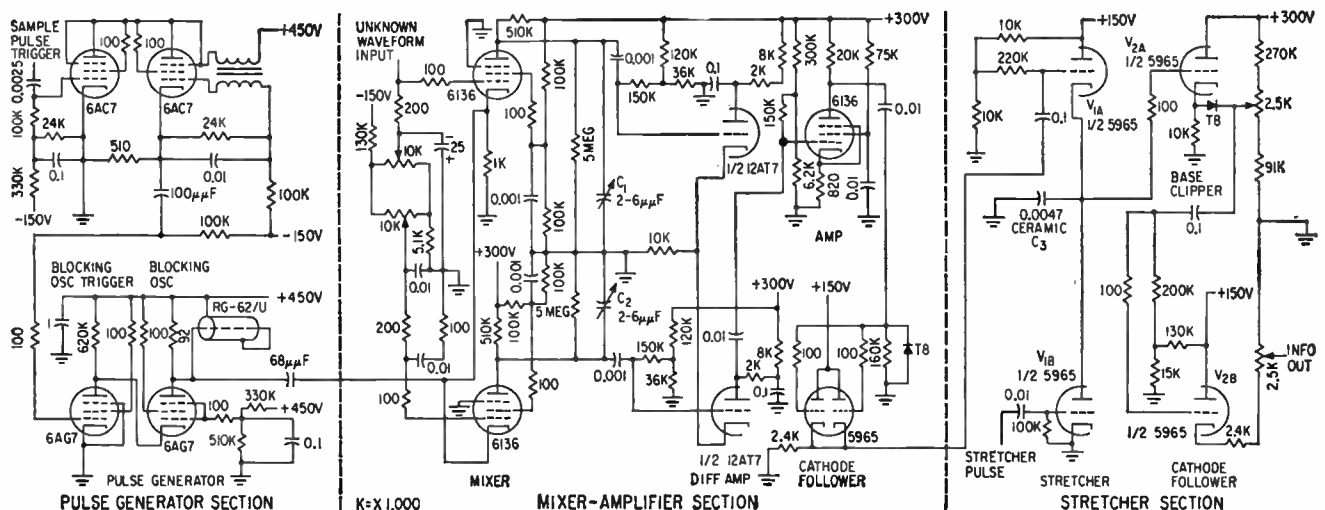


FIG. 4—Size and cost of waveform detector unit can be reduced by using 5687 duo-triodes in place of 6AC7 tetrode-connected pentodes and 6AQ5's in place of 6AG7's. Pulse shape and magnitude are not degraded by these changes

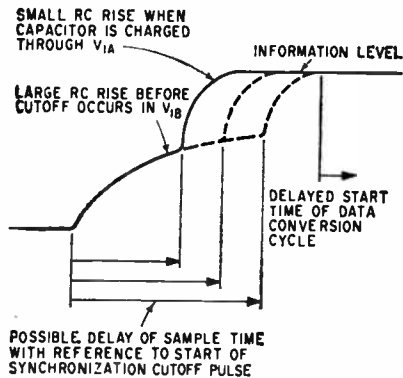


FIG. 6—Rise time characteristics of stretcher circuit

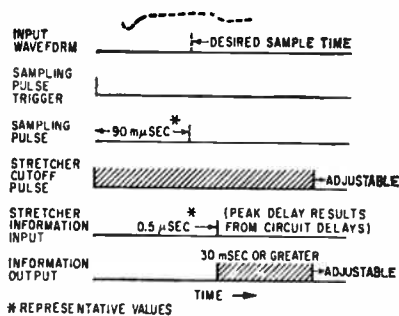


FIG. 7—Waveform detector timing chart. Drawing is not to scale

ever, although the circuit can produce pulses of 2- μ sec duration, the mixer is not able to handle them because of interelectrode capacitance and required grid impedance. A usable 5- μ sec pulse was obtained by increasing the delay time.

Mixer-Amplifier

The mixer circuit uses two 6136 pentodes to perform the sampling operation. A negative sampling pulse is applied to the cathodes of both tubes coincidental with the application of an unknown waveform to the grid of one of the tubes. The tube that receives the sampling pulse at the cathode and the unknown waveform at the grid generates a negative-going signal at the plate. Peak amplitude of this signal is proportional to the sum of the amplitudes of the sampling pulse and the unknown waveform at the time of the sampling pulse.

Output from the tube to which the unknown waveform was not applied is a negative-going signal proportional in amplitude to the sampling pulse. Only the peak amplitudes of the mixer outputs represent the sampled intelligence of

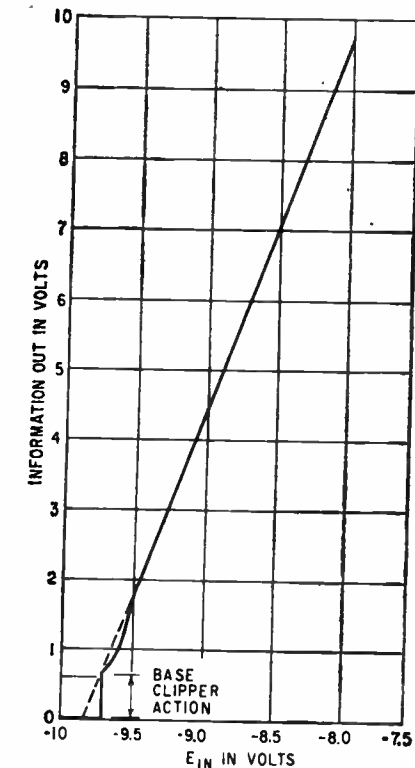


FIG. 8—Waveform detector input-output characteristics

the sample pulse amplitude. Output response of the pentodes is not sharp enough to reflect the cut off of the sampling pulse because of plate shunt capacitance; therefore, the output waveform returns exponentially to its quiescent condition.

The mixer responds to positive input waveforms of from 0- to 2-v peak amplitude. If preceded by an inverter, however, the mixer also handles negative inputs. The specific application for which the waveform detector was designed uses a preamplifier stage having a 5-mv peak-to-ground noise level. The 2-v full scale operating range provides for a maximum signal to noise ratio of 400 to 1. Biasing is used to permit the mixer to operate in the linear range of its transfer characteristic to give additive output.

Balancing

Differences between components are adjusted by trimmer capacitors C_1 and C_2 in the mixer output. The trimmers permit balancing of the waveform detector for a zero mixer input signal so that the difference amplifier output may be set at zero.

The difference amplifier uses a

12AT7 twin triode. The output is proportional in amplitude to the difference between the sampling pulse and the sampling pulse plus the unknown waveform impressed on the grids.

Signals from the differential amplifier are applied through a degenerative feedback amplifier to the cathode follower circuit.

A diode limiter in the cathode follower restricts the input to positive signal levels. Both halves of the 5965 twin triode are connected in parallel to provide a gain close to unity and to supply a low output impedance. Where only a go, no-go type test sample is required, the cathode follower could feed a voltage comparator circuit set to the required reference level.

Stretcher Circuit

The stretcher circuit accepts two inputs: the amplified signal from the difference amplifier; and a negative pulse from the synchronization unit. Duration of the negative pulse is equal to that time required to operate the data processing device.

Tube V_{1A} provides a charging path through its effective grid-to-cathode resistance for the ceramic capacitor C_3 shunting tube V_{1B} . The amount C_3 is charged depends on the amplitude of the a-m signal from the difference amplifier, providing V_{1B} is cut off. Thus, at the same time the signal arrives from the difference amplifier, the synchronization unit must provide a negative voltage pulse to cut off V_{1B} .

Duration of the synchronization unit cutoff pulse determines the stretching duration as shown in Fig. 6. The cutoff pulse allows C_3 to charge to a value proportional to the amplitude of the difference amplifier signal at a rate determined by grid-to-cathode resistance of V_{1A} and C_3 . When the a-m pulse subsides, V_{1A} cuts off, leaving C_3 charged.

Since the new R-C path formed with the output circuit has a long time constant resulting from the high cutoff resistance of the V_{1B} , negligible droop of the output signal is encountered. The output voltage, therefore, remains at this

value until the synchronization pulse is removed. Removal of the synchronization pulse drives V_{1a} to conduction, discharging C_3 .

With no input signal present, the synchronization unit cutoff pulse causes a voltage pulse to appear across C_3 which cuts off V_{1a} for substantially the same time V_{1b} is cut off. The cutoff pulse causes an initial voltage increase across C_3 ; therefore the output of the pulse stretcher circuit is fed to base clipper V_{2a} to slice off the voltage increase.

The final stage of the detector unit and the pulse-stretching and shaping circuits is cathode follower V_{2b} . Output of this low-impedance driving source is tapped from a potentiometer to allow for range adjustment to suit the individual needs of the data conversion or processing device to be used.

Timing Considerations

Relative timing established by the output of the synchronization unit for a time sample operation is shown in Fig. 7. The timing operation allows a sample to be taken at any point on the input waveform. Adjustment of the sample pulse trigger in time is done in the synchronization unit; however, initiation of the sample pulse trigger must occur approximately 90 μsec before the desired sample time.

After being initiated by the sampling pulse trigger, the stretcher

cutoff pulse is held on for the period required by the output data processing device. Resultant output of the detector unit starts at the time that the mixer output reaches the stretcher circuit and lasts for a period established by the stretcher cutoff pulse. Delay of the sample pulse with reference to the synchronization unit stretcher cutoff pulse does not affect the level of the information out of the stretcher circuit over the 15 μsec range investigated. Only the rise characteristics of the information pulse is affected by delay of the sample pulse.

Performance

Transfer characteristics of the waveform detector unit were measured by simulating an a-c input through a change in mixer bias. As shown in Fig. 8, the characteristics when the mixer bias is varied from -10 to -8 v show an accuracy of at least 5 percent at every point on the curve down to the region of 0.5-v input.

Information out resulting from inputs of 0.3 to 0.5 v deviates from a straight line by a large percentage; therefore, these points must be precalibrated for use. All inputs of 0.3 v or less are clipped at zero by the action of the base clipper to eliminate the nonlinearity of the stretcher circuit at low input voltage as shown in Fig. 9.

Since the input stage of the mixer is biased at -10 v, it is necessary

to keep the peak of the input waveform signal at less than 3 v to prevent the peak from driving the mixer into conduction thereby causing distortion of the sampled waveform at the mixer output. It is possible to determine an additive constant voltage needed to shift the transfer curve so that its intercept passes through zero. This addition may be achieved through the use of a d-c divider network.

Scale Readings

If low scale readings are required, the waveform detector input-output characteristic can be adjusted to have readable output information from zero input voltage. This is done by adjusting the -10 -v bias on the grid of the mixer tube accepting the unknown waveform input to a more positive value. The adjustment of this bias must be of sufficient magnitude to cause an unbalanced pentode amplifier output voltage to operate at the start of the linear transfer characteristic of the stretcher.

Figure 10 gives the waveform detector input-output characteristics with the d-c bias adjusted so that a fixed 4-v pulse feeds the input of the stretcher with zero input waveform and the base clipper properly adjusted. The method has the disadvantage of partially canceling the effect of the balanced mixer circuit which stabilizes variations in the sample pulse magnitude.

Any loss of stability results from the fact that the characteristics of the mixer pentodes deviate increasingly from the balanced null point. However, it has been experimentally determined that the decrease in stability of the prototype waveform detector unit using this bias offset method is not appreciable.

Application

The prototype automatic waveform detection system has been in reliable use for 1½ years in a ferrite core sorting application. In general applications, the system could provide great economic savings to any aspect of the electronics industry in which waveforms of components must be determined.

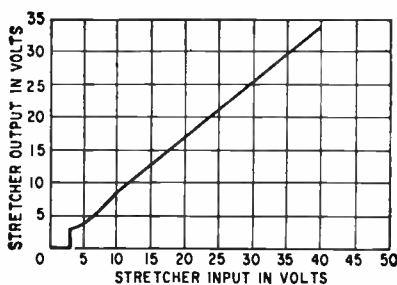


FIG. 9—Stretcher circuit transfer characteristic is clipped to eliminate nonlinearities in the circuit

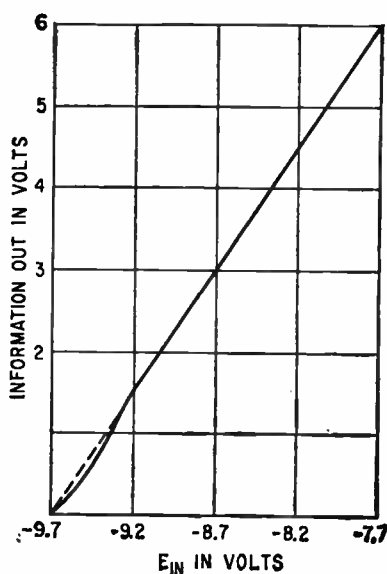


FIG. 10—Waveform detector input-output characteristics using bias offset method

Special-Purpose Magnet

Electronic component designers faced with space limitations, extreme temperatures, corrosive environments or special manufacturing problems can choose from these special magnet wire insulations

By **GEORGE SIDERIS**, Associate Editor

TABLE I—Magnet Wire for Special-Purpose and High-Temperature Uses

ENAMELED AND COATED	Temp. Class (° C)	Dielectric Strength ^a	Flexibility ^b	Stretchability ^c	Varnish Compatibility	Abrasion Resistance	Remarks on Application
Nylon.....	90-105	high	good	good	fair	good	Solderable without stripping, also applied over polyvinyl-formal to resist solvent craze To fabricate odd-shaped coils without varnish; cure with heat, solvent, resistance Solderable without stripping; good chemical, moisture and corona resistance
Self-bonding Formvar..	105	high	good	good	.....	good
Polyurethane.....	105	high	good	good	good	good	
Epoxy-based.....	105-130	high	good	good	good	good	Good space factor, chemical, corona and moisture resistance; thermosetting Moisture a problem, usually requires potting; chemical resistance good Major uses in tv yoke coils, hermetically sealed motors; low moisture resistance Use silicone varnishes; good space factor; tends to craze upon curing Must be carefully wound to prevent damage to insulation Chemically inert, poor varnish adherence unless treated; also tape-wrapped Teflon protects ceramic base, adds flexibility, but tends to tear Silicone enables use of clad wires for higher temperatures Cracks easily, is porous; insulation thinness assists space factor Difficult to handle, temperature rating raised by baking out binder Not a true ceramic; stretchability depends on conductor, rated over 500 C
Polyesters.....	130-155	high	good	good	fair	good	
Acrylic.....	130	high	good	good	.....	good
Silicones.....	155-180	high	good	good	silicone	good	
Silicone-ceramic.....	180	high	fair	fair	silicone	fair	
Teflon.....	180-220	high	good	fair	poor	fair	
Teflon-ceramic.....	220	high	fair	fair	poor	fair	
Teflon-silicone.....	>220	high	good	good	poor	fair	
Anodized aluminum....	>220	low	poor	poor	.....	fair
Ceramic.....	>220	low	fair	poor	.....	fair
Flexible ceramic.....	>220	high	good	.....	.....	good
FIBROUS INSULATION							Are used when high cut-through strength is needed or when long service at elevated temperatures will drive out binders. They are generally reliable at high temperatures due to spacing provided by the glass. Care must be taken that fibers are not stretched or twisted during winding. Interwinding and subsequent temperature fusing of Dacron fibers largely overcomes fraying and flexibility problems
Glass-Formvar.....	105-130	medium	fair	fair	good	fair	
Glass-organic.....	130-155	low	poor	poor	good	fair	
Glass-Dacron.....	130	low	fair	good	good	good	
Glass-silicone.....	180-220	low	fair	fair	silicone	fair	
Glass-Dacron-silicone..	180	low	fair	fair	good	good	

In Awg 25-30: ^a >1,000 v/mil: high
500-1,000 v/mil: medium
<500 v/mil: low

^b <5 X dia. bend: good
5X-10X dia. bend: fair
>10 X dia. bend: poor

^c >20% elongation: good
10-20% elongation: fair
<10% elongation: poor

Wire Insulation

OLEORESINOUS ENAMELS, polyvinyl formal and processed natural fibers are the magnet-wire insulations conventionally used in the great majority of electronic equipment. These insulations are low in cost and provide reliable insulation at service temperatures up to 105 C.

During the past decade, wire and insulation manufacturers have developed many types of magnet wire insulations which are reliable at temperatures over 105 C or satisfy special manufacturing requirements. A number of these are described in Table I.

Only general characteristics are given because the properties vary with formulation, insulation thickness and wire size. Insulations can be upgraded in temperature rating after varnishing or impregnating. When life expectancy is short, further upgrading is possible, as shown in Fig. 1.

Dielectric strength deficiencies are often overcome by impregnants and other supporting insulation. The other properties determine the amount of care required during manufacture of a component.

Even when wire-wound components are not intended for high-temperature environments, high-temperature insulation is sometimes necessary to offset overload, avoid the necessity of dissipating heat or prevent damage from soldering. The net result is often savings in space and weight.

ENAMELS—Wires covered with enamel-type insulations are used whenever possible because of their space factor (ratio of copper section to coil section occupied by the wire as shown in Table 2), their high dielectric strength and their availability in the small wire sizes. Enameled wires are usually easy to wind in tight and unusual shapes because there is little likelihood of the coatings opening on sharp bends.

The problem of unsupported coils opening up has

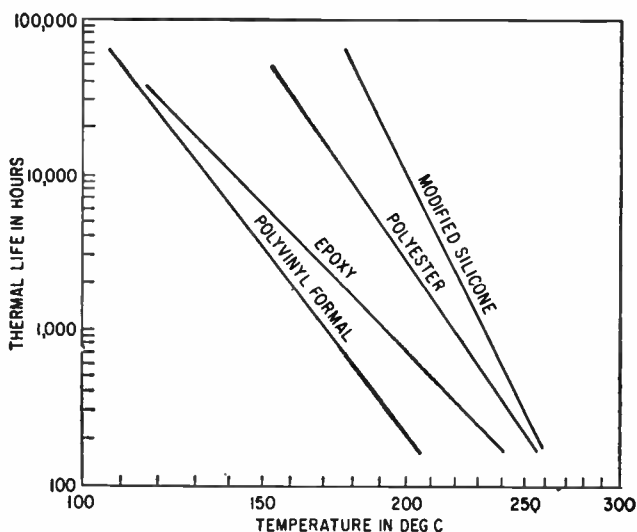


FIG. 1—High temperature life of magnet-wire enamels

TABLE II—Approximate Space Factors

INSULATION	Avg Size					
	18	22	26	30	36	40
Single enamel.....	74	72	70	69	67	67
Heavy enamel.....	70	66	63	60	55	55
Single silk-enamel.....	67	63	56	48	35	29
Single cotton.....	65	56	49	40	25	—
Single cotton-enamel.....	60	53	43	33	20	15
Single glass.....	65	55	49	43	27	—
Single glass-enamel.....	55	46	37	27	15	—
Single silicone-ceramic.....	74	74	73	69	60	56
Single Teflon.....	73	71	69	66	63	62
Ceramic-single Teflon.....	74	74	73	69	62	58
Bare copper wire.....	78	78	78	78	78	78

been solved by application of adhesive coating to enamel. The adhesive is fused by the application of a solvent or heat. Nylon and polyurethane-coated wires can be dip-soldered without stripping. The coating melts at soldering temperatures. Certain polyvinyl-formal based enamels are also solderable.

INORGANICS—An advantage of the inorganic fiber coated wires is the positive spacing which the insulation provides between turns. Even if the bonding material is destroyed by long exposure to heat or chemical action, the inorganic material can keep the turns separated. Glass and asbestos are widely used, although asbestos is not applied to extremely fine wires.

Anodized aluminum wire is now being mass-produced. The coating retains its insulating properties almost to the melting point of aluminum. However, the coating is porous and cracks when bent, so must be treated as a spacer-type insulation. The oxide can be overcoated with a more flexible material. The coating is hard enough for automatic winding, but difficult to remove for soldering.

Aluminum's lower conductivity imposes a space penalty, partially recaptured by the thinness of the oxide coating. A good deal of development is being done in aluminum foil coils insulated by coatings or capacitor-type layer insulation.

Substitution of aluminum, clad copper or silver for copper conductors is a promising method of getting higher temperature performance out of inorganic insulations. Opening of the insulation by oxidized copper is avoided.

In one study made for the Air Force, glass-served nickel-clad copper wire, Awg 28, had an insulation resistance of 3.2 megohms after 1,000 hours at 600 C. Awg 28 glass on silver showed 53 megohms and anodized aluminum, 174 megohms under the same conditions. The glassed wires were treated also with silicone resin.

Digital System Positions

Unique modulator superimposes digitally encoded master shaft positions on a carrier, mixes modulated signal with necessary control data and transmits composite signal at 750 bit-per-sec line rate. Novel agc amplifier and demodulator reforms original signals which are then compared with digitally encoded slave shaft positions. Differences are converted into analog correction signals

By **R. B. PALMITER**,* Chief Electronics Engineer, Electronics Division, American Machine and Foundry Co.

PRIME COMPONENTS of the shaft position data set system discussed here are a transmitter, a voice-bandwidth telephone line and a receiver. Data describing the position of three master shafts as well as all necessary synchronizing and auxiliary information are generated in the transmitter. These signals are then multiplexed into the phone line and sent to the

A data frame describing three shaft positions consists of 64 bits which are divided into four 16-bit words as shown in Fig. 1. The first word is further subdivided into two parts: synchronizing data consisting of a series of six ONES followed by a ZERO and another ONE; and auxiliary data consisting of eight bits set in manually at the transmitter control panel. The re-

signals to the approximate Gaussian waveform shown in Fig. 1.

Transmitter

A block diagram of the transmitter is shown in Fig. 2. A master clock in the programmer generates the 48-kc trigger pulses used for internal data processing and in the count down stages from which the 1.5-kc carrier, the 750 bit per sec line data shift pulses and various other reset and trigger pulses are derived. The programmer also controls the 600-cps ready signal produced by a gated oscillator in the modulator unit.

Internal programming of the shaft 1 encoder takes place at the 48-kc rate, during the 1.33 millisecond required for the 16th bit in the synchronizing and auxiliary word to be presented to the line through the adder and modulator. A reset pulse starts the program by clearing the data register, zero set register and carry trigger pair in the adder.

Then another trigger pulse flashes the strobe lamp in the shaft 1 encoder which generates shaft position information and reads it into the register in parallel, cyclic form.

The strobe trigger pulse is also routed to a shaft 1 zero set switch bank consisting of 16 miniature toggle switches, each of which corresponds to a bit in the shaft position number. Zero correction data is manually set on the switch bank from which it is automatically read into the zero set register.

Immediately following read in,

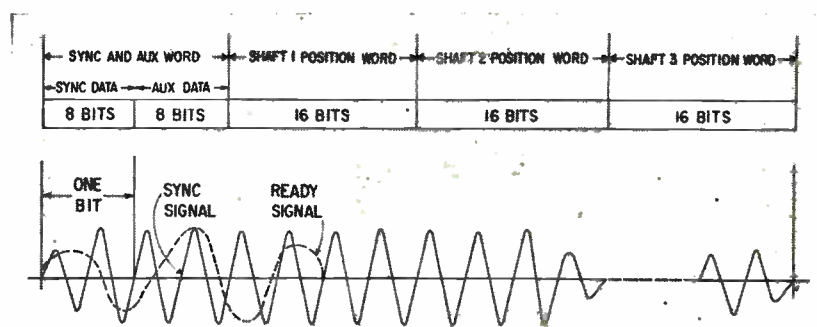


FIG. 1—Data frame (A) describes position of three shafts in binary numbers. Sync and ready signals are shaped to eliminate noise-producing high-order harmonics

remotely located receiver which converts the data into slave shaft displacements corresponding to the master shaft displacements.

Digital data handling circuits used in the system are conventional, hence are not described. Bistable multivibrators and nonreturn-to-zero logic are employed throughout the system. Except for trigger circuits and power supply, the entire system is transistorized.

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maintaining three words each describe a shaft position to one in 2^{16} parts. These data are transmitted on a 1.5-kc carrier at a communications line rate of 750 bits per sec.

Also transmitted is a 600-cps ready signal indicating initiation of a new data frame. This signal appears in 4-millisecond bursts beginning concurrently with the start of the synchronizing signal. To avoid transmission of high-order harmonics on the low-bandwidth line, filter circuits shape both data and ready

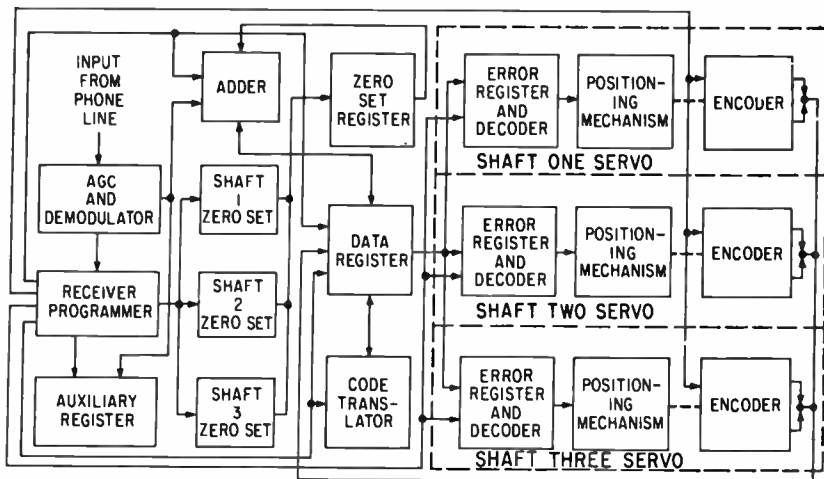


FIG. 4—Receiver shafts are set by transistorized version of conventional tachometer-stabilized servo. Frame length and line data rate establish shaft position sampling rate at 11.7 cps

ately high-Q circuit tuned to 1.5 kc which shapes the input square wave into a 1.5-kc sine wave. The shaped signal is then passed through emitter-follower pair Q_3 and Q_4 to a balanced modulator.

Logic levels from the adder are applied to the balanced modulator through two isolating emitter followers Q_5 and Q_6 . Use of a balanced modulator avoids d-c level shift in the output line signal caused by components of the modulating data wave train.

After being modulated, the sine wave passes through another isolating emitter-follower pair Q_7 and Q_8 to a parallel resonant circuit tuned to 1.5-kc. This filtering device impresses an approximate Gaussian wave form on the modulated line signal thus significantly reducing the harmonic content of the transmitted signal.

Duration of the 4 millisecc ready signal is exactly equivalent to the

first three line bit intervals in the data frame. Dual logic-level gating waveforms defining each of these bits are derived in the programmer and combined in the modulator mixing circuits. Diodes D_1 through D_6 form a 4 millisecc gate which shock excites a 600-cps parallel resonant circuit through the complementary symmetrical transistor pair Q_9 and Q_{10} . The output of the tank circuit passes through emitter-follower pairs Q_{11} through Q_{12} . These tandem-coupled stages provide a high impedance across the tuned circuit and assure sufficient isolation between the output and the input at the point where feedback to the capacitance divider on the tuned circuit is derived. This feedback improves the wave form of the 600-cps signal and will, with the proper selection of the feedback factor, maintain a constant amplitude sine wave. Finally, the ready signal is applied to a Gaussian filter similar

to that described for the 1.5-kc modulator.

The 1.5-kc data and the 600-cps ready signals are passed through isolating emitter-followers Q_{13} and Q_{14} , and individual level control adjustment potentiometers R_2 and R_3 , respectively, to a common summing point. Line level adjustment potentiometer R_1 combines the signals and applies them to divided-load phase splitter Q_{15} , which drives push-pull transformer-coupled amplifiers Q_{16} and Q_{17} .

Receiver

A block diagram of the shaft position data set receiver is shown in Fig. 4. Information from the phone line enters the demodulator and passes through an agc amplifier which has 20 db of dynamic control over a selectable total range of from 0 to -36 dbm. Filter circuits separate the 600-cps ready signal and the 1.5-kc data carrier. These signals are then rectified and shaped to restore the original square wave form of the modulated information introduced at the transmitter.

A synchronizing circuit in the receiver programmer detects the reshaped ready signal and checks for the presence of a synchronizing signal. After performing the synchronizing operation, the receiver programmer emits a series of eight pulses which shift the auxiliary data into the auxiliary data register. The register makes the auxiliary data available through relays by providing parallel outputs to a set of eight relay amplifiers. Time constants in the relay amplifier circuits are adjusted so that the relays will respond to changes in data at any low rate, but not at the

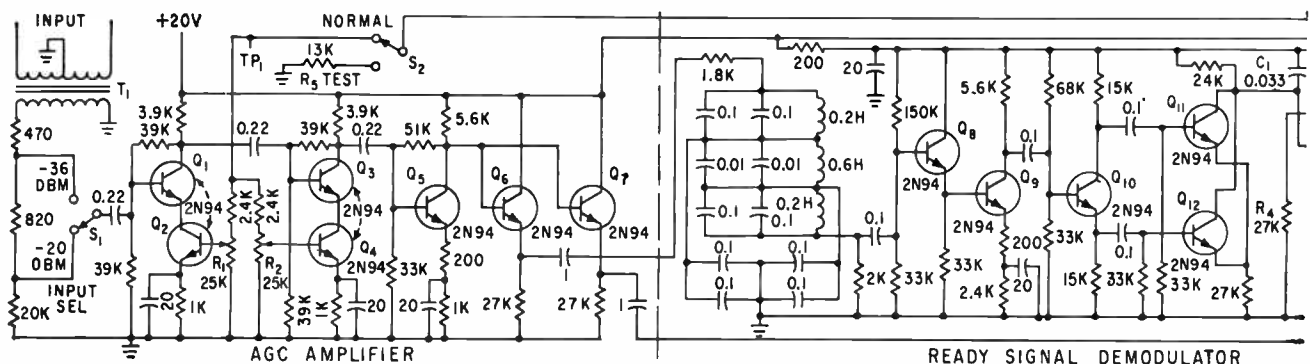


FIG. 5—Gain of the agc amplifier must be adjusted to give a constant output within ± 1 db for a 20-db variation of input signal. This is gain between input from switch S_1 and outputs at collectors of Q_1 and Q_7 , respectively, is obtained. When the output voltage measured across

750-cps line data rate.

Throughout reception of the synchronizing and auxiliary word, no shift pulses are provided, hence, no information can enter the data register. During the time interval required to handle the 16th bit of the synchronizing and auxiliary word, all registers and the carry trigger pairs in the adder are cleared, the shaft 1 encoder position read into the data register and translated, and the zero set shaft 1 number read into the zero set register.

As the shaft 1 position word is received, it is shifted through a four-input adder which accommodates the three primary numbers and the generated carriers. After the 16th bit in the shaft 1 position word has been received, the difference between the transmitted shaft position and the actual receiver shaft position is stored in the data register. This digital error is then shifted, in parallel, to the seven-bit shaft 1 error register which drives a seven-stage digital-to-analog decoder. The decoder develops an analog error signal sufficient to position the shaft 1 servo until the error is reduced to zero.

A similar sequence of events takes place for the shaft 2 and 3 position words. Storage of the error signal from one data frame to the next is provided by the seven-bit error registers, which are more accurate than are holding circuits for the analog error signal.

AGC Amplifier and Demodulator

A schematic of the agc amplifier and demodulator circuit is shown in Fig. 5. Switch S_1 permits manual selection of either a -20dbm or

a -36dbm minimum input signal level to gain-controlled amplifiers Q_1 and Q_2 . Transistors Q_2 and Q_4 serve as emitter resistors whose effective resistance varies as a function of the agc voltage applied to the bases of Q_2 and Q_4 , respectively. The amplified signals are then applied to conventional fixed-gain stage Q_3 , used to drive parallel-coupled emitter followers Q_5 and Q_7 , which feed the 600-cps ready signal and the 1.5-kc data channels.

A 600-cps low-pass filter in the

emitters returned to ground, hence they are virtually cut off. Since Q_{11} and Q_{12} are driven in parallel from the two phases of inverter Q_{10} , the full wave rectified output appears across C_1 . Noise is eliminated by Q_{13} which has fixed emitter bias applied through resistors R_3 and R_4 . By biasing Q_{13} somewhat below cut-off, noise near the reference level of the rectified output is removed. Output from Q_{13} is applied to Schmit trigger circuit Q_{14} and Q_{15} which restores the rectified ready

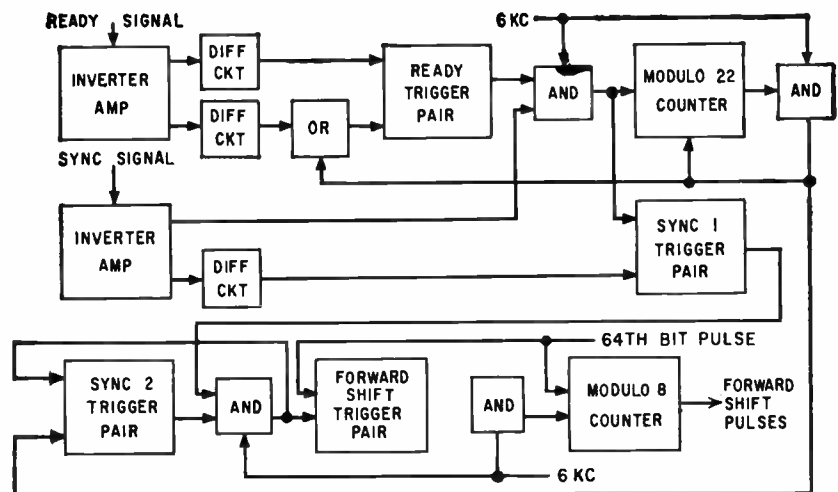
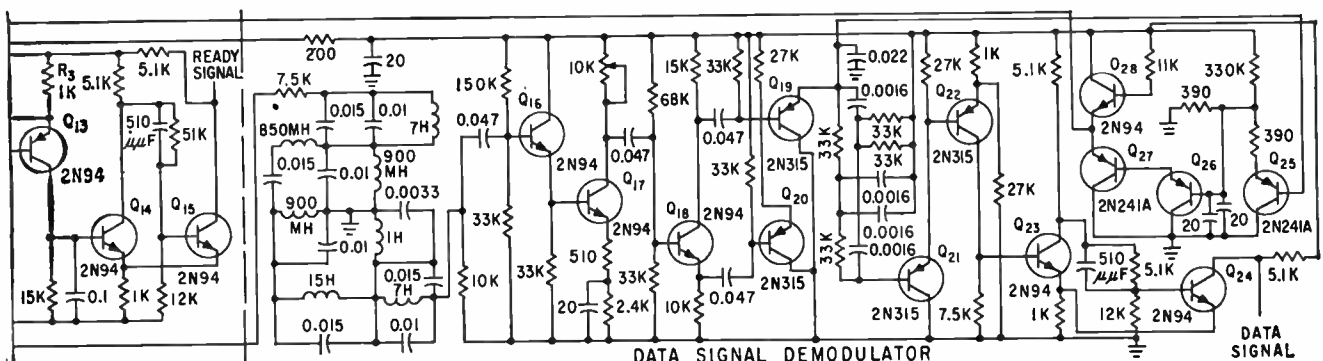


FIG. 6—Receiver synchronizer circuits tolerate a 4-millisecond ready signal delay as compared with the synchronizing signal and provide a high degree of noise discrimination

ready signal demodulator channel removes the 1.5-kc data carrier component from the line signal. Emitter-follower Q_6 provides a high load impedance across the filter while driving amplifier Q_7 . The amplifier output is then fed into split-load phase inverter Q_{10} . Each of the two output phases of Q_{10} drive a collector-detector. Both detector stages Q_{11} and Q_{12} have their bases and

signal to a square wave form.

In the case of the data signal demodulator channel, the 600-cps component of line signal is removed from the data channel with a 1.5-kc band-pass filter. Circuits containing transistors Q_{16} through Q_{20} correspond identically to those containing Q_6 through Q_{12} , respectively, in the ready signal demodulator. The output of detector stages Q_{21}



done by placing switch S_2 in the TEST position, applying an external bias of 13 volts at test point TP₁, and adjusting R_1 and R_2 until unity dummy load R_3 equals the externally applied bias, the correct agc has been established

and Q_{21} is applied to a twin-T filter, tuned to 3-kc, which removes the rectified component of the carrier frequency. After passing through fixed gain stage Q_{21} , used to compensate for the filter insertion loss, the signal is applied to clipping amplifier Q_{22} . Output from Q_{22} actuates Schmitt trigger circuit Q_{23} and Q_{24} , which restores the rectified data signal to a square wave form.

The agc voltage is derived from the 3-kc rectified carrier at a point just ahead of the twin-T filter and applied to emitter-follower detector Q_{25} . To achieve a high impedance across the detector load capacitance, the carrier is applied to emitter-follower stage Q_{26} which is followed by complementary emitter-follower Q_{27} and Q_{28} whose output is the agc control voltage.

Synchronizer

To eliminate necessity for continuous synchronization between transmitter and receiver, the line shift program and, therefore, the receiver's internal data processing program, is started at the beginning of every data frame. This synchronization is accomplished by the system of digital logic shown in Fig. 6.

Synchronizer inputs are the detected and reshaped synchronizing and ready signals from the agc amplifier and demodulator. Each input signal enters an inverter-amplifier which reshapes the transmitted Gaussian modulation envelope to a rectangular waveform.

When the ready signal is received, a trigger pulse is derived from the OFF to ON transition of the ready inverter-amplifier and is used to set the ready trigger-pair. The output from this trigger-pair and the output from the synchronizing signal inverter amplifier form the two controlling inputs to the following

pulse AND gate. Therefore, a train of 6-kc trigger pulses derived from the receiver programmer trigger the modulo 22 counter. This continues for 3.67 millisecc out of the 4 millisecc that both ready and synchronizing signals are simultaneously present at the receiver input. These pulses are also used to reset the synchronizing trigger-pair in preparation for the subsequent synchronizing signal check.

Output from the counter stage enables the AND gate to pass another 6-kc pulse for resetting the ready trigger pair through an OR gate, for resetting the counter and for turning on synchronizing trigger pair number 2.

Use of this counting arrangement provides a simple means for discriminating between a true ready signal and noise on the ready channel. Valid results are obtained regardless of relative ready signal transmission delay with respect to synchronizing signal, so long as the ready signal lies somewhere within the first 6-bit interval of the synchronizing signal.

When a ready signal is present, it is followed by the ZERO and ONE sequence in the last two bits of the synchronizing signal. The appropriate output phase of the synchronizing inverter-amplifier is differentiated and the transition used to turn on synchronizing trigger pair number 1. Inputs from synchronizing trigger pairs number 1 and 2 to the AND gate enable a 6-kc clock pulse to set the forward shift trigger pair and to reset synchronizing trigger pair number 2 which then turns off the AND gate. The forward shift trigger pair permits the following AND gate to pass 6-kc pulses which trigger a modulo 8 counter. A pulse generator driven by the counter produces forward

shift pulses for the data register at 750 cps.

The modulo 8 counter and the forward shift trigger pair are pre-set to a count of four by the last pulse, or 64th bit, in each frame. Since the counter starts its operation on the first 6-kc clock pulse after the start of the eighth bit interval in the synchronizing signal, the forward shift pulses derived as described must lie within $+0$ to $-\frac{1}{2}$ bit of the center of the incoming line-data bit intervals. This synchronizing operation is repeated for every 64-bit frame; therefore, the receiver data sampling pulses will occur well within each line data bit interval. Precise master clock oscillators at both transmitting and receiving locations are not required.

Decoder

Receiver shaft position error is transferred from the data register to a seven-bit error subregister and converted to an analog error signal by the seven-stage decoder shown in Fig. 7. Since all seven stages function identically, only the stage with 2^0 — a logic-level input will be discussed.

If the input logic level is high, the output of Q_1 is low, Q_2 is cut off and Q_3 conducts. Current then flows from the -6 -volt supply through D_2 and Q_3 to the -10 volt supply clamping the junction point between D_1 and D_2 at -6 volts. Conversely, if the input level is low, Q_1 and D_2 are cut off and Q_2 conducts. Current then flows from the $+10$ volt supply through Q_2 and D_1 to the $+6$ volt supply clamping the junction point at $+6$ volts. This action determines the output polarity. Magnitude of the output current is established by the value of weighting resistor R , which is tied to the common summing point for all decoder stage currents.

Potentiometer R_2 provides a bias adjustment to compensate for two independent phenomena: the unit error which arises from certain combinations of input values sent to the adder and the quantized nature of the error signal.

The author acknowledges the guidance of J. Buegler, the efforts of J. DeClue, R. Dolbear, W. Fenter, R. Leighou, H. Nagle, R. Young and H. Zitzow.

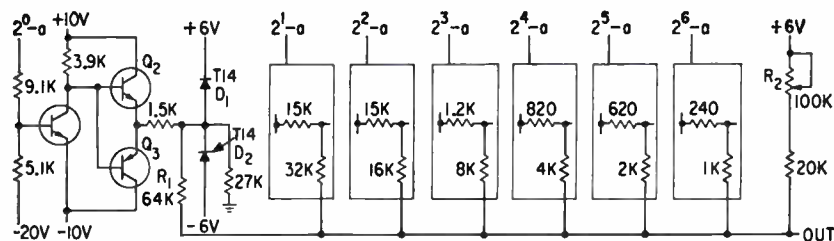


FIG. 7.—Decoder output voltage is a direct function of both sign and magnitude of the digital input number for either positive or negative numbers. Low impedance offered by common junction point of weighting resistors permits accurate summation

Tailor-Made Ferrites

Wide-ranging magnetic properties of ferrites allow their use at frequencies from d-c, in motors, to microwave. One common advantage is high resistivity

FERRITES are one of the few basic materials created for electronics. Except for permanent magnet types, ferrites are used almost exclusively by our industry.

In addition to nickel, zinc, manganese and magnesium, other materials such as copper, cobalt and cadmium, with divalent ions, can be used to form ferrites. Combinations of trivalent and monovalent ions can be substituted for divalent ions or a trivalent ion can replace part of the trivalent ion in the ferrite.

Addition of cobalt, for example, will narrow the hysteresis loop while copper reduces dielectric losses. Aluminum will cut down saturation magnetization while rare earths provide the narrower resonance line widths desired in microwave ferrites.

Table I indicates the wide ranges of values reported for the most commonly used ferrites and Table II gives general uses. There are about 100 other variables and constants which can be used to describe the properties of ferrites, or ferrite components.

PROPERTIES—But while the properties can be varied widely, choice of values is more restricted. As permeability rises, for example, Q and Curie temperature may drop. Hexagonal ferrites have retained a permeability of 10 to a frequency of 1,000 mc.—G.S.

TABLE II—Typical Applications of Ferrites

Ferrite	Freq	Initial μ	Components
Mn-Zn Ni-Zn	15-100 kc	> 750	Flyback transformers, deflection yokes
Mn-Zn	5-500 kc	1,000	Wideband transformers
Mn-Zn	to 1 mc	>1,000	Pulse transformers, inductors
Mn-Zn	to 15 mc	2,500	Wideband transformers
Ni-Zn	15-100 kc	>3,000	Pulse transformers, small coils
Ni-Zn	100-500 kc	2,500	Filter inductors, wideband transformers, small coils, antennas, cup cores, magnetic amplifiers
	10 kc-2 mc	500	
	1-15 mc	50	
	20-50 mc	15	
Ni	>25 mc	50	high frequency inductors, tuning plugs, attenuators, modulators and switches
Mg-Mn	pulse		Memory cores, switching, mag. amps.
Ni Ni-Zn			Magnetostrictive Properties
Ba			Permanent magnet Properties
			Transducers, filters, delay lines, oscillators
			Magnetostrictive traveling wave tubes, loudspeakers

TABLE I—Properties of Ferrites Developed for Electronic Applications

Ferrite Class	Initial Permeability	Maximum Permeability	Sat. Flux Density (gauss)	Residual Flux Density	Coercive Force (oersted)	Resistivity (ohm-cm)	Curie Temp (°C)
Ni-Zn ^a	7-6,000	200-12,000	1,750-4,200	500-2,400	0.04-14	10-10 ⁷	70-600
Ni-Zn (stressed) ^b	2,500	37,000	1,870	1,460	0.03	—	70
Mn-Zn ^a	500-2,500	1,500->2,500	3,300-5,100	1,100-1,200	0.1-0.5	20-100	100-210
Ni	15	100	2,500	1,400	14	10 ⁶	585
Mg-Mn ^b	40-50	350-1,800	1,600-2,250	1,530-2,150	0.65-2.5	>10 ⁶	150-300
Ba (isotropic) ^{c,d}	—	—	—	1,800-2,100	1,600-1,750	10 ⁶	450
Ba (oriented) ^{c,e}	—	—	—	3,100-3,900	1,600-2,000	2 × 10 ⁴	450

Ferrite Class	Hysteresis Coeff (× 10 ⁶)	Eddy Current Coeff (× 10 ⁹)	Magnification Factor (μ Q) (× 10 ⁻³)				Sat. Magnetostriction (× 10 ⁶)
			10 kc	100 kc	1,000 kc	10,000kc	
Ni-Zn	3.6-50	0.1-3.5	7.5-50	7.5-30	1.8-12	0.2-5	-4 to -22
Mn-Zn	1-1.6	0.3	300-500	150-200	9-10	0.05	-0.5
Ni	50	0.1	2-3.8	2-3.2	2-3.2	1.6-2 ^f	-25

^a Values depend on proportions of prime materials and/or other oxides added

^b Square B/H loop ^c Permanent magnet materials ^d BH_{max} is 0.8 - 0.95 × 10⁶

^e BH_{max} is 2.75 - 3.5 × 10⁶ ^f 500 at 50 mc

Close frequency control of transmitter and receiver local-oscillator klystrons in a six-kmc microwave link is achieved using magnetic amplifiers and transistors. Overall system is for use in toll telephone and similar services handling up to 240 voice channels over a few miles

By MAURICE C. HARP, Lenkurt Electric Co., Inc., San Carlos, Calif.

Nonvacuum Devices

REFLEX KLYSTRONS are well established as reliable and economical sources of microwave power. In critical applications, maintaining accurate and reliable frequency control with these tubes has been a problem.

Aging and thermal drifts of the L-C oscillating tank (in this case, a cavity internal to the tube) and the fact that operating potentials pull

the frequency are two main problems. Frequency pulling is basic to the tube because operation is dependent upon an electron-beam drift time. This, in turn, is established by the potentials applied to the resonator and particularly the reflector (repeller) element.

The six-kmc microwave link under discussion uses a VA-222 power tube which must dissipate some 60

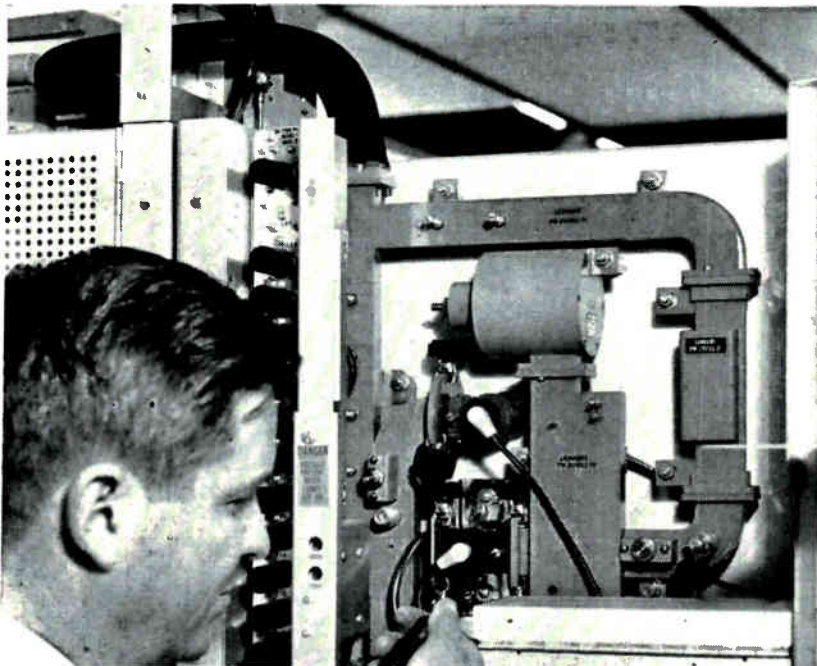
watts continuously. Voltage/frequency control characteristics of the reflector are about five times more sensitive than the resonator. The power-supply arrangement supplies the resonator through a nominal amount of regulation.

Magnetic-Amplifier Regulation

Figure 1 shows how the basic magnetic-amplifier regulator is connected to supply several rectifier circuits. Rectifiers with associated filter circuits are connected in series to provide various voltages required by the klystrons.

In the schematic diagram of Fig. 2, the main regulation magnetic amplifier is identified as MA-REG. Two separate Deltamax cores with identical windings operate through gating diodes on alternate half-cycles to provide full-wave operation. Load current at the start of each half-cycle is small because of the large reactance of the amplifier winding. As the flux in the core reaches saturation, the reactance drops drastically, gating the load current full on. The magnetic gating action is called firing because of the similarity to the action in thyatron control operation.

While one core is operating to supply power to the load, the opposite core is being reset. A small current flows through the 1,000-ohm resistor, shunting the diode gate.



Transmitting klystron being tuned in one transmitter-receiver of a diversity pair. At right center is the discriminator, framed by waveguide, with the cylindrical cavity above it

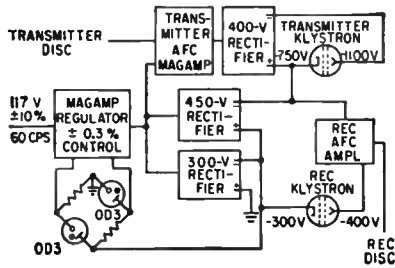
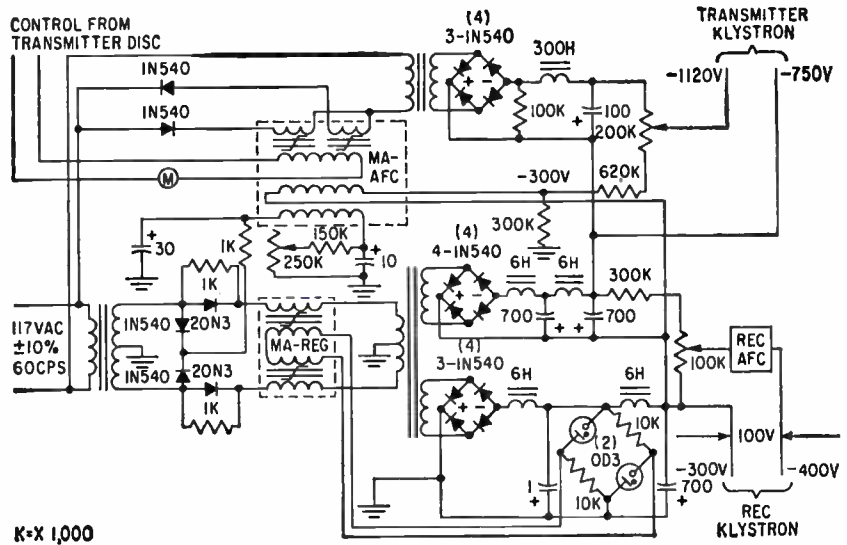


FIG. 1—Block diagram showing stacking arrangement used to obtain the various regulated voltages

FIG. 2—Schematic diagram of the power supply including the transmitter afc magnetic amplifier



Control Klystrons

This current shifts the core flux away from the saturation state where it was left at the end of its conducting half-cycle. Any increase in supply potential causes the reset action to move the starting point of the following conduction half-cycle further from saturation. It is this variable conduction time which provides the regulating control to the magnetic-amplifier output.

To further enhance the regulation, control windings have been added which are connected back to a bridge using two OD3, 150-v regulator tubes for reference. As long as the rectifier output is exactly 300 v, the bridge is balanced. Any direct-voltage change unbalances the bridge delivering current to the control windings of appropriate polarity to shift the firing point of the cores toward correcting the error.

Voltage Stability

Long-term stability of the regulator depends upon the OD3 reference tubes. Stability is good since the tubes are in continuous service at relatively constant current. Stabilization of d-c output for a-c line variation of ± 10 percent is better than ± 0.3 percent. A step change of 10 percent on the a-c line causes a surge in the d-c output of 0.6 percent for a period of about

0.5 sec. This surge regulation is achieved by a combination of three-cycle magnetic-amplifier attack time plus a large energy storage factor in the rectifier filters.

The repeller supply voltage for the transmitter klystron is subject to further regulation by a secondary magnetic amplifier designated

MA-AFC. The normal condition for this winding is zero control current with nominal a-c line voltage.

The second winding passes a continuous bias current which operates to reset the cores during their off cycle. Since the source of bias current is an unregulated rectifier, changes in a-c line voltage provide a change in bias which over-regulates the repeller voltage. The amount of over-regulation is set on a 100,000-ohm control as part of initial line-up. Sudden changes in source voltage are integrated by the 10- μ f capacitor to provide a hurry-up kick to the control current on this winding as an aid to fast regulation recovery.

Regulation

These regulator circuits are effective in maintaining stable frequency transmission during a-c line variations. With transmitter afc disabled, slow a-c line voltage variations of ± 10 percent result in typical frequency pulling of under 0.5 mc at 6,000 mc. Step changes

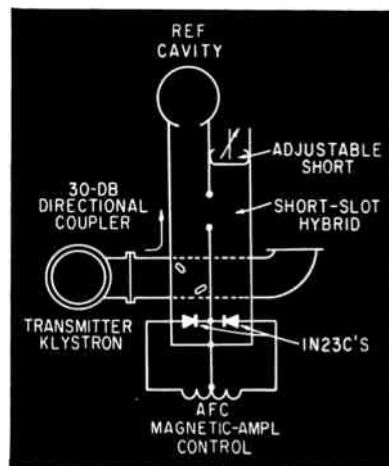


FIG. 3—Transmitter waveguide discriminator uses a single high-Q stabilized cavity

MA-AFC in Fig. 2. Internal operation of this magnetic amplifier is similar to the main regulator except that control is supplied from three sources to three control windings.

Two of the control windings are used to create the slight over-control regulation characteristic neces-

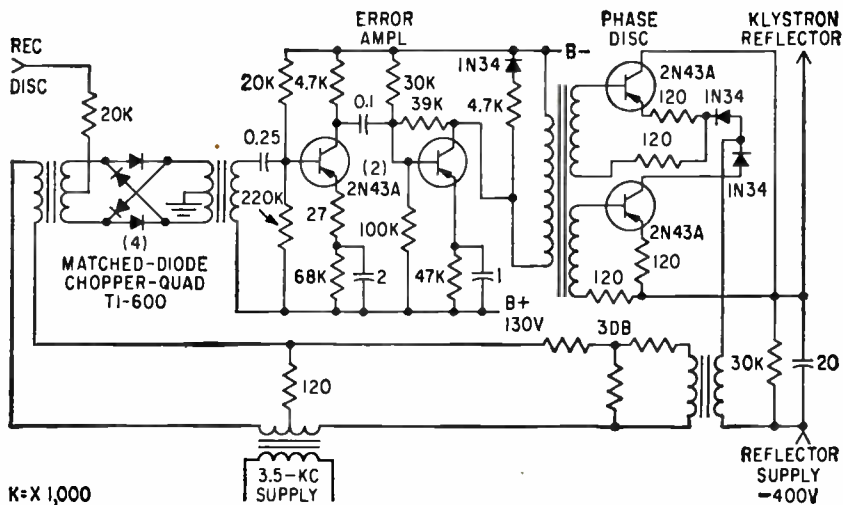


FIG. 4—Receiver automatic-frequency-control amplifier schematic

of 10 percent may cause as much as 1.5-mc momentary error.

In addition to the voltage problem, the klystron may drift as much as three mc at temperature extremes. These changes are detected in a microwave discriminator which feeds a current proportional to the error back to the tertiary control winding. This arrangement completes a negative feedback loop to provide a voltage control action reducing klystron frequency error with a correction stiffness of greater than 10 to 1. Metering provision is included so that klystron frequency drift is indicated as an off-zero reading of afc control current.

Transmitter AFC

The transmitter afc control current originates in a Pound-type microwave discriminator. Inner circuit arrangements of the discriminator are shown in Fig. 3. The 30-db directional coupler bleeds about one mw of transmitter power out of the main waveguide branch into the discriminator circuit. Power is split two ways in the short slot hybrid so that reflections are taken from both the reference cavity and the adjustable short circuit. These two reflections reenter the hybrid from where the discriminator detecting diodes are fed.

With the reference cavity adjusted carefully to the required transmitting channel frequency and the klystron on frequency exactly, the adjustable short is set so that equal power reaches each of the

diodes. Because the reference cavity is a high-Q device, a small change in klystron frequency will result in a rapid change in the phase of its reflection. The short circuit will not change reflection phase. On reentering the hybrid, this new phase relationship causes the power to add at one diode and cancel at the other.

Heart of the afc circuit is the reference cavity. The barrel of the cavity is machined from a block of Invar to achieve a temperature stability of about three parts in 10^6 per deg C. Initial Q of the cavity is about 20,000 but loading from the associated circuits yields an operating Q of about 1,000. This loading is necessary to yield a discriminator of about six-mc peak-to-peak response so that the afc circuit will seize control quickly and with certainty on a cold startup. In normal operation, the afc will control the frequency to within 0.6 mc under the combined effects of line voltage and temperature changes. This control is about five times better than the FCC requirement of 0.05 percent and is considered desirable from a spectrum usage economy viewpoint.

Receiver AFC

The receiver local-oscillator klystron (l-o) is frequency-controlled by a different technique. The available afc control signal from the receiver discriminator is only about five μ a/mc error and requires high amplification. Since high-gain magnetic amplifiers tend to be slow in

action, a different afc approach is used for the l-o.

The amplifier is chopper-stabilized and uses the circuit shown in Fig. 4. The input chopper is a balanced silicon-diode modulator lattice which is excited at 3.5 kc by a transistor oscillator. Only the presence of an error signal from the receiver discriminator will unbalance this net to pass the 3.5 kc on to the following amplifier. Sign of the error signal determines whether the unbalance signal will be of positive or negative phase. A carefully matched diode quad is required to avoid initial unbalance in the absence of input signal over the expected temperature range.

The 3.5-kc error signal out of the chopper is amplified in the two-stage transistor amplifier. No critical requirements for stability, distortion or frequency response are demanded of this portion of the circuit.

Amplified error signal from the amplifier is fed to an amplifying phase discriminator. This circuit uses transistors on a half-wave basis. The two transistors are powered, collector to emitter, on alternate half cycles at 3.5 kc from the carrier oscillator. The error amplifier output gates both transistors, base to emitter, on alternate half cycles. Depending upon error-signal phase, one or the other of the transistors will conduct. This conduction flows through the common 30,000-ohm load with the direction of the current in the load reversing for a reversal of signal phase. Since the phase discriminator needs no d-c supply, the whole circuit is divorced readily from ground potential. This permits connection of the afc output voltage directly in series with the 400-v l-o repeller supply to add or subtract the necessary correction voltage.

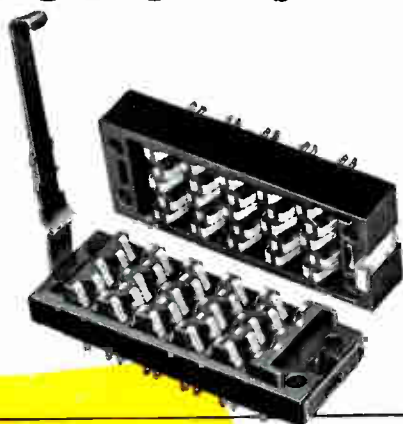
In operation, the speed of attack of the receiver afc circuit has been set to about 0.1 sec—substantially faster than the one-sec time constant of the minor transmitter frequency variations caused by line-voltage bumps. This technique insures that the received signal will be kept in tune to an accuracy exceeding ± 0.3 mc at the receiver i-f regardless of transmitter and receiver l-o klystron drift.

CINCH HINGE CONNECTORS

PLUG AND SOCKET SHOWING CONTACT ARRANGEMENT

Patent Pending

The top section of the lock fits into a slot in the top of the cap forming a perfect lock which cannot be accidentally opened, as shown below. Lifting up top section releases same prior to unlocking.



**INSURE POSITIVE CONTACT;
HAVE SIMPLE LOCKING DEVICE,
EASY RELEASE. MAXIMUM
NUMBER OF CONTACTS
IN MINIMUM SPACE**

The plug and socket units of the "H" Series are easily engaged with normal pressure and the lock holds them securely together. Releasing the lock the units separate by the spring action of the contacts. A simple locking device insures positive contact. Wiping contact action keeps contacts clean at all times. Either the plug or socket body fit into the cap. Cable entrance hole can be placed at the one end, or in the top, or both. Cover is finished in black wrinkle and the cable clamps are cadmium plated. Contact tails will take either conventional solder wiring or AMP "78" series Taper Tab receptacles.

Standard units are supplied with general purpose Bakelite insulation and cadmium plated contacts.

For more severe conditions of temperature and humidity we have available glass filled Diallyl-phthalate insulation (Type GDI-30 per Mil. M-19833). Contacts can be supplied with gold plate over silver.

The plug or socket bodies can be ordered from the code numbers listed. The one that is attached to the chassis should have the lock attached. If an insulating liner is required in the cover, suffix L should be added to the Code Number.

The cap is ordered according to the number of contacts required. Then the letter L designating the liner. The letter giving hole size follows. Then the letter indicating the location of the hole; either T for top, or E for end, and if a cable clamp is required, the letter C is added.

For example, if a 50 contact unit is required with cover, having a 3/4" hole in the top with a cable clamp and liner, the code would be 24540-LBTC. The chassis socket would be 24495 and the plug for the cap 24504.

The Cinch "H" series is made in 20 to 100 contacts, in multiples of 10 contacts. (20, 30, 40, etc.)

Socket with Lock

Code No.	Contacts	Dimensions Mtg. Centers	Overall
24492	20	1.375	1.750
24493	30	1.812	2.187
24494	40	2.250	2.625
24495	50	2.687	3.062
24496	60	3.125	3.500
24497	70	3.562	3.937
24498	80	4.000	4.375
24499	90	4.438	4.812
24500	100	4.875	5.250

Socket without Lock

Code No.	Contacts	Dimensions Mtg. Centers	Overall
24484	20	1.375	1.750
24485	30	1.812	2.187
24486	40	2.250	2.625
24487	50	2.687	3.026
24488	60	3.125	3.500
24489	70	3.562	3.937
24413	80	4.000	4.375
24490	90	4.438	4.812
24491	100	4.875	5.250

Plugs without Lock—Mates with above

Code No.	Contacts	Dimensions Mtg. Centers	Overall
24501	20	1.375	1.750
24502	30	1.812	2.187
24503	40	2.250	2.625
24504	50	2.687	3.062
24505	60	3.125	3.500
24506	70	3.562	3.937
24507	80	4.000	4.375
24508	90	4.438	4.812
24509	100	4.875	5.250

Plug with Lock—Mates with above

Code No.	Contacts	Dimensions Mtg. Centers	Overall
24476	20	1.375	1.750
24477	30	1.812	2.187
24478	40	2.250	2.625
24479	50	2.687	3.026
24480	60	3.125	3.500
24481	70	3.562	3.937
24412	80	4.000	4.375
24482	90	4.438	4.812
24483	100	4.875	5.250

50 CONTACT ASSEMBLY WITH CABLE CLAMP



Caps for Plugs or Sockets without Locks

Code No.	Contacts	Hole Size	Mtg. Ctrs.	Overall
24537	20	A or B	1.375	1.750
24538	30	A B or C	1.812	2.187
24539	40	B or C	2.250	2.625
24540	50	B or C	2.687	3.062
24541	60	B C or D	3.125	3.500
24542	70	B C or D	3.562	3.937
24543	80	B C or D	4.000	4.375
24544	90	C D or E	4.437	4.812
24545	100	C D or E	4.875	5.250

Cap Hole Size Cable Clamp Size

Letter	Dimension	
A	1/2" dia.	Small
B	3/4"	Small
C	13/16 x 1	Medium
D	13/16 x 1 1/2	Medium
E	13/16 x 1-11/16"	Large

Electrical Rating

	Volts AC RMS	DC
Adjacent Terminals	930	1300
to Ground	1400	2000
Current Rating	4.5 Amperes	
Contact Resistance rated current @	.020 ohms	
Insulation Resistance	1000 megohms	
Capacitance adjacent contacts	.75 MMF	

Components shown
reduced in size

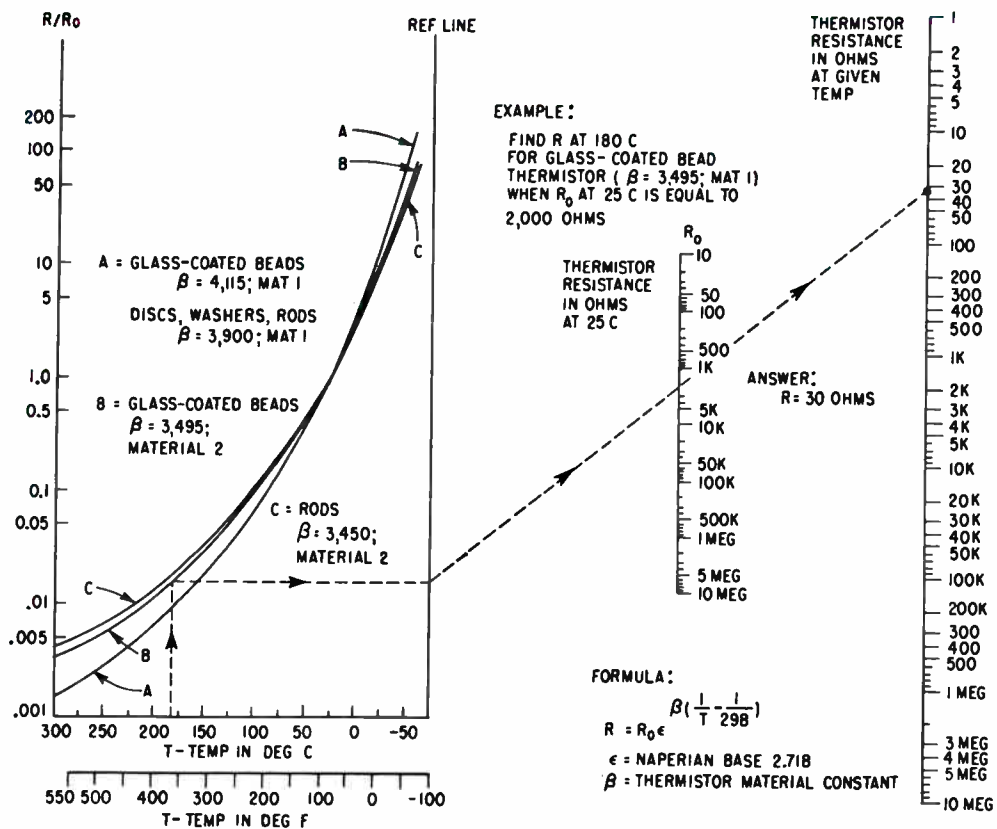
Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; La Puente, California; St. Louis, Missouri



Cinch
ELECTRONIC
COMPONENTS

CINCH MANUFACTURING COMPANY

1026 South Homan Ave., Chicago 24, Illinois
Division of United-Carr Fastener Corporation, Boston, Mass.



Thermistor Data Chart

Chart quickly spots thermistor resistance values at desired application temperatures for standard thermistor types

By A. E. LAWSON, JR, Chief Engineer, Fenwal Electronics Inc., Framingham, Mass.

SELECTING THERMISTORS for temperature compensation, measurement and control requires analysis of resistance at known application temperatures.

The accompanying nomograph is a timesaver for solving the thermistor resistance formula given on the chart. Resistance R_0 and thermistor constant β are commonly given for each thermistor type and so are curves of resistance ratio R/R_0 .

Representative nominal magnitudes of β are given on the

graph for the various forms of the two thermistor materials. All thermistors of either material have β values close to the indicated nominal. It is possible to interpolate on the graph for actual values of β that vary significantly. However the ratio R/R_0 is a more useful characteristic in selecting thermistors.

Example

In the example given on the chart, a vertical line is drawn to curve B and from this point

horizontally to the reference line. A line drawn from this point on the reference line to 2,000 ohms on the R_0 scale, intersects the R scale at 30 ohms.

Conversely, to find R at 25 C when a thermistor resistance of 30 ohms is needed, the line crosses the R_0 scale at 2,000.

Limitations of thermistor types are described in manufacturers catalogs. After a particular value is found with the chart, the user should check the catalog to see if it is feasible.

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DIGITAL VOLT-OHM METERS



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FULLY TRANSISTORIZED

No Stepping Switches • No Relays

● **VERSATILE** accurately measures both resistances and AC-DC voltages and counts external events, too! Directly drives printers, punches and memory storage units and can be directly used as a bi-directional tele-meter.

● **FAST** less than 2 millisecond reading time . . . up to 100 completely independent measurements per second for any system use.

● **EASY TO READ** in-line, in-plane visual display . . . lamp life up to 10,000 hours . . . numerals 1 1/8 inch high . . . automatic indication of polarity, decimal point and mode of operation

True dependability and versatility have at long last come to digital volt-ohm meters in EPSCO'S new DVOM. Fully transistorized . . . adjustment-free . . . no stepping switches or relays. Provides precise numerical measurement of AC-DC voltages, resistances . . . fast, accurate visual or printed quality control data . . . high-speed data acquisition for direct print-out or storage . . . remote indication and data transmission over a single line. Compact, lightweight, portable — also for rack-mounting. Write for Bulletin 95801, Epsco, Inc., Equipment Division, 588 Commonwealth Ave., Boston 15, Mass.; in the West: Epsco-West, 125 E. Orangethorpe Ave., Anaheim, California

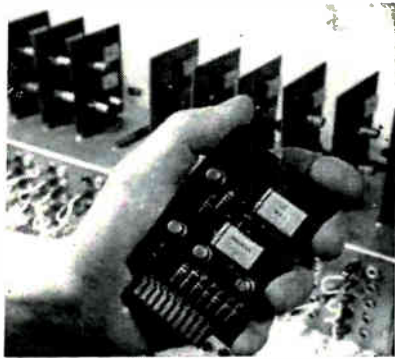
DVOM price \$1,475

Ask for a demonstration.



First in data control

Artificial Neuron Uses Transistors



Elements of electronic nerve cell are mounted on printed-circuit card for ease of handling. Network of such cells can be seen in background

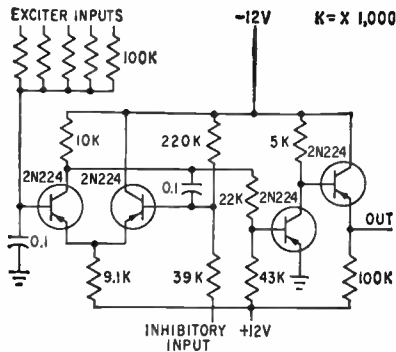


FIG. 1—Simple transistor circuit simulates many of the functions of nerve cells of the eye and ear. Groups of the cells can be combined to form simple nerve systems

ELECTRONIC circuit, developed at Bell Telephone Labs, simulates some functions of individual biological nerve cells (neurons). Numbers of the artificial cells are being combined into experimental networks that are roughly analogous to the nerve systems of the eye and ear.

Scientists are especially interested in discovering how visual and auditory nerves function and how their signals are interpreted by the brain.

The circuit shown in Fig. 1 delivers 6-millisecond pulses, considerably longer than the biological cell, but they can be shortened. If the circuit is driven by a constant

stimulus, simulating receptor cells of the eye or ear, trains of pulses are emitted. Higher intensity excitation increases frequency; and when the neuron is excited continuously, frequency can be made to decrease with time, exhibiting accommodation as a living nerve cell does.

Input Threshold

Input must, as in a biological cell, surpass a threshold value, and the cell will integrate two or more input pulses below threshold value to cause firing. A particular input connection can also, while energized, inhibit firing of the neuron by other inputs. Similarly, immedi-

ately after firing, the electronic neuron's threshold rises to infinity and for a few milliseconds no input signal can fire the neuron again.

The cell has an integrating time constant of two milliseconds and a refractory time constant of about ten milliseconds, approximating time constants of the biological neuron. Because the electronic inputs and outputs are compatible, the cells can be assembled into chains and networks.

Electronic neurons can be combined with photo-resistive cells to simulate simple functions of nerves in the retina. Some receptors (on receptors) fire only when light intensity is increasing, off receptors fire only when light is decreasing and during receptors fire while light is steady.

Flicker-fusion phenomena have also been produced. In the human eye, these cause a sequence of flashes to be seen as continuous illumination.

Mutual inhibition of cells in an array has been demonstrated experimentally. Some animals have been observed to possess this arrangement, in which a cell receiving greater light inhibits firing of nearby cells that receive less light. Result is local sharpening of image boundary detail.

Polarimeter Provides CRT Presentation

POLARIZATION characteristics of an electromagnetic wave can be seen directly on a crt. Key to the technique is the trimode turnstile wave guide junction.

The new microwave polarimeter technique uses both phase and amplitude information to provide an accurate, instantaneous presentation of input signal polarization characteristics.

Trimode Turnstile Junction

The trimode turnstile junction shown in Fig. 1 is a 7-port hybrid device that couples three different

transmission-line modes in a variety of ways. The junction can be matched for any two, but not for all three modes simultaneously.

The coupling properties of the trimode turnstile junction make it ideally suited to a precision dual balanced mixer. The rectangular waveguide at the bottom is an end-on waveguide-to-coax transition to port 7 and serves as the local oscillator input.

When an electromagnetic wave of arbitrary polarization is introduced into the circular waveguide arm in which the coaxial and circular ports

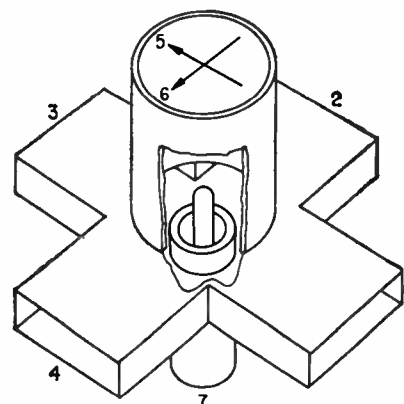
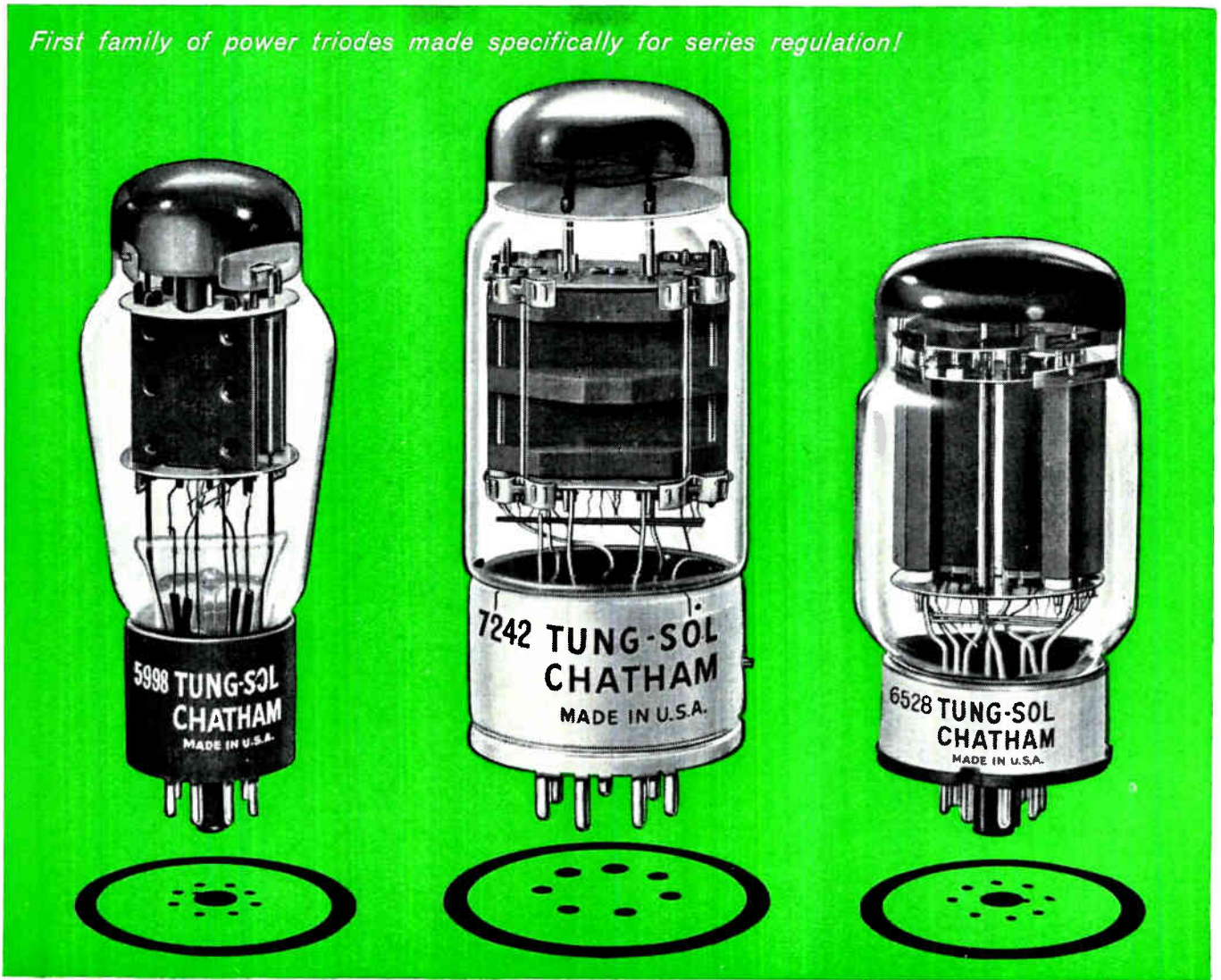


FIG. 1—Trimode turnstile waveguide junction has 7-port hybrid junction and couples 3 transmission-line modes

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heater versions available on most types. All embody sturdy construction features that contribute to overall ruggedness and long hours of heavy-duty operation.

Compare the ratings below against your particular application! If you desire complete data sheets . . . or you have a specific design problem, contact us today! We'll be glad to give whatever assistance we can. Just write: Tung-Sol Electric Inc., Newark 4, N. J., Commercial Engineering Offices: Bloomfield and Livingston, N. J., Culver City, Calif., Melrose Park, Ill.

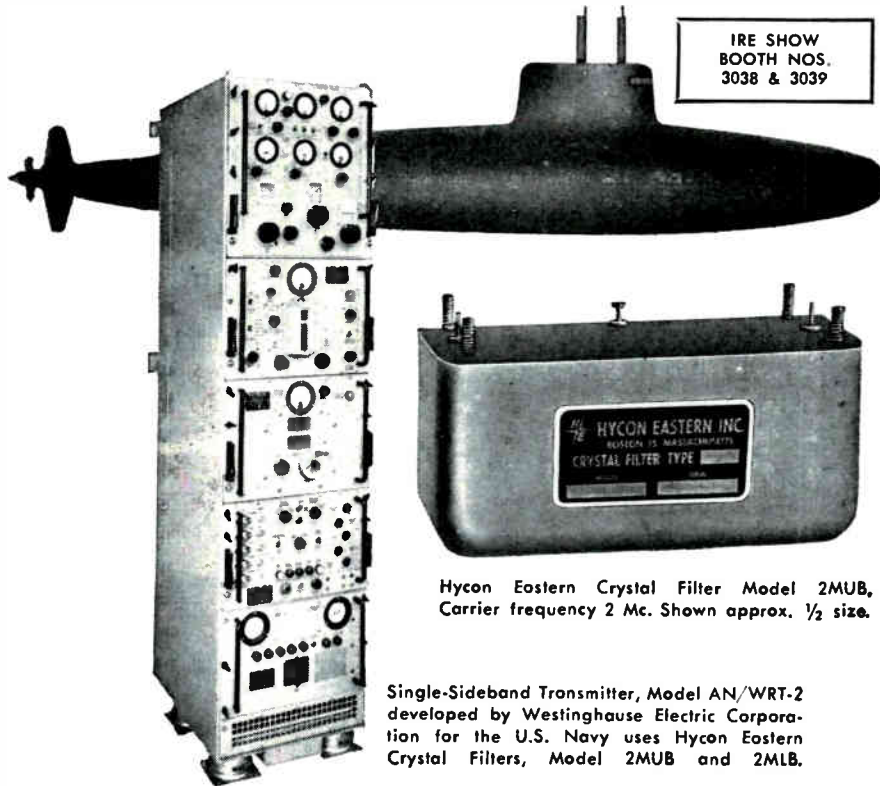
TYPICAL VALUES				
	Total Plate Current	Range of Tube Voltage Drop	Minimum Tube Drop	Grid Voltage Swing
5998	200 ma	80 v	45 v	20 v
6528	400	65	70	10
7242	600	80	70	13

PERTINENT CHARACTERISTICS PER TUBE				
	Max. Plate Current	Max. Plate Voltage	MU	Gm
5998	280	275	5.5	28,000 umhos
6528	600	400	9.0	74,000 umhos
7242	900	400	9.0	111,000 umhos

TUBE TYPES BY PLATE DISSIPATION RATINGS			
Total Plate Dissipation	26 to 30 W	60 W	100 W
Low Mu	6AS7G, 6082 6080WA, 7105	6336A 6394A	7241
Medium Mu	5998	6528	7242

TUNG-SOL®

FIRST Navy Militarized SSB Transmitter Generates Cleaner Signal Using HYCON EASTERN CRYSTAL FILTERS



Hycon Eastern Crystal Filter Model 2MUB, Carrier frequency 2 Mc. Shown approx. 1/2 size.

Single-Sideband Transmitter, Model AN/WRT-2 developed by Westinghouse Electric Corporation for the U.S. Navy uses Hycon Eastern Crystal Filters, Model 2MUB and 2MLB.

Recently installed on the atomic submarine SKIPJACK (SSN585), the Westinghouse Electric AN/WRT-2 SSB Transmitter is soon to be standard Navy equipment.

Single sideband signals are generated in the AN/WRT-2 by the selective filter method employing Hycon Eastern 2MUB and 2MLB Crystal Filters. These 2.0 Mc Crystal Filters not only offer all the basic advantages of the filter SSB generation method, but reduce the number of heterodyning stages required to translate the modulated signal to the required output frequency. The attendant decrease in unwanted signal generation results in a cleaner signal. The AN/WRT-2 is also a more reliable transmitter because fewer components are used.

In addition to the 2.0 Mc Crystal Filters, Hycon Eastern has also supplied SSB units at 100 Kc, 1.75 Mc, 3.2 Mc, 10 Mc and 16 Mc. These Crystal Filters are presently installed in airborne HF, mobile VHF and point to point UHF SSB systems.

Whether your selectivity problems are in transmission or reception, AM or FM, mobile or fixed equipment, you can call on Hycon Eastern engineering specialists to assist you in the design of your circuitry and in the selection of filter characteristics best suited to your needs. Write for Crystal Filter Bulletin to Hycon Eastern, Inc., 75 Cambridge Parkway, Cambridge, Mass.

A limited number of opportunities are available to experienced circuit designers. Send resume to Dr. D. I. Kosowsky.



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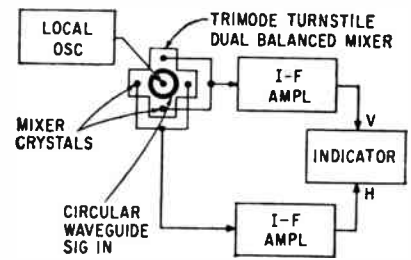


FIG. 2—Simple arrangement permits crt display of polarization characteristics

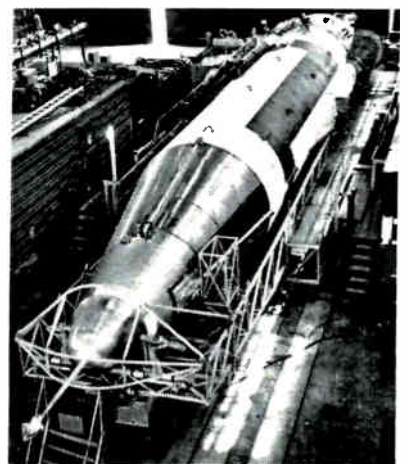
are matched, arrows 5 and 6 represent orthogonal components of the input signal, which are not necessarily equal nor in phase. On entering the junction, component 5 divides equally but out of phase between arms 1 and 3. Similarly, component 6 divides equally but out of phase between arms 2 and 4.

Local oscillator input to port 7 divides equally and in phase between the four rectangular arms 1, 2, 3 and 4. Mixer crystals attached to all four rectangular arms, equidistant from the junction, will be excited in phase by the local oscillator input, while opposing crystals can be combined to obtain balanced mixer operation by using reversed matched crystals connected in d-c series with a simple shunt connection for single-ended i-f output.

Trimode Turnstile Polarimeter

With linear mixing, phase and amplitude relationships of the

Atlas Gets Final Check



Acceptance tests of an Atlas missile are underway as it lies in its carrier. Costly electronics associated with missile include Burrough's ground guidance computer which steers missile through initial stages of flight

orthogonal components of the input signal will be accurately preserved in the i-f outputs of the two balanced mixers.

The i-f signals are used to make polarization characteristics of the input signal visible using the arrangement shown in Fig. 2. Typically, the two i-f signals are applied to orthogonal deflection planes of a crt, after amplification, to obtain a Lissajous figure that represents input signal polarization.

A circularly polarized input will generate a circle, elliptical polarization an ellipse that portrays axial ratio and orientation and linear polarization a line oriented to indicate plane of polarization.

Excellent presentations have been obtained using separate reflex klystrons for signal source and local oscillator. They are tuned to produce an i-f beat that is within the passband of the scope amplifiers. Satisfactory results were obtained without afc.

This material was abstracted from NRL Report 5214, An Instantaneous Microwave Polarimeter Technique by P. J. Allen and R. D. Tompkins of the U.S. Naval Research Laboratory.

Unit Reduces Required Tv Scan Power

SCAN MAGNIFICATION system recently developed brings practical transistorized tv receivers closer to reality. The system, just announced by Mullard Research Labs, London, reduces power required from crt scanning circuits.

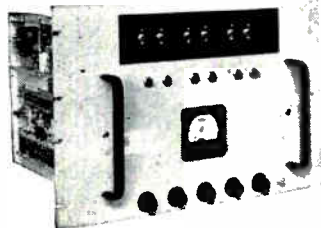
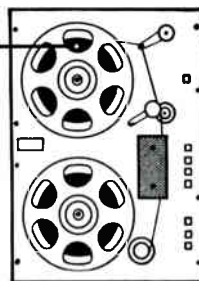
The magnetic lens used to obtain the scan amplification is a quadrupole, positioned about the axis of the tube. The quadrupole acts as a diverging element in the horizontal plane and as a converging element in the perpendicular. It is the diverging element that is responsible for the magnification. Two more quadrupoles provide a form of alternating gradient focusing.

Using scan magnification, the power required from the horizontal scanning circuits may be reduced by as much as 100 to 1, according to Mullard.

RAPID ACCESS

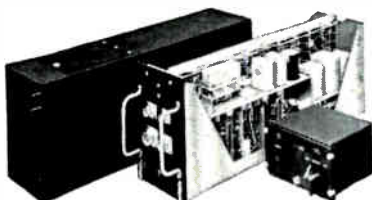
IN ANALOG DATA REDUCTION SYSTEMS

Three companion units by Hycon Eastern provide automatic indexing and high-speed access to selected data in multi-channel magnetic tape instrumentation systems.



For Tape Indexing

DIGITAL TIMING GENERATOR, MODEL 201, generates numerically coded timing signals which are recorded on magnetic tape throughout the data recording periods, providing a precise digital index in terms of elapsed time. The Generator also visually displays the exact time in hours, minutes and seconds as illuminated digits.



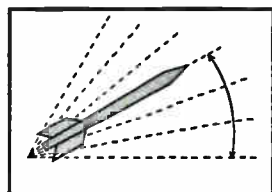
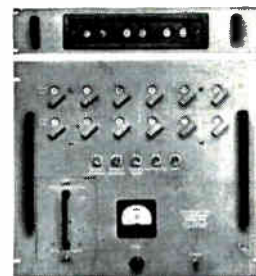
DIGITAL TIMING GENERATOR, MODEL 206A, FOR AIRBORNE APPLICATIONS is a militarized version of Model 201. A Remote Control Box contains Power off-Standby-Operate Switch, the Digital Clock Set, and the Time Display. Completely transistorized, Model 206A includes a binary coded decimal system although other timing formats are available to meet customer requirements.

Weighing only 15 pounds, Model 206A is stable to 1 part in 100,000 giving an accuracy of ± 1 second in 1 day's time.

For Tape Search

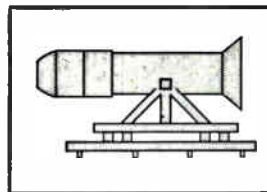
MAGNETIC TAPE SEARCH UNIT, MODEL 202, operates during data reduction periods. On the basis of time indices recorded on the tape by the Digital Timing Generator, this instrument automatically locates and selects for controlled playback the tape data included between a "sequence start time" and a "sequence end time" specified by panel dial settings. The time index is visually displayed as illuminated digits on a small separate panel which may be remotely located for convenience. Model 202 may be modified to search for timing formats other than those originated by Model 201.

IRE SHOW
BOOTH NOS.
3038 & 3039



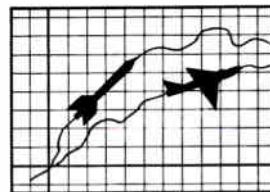
WIND TUNNEL TESTING

Pressure and temperature data of missiles are referenced to angle of attack. Model 201 records on tape a digitized position signal for each new angle of attack.



JET ENGINE TESTING

Digital Timing Generator, Model 201 synchronizes all data receiving equipment. Its output can be piped to multiple test cells and control rooms simultaneously.



MISSILE AND AIRCRAFT TESTING

Model 206A generates timing signals simultaneously with other flight test data. Model 201 generates a timing code format for synchronizing ground station recordings.

Write for Technical Bulletin TSG



HYCON EASTERN, INC.

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Three Approaches to Stereo Pickups

ONE MAGNETIC and two ceramic stereo cartridges, described at the recent Audio Engineering Society Annual Meeting, illustrate component design versatility.

Magnetic Cartridge

The magnetic cartridge¹ shown in Fig. 1, consists of the stylus assembly and magnet common to both channels with a pole piece and coil for each channel. Lower parts of the pole pieces incline towards each other. With the armature, they form the air gap.

When the armature is in a quiescent position resting in an unmodulated groove, flux from the magnet is distributed equally between both pole pieces. Flux flows from the magnet, along the armature up each pole piece and then back to the magnet. When the armature is moved by one groove wall being modulated at 45 deg, the armature approaches and recedes from one pole piece alternately, and remains at about a constant distance from the other. A flux change is induced in the first pole piece giving an output in its associated coil. Constant flux is maintained in the second pole piece. When the opposite groove wall is modulated, output occurs in the second coil in a similar manner. The arrangement gives good and consistent separation between channels.

One of the generators in a ceramic pickup² is shown in Fig. 2

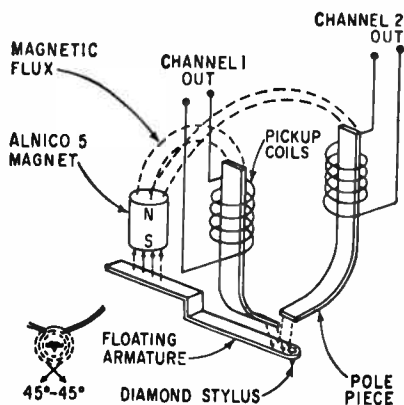


FIG. 1—Magnetic stereo cartridge (General Electric)

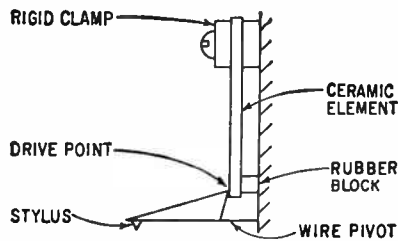


FIG. 2—Bell crank drive of ceramic cantilever for stereo pickup (Columbia)

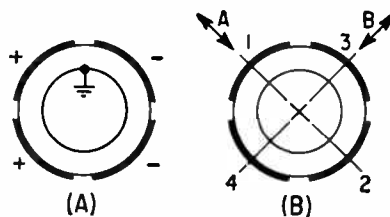


FIG. 4—Four quadrants and polarization of ceramic element (A) and bending forces (B)

in a 45-deg plane. It is a hill and dale reproducer. Vertical motion of the stylus is stepped down and rotated to horizontal motion of the drive point. This action gives a bending moment to the ceramic element. A soft rubber block under the element balances the biasing force from the drive point caused by static force of the needle on the record.

A horizontal wire is used as the fulcrum of the bell crank lever. Use of the wire eliminates any lost motion which would occur with less than perfect pivots. And the wire combines both high longitudinal stiffness with high compliance to lateral and vertical movement in the plane perpendicular to the one in which the stylus lies. The bell crank imparts motion to the transducer from vertical stimulation of the stylus. Motion in the perpendicular plane (horizontal in Fig. 2) is ignored since the bell crank pivots about a vertical axis which includes the drive point and the wire virtual pivot. Motion in the quadrature plane does not impart a twisting moment to the element.

In the actual cartridge, there are two bell cranks 90-deg apart with

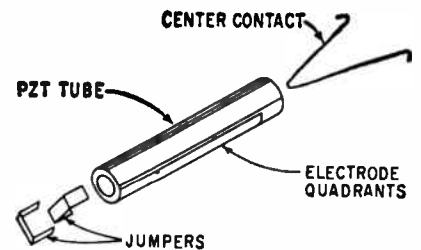


FIG. 3—Ceramic cylinder used in single-element cartridge (Electro-Voice)

a common stylus and wire pivot. The two drive points form a right angle about the wire pivot in the plane of the elements. The lever couples the transducer rigidly to the record at the drive point and the undriven end is clamped. Since there is no lost motion between the stylus and ceramic cantilever, the voltage generated is proportional to displacement of the stylus.

Single-Element Ceramic

A second ceramic cartridge³ uses a single ceramic element in the form of a cylinder, as shown in Fig. 3. The tube is made of lead zirconia titanate and is electroded on the inner and outer surfaces with conductive silver. The outer electrode surface is divided into four quadrants and the element is polarized as shown in Fig. 4A.

To operate the element as a Bender, it must be connected in parallel with opposite diagonal quadrants bridged. The center electrode is grounded for maximum interelectrode shielding. When properly polarized, a force A applied to produce a bend about axis 1, 2 in Fig. 4B will stress one quadrant in tension and the opposite in com-

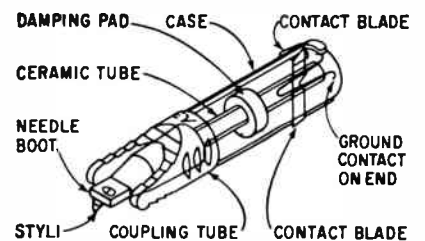
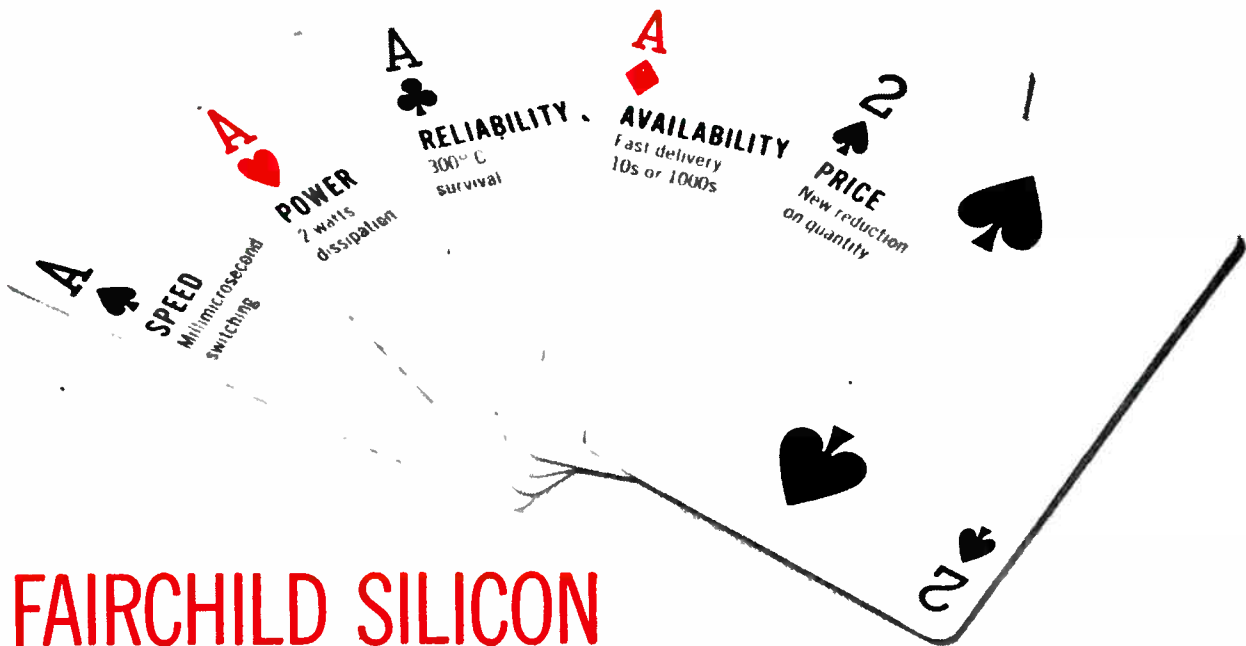


FIG. 5—Mechanical drawing of complete single-element cartridge

TRANSISTOR EXPERTS...

are betting that
this is the
winning combination:



FAIRCHILD SILICON TRANSISTORS

come through, fulfilling the extraordinary promises you've heard rumored about the new solid-state diffusion devices.

A ♠ SPEED — 80 milli-micro-second rise time affords the fastest switching yet available with silicon.

A ♥ POWER — 2 watts dissipation at 25° C. leaves plenty of power handling capability at higher temperatures too.

A ♣ RELIABILITY — Storage at 300° C. for 350 hours caused no serious changes, assuring a large safety factor at operating temperatures. Mesa construction provides extraordinary ruggedness too.

A ♦ AVAILABILITY — Thousands of the 2N696 and 2N697 transistors have been delivered in the first months after announcement. Stock is available for immediate shipment.

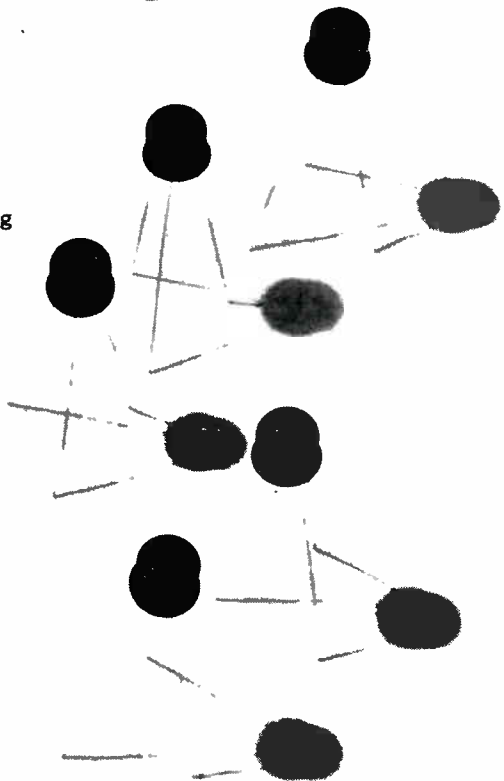
2 ♠ LOWER PRICES — Fairchild is gearing for quantity sales and bringing prices down within reach of more users. A second large plant expansion is being made in response to demand.

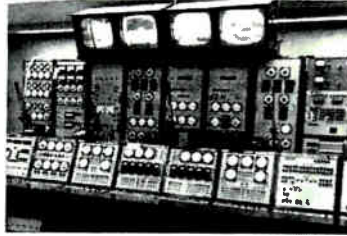
Look to the future

Existence of Fairchild's multiple-diffused transistors is already having a profound effect on the breadboard designs of today. It means competitive improvements in the quantity production of tomorrow — both in the race for military superiority and in various commercial bids for sales leadership. May we send you specifications?



844 CHARLESTON RD. • PALO ALTO, CALIF. • DA 6-6695

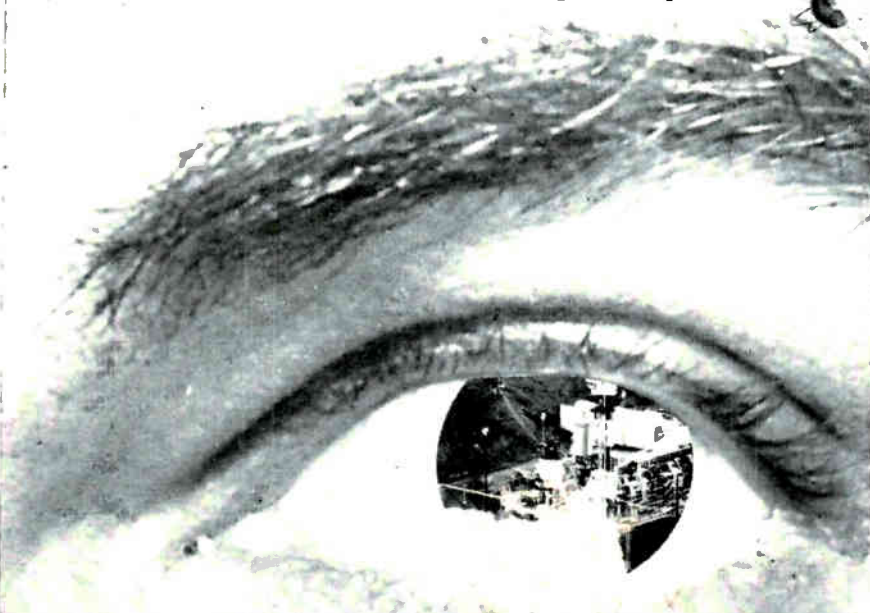




THROUGH THE EYE OF HALLAMORE CLOSED CIRCUIT TELEVISION

...each testing complex at the massive
MARTIN-DENVER "Titan" facility

is visually monitored, from as close as 10" from direct missile blast as well as from perimeter checkpoints. Environmentally protected, transistorized Hallamore cameras (Model CC420), remotely controlled from more than 2000 feet, provide a continuously clear picture through every phase of firing. Over 32 Hallamore designed, manufactured, and installed CCTV systems support the Hallamore designed and installed electronic system (over 900 racks) that provides telemetry for the entire Martin-Denver testing complex. Hallamore capability and creativity can be the answer to your systems requirement. Write Hallamore Electronics Company, 8352 Brookhurst, Anaheim, California. TWX: AH 9079... a division of The Siegler Corporation



ENGINEERS... FOR IDEAL WORKING CONDITIONS WITH A DYNAMIC, CREATIVE ORGANIZATION, ADDRESS RESUME TO CHIEF ENGINEER

HALLAMORE

pression. A force B applied to produce a bend about axis 3, 4 will stress the other quadrants of the element to generate a potential with respect to ground. In both cases, the electrodes adjacent to the neutral plane will be stressed in the same direction and the generated potential will be cancelled. Figure 5 shows a phantom view of the complete cartridge.

References

1. P. E. Pritchard, A Variable Reluctance Stereophonic Pick-Up Cartridge, paper presented at 10th Annual Meeting Audio Engineering Society.
2. W. S. Bachman, A Constant Displacement Stereophonic Cartridge, paper presented at 10th Annual Meeting Audio Engineering Society.
3. J. F. Wood, A Single Element Stereophonic Cartridge, paper presented at 10th Annual Meeting Audio Engineering Society.

Isotope Powers Thermo Converter



Maj. Gen. D. J. Keirn, USAF, director of SNAP III shown with demonstration setup

DEVELOPED as a proof-of-principle device by the Joint AEC—Air Force Aircraft Nuclear Propulsion Office, the SNAP III thermoelectric conversion device weighs five lb, is 5½ in. high and 4½ in. in diam. Energy is derived from radioactive polonium-210. Radiation of the polonium is converted directly into electricity by means of lead-telluride thermocouples.

Using a fresh 3,000-curie supply of polonium-210, the generator will deliver five watts of electrical power at an efficiency of eight to 10 percent. After the first 140-day half-life of the polonium, output power is three watts at an efficiency of between five and six percent.

Contrary to some newspaper reports of the development, total cost of the device was \$30,000. Half of this sum was the cost of the polo-

nium. Prime contractor for SNAP III was the Martin Company. Minnesota Mining and Manufacturing Co. was subcontractor for the inter-metallic thermocouples.

Operating Principle

Basic operation of the device is based on long-known principles. Energy liberated by the spontaneous decay of the radioisotope raises the temperature of the metallic core and container surrounding it. This temperature increase starts the movement of electrons. Twenty pairs of semiconductor thermoelectric conversion elements extend like spokes from the center to cold junctions along the inside of the outer wall. These lead-telluride rods are doped alternately to produce an excess or deficiency of electrons and are connected in series between the hot and cold junctions.

Usable electrical energy is created by the Seebeck electromotive force generated between the hot and cold junctions.

New Material Takes Temperatures of 5000F

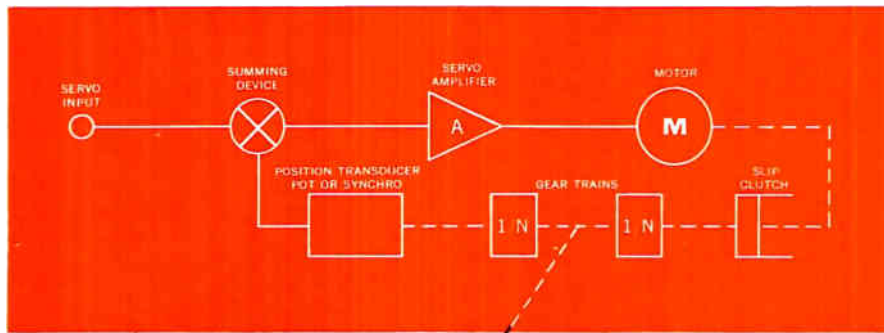
DESIGNATED AVCOITE by Avco Research and Advanced Development, a new material of specially designed reinforced ceramic will withstand temperatures in excess of 5000 F. The new ceramic has been developed to be quasi ductile.

Special Alloy Gives Continuous Getter

THORIUM, aluminum and rare earth metals are combined in an alloy called CerAlloy 400. The alloy is used as a gettering agent for electron tubes acting to sorb gases continuously throughout the active life of the tubes.

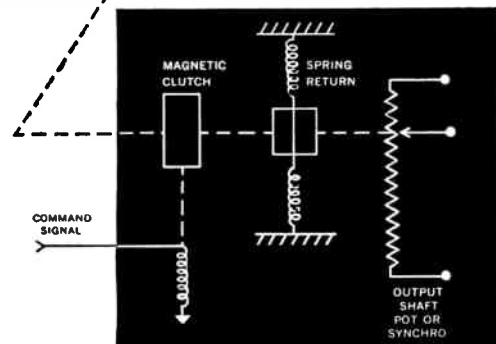
Available from New Process Metals, Inc., the getter is reported to cut cathode interface resistance in half. The getter combines with active gases to the limit of its bulk capacity. Its optimum gas sorption occurs in the temperature range from 400 to 500 C. But it will getter from its sorptive threshold to 700 C.

PROBLEM: To provide an output Potentiometer-Transducer which can be readily engaged with a minimum angular error to a servomechanisms gear train when energized by an external command signal. The transducer must accurately return to a specified null position when the command signal is removed.



A SOLUTION:

Provide an electro-magnetic clutch, spring return mechanism and rotary potentiometer. Assemble these parts into the required package with the resultant difficulties brought about by the mounting and coupling problems with a consequent increase in cost.



THE OPTIMUM SOLUTION:

Technology Instrument Corporation's west coast engineering facilities developed and offer a unitized package consisting of an electro-magnetic clutch, spring return mechanism and rotary potentiometer as one compact assembly. The clutch will transmit high torque without slippage and has negligible angular engagement error. TIC's unique spring return mechanism will accurately return the output transducer to the desired null, yet requires low driving torque. TIC's unitized assembly replaces three (3) individual components with their inherent assembly difficulties.



TIC
unitized
package

GENERAL INFORMATION:

Shaft Position Transducers can be linear or nonlinear potentiometers, synchros, linear transformers or digitizers. Spring return mechanism can be supplied designed to return to any desired point. A built-in slip clutch can also be furnished if the input torque can exceed the rating of the clutch.

TIC UNITIZED PACKAGE HAS MANY APPLICATIONS,

SUCH AS: Auto pilots, altitude controllers, machine controllers, measurement and control problems, speed control, process control of temperature and flow, differential measurement, expanded scale servos, or any other problem requiring an output, commencing at some specified servo position determined by an external command signal.

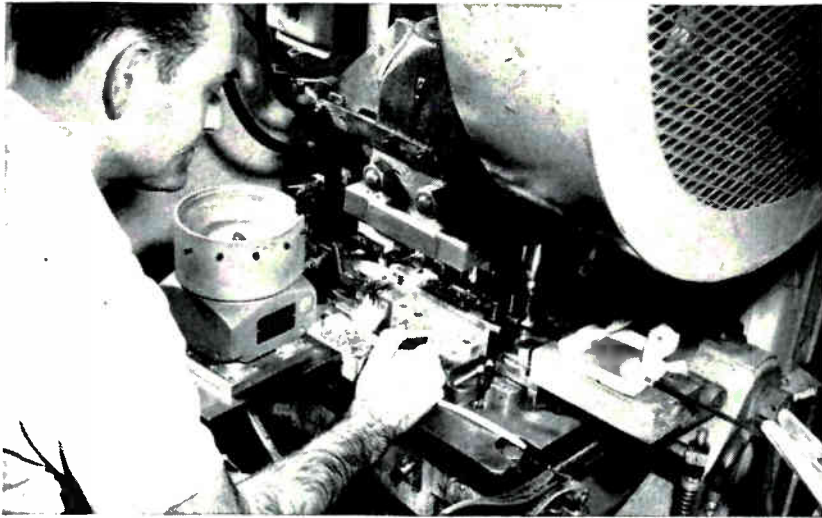


TECHNOLOGY INSTRUMENT CORPORATION

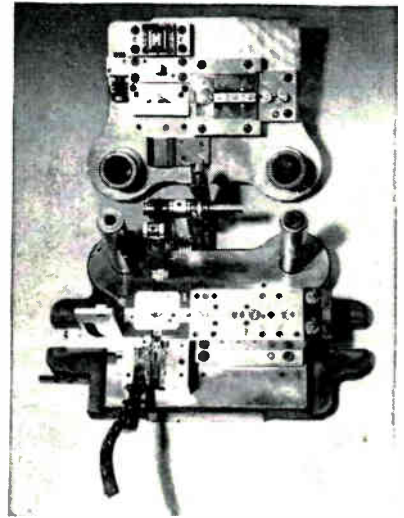
Subsidiaries: Technology Instrument Corp. of Calif.
North Hollywood, Calif.
Acton Laboratories, Inc., Acton, Mass.
Tucson Instrument Corp., Tucson, Ariz.
Servotrol, Inc., Chicago, Ill.
Allomac Corp., Canton, Mass.

569 Main Street
Acton, Massachusetts

Progressive Die Forms Getters



Operator checks getter assemblies as they drop from die. Machine automatically produces 4,000 assemblies an hour from nickel strip and hopper-loaded barium-aluminum pellets

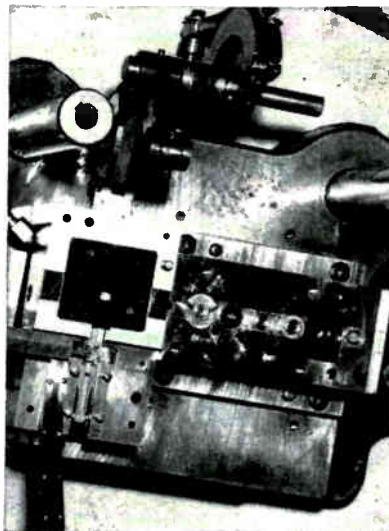


Die in open position; pellet feed chute is at lower left

FLAG-MOUNTED GETTERS, formed in a progressive die, are being used in subminiature tubes made by Raytheon Manufacturing Co., Waltham, Mass. Barium-aluminum getter alloy is forced under pressure into a tiny cup in the nickel flag, which is in turn mounted at an angle above tube elements.

Quantity production of the getter flags is accomplished in a progressive die in a 20-ton press. The cup is first formed oversized in nickel strip and is then reduced in 3 stages to a diameter of 0.105 inch. Following stations form the legs as shown in Fig. 1.

The strip then advances to the sixth station where the flag is punched out and driven through the die onto a set of movable fingers. The fingers push the flags forward to an assembly station. The flag



Closeup of bottom half of die. Fingers are directly under square plate in left center

intimate contact with the cup so that the getter alloy is held in the cup by surface tension. The finished flags drop into a receiving box and are given a 1,000-hour hot-box test before delivery to the tube assembly line.

The fingers are thin metal plates on each side of a firm metal rod. The plates are slightly notched to exert a pushing motion and transfer the flag blanks to the assembly station. They move back and forth about 1/16 inch each time the press is actuated.

Advantages of the new technique, according to Raytheon, include: it practically eliminates flaking off of small particles of getter in the tube; the flag acts as a shield, eliminating the usual mica shield; it is economical with ex-

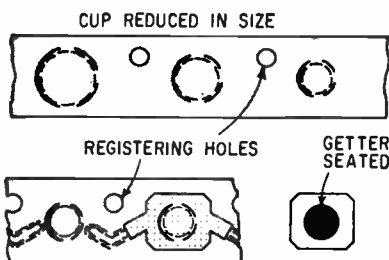


Fig. 1—Steps in formation of flag-mounted getters

legs are bent back at a 30-degree angle.

A vibratory hopper feeds the fragile pellets of getter material down a gravity chute. A cutoff feed separates the pellets and delivers them, 1 at a time, for assembly into the flags. The pellets are 0.100 inch in diameter and 0.012 to 0.014 inch in thickness.

At the assembly station, a die reshapes the pellets into smooth elliptical form and seats them in



Getter pellet, flag and getter in position on subminiature tube assembly

New Plasmarc Torch Service for Production Parts from Refractory Metals—By harnessing the highest controlled temperatures ever used in industry—up to 30,000 degrees F.,—the new *Plasmarc* Torch makes possible the fast and accurate mass production of ultra-hard materials that have been virtually unworkable by any previous means.

With the patented *Plasmarc* Torch, LINDE is equipped to supply parts made of, or coated with refractory metals, or made of a variety of metals combined with non-metals or reinforced plastics. This method has been used successfully with pure tungsten, molybdenum, zirconium, and tantalum (all metals in the highest temperature range), hard carbide materials, and even precious metals, including platinum and palladium.



In powder or wire form, the metal being worked is fed into the torch chamber where a non-transferred electric arc generates temperatures above

15,000 degrees, literally melting the particles to a fluid or plastic state. Inert gases, flowing continuously, deposit them at near-sonic speeds on the work-piece. Jets of CO₂ cool the particles instantly to form heat-and-erosion-resistant material. Coatings, even on graphite, have an excellent bond. Shapes are built up on machined mandrels which are then etched away to leave the finished parts.

There are no known limitations on size or complexity of shape. Accuracy of ±.002 in. can be maintained. The *Plasmarc* Torch has been used to make high-density tungsten crucibles, special parts for nuclear work, sensitive electrical contacts, and electronic components and x-ray targets. LINDE will also provide a wind-tunnel materials testing service based on this device.

For information on this extension of LINDE's well-known Flame-Plating service, write Dept. BD-22, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: LINDE COMPANY, Division of Union Carbide Canada Limited.

FOR MEN WITH IMAGINATION

Three-Level Ruby Maser—The Maser is a microwave amplifier utilizing energy stored in a molecular or atomic system. Emission of this energy is stimulated by the input signal. Masers operate at liquid helium temperatures and have incredibly low noise levels approaching zero db. Recently a University research laboratory* used LINDE single crystal synthetic ruby (Al₂O₃ with Cr₂O₃ additive) in a three-level solid state Maser. The ruby crystal was placed at the center of the Maser's tuned cavity and a magnetic field of 4200 gauss was applied. To bring electrons from a ground state into a permissible higher energy level, a pumping frequency of 24 kMc was used and the Maser successfully amplified signals at 9.3 kMc.



LINDE also supplies other crystals including rutile, spinel and sapphire (Al₂O₃). Sapphire is used in infra-red optical systems, windows for high power microwave tubes, spacers and supports in vacuum tubes, radiation pipes. It has strength at elevated temperatures, melts at 2040°C, is hard, inert, non-porous and can be sealed to metals and glasses. Sapphire is currently available in the shape of domes, windows up to 4½ inches in diameter, rods and special configurations.

For further data write to Crystal Products Department BD-22, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, New York.

*"Maser Action in Ruby," by G. Makhov, C. Kikuchi, J. Lambe, and R.W. Terhune. "Physical Review," Volume 109, Number 4, Page 1399, Feb. 15, 1958.

PRODUCTS WITH A FUTURE

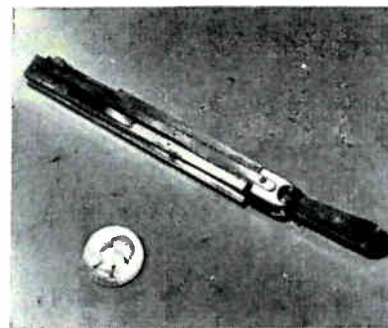
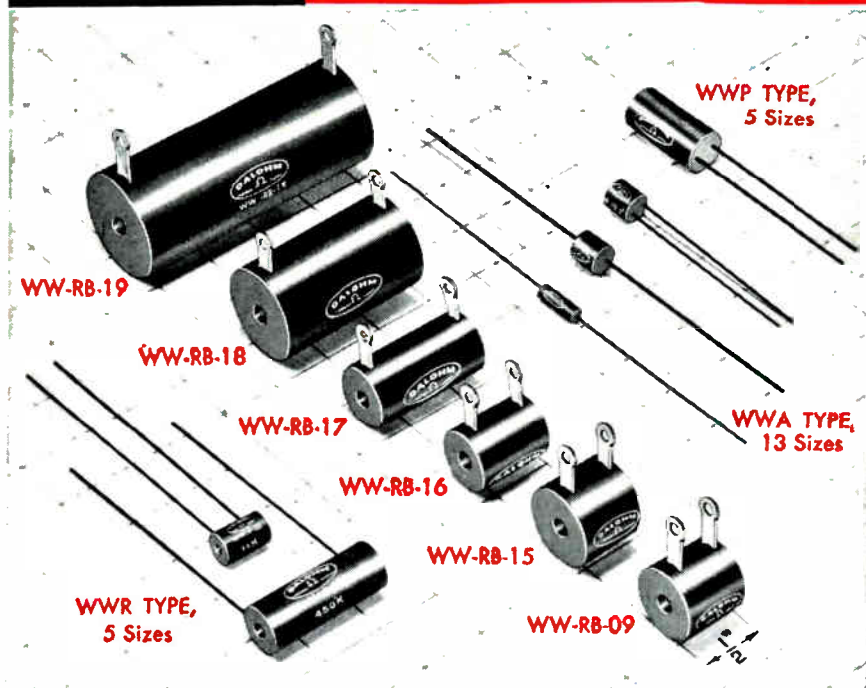
Linde



The terms "Linde," "Union Carbide" and "Plasmarc" are trade-marks of Union Carbide Corporation. TRADE-MARK



... for Complete Reliability Under Severe Environmental Conditions



Side view of fingers

pensive getter material and improves gas cleanup. Application to other tube types is under development, but the company does not plan to manufacture the getters for outside sale.

Air Pulses Measure Abrasive Case Filler

PRECISELY MEASURED amounts of fluid must be dispensed in transistor case-filling operations. Measuring accuracy is difficult to maintain with mechanical metering pumps when the thermally conductive potting suspension contains a filler which happens to the abrasive in nature.

A case-filling machine at RCA Semiconductor and Materials Division, Somerville, N. J. avoids erosion of mechanical parts by using compressed air pulses to move the abrasive-filled dielectric. The only moving part in contact with the fluid is a stirrer.

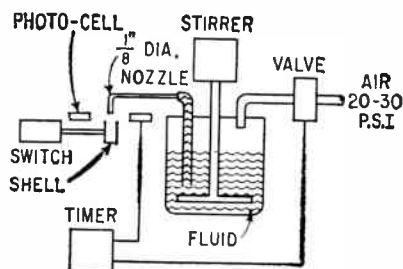


Fig. 1—Principal parts of abrasive fluid dispenser

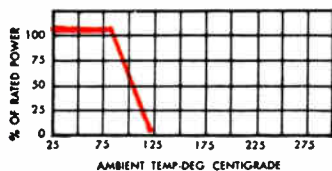
The fluid is contained in a closed vessel. A port above the fluid level is the air entry. A valve in the compressed air line is opened and closed by a timer when a case is in filling position.

As the air pulse enters the vessel, the air pressure forces out a pre-

TYPE WW ENCAPSULATED RESISTORS

Wire Wound, Precision, Hi-Value, Non-Inductive

TYPICAL DERATING CURVE



JUST ASK US

The DALOHM line includes precision resistors (wire wound and deposited carbon); trimmer potentiometers; resistor networks; collet fitting knobs and hysteresis motors designed specifically for advanced electronic circuitry.

If none of the DALOHM standard line meets your needs, our engineering department is ready to help solve your problem in the realm of development, engineering, design and production.

Just outline your specific situation.

High resistance value, wire wound resistors designed for non-inductive requirements that demand the closest precision tolerance. Encapsulated in carefully compounded material, selected for matching coefficient of expansion to that of the wire.

- Rated at .1 watt to 2 watts, with a wide selection, depending on type and size.
- Resistance range from 0.6 ohm to 6 Megohms, depending on type.
- Tolerance: $\pm 0.05\%$, $\pm 0.1\%$, $\pm 0.25\%$, $\pm 0.5\%$, $\pm 1\%$, $\pm 3\%$.

TEMPERATURE COEFFICIENT: Within 0.00002/degree C.

OPERATING TEMPERATURE RANGE: -55° C. to 125° C.

SMALLEST IN SIZE: $\frac{1}{8}'' \times \frac{3}{16}''$ to $2\frac{1}{2}'' \times \frac{7}{16}''$.

COMPLETE PROTECTION: Encapsulating material makes them completely impervious to penetrating effects of salt spray, humidity, moisture and corrosive gases and vapors.

CONFIGURATIONS: WWA — axial leads; WWP — parallel leads; WWR — radial leads; WWL — lug style terminals; WW-RB — military style with lug terminals; HWA and HW-RB — high temperature applications.

MILITARY SPECIFICATIONS: Surpasses MIL-R-93B, characteristic A and B; MIL-R-9444.

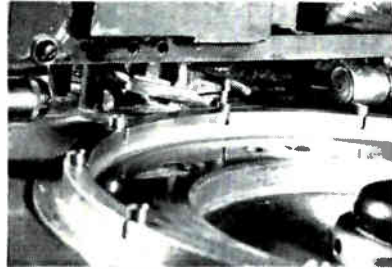
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DALE PRODUCTS INC.

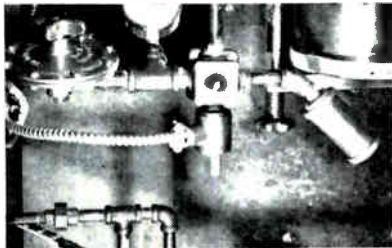
1300 28th AVE.
COLUMBUS, NEBRASKA



Operator color-codes cases with ink pod as she removes them from turntable



Case-filling station. Light source and photocell are at left and right edges of photo



Rear view of air plumbing

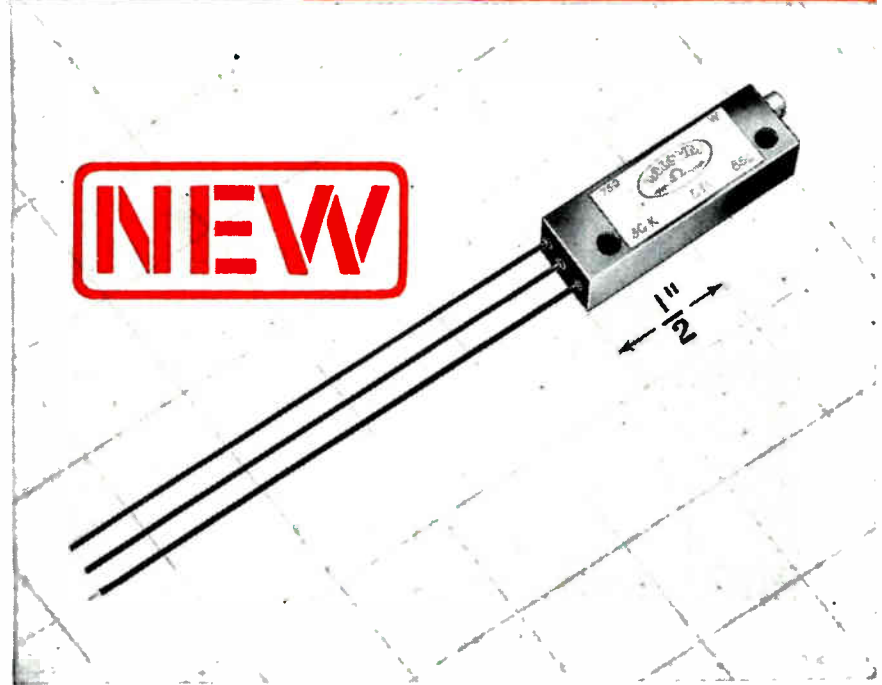
determined amount of fluid. The fluid escapes through a tube with one end immersed in the fluid and the other end above the case.

Air pulses are initiated by the turntable on which the empty cases are loaded. Each indexing of the turntable brings a case under the filling tube. A spring arm attached to a small snap-action switch feels for a case. If the case is in position, fluid begins flowing from the tube. The switch operates a solenoid valve admitting air to vessel and forcing out fluid.

The first drop of fluid is detected by a photoelectric cell which triggers the air pulse timer. After a given length of time, the timer then closes the solenoid air valve, shutting off the air and exhausting the air in the vessel to atmosphere. Pulse is approximately $1\frac{1}{2}$ seconds. At the same time, the indexing mechanism is triggered to bring the next empty shell into position.



NEW



TYPE 750 TRIMMER POTENTIOMETERS

Super-Miniature, Wire Wound, Precision

The 750 trimmer, with a completely sealed case and welded construction, offers outstanding performance and stability.

It has a space saving design for advanced electronic circuits where it's mandatory to meet demanding conditions of miniaturization, reliability, precision and severe operating conditions.

Two terminal styles available: 750W —with leads extending from end of case; 750WP—with leads extending from bottom of case for printed circuits.

- Rated at 2 watts, up to 70° C. ambient.
- Resistance range from 100 ohms to 30K ohms.
- Standard tolerance: $\pm 5\%$, closer tolerance available.

OPERATING TEMPERATURE RANGE: —55° C. to 175° C.

SUPER-MINIATURE SIZE: .180 x .300 x 1.00 inch.

RESOLUTION: .1% to 1%, depending on resistance.

SHAFT TORQUE: 5 inch/ounces max.

BACKLASH: 10° maximum.

SCREW ADJUSTMENT: 18 turns, nominal.

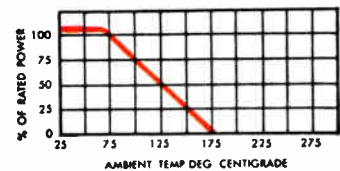
MOUNTING: Individually or in stacked assemblies with standard 2-56 screws.

SAFETY CLUTCH: Clutch arrangement on movable wiper contact prevents breakage due to over-excitation.

WEIGHT: 1.8 grams.

MILITARY SPECIFICATIONS: Surpass applicable paragraphs of MIL-R-19A, MIL-R-12934A, MIL-E-5272A and MIL-STD-202A.

TYPICAL DERATING CURVE



JUST ASK US

The DALOHM line includes precision resistors (wire wound and deposited carbon); trimmer potentiometers; resistor networks; collet fitting knobs and hysteresis motors designed specifically for advanced electronic circuitry.

If none of the DALOHM standard line meets your needs, our engineering department is ready to help solve your problem in the realm of development, engineering, design and production.

Just outline your specific situation.

Write for Bulletin R-41

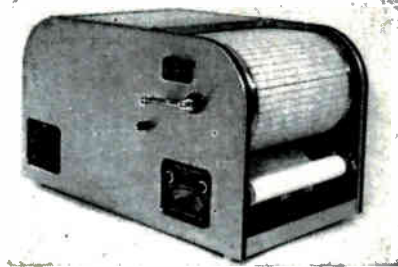
**DALE
PRODUCTS
INC.**

1300 28th AVE.
COLUMBUS, NEBRASKA

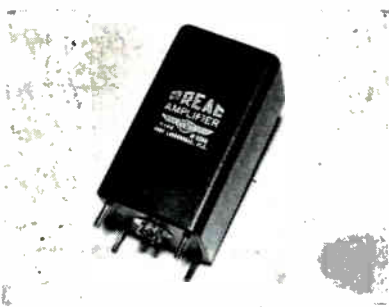
ON THE MARKET

Processor for oscillograms

CONSOLIDATED ELECTRODYNAMICS CORP., 300 N. Sierra Madre Villa, Pasadena, Calif. A thermistor drum temperature control is one of several new features on the 23-109A oscillogram processor.



Control system consists of a sealed thermistor sensing unit and a transistorized control amplifier in the electrical compartment. The 23-109A has a knob adjustment that will vary the bath temperature. The processor also features portability and simple operation. **Circle 200 on Reader Service Card.**



Magnetic Amplifier high sensitivity

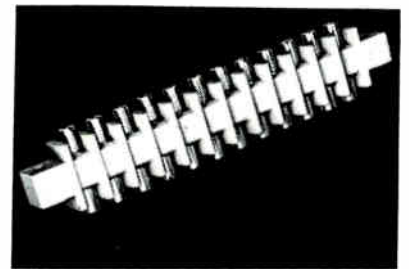
AIRPAX PRODUCTS Co., Seminole Division, Fort Lauderdale, Fla., has developed a new line of PREAC 60-cps high sensitivity magnetic amplifiers. Each of the four types available can be used by itself or as a preamplifier for such data

sensing devices as thermocouples, strain gages, bolometers, as well as for high impedance d-c sources. Each provides a power gain greater than 50 db and a full linear output of 2 v into a 5,000 ohm load with null drifts as low as $0.03 \mu\text{a}$, $2.25 \times 10^{-12} \text{ w}$, referred to the input. **Circle 201 on Reader Service Card.**

Terminal Blocks through-connection

KULKA ELECTRIC CORP., 633 So. Fulton Ave., Mt. Vernon, N. Y. Type 7TB12 heavy-duty terminal block provides for feed-through connections at top and bottom, and comes in several different lengths and

number of terminals. It is molded of glass-filled Alkyd plastic (type MAI-60) as per MIL-M-14E. The molded-in threaded studs are of manganese-bronze. It is supplied with slotted brass nuts made to specifications, packaged separately or supplied assembled, as desired. **Circle 202 on Reader Service Card.**



Sweep Generators high-precision

TELONIC INDUSTRIES, INC., Beech Grove, Ind. A new line of sweep generators feature exceptional flatness, high output and low leakage.



Designed for production test or developmental checkout applications, the units are engineered with crystal controlled single frequency, or harmonic plug-in markers, with external marker provisions. **Circle 203 on Reader Service Card.**



Power Supplies transistorized

ELECTRONIC RESEARCH ASSOCIATES, INC., 67 Factory Place, Cedar

Grove, N. J. The new Magitran line of high current, high voltage, regulated power supplies combine the characteristics of the magnetic and transistor regulator. These units

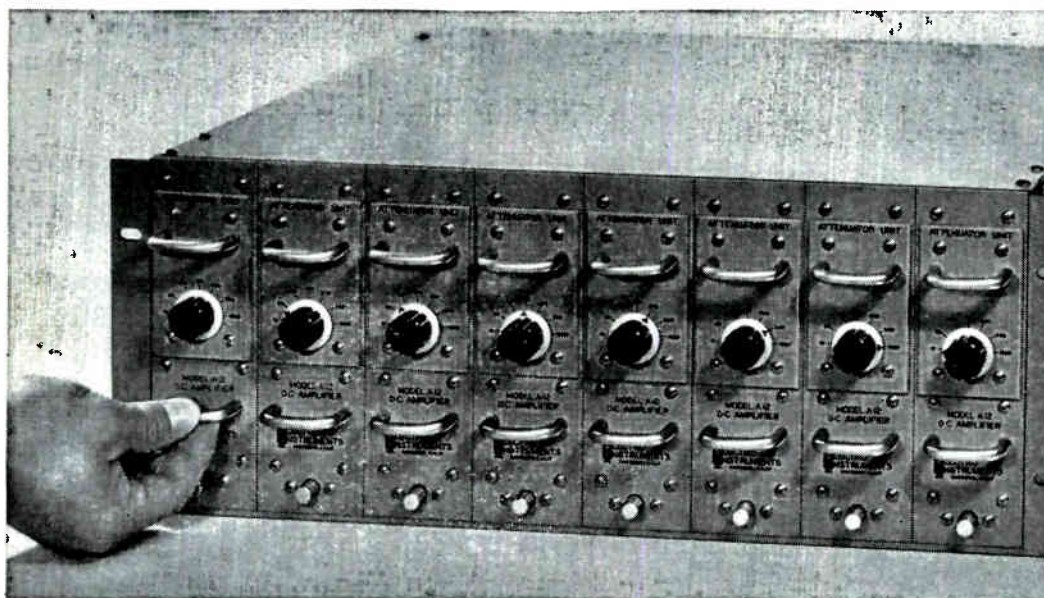
New Electro Instruments A-12 DC amplifier totally transistorized

equal to or better than the best
vacuum tube instruments!

The new Model A-12 DC Amplifier is the preferred systems link for amplification, normalization and impedance transformation. Use of solid state elements assures maximum reliability; power dissipation is only seven watts. Mil-type components are mounted on coated plug-in printed circuit boards for protection against vibration and corrosion.

versatility plus economy

Electro Instruments produces a series of plug-in mode selectors and attenuators for the A-12: single ended, differential and operational, fixed and variable gain.



Eight to a rack
The A-12 is packaged for high density use; mounts eight across in 19" rack panels.

SPECIFICATION SUMMARY

	Single Ended Input
Gain:	Fixed gain set to any value from 10 to 1000 inclusive by front panel plug-in units. Gain switching plug-in attenuator available with gains of 0, 10, 20, 50, 100, 200, 500 and 1,000. Adjustable upward 6db from setting with potentiometer.
Input Impedance:	100 megohms shunted by 0.001 mfd (typical).
Source Impedance:	5K or less (to meet noise specification).
Drift:	Less than 2 microvolts in 200 hours at constant ambient temperature. Less than 0.4 microvolt per degree centigrade.
Ambient Temperature:	0° to 50°C.
Noise (Referred to input):	0-3 cps 5 microvolts peak to peak 0-750 cps 4 microvolts rms. 0-50 kc 8 microvolts rms.
Frequency Response:	±3db to 50 kc (typical); ±1.0% to 2 kc
Output Capability:	±10 volts at ±100 ma DC or peak AC to 10 kc

Write today for complete specifications on single-ended, differential and operational models.



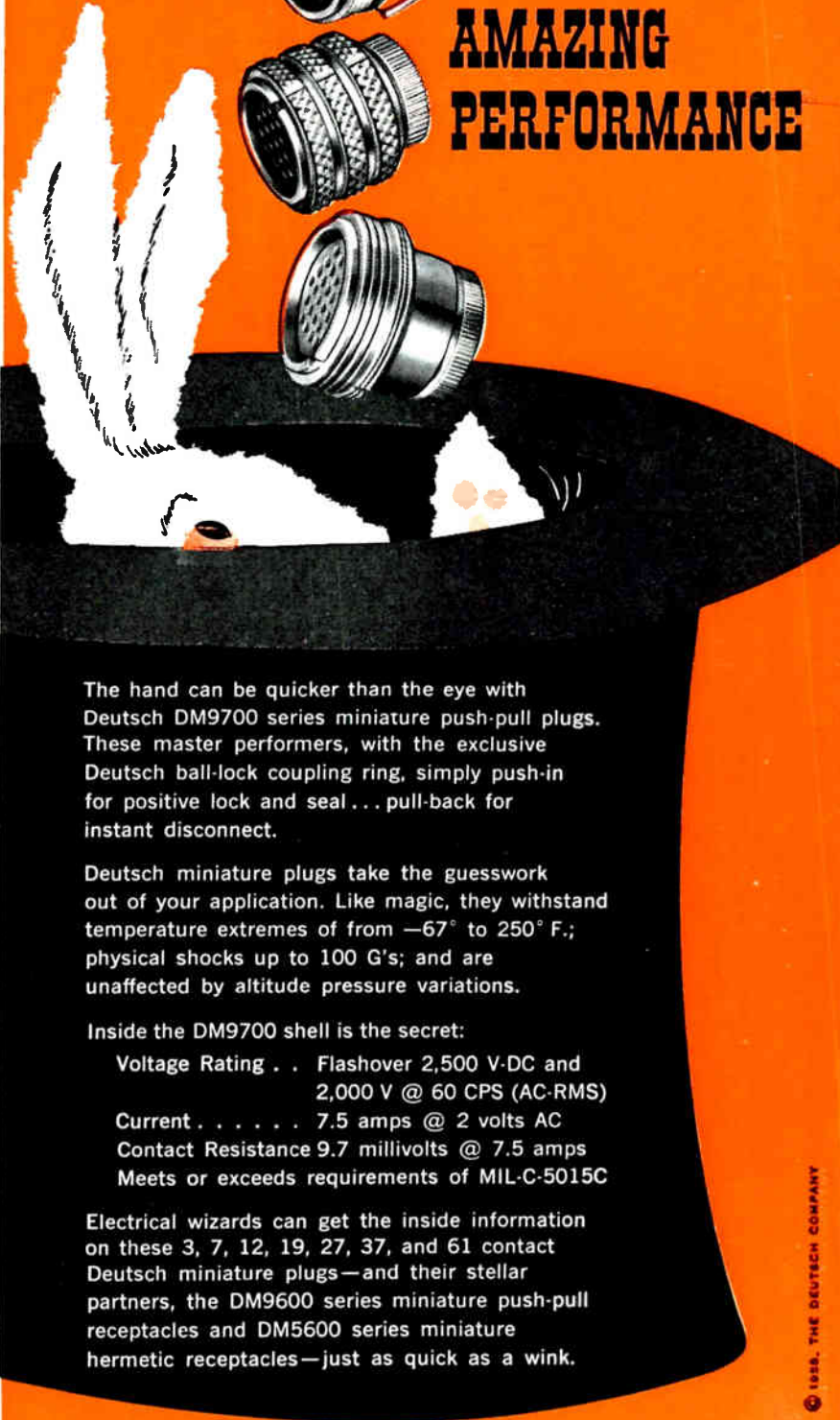
Electro Instruments, Inc.

3540 Aero Court
San Diego 11, California

All the right connections for



AMAZING PERFORMANCE



The hand can be quicker than the eye with Deutsch DM9700 series miniature push-pull plugs. These master performers, with the exclusive Deutsch ball-lock coupling ring, simply push-in for positive lock and seal . . . pull-back for instant disconnect.

Deutsch miniature plugs take the guesswork out of your application. Like magic, they withstand temperature extremes of from -67° to 250° F.; physical shocks up to 100 G's; and are unaffected by altitude pressure variations.

Inside the DM9700 shell is the secret:

- Voltage Rating . . . Flashover 2,500 V-DC and 2,000 V @ 60 CPS (AC-RMS)
- Current 7.5 amps @ 2 volts AC
- Contact Resistance 9.7 millivolts @ 7.5 amps
- Meets or exceeds requirements of MIL-C-5015C

Electrical wizards can get the inside information on these 3, 7, 12, 19, 27, 37, and 61 contact Deutsch miniature plugs—and their stellar partners, the DM9600 series miniature push-pull receptacles and DM5600 series miniature hermetic receptacles—just as quick as a wink.

© 1958. THE DEUTSCH COMPANY

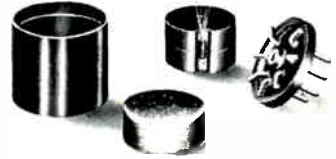
Ask for data file 2-B. And don't forget—big news awaits you at the IRE Show, March 23-26.

The Deutsch Company

7000 Avalon Boulevard • Los Angeles 3, Calif.



provide full automatic protection against all types of short circuits or transients, either on an intermittent or continuous basis, and recover instantaneously. Circle 204 on Reader Service Card.



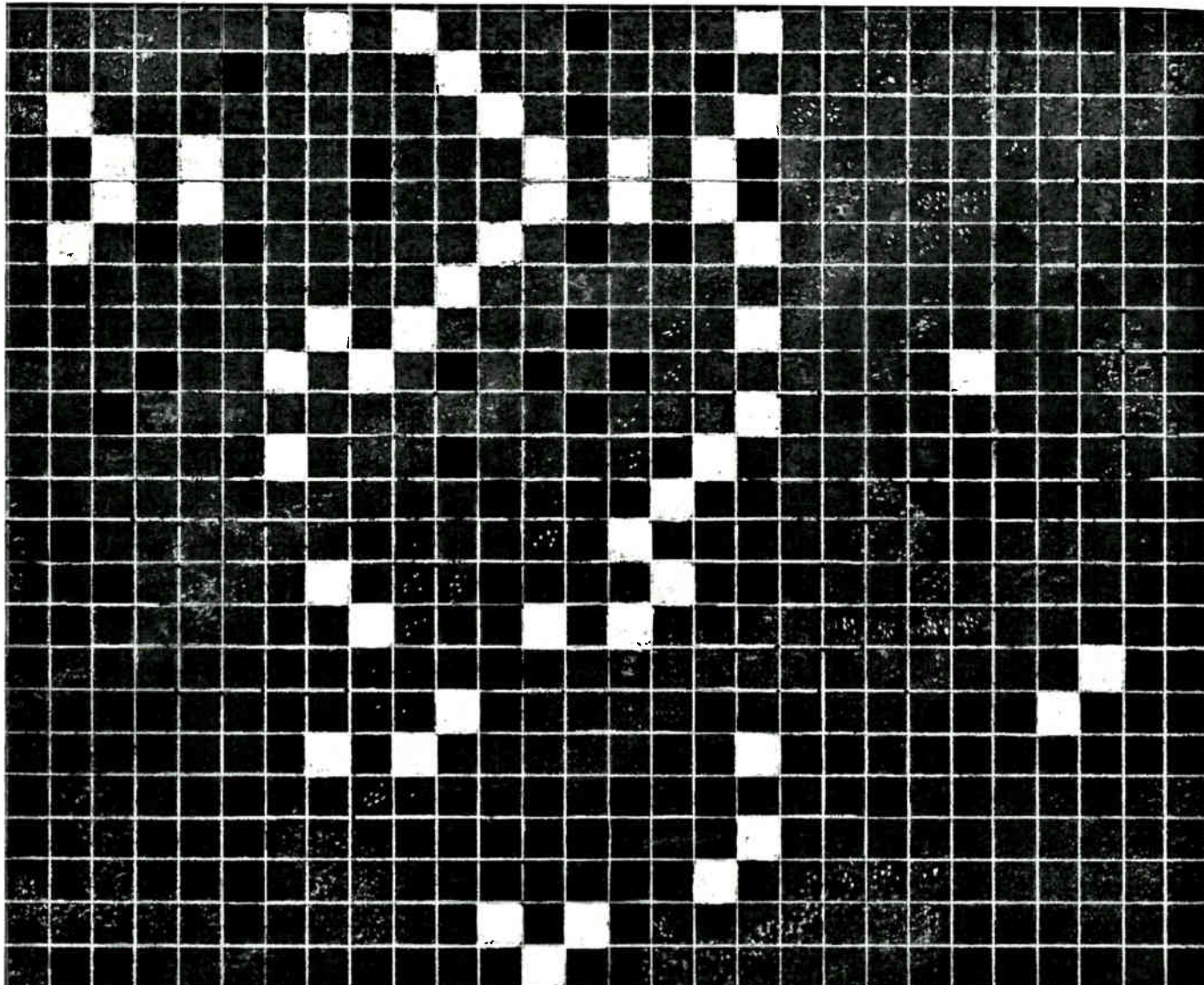
Encapsulation System cuts reject rate

EPOXY PRODUCTS, INC., 137 Coit St., Irvington, N. J., has developed a new, all-epoxy encapsulation system that drastically reduces both assembly time and reject rates on electronic components. Called the E-Pak system, it consists of an all-epoxy header with embedded lead wires, a cured epoxy shell and a premeasured epoxy pellet. All three parts of the system may be custom-made for particular requirements. The all-epoxy cover replaces the conventional glass-to-metal header in this type of packaging. Circle 205 on Reader Service Card.



Rotary Switch high-performance

MASON ELECTRIC CORP., 3839 Verdugo Road, Los Angeles 65, Calif. A high-performance rotary switch only $1\frac{1}{8}$ in. in diameter and designed for high reliability is announced. Rated 5 amperes, 208 v d-c, 400 cps, the switch provides 8 positions. It can be built up to 6 wafers in length, giving a total of 48 separate circuits. A wafer has from 1 to 4 rollers, permitting 4 poles, 2 positions in a single (Continued on p. 92)



A NEW DIMENSION IN COMPUTER TECHNOLOGY

Never has so vast and complex a project been undertaken in data processing and data communications. Billions of bits to be handled . . . information flowing in from hundreds of electronic sources, processed by digital techniques, displayed, solutions and commands issued . . . in precious seconds.

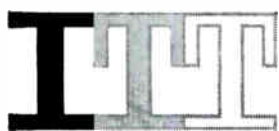
A very short time ago we were a newly created subsidiary of International Telephone and Telegraph Corporation. Today we are a purposeful engineering management group actively forging ahead with the myriad problems of our challenging project.

As systems manager we are charged with the development and production of a world-wide electronic control system which will transmit, process and display information required in

military operations — global, in seconds. This project demands a wealth of engineering imagination. It will result in creation of a wholly new technology in digital computer science.

If your interests as an engineer lie in electronic systems engineering, in data processing and communications, you will find in this project unusual opportunity to express imagination and creative competence, in a degree surpassing anything previously undertaken in computer engineering.

To obtain information on engineer openings write A. J. Crawford, Personnel Manager. A resume of your education and experience is essential. An interview will be arranged at your convenience.



INTERNATIONAL ELECTRIC CORPORATION

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A Subsidiary of International Telephone and Telegraph Corporation



MAGNETIC AMPLIFIER ENGINEERING

Theory, operating principles, and practical applications of all types of magnetic amplifiers, presented in language of the electronic circuit and systems engineer. Saturable reactors, reactor-rectifier amplifiers, and reversible single-core amplifiers are covered. Gives basic information on electric and magnetic variables, and characteristics of magnetic amplifiers. By G. M. Attura, Industrial Control Co. 224 pages, 200 illus., \$7.50

SWITCHING CIRCUITS With Computer Applications

Applies switching-circuit techniques to design of electronic systems using digital circuits, particularly computers and data processing systems. Sequential systems, Karnaugh maps, Boolean matrices, and other topics are covered. Includes a logical treatment of fundamental switching theory and many worked-out examples. By W. S. Humphrey, Jr., Sylvania Electric Prod., Inc. 264 pages, 259 illus., \$8.50



Introduction to MONOPULSE

First unified treatment of a special type of radar, giving you a sound theoretical basis in the field. Describes concept of direction-finding by monopulse, and explains three postulates which form a general theory of monopulse operation. Dual-plane systems, monopulse antenna principles, (Class I system characteristics, and other topics are covered. By D. R. Rhodes, Radiation Inc. 119 pages, 53 illus., \$6.00

ELECTRICAL MEASUREMENTS

In Theory And Application

Revised edition of a widely consulted guide, showing how principles of electricity and magnetism are applied to electronic instruments. Gives you exact mathematical procedures, and a fresh treatment of errors, circuit equivalents of vacuum tubes, and other topics. By A. W. Smith; and M. L. Wiedenbeck, Univ. of Mich. Fifth Ed., 307 pages, 309 illus., \$7.50

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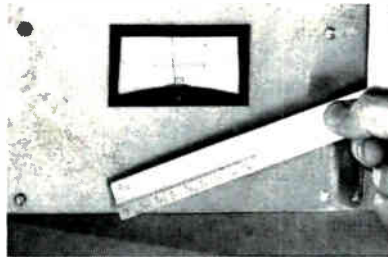
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Position

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wafer. Individual wafers may be bussed externally to meet any sequence requirements. The 2-wafer switch weighs only 8 oz. Unit is completely resistant to acceleration, vibration and shock, withstanding 2 to 2,000 cps at an acceleration to 60 g's, with no contact opening. Circle 206 on Reader Service Card.



Panel Meter small size

ASSEMBLY PRODUCTS, INC., Chesterland, Ohio. Model 361 panel meter occupies panel space of only 3 1/2 by 2 in. and projects only 3/16 in. The dial and window are slanted for easier reading and may be illuminated through a translucent rear window. Sensitivity ranges are 0-5 μ a to 0-50 amperes, and 0-5 mv to 0-500 v. The meter slips easily through a rectangular panel hole and is held in place by rear screw-on clamps. It requires no positioning holes for mounting studs. Circle 207 on Reader Service Card.



Band Pass Filter miniature line

CONTROL ELECTRONICS CO., INC., 10 Stepar Place, Huntington Station, L. I., N. Y., has added a line of miniaturized band pass filters in wide ranges of frequencies with impedance from 50 to 10,000 ohms, with a different input and output

FLIGHT DATA and CONTROL ENGINEERS

Cross new frontiers in system electronics at The Garrett Corporation.

High-level assignments in the design and development of system electronics are available for engineers in the following specialties:

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- 2. SERVO-MECHANISMS AND ELECTRO-MAGNETICS** Requires engineers with experience or academic training in the advanced design, development and application of magamp inductors and transformers.
- 3. FLIGHT INSTRUMENTS AND TRANSDUCERS**
 - 1) DESIGN ANALYSIS Requires engineers capable of performance analysis throughout preliminary design with ability to prepare and coordinate related proposals.
 - 2) DEVELOPMENT Requires engineers skilled with the analysis and synthesis of dynamic systems including design of miniature mechanisms in which low friction freedom from vibration effects and compensation of thermo expansion are important.
- 4. PROPOSAL AND QUALTEST ENGINEER** For specification review, proposal and qualtest analysis and report writing assignments. Three years electronic, electrical or mechanical experience required.

Forward resume to:

Mr. G. D. Bradley

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CIRCLE 61 READERS SERVICE CARD
February 13, 1959 — ELECTRONICS

AiResearch centralized air data computing system...

on Navy's new McDonnell F4H-1

...supplying the following major airplane subsystems: Autopilot, Air Induction, Armament Control, Navigation, Surface Controls, Cockpit Indication and Pneumatic Static Pressure Correction.

The AiResearch centralized air data computing system integrates pneumatic, electronic, electrical and mechanical components on one of the Navy's fastest jets. It senses, measures, and automatically corrects all air parameters affecting flight. It supplies air data information to the pilot and all major airplane subsystems.

This centralized combination of transducers, computers and indicators is the

most complete air data computing system ever devised. It enables aircraft to operate at maximum efficiency continuously.

Eliminating duplication of components, the AiResearch centralized air data computing system cuts down space and weight requirements over decentralized systems by many times. Its principal functions: angle of attack, true static pressure (electrical and pneumatic), true air speed,

true Mach, altitude, rate of climb, total temperature, dynamic pressure and altitude and Mach error.

AiResearch has been the leader in the development of centralized computing systems. The F4H-1 installation is the first, single package air data computer possessing completely interchangeable, modular construction.

Your inquiries are invited.

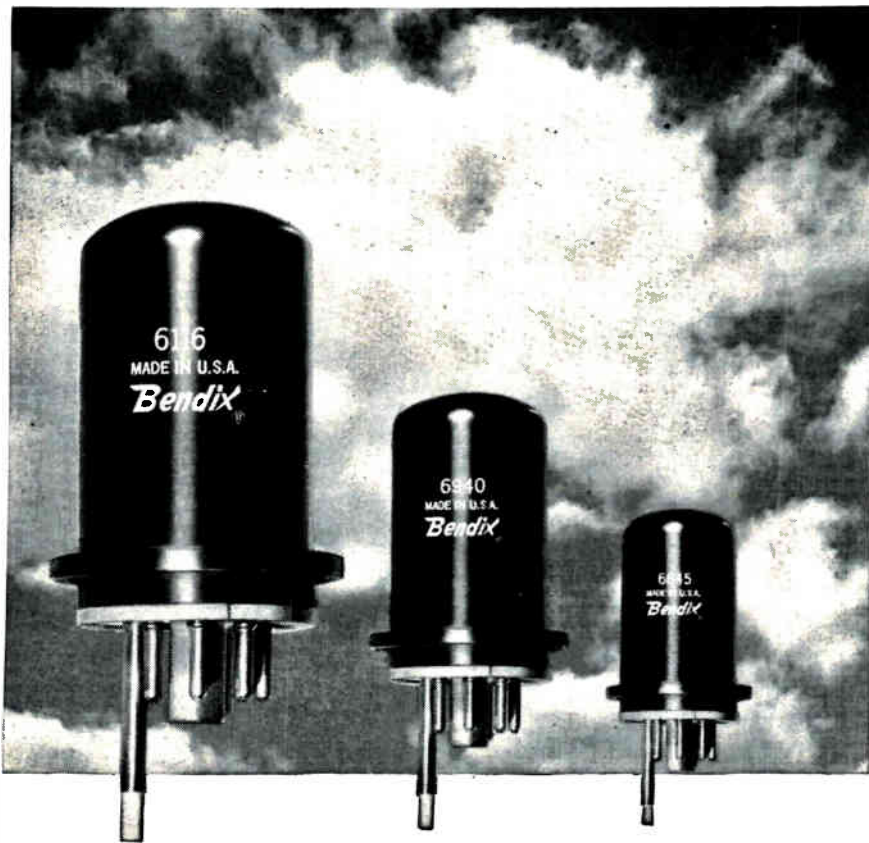
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The 6116/TE-39 ruggedized Reflex Klystron thermally tunes a band of 8500 to 9660 MC by means of a diode within the vacuum envelope. Tuning speed over the required frequency range is 0.7 seconds min. to 3.0 seconds max.

The 6940/TE-58 is identical to the 6116, but has special characteristics limiting spectrum width and spectrum continuity under adverse load conditions.

The 6845/TE-59 is similar in electrical and mechanical characteristics to the 6116 but may be operated under pulsed conditions with minimum frequency modulation.

BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

The 6116/TE-39 Klystron tube combines ruggedized construction and thermal tuning. The combination provides a desirable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency jitter of less than ± 1.3 MC . . . at vibration levels up to 10 G at 50 cps. Thermal tuning provides a twofold advantage. It permits tuning the tube over its entire operating frequency remotely without mechanical means—and the tube can be

repeatedly cycled throughout its tuning range without damage or deterioration.

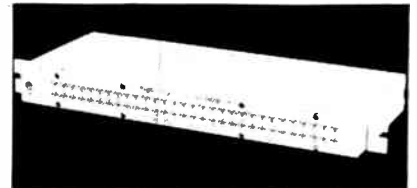
These Reflex Klystrons are but one example of how Bendix Red Bank technology can help you meet specialized tube needs. For information on these tubes . . . and on backward-wave oscillators and traveling-wave tubes . . . write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario

Red Bank Division

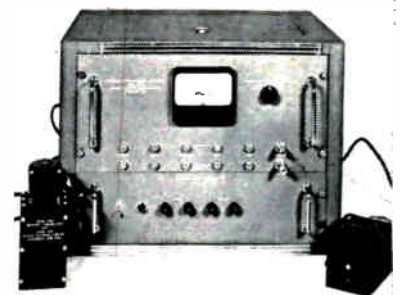


impedance available for matching purposes. The BF-101 filter is flat within one-half db from 40 kc to 310 kc. It has an attenuation greater than 40 db at 450 kc and higher frequencies. Providing for an insertion loss of less than 3 db, the filter maintains a constant impedance of 50 ohms within the pass band. Circle 208 on Reader Service Card.



Delay Chassis thirty-unit

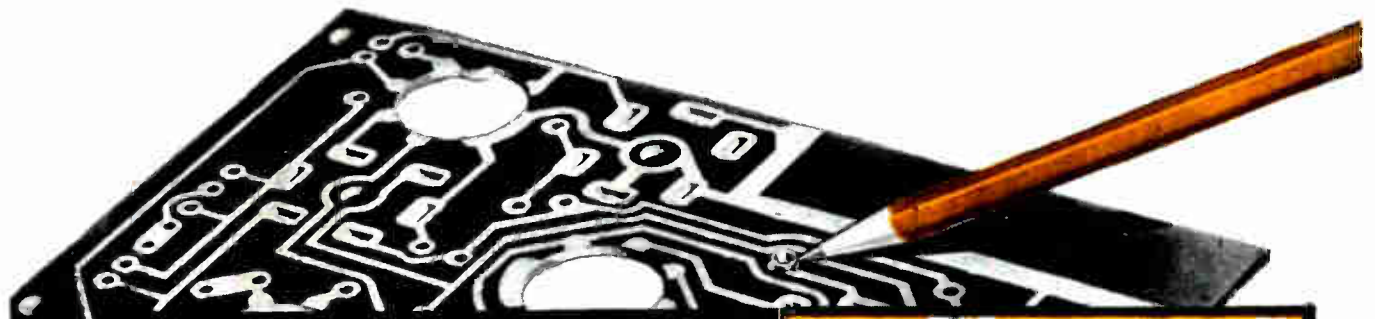
COMPUTER CONTROL Co., Inc., 92 Broad St., Wellesley, Mass. Model DU-10, a 30-unit delay chassis, is fully compatible for use with the company's series T digital modules. It contains 30 separate electrical 1- μ sec delay lines conveniently packaged in a standard 19 by 1 $\frac{3}{4}$ in. rack mounting chassis. Each delay line is completely independent. The lines can be used separately or joined in series by simple taper pin jumper connections to form the desired total delay. Circle 209 on Reader Service Card.



Voltmeter measures static

MONROE ELECTRONIC LABORATORIES, Inc., Middleport, N. Y. The ability to measure the voltage of an electrostatically charged surface without touching it is now made possible with a new voltmeter. The

RELIABLE CONNECTIONS



... with
LOW COST EYELETS



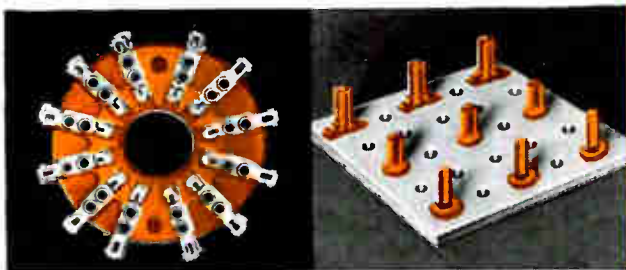
NEW FUNNEL FLANGE eyelets designed especially as connectors for PW boards. Solves two-sided circuitry and solder problems. Speeds insertion. Are fed and set automatically on United Machines.

Eyelets give you unlimited opportunities for savings as connectors, fasteners, terminals, bushings, contacts for switches and hundreds of similar applications. Only with United Eyelets do you have such a wide choice of standardized sizes, special designs for cutting costs on unusual production problems, combined with a comprehensive line of the most versatile eyelet setting machines available.

In no other way can you get the flexibility obtainable with eyelets at comparable installed costs. Call or write us today for more information. Our national sales and service organization is ready to help with your most challenging problem.



Simultaneous multiple eyeleting from either or both sides of machine. Typical six eyelet application illustrated. 50 years' experience is your assurance of complete dependability.



NEW MINIATURIZED EYELETS as connectors and fasteners for low cost, high speed insertion in components, PW boards, miniature equipment. Designed for high speed automatic feeding with United Machines. Copper or brass.

CUT COSTS WITH SHEARED EYELETS as stand-off terminals. Set as many as 3000 terminals per hour. Cuts soldering time too.



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AIRPAX ELECTRONICS

INCORPORATED

Note our name change:
Formerly THE AIRPAX PRODUCTS COMPANY



Airpax Ferrac amplifiers are exceptionally stable self-contained ferromagnetic computing amplifiers. Frequency response extends from DC to an upper limit determined by the input circuit.

Ferrac amplifiers are powered from 115 volt 400 or 60 CPS sources and are unusually insensitive to fluctuations in supply voltage or frequency. Potted for mechanical stability and hermetically sealed for environmental protection, their life exceeds 10,000 hours. Input (control) windings are electrically isolated and the output is insulated from the input and ground. These features permit signal mixing, phasing, limiting, integrating and all analog functions necessary for automatic control.

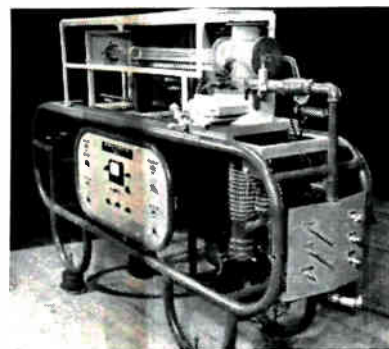
Ferrac type M-943, illustrated, is for use in commercial and military airborne control equipment and industrial automatic controls where extremely stable operation is essential. Other Ferracs are available, with rectangular packaging, having solder hook terminals and mounting studs.



SM14

SEMINOLE DIVISION, FORT LAUDERDALE, FLORIDA

equipment can be mounted wherever static is suspected and its presence not only established but actually measured. Measurements are made without contact of probe to surface and results are relatively independent of distance from probe to surface being measured. A portable type instrument operating on the same principle is also available for use where probe can be located close to surface area being measured. Circle 210 on Reader Service Card.

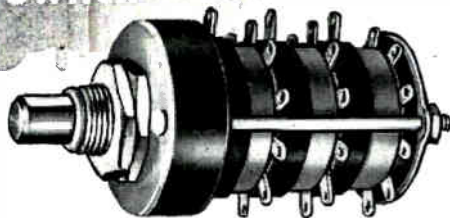


Zone Melter automatic apparatus

MATERIALS RESEARCH CORP., 47 Buena Vista Ave., Yonkers, N. Y. Model Z-81 zone melting apparatus is designed for quicker, easier preparation of super-pure materials for semiconductor applications. It can be operated either vertically or horizontally to do zone refining, zone leveling and crystal pulling. It is an integrated, fully automatic, lightweight machine which is safe and convenient to operate. The extremely narrow melting zone, made possible by an induction coil transformer, ensures precision control of the refining operation. For low melting point solids, an elliptical reflector furnace is available as optional equipment. Circle 211 on Reader Service Card.

Metal Film Resistors gas-filled

WESTON INSTRUMENTS, Division of Daystrom, Inc., Newark 12, N. J. Addition of an inert gas to hollow tube Vamistors has permitted doubling of ratings without any



...with Positive Detent Action

Grayhill
Series
24

This fully enclosed one inch diameter miniature tap switch, designed for high reliability in military and commercial applications, provides accurate indexing by precision detent mechanism.

One to 10 decks, 2 to 10 shorting or non-shorting positions per deck. 36° indexing. Break 1 amp. 115 V. AC, or carry 5 amps. Has passed many military environmental tests including explosion test per MIL-E-5272A Procedure 1.

Write for Complete Specifications



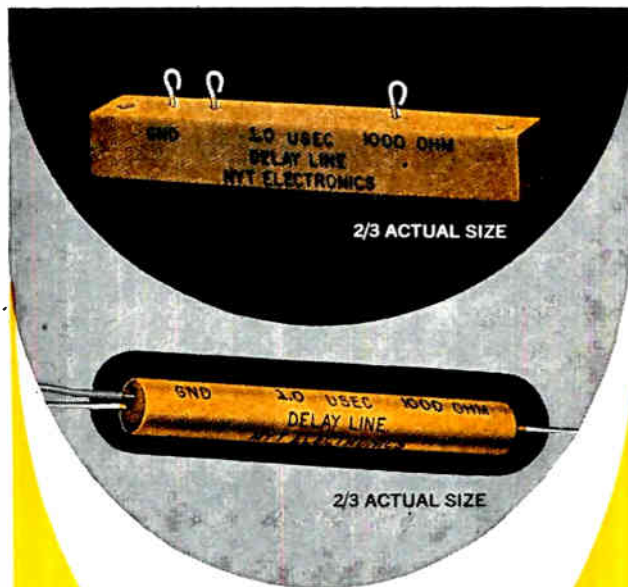
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“PIONEERS IN MINIATURIZATION”
CIRCLE 66 READERS SERVICE CARD

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It'll get there quicker if you give your postal delivery zone number with your address.

The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include your zone number in your return address—after the city, before the state.



Announcing a new series of standard delay lines:

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DELAY LINES

...a complete miniature series mounting horizontally or vertically... stackable for higher delays, and with tap-off points for lower delays. Molded in epoxy.

DELAY BANDWIDTH product per cubic inch: as high as 7.5.

RANGE OF DELAYS—from .05 to 1.0 μ sec. Higher delays when stacked.

IMPEDANCE RANGE—from 500 to 2000 ohms.

CHASSIS OR PRINTED CIRCUIT MOUNTING.

MAINTAINS DELAY TOLERANCE over temperature range of -55° C to $+125^{\circ}$ C.

WORKING VOLTAGE: 500 VDC.

HUMIDITY: Meets MIL-C-15305A, Grade 1, Class B.

SPECIAL DELAY LINES—quotations on request.



Send for Bulletin 140.

ELECTRONICS, INC.

2979 N. ONTARIO ST., BURBANK, CALIF.

MANUFACTURERS OF INDUCTIVE DEVICES FROM POWER TO RADIO FREQUENCIES, PULSE CIRCUITRY COMPONENTS, MAGNETIC AMPLIFIERS & POWER SUPPLY MODULES

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... now wind 19,000 times!

If you're dedicated to the cause of high resolution, you *could* wind your *own* pots and be sure. Allow yourself plenty of time, though — because the secret's in the number of turns per inch, and the spacing between 'em. Pack those turns right in there *closely* and *accurately*, and you *might* have a pot you'll be proud of!

But if you want to eliminate all bother, but not the high resolution, call on Ace! We've designed and built our own special winding equipment; we use premium, close tolerance resistance wire — and really leave no winding unturned to produce pots with the highest resolution in the industry. All AIA sizes, all mounting styles, specials and standards. So get your resolution the easy way — get Acepots! See your ACErep at once!

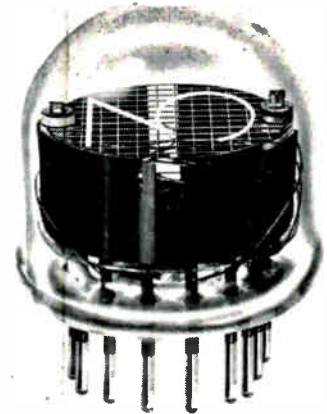


Here's highest resolution in a standard sub-miniature pot: The 500 Acepot® ½" size, ±0.3% independent linearity. Special prototype section insures prompt delivery on the Acepot® — ½" to 6" AIA sizes.

ACE ELECTRONICS ASSOCIATES, INC.
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Acepot® Acatrim® Aceset® Aceohm® *Reg. Appl. for

increase in size of these precision metal film resistors. The new models 9854 and 9855-4 Missile Line Vamistors were specially designed for use in transistor circuits, aircraft and missile gear, computers, and other precision instruments requiring a high degree of stability and miniaturization under extreme environmental conditions. Circle 212 on Reader Service Card.



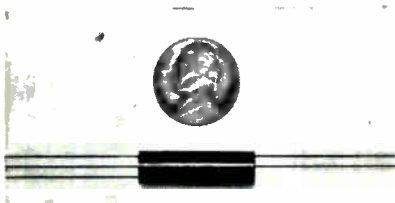
Indicator Tube rugged design

BURROUGHS CORP., P.O. Box 1226, Plainfield, N. J., announces production of a Nixie indicator tube with life of more than 10,000 hr. Type B-5031 is an all-electronic indicator which presents the ten numerals (0 through 9) in a common in-line viewing area. It is similar in mechanical and electrical characteristics to the standard type 6844-A. The only change required to make the tubes interchangeable is a reduction in the value of series anode resistance under rated operating conditions. Circle 213 on Reader Service Card.

Tracer Drives for machine tools

RELIANCE ELECTRIC AND ENGINEERING CO., 24701 Euclid Ave., Cleveland 17, Ohio, announces a new line of electronic tracer drives applicable to machine tools as feed drives on tracing operations. The V*S tracer drives are available with single-axis, dual-axis and full two-axis travel. The three

types of drives are offered to meet all types of tracing requirements, which vary in complexity. Each drive unit consists of a tracing template follower; an operator's station; a packaged, cabinet-mounted control unit; and controlled variable-speed d-c feed motors. **Circle 214 on Reader Service Card.**



Electronic Chopper transistorized

SOLID STATE ELECTRONICS Co., 8158 Orion Ave., Van Nuys, Calif. Model 70 silicon transistor chopper (or modulator) is a solidly encapsulated unit designed to alternately connect and disconnect a load from a signal source. The unit may also be used as a demodulator to convert an a-c signal to d-c. It is capable of linearly switching or chopping voltages over a wide dynamic range which extends down to a fraction of 1 mv and up to 10 v. Unit is an inertialess device that can be driven from d-c to hundreds of kc. **Circle 215 on Reader Service Card.**



Plastic Ties for wire bundles

WESTINGHOUSE ELECTRIC CORP., East Pittsburgh, Pa., has available a new cost-saving plastic tie to bind wiring harnesses neater and faster. Made of Nylon base Moldarta material, the new flexible tie offers many advantages over the old string tie method. The ratchet-like design makes it self-adjusting to a wide range of wire

ALLIED'S NEW ADDITIONS TO THE KH SUBMINIATURE LINE

Types KHJ and KHY GENERAL FEATURES:

Contact Data:
 Contact Arrangement—DPDT
 Contact Rating—
 Low-level up to 2 amps at 29 volts d-c,
 1 amp at 115 volts a-c 400 cps
 non-inductive or 0.5 amp inductive.
 Life—100,000 minimum at 125°C
 Also available 3 amps at 29 volts d-c
 2 amps at 115 volts a-c 400 cps
 non-inductive or 1 amp inductive.
 Life—100,000 at 3 amps or 500,000
 minimum at 2 amps at 125°C.
Initial Contact
 Resistance—0.05 ohms maximum
Contact Drop—1 millivolt maximum
 at low level rating, initial and during
 low level miss test.

Operate Data:
 D-C Coil Resistance—up to 10,000 ohms
 Nominal Power—1.2 watts
 Pull-in Power—240 milliwatts (standard)
 100 milliwatts (special)
 Operate Time—5 milliseconds max.
 Release Time—3 milliseconds max.

Dielectric Strength:
 1000 volts rms at sea level
 500 volts rms at 70,000 feet
 350 volts rms at 80,000 feet

Insulation Resistance:
 10,000 megohms minimum at 125°C

ENVIRONMENTAL FEATURES

Vibration:
 5 to 10 cps at 0.5 inch double amplitude
 10 to 55 cps at 0.25 inch double amplitude
 55 to 2000 cps at 20 g
Shock: 100 g's operational • 200 g's mechanical
Ambient Temperature: —65°C to +125°C

MECHANICAL FEATURES

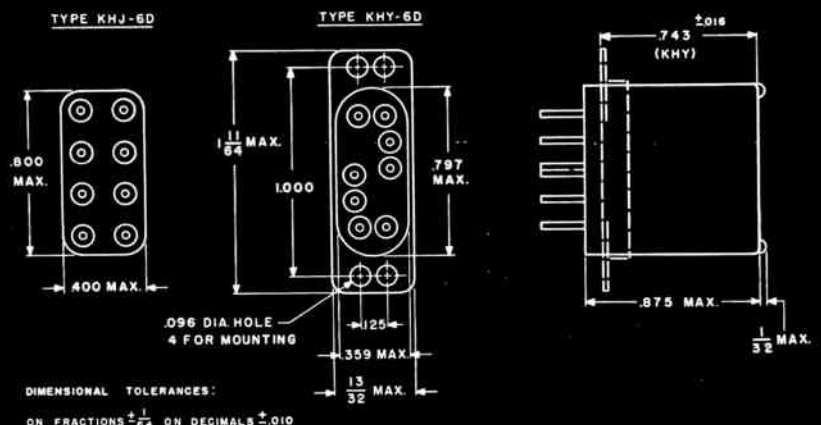
Weight: 0.5 ounce
Terminals:
 Hooked Solder • Plug-in • Printed Circuit
Mountings:
 2 or 4 hole brackets at base or center of gravity
 1 or 2 studs on top or side of housing

MILITARY SPECIFICATIONS

MIL-R-25018 • MIL-R-5757C

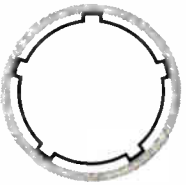


Allied's type KHJ and KHY subminiature relays have a higher contact rating than Allied's original subminiature relay and are designed to meet the increased vibration and shock requirements of the latest MIL specs. In addition, the type KHJ relay has incremental grid spaced terminals for application to "Automation" assembly. Both relays are available with brackets for mounting interchangeable with that of Allied's type KH subminiature relay.



ALLIED CONTROL
 ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N. Y.

AL 190



Announcing — IERC's

THERMA-flex®

Heat- Dissipating Electron Tube Shields!



New THERMA-flex liner makes IERC's heat-dissipating tube shields cool electron tubes more efficiently!

IERC and government testing*, using latest techniques, proved THERMA-flex tube shield liners to be the most efficient heat-dissipating liners available! IERC THERMA-flex liners and tube shields will meet all requirements of MIL-S-9372 (USAF) and MIL-S-19786 (NAVY). In the shield, the broad areas of the liner attain a particular semi-elliptical precision spring curve. Tube insertion causes spring curve to flex and adjust to contours of bulb. This action grasps a major portion of tube surface, absorbing heat from hot spot which is transferred to shield and heat sink and dissipated by conduction, radiation and convection.

THERMA-flex high-efficiency tube shield liners are available now for most sizes and types of IERC Miniature Heat-dissipating Electron Tube Shields.

See NEL Reliability Design Handbook, Sec. 502 — "Improved Type Miniature Tube Shields," OTS — Jan. 15, 1959



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PATENT PENDING

International Electronic Research Corporation
145 West Magnolia Boulevard, Burbank, California

Write for helpful, FREE, IERC Tube Shield Guide with over 1,200 tube and tube shield combinations to help you avoid thermal problems in your new equipment designs or retrofitting plans!

Heat-dissipating electron tube shields for miniature, subminiature and octal/power tubes.

bundle diameters. It will reduce the time required to tie a bundle by about 30 percent. The tie is fungus and moisture resistant resulting in a long useful life. Circle 216 on Reader Service Card.

Motor-Generator Set precise power

ELECTRIC MACHINERY MFG. Co., Minneapolis 13, Minn., has developed a new 400 cycle, high performance motor-generator set. Model 40 SG 50 is built particularly for ground power support of missiles and jet aircraft. It is complete with a free standing control cubicle which houses all control components. Remote operation of the unit is easy with the separate control cubicle. Rated to deliver 50 kw of 400 cycle power, the unit is built with voltage regulation of ± 1 percent, harmonic content of 2 percent maximum and voltage recovery to within ± 1 percent within 0.25 sec. Circle 217 on Reader Service Card.



Vibrating Capacitor ceramic insulated

STEVENS-ARNOLD, INC., 22 Elkins St., South Boston, Mass. In appearance the VC-1006/500 is identical to the VC-713/500 recently announced except that ceramic insulation is used in place of the considerably more expensive fused quartz, resulting in a minimum insulation resistance of 10^{12} ohms. Further cost reduction has been achieved by relaxing the contact potential and drift specifications to 30 mv maximum and ± 2 mv per day respectively; this is because cost of a vibrating capacitor is governed largely by the processing

here is the world's smallest and simplest
strip chart recorder!



- **AMPLE STORAGE:** Contains 63-ft. chart roll, or 31 days' recording at one inch per hour. Useful chart width 2 3/16".
- **ACCURATE:** Galvanometer pointer swings free for maximum accuracy, being clamped briefly for marking.
- **INKLESS:** Recording process is completely dry, utilizing special pressure sensitive paper. Method provides remarkable definition.
- **RECTILINEAR:** Advanced design provides true rectilinear recording free from distortion.
- **RELIABLE:** Positive synchronous motor drive with sprocket engaging holes in paper for accurate time indication.
- **VERSATILE:** Portable or panel mounting models. Stocked in a variety of scales and chart speeds.

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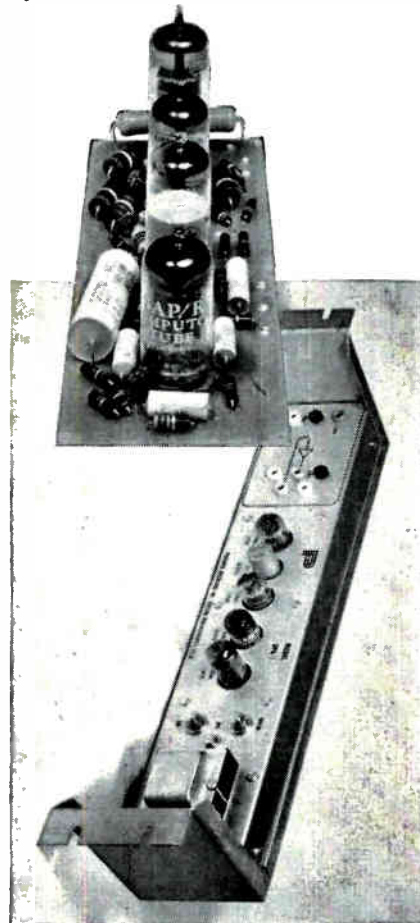
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"We insist on the Philbrick amplifier for our new package" says Philbrick
HERE'S PHILBRICK ON PHILBRICK
"We use only the finest components in our products. That's why we insisted on Philbrick's new USA-3 Operational Amplifier as a sub-assembly for our new Analog Package, the UPA-2. We have found it (the USA-3) nifty and thrifty. We recommend it without reservation. And that goes for the UPA-2—too."

PHILBRICK OPERATIONAL AMPLIFIER... USA-3

More performance per dollar than any other amplifier. Highly reliable—no electrolytic capacitors or glow tubes. Designed to prevent self-destruction even when the output is grounded. Drift, noise, offset under 100 microvolts. Output is ± 116 VDC. Wide frequency range—DC to 100kc (attenuation less than 3db) when connected as a gain-of-ten amplifier. 7" x 2 1/2" printed circuit board mounts by several convenient methods. Price \$95.



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Combines new level of flexibility and convenience. Performance characteristics same as the USA-3 amplifier, the heart of this package. Can drive 12,000 ohm load to 100 volts in either direction. Designed for 3 1/2" rack mounting but can be used equally well as a bench amplifier, or plug-in assembly without modification. Use it for analog computing, measurement and control, continuous data reduction, and many other feedback operations. Price \$149.

Write for technical literature and advice on your application.

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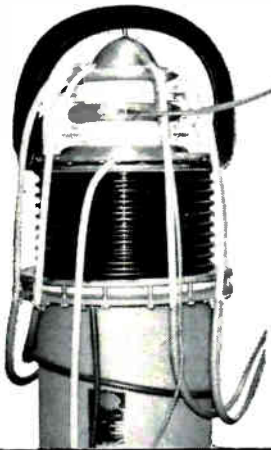
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285B Columbus Avenue, Boston 16, Mass.

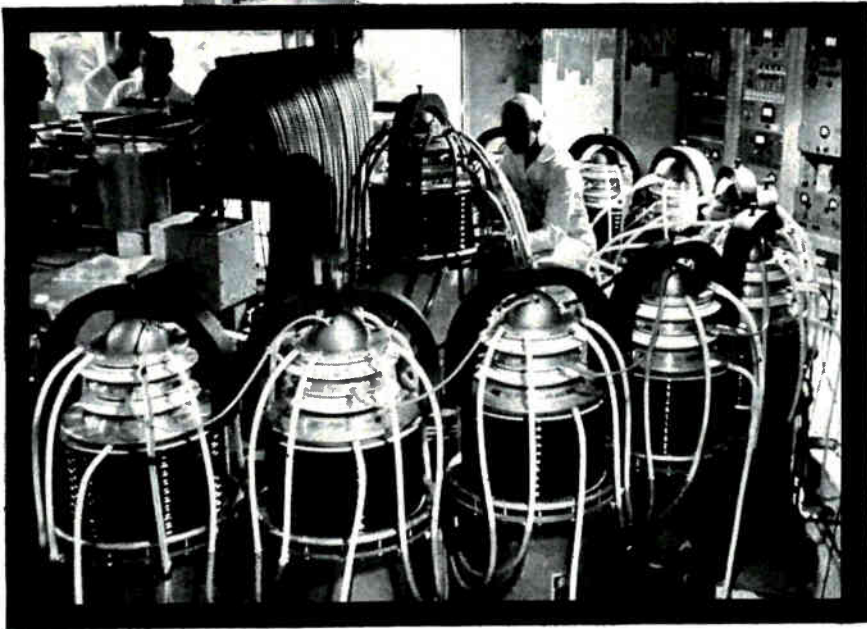
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amperes
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At the recent Geneva Atoms-For-Peace Conference, Los Alamos scientists unveiled *Scylla*—a fusion device used to heat a plasma of ionized heavy hydrogen particles millions of degrees by blasting it with a 600,000-ampere thunderbolt.

Surrounding the heart of this thermonuclear machine is a bank of Tobe low-inductance, energy-storage capacitors...each rated at 100,000 volts each capable of a 20,000 megawatt peak surge.

Why Tobe capacitors? Because only Tobe, with over 30 years of capacitor manufacturing experience, could meet the rigid design specifications set for the project. Tobe can meet yours too. So, whether you need a bank of thermonuclear energy-storage capacitors or a miniaturized tubular, talk to Tobe. Our engineers speak your language.

For further technical information or engineering aid, write Tobe-Deutschmann Corp. Norwood, Mass.



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needed to obtain a specified level of performance. Price is \$75 each in quantity. Circle 218 on Reader Service Card.



Selenium Rectifier encapsulated

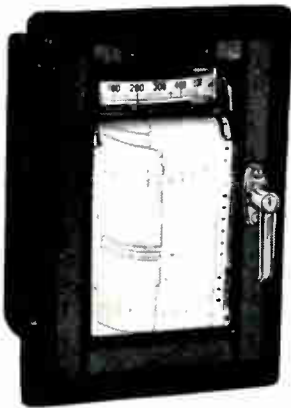
INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif. Type QM50 selenium rectifier features a rugged, phenolic-encapsulated package which completely seals rectifier cell surfaces; assures positive insulation from other chassis components. The new molded rectifier has rectified d-c output current rating of 50 ma, with a maximum rms input voltage of 130 v. Stud mounting of the unit insures ease of mounting and wiring to chassis. Circle 219 on Reader Service Card.



Transistor Radiator for diamond shapes

THE BIRTCHE CORP., 4371 Valley Blvd., Los Angeles 32, Calif. A heat dissipation device designed for diamond shape power transistors has been developed. The 3B-663 radiator consists of a series of black ebanol finished metallic radiating fins mounted on a base plate which is interposed between the transistor and the chassis. It may be used with or without a mica insulating washer. The device attaches to the chassis with four bolt posts and in no way inter-

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The
A. W. HAYDON COMPANY'S
TRANSISTORIZED SUB-MINIATURE
ELECTRONIC TIME DELAY RELAYS!

SAVE SPACE AND WEIGHT!

	Miniature Series	Sub-Miniature Series
Cross Section	1 7/16" x 1 1/2"	3/32" x 1 3/16"
Length	2 1/4" long	2" long
Weight	6 ounces	3 ounces
WRITE FOR:	Bulletin AWH TD-503	Bulletin AWH TD-504

TEST-PROVED PERFORMANCE!

High Temperature: 125°C (250°F)
Vibration: 2000 CPS at 15 g.
Contact arrangements up to 4 pole double throw.
Unique transistorized R.C. time constant network.
Time Delays from 50 MS to 120 seconds. Longer Delays available.
Hermetically sealed housings.

MEET
REQUIREMENTS
OF MIL-E-5272A.

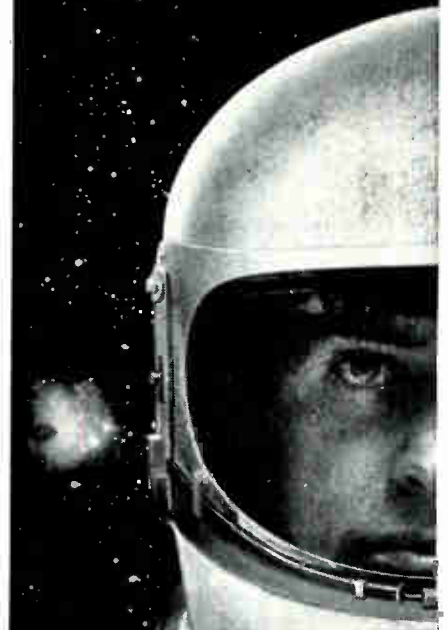


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Top-Level Systems Engineers interested in performing applied research for the laboratory evaluation of such complex electronic systems as fire control, bombing systems, mission and traffic control systems, air data, and automatic flight control. Evaluation consists of the integration of related electronic systems and related interference problems.

Other top-level positions are available in radome development, antenna development, and infra-red.

Minimum requirements are actual experience plus B.S. or advanced degree in E.E. and Physics.

For more information please write to: Mr. F. B. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

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CALIFORNIA at our ElectroData Division in Pasadena

Electronic Engineers with experience in areas such as logical design, computer components, circuit design, electronic packaging, sub-miniaturization, manufacturing costs and processes.

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For Details, write Mr. C. J. Blades, Manager, Professional Employment, Dept. 201A, Burroughs Corporation ElectroData Division, 460 Sierra Madre Villa, Pasadena, California.

PENNSYLVANIA at our Research Center near Philadelphia

Systems Engineers with specific experience in systems analysis and design of digital data processors. Should be trained in engineering, physics or mathematics. Graduate training desirable.

Mathematicians, computer-oriented, with particular experience in problem formulation, numerical analysis, and applied mathematics—in connection with formulation and design of computational procedures. Procedures involved in problems of guidance and air defense, trajectory calculations, logical design, sampled data systems, circuit analysis and more. Advanced degree in mathematics preferred.

For Details, write Mr. James Gilroy, Professional Placement Coordinator,

Dept. 201B, Burroughs Corporation Research Center, Paoli, Pennsylvania.

PENNSYLVANIA at our Military Field Service Division in Phila.

Field Engineers responsible for the direction of several field teams in installation and maintenance of digital computers and integrated data processing systems. Required BSEE, with extensive field service experience in military electronic equipment.

Site Engineers to attend formal lab and lecture training program of 16 weeks in electronic data processing equipment at full salary. Assignments after completion of formal program plus field training will involve direct supervision of a field team in installation and maintenance of data processing equipment. BSEE preferred, or equivalent experience. Must be willing to travel and relocate.

For Details write Mr. A. J. Bellace, Employment Supervisor, Burroughs Corporation Military Field Service Division, Dept. 201C, Burroughs Drive, Radnor, Pennsylvania.

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Experienced Electronic, electrical and mechanical engineers to work in many areas of research and development for information processing equipment applicable to commercial and military use.

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feres with servicing or operation of the transistor. It is reported to be ideal for use above ground potential. Circle 220 on Reader Service Card.



Power Supplies transistorized

SOUTHWESTERN INDUSTRIAL ELECTRONICS Co., 10201 Westheimer, Houston, Texas, has introduced the TPC-18 and 19 transistorized power supplies. They are designed specifically to replace 14 and 28 v D-10A dynamotors in the supply of power to aircraft communications and navigation receivers. Both utilize a transistor multi-vibrator circuit to deliver 250 v d-c and 100 ma at over 80 percent efficiency with regulation better than 10 percent. The transistor circuitry is not only completely reliable due to the absence of moving parts, but also incorporates protection against overload or short circuits. Circle 221 on Reader Service Card.



Commutator for missile uses

APPLIED SCIENCE CORP. OF PRINCETON, P. O. Box 44, Princeton, N. J. The command commutator is a spring-driven, rotary sampling switch that offers a number of important advantages for missile and space telemetering systems. Due to its precision, self-contained



SANDERS MINICUBE[®] BLOWER

*Blower and Motor in 1" Cube
Cools and ventilates miniature equipment*

Designed for use in aircraft and missiles, this Sanders Minicube Blower is ruggedly packaged . . . operates over wide ranges of vibration, acceleration and temperature.

- APPLICATIONS**
- Maintaining uniform flow of air in restricted spaces.
 - Preventing fogging of lenses and viewing glasses.
 - Eliminating hot spots around Klystrons and other electronic tubes and devices.

SPECIFICATIONS

Input: 400 cps, 3 watts **Speed:** 22,000 rpm approx.
Voltage: Model 1A — 6.3 volts **Size:** 1" x 1" x 1"
 Model 2A — 26 volts **Weight:** 1 1/4 oz

For complete details about prices, delivery schedules, and conformance to military specifications, write:

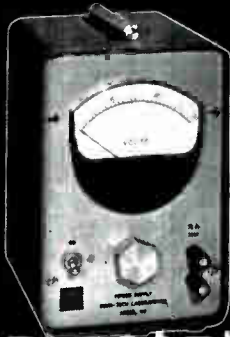


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Quan-Tech's Transistor-Regulated Power Supplies



Model 103

POWER SUPPLY SPECIFICATIONS you can count on!

You'll find Quan-Tech's low voltage, precisely-regulated power supplies ideal for laboratory use and for specific applications. So lightweight and compact. Take only a minimum of bench space. Short-circuit current is held to a safe value, *automatically*.

Four models regulated from $\pm 0.25\%$ or ± 25 millivolts for line and load combined. Feature low ripple, low internal impedance, small size ($8\frac{1}{4}'' \times 5'' \times 6\frac{3}{4}''$ deep; weight, $7\frac{1}{2}$ lbs.).

- MODEL 101 0-8 v. DC, 0-2 amps. . . Price \$195
 - MODEL 102 0-14 v. DC, 0-1 amp. . . Price \$175
 - MODEL 103 0-30 v. DC, 0-1/2 amp. . . Price \$175
 - MODEL 105 0-50 v. DC, 0-1/4 amp. . . Price \$205
- Also
 MODEL 104 0-50 v. DC, 0-1 amp. . . Price \$375

All models, racks, special units — including closer regulation, current metering, etc. — furnished to your specifications.

Write or call us for complete information:



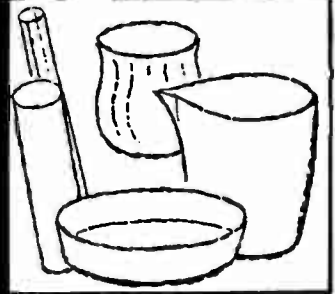
QUAN-TECH LABORATORIES

● **Morristown, New Jersey**

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ELECTRONICS — February 13, 1959

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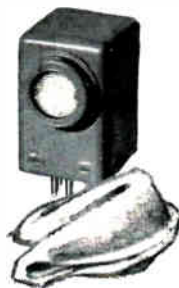


The artist has captured a rare expression on the face of Sigma's general manager — one of happy satisfaction and complete contentment. This is because the sales dept. has just told him (1) about a new Machine of Pleasure which uses a Sigma product and (2) that the customer is overjoyed because the Sigma product works right. His corporate corpulence is enjoying every minute of it, while it lasts. By publicizing this latest application triumph, it is hoped that others will be spurred on to similar successes.

An enterprising consulting engineer on the West Coast recently took on the job of building a fully automatic machine for folding Chinese fortune cookies. The specs called for handling a piece of hot, flexible cookie dough every five seconds; folding it in two directions and getting the fortune inside the cookie between folds; using up 420 different fortunes before repeating. The machine slices printed fortunes as required from continuous rolls. It was at this point that consulting cookie engineer William E. Thomas asked his E. E. brother Frank how to keep the slices between the lines; since brother Frank reads Sigma ads, his immediate reply was "Sigma Photorelay" (we like to think). One was purchased and rigged up to control the paper feed, by sensing black bars printed on the rolls. Brothers Thomas, their project engineer Charles A. Lindberg (honest!), their customer and Sigma are now all entranced by the results.

So one more banner should be raised for the unsung heroes whose accomplishments do not go up in three stages and a deafening roar, but simply "kerplunk" every few seconds as a new little item is unflinching produced. If you have such a project, and light sensing can be put to a useful purpose, a Sigma Photorelay might be worth trying.

They come ready to plug in, switch 3 amps. resistive at 120 VAC, cost only about \$12.00; the cookie boys even went so far as to say "we certainly could not have installed anything else that worked properly so inexpensively." Who knows, maybe you could even build a machine to get the ordinate and abscissa straight on hot cross buns.



SIGMA

SIGMA INSTRUMENTS, INC.

62 Pearl St., So. Braintree 85, Mass.

AN AFFILIATE OF THE FISHER-PIERCE CO. (Since 1930)

driving mechanism, the command commutator has no r-f noise generation, no gyroscopic effect, no heat generation and extremely low average power consumption. The commutator is hand-wound before a flight. It will make one complete sampling cycle for each command received. **Circle 222 on Reader Service Card.**

Anemometer hot wire type

SHAPIRO & EDWARDS, 1130 Mission St., South Pasadena, Calif. Model 60B hot wire anemometer is an instrument for measuring the velocity of an air stream, making use of the ability of the stream to absorb heat from an electrically heated thin wire filament. The wire filament forms one leg of a Wheatstone bridge which is driven by a d-c amplifier. A feedback circuit maintains constant resistance and temperature of the wire. The energy input to the wire goes directly into the air stream. The wire current is a measure of the instantaneous velocity. An output voltage is obtained across a fixed resistor in which wire current is flowing. Frequency response of the model 60B extends from d-c to 10 kc. Accuracy is 1 percent. **Circle 223 on Reader Service Card.**



Core Materials extended range

THE POLYMER CORP. OF PENNSYLVANIA, 2140 Fairmont Ave., Reading, Pa., has developed two new non-memory, inductive core materials which have been used successfully as antenna couplers at intermittent service temperatures up to 350 C. Known as Ferrotron

DELTA Air Freight costs less than you think!

Holds down inventories! Holds down costs of crating, insurance, capital tie-up. Protects against deterioration and market declines!



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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.

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Precision gauges from ¼ to .002. Close tolerances held.

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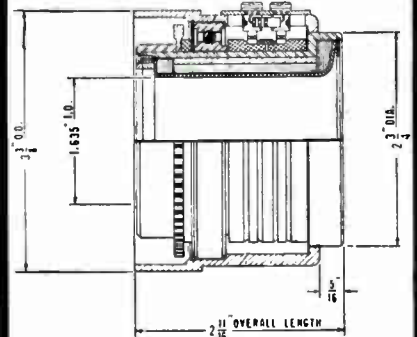
ELECTRONICS — February 13, 1959

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Compact Rotating Coil Yoke



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OTHER ROTATING TYPES available with fixed off-centering or rotating off-centering. Many mechanical and electrical variations.

FIXED TYPES with push-pull windings. Low current coils for slower sweep speeds. Low impedance coils for transistor drives.

Neck diameter, core material, configuration, deflection angle and electrical design to your precise spec. For engineering help, contact Dr. Henry Marcy today.

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ADC's Complete

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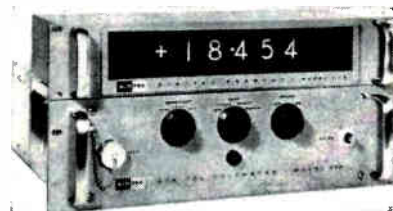


Expensive testing hours are saved by the accurate and complete test reports submitted with each ADC sample. The transformer illustrated above is typical. Specifications called for an output transformer for a high power, ultrasonic application. The sample was promptly submitted with complete test data and outline drawings.

As is its custom, ADC also included the test circuit so that the customer could see how the test data was obtained, and more easily verify test results.

From sample design through production, you'll like the way ADC fulfills your transformer and filter requirements.

ferromagnetic materials, the cores are claimed to extend the operating range 75 C to 150 C over previously available compositions. Ferrotron materials are characterized by a positive Q coefficient and constant magnetic permeability. They have a volume resistivity higher than 10^{10} ohm-cm and high dielectric strength. The dielectric losses are low across the frequency spectrum. Circle 224 on Reader Service Card.



Digital Voltmeter with fifth digit

KIN TEL DIVISION of Cohu Electronics, Inc., 5725 Kearny Villa Road, San Diego 12, Calif. A fifth digit has been added to ensure accuracy at the upper limit of each range in the new model 501 digital voltmeter. New instrument has an accuracy of 0.01 percent ± 1 digit in four automatic ranges from 0.0001 to 1000.0 v d-c. It retains this accuracy even in the transition area between ranges. Circle 225 on Reader Service Card.

ADC AUDIO DEVELOPMENT COMPANY
2838 THIRTEENTH AVENUE SOUTH, MINNEAPOLIS, MINNESOTA

ENGINEERING TEST REPORT
FOR E. F. WILTON & CO.
ATTN: MR. WM. HARTER - DEPT 5
PART NO. 0097632 REV. _____

A No. XY0068
TESTED BY: REB
E.O. 40022A
TYPE: ULTRASONIC
OUTPUT T/F
DATE: 12-20-57

TESTS AS FOLLOWS:

- 1) TURNS RATIO
CONTINUITY $\frac{1-3}{5-6} = \frac{1-3}{7-8} = \frac{25.25}{7}$
 $\frac{1-3}{4-6} = \frac{1-3}{7-9} = \frac{18.12}{1}$
- 2) PHASING, ADDITIVE WITH 3 TIED TO 4 & 6 TIED TO 7
- 3) PBT 11,000V PRI TO SEC / CASE - PASSED
1500V SEC TO CASE - PASSED
- 4) PRI (1-3) OCL 4.03 Hrs @ 10V 3000 CPS
- 5) FREQUENCY RESPONSE

F _{FC}	D _B	F _{FC}	D _B
1.0	-1.7	700	-1.1
5.0	-1.5	800	-1.2
10.0	-1.3	100.0	-1.3
20.0	0	120.0	-1.4
50.0	0	150.0	-1.7
100.0	0	200.0	-1.2

TEST CRT:

COMMENTS: T1 = WIDE RANGE 1:1:1 COUPLING T/F
E1 = 5V (CONSTANT)
D_B = 20 LOG E_o / E_i
METERS - H.P. 400 D
OSC. - MR 200 C

REFERENCE: REB 12-20-57 APPROVED: *R. J. Sell*

OUTLINE DRAWING

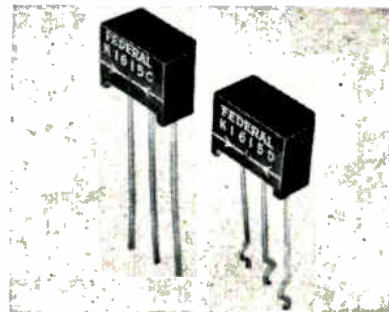
C4 MOUNTING STUDS
1/4 20 UNC-2A
2.090
1.125

6062
2.125 2.125
11
11
2.375
2.375

ULTRASONIC OUTPUT TRANSFORMER

10,800W
62.5
125W

POWER LEVEL 2200 WATTS
RESPONSE 2168 SEC. 100 KC
MFG BY AUDIO DEVELOPMENT CO.
XY 0000



Selenium Diodes encapsulated

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP., Clifton, N. J., has improved the design of its type K1615 center-tap and K1616 doubler line of "Federal" encapsulated selenium diodes. The components, retaining the same type numbers,

write for the **NEW** ADC CATALOG!

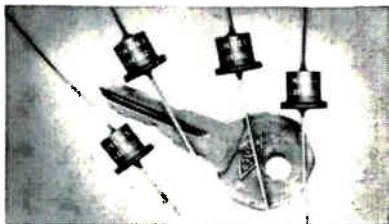


AUDIO DEVELOPMENT COMPANY
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TRANSFORMERS • REACTORS • FILTERS • JACKS & PLUGS • JACK PANELS

are used in horizontal phase detector circuits of tv receivers. The improvements, which include use of a new Bakelite case and a new filler, result in components with distinct advantages over a 6AL5 vacuum tube. These advantages include operation at ambient temperatures up to 85 C, rugged mechanical construction assuring long life with resistance to shock, vibration, humidity and low shunt capacitance. Circle 226 on Reader Service Card.

Analog Computer desktop size

DONNER SCIENTIFIC Co., Concord, Calif. Model 3400 analog computer performs the functions of general purpose analog equipment with an exceptional combination of versatility and economy. In design, analysis, or control problems, it affords an accurate, time-saving model of an arbitrary physical system. Easily measured varying voltages represent the physical variables of the problems. Measurement of the voltage yields complete information on the system. Parameters can be altered with the twist of a dial. Circle 227 on Reader Service Card.



Silicon Rectifiers two new types

RAYTHEON MFG. CO., 55 Chapel St., Newton, 58, Mass., announces the addition of types 1N1763 and 1N1764 to its line of silicon rectifiers. These new types of the wire-in construction are small in size, suitable for high temperatures and usable in a variety of equipments where previous silicon rectifiers have been too expensive. The 1N1763 has a piv rating of 400 v and a d-c load current rating of 500 ma at 25 C. Ratings for 1N1764

Only Bruning's *New*, Years-Ahead Copyflex 675 Offers So Many Operator Conveniences!



Look! No Hands! But the Paper Stays in Place!

No hands need hold paper on the feedboard of Bruning's new Copyflex 675 reproduction machine. A unique system of vacuum ports keeps material in position until the operator is ready to feed it into the machine.

This is just one of many new, advanced operating conveniences that include an exclusive four-way tracing tray that adjusts to stack or to permit fast removal of tracings... a feed band system that eliminates curling and wrinkling of tracings... enclosed, easy-to-load feed rods for roll stock... an electrically controlled machine

height adjustment, and a split-shade lamp control that enables simultaneous insertion of different materials. For added convenience, there's a handy storage drawer and swing-out ash tray.

Add to these operator conveniences the 675's 46-inch printing width, a mechanical speed of up to 75 f.p.m., and a fast-printing 7,500 watt lamp variable to 5,000 watts. All this, plus many other advancements, puts the "675" years-ahead of any other reproduction machine on the market. It's the modern whiteprinter that gives your operators MORE to do MORE for you.

BRUNING

Copyflex

Diazo Reproduction at Its Best

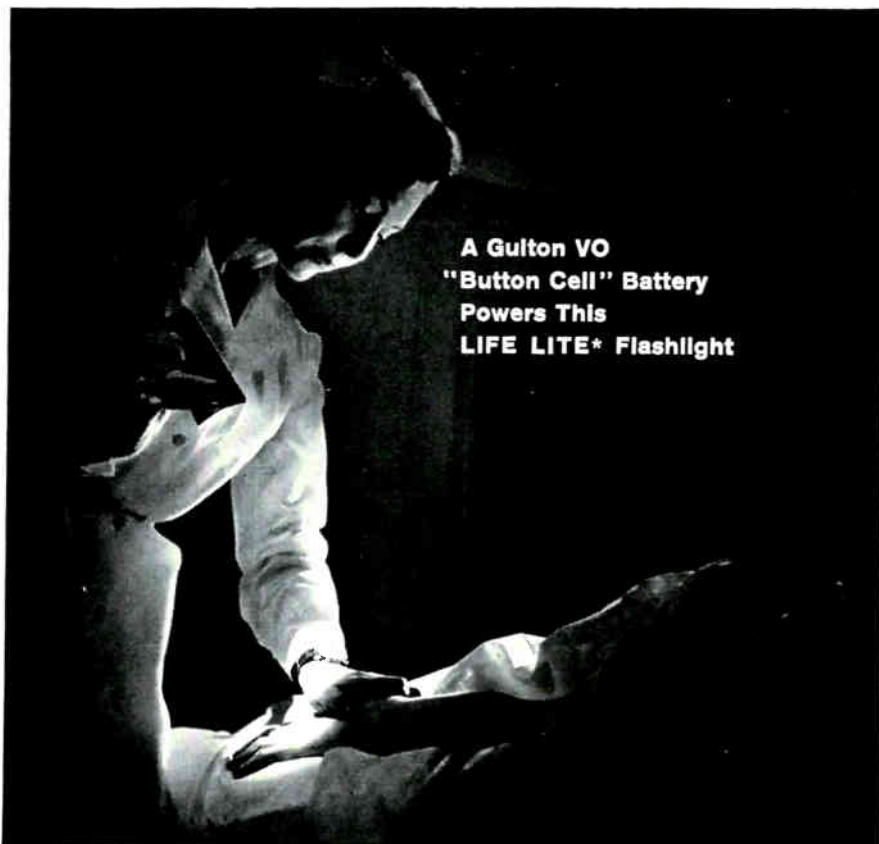
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A Gulton VO
"Button Cell" Battery
Powers This
LIFE LITE* Flashlight

*Trademark

reliable . . . long-lived ... rechargeable!



You can read a watch in the dark with any flashlight. The difference in the one the night nurse is using is that it will probably last a lifetime.



That's because it's powered by a *sealed* nickel cadmium button cell battery that's recharged simply by plugging it into an ordinary wall socket for a few hours.

Result: A dependable flashlight that can't corrode and never needs battery replacement.

How Can You Use These Versatile Batteries?

The rechargeable *Life Lite* is only one of many interesting ways in which imaginative engineers are employing these Gulton VO batteries.

Other applications: transistorized radios, guidance canes, missiles, photoflash power packs—*wherever small size, large capacity, light weight, long life, no maintenance, complete reliability, and easy recharging are desired.*

Most Complete Line Available

"VO" cells are available in capacities of 100, 180, 250, 500 and 1750 mah; have a nominal 1.2 voltage; can be packaged in any combination to meet your voltage specs. Patented sintered plate construction provides exceptional cycling characteristics; highest capacity per unit size. Like more information? Write us for Bulletin No. VO-110.

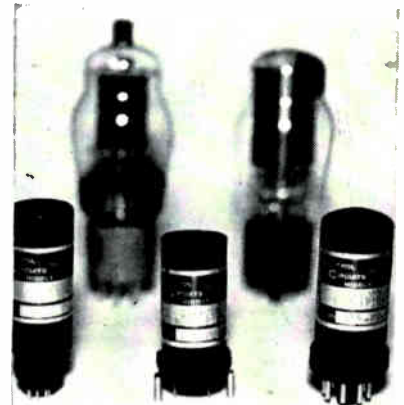


ALKALINE BATTERY DIVISION

Gulton Industries, Inc.

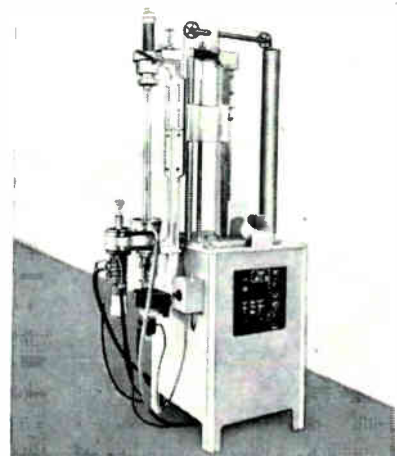
Metuchen, New Jersey

are identical except for a 500 volt peak inverse. Circle 228 on Reader Service Card.



Silicon Rectifiers encapsulated

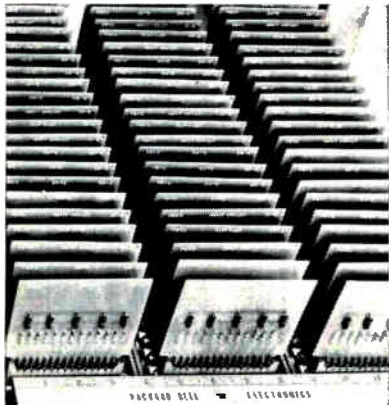
CONTROL CIRCUITS INC., 5 Barton Hill, East Hampton, Conn. A new line of encapsulated silicon rectifiers includes piv values from 350 to 3,200, and current ratings from 150 ma to 1 ampere. Ambient ratings are up to 140 C. Stock items include direct-replacement types for 6X4, 5Y3, and other vacuum tubes. Printed circuit and under-chassis types are also available in full-wave, full-wave bridge, and half-wave versions. Circle 229 on Reader Service Card.



Induction Heater floating zone type

LEPEL HIGH FREQUENCY LABORATORIES, INC., 55th & 37th Ave., Woodside 77, N. Y., has introduced its new floating zone fixture for the production of ultra-high purity

metals and semiconductor materials. Purification or crystal growing is achieved by traversing a narrow molten zone along the length of the process bar while it is being supported vertically in vacuum or inert gas. Designed primarily for production purposes, the model HCP also provides great flexibility for laboratory studies. Circle 230 on Reader Service Card.



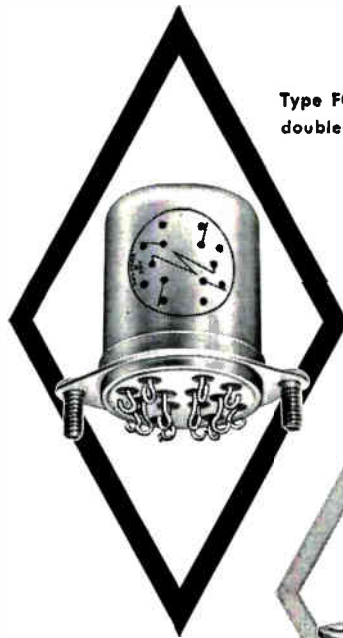
Logical Packages low cost

PACKARD-BELL ELECTRONICS CORP., 12333 W. Olympic Blvd., Los Angeles 64, Calif. A complete set of solid state digital logical packages can be combined to build registers, counters and other data handling equipment, including computers. The packages include flip-flops, inverters, gates, drivers, and clock generators. These low-cost, plug-in modules are easily replaceable and can be built into systems of any size. High reliability is achieved through the elimination of both eyelets and printed circuit connectors. Circle 231 on Reader Service Card.

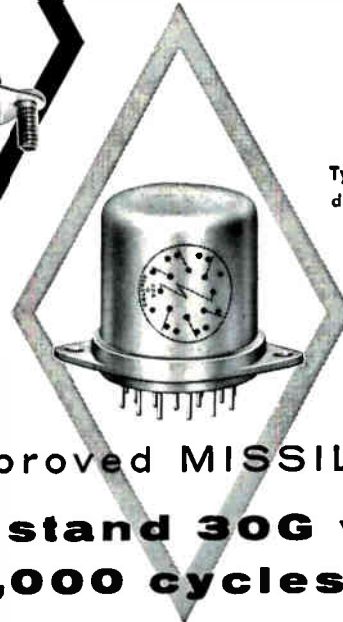


Metal Film Resistor low noise

RESISTANCE PRODUCTS Co., 914 S. 13th St., Harrisburg, Pa., announces a new precision low noise



Type FC-4 4-pole
double-throw.



Type FC-6 6-pole
double-throw.

These Improved MISSILE RELAYS withstand 30G vibration at 2,000 cycles

- ... up to 60G shock without contact opening
- ... and 2,000 ft.-lbs. shock without contact transfer

Backed by more than ten years of intensive development and refinement, these rugged, precision-built Struthers-Dunn FC relays have the high reliability required for missile uses. The outstanding characteristics indicated above typify performance that meets or exceeds the operational and environmental requirements of MIL-R-5757C and MIL-R-25018. Thanks to simplified design, S-D FC Relays, are priced materially lower than other types frequently used to meet these exacting specifications.

MAKERS OF THE
WORLD'S LARGEST
ASSORTMENT OF
RELAY TYPES



NEW BULLETIN AVAILABLE...
giving full details and electrical and mechanical specifications. Ask for FC Relay Bulletin.

STRUTHERS-DUNN, Inc.

Pitman, N. J.

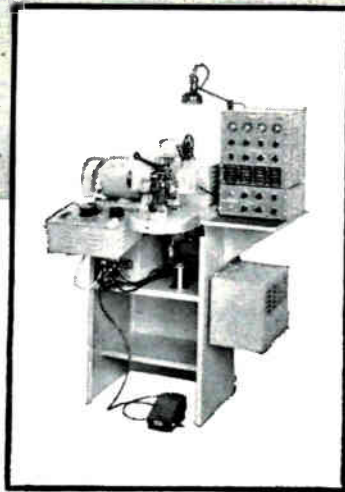
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NEW

*electronically
controlled*

TOROIDAL WINDER TW 300

*faster production at lower cost
speeds up to 2000 turns per minute
4-digit, 2- or 7-position predetermined
turns counting*



The entirely NEW electronic system of the TW 300 provides unmatched features in a toroidal winder . . . proximity pick-up for use with any size wire without physical contact . . . 100% accurate turns counting . . . controlled slow-start, slow-stop driving motor . . . automatic segmental winding with perfect repeatability . . . progressive winding of segments or continuous coils in either direction.

The TW 300, designed for easy servicing and maintenance, cuts production time and operator fatigue to the bone. Flexibility in production of new coil types with superior electrical characteristics is unlimited because of the new control system with automatic winding features. This machine is a significant advance toward complete automation of toroidal winding.

You get the BEST from BOESCH



**BOESCH MANUFACTURING
COMPANY, INCORPORATED
DANBURY, CONNECTICUT**

metal film resistor with a temperature coefficient of ± 50 ppm per deg C over a temperature range from -65 C to $+165$ C independent of resistance value. The precision assembly is enclosed in a specially designed hermetically sealed plastic casing to provide utmost protection for the precision resistor element. Circle 232 on Reader Service Card.



Proximity Pickup miniature size

ELECTRO PRODUCTS LABORATORIES, 4500 N. Ravenswood Ave., Chicago 40, Ill., has announced a new miniature proximity pickup, model 4912-AN. The sensing face is $\frac{3}{8}$ in. in diameter. Overall length is $2\frac{1}{2}$ in. Mounting thread is 7/16-20. This probe-type pickup is a very small sensing unit for proximity control systems. The pickup can be used with Electro proximity control units for detecting stationary metal objects, as well as moving metal pieces passing the pickup at a rate up to 60,000 per minute. Operating clearances up to $\frac{1}{4}$ in. can be achieved for metal pieces over $\frac{3}{8}$ in. in diameter. Circle 233 on Reader Service Card.

V-R Power Supply transistorized

KEPCO LABORATORIES, INC., 131-38 Sanford Ave., Flushing 55, N. Y. Model SC-36-2 delivers 0 to 36 v, 0 to 2 amperes. Regulation for line or load is less than 0.1 percent or 0.003 v, whichever is greater. Ripple is less than 1 mv rms. Recovery time is less than 50 μ sec. Stability for eight hours is less than 0.1 percent or 0.003 v, whichever is greater. Operating ambient temperature is 50 C maximum. Temperature coefficient is less than

0.05 percent per deg C. Output impedance is less than 0.02 ohm. Circle 234 on Reader Service Card.



Pulse Generator versatile unit

AMERICAN ELECTRONIC LABORATORIES, INC., 121 N. 7th St., Philadelphia 6, Pa. Pulses, paired-pulses, and trains of pulses are standard outputs for this new instrument. The internal synchronization covers the range of 0.5 cps to 250 kc. External synchronization runs from 0 to 250 kc. Pulse widths from 1 μ sec to 1.0 sec are generated with amplitudes of 35 v into 50 ohms. Unit has a built-in attenuator variable from 0 to 70 db in 1 db steps. Pulse output is positive or negative. Circle 235 on Reader Service Card.

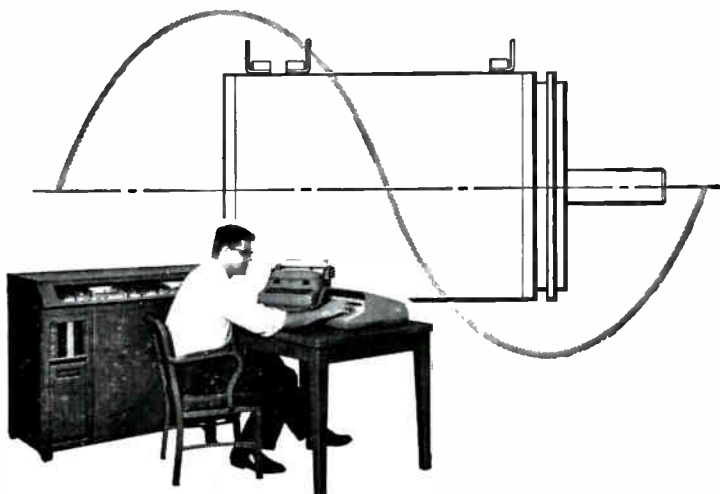


Oscillographs miniature units

APPLIED SCIENCE CORP. OF PRINCETON, P. O. Box 44, Princeton, N. J. A new line of miniature oscillographic recorders with multichannel data handling capacity has been announced. The compact and rugged oscillographs can handle simultaneously 6 continuous analog data channels plus 3 on-off channels for timing and event markers with an accuracy of better than 1 percent. The units are ideal for recording flight and per-



How Spectrol uses an IBM 610 to design better **NON-LINEAR POTS**



Buying non-linear potentiometers is usually a big headache for the engineer interested in quick delivery and accurate performance.

First, you must provide the pot maker with detailed design requirements. Then wait until the design has gone through the manufacturer's engineering department... almost always a matter of weeks. Even then, the cut and try engineering approach ordinarily used often yields unsatisfactory results.

To solve this problem, Spectrol recently installed an IBM 610 Computer. Spectrol is the only precision potentiometer manufacturer to adapt IBM computer techniques within its own facilities to accurately compute non-linear functions. Using the computer, Spectrol makes complex non-linear precision potentiometers in record time, both single and multi-turn.

How it works. Design information in the form of X and Y coordinates or mathematical equations describing the particular parameters of a given non-linear function is entered in the computer. Previously programmed general equations automatically compute from these data points manufacturing directions in terms of winding equipment settings, cam angles and radii. Using a high speed electric typewriter as a readout, the directions are automatically printed on a form which is sent to production. Simultaneously, a punched tape is made to store information for repeat requirements.

How the user benefits. Because Spectrol's technique takes the guesswork out of non-linear potentiometer calculation, minimizes time consuming hand calculations, and provides error free results, the customer receives a superior product sooner. In quoting on particularly complex requirements, quote time is reduced from weeks to days. In emergencies, engineering and sales data can be prepared in a few hours.

Your nearby Spectrol representative will be happy to provide more information about Spectrol linear and non-linear precision potentiometers or you may write direct. A free Spectrol potentiometer specifications book is yours for the asking. Please address Dept. 182



ELECTRONICS CORPORATION

1704 S. DEL MAR AVE., SAN GABRIEL, CALIFORNIA

*For Frequency Measurement, Counting,
Periods, Time Intervals . . .*



ELECTRONIC COUNTERS

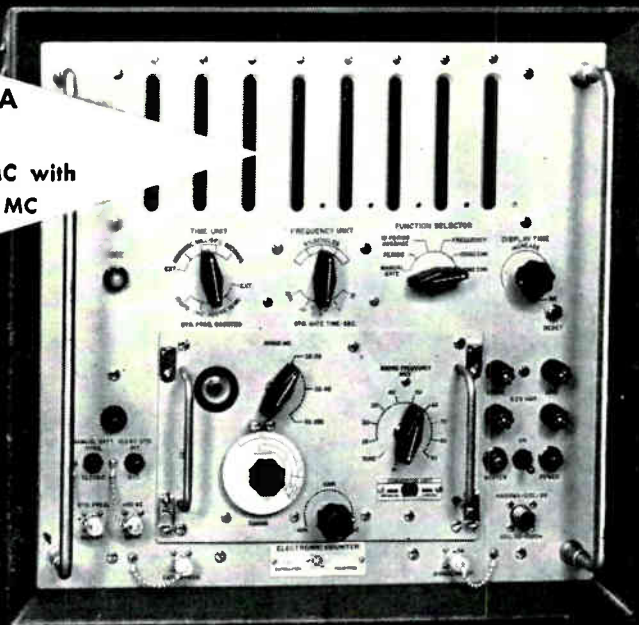
MODEL 14-20A

\$1,700

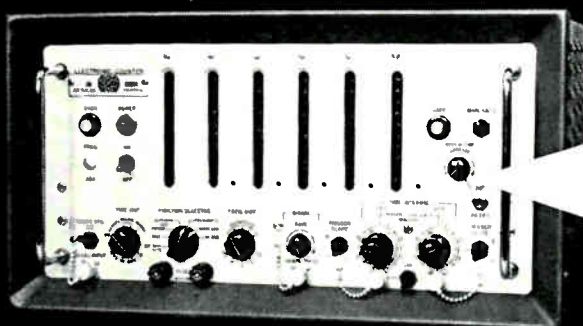
10 cps to 10 MC with
Plug-Ins to 220 MC

**NEW—
Advanced
Circuitry**

**NEW—
Mechanical
Design.**



**NEW HIGHS in STABILITY and ACCURACY
Yet at New LOWS in COST !**



MODEL 13-20

\$995

10 cps to 1.1 MC

**BOTH MODELS available with optional Transistorized Oscillator:
Stability 5 parts in 10^8 per week; and 5 parts in 10^3 per month
thereafter; at nominal additional cost.**

NORTHEASTERN ENGINEERING, INC.

MANCHESTER, N. H. • 25 So. Bedford St.

P. O. Box 150 • NAional 2-6485

formance parameters in aircraft
and missile test programs. Circle
236 on Reader Service Card.



Closed-Circuit Tv for remote viewing

INDUSTRIAL PRODUCTS DIV., Inter-
national Tel. & Tel. Corp., 15191
Bledsoe St., San Fernando, Calif.
A versatile and complete new line of
c-c tv for military, industry, busi-
ness and education makes possible
remote viewing of an action or
process otherwise inaccessible or
hazardous. The basic system consi-
sts of new and improved vidicon
camera, monitor, and control unit.
Camera features an entirely elec-
tronic light compensator, which
instantly and automatically ad-
justs to compensate for light
changes over a practical range
eight times as great as normally
covered by lens stops. Circle 237
on Reader Service Card.



Transceiver transistorized

RIXON ELECTRONICS, INC., 2414
Reedie Drive, Silver Spring, Md. A
transistorized transceiver recently
developed is capable of transmit-
ting digital data over voice com-
munications circuits at speeds up
to 2,500 baud (bits/sec). Called
the Sebit-25 (short for Serial
Binary Information Transmis-
sion), the unit is a simple a-m
system that uses vestigial side-
band transmission and synchro-
nous operation. It includes time
delay and amplitude distortion

compensating circuits. Field tests show that the unit can be operated successfully over wire lines several thousand miles long. Circle 238 on Reader Service Card.

Digital Voltmeter all solid-state

BECKMAN SYSTEMS DIVISION, 325 N. Muller Ave., Anaheim, Calif. Model 81 digital voltmeter is an all solid-state device using a unique comparison technique for operation. The unknown input voltage is first compared to the signal from a precision digital to analog converter. The digital to analog converter output is varied until equal to the input and the converter's contents are then presented in digital form. This entire operation, including automatic range and polarity determination, is accomplished 15 times per sec. Circle 239 on Reader Service Card.



Rectangular CRT ultra-short

WATERMAN PRODUCTS Co., 2445 Emerald St., Philadelphia, Pa., announces a new ultra-short high performance rectangular crt. This 1½-in. by 3-in. Rayonic type 3YP tube can be operated at anode potentials as low as 500 v with vertical and horizontal sensitivities of 26 and 40 v d-c in. respectively. Despite its short length of 7 in. overall, it has a high brightness and can operate with anode potentials as high as 2,750 v. Tube is electrostatically focused and deflected. Circle 240 on Reader Service Card.

A-M/F-M Tuner low noise level

THE ERIE RESISTOR CORP., Erie, Pa., has introduced a new a-m/f-m tuner, model EM-085-ER, featur-



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SCIENTIARUM*



The Westinghouse symbol represents a select circle of scientists and engineers dedicated to the betterment of man through the advancement of science. At Westinghouse-Baltimore, your engineering skill and creative abilities would be developed to their fullest capacity to further the attainment of this ideal. Write for details on the Westinghouse-Baltimore operation and the opportunities it offers you.

CAREER OPPORTUNITIES EXIST IN THE FIELDS OF:

TO APPLY:

Please send a resume of your education and experience to Dr. J. A. Medwin, Dept. 878, Westinghouse Electric Corporation, P. O. Box 746, Baltimore 3, Maryland.

ADVANCED FILTER DESIGN
COMMUNICATION SYSTEMS
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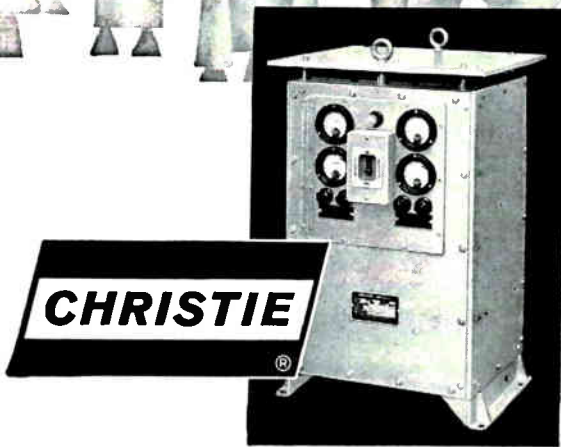
BALTIMORE

*The Circle of the Sciences

THOR TITAN ATLAS BOMARC POLARIS TALOS



D-C POWER



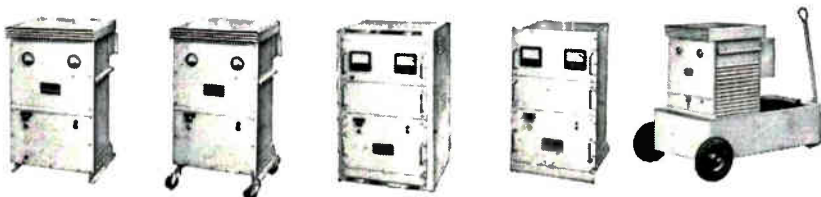
THERE IS A REASON...why *CHRISTIE* was selected as the principal source of D-C Power Supplies for all the above projects...RELIABILITY

CHRISTIE'S rigid Quality Control is approved by the A. E. C. and leading Aircraft and Missile Manufacturers.

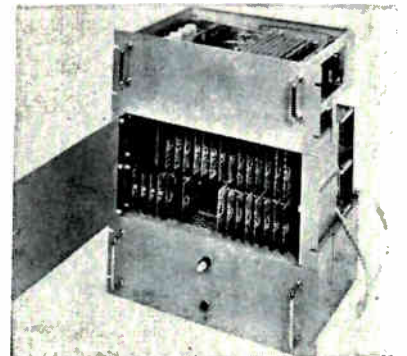
CHRISTIE ELECTRIC CORP.

3410 W. 67th St., Los Angeles 43, Calif., Dept. EL

Precisely regulated Power Supplies of permanent stability. Ratings up to 1500 amperes. Bulletin on Standard Militarized units available on request.



ing an etched wiring board and Erie PAC's. It includes two i-f stages, a limiter stage, and a Foster-Seeley discriminator circuit. Company says that the 300 ohm balanced input, with tri-flar matching coil, eliminates the usual dual input stage, and that low noise level and strong afc control voltage, for positive afc action, and high level of audio output signal, are the outstanding characteristics. Circle 241 on Reader Service Card.



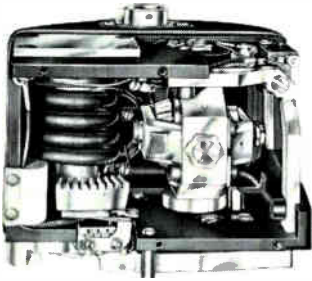
Auxiliary Memory saves computer time

TELEMETER MAGNETICS, INC., 2245 Pontius Ave., Los Angeles 64, Calif. A new low-priced core storage buffer is announced. The unit permits full utilization of valuable computer time in data processing involving slower functioning external equipment. Operating at a rate of 100,000 characters per sec, the new buffer accepts any size block of data up to 720 characters of 6, 7 or 8 binary bits each. Circle 242 on Reader Service Card.

Transistor alloy-junction

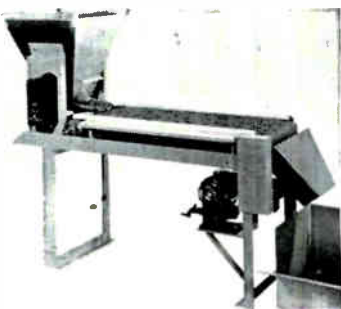
RADIO CORP. OF AMERICA, Somerville, N. J. The 2N647 is a new alloy-junction transistor of the germanium npn type intended especially for use along with its pnp counterpart, the 2N217, in class B complementary-symmetry power output stages of transformerless, battery-operated portable radio receivers, phonographs, and audio amplifiers. It is particularly useful in equipment in which compactness, good frequency response, and relatively

high power output at low cost are important design considerations. Circle 243 on Reader Service Card.



Gyroscope spring driven

WALTHAM PRECISION INSTRUMENT Co., Waltham, Mass., announces a new spring driven gyro for use in short range missiles and target drones. This 2 deg of freedom gyroscope supplies a potentiometer signal to control roll with ± 50 deg of freedom. Its rotor is energized by a spring, bringing the rotor up to peak speed in a fraction of a second. Simplicity of design makes the instrument well suited to high-volume, low-cost applications. Circle 244 on Reader Service Card.

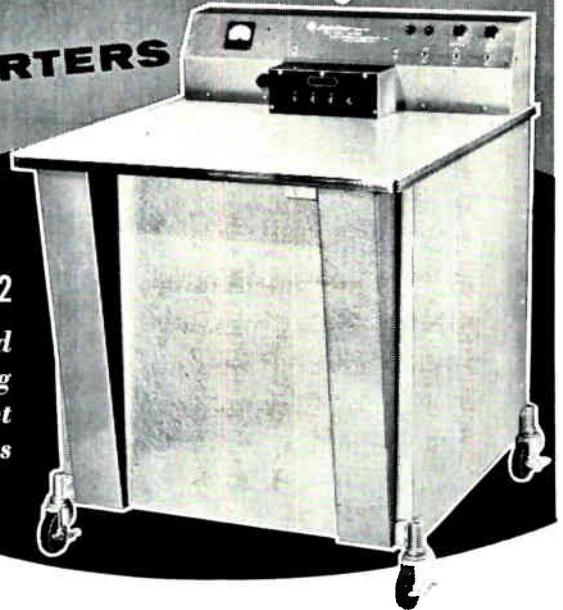


Inspection Table short model

G. F. GOODMAN & SON, 401 Richmond St., Philadelphia 25, Pa., has introduced a short model version of its inspection table. It is claimed to provide a high quality unit for small parts inspection, at a very low price. Seating two operators, it occupies only 6 ft by 2 ft of floor space. The work belt, without center drop, offers variable speeds from 10 to 20 ft per min. The belt is 15 in. wide, with working surface 36 in. long. A stainless steel

from Magnet Charger

HEADQUARTERS



MODEL 942
*Recommended
by Leading
Magnet
Makers*

3
**VERSATILE
MODELS**

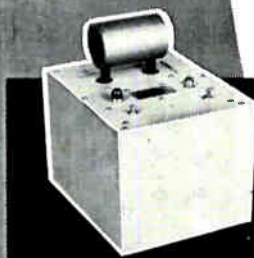


MODEL 1500

For saturating Alnico magnets weighing up to 34 lbs. and high flux ceramic magnets of any shape or pole configuration. Operates on condenser discharge principle from regular 115-volt, 60-cycle line.

Charging outputs from 100,000 to 200,000 ampere-turns through plug-in transformers, up to 3600 watt-seconds using wire-wound fixtures. Adapters for multi-pole rotors, rod, bar, ring and various other shapes available. Designed for continuous production use with low power consumption. Price of basic unit is less than \$2100.

A medium power Magnet Charger capable of developing peak magnetizing force of 40,000 ampere-turns. Designed for production, research and instrument repair work. The Model 1500 easily saturates the new high coercive materials such as Cobalt Platinum and Barium Ferrite. Portable table model operates on 115-volt, 60-cycle line; size 11" wide x 15" high x 20" deep; weight 125 lbs. Price \$945.



MODEL 1221

A low cost, condenser discharge unit employing novel, plug-in wire-wound type charging fixtures, the Model 1221 is designed for the user of small magnets. Its 10,000 ampere-turn output will saturate about 2" of Alnico V. Charging cycle rate is approximately 3 seconds, continuous duty, operates from 115-volt line. Price \$180.

Performance of all models is rigidly guaranteed. Prices are net f.o.b. Boonton, N.J. and subject to change without notice.



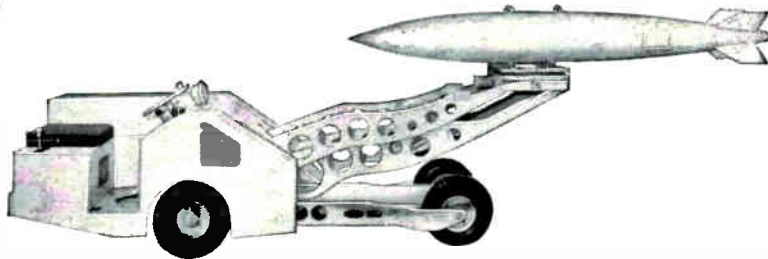
**Radio Frequency
LABORATORIES, INC.**
Boonton, New Jersey, U. S. A.

a **NICAD** battery

TRADEMARK

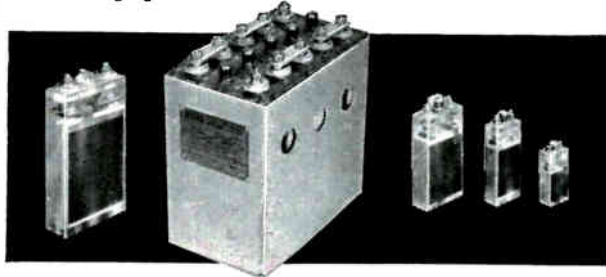
...PACKAGED PAYLOAD of RELIABLE POWER at -40° for Standard Manufacturing's MJ-1

Capable of completely dependable operation at -40°F.— an exceptionally rigorous performance demand met by Standard's MJ-1 and its components—of which the NICAD nickel cadmium battery is a vital one. Standard uses a 6 volt NICAD sintered plate battery as the engine starting power source on these bomb lifts . . . and avoids engine starting failure which would detract from the service and dependability of its products.



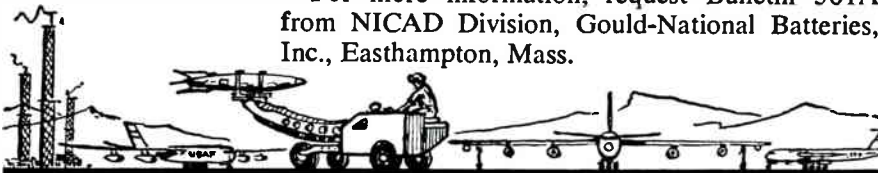
NICAD batteries will not freeze in any state of charge, and perform at peak efficiency in temperatures below the -40° requirement here, and as high as 140°.

Also produced in smaller sizes that make sense to designers, NICAD sintered plate batteries possess power output and other advantages that make them especially adaptable to the confined systems of missiles, aircraft, telemetering instruments, and similar equipment.



NICAD offers cycle life which far exceeds that of any other type battery . . . peak operational efficiency under severe conditions . . . low internal resistance that creates high discharge rates . . . capacity range from 1/2 to over 150 ampere hours.

For more information, request Bulletin 501A from NICAD Division, Gould-National Batteries, Inc., Easthampton, Mass.

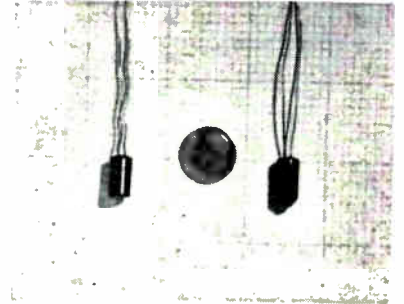


NICAD

TRADEMARK

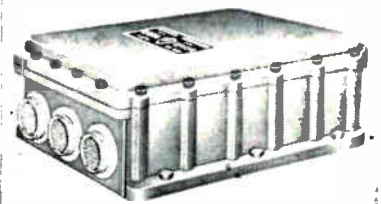
**NICKEL CADMIUM
ALKALINE
STORAGE BATTERIES**

storage hopper (2 cu ft) supplies a vibratory feed mechanism for even distribution across the belt. Circle 245 on Reader Service Card.



**Tiny Motor
squib-actuated**

ATLAS POWDER Co., Wilmington 99, Del., has developed a powerful miniature, squib-actuated dimple motor, which provides positive displacement for the performance of mechanical work. It should be of special interest to designers of missiles, weapons and weapons systems. The motor is 0.300-in. in diameter and 1/2-in. long. Actuated by as little as 7,500 ergs, the motor is capable of providing 8 lb of thrust over a 0.1-in. minimum stroke within an elapsed time of 1 millisecond. Circle 246 on Reader Service Card.



**PDM Multicoder
highly reliable**

GENERAL DEVICES, INC., P. O. Box 253, Princeton, N. J. The ML series low level pulse duration modulation multicoders are available in all the standard IRIG sampling rates and channel configurations. Maximum input sensitivity is from 0 to 10 mv for full scale, with amplifier gain adjustable to provide any range to 100 mv for full scale. The multicoder consists of an electromechanical commutator, d-c amplifier, pam to pdm converter and power supply. Circle 247 on Reader Service Card.



Pulse Generator fast rise time

RESE ENGINEERING, INC., 731 Arch St., Philadelphia 6, Pa. Model 1051 millimicrosecond pulse generator produces high amplitude, ultra short duration current pulses for development and design applications in high speed logic and memory problems, solid state research, and high speed transistor switching operation. Featuring jitter-free pulses with rise times as fast as 5 millimicroseconds, the 1051 generates positive or negative pulses at ground level with durations of 10, 20, 50 and 100 light feet. Circle 248 on Reader Service Card.



Ten-Turn Pot miniature unit

VOAK ENGINEERING CO., 129 East A St., Upland, Calif. New miniature ten-turn potentiometer (voltage dividing resistor) features a diameter of only $\frac{3}{8}$ in., a length of $1\frac{1}{2}$ in., and a shaft diameter of $\frac{1}{8}$ in. It can be provided with either a standard bushing mount, or servo mount, with or without ball bearings. It contains the maximum possible length of resistance element, providing higher than usual resolutions for a unit of this size, and with linearity as close as ± 0.05 percent. Any resistance in the range from 50 ohms to 200,000 ohms, and any number of turns from three to ten, may be supplied. Circle 249 on Reader Service Card.



Developed and constantly tested to surpass all requirements of MIL-I-631C (Grade c) Resinite HI-Heat 105A offers an extra margin of safety. Particularly suited for electrical applications encountering high heat, oil and pitch, it is also fungus, flame, corrosion and acid resistant. Eleven colors, including transparent. Full size range, AWG 24 through $2\frac{1}{2}$ " I.D.

For LOW temperature MIL-I-631C (Grades a & b) sleeving, specify Resinite EP-69A.

PROPERTY	REQUIREMENTS MIL-I-631C	PERFORMANCE HI-HEAT 105A AND 105
Oil resistance.	No oil penetration. 10% max. diam. increase.	No penetration. No change.
High temperature resistance.	200 hrs. @ 100°C.	Maintains flexibility after 1000 hrs. @ 125°C.
Dielectric strength.	400 to 800 volts/mil min. for range of wall thicknesses.	1000 volts/mil avg.
Tensile strength.	1800 psi min.	2700 psi min.
Softening temp.	80°C min.	94°C min.
Cold brittleness.	Below -10°C.	-18°C.
Flame resistance.	15 sec. max.	10 sec. max.

Write for samples and performance data.

Resinite
 THE BORDEN CHEMICAL COMPANY Resinite Department
 Plants: Santa Barbara, Calif. • No. Andover, Mass.

SPECIALISTS IN VINYL SLEEVING AND TUBING FOR THE AIRCRAFT, ELECTRONICS, ELECTRICAL AND PHARMACEUTICAL FIELDS

Literature of

MATERIALS

Molded Fiber Glass. Molded Fiber Glass Companies, 4826 Benefit Ave., Ashtabula, Ohio. A 32-page brochure describes molded fiber glass and the methods used to produce it. Circle 275 on Reader Service Card.

COMPONENTS

Germanium Diodes. Ohmite Mfg. Co., 3683 Howard St., Skokie, Ill. Bulletin 158 describes a line of gold-bonded germanium diodes. It lists many types for general purpose and computer use, where from one to four operating characteristics are specified. Circle 276 on Reader Service Card.

Magnetic Amplifier Design. Acromag, Inc., 22519 Telegraph Rd., Detroit 41, Mich. Engineering bulletin No. 403-A has 45 schematic diagrams and graphs describing magnetic amplifier design and application techniques. Circle 277 on Reader Service Card.

Toggle Switches. Sargent Electric Corp., 630 Merrick Road, Lynbrook, N. Y. A new, 8 page, comprehensive catalog (S106) lists 200 models of toggle and trigger switches. Circle 278 on Reader Service Card.

EQUIPMENT

Environmental Test Chambers. Conrad, Inc., Holland, Mich. A six-page folder illustrates and describes temperature, altitude and humidity test chambers with capacities up to 1,200 cu ft and larger. Circle 279 on Reader Service Card.

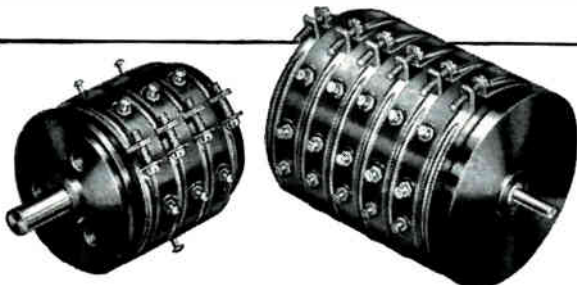
High Speed Printer System. Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif., offers a 4-page brochure describing the 220 high speed printer system, which prints out copy direct from the computer or from magnetic tape at up to 1,500 lines per



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This special Gamewell Phasing Clamp design has two important extras: Extreme compactness and High Temperature compatibility. Check these features . . .

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More information, prices and delivery available from Gamewell representatives or write: **THE GAMEWELL COMPANY**, Newton Upper Falls 64, Mass.



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RVG-17XS 1 1/16"
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SPECIALI

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Catalog on complete line.

the Week

minute. Circle 280 on Reader Service Card.

Electronic Instrumentation. Kay Electric Co., Maple Ave., Pine Brook, N. J. A recent mailing piece describes the Megalator, catalog No. 3000, a d-c to 1,000 mc amplitude modulator; and the Vari-Vox, catalog No. 615A, a speech time compressor and expander. Circle 281 on Reader Service Card.

Phase Meter. Control Electronics Co., Inc., 10 Stepar Place, Huntington Station, L. I., N. Y., recently issued a data sheet on their direct reading phase angle meter and monitor. Circle 282 on Reader Service Card.

Data Loggers. Gilmore Industries, Inc., 13013 Woodland Ave., Cleveland 20, Ohio, has published a four-page bulletin on data loggers for weight, strain, force, flow, pressure and temperature. Circle 283 on Reader Service Card.

Power Supplies. Lambda Electronics Corp., 11-11 131 St., College Point 56, N. Y. A new 36-page catalog contains information and specifications on the company's full line of transistor-regulated and tube-regulated power supplies. Circle 284 on Reader Service Card.

Magnetic Tape Tester. General Kinetics Inc., 555 23rd St., South, Arlington 2, Va. A bulletin describing a new digital computer accessory, the model U-1 automatic magnetic tape tester, is available. Circle 285 on Reader Service Card.

FACILITIES

Missile Systems. Ford Instrument Co., Division of Sperry Rand Corp., 31-10 Thomson Ave., Long Island City 1, N. Y. An 8-page 2-color brochure covers the firm's abilities and facilities in missile system development and precision production. Circle 286 on Reader Service Card.

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No Moving Parts
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Isolated Switching Circuit
S. P. S. T. 10 Mills to 10 Amps.
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18 to 30 Volts D. C. Operating
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Pick Up Time 5 μ sec —
Drop Out 30 μ sec
-55° F to +160° F or -55° C to +125° C

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50 Milliseconds to 2 minute Delay on Make or Break
Single-Pole, Double-Throw to 5 Pole Double-Throw Contacts
Rated 1 to 10 Amps. 28 Volts D. C.
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No moving parts
50 to 5000 Flashes per minute
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Push On Push Off or Momentary Snap Action
Double-Pole, Double-Throw, Double Break Contacts
Independent Lamp Circuit 6 or 28 Volt D. C.
5 Amps. Inductive Contacts 28 Volts D. C.
Operating Pressure — 3 lb. \pm 1 lb.
Maximum Plunger Travel, .180
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Variety of Lens Available

KEYBOARD SWITCH 6 POLE



Push-On Push-Off or Momentary Snap Action
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Contacts Rated 1/2 Ampere Resistive, 28 Volts D. C.
Operating Pressure — 1 lb. (Approx.)
Maximum Plunger Travel, .187
Case Diameter, 3/4"
Variety of Caps Available

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Metal Case Construction
Steatite Wire Insulation
Screw or Solder Terminals
3/4" Diameter, 3 inches long
100 Watts — Low Ohms at 28 Volts D. C.
High-Shock and High-Temperature Approved

The components shown here represent some of the units which were designed and engineered and are being produced at Pendar. It is entirely possible that many of these units could fit your system without modification, however, any requirement you may have can be engineered and produced in accordance with your specifications, using the latest techniques.

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SALES ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES





In Puerto Rico: 68 U.S. Firms

Two West Coast firms and one about to be founded—all active in space age work—are setting up Puerto Rican plants. This brings to 68 the number of U. S. electronics and related companies operating in P. R., the island government reports.

The Commonwealth's Economic Development Administration identifies the firms recently signed up as Endeveco Corp., Pasadena, and two Los Angeles companies, Statham Instruments, and Luce International, a new company to be founded in Puerto Rico by inventor Milton A. Luce.

Reasons for the missile program companies' expansion to Puerto Rico include: (1) Freedom from Federal taxes and exemption from local taxes for ten years, which along with lower wages make for overall lower-than-stateside operating costs; (2) rising productivity; (3) proven high profits, in some cases as high as 60 cents on the sales dollar; and (4) despite the long distances involved, surprisingly low transportation costs.

H. Dudley Wright, president of Endeveco Corp., (shown at right with Peter Martinez, left, western industrial representative, Economic Development Administration of Puerto Rico, and Wilson Bradley, Jr., Endeveco general manager) says one reason he picked Puerto Rico was . . . "our close association with military markets requires plant decentralization to assure continued product availability."

The firm will produce accelerometers at Endeveco Puerto Rico, Inc., in the town of Guaynabo.

Statham Instruments, Inc., will manufacture scientific instruments and transducers. This is the second plant in Puerto Rico for Statham.

Luce International will produce its recently-developed self-energizing valve for guided missiles and aircraft. Company expects to start operations in the town of Fajardo in March.

RCA To Set Up Missile Center

RADIO CORP. OF AMERICA will establish a major missile and radar center at Van Nuys, Calif.

Construction of the new facility, a cluster of engineering, production and administrative buildings located on a 50-acre tract in the San

Fernando Valley, has just begun. Partial occupancy is scheduled for late summer, with completion of the initial phase of construction due by the end of the year.

The decision to locate a major plant at Van Nuys stems from the company's growing business in the weapons system and radar fields, according to A. L. Malcarney, executive vice president, RCA Defense

Electronic Products.

Among major radar and systems contracts held by the company are those for the ballistic missile early warning system (BMEWS), for which RCA is the prime system contractor to the U. S. Air Force, and the electronic check-out and launching system for the Atlas missile, under subcontract to Convair.

L.I. Firm Expands

MICROTRAN CO., INC., Valley Stream, N. Y., has completed a 5,000-sq ft addition to its present transformer manufacturing facilities. Incorporated in this 50-percent addition to plant facilities also will be dust and humidity control to improve transformer reliability and minimize rejects.



Degen Takes New Post

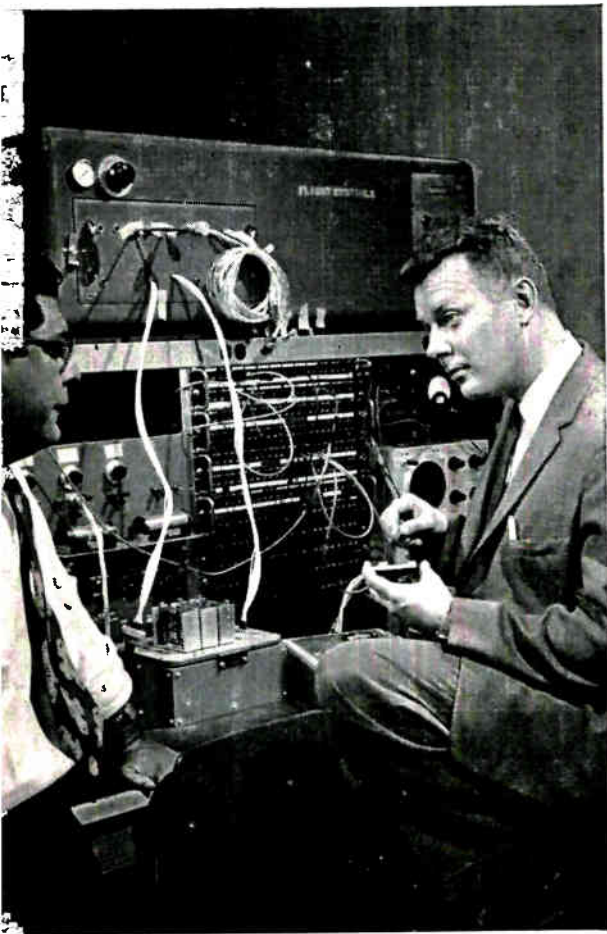
JOSEPH F. DEGEN is the newly appointed vice president—manufacturing of Daystrom-Weston Divisions, Daystrom, Inc. He was vice president of manufacturing for Weston Instruments Division.

Prior to joining Daystrom in 1957, Degen was superintendent of the Poughkeepsie, N. Y., plant of IBM.

Mieher to Head Big Sperry Job

APPOINTMENT of Walter D. Mieher as engineering manager of Sperry Gyroscope Company's counter meas-

EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY



Transistorizing missile flight control systems by Lockheed scientists has meant significant reductions in weight and space requirements.

... Flight Controls

Flight Controls offers one of the most challenging areas of work at Lockheed's Missiles and Space Division.

From concept to operation, the Division is capable of performing each step in research, development, engineering and manufacture of complex systems. Rapid progress is being made in this field to advance the state of the art in important missile and spacecraft projects under development at Lockheed.

Flight controls programs include: analysis of flight data and sub-systems performance, design and packaging of flight control components, development of transistorized circuits, operation of specialized flight control test equipment, and fabrication of flight control prototypes. Other work deals with the design, development and testing of rate and free gyros; accelerometers; programmers; computer assemblies; guidance control systems; circuitry; and hydraulic systems and components.

In the flight controls simulation laboratory, mathematical representations of elements in a control system are replaced one by one with actual hardware to determine acceptability of specific designs. From these studies, Lockheed obtains information which is used in further refinement and improvement of final control systems designs.

Lockheed Missiles and Space Division is weapons systems manager for such major, long-term projects as the Navy Polaris IRBM; Discoverer Satellite; Army Kingfisher; Air Force Q-5 and X-7; and other important research and development programs.

Scientists and engineers desiring rewarding work with a company whose programs reach far into the future are invited to write: Research and Development Staff, Dept. BB-22, 962 W. El Camino Real, Sunnyvale, California, or 7701 Woodley Avenue, Van Nuys, California. For the convenience of those living in East or Midwest, offices are maintained at Suite 745, 405 Lexington Avenue, New York 17, N. Y. and at Suite 300, 840 N. Michigan Avenue, Chicago 11, Ill.

"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics."

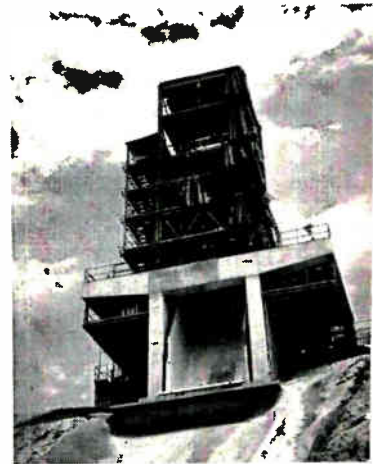
NATIONAL MISSILE INDUSTRY
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Lockheed

MISSILES AND SPACE DIVISION

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Pre-flight check-out on final assembly on X-7 missile. The X-7 holds free-world's speed and altitude records for air breathing missiles.



One of Lockheed's test stands with dynamic thrust mount to simulate flight environment.

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ures division has been announced recently.

He will be in charge of all the company's countermeasures research and engineering activities, including the multimillion-dollar Air Force program now underway to equip B-52 intercontinental bombers with electronic jamming and missile deception capabilities of extremely advanced nature.

Mieher has been serving for the past three years as a consultant to the Assistant Secretary of Defense for Research and Engineering.



Fullerton Takes New Position

APPOINTMENT of Richard B. Fullerton as chief engineer, Systems Division, for Pacific Automation Products, Inc., Glendale, Calif., is announced. Prior to joining the company, he was associated with RCA, Missile and Surface Radar Department, as systems project engineer leader for various missile programs.

Dudley Joins Lincoln Lab

EDITOR of *The Technology Review* at the Massachusetts Institute of Technology since 1945, Beverly Dudley has joined Lincoln Laboratory as assistant to the director. Volta W. Torrey, director of television at MIT, has been appointed

February 13, 1959 — ELECTRONICS

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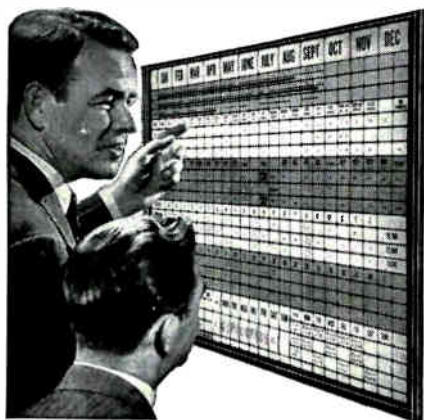
Every year Bead Chain produces billions of tubular metal parts for electronic and mechanical applications. Multi-Swage eliminates costly turning, drilling, stamping and forming—automatically swages from flat stock into strong precision forms with positive, tight seams. If you're a volume user of such parts, in any metal, up to 1/4" diam. x 1 1/2" long, find out how much Multi-Swage can save you. Send sketch or standard parts for prompt estimate. Write for catalog today.

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ELECTRONICS — February 13, 1959

to succeed him on the *Review*.

Before becoming editor of *The Technology Review* 14 years ago, Dudley was associated with the McGraw-Hill Publishing Co. for nine years, successively as assistant and associate editor of *ELECTRONICS*. He was managing editor of *Photo Technique*, consulting editor for McGraw-Hill technical books on radio communication and was originator of the Radio Communication Series.

News of Reps

Premier Instrument Corp., Port Chester, N. Y., appoints Floyd Fausett & Co. as sales rep in the areas of Alabama, Mississippi, Georgia, North Carolina, South Carolina, Tennessee and Virginia with the exception of Fairfax County; the Shephard-Winters Co. for southern California.

Hunter & Salsbury Inc., Hicksville, N. Y., announce their appointment as reps for Electro Development Co., Van Nuys, Calif. They are covering the metropolitan New York-New Jersey territory for Electro's line of precision molded slip ring and brush block assemblies and subminiature selector switches.

The Daven Co., Livingston, N. J., announces appointment of Norman W. Kathrinus & Co. of St. Louis, Mo., as its rep in the Missouri, southern Illinois and Kansas area on its complete line of rotary tap switches, precision wire wound resistors, transistorized power supplies, miniature switches, hermetically sealed metal film resistors, attenuators, LC filters, RC and resistive networks and laboratory test equipment.

Richard A. Strassner Co. of Los Angeles and Redwood City, Calif., has been appointed sales rep for the line of special-purpose tubes manufactured by National Union Electric Corp., Bloomington, Ill. Rep firm will cover the entire states of California, Arizona, Nevada and New Mexico.

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MEASURE DELAY ACCURATELY.

without
JITTER
WITH TLI's NEW
**PULSE
TIMER**



MODEL PT244 \$1895⁰⁰

WHAT IT IS —

... a paired trigger generator with fixed and delayed pulses. Combination of counters and digital dial provides direct reading delay to 9,999.99 microseconds accurate to better than 0.01 microsecond. Note that this instrument is a full size module of the TLI Modular Instrumentation System.

Incorporates design of Hazeltine Electronics Corp. Model 1754 Precision Time Measuring Equipment.

HOW IT WORKS —

Delay controls position gates which select desired pulse from 100kc crystal controlled pulse chain to avoid jitter inherent in delay circuits. Phantastron circuit provides vernier control between 10 microsecond pulses. Jitter less than 0.001 microsecond.

Full specifications and application information available on request in Bulletin ED-82



TELETRONICS LABORATORY, INC.

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COMMENT

Envious Coexistence

Hot idea: you can disrupt the whole Soviet scientific program.

They read *ELECTRONICS* avidly. They extract from it charts and nomographs that might be of use to their schools and scientists.

I am inclined to think that their translators may not know always how important technical material may be, and therefore clip nearly everything to avoid criticism of not providing their technical staffs with the latest information from America.

Here is how to disrupt the works.

On the back of nomograph pages, and pages containing circuit diagrams, publish one-page articles of these three types:

Profiles of middle-class Americans: assistant engineers, draftsmen, technical interpreters, assistant professors, even one of your staff. Describe his work briefly. Describe his home, the modern appliances in it, his car, his family life, his social life, his recreation, a typical evening meal, his reading habits, even his clothing and shoes. Paint a picture in words so fascinating that his Russian equivalent will be green-eyed. A man in America, doing no more than he is doing in Russia and having all the luxuries we take for granted in this country.

Domestic readers will like this feature, too. I would say of my counterpart, "he's not so hot; I've got more kids and live just as well as he." This series would make Russian engineers very unhappy with their lot. As Mikoyan said, "even the poor in this country live surprisingly well."

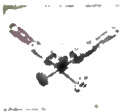
Historical vignettes. It is said to be taught in Russia that many inventions patented years ago in this country were of Russian origin. The story of some of these inventions, the struggles of putting the basic idea across, and intimate details—with dates and places—would make your Russian readers wonder about the truth of their teaching.

Brief summaries of the great patent cases and how the courts



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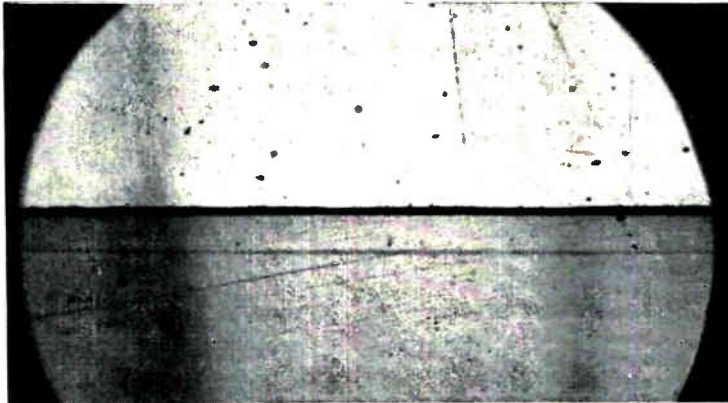
News about

RAYTHEON'S

SEMICONDUCTOR DIVISION—the place for the man

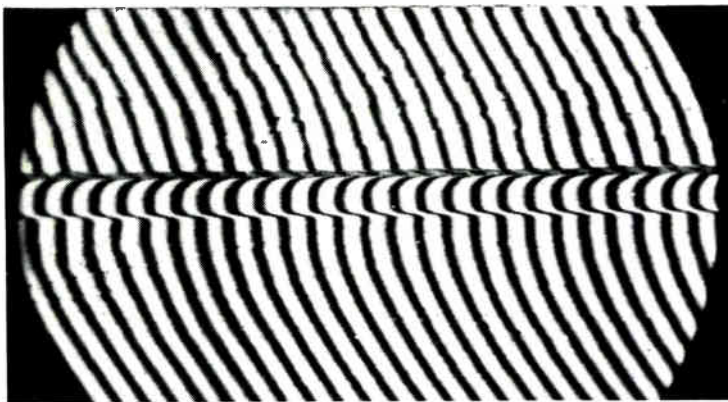
who is growing faster

than his associates



Bright Field ↑

↓ Interference



INTERFERENCE FRINGES are useful in determining slight changes in elevation and measurement of thin coatings such as those that might be laid down by vacuum evaporation. The above photomicrographs (112x) show gallium diffused silicon used in making Raytheon diffused base NPN silicon high frequency transistors. The silicon is at the bottom of each picture. The depth of the gallium penetration is .0007". The height of the junction step after etching is .000088". The bright field picture shows how the junction looks normally under a metallurgical microscope. The interference picture shows how this same junction looks under an interference microscope.

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- Application Engineering

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"The place for the man who is growing faster..."

SEMICONDUCTOR DIVISION of

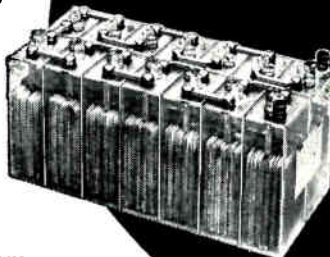


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reached their decisions in favor of the inventor. Convey the thought that justice prevails in our courts and that inventors are protected and rewarded for their ingenuity.

This idea developed at a Christian Family Movement meeting of three neighbor couples in our house last night, discussing what we could do to combat communism. You and fellow editors of *ELECTRONICS* and other McGraw-Hill magazines are in a position to wreck the whole USSR scientific program without bombs or bullets. Just play upon human avarice.

JAMES P. KENNEDY

CHICAGO

Although our first reaction to this idea was altogether positive, it will remain an idea for several cogent reasons. For one thing, there are agencies and organizations that are far better equipped than we, whose sole purpose is to put across exactly the message that reader Kennedy suggests.

Second thoughts bring some doubts. Our experience with Soviet thought leads us to believe their whole semantic framework rejects luxury and almost welcomes hardships and tribulation as necessary corollaries of power. They honor toughness and scorn comfort, and in many cases would endure anything to see their country master of the world.

Furthermore, is it really morally proper to interfere with the pursuit of scientific truth anywhere? It is against the pseudo-religion of totalitarianism that we should take our stand, not the Soviet scientific program.

A Square Root

The article "Passive Elements Form Time Delay" (p 70, Jan. 16) should have a square-root sign in the time-delay equation. I am correcting my copy to read:

$$\tau = \pi \left[\frac{L_2 C_1 C_2}{C_1 + C_2} \right]^{1/2} = t_2 - t_1$$

ALFRED WINDSOR

UNIVERSITY OF CALIFORNIA
BERKELEY, CALIF.

WE'RE LOOKING
FOR A MAN
LIKE Bernoulli



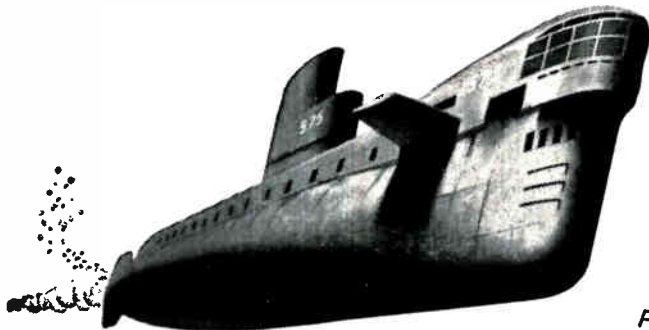
$$P_0 v_1 + h_a d_a v_1 g + \frac{1}{2} d_a v_1 V_1^2 = P_0 v_1 + h_b d_b v_1 g + \frac{1}{2} d_b v_1 V_b^2$$

-WITH A MODERN TURN OF MIND

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Today the underwater-to-air-to-underwater SUBROC antisubmarine missile is being developed at Goodyear Aircraft.

If you have a Bernoullian bent, this program will appeal to you — and so will the company — the people and the organization.



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If you're good, we'll sign you in. If we sign you in, you won't want to leave — for reasons as sound as your future. And ours.

Write: Mr. Charles Jones, Director of Technical & Scientific Personnel, Goodyear Aircraft Corporation, Akron 15, Ohio.

GOOD YEAR AIRCRAFT

* Programs in rocket propulsion, interplanetary guidance, nose cones, advanced black boxes, crew-escape capsules — also in ground support systems for missiles, radar structures, radomes, radiation research, structures engineering.



QUARTERBACKING THE EAGLE PROJECT

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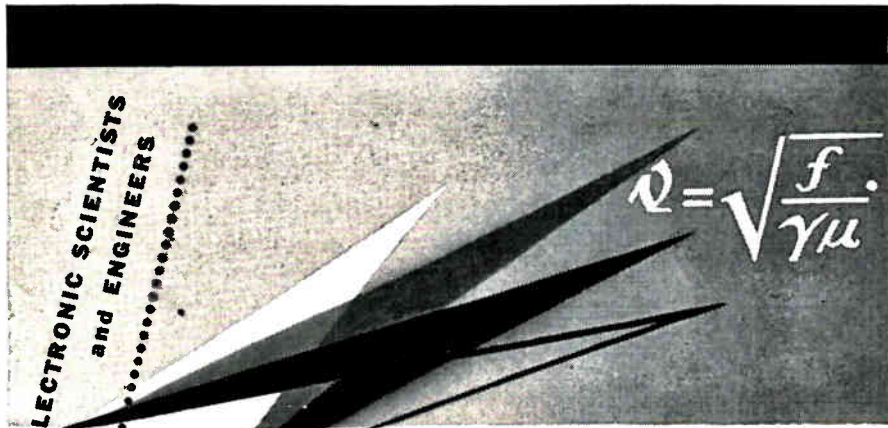
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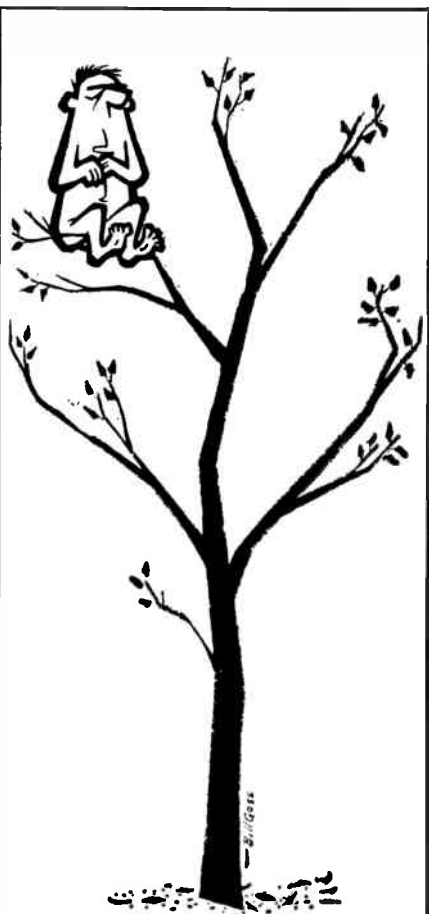
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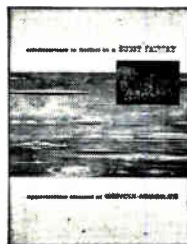
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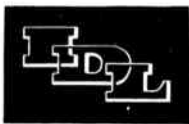
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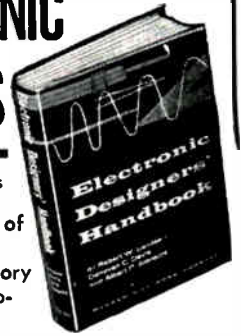
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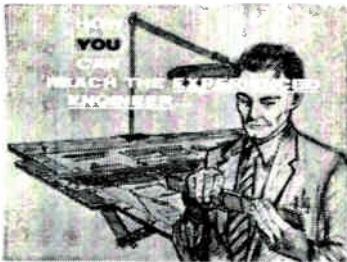
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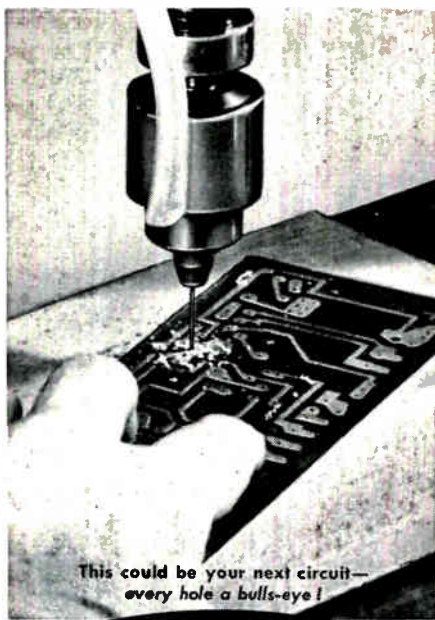
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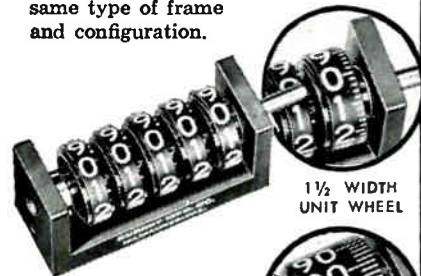
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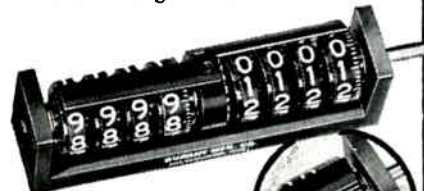
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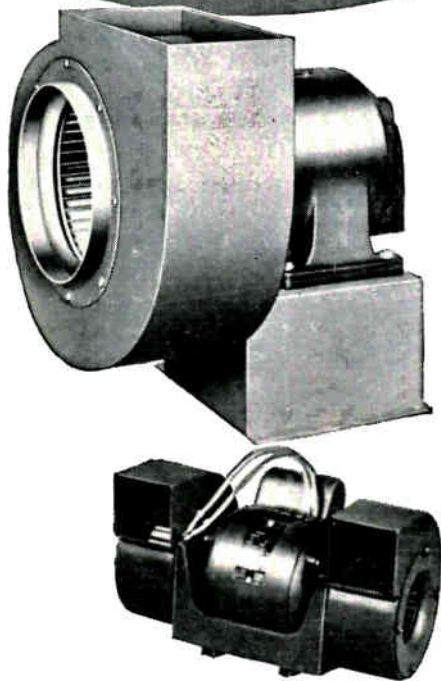
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NEW! This precision low noise metal film resistor meets and exceeds requirements with temperature coefficient of plus or minus 50 ppm/°C independent of resistance value. Standard tolerance plus or minus 1 per cent. Type WHM-1.125" long x .406" diam.—is equivalent to MIL Style RN 75, maximum voltage rating 500V. Type WFH-781" long x .250" diam.—equivalent to MIL Style RN 70, maximum voltage rating 350V.

Enclosed in specially designed hermetically sealed plastic casing (patent pending) to protect precision resistor element.



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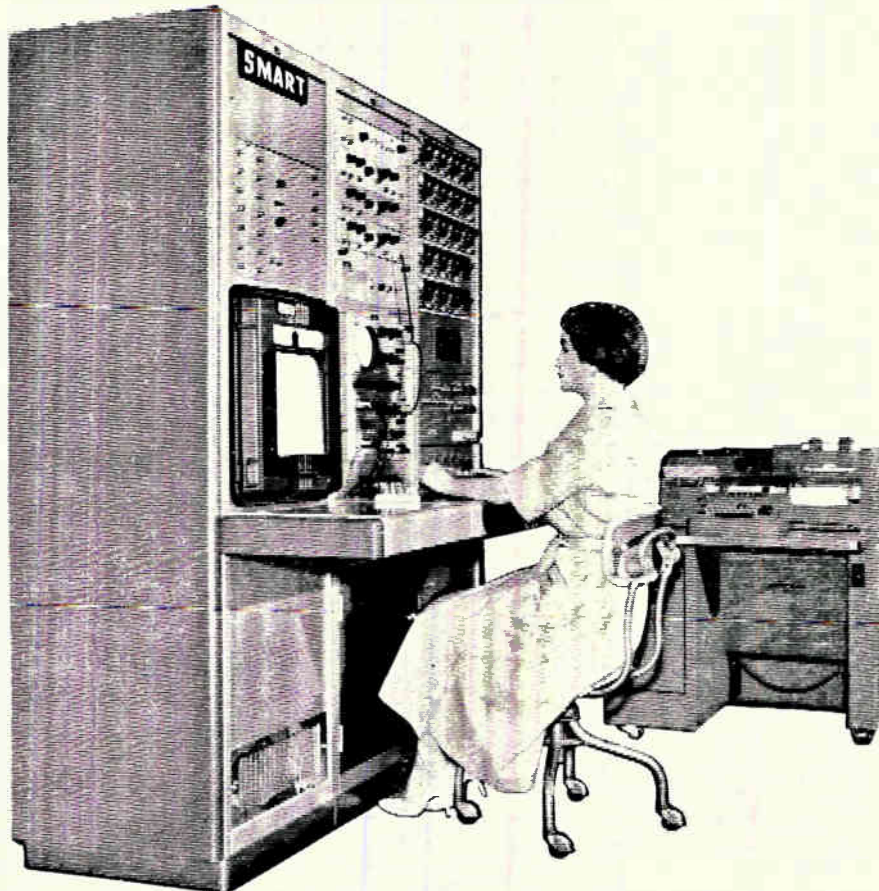
Specialists in manufacturing quality resistors: Precision Wire Wound — High Voltage — High Megohm — High Frequency. Our test equipment and standards for checking and calibrating are matched only by leading laboratories. Write for more information.

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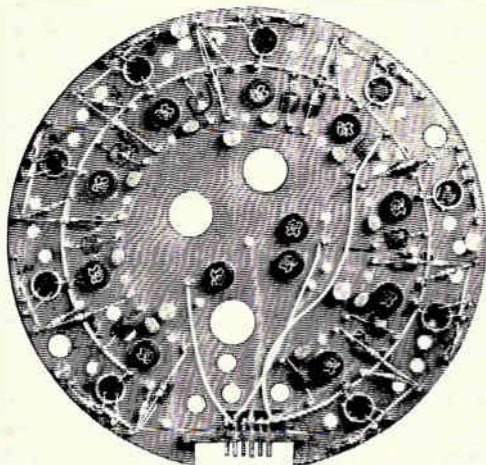
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James A. Van Allen
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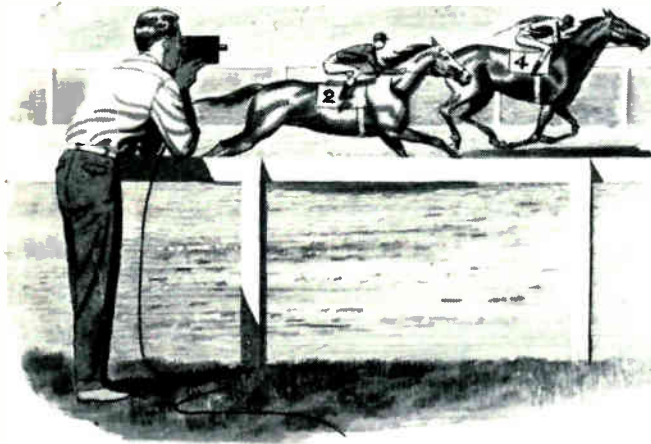
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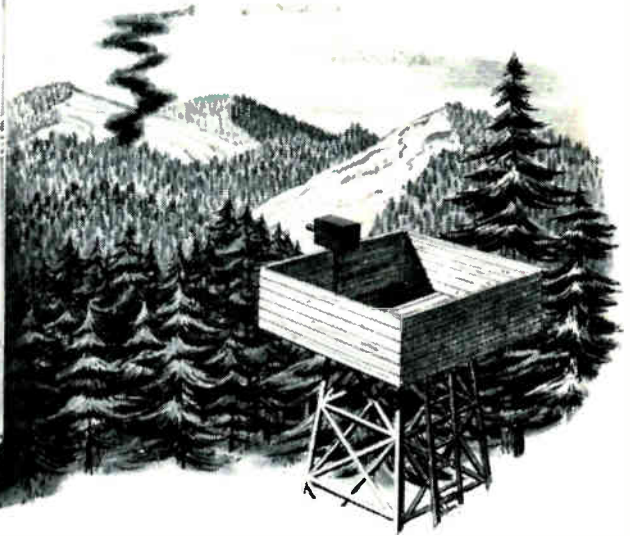
...for transistorized TV cameras



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RCA-7262 for Moderate Environmental Conditions



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