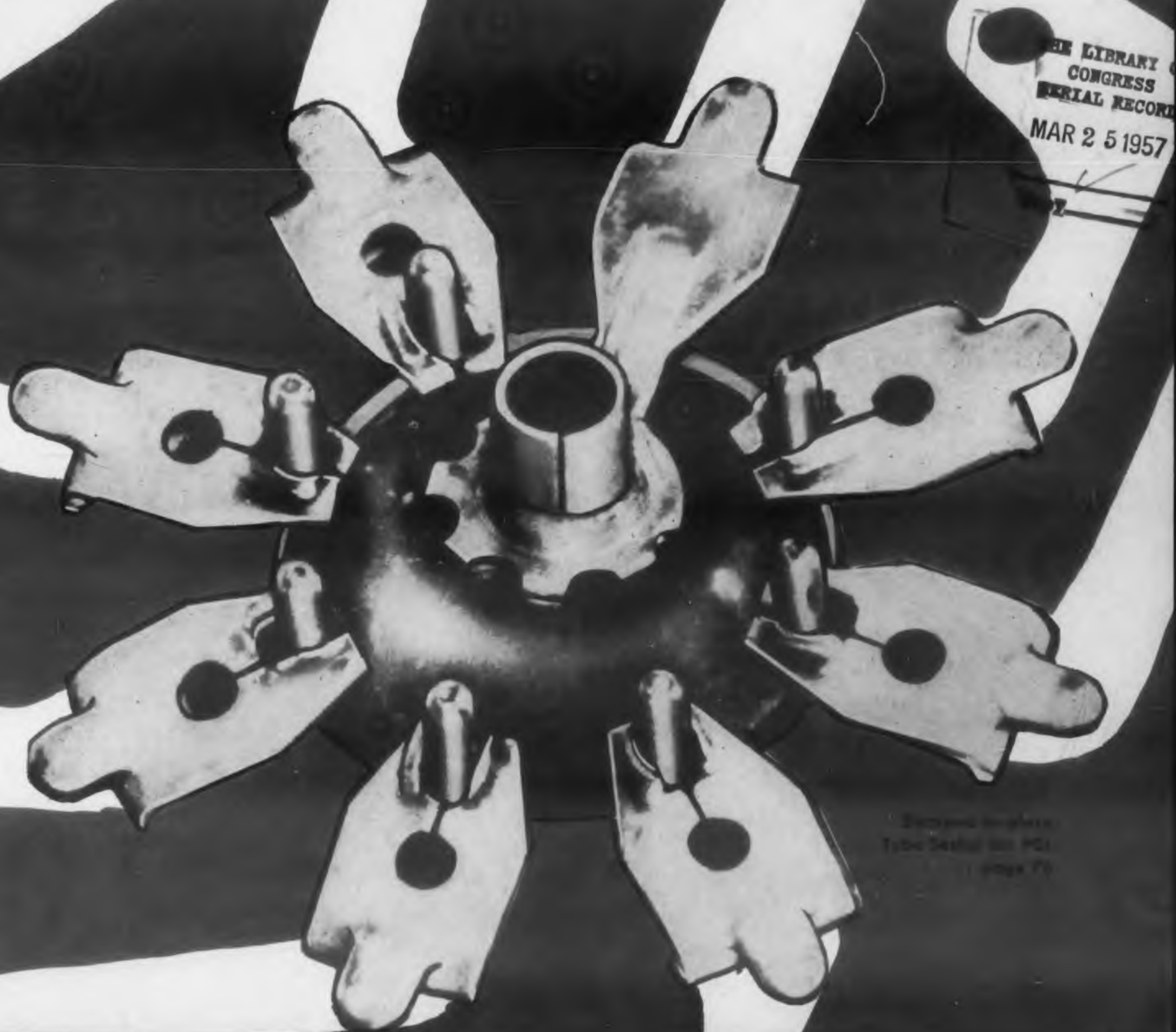


ELECTRONIC DESIGN



IRC® Hermetic Sealing Terminals

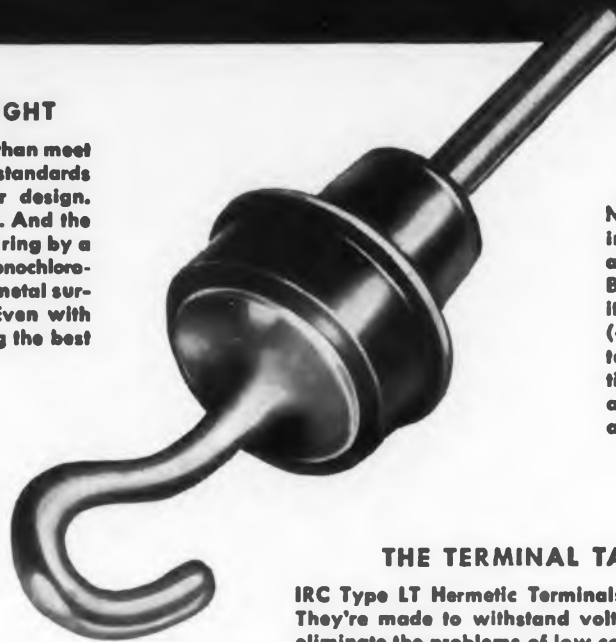
Only the signal ever gets through



THE SEAL STARTS AIR-TIGHT

IRC Type LT Hermetic Terminals more than meet military requirements and commercial standards because of their inherently superior design. First of all, they are a solder seal type. And the terminals are separated from the seal ring by a specially-compounded plastic (polymonochlorotrifluoroethylene) which is bonded to metal surfaces by an exclusive IRC process. Even with rough handling, you're sure of getting the best possible seal from the start.

Type LT
HERMETIC SEALING
TERMINALS
1, 2, 3 & 5 KILOVOLT SIZES
6 LEAD TYPES



THE SEAL STAYS AIR-TIGHT

Not only is the special plastic body a superior insulating material, but it also keeps the seal air-tight under demanding service conditions. Because of its high resistance to thermal shock, it withstands higher operating temperatures (-70°C. to +150°C. continuous or +190°C. intermittent). Furthermore, its zero water absorption eliminates the effects of high humidity. It is also chemically inert to organic solvents, acids, alkalis, oils, fumes, and other atmospheres.

THE TERMINAL TAKES HEAVY LOADING

IRC Type LT Hermetic Terminals give superior electrical performance. They're made to withstand voltages as high as 5,000 volts and they eliminate the problems of low corona breakdown voltage and excessive electrolysis under high DC voltage. Available in a choice of leads—phosphor bronze, copper, and brass.

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ELECTRONIC DESIGN

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CK847	200	1.0	0.002			
CK848	300	1.0	0.002			
CK849	400	1.0	0.002			
CK850	500	1.0	0.002			
CK851	600	1.0	0.002			
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Editorial

It's Your Duty Too, Not Just Industry's

The shortage of engineers and scientists is similar to the weather—everybody talks about it, but nobody does anything. The last round of talks at the annual meeting of the AIEE, though, proved that action must begin now at the elementary and high school level. Potential electronic engineers are short-circuited by untrained, uninspired teachers and ignorant guidance counselors.

What should we do? For one thing, we might copy the approach of the Stamford Engineering Council. They have a program that plans to bring together schools, industries, and professional societies in an integrated series of seminars, plant tours, assemblies and classroom discussions. Engineering and vocational guidance specialists are being picked to offer services to schools. In addition, engineers are helping in the forming science clubs.

Of all the science and industrial arts courses, electronics is probably neglected most. Teachers have never been trained in electronics and, in their ignorance, they are afraid of it. As a result, children in their formative years have little or no opportunity to explore electronics. Deterring any improvement of the situation is the fact that the novice teacher will have to spend considerable time and effort to develop background in electronics adequate to give him teaching confidence.

One solution to this is to have engineers teach the teachers—the teachers to receive educational credit. The National Science Foundation is about to offer aid in this area; but, according to A. R. Jubenville, training consultant, there are some two dozen more steps that can be taken now by industry, educators and individual engineers.

A key point in Jubenville's recommendation is that training equipment or instructional aids be studied by experts. He feels there are aids and systems used now that should be adopted by all schools.

Heretofore, 95 per cent of students' time in experimental electronics has been spent on mechanical manipulations—connecting and disconnecting circuits. This need not be so if new fastener schemes, now used at MIT, for example, were adopted. Enlightened approaches to exploring electronics provides for self-help kits, one for every student, that can also be taken home.

It seems to us it's the engineer's duty to offer help to educators in selecting curriculum, training teachers, and promoting development of effective training equipment. We will have to proffer our help with wisdom, else we will further burden our now overworked educational system. This requires consideration of the practical problems involved. Your editors offer to help communicate ideas you may have.—JAL

*We will be happy to send a copy of Mr. Jubenville's outline for needed action to those who request it.

Engineering Review

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

Cryotron—Computer Revolution

The first useful application of superconductivity is embodied in the Cryotron, a new device that may upset transistor use in computers. The Cryotron operates only at the temperature of liquid helium within a cryostat. The advantages of the device are extremely small size—100 of the units will fit into a thimble, and small use of electric power.

The complexity of computer circuits required for such applications as language translation are well suited to the size and simplicity of the Cryotron. Built-in multiplication tables in the memory unit would free the arithmetic section for higher mathematical or logical problems.

Developed for practical application by Arthur D. Little advanced science laboratory in Boston from research at M.I.T. by Dudley A. Buck, a Cryo-

tron memory device could have all elements searched simultaneously, improving speed and efficiency of access.

The Cryotron comprises a single straight wire around which a wire coil is wrapped. The straight wire conducts current with no resistance. In the control winding a current produces a magnetic field which destroys superconductivity in the straight wire—and resistance is returned. Control winding current can also cut off current in the straight wire. One disadvantage is the slow speed in switching current among multiple paths, but the Cryotron itself can switch from one condition to another as rapidly as a transistor or vacuum tube. Present Cryotrons use tantalum and niobium wires. New metals and alloys may make possible a faster operation of the Cryotron.

Radar for Space Targets

Immediate evaluation of missiles or space satellites is achieved by a new radar system developed by RCA which gives instantaneous, precise tracking data. The system is said to overcome the limitations of present optical, radio, or radar tracking devices which require months for trajectory data reduction.

The device emits a new type of pulse which does not require the use of amplifying reflectors on the target craft to return signals to the transmitting station. The radar will be used to track missile and aircraft targets with and without beacon transponders, and to produce spherical coordinate data outputs of high accuracy, which will provide an instantaneous trajectory record.

The AN/FPS-16 is designed for installation as a fixed station and will be housed in an enclosure specifically designed for it. The antenna pedestal is designed for mounting on a tower, detached from the enclosure proper. This is designed to lessen the chance of vibrations being sent to the tower.



Antenna pedestal of new instrumentation radar system is designed for mounting on a detached tower, to minimize vibrations.

Representing ten years of advanced research, the RCA system is the first precision radar designed specifically for guided missile range instrumentation. It is understood that it will be among units used in tracking the first artificial earth satellite. It is capable of tracking with accuracy any atmospheric conditions.

Look, No Hands

A fully automatic carrier landing system where the pilot never touches the controls has been developed and tested by Bell Aircraft Corp., at Buffalo, N.Y. It is a radar-plus-computer system which lands the plane automatically in zero-zero weather—no ceiling and no visibility. The computer compares



Applying superconductivity to computer problems, the Cryotron memory device is so small that 100 of them will fit in a thimble.

the plane's gyrations with an ideal flight course set in its memory drum, and compensates for roll, pitch, and yaw of the carrier. The computer feeds corrections in the plane's course to the automatic pilot through a radio link. The computer even anticipates the roll and pitch of the ship at the moment of contact with the plane.

To use the system the pilot flies his plane to a "radar gate" two to four miles astern of the carrier. The radar set locks on the plane and the rest of the operation is automatic.

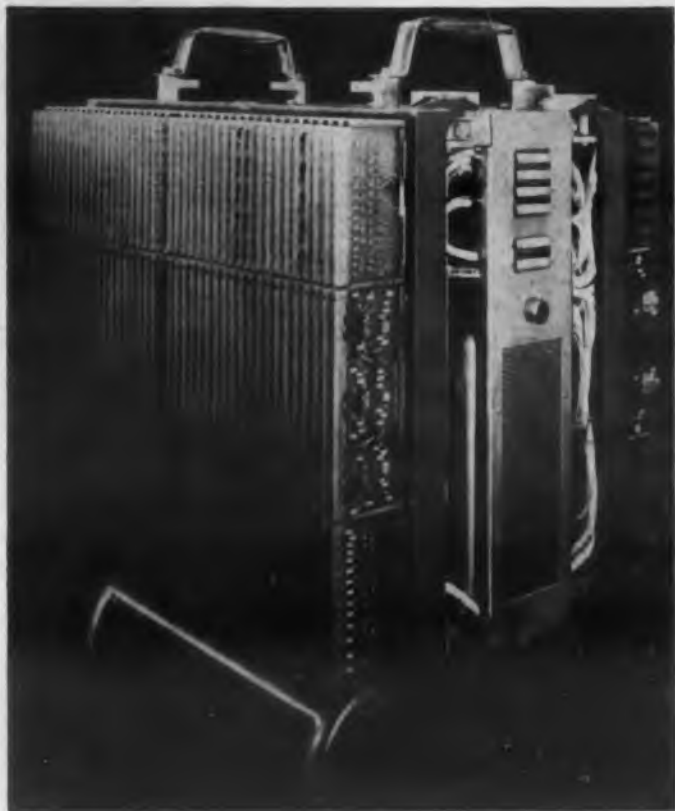
The only necessary equipment is a three pound corner reflector mounted on the landing gear. Optional is an eight-pound air-speed controller which adjusts the throttles for constant air speed. Otherwise, the pilot makes throttle adjustments.

In an emergency, if the carrier hits an unusual ocean swell at the last moment, the plane is "waved off" by the computer for another try.

Midget Field Computer

RECOMP, a midget computer that can add, subtract, multiply and divide several times faster than the familiar desk type calculator, has been designed and developed by Autonetics, a division of North American Aviation, Inc.

To be used by the Air Force, RECOMP had to have the features of a true field instrument, for use where data transmitted over long distances to and from a central computing facility is too inaccurate or late. It weighs 200 lb, can be carried suitcase



This midget computer can be carried by two men, transported in a jeep to the research site, and simply plugged into the ac line.

*Design engineers indicate widespread
use for*

Sylvania Power Transistor Type 2N242

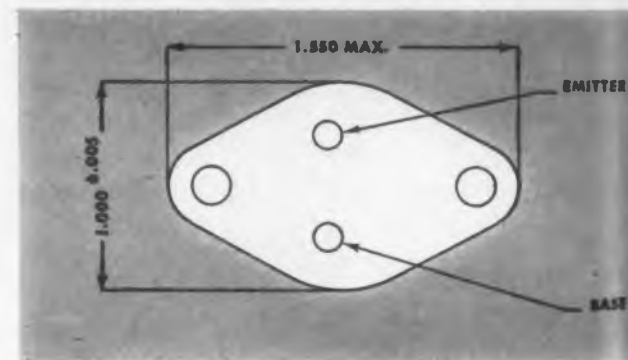
While the type 2N242 is well known for its original use in the output stage of hybrid auto radio, it is rapidly becoming the standard for general purpose use in a wide range of power applications.

There are good reasons for its growing popularity—10 watts collector dissipation, for instance—welded hermetic seal—and a storage temperature of 85° C to eliminate heat problems under idle conditions.

GENERAL FEATURES OF THE 2N242 PNP POWER TRANSISTOR—

- 10 watts max. collector dissipation
- 2 amps max. collector current
- 45 volts max. collector voltage
- New welded hermetic seal
- 30 db minimum power gain (typically 35 db)
- 85° C storage temperature
- 100° C junction temperature
- Thermal drop—3° C per watt (typically 2° per watt)

If you have plans for general purpose transistors you'll be glad to know Sylvania's semiconductor plant in Hillsboro, New Hampshire is just about completely devoted to the production of the Type 2N242. That means Sylvania can meet your volume requirements. And, Sylvania's leadership in the manufacture of semiconductors means you're assured of high product uniformity and dependable performance.



SYLVANIA

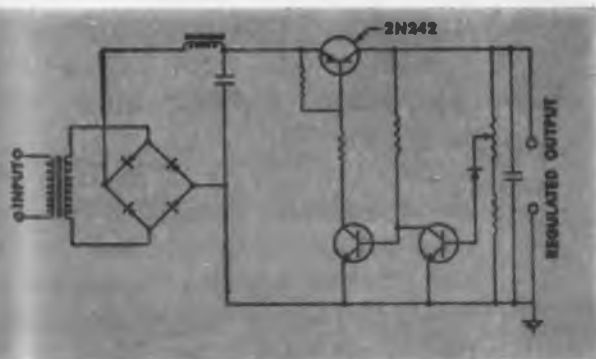
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Here are just some of the applications in which designers are effectively using or planning to use the 2N242

- * VOLTAGE REGULATION
- DC CONVERTER
- OSCILLATOR, AMPLIFIER
- TRANSISTOR COMPUTER
- MAGNETIC CORE DRIVER
- SERVO AMPLIFIER
- VERTICAL SWEEP OUTPUT
- PULSE POWER OUTPUT
- HIGH CURRENT SWITCH
- RF MODULATOR



Transistor Voltage Regulation

Transistorization of voltage regulator circuits is one of the most popular general purpose applications indicated for the 2N242. Here is a typical regulator circuit incorporating the Type 2N242. DC to AC converter rates second in popular usage for this power transistor.

How about your general purpose plans for the Type 2N242 power transistor? Call your Sylvania representative or write for technical data.

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fashion by two men, or it can be transported, without bracing or padding, in a jeep or weapons carrier. Power dissipation has been held to 600 w, and the computer can be plugged in to any standard source of 115 v, 60 to 60 cps ac.

RECOMP is a serial, single address, internally binary computer, having from 12 to 16 arithmetic instructions, 17 logical and transfer instructions and from 5 to 8 input-output instructions. It was designed to utilize a rotary magnetic disc memory with a main memory capacity of 2048 words and 4 arithmetic registers (a new model has a 4032 word capacity). Transistors are used exclusively and the circuits in the computer are so designed that component values are not critical.

Transistorized Highway Flasher

Development of a wholly transistorized electronic highway hazard flasher with a battery life of over 1200 working hours has been announced by the R. E. Dietz Co. of Syracuse, N.Y.

The electronic hazard flasher is a small, compact device operating from a set of batteries wholly enclosed in the flasher case itself.

Yellow lenses are used on all models to avoid confusion with red stop lights and traffic lights. In addition, field tests have shown that yellow lenses provide greater visibility. Flashing rate is 60 to 70 times per minute. Eventually, most automobiles and trucks may carry two or more hazard flashers as standard equipment in case of emergencies.



Tandem Accelerator: Artists sketch of a 10 million volt "atom smasher," highest-energy Van de Graaff announced to date. The particle accelerator will be installed early in 1958 at the Chalk River facility of Atomic Energy of Canada Ltd. Designed and manufactured by High Voltage Engineering Corp., Burlington, Mass., the machine will enable physicists to study in continuous detail the nuclear energy level of heavy elements which they know only in patches today.

Called a Tandem Accelerator, it consists of two 5 million volt accelerators placed end to end with a common high voltage terminal.

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Taking Atomic 'Pictures'

A new technique for taking pictures of the atomic "insides" of metals and other crystalline materials, has been perfected by Westinghouse scientists at Pittsburgh, Pa. It will be used to study the common properties of metals such as strength, brittleness, magnetic behavior, and the like which ultimately depend on the arrangement of its atoms.

Secret of the technique developed by Dr. Sun, is an improved method for making the neutrons "visible" to a photographic film. After being "scattered" by a crystal, the neutrons are allowed to strike a special fluorescent screen placed next to the film.

The screen is made by imbedding a phosphor in a thin layer of special glass or plastic which contains atoms of boron. Neutrons pass through the photographic film and strike the screen, where they smash into the boron atoms. This releases tiny, powerful atomic particles, which causes flashes of light on the screen. These flashes are "seen" and recorded by the photographic film, giving an exact picture of the diffracted neutrons.

The round-about conversion of the neutron's energy to visible light is necessary because standard photographic film is "blind" to neutrons.

Traffic Control by Television

Effective use of closed-circuit television in traffic control may be the answer to choking traffic problems now faced by most American cities. This was suggested by a General Electric spokesman in a speech delivered to the AIEE at Mellon Institute, Pittsburgh, Pa.

Closed-circuit TV cameras would be strategically located along busy cross-city intersections or other important traffic arteries. Each camera would be focused on a system of mirrors at the intersection. The mirrors, in turn, would afford a view of traffic flow from all four directions of the intersection. By a system of measured stadia or graduated marks on each mirror, the distance of the traffic from the mirror could be calculated.

A traffic coordinator, seated in front of a bank of television monitors, or receivers, at a central traffic bureau.

◀ CIRCLE 6 ON READER-SERVICE CARD

ould thus view traffic conditions at any number of intersections. The closed-circuit TV system, combined with radio controls, would give the traffic coordinator push-button control over the timing of the red and green lights at each intersection.

Cooling Airborne Electronics

Engineers associated with the Bureau of Aeronautics feel that the cooling problem "is a thing that must be tackled jointly by the electronics design people and the airframe design people." No matter how well the airframe designer pipes in ram or compressed air, there also has to be built into electronic modular equipment provisions for proper heat transfer. It appears that there are three ways to cool the packages: the circulation, single stage, of bleed air from the main engine compressor; the use of ram air head pressures; and the use of a refrigerant with a heat exchanger.

Engine compressor bleed air has definite limitations since above certain Mach numbers it loses effectiveness. Ram air is for the most part usable provided the modules have adequate circulatory channels and proper sealing. "Ram air will probably be used in the foreseeable future, at least in the early use of modular arrangements," says a BuAer spokesman. But at speeds approaching Mach 1.5, even ram air develops a heat problem of its own that precludes much coolant value.

The long range cooling fix may include something like a two stage cycle utilizing liquid oxygen and a heat exchanger. Here again, there must be the closest harmony between electronics design and airframe design.

Press For Radioactive Material

A special, multi-purpose press to operate with kid-glove gentleness on radioactive materials is being built for the Atomic Energy Commission. The press is ideally adapted to remote control functioning in a completely sealed chamber. The units, developed by the Loewy-Hydropress Div. of Baldwin-Lima-Hamilton Corp., will be installed in the AEC atomic weapons plant, Rocky Flats, northwest of Denver.

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Internal and external cavity type klystrons are used in PRD microwave oscillators. Both types belong to the reflex klystron group which is usually preferred because it provides easy tuning over a relatively wide frequency range and easy frequency or amplitude modulation.

The coaxial cavity is most often used for broadband oscillators since its principal mode is the *TEM*. This permits greater frequency coverage than either the *TE* or *TM* modes of rectangular waveguide sections.

PRD's line of signal sources is conveniently operated through the use of PRD Klystron Power Supplies. Electronically regulated beam, grid, and reflector voltages provide extremely stable klystron output signals.

A spectrum analyzer is a special type of self-contained receiver. It presents an instantaneous display of the power spectrum of the input r-f pulse on an oscilloscope screen. Basically, it is a superheterodyne receiver with a frequency modulated local oscillator.

While the analyzer delivers an accurate envelope of the pulse frequency spectrum, it does not necessarily display each frequency component, since the frequency separation between adjacent spectral lines on the screen is a function of the local oscillator sweep rate, f_s , as well as the PRF, f_R . Actually, the number of lines produced on the screen is f_R/f_s . By varying f_s , the operator can control the spectrum detail presented.

Data such as that contained in the foregoing paragraphs are available in our PRD Reports. Published periodically, these reports give practical information on virtually every aspect of microwave research and engineering. Mathematical derivations, graphs, and charts are always included. If you'd like to receive these reports (there's no charge of course), we'll be happy to add your name to our mailing list. Please address your request to: Reports Dept. R-1.



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PRD Klystron Power Supply for low and medium voltage klystron tubes

Three Protective Devices Prevent Klystron Burn-out!

Another first from PRD. A compact, easily transportable klystron power supply that provides: a protective diode to safeguard the reflector against turning more positive than the cathode; a fuse in the klystron cathode return to protect the beam supply; and a "Beam Off" position to allow for warming up of the klystron filament.

A special feature of Type 809 Klystron Power Supply eliminates readjustments when changing from cw to square wave modulation. The top of the square wave is automatically clamped to the previously chosen reflector voltage.

With good stability and regulation, and with square wave and saw tooth modulation plus provision for external modulation, Type 809 Klystron Power Supply is equally at home in the laboratory or on the production line.

SPECIFICATIONS					
	Type	Voltage (volts)	Current (milliamperes)	Additional Specifications	
Output	Beam	Continuously variable 250 to 800	0 to 65	Ripple: < 5mv RMS	
	Reflector	Continuously variable 0 to -900	50 μ a max.	Ripple: < 10mv RMS	
	Filament	6.3	2 amperes	$\pm 3\%$ center tapped	
Modulation	Type	Frequency Range (cps)	Nominal Voltage (volts)	Rise Time (microseconds)	Decay Time (microseconds)
	Square Wave	400 to 2000	0 to 90	< 10	< 10
	Saw Tooth	60 (fixed)	0 to 125		

Price—\$350 f.o.b. Brooklyn, N. Y.

For additional details on PRD 809 Klystron Power Supply, contact your local PRD Engineering Representative or write to Technical Information Group, Dept. TIG-1.

Tomorrow's Space Travel

A device for realistically testing aircraft and missile in airflow of 10,000 mph and temperatures of 9,000 F for times far greater than before possible is being developed at Cornell Aeronautical Laboratory, Ithaca, Buffalo 21, N.Y. The laboratory will build and operate the high temperature test facility under a one million contract with the Air Force Office of Scientific Research, Air Research and Development Command.

The large-scale device will be used to study materials, structures and aerodynamic problems of aircraft and missiles flying at hypersonic speeds (five times the speed of sound or greater). Brigadier General H. F. Gregory, USAF, Commander of the Air Force Office of Scientific Research, says, "Some day Air Force planes and missiles will fly so fast that the whole vehicle will be exposed to skin temperatures twice as hot as the flame of a rocket engine."

The most significant feature of the new research facility will be its ability to operate at the extreme temperatures and speeds of hypersonic flight for periods of 15 seconds or greater. Although test devices producing hypersonic air flow and temperatures are currently in operation at Cornell Laboratory and other research centers, they can produce the high temperatures and speeds only for brief periods—generally a few thousandths of a second.

The heart of the Cornell Aeronautical Laboratory test facility will be the "wave superheater." Essentially, the wave superheater is a unique arrangement of tubes capable of producing a continuous flow of high-speed, high-temperature air. Outstanding feature of its design is the ability to operate at the extreme temperatures well beyond the melting point of all known materials.



Air and model glow instantaneously (in ten thousandths of a second) as airflow of 10,000 mph strikes blunt model during hypersonic testing. Temperature at model's nose approximates the surface temperature of the sun.



Helicopter transports "Flying" control tower to temporary air field.

Coming Equipped—

The Craig's Systems Inc. of Danvers, Massachusetts, are coming equipped to this year's IRE show. They are bringing their booth with them in the form of a "new product," Helicop-Hut Radio Relay station. The Helicop-Hut is a highly mobile shelter constructed of aluminum skins and a foamed-in-place plastic core. It can be picked up and transported by helicopter or standard cargo aircraft.

Fluid Filled Ear Protector

A new "noisebarrier" ear protector—smallest, lightest, most flexible of its type—will enable ground crews to work around jet engine aircraft without danger of hearing loss or ear damage. The device combines fluid-filled sealing pads and a simple self-adjustment feature to provide universal fit and maximum noise-shunting protection.

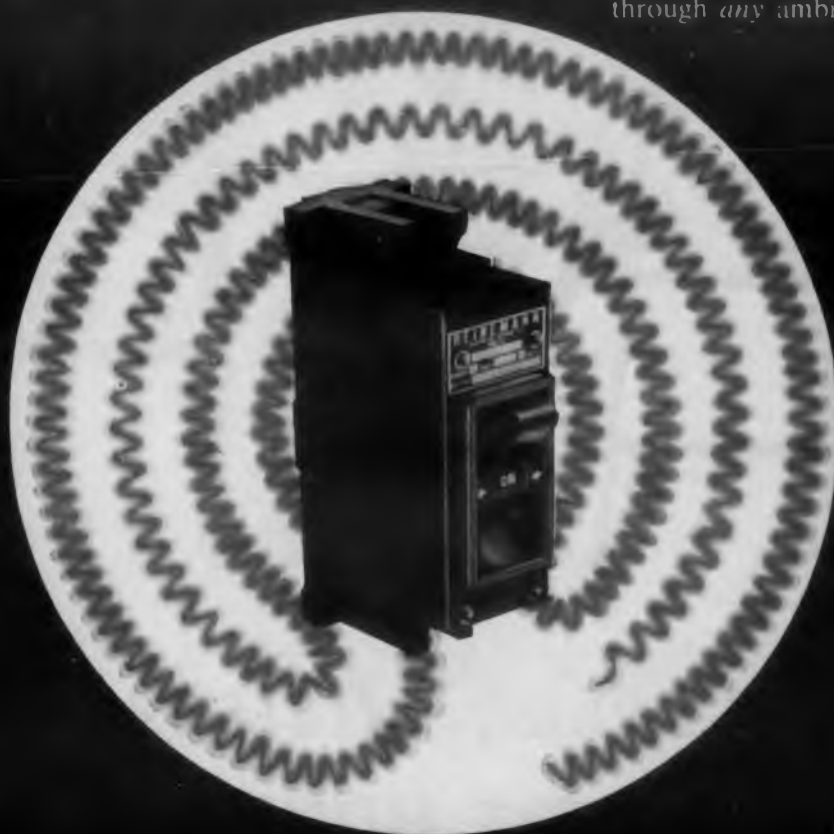
Developed by RCA, Camden, N.J., the ear protector resembles a set of ear phones. It weighs less than 10 oz and exerts only moderate pressure on the head. Despite the ultra-light weight and pressure, the protector remains 'sealed' to the head by automatically adjusting according to working position and movements.

Hearing loss generally is induced by ambient noise levels approaching 130 db. Higher noise levels result in intense ear pain and possible damage to eardrums. Ground crews for jet aircraft, particularly, are required to wear ear protectors because of ambient noise levels which soar appreciably higher than 130 db.

de-rating factor?

ZERO!

When you specify HEINEMANN *Circuit Breakers*, the current ratings you select are *stable ratings* . . . precise, actual indications of the load current the breakers will carry continuously—through *any* ambient temperature range.



Unlike thermal devices, there is no erratic behavior when the heat's on. No compensation or de-rating needed.

HEINEMANN dependability is yours in standard, odd or fractional ratings—to your specs—from 0.010 to 100 amperes. And with HEINEMANN you can match tripping characteristics (time delay or instantaneous) directly to the application . . . for sure, precise equipment protection.

HEINEMANN

HEINEMANN ELECTRIC COMPANY
Plum Street, Trenton 2, N. J.

Circuit breakers

CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION

all
at
once...



the HONEYWELL VISICORDER®

directly records six phenomena

at frequencies from DC to 2,000 cps

The versatile Visicorder will fit almost unlimited oscillograph applications where instantaneous monitoring and direct recording at high frequencies are needed.

The Visicorder is the only oscillograph that records directly at frequencies up to 2,000 cps, and at sensitivities comparable to photographic-type oscillographs. No peaked amplifiers or other compensation of any kind are needed. The record requires no liquids, vapors, powder magazines or other processing materials.

Deflection is six inches peak to peak, covering the full width of the chart. The D'Arsonval-movement mirror galvanometers, in your choice of natural frequencies will, of course, overlap their traces; they are not limited by adjacent channels.

Let your nearest Honeywell Industrial Sales Engineer tell you more about how the Visicorder fits *your* application. Call him today.



MINNEAPOLIS
Honeywell

HEILAND INSTRUMENTS

5200 EAST EVANS AVENUE • DENVER 22, COLORADO



CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION



Magnetic Controlled Dispatcher: An automatic dispatching system, called Magnepulse Dispatcher, controls pneumatic tube carriers travelling up to 30 miles per hour. Developed by Gemco Electric Co., Detroit, Mich., the Magnepulse Dispatcher employs small permanent magnets fixed to the carrier.

When the carrier is in transit, the position of these magnets in reference to a first magnet is detected at each loop switching point and station. Detectors consist of magnetic pick-up coils and an electronic control unit. Depending upon the magnet positions, the control unit causes switching or stopping action, or lets the carrier pass.

Installations have been made in hospitals, department stores, warehouses and industrial plants.

Twelve Satellites To Be Launched

Environmental experiments will be the first ones conducted using the earth satellites to be launched during the International Geophysical Year ending December 31, 1958, according to Dr. Joseph Kaplan of the National Academy of Science, who heads the Geophysical Year program. Present plans call for launching 12 satellites, if budget requests to Congress are approved.

Equipment to be included within each of the satellites will depend upon specific experiments to be made in the outer atmosphere. The actual experiments that will be conducted are being determined by a panel under the chairmanship of Dr. Richard Porter of General Electric Co. This panel has the responsibility for establishing experimental priorities and screening requests for experiments to be performed. Experiments of the Naval Research Laboratory scientists are to be conducted first since they have responsibility for propulsion of the satellites.

In the first satellite will be equipment for measuring temperature variations within the satellite from 10 to 60 C, detection equipment to determine if and when various sealed off compartments are punctured, a device for counting the number of small meteorites that bombard the satellite, measuring equipment to determine solar radiation of

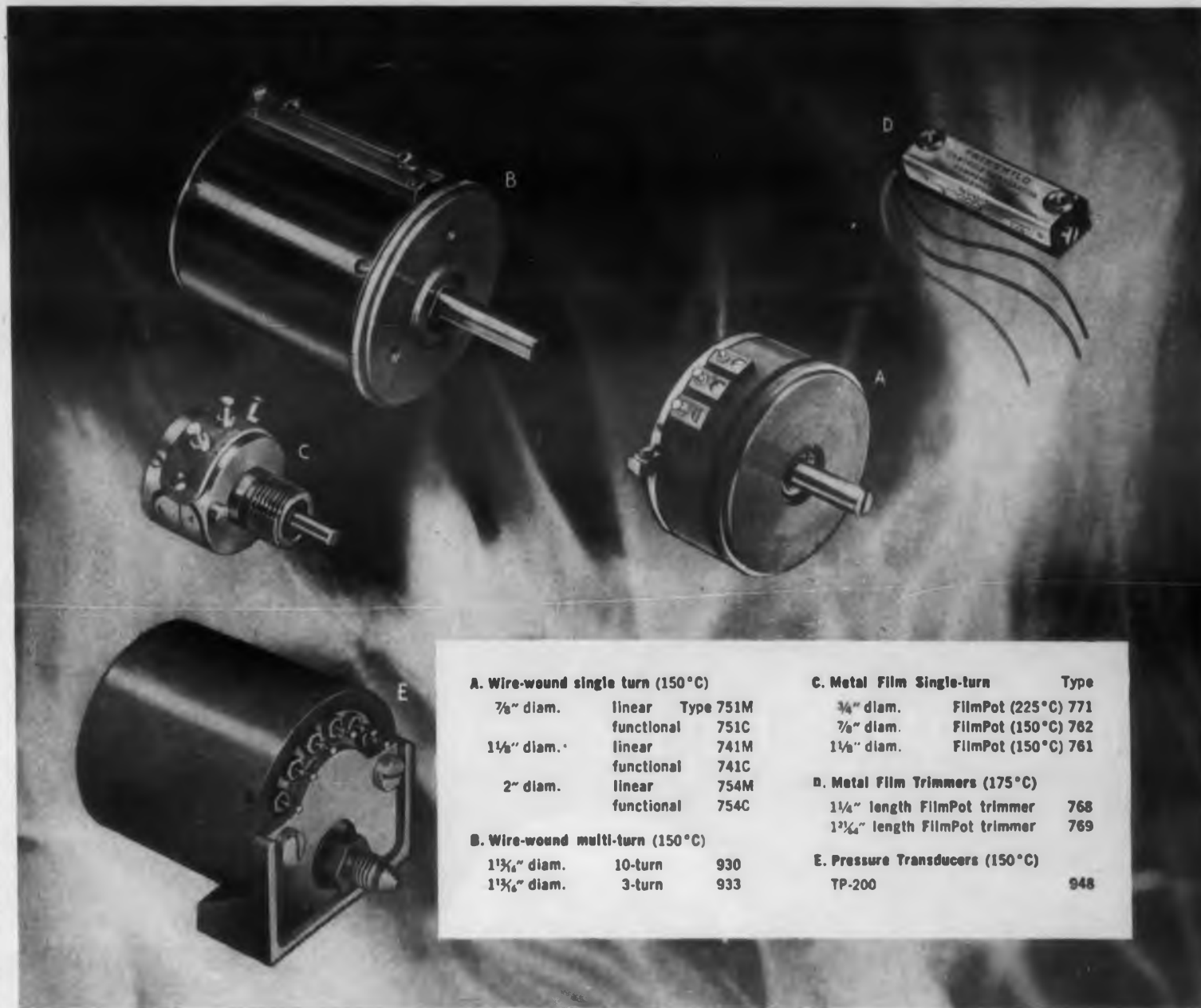
ultra-violet and possibly X-ray character, and a
 means for determining the effect of meteorite
 impact on the skin surface of the satellite.

The second satellite to be launched is expected
 to contain cosmic-ray experimental equipment. One
 of the big questions that will automatically be
 answered upon a successful satellite launching will
 be the actual air density at the various altitudes it
 traverses. This information can be obtained by
 measuring the drag on the satellite itself. Based on pre-
 liminary calculations the satellite should remain in
 orbit in space anywhere from two weeks minimum to
 one year maximum, depending on air density.

Tracking will be done by a network of stations,
 spread all over the world. The antenna pattern from each station
 is such that the satellite will be tracked when
 it is in a cone 600 to 700 miles in a north-south
 direction, and 60 to 70 miles in an east-west direc-
 tion. Information obtained by the tracking stations
 will be supplied to a computer which will quickly
 provide complete orbital information to optical
 stations for direct observation of the satellite.

Particularly valuable for weather observation
 will be the information on energy exchange between
 the earth and other bodies; such information can
 only be obtained from the satellite.

Advances in miniaturization are evidenced by
 the satellite of a 48 channel telemetering
 system consisting of magnetic cores and switching
 resistors, the entire unit weighing 3.2 oz. plus
 1.5 oz. for batteries. This telemetering system will
 operate for three to four weeks.



A. Wire-wound single turn (150°C)			C. Metal Film Single-turn		Type
7/8" diam.	linear	Type 751M	3/4" diam.	FilmPot (225°C)	771
	functional	751C	7/8" diam.	FilmPot (150°C)	762
1 1/8" diam.	linear	741M	1 1/8" diam.	FilmPot (150°C)	761
	functional	741C			
2" diam.	linear	754M			
	functional	754C			
B. Wire-wound multi-turn (150°C)			D. Metal Film Trimmers (175°C)		
1 1/4" diam.	10-turn	930	1 1/4" length	FilmPot trimmer	768
1 3/8" diam.	3-turn	933	1 3/4" length	FilmPot trimmer	769
			E. Pressure Transducers (150°C)		
			TP-200		948

NEW HIGH TEMPERATURE POTENTIOMETERS AND TRANSDUCERS

Fairchild announces five new lines of high temperature components. Five general categories are available: single- and multi-turn wire-wound potentiometers, FilmPot® potentiometers and trimmers, and precision pressure transducers.

High temperature lubricants, insulations, solders, rhodium-plated parts, and the elimination of pressure contacts — all these have been designed, tested and incorporated into a complete line of high temperature units to give you precision potentiometers that will function accurately and reliably under high temperature conditions—to 150°, 175°, or 225°C.

Rotational life for FilmPot and wire-wound single-turn potentiometers is 500,000 cycles; for multi-turn units—up to 1,000,000 shaft revolutions. Load life is rated in excess of 500 hours exposure to hot spot temperatures.

Fairchild components research, implemented by critical production techniques and severe testing programs, is continuing to develop units for even higher

temperatures, and can offer constructive cooperation in guided missile and aircraft control programs.

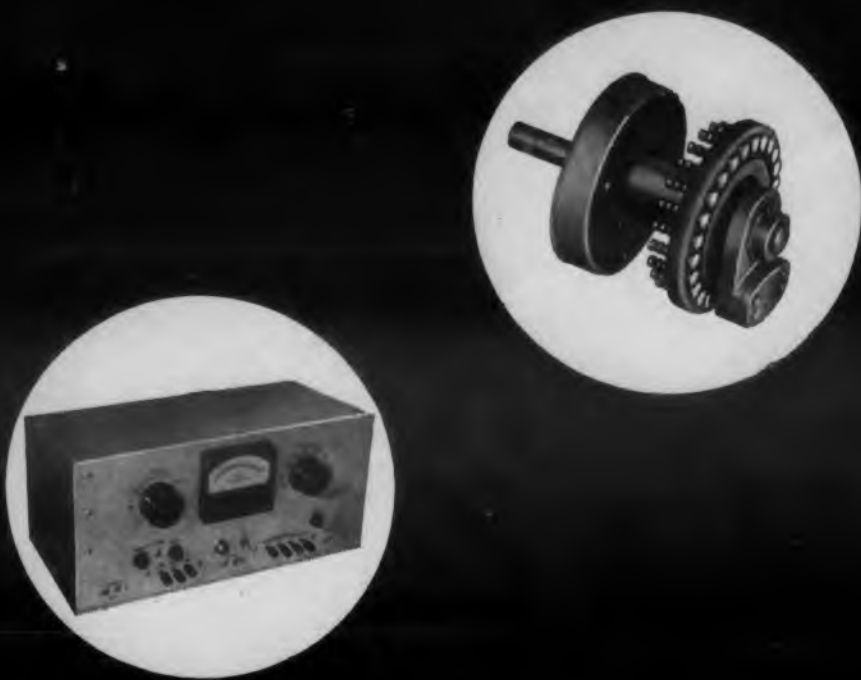
For data sheets, or for assistance on specific problems, write to Fairchild Controls Corporation, Components Division, Department 140-81N.

East Coast
 225 Park Avenue
 Hicksville, L. I., N. Y.

West Coast
 6111 E. Washington Blvd.
 Los Angeles, Calif.

FAIRCHILD
 PRECISION POTENTIOMETERS
 and COMPONENTS

CIRCLE 11 ON READER-SERVICE CARD FOR MORE INFORMATION



Consult DAVEN for the finest in electronics


- PRECISION WIRE WOUND RESISTORS
- ROTARY SWITCHES
- ATTENUATORS
- TEST AND MEASURING INSTRUMENTS

Outstanding achievement in the design of precision wire wound resistors, rotary step-type switches, attenuators and test equipment has established DAVEN as the leading producer and supplier of precision electronic components and instruments.

When confronted with a procurement or design problem concerning precision wire wound resistors, rotary switches, attenuators or test equipment, consult DAVEN's sales department or engineering staff first.



THE **DAVEN** CO. 526 West Mt. Pleasant Avenue, Livingston, New Jersey

TODAY, MORE THAN EVER, THE DAVEN 
STANDS FOR DEPENDABILITY!

TV Light Compensator

A new automatic light compensating system changes the voltage fed to the vidicon camera tube according to the illumination falling upon the scene being televised. Previous versions of automatic controls for unattended television cameras involved mechanical changing the lens opening by means of a servo motor geared to the diaphragm. Disadvantages of this type of control are bulkiness, long response time and an excessive drain on the power supply.

By varying the voltage driving the camera tube to fit existing light conditions, it is unnecessary to alter the lens aperture setting. A constant output video signal is maintained from the vidicon tube regardless of the light conditions at the time. In effect the sensitivity of the tube is modified to existing lighting, much as the iris of the human eye adjusts the amount of light striking the retina.

Accuracy of the voltage-varying system developed by the Temco Aircraft Corp., Dallas, Tex. is within 1 per cent over an incident light change ratio of 200 to 1.

Commercial applications of unattended television circuits include shoplifter surveillance in department stores, production line monitoring and industrial operations too hazardous for human attention.

SMPTTE Increases Activity

The Society of Motion Picture and Television Engineers have embarked on a program to provide more and broader services for its members and for the industry. According to Bart Kreuger, president, future technical sessions of the society will cover new materials and techniques, involving semi-conductors, color television automation, video-tape recording, high speed photograph and closed circuit television of several types.

Correction

In the article "Automatic Interpolation With Spiral-Scale Dials," Feb. ED, page 40, Figs. 5 and 8 were interchanged.

◀ CIRCLE 12 ON READER-SERVICE CARD

Washington Report

Herbert H. Rosen

FCC Radio Equipment List

The FCC has revised its list of radio equipment acceptable for licensing in the radio service other than broadcast. Known as "Radio Equipment List, Part C," it lists equipment acceptable as of December 20, 1956, for licensing in the Maritime, Public Safety, Industrial, Land Transportation, Citizens, and Domestic Public Radio Services.

Copies of the new revised list are available for inspection at FCC offices in Washington, D.C. and in the regional field offices. Industries and other interested parties may reproduce the list. Loan arrangements can be made through the Technical Research Division of the Office of the Chief Engineer.

Solar Cell Boosted

Hoffman engineers came to Washington recently to show off the equipment they have designed to use their new solar cell. Shown at a symposium for government and military representatives were solar flashlights, a transmitter-receiver, a new 504-cell Big Bertha, cell-driven models of a boat and an airplane, a signal beacon, and solar-transistor portable radio.

Right now the cost of the Big Bertha is about \$100 per watt, rated at 25 w and 2 or 3 amp. Hoffman engineers speculated that the cost should go down to about \$30 per watt in two years and to about \$10 per watt in 5 or more years. Hoffman is now experimenting with ultrasonics as a means to improving production. The company claims to have raised efficiency from 2 per cent up to 9 or 10 per cent. The theoretical limit is 22 per cent, but losses restrict that to a practical upper limit of 15 per cent.

Hoffman engineers claim that their solar cells will operate satisfactorily at temperatures of 200 C. They also say that the energy conversion characteristic of the cells is inversely proportional to temperature. Both of these features indicate that the solar cell may have applications in both low temperature and high temperature technology.

Get proven performance...



adapt from
WESTERN GEAR'S
many basic motor designs

Western Gear's extensive miniature motor line ranges from 1/500th to 4 H.P., 50 to 400 cycles, any voltage required, designed and built to meet military specifications. Our engineers will gladly work with you in solving your rotary electrical problems without obligation.

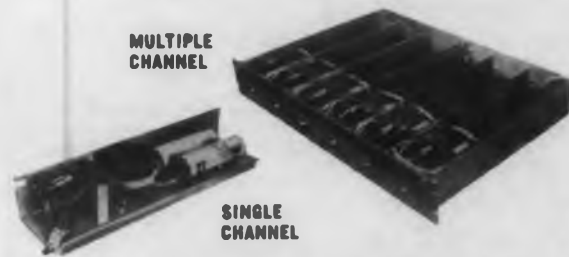
special power supply units, too!

Transistorized D.C. voltage regulator employing series power transistor and temperature compensated Zener diode reference voltage. Input voltage is 27.5 V.D.C. plus or minus 15%. Model 7VR09 output is 20 V.D.C. at 50 to 250 MA; Model 7VR08 20 V.D.C. at 10 to 150 MA. Regulation less than plus or minus .1% for combined variations of input voltage, load current, temperature, drift and vibration. Shunt loss is less than 25 MA. Temperature range from 32°F. to 150°F. Measures 2" x 2" x 2".

Model 7P01 single or multiple channel strain gage power supply, 115 V., 60 cycle input, 10 V.D.C. output, adjustable from 9-11 V.D.C. with a 10-turn potentiometer. Output voltage changes less than plus or minus .05% due to temperature change from 0 to 45°C.; output voltage changes less than .1% due to 2% change in load current. Output ripple is less than 300 microvolts RMS, isolated from ground as follows: insulation resistance to ground, 10,000 megohms; AC pickup voltage to ground, 5 microvolts peak.



MODEL
7VR08-9



MULTIPLE
CHANNEL

SINGLE
CHANNEL



Western Gear Corporation
Electro Products Division
132 W. Colorado St., Pasadena 1, Calif.

- Please send me motor catalog No. 254-A
- Data sheet on voltage regulator
- Data sheet on strain gage power supply

Name _____

Title _____

Company _____

Address _____

City _____ State _____

"The difference is reliability" • Since 1888

WESTERN GEAR
Corporation

ENGINEERS AND MANUFACTURERS

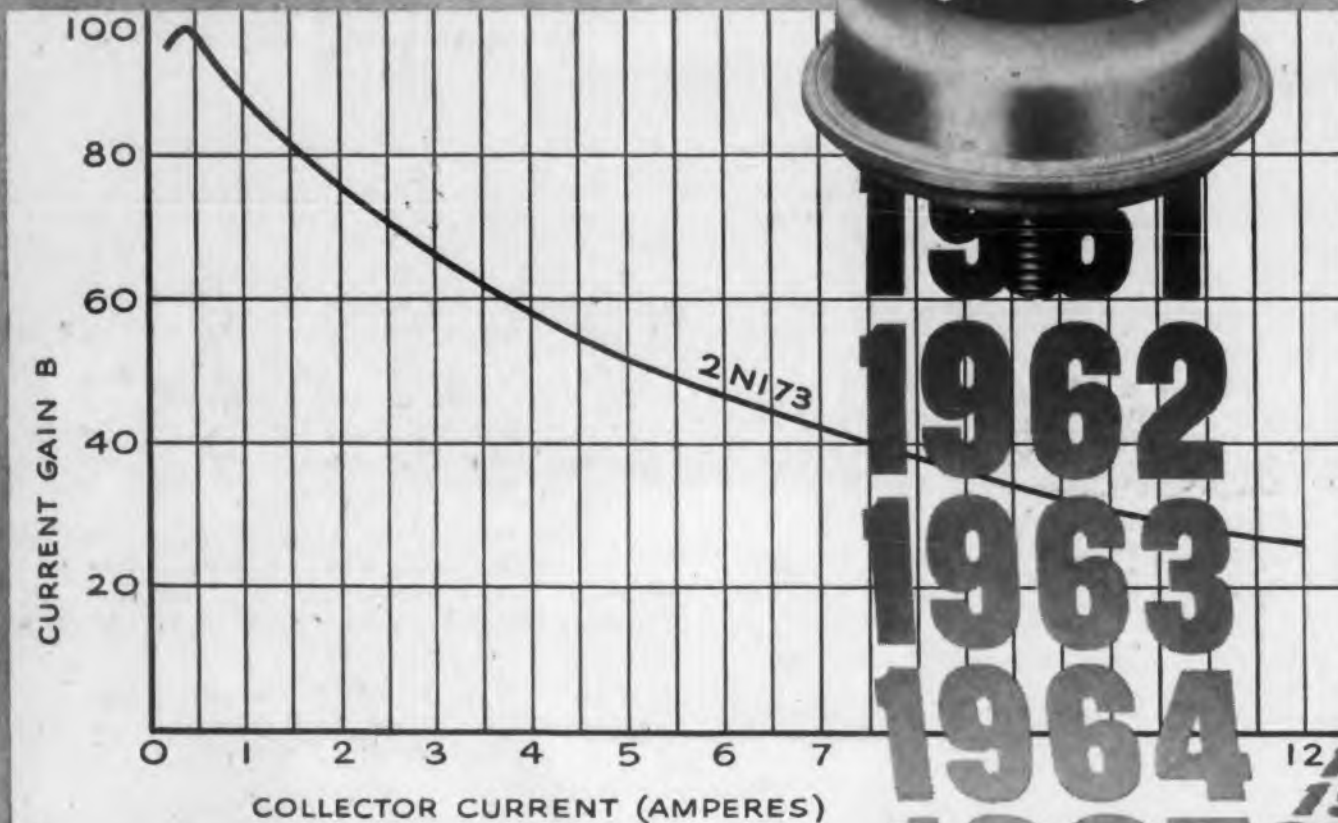


PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.)

CIRCLE 13 ON READER-SERVICE CARD >

Industry's Highest Power Transistors

Combine stability with long life



Delco Radio's 2N173 and 2N174 alloy junction germanium PNP transistors have unusual stability and reliability. These superior characteristics are retained by hermetic seal and proper internal atmosphere.

In addition, normalizing processes contribute to the high output power, high gain and low distortion characteristics that were designed into them. Delco Radio High Power transistors, ideal for your audio as well as general power applications, are produced by the thousands every day. Write for information and engineering data.

1957
1958
1959



1960
1961
1962
1963
1964
1965
1966
1967

TYPICAL CHARACTERISTICS

	2N173	2N174	2N277
Properties (25°C)	12 Volts	28 Volts	12 Volts
Maximum current	12	12	12 amps
Maximum collector voltage	60	80	40 volts
Saturation voltage (12 amp.)	0.7	0.7	0.7 volts
Power gain (Class A, 10 watts)	38	38	38 db
Alpha cutoff frequency	0.4	0.4	0.4 mc
Power dissipation	55	55	55 watts
Thermal gradient from junction to mounting base	1.2°	1.2°	1.2° C/watt
Distortion (Class A, 10 watts)	5%	5%	5%

DELCO RADIO

DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION



Common Sense

Dear Sir:

May I take issue with your editorial "Common Sense is Not the Answer," in the November 1956 *ELECTRONIC DESIGN*.

Granted, probably not more than five per cent of all engineers are creative. However, this cannot be construed as a failure of the common sense approach. Creativity—in an engineering sense at least—might be defined as the uncommon application of common sense.

True, a Max Planck or an Einstein may come along with a radically new principle and have arrived at this principle with only a modicum of common sense, but these men have created nothing in a tangible sense. It was the men who were able to translate these new principles into an atom bomb who were the engineering creators.

Consider a simpler and more familiar example of steam propulsion. The discovery of the principle that expanding steam could do work is accredited to Hero of Ancient Alexandria, yet it was not until Newcomen's invention of the steam pump in the 18th century that steam was made to do work. It was an additional 25 years before James Watt made the pump reciprocating, thus creating the first practical steam engine. Many more years passed before the steam engine was applied successfully to sea and land transportation by Messrs. Fulton and Stephenson.

Were Watt, Fulton and Stephenson creative? Certainly they discovered no dramatic new principles. Yet we need only remember the sentiments expressed by their critics—learned and otherwise—to realize that they applied common sense in an uncommon way.

W. E. Warden
Project Engineer
General Electric
Waynesboro, Va.

► Common sense should have told us that the "Common Sense is Not the Answer" was not appropriate—"Common Sense is Not Enough" would have

Letters to the Editor

...en better. We apologize for too much adamship bold headlines. We like Mr. Warden's point that creative engineering might be defined as uncommon application of common sense. The main point we tried to stress in the editorial was: be conscious of your assumptions. Erroneous assumptions or a priori reasoning are not likely to overcome stalemates to progress.

Product Features

Dear Sir:

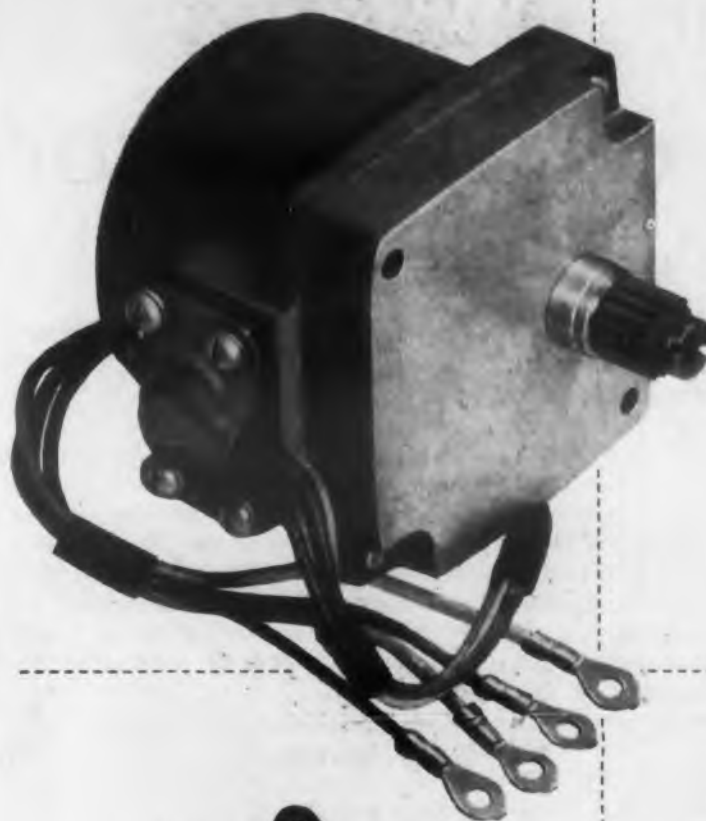
... I lift my pen to protest against the insertion of your publication of certain types of promotional material regarding new products, which appears to have been gathered and reported on by your staff. . . .

I believe that I can readily grasp your basic problem of presenting new products every month . . . and yet not having the necessarily extensive test facilities available to you to evaluate the vendor's statements and declarations prior to publication. . . .

I suggest that your magazine include a preface statement before an expository article which will state that the performance claims of the remainder of the article has been entirely provided by the vendor, and that no attempt has been made by ELECTRONIC DESIGN to validate them. Another sentence should be added to caution designers to verify performance claims before accepting them in their design models.

B. R. Schwartz
Haddonfield, N.J.

One of the primary policies of ELECTRONIC DESIGN is to call the attention of electronic design engineers to new products which to us appear especially significant. Feature treatment should not imply, however, that independent laboratory tests have been made. We do our best to insure that the manufacturers of the equipment or components featured are reputable and can therefore stand behind their claims.



ElectroniK Null Indicator

Modern successor to the spotlight galvanometer. Immune to vibration . . . self-protected from overloads. Needs no leveling, no special mounting. Ideal for lab or factory. Sensitivity 0.001 microamp or 1 microvolt per mm. Price \$175.00 f.o.b. Philadelphia.



Brown Servo Amplifiers

For instrument and computer servo loops. Convert low-level d-c input signal to ac, and amplify it to power level to drive a Brown servo motor. Extremely low stray pickup, high stability, excellent sensitivity, fast response. Four models with gains of 1, 4, 12 or 40×10^4 . Choice of 4 input impedances from 400 to 50,000 ohms. Prices from \$98.50.

For positive positioning
use Brown
2-phase motors
in your servomechanisms

NEEDED up to 85 inch-ounces of torque, at low speeds—for remote positioning in servos, computers, null circuits?

Brown 2-phase reversible motors are ideal for these applications. They're the same design that has given years of continuous service in thousands of Brown *ElectroniK* instruments throughout industry. And continuing refinements make them better than ever.

Long-life needle bearings reduce friction and maintenance. Improved gear trains deliver a smooth flow of power. Better seal, better lubrication, simpler and more attractive housing . . . all add to greater value in the latest models of Brown servo motors.

Shaft speeds of 27, 54, 162, 333 or 1620 rpm are available. Many variations in design of pinion, shaft, leads and materials can be supplied for special applications.

Power input is 115 volts, 60 cycles . . . 25-cycle model also available. Line field takes 11 watts; amplifier field 2.5 watts. Motor load impedance averages 12,000 ohms.

Check the table below for the models you need. Order single units for development work, or thousands for production runs. Prices from \$42.00 (even more favorable depending on quantity).

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

No-load speed—rpm	27	54	162	333	1620
Rated torque—in. oz.	30	15	5	4	5
Max torque—in. oz.	85	43	19	11	9
rpm for max power	15	31	92	190	900



MINNEAPOLIS
Honeywell

BROWN INSTRUMENTS

First in Controls

Quick-Opening Fasteners: Screw Type or 1/4 Turn?

Know the features of each before you specify.

M. R. TUOZZO

The selection of a quick-operating door fastener usually involves a choice between two basic designs; the quick-acting screw fastener and the 1/4 turn fastener. Both are relatively inexpensive. Each has advantages that make it the logical choice for certain applications.

THE SCREW FASTENER is a rugged, square threaded screw assembly engaging in a special heavy stamped nut. The nut is clipped, riveted, or welded to the door frame. A special washer behind the thread captivates the screw in an oversize hole in the door.

Because of its exceptional "float," it is installed without precision measure-

ments and will always line up with ease. Where a variation in material thickness may occur or a gasket must be compressed, the screw fastener is preferred, since a single grip length can be used throughout. Under most conditions it will completely disengage in two to four turns. It offers excellent resistance to vibration and forms a solid joint with no "give."

The screw fastener can be backed all the way out of the door frame without moving the door. If required, it can be installed so as to jack the door open as it is unscrewed.

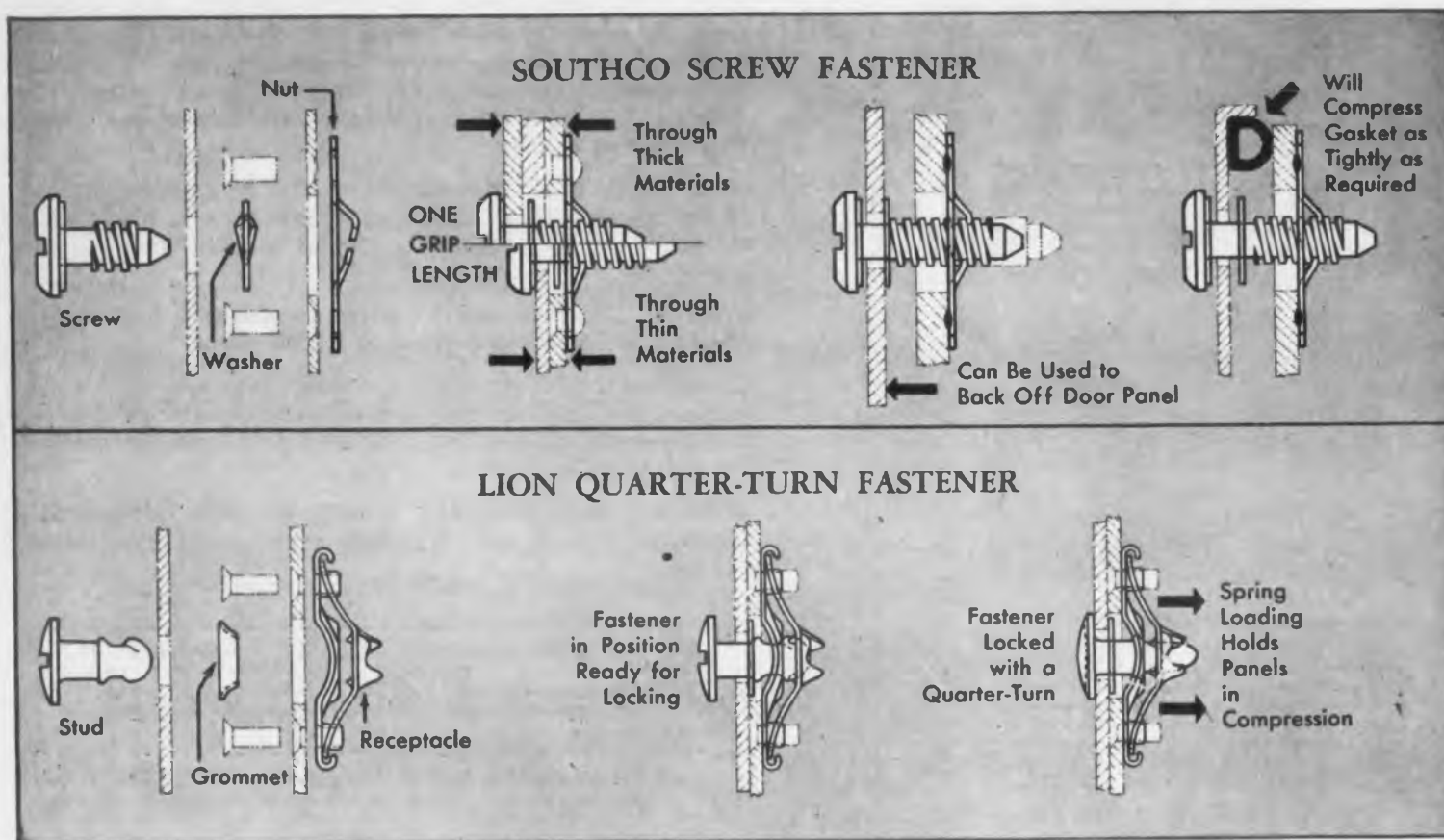
THE QUARTER-TURN FASTENER is usually selected for application on aircraft (under Army-Navy-Air Force specification MIL-F-5591A) where in-

stantaneous removal of fastened parts is required. As the name implies, it is quickly locked or unlocked by a fractional turn.

Its strength characteristics also are very high when the stud is formed from a single piece and no thin springs, wires, or cross pins exist in the assembly. The stud is retained in the door panel by a metal grommet, and engages in a full floating spring-loaded receptacle, riveted or welded to the door frame.

Where the thickness of door and frame are fairly constant through an entire production run, the quarter-turn fastener is a wise choice. Its design affords maximum speed in fastening, and excellent vibration resistance.

COMPARISON OF STANDARD QUICK-OPENING FASTENERS



SOUTHCO FASTENERS

©1956

LION

Southco Div., South Chester Corporation
235 Industrial Highway, Lester, Pa.

CIRCLE 297 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

March 18-21: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum, New York, N. Y. Twenty-three technical subjects such as Telemetry, Antennas and Propagation, Circuit Theory, Electron Devices and Receivers, Computers, Information Theory, Automatic Control, Microwave and Instrumentation, Manufacturing Electronics, Audio and Broadcast, Aeronautical Communication and Military Electronics, Ultrasonics, Medical and Nuclear Electronics will be presented at the convention. For further information, contact the IRE, 1 East 79th St., New York, N.Y. for other information. See the March 1 ED for detailed program.

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

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

March 25-27: Special Conference on Research and Development

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

April 4-5: Special Conference on Research and Development

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

April 8-11: Fourth National Electrical Industries Show

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

April 11-13: Southwestern IRE Conference and Electronics Show
Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

April 15-17: Symposium on Systems for Information Retrieval
Western Reserve University, Cleveland, Ohio. Sponsored by the School of Library Science of Western Reserve University in conjunction with its center for Documentation and Communication Research. This will be a comprehensive demonstration of systems presently in use for the organization, storage and retrieval of recorded information, together with a symposium on information-handling problems and techniques. Further information may be obtained from Jesse H. Shera, Dean, School of Library Science, Western Reserve University, Cleveland 6, Ohio.

April 16-18: Symposium on Nondestructive Tests Developed in the Field of Nuclear Energy
Morrison Hotel, Chicago, Ill. Sponsored by American Institute of Chemical Engineers, American Nuclear Society, American Society for Testing Materials, and Society for Nondestructive Testing. Information resulting from 15 years research and development in testing applications in the nuclear field will be presented. Papers will be in three categories: reactor materials, completed fuel assemblies, and miscellaneous. For information, write to American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

April 23-25: International Symposium on the Role of Solid State Phenomena in Electrical Circuits
Auditorium of the Engineering Societies Building, New York, N. Y. Symposium will cover recent developments in application to electrical circuits on systems of unusual physical effects in solids. For information write to the Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N.Y.



April 25-26: Annual Technical Meeting of the Institute of Environmental Engineers
Salle Hotel, Chicago, Ill. For information contact the President of EEI, Henry F. Sander, Vapor Heating Corp., 6420 W. Howard St., Chicago, Ill.

TUNG-SOL

Alloy Junction Germanium Transistors

Reliability is the principal characteristic of these hermetically sealed Tung-Sol transistors now in volume production. Gain factor is extremely high over the operating ranges, with excellent heat dissipation. Design and construction methods provide a wider safety margin against the effects of shock, vibration, contamination and temperature. Rigorous testing of electrical and mechanical characteristics assures accurate maintenance performance and life standards. If your equipment designs call for transistors of these or related types, you will find Tung-Sol quality and dependability extremely valuable in maintaining your own output at highest levels.



HIGH POWER TRANSISTORS						
	RATINGS (25°C)		TYPICAL CHARACTERISTICS (25°C)			
	V _c	P _c	Current Gain 500 MA I _{ce}	Power Gain CL A	Power Output CL A	Distortion Max.
 TS176	-30 Volts	10 Watts	50db	32db	2.5 Watts	5%
Type TS176 PNP junction transistor is designed for high power audio service in mobile battery operated equipment. The collector is connected directly to the case for conduction cooling. Emphasis is given to efficient thermal design, high power sensitivity, low distortion at high current levels and reliable hermetic sealing.						
TS612 TS613	These are high power units rated for non-audio applications such as series regulator and power switching. Collector-to-emitter voltage ratings range from 50 to 90 volts depending on circuit conditions.					
MEDIUM POWER TRANSISTORS						
	RATINGS (25°C)		TYPICAL CLASS B OPERATION (25°C)			
	V _c	P _c	E _{cc}	Power Output	Distortion Max.	Power Gain
 TS616	-25 Volts	150 MW	-12 Volts	500 MW	5%	28 db
TS617	-25 Volts	150 MW	-12 Volts	500 MW	5%	31 db
TS618	-25 Volts	150 MW	-12 Volts	500 MW	5%	34 db
PNP alloy junction transistors designed and tested for medium power class B audio applications. Close parameter control, particularly at high collector currents, makes special matching within type classification unnecessary.						
	RATINGS (25°C)		TYPICAL CLASS A OPERATION (25°C)			
	V _c	P _c	E _{cc}	Power Output	R _L	Power Gain
TS619	-25 Volts	75 MW	-12 Volts	2 MW	15,000 OHMS	44 db
PNP alloy junction transistors designed and tested for class A driver service in audio amplifiers. Close parameter control and hermetic sealing insure production uniformity and performance stability.						

More Data? Requests for additional information about these—and other related types of transistors for special applications—should be addressed to: Semiconductor Division, 95 Eighth Avenue, Newark 4, N. J.

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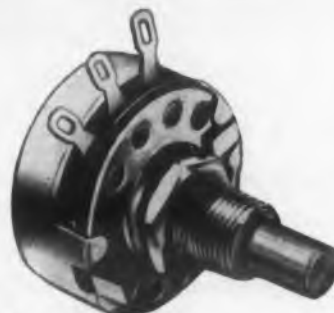
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April 24-26: Seventh Region IRE Conference
San Diego, Calif. Theme of the meeting is "Electronics in Space." Sessions will be held on electronic aids to air navigation, audio, management uses of computers, antennas and propagation, nuclear activation and damage of electronic equipment, electronic devices, electron tubes, microwave instrumentation, telemetering, data handling and automation, magnetic components, and radio astronomy. For information, write to IRE Seventh Region Conference, U. S. Grant Hotel, San Diego, Calif.

May 1-3: Electronic Components Conference

Hotel Morrison, Chicago, Ill. Sponsored by the AIEE, IRE, RETMA and WCEMA. Papers to be given on high temperature components, radiation effects, component reliability, passive components, active components, instrumentation and measurements, materials development and general component needs. For information write to J. S. Powers, Electronic Components Symposium, 84 E. Randolph St., Chicago 1, Ill.

May 3: Fourth Annual Conference for Engineers and Architects

Ohio State University campus. Sponsored by the College of Engineering.

May 13-15: National Conference on Aeronautical Electronics

Dayton, Ohio. Sponsored by Dayton Chapter, IRE.

May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers

New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 50, New York.

June 6-7: First National Symposium on Production Techniques

Hotel Willard, Washington, D. C. Sponsored by the IRE Professional Group on Production Techniques. Discussions will be held on "How to Prepare For and Implement Automation" and "Military Problems in Electronic Automation." Papers will be presented on "Designs for Production." For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

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June 10-11: Second RETMA Symposium on Applied Reliability

Syracuse, N.Y., Hotel Syracuse. Symposium emphasizes the practical aspects of achieving reliability. Sessions will be held on mechanical design, selection and use of components, proof of mature design and case histories of reliable and unreliable designs. A panel discussion is planned on industry vs. military responsibility on contract and specification control for reliability. Advance registrations will be handled by the RETMA Engineering Office, Rm. 550, 11 W. 42nd St., New York 36, N.Y.

June 10-14: Fifth Annual Technical Writers' Institute

Rensselaer Polytechnic Institute, Troy, N.Y. Designed for those who supervise technical writing in business, industry and the professions. Sessions on manuals and instruction books, reports, technical promotion, training programs, industrial films and graphic and illustrative aids. For additional information, write Jay R. Gould, Director, Technical Writers' Institute, Rensselaer Polytechnic Institute, Troy, N.Y.

Paper deadlines

May 1: Deadline for papers submitted for the Western convention August 20-23 in San Francisco. Send 100-200 word abstracts, together with complete texts or additional detailed summaries, to D. A. Watkins, Technical Program Chairman, Stanford Electronics Laboratories, Stanford University, Stanford, Calif. Authors will be notified of acceptance by June 1.

May 1: Deadline for papers submitted for the April, 1958 convention of the American Society of Tool Engineers. ASTE membership is not required. Each proposal should include an outline of the paper, the author's name, his title and affiliation. Send outlines to L. S. Fletcher, Program Director, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 83, Mich.

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Report on Power Transistors For Converters

Bernard Reich

Signal Corps Engrg. Labs.
Fort Monmouth, N. J.

THIS REPORT indicates the present status of power transistors with respect to their mechanical and electrical reliability. Power transistors from eleven manufacturers were solicited to determine their reliability in dc-dc converter type of service. Prior to the initiation of this program, it was found that devices applied to converter circuits were suspected of failing for various reasons; voltage spikes acting on the collector to base diode, peak powers which exceeded the transistor rating and finally, the possibility of collector to emitter punch through. These theories of transistor failure represented the picture encountered on dc to dc converter applications prior to the investigations of the Signal Corps. Eng. Labs.

From the studies that were made it was concluded that:

- the effects of poor moisture seals is still a major problem to the transistor industry.
- the only effects on transistor parameter degradation seem to be due to temperature.

Another conclusion was that the failure of operating dc to dc converter circuits resulted from the following conditions:

- The entry of moisture into the units causing large increases in I_{co} and resultant failure.
- The degradation of device parameters H_{fe} and G_m causing operation in regions which are conducive to transistor failure.

It is believed however, that many of the failures in the past has resulted from moisture entry.

Recommendations

If reliability is of great importance to the user, it is recommended that the following selection process be included:

- Units should be subjected to moisture resistance tests to remove leakers.
- Wherever possible a "run-in" or aging process be included to remove initial parameter variations.

If these initial procedures are included circuit reliability should be greatly enhanced.

Variations in Collector Cut-Off Current

The variation of collector cut-off current, I_{co} was one of the parameters used in determining the reliability of the devices under investigation. Marked excursions in this parameter were noted during the initial portion of the reliability studies. The overall time involved in the worst situation was ninety-six hours, however, most of the units seemed to stabilize within the initial twenty-four hour period. The severity of these initial variations in the collector cut-off current were a function of the operating temperature, the higher the operating temperature the greater the initial variation.

In addition to the above observations on the collector cut-off current, radical failures were especially occurring when the units were voltage pulsed. The manufacturer's units which had a high rate of moisture resistance failure suffered heavy radical failures during voltage pulsing tests.

One final observation on the magnitude of the collector cut-off current is in order. Units with large values of I_{co} were subjected to the reliability tests. The radical failures noted in I_{co} did not appear to be a function of the magnitude of this parameter. For this paper a radical failure in I_{co} is defined as the unit changing by at least an order of magnitude.

Variations in Current Gain

Another parameter examined for the reliability studies was the dc common emitter current gain. Initial excursions in this parameter were also noted during the reliability studies. The severity of the excursions were a function of operating temperature, the higher the temperature the more initial degradation noted. In general degradation during the initial 24 to 48 hour period was noted. In two cases, however, it was found that the current gain increased initially.

In some units however it was noted that little or no initial variation occurred. This lack of variation is attributed to pretreatment by the manufacturer after encapsulation.

Thermal Characteristics

A power transistor reliability report is not complete without some data on their thermal characteristics. One important power device parameter is thermal resistance, which gives some indication of the ability of the device to rid itself of heat developed at the junction. The important consideration here is the variation in this parameter from one unit to another. Ten random samples were chosen for this determination.

It was found that some devices exhibit as much as 3.2 to 1 spread in this parameter. This spread is of importance if operating life tests are contemplated. In this situation variations in operating junction temperature may limit the usefulness of gathered data, especially under conditions of high power dissipation.

Overall Reliability

Concerning the overall reliability of power transistors two aspects of the problem must be considered:

- The radical failure of the device due to large increases in the collector cut-off current, I_{co} , or emitter cut-off current, I_{eo} .
- The failure of the device due to severe degradation in performance as a result of critical parameter changes.

Most of the radical failures were due to large increases in the I_{co} parameter because of moisture entry

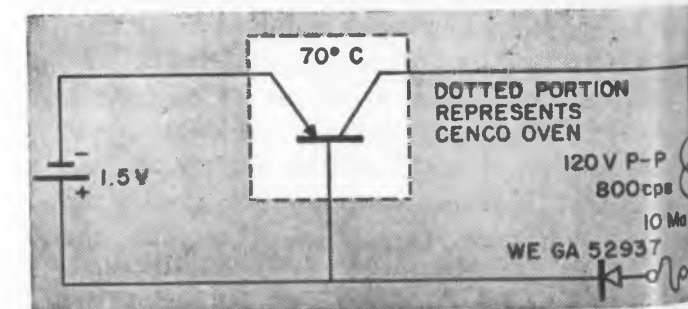


Fig. 1: Pulsing circuit for power transistors at 70 C ambient.

to the units. If the problem of sealing transistors is solved then it will be possible to eliminate failures resulting in this manner.

With respect to the degradation of critical device parameters such as current gain H_{fe} , and the transconductance G_m , it appears that these are sensitive to temperature only. The amount of degradation is a function of temperature with voltage and current effects not being noticed. At the present state of the art this is not considered a major problem because it appears that processing techniques have been mastered.

Mechanical & Environmental Reliability

Available units were subjected to the various mechanical and environmental tests outlined in the mechanical and environmental program of this report. On the basis of the tests performed it was found that the biggest problems in the power transistors evaluated seemed to be the failure of the units to meet the 10,000 g centrifuge requirement and the entry of moisture into the units during the moisture resistance tests. The latter situation can be a large contributor to transistor unreliability. It is apparent that the industry will have to concentrate heavily on this problem in order that units will not fail from this condition during operation.

Test Procedure

In most cases failures which occur in the mechanical and environmental tests are very readily discernable. The values of I_{co} and I_{eo} increase radically following moisture resistance tests if leaks are indicated. Open or short circuits are indicated following the mechanical tests if failures occur.

Three types of electrical reliability tests were performed. In general, six random samples were chosen for the storage and pulsing tests and five samples for the switching test. Initial measurements were made on all electrical parameters. Periodic measurements were made during the course of the reliability tests at the following intervals; 24, 96, 240 and 504 hours. All periodic measurements were made at room ambient and included; I_{co} at 6 and 60 volts, H_{fe} and G_m at 1.5 amp, I_{eo} at 28 v, V_{fl} at 60 v.

a. Measurements:

On the basis of available information, it was decided to approach this problem in the time allotted

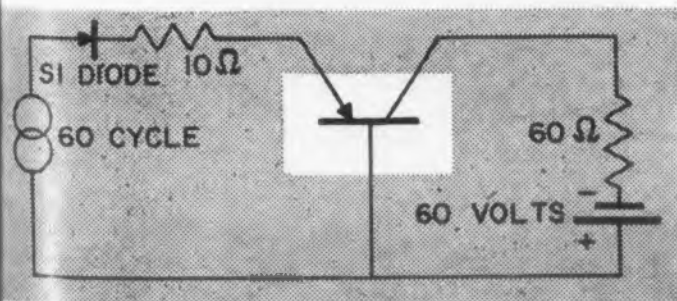


Fig. 2: Switching circuits for power transistors.

in the following manner. Certain electrical measurements were necessary to insure best operation in converter circuits. The following is a list of initial electrical measurements made on the units examined, slanted toward the application at hand.

1. I_{co} - The collector cut-off current at 6 and 60 v.
2. I_{eo} - The emitter cut-off current at 28 v.
3. V_{fl} - The emitter floating potential at a collector to base voltage of 60 v.
4. H_{fe} - The dc common emitter current gain measured at collector currents of 200 ma and 1.5 amp.
5. $G_m \frac{I_c}{V_{be}}$ - The dc transconductance at collector current of 1.5 amp.
6. V_{ce} - The collector to emitter saturation voltage at a collector current of 1.5 amp.
7. f_{ac} - The small signal alpha cut-off frequency.
8. θ - The thermal resistance between the junction and the stud or mounting surface.

b. Mechanical and Environmental program:

The second group of tests performed on the units were mechanical and environmental in nature.

These included:

1. Moisture Resistance - 10 cy (MIL-STD-202).
2. Temperature Non-Operating - 5 cy.
3. Centrifuge - 10,000 g.
4. Shock - 500 g.
5. Vibration fatigue.

The above tests were performed in accordance with standard Signal Corps specifications. No electrical measurements were performed during the course of the mechanical and environmental tests but the following parameters were monitored at the conclusion of these tests; I_{co} , I_{eo} , H_{fe} , G_m and V_{fl} .

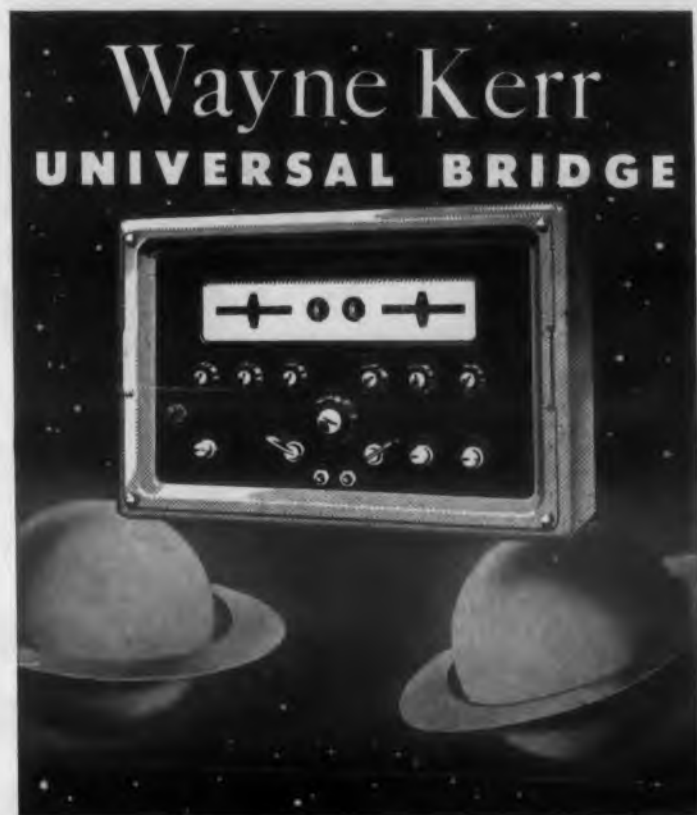
c. Reliability Tests:

In addition to the above electrical and mechanical and environmental tests, it was necessary to conduct various reliability studies. Certain tests were designed to extract the most useful information for the application at hand, these included:

1. An 85 C storage test to determine the effects of temperature on the devices.
2. Pulsing the collector diode of the transistor with 60 v, 800 cy half wave rectified sine waves, which is approximately the magnitude of voltage square wave in the collector diode of the device in the circuit exclusive of spikes. This was done with the emitter diode back biased at 1.5 v. During the course of this test the transistor was subjected to an ambient temperature of 70 C.
3. The units were switched between sixty v and one amp at room ambient on a 4 x 4 x 1/16 in. aluminum dissipator.

The purpose of the above tests was to determine the reliability of units under various conditions and to determine causes of failure, although further circuit work is necessary to bear out the conclusions reached in this article.

References: "Measurement of Thermal Resistance of Power Transistors," B. Reich, ELECTRONIC DESIGN, Dec. 1, 1956.



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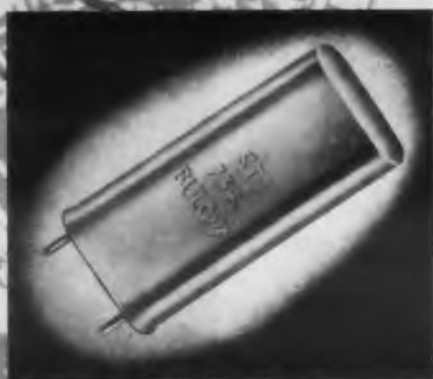
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High Power Silicon Rectifier

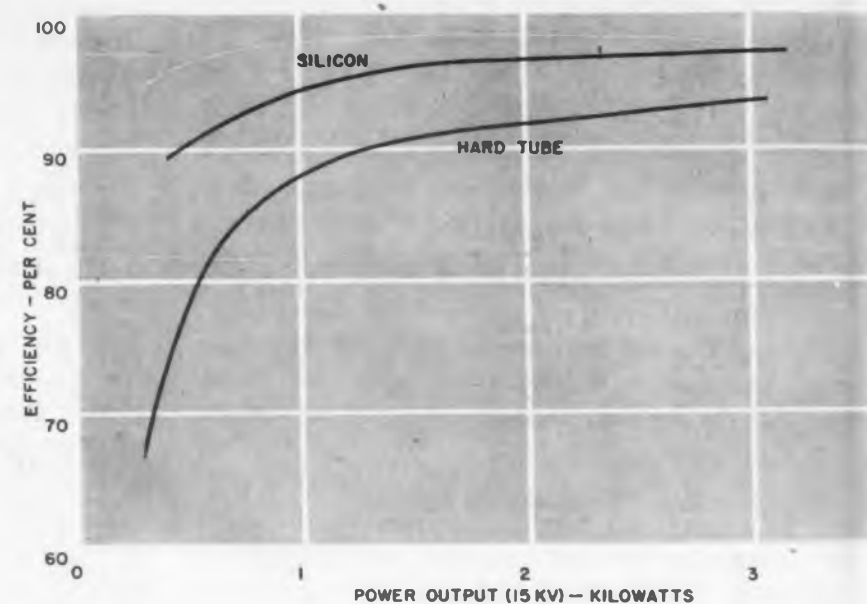


Fig. 1. Efficiency comparison — Silicon vs Hard tube (3B24) rectifier.

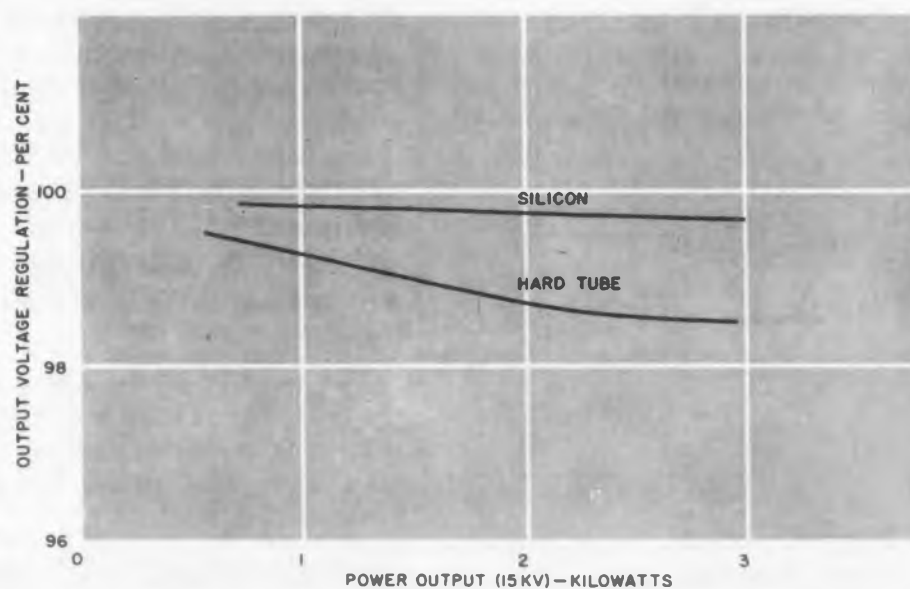


Fig. 2. Voltage regulation comparison — Silicon vs Hard tube rectifier.

Switch Ideas

REPLACEMENT of six hard tube rectifiers in a 3000 w, 15,000 v power supply by a single 3-phase full-wave bridge silicon rectifier unit has reduced circuit complexity and improved reliability, efficiency, and regulation. The silicon rectifier also eliminates the need for filament transformers.

The unit shown operates over a temperature range from -20 to $+85$ C and is connection-cooled. Maximum input is 11.4 kv, 3-phase ac, at 60 cps; and maximum peak inverse voltage at -50 C is 16 kv. Storage temperature is from -60 to $+85$ C. Designed for radar application but applicable to other purposes as well, the manufacturer is Bogue Electric Manufacturing Company, 52 Iowa Ave., Paterson 3, N.J.

The rectifier can be used in all applications where medium power is required such as for radio transmitters, radar transmitters, etc., and delivers 3000 w at 15,000 v dc (200 ma). The sealed unit measures 6 x 8-1/4 x 8-1/2 in. and occupies approximately 40 per cent of the space previously required by six 3B24 tubes and their associated filament transformers. Elimination of the filament transformers boosts efficiency.

The silicon rectifier has only about 40 per cent of the power losses of the tube rectifier, and this lightens the load on the cooling system which is a factor in compact electronic equipment. The minimum life of the rectifier is 10,000 hours with an expected life of approximately 2-1/2 times this value or more. This assures a lower maintenance cost.

The weight of this silicon high-voltage high-power rectifier is 11 lb—only about half that of the tube rectifier and components. The individual rectifier cells employed are hermetically sealed and then the entire unit is hermetically sealed in the case. To provide maximum cooling and insulation, the unit is filled with a suitable high-temperature silicone oil.

Although units of the type shown are available, other designs of similar configuration can be obtained on special order. Curves of efficiency and regulation are shown for the rectifier described.

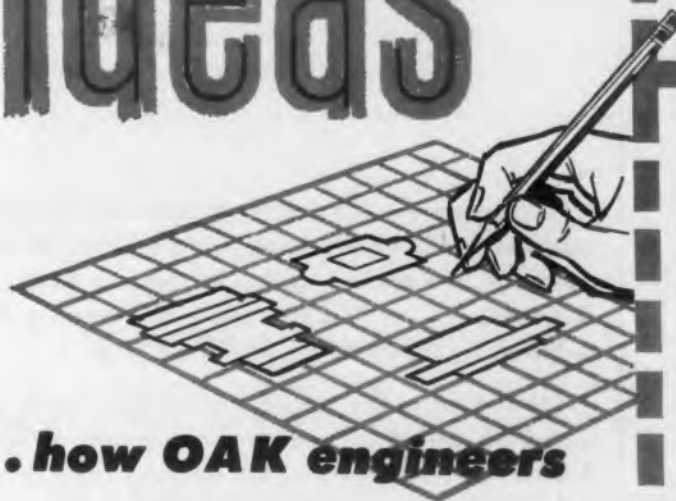
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CORONA discharge voltage regulator tubes are particularly suitable for stabilizing voltages of from 300 v to 30 kv, at currents up to a few ma, within a maximum tolerance of ± 1 per cent. Erratic starting conditions exhibited by corona regulator tubes of the past have been remedied by introducing a minute amount of a long-lived radioactive isotope. The isotope maintains the gas in a continuous state of ionization, and consequently shortens the region of unstable corona, which depends on the number of free electrons available per unit time. Another benefit derived from this development is to lower the starting voltage to some value below the regulated voltage. Characteristics and application notes for these tubes are discussed in this article.

Without the introduction of the radioisotope to sustain the ionization, the low-current end of the tube characteristic is extremely sensitive to voltage decrease, Fig. 2. A conventional tube operating at I_1 min would extinguish with a sudden decrease in voltage since the decreased voltage would be inadequate to sustain the self-maintaining corona. The voltage across the tube would then increase and approach in magnitude the supply voltage E_s . However, at some point V_s (starting voltage) the tube would fire again and would go back into regulation. This cycle could then repeat itself, if the frequency of the ripple or other transient voltage are of the right magnitude, and give rise to an oscillatory condition at this operating point.

Introduction of a long lived radioactive isotope provides a lower starting voltage V_s' . Tubes can then be rated for operation at lower values of current and will be insensitive to voltage fluctuations whose amplitudes are considerably below the regulated voltage. Too rapid a rise in voltage applied to the regulator tube may also result in the onset of relaxation oscillations. Electrode potential difference can increase at a rate approximately 4-5 v per millisecond for voltages in the vicinity of the ionization voltage specified for the tube type. This contrasts with a corresponding rating of the order of seconds for conventional corona tubes. Greater rates of increase may result in forcing the tube to operate in a mode capable of supporting relaxation oscillations.

Characteristic Curves

The curve shown in Fig. 3 is the volt-ampere characteristic of a typical corona regulator tube. Load line "A" applies to the circuit of Fig. 3. If the source voltage E_s is lowered to a value E_s' (but the internal resistance of the source remains constant), the operating point of the regulator moves from point A to point B with a corresponding change in regulated voltage from E_A to E_B . The more nearly the corona tube characteristic approaches the horizontal, the smaller will be the

Mr. Anton is President and Director of Research; M. Youdin is Vice-President and Ass't Director of Research.

Corona Discharge VR Tubes

Nicholas G. Anton and Myron Youdin

Subsidiary of U.S. Hoffman Machinery Corp.

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Background

Behavior of the gas discharge in a coaxial cylindrical structure is reviewed briefly here. Conduction through the gas occurs only when free electrons are present. When a potential is applied to the tube free electrons are collected at the anode. As the applied voltage increases a current will begin to flow. At first this current is so small as to be almost undetectable. The current increases with increasing voltage as free electrons are accelerated by the increasing field and collected as shown for the region AB. (Fig. 1)

The number of free electrons in the gas is fairly constant and unless a new mechanism of electron generation is introduced the current will remain constant with increasing voltage. This voltage-saturated range is shown by the region BC. Beyond this voltage value, the electrons are accelerated further and ionize other gas molecules by collision. Free electrons obtained by this collision process increase rapidly as they in turn are accelerated by the field and ionize new molecules. This cascade ionization process is called a Townsend avalanche and, is the result of the action of the electric field on an initial single free electron.

CD represents the region of externally initiated Townsend avalanches and is called the region of unstable corona. Further increases in applied voltage increase the number of avalanches. When the applied voltages are sufficient to generate a continuous flow of secondaries from the cathode we have reached the region DE. This region is characterized by a rapid increase in current for slight increases in voltage, and is the region of corona voltage regulator tube operation.

During the process of ionization by collision a number of low voltage photons are generated by incomplete excitation. These photons reach the cathode and release secondary electrons.

change in regulated output voltage for a prescribed change in input voltage.

Consider next the circuit of Fig. 4 in which a load resistor R_L has been added to the output of the regulated supply. This graph shows the load lines for the various values of R_L as its value is lowered progressively from an open circuit. The voltage across the parallel combination of regulator and load varies from E_A (operating point A) for R_L through lower and lower values reaching E_B when R_L has the smallest value assumed in Fig. 4. The intersection of the load line with the axis $I_R=0$ occurs at

$$E_s = \frac{R_L}{R + R_L}$$

when $R = R_L$ the intersection is at $E_s/2$. Thus it is seen that changes in load resistance or in source voltage produce comparatively small changes in regulated voltage as long as the regulator tube characteristic has

a small enough slope. Combined changes in load resistance and source voltage can be treated by combining the two constructions.

Dynamic Resistance

The dynamic resistance, r_b , of these tubes is defined as the slope of the curve (Fig. 3) at a special operating current and voltage. Symbolically,

$$r_b = \frac{(dE)}{(dI)_{BoIo}}$$

As can be seen from the curve of Fig. 3, this resistance in general varies over the operating range of the tube, the resistance tending to decrease as the operating current increases. A numerical value of dynamic resistance is required when computing the voltage change across the regulator tube as a result of the change in source voltage or as the result of change in load current. Its value can be computed

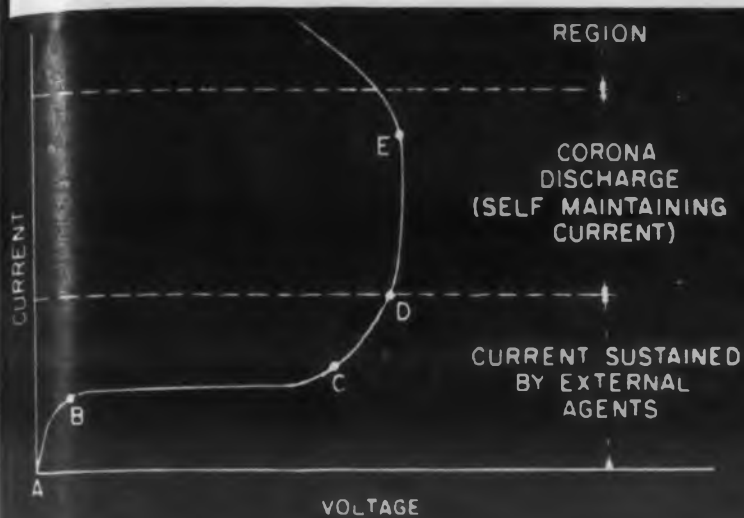


Fig. 1. Volt-ampere characteristic of a gaseous discharge.

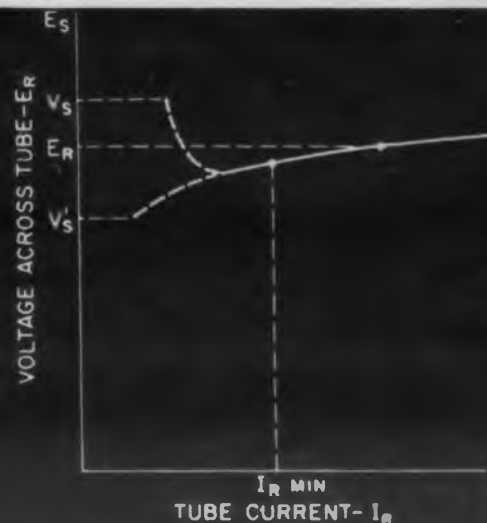


Fig. 2. Effect on starting voltage of adding minute trace of radioactive emitter into tube

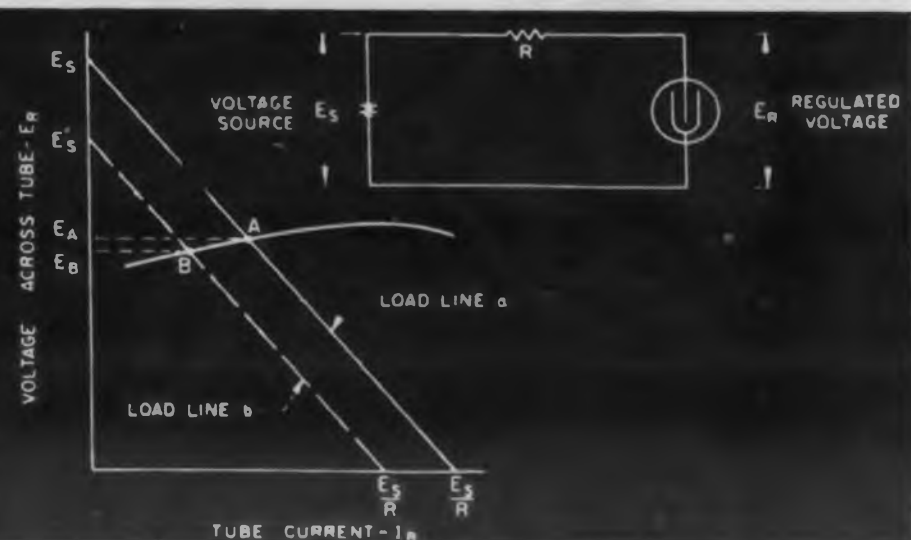


Fig. 3. Volt-ampere characteristic of typical corona regulator tube.

from the published regulation characteristic curves for any particular tube. To compute the change in regulator tube voltage $\Delta E_r = (E_A - E_B)$ in response to a change in source voltage (or a ripple voltage) $\Delta E_s = (E_s - E'_s)$ for the circuits of Fig. 3 and 4, the equivalent circuits of Fig. 5 are used.

$$\therefore \Delta E_r = \frac{r_b}{R + r_b} \Delta E_s$$

where R = internal resistance of the source plus external series resistance.

It is frequently of interest to determine the change in regulator tube voltage, when the resistance R_L (Fig. 5) is increased or decreased, resulting in a change ΔI , the current in the branch in which R_L is located. The effective resistance which faces R_L is equal to r_b parallel with R . For most practical applications R is much greater than r_b , so that this latter resistance is essentially r_b . Denoting the parallel combination of

r_b and R as r''_b then the change in regulator tube voltage for a load current change of ΔI amp is $\Delta E_r = r''_b \Delta I$.

Application Precautions

Fig. 6 emphasizes certain other precautions that must be observed in the application of corona voltage regulator tubes in order to avoid "oscillation" or instability of the regulated output voltage. In the figure, the characteristic beyond the point C is shown dashed. The downward slope of the curve has been exaggerated for illustrative purposes. Point C represents that point on the regulator characteristic at which the rate of change of regulator current with change of regulator tube voltage is infinite, corresponding to a dynamic resistance of zero. For proper operation it is necessary to limit the excursions of the operating point so that currents in excess of the value corresponding to that at point C are not obtained. Circuit conditions

must be established so that the combination of the open circuit voltage and the internal resistance facing the regulator tube do not produce a load line intersecting the regulator tube characteristic in the region where the dynamic resistance is negative (i.e., the portion of the characteristic beyond point C). If operation is permitted beyond point C , the regulator tube presents a negative dynamic resistance which can result in relaxation oscillations. The circuit designer will encounter no trouble as a result of this effect if the circuitry is designed to limit the regulator tube current to the maximum value specified for the particular tube type to be used.

The tubes utilize a cold cathode and hence require no filament or heater power. They can be mounted in any position and their life is unaffected by normal operation. Improved processing has extended their shelf life indefinitely. Maximum voltage regulation is in the order of 0.5 to 1.0 percent per 100 μ amp.

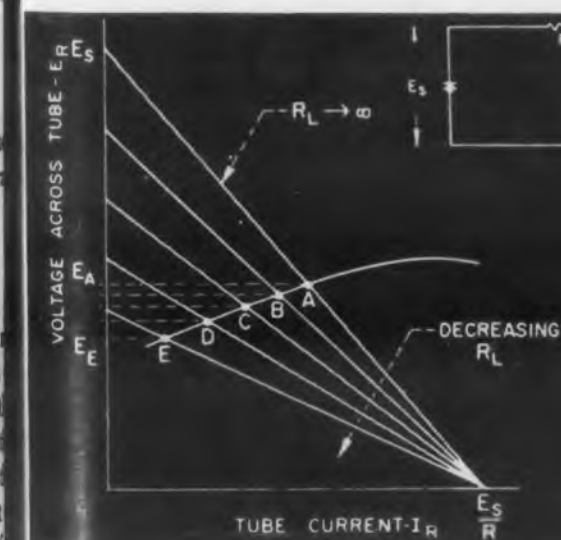


Fig. 4. Change in load line as R_L is decreased.

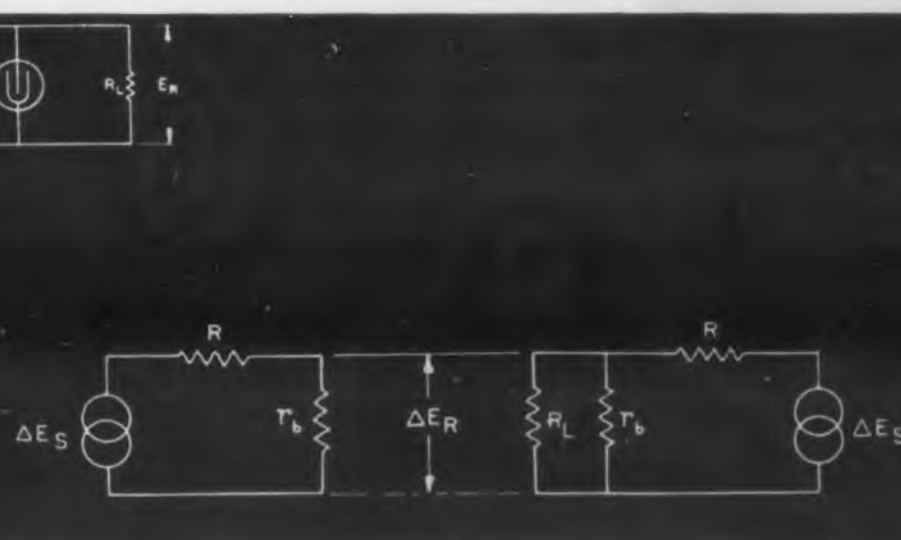


Fig. 5. Equivalent circuits for Figs. 3 and 4.

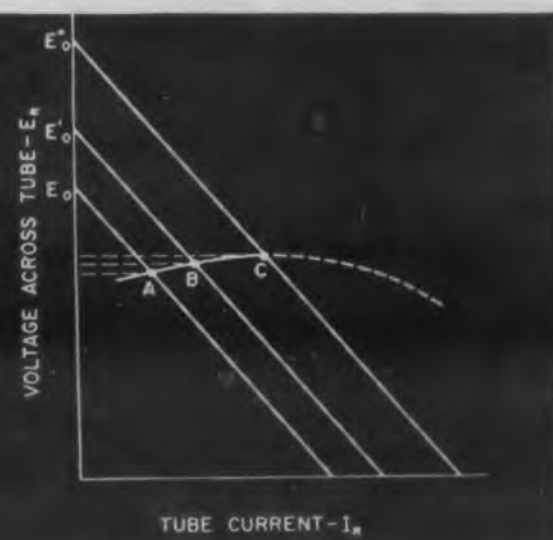


Fig. 6. Unusable region of characteristic curve (negative slope).

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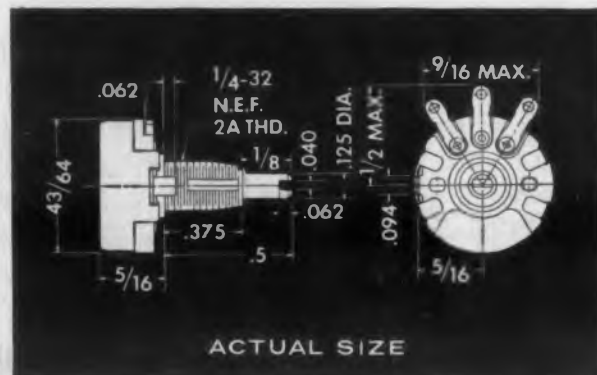
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CIRCLE 22 ON READER-SERVICE CARD FOR MORE INFORMATION



Fig. 1: Construction of typical elastic cable. This cable is for microphones.

Stretchable Cable

STRETCHABLE to more than twice its relaxed length, this unusual electrical cable features excellent shock absorption and interesting electrical characteristics. When the stretching force is removed it returns at once to its original length. This makes it ideal for applications where a long standard cable would be in the way, or where cable length must be temporarily extended.

Due to its construction, the Elasticable, made by the United Cable Div. of the Mutual Electronics Industries Corp., 85 Beechwood Ave., New Rochelle, N. Y., has exceptionally high current carrying capacity. The basic cable consists of a rubber

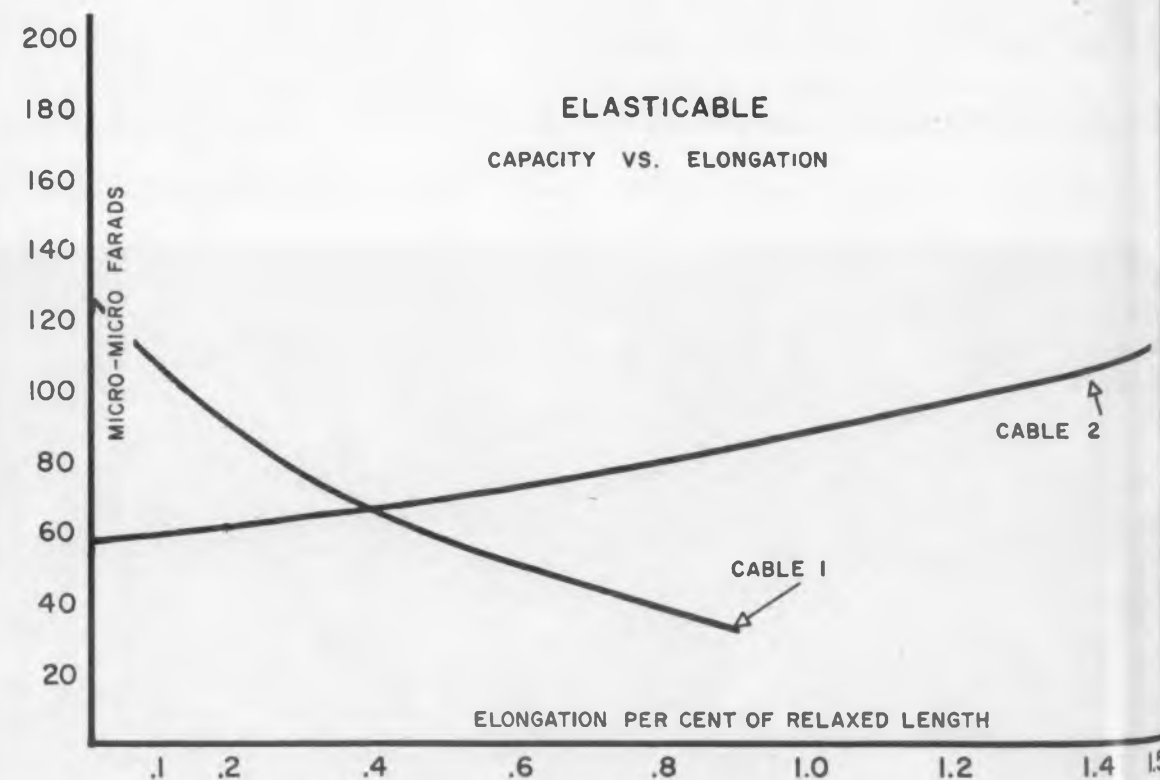


Fig. 2: Chart of capacity versus elongation for different cable constructions.

Cable

core surrounded by a copper braid and a rayon insulating cover. Two or more of these stretchable units can be combined into a cable with an overall cover of rayon or nylon, silicone rubber, copper shield braid or steel spiral shield. (Fig. 1).

A concentric stretchable cable has been developed which shows unusual electrical vibrations with stretch. Such a concentric conductor with an expansion factor of 250 to 300 per cent can have a variable resistance value. The resistance can vary inversely as the percentage of stretch, or it can be made to maintain its 'relaxed condition' resistance, irrespective of stretch.

An interesting characteristic of the cable is its capacitive tunability. With a certain concentric construction, the inter-conductor capacitance can be made to vary directly as the extension (cable 1 in Fig. 2). The capacitance can also be made to vary inversely as the amount of stretch (cable 2 in Fig. 2) by special construction. Obviously it is possible to obtain a constant capacitive value irrespective of stretch between these two limits.

Holding resistance and capacitance constant suggests an inductive tuner for the upper frequency ranges. Inductive tuning can be arranged by a combination of helically wound or braided conductor strands. By careful choice of such technique, magneto-static charges can be avoided.

Shock and vibration transmission was found to be considerably less with the Elasticable than with harnesses made of rigid or stiff cable. This resistance to oscillation and vibration absorption can give protection to delicate electronic instruments. The cable is made in sizes required for the electrical equipment to which it would be adapted. It comes in many kinds of fittings, clips, jacks, or spade terminals.

For more information about this stretchable cable fill out Reader's Service Card and circle 24. See this product at the IRE Show, Booth 3313.



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U. L. 105°C GRADE.* For continuous operation at 105°C with good resistance to oils and chemicals. Met by Resinite Hi Heat 105.

Resinite Super Heat 125* is far superior to normal grades of 105°C sleeving. Exceptional resistance to cut-through, oil, varnish, pitch. High dielectric strength. Operating range is from -42°C to 125°C .

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Optimizing Airborne Electronic Equipment

Sherman Hubelbank

The Air Force's new general specifications for the design of airborne electronic equipment, MIL-E-25647, dated September, 1956 is currently being distributed. The primary objective of this spec is to obtain an optimum over-all system or equipment design which shall provide the function and performance as specified in the detail requirements. The spec recognizes that many of the factors which influence the choice of a design are not necessarily of a technical performance nature, and the importance of such factors should be considered on an equal basis with the straightforward technical factors. We are presenting the highlights of the spec here. The philosophy is applicable to all design—not necessarily Air Force equipment.

In designing airborne electronic equipment broad, over-all design thinking should take place during the experimental and developmental phase—not after a first prototype is built. Equipment design should embody the current state of the art, as necessary.

First, determination of all essential requirements must be made. Then, the extent and manner in which all essential requirements can be satisfied. The third step is to determine the important limitations and opposing factors involved. Fourth is to evaluate all factors and establish their relative order of importance. Fifth is to determine the compromises necessary on the basis that factors of lesser importance must yield to factors of greater importance. Lastly, to test the practical results and apply suitable corrections where necessary.

Many of the factors which influence the choice of design are not necessarily of an electronic or engineering nature, yet the importance of these factors is such that they should be considered on an equal basis with the straightforward technical factors.

Major policy, reliability, vehicle compatibility, operation and maintenance suitability, economy and manufacturability are some of the major design factors which must be considered.

Major policy factors cover such things as: prior commitments or agreements with other Government services; emergency conditions; scheduling; volume availability and standardization; cost limitations; availability of strategic and critical materials; and enemy vulnerability.

Reliability

The scope of reliability as a design factor includes: equipment performance; hazards to safety; dependable materials and components; and faults in basic design. The reliability requirements are such that the equipment must perform its intended function throughout its required life with certainty, thoroughness, uniformity and endurance. Adequate provisions should be made to provide against hazards from such sources as unprotected lethal high voltages, very toxic gasses or liquids, high pressure and explosion vulnerability. Reasonable protection should be made against moderate hazards.

Materials and components should be chosen based on long-term proven reliability. Materials and components should be derated. Abnormal voltages, cur-

rents, over-heating, and other abnormal conditions that might reasonably be expected to occur during testing, tuneup, adjustment and switching of controls should be considered in the design and rating of components.

Vehicle Compatibility

The design factor of vehicle compatibility includes the installation aspects such as the number of assemblies, form factor, size, weight, location, cooling, power requirements, mounting, interconnection, protection and interference. Care should be taken that the design and other installation requirements are accomplished in a manner that is an optimum compromise in the overall installation.

Size and Weight

The achievement of the smallest size and the lightest weight, consistent with other design requirements, is accomplished by design techniques and the selection of parts and components having a small physical size. Weight-saving materials, such as aluminum, magnesium and titanium, should be employed to the greatest practical extent. Use "rigidized" sheet-metal construction in lieu of depending upon the thickness of the materials only. Employ form-fitting cases for components which are liquid or solid filled, instead of filling unnecessary voids with such materials.

Employ parts and components which are designed and rated for operation at high temperatures. Inefficient use of electrical power, cooling, etc. results in the equivalent of increased weight burden in the overall installation.

Operation and Maintenance Suitability

The importance of simplicity and ease of operations by the using armed services cannot be over-emphasized. Since it is necessary to utilize personnel with the barest minimum of technical training and technical skills, the system or equipment design, test equipment and procedures should be compatible with this situation. The requirements for "engineering level" and "special trained" personnel should be held to an absolute minimum. Preflight tests and inspections, equipment adjustments and replacements of assemblies should be able to be accomplished by nontechnical type personnel with not more than three months of technical training. Special test circuits built into the equipment, of the go-no-go type, should be used where possible. Circuit test points and connectors to facilitate preflight testing and sufficient analysis to determine faulty assemblies should be used as far as practicable.

In order to facilitate rapid repair, equipment should be designed and constructed of suitable and quickly replaceable major and subassemblies. The equipment should also be designed so that no special maintenance is required because of storage degradation.

Provision should be made to provide each major assembly and subassembly with easy and ready access to its interior parts without removing wires, cables or parts.

Economy

The designer should select the least costly system which will adequately accomplish the function intended. Severe costs for special items for the achievements of minor gains which are not required to meet important requirements should not be acceptable in the final design.

Manufacturability

The equipment should employ design techniques and methods which are compatible with the potential quantity and the desired rate of production on a war time basis. Every effort should be made to avoid the use of special or unique processes which are non-standard or are not recognized commercially. In particular, methods which are not readily adaptable to quantity production at reasonable cost should not be used. However, the employment of such techniques as printed circuits and encapsulation to effect adequate reliability is justifiable.

The design should be predicated upon the use of standard JAN components wherever possible.

Insofar as possible, the complexity and cost of tooling and production facilities should be compatible with the complexity of the equipment and the scale and rate of manufacture.

Copies of MIL-E-25647, General Specification for the Design of Airborne Electronic Equipment, may be obtained from the Commander, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, Attn: WCXP.

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a new Sylvania Standard Line of Long Life Power Transformers

Brought about by the request of a national research laboratory taking a prominent part in the National Defense Program, Sylvania is now making available a line of transformers with the following user benefits:

- (1) Ability to apply to multi-purposes (80% of the electronic power circuitry done today can be handled with the 34 types offered by Sylvania).
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- Transistor Circuitry • Amplifiers
- Test Equipment • Computers

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SPECIFICATIONS

*DuPont's trademark for polyester film.

INSULATION RESISTANCE: See curve reproduced below for typical performance

LEAD PULL TEST: Steady force of 10 lbs. applied axially for 60 seconds.

LIFE TEST: 250 hours at 85°C and 125% of rated voltage

DIELECTRIC STRENGTH: 2 times rated voltage

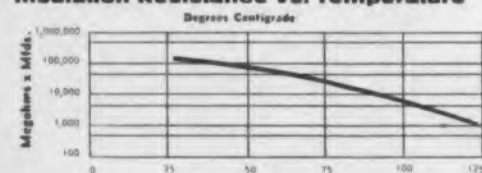
HUMIDITY RESISTANCE: Far exceeds requirements of RETMA Spec. REC-118-A

TEMPERATURE RANGE: Operation at rated voltage from -60°C to +85°C and to +125°C with 50% derating.

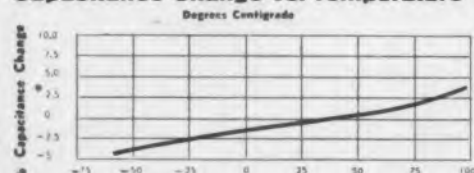
TYPICAL SIZES

Capacity	100 Volts	200 Volts	400 Volts
.001	.156 x 1/2	.156 x 1/2	.156 x 5/8
.0047	.156 x 1/2	.156 x 1/2	.186 x 5/8
.01	.156 x 1/2	.171 x 5/8	.250 x 5/8
.047	.234 x 3/4	.296 x 3/4	.343 x 7/8
.1	.281 x 7/8	.375 x 7/8	.421 x 1
.47	.468 x 1 1/4	.546 x 1 1/4	.671 x 1 5/8

Insulation Resistance vs. Temperature



Capacitance Change vs. Temperature



Our engineers are ready to work with you on special applications. Write or wire for specifications and quotations.

Fire-and-Overheat

USING newly-developed inorganic salts as temperature-sensing elements, this continuous fire and-overheat detector system is not susceptible to "averaging" and can be used in relatively high ambient temperatures. It is designed to resist vibration and shock in aircraft applications; contains no tubes, transistors, relays or other moving parts.

The system, manufactured by Fenwal Inc., Ashland, Mass., consists of a detector element and a control unit. The detector element is a length of 0.088 in. in diam. Inconel tube coaxial with a nickel wire center conductor. The volume between the conductors of the detector is filled with an inorganic salt whose electrical resistance decreases sharply at a discrete temperature. The outer conductor of the tube is grounded at several points along the line by connectors of various physical configurations. A hermetically sealed magnetic amplifier functions as the control unit. Weighing 9-1/2 oz and measuring 4 in. in length and 2 in. in diam. this unit is constructed without relays or mechanical switches.

In operation, a low voltage ac is fed through the detector. When an overtemperature condition occurs, the resistance of the insulating material decreases and the current change is registered by the control unit, which activates an alarm. The inorganic salts used in the insulating material have a sharper temperature-resistance response than thermistor-type materials, and, at the operating point, are not subject to "averaging." Resistance varies negligibly with exposure length as shown by the curves.

Designed to avoid false alarms, this system will not give a false indication if there is a single open or ground in the external wiring of the detector, or if the detector unit is broken at one point, and will continue to operate. The low (25 ohms) impedance of the system lowers its susceptibility to



Fig. 1. Mockup of detector loop shows control unit, detector elements, three types of connectors and mounting clamp.

CIRCLE 26 ON READER-SERVICE CARD FOR MORE INFORMATION

Detectors

moisture, and the mounting clamps are designed to meet vibration requirements even when left open—a margin of safety for mechanic's error. Segments of detector loops having different response temperatures may be connected together, using the same control unit.

The system is repeatable; no temperature change or sort of destruction will alter the electrical characteristics of the insulator material. Detectors can be produced for operation at any temperature between 350 and 1200 F.

For more information on this overheat detector, fill out the Reader's Service Card and Circle 27.

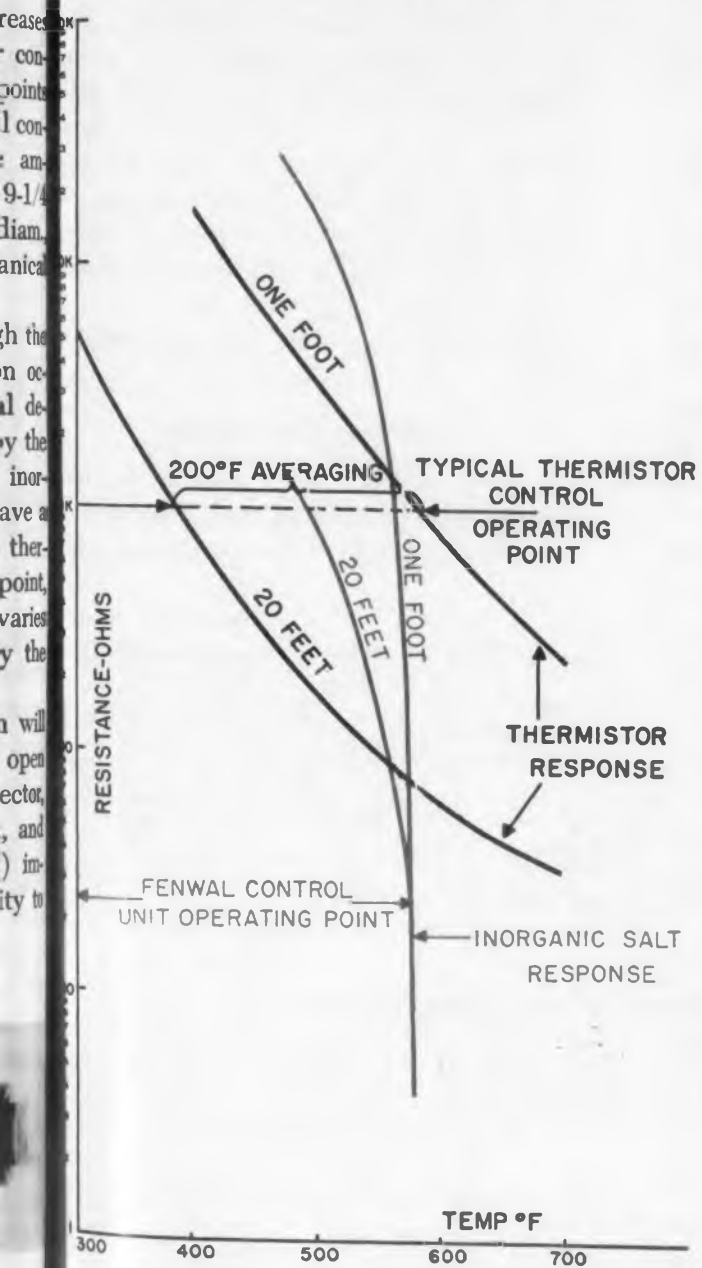


Fig. 2. Resistance vs temperature response of Fenwal inorganic salts compared with that of typical thermistor materials.



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Honeywell Aero's MIG (Miniature Integrating Gyroscope). Weight: 0.5 lbs. Size: 1.75 inches in diameter. Performance: equal to gyroscopes 3 times larger. Just one of more than 70 new Honeywell Aero products put into production during the past year.

Design
Forum

Fast Digital Printer with Analog Output

PRINTING eleven-digit lines at the rate of five lines per second, this freshly-designed recorder produces a simultaneous analog output which can be fed into a separate graphic recorder. Intended for use with electronic decade counters, the printing rate of the recorder is controlled by the display and gate times of the counter.

Basically the Hewlett-Packard 560A Digital Recorder consists of a motor driven printing mechanism, eleven number wheels, an inked ribbon and paper. Eleven identical mixers and comparative circuits position the number wheels according to the count appearing on the associated electronic counter. Each number wheel and comparative circuit in the printer is connected to its corresponding decade in the counter, so that each wheel is positioned independently. This makes possible a total position-

ing and printing cycle of about 200 milliseconds, of which 160 milliseconds is the scan time to position the wheels.

While the counter is counting, the number wheels are locked in position and the recorder is effectively disabled. At the end of the counting period each decade commutator rests on a particular step of the staircase voltage, corresponding to the digit displayed. Each of these decade voltages is sent to the recorder over a multi-conductor cable. At the end of the count period, a print command pulse is sent from the counter, initiating the printer's scanning cycle.

Staircase Comparison

As each wheel rotates during the scanning cycle, it brushes against a printed circuit commutator producing a staircase voltage.

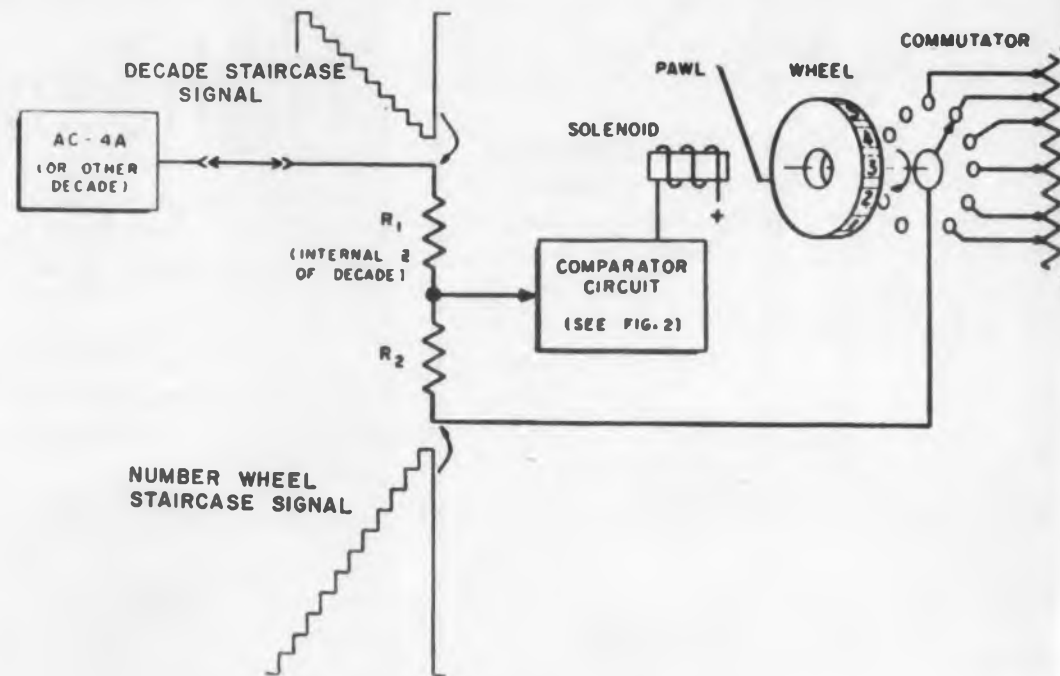
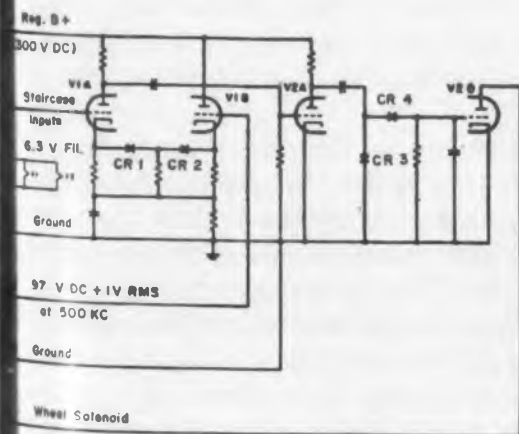


Fig. 1: Wheel positioning diagram. The number wheel is frictionally connected to a rotating shaft.



similar to that from a decade counter, each step corresponding to a position of the number wheel. This staircase voltage is sent to the resistive mixer in the comparator circuit along with the staircase voltage level in the corresponding decade in the counter. The commutator staircase voltage is inverted with respect to that of the decade, and is considerably larger. The two stages are combined in a resistance mixer (and R_2 in Fig. 1) so that a sum of about 97 volts occurs when the decade and printer wheels match coincidence). At coincidence the comparator circuit becomes de-energized and a solenoid locks the number wheel in place. In a non-coincident condition the sum voltage will be either less or more than 97 volts and the wheel will be unlocked for repositioning. All the wheels are friction connected to one rotating shaft.



SCHEMATIC DIAGRAM OF COMPARATOR CIRCUIT

Fig. 2: Schematic of comparator circuit. V1 is a balanced comparator tube and V2 is an amplifier connected to the wheel solenoid.

The unlocking of the wheels are accomplished by eleven plug-in comparator units, one of which is shown in Fig. 2. It consists of a balanced comparator tube (V1) and an amplifier (V2). The comparator is a cathode-coupled twin-triode with one grid connected to a 97 v d-c reference on which is superimposed an ac voltage of about 1 at 500 kc. When the voltage from the resistive mixer network connected to the opposite grid is also 97 v (coincidence) both triode sections conduct and the 500 kc signal appears in the plate circuit of V1A. This ac signal is amplified by V2A and rectified by diodes CR3 and CR4 to produce a high negative grid bias that cuts off V2B. Cutting off V2B prevents current from flowing through the solenoid in its plate circuit and thus holds the number wheel locked.

During non-coincidence, the sum of the staircase voltages will differ from the 97 v d-c reference. In this case one of the diodes CR1 and CR2 will not conduct and the 500 kc signal will not appear in the plate circuit of V1A. V2B will return to zero bias, plate current will flow, and the locking pawl will be withdrawn so the wheel can rotate.

Analog Output

Since the wheels do not move during identical successive readings, they act as memory or storage devices, and permit the recorder to function in many analog applications.

A particular analog output network will combine the voltage outputs of from any three consecutive digits into a 1000 step staircase. This is achieved by the resistance mixing of three wheel staircase voltages in the proportions of 90, 9, and 0.9 per cent. The resistors in the commutator voltage divider network are wound to 1/10 per cent relative accuracy to insure a linear voltage representation and allow a full-scale accuracy of a fraction of a percent on a suitable recorder.

In practice the ability to plot from any three consecutive digits results in much greater accuracy when used on an expanded scale basis. The plot of the last three digits of a varying six-place counter reading may actually be accurate to within a few parts per million as far as the total measurements are concerned. This type of expanded scale recording has the added advantage that it never goes off scale.

For more information about this product, turn to the Reader's Service Card and circle 31.

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Dearborn engineering delivers other benefits, too . . . greatest range of values, smallest size. Sizes like these, for example, one end insulated:

.018 mfd 200 WVDC, .174" OD x $\frac{1}{8}$ " long
.047 mfd 200 WVDC, .235" OD x $\frac{1}{8}$ " long
10.0 mfd 200 WVDC, 1" OD x $2\frac{1}{4}$ " long

- Operating temperature range -65°C to $+125^{\circ}\text{C}$
- 50,000 megohm-mfds at 25°C
- Low RF impedance and higher self resonant frequencies not previously available in similar design
- Furnished in hermetically sealed tinned brass cases, glass to metal seals, bath tub or rectangular cases, single or multiple sections

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CHICAGO 4, ILLINOIS

ASK FOR ENGINEERING BULLETIN DC-15

OPERATING EXCLUSIVELY UNDER MIL Q5423B

CIRCLE 30 ON READER-SERVICE CARD FOR MORE INFORMATION

Aeronautical Electronics Problems

Problems and trends in airborne electronics were brought up in recent annual meeting of the Institute of the Aeronautical Sciences. Reported here are topics of interest to electronic design engineers.

Component Developments for Aviation Electronics

Temperature, altitude, and acceleration encountered in high performance aircraft pose new problems. As the performance of the aircraft increases, the temperatures to which the skin of the air frame is subjected increases very rapidly. The operational temperature range of many electronic components must be extended to keep cooling demands reasonable. The problem of hook-up wire to withstand these temperatures must be solved. High temperature silicone resins and ceramic coatings for wire insulation at these very high temperatures are a step. In addition, the potting material of transformers must be capable of withstanding these very high temperatures.

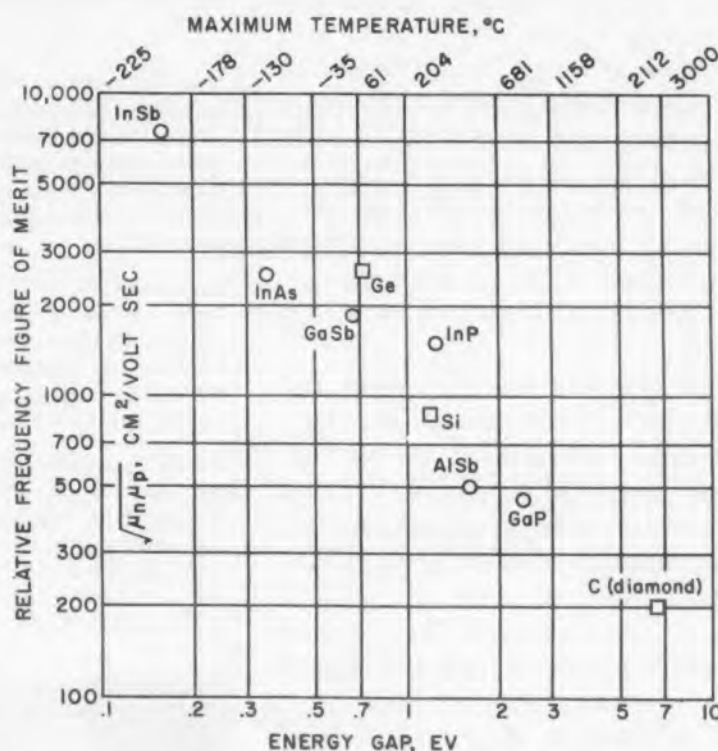
Work is being done on high dielectric ceramics for capacitors and ceramic vacuum tubes, but more must be accomplished. In place of the few specialized ceramic tubes withstanding temperatures up to 500 C that have been announced, a whole family must be designed and put into production. Capacitor ratings must be extended. All this implies ceramic or other inorganic materials must be developed which are capable of withstanding these temperatures with thicknesses of the order of one ten-thousandth of an inch.

Transistors

While silicon transistors approaching 200 C are available today, this is not enough. Different materials which show promise of operation at high temperatures are being studied. There are semiconductor materials capable of operating at high temperatures. A few are

silicon carbide (1300 C), gallium phosphide (870 C), and aluminum antimonide (500 C). However, the forbidden band gap rises for the higher temperature materials and the intrinsic carriers are much less. In choosing a material, frequency performance must also be considered.

The relative frequency figure of merit as a function of temperature and band gap of the semiconductor in question is illustrated. This figure of merit is represented by the geometric mean of the electron and hole mobilities, μ_n and μ_p , respectively. The maximum frequency of oscillation of a transistor of given geometry and construction is directly proportional to $\sqrt{\mu_n \mu_p}$.



a) Relative frequency figure of merit and energy gap of various semiconductors.

It can be seen that a variety of materials may be chosen for operation up to 800 C. Examples are zinc telluride, cadmium sulphide and gallium phosphide. Materials for high temperature operation may present problems over and above those simply due to the semiconducting properties. For example, compounds may have volatile components, and operation at 500 C may involve a gradual deterioration of the compound by the loss of its most volatile component.

Furthermore, surface stability has still not been brought under sufficient control to allow higher temperature operation. Therefore, at temperatures such as 500 C, the greatest hurdle to be overcome will undoubtedly prove to be that of surface stability, and hence transistor reliability.

Photoconductive Infrared Radiation Detectors

The solution to the problem of detecting high temperatures of high speed aircraft surfaces should be possible with photoconductive detectors. These detectors may be designed to have the proper wavelength of maximum sensitivity as well as the desired frequency response for the particular application involved.

Photoconductivity by the photon excitation of electron pairs is limited by the fact the holes are also generated thermally within the bulk of the material. To minimize this trouble, semiconductive photoconductors must be made in extremely thin sections. The thickness should be such that most of the radiation is absorbed within the thickness of the material. This involves materials of about one micron to a few microns thick. It is in this thickness range that the film-type photoconductive detectors must be made.

Impurity excitation may be used in order to avoid the difficulties associated with the fabrication of film-type devices. The semiconductor material can be doped with a specifically-added impurity having

ry low energy of excitation. By cooling the material a temperature where most of these impurities are excited, radiation of sufficient energy will cause purity photoconductivity.

Ferrite Materials and Devices

In the ferrite field, perhaps most interesting to airborne electronics people are the properties of ferrites when used in the vicinity of their ferromagnetic resonance. At frequencies above 500 to 1000 mc it is possible to take advantage of the gyromagnetic effect—the Faraday effect—to make nonreciprocal circuit elements. Applications include circulators (with the possibility of eliminating ATR or TR tubes in radar) and isolators.

The properties of the ferrite at values of dc (or low-frequency ac) magnetic field below saturation is responsible for another class of device, the phase shifter. This device, which can be made reciprocal, offers the possibility of either amplitude or phase (frequency) modulation of a fixed CW wave.

The possibility of using ferrite elements in antenna systems to get electrically, rather than mechanically, steered beams is being considered and is typical of many circuit designs not previously possible.

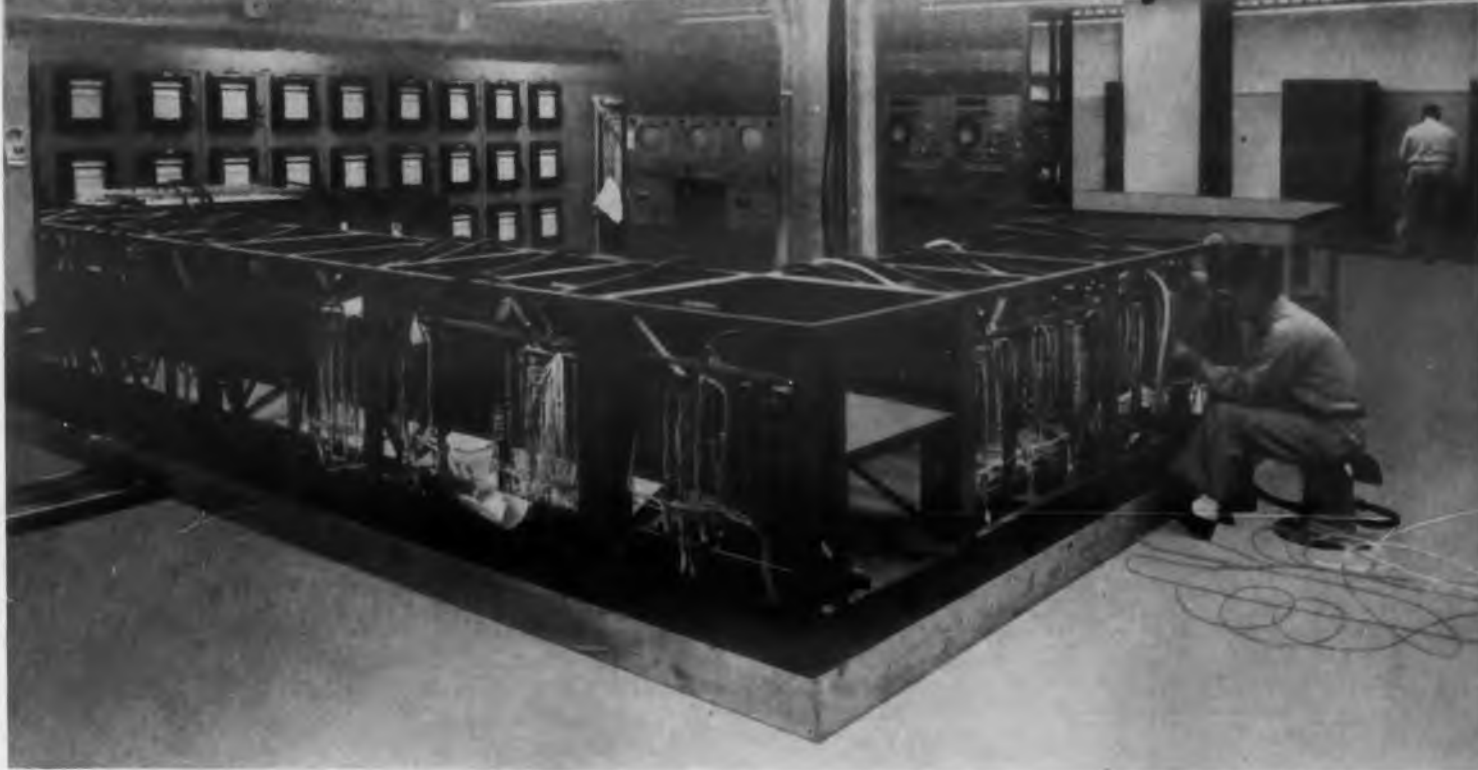
In many of the ferrite materials in use today, maximum operational temperatures of the order of 300 C are the rule. This limitation is set by the Curie temperature of the ferrite, the temperature at which the material loses all its ferromagnetic properties. New families of ferrites, such as the nickel ferrites, with Curie temperatures close to 600 C are being investigated. They may not be inferior in their electrical and magnetic properties to their low-temperature counterparts. *These developments were reported by Luther Lewis, Jr. and Lawrence G. Rubin, Raytheon Mfg. Co.*

Antenna System Problems

High speed aircraft require flush antenna installations. Flush antenna installations force the structural and electronic designers to cooperate in the antenna system design. Approximately 15 separate antenna systems are required on modern commercial aircraft and as many as 35 antenna systems on large military aircraft. Two are treated here: one in the high frequency band and the other in the super high frequency band.

The high frequency antenna system is used for long range communication of several hundred to several thousand miles. Transmitter powers up to 100 kw and frequencies from 2 to 36 mc/s are used. Since the aircraft is less than 1/2 wavelength long at 2 mc, the antenna problem is one of exciting currents on the entire airplane which then acts as the radiating structure. This has been done externally by the installation of a long wire antenna or a short probe installed from a wing or tail with its axis parallel to the line of flight (see illustration). Another means of exciting the airframe is an isolated tail cap antenna which provides a flush in-

Reliable Cable Systems Engineered to Provide Tomorrow's Answers Today



Pacific Automation Products' systems engineering service, based on broad missile, aircraft, radiation, communication, computer and allied electronic experience, is available to assist you in your military and commercial projects.

This comprehensive service integrates and coordinates the cabling responsibility for a system in one facility.

PROGRESSIVE STEPS TO RELIABLE CABLING SYSTEMS

- ANALYZE** overall system
- PROPOSE** engineering concept of cable requirements conceived by the following criteria: combining circuits; minimizing total number of cables; establishing re-usable standard types
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- CHECK-OUT** the cable system to guarantee compatibility of cable installation with the overall function of the system
- DOCUMENT** the complete cable system, including drawings, broken down into components covering consideration to segregation of elements that may be used as building blocks for future addition to the system

Reliability is the product of this comprehensive systems engineering service . . . achieved only through the thoroughness of the above procedure. For additional information regarding Pacific Automation Products' systems engineering service, write for Bulletin 156.

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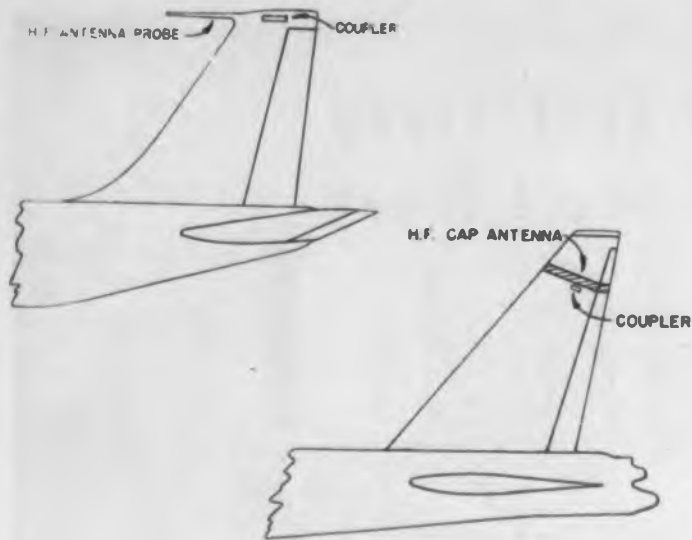
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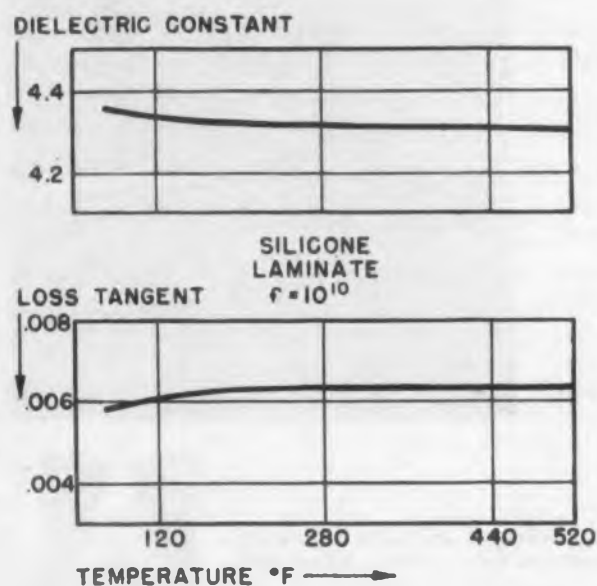
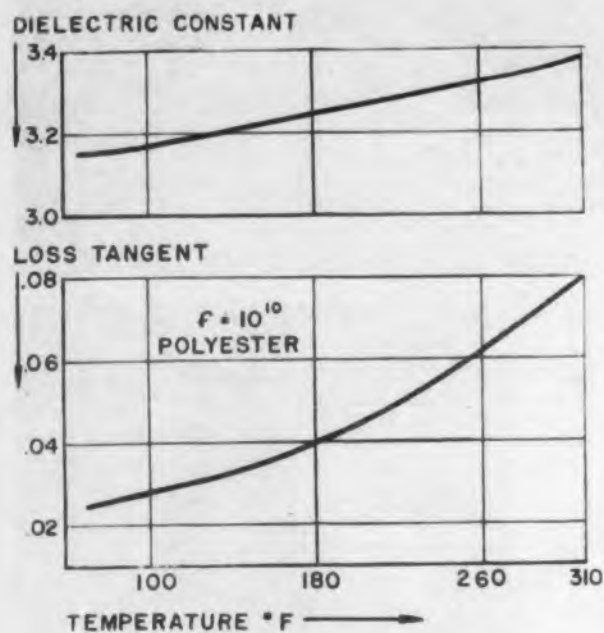
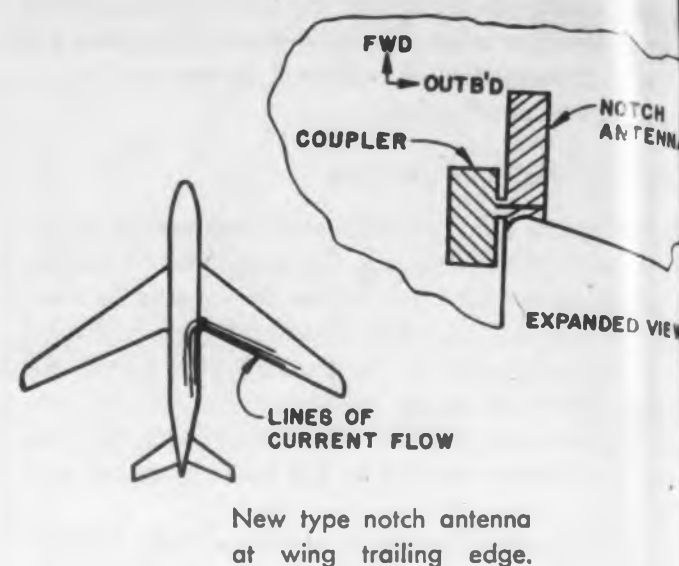
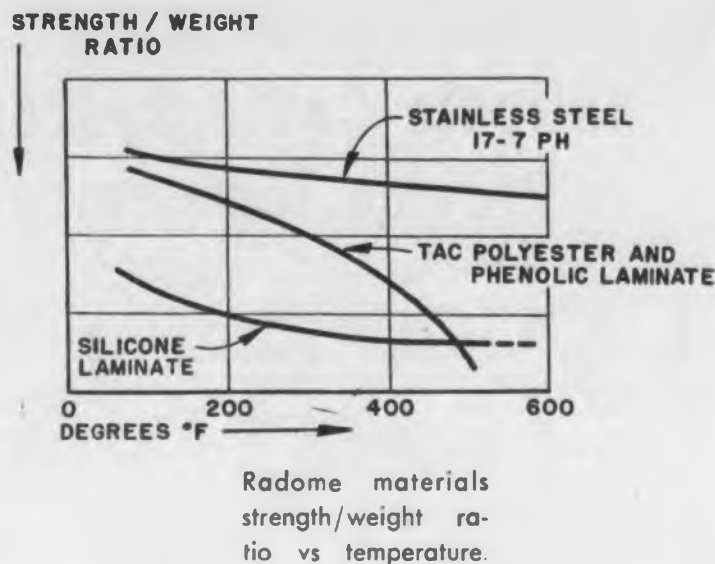
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CIRCLE 32 ON READER-SERVICE CARD FOR MORE INFORMATION



HF antenna probe and cap antennas on vertical stabilizer.



Dielectric constant and loss tangent vs temperature for two materials.

stallation using the same voltage feed technique that the probe uses (see illustration). Impedances are matched by an automatic coupler which resonates the capacitive reactance of the high Q antenna with a high Q coil.

The shf antenna system discussed here is part of a radar for navigation. The reflector is installed within the aircraft in a recess behind a dielectric radome which maintains the aircraft contour and withstands the aerodynamic forces of flight. Radar trends are directed toward increasingly narrow, high resolution beams. Increasingly larger apertures with smaller angular refractions of the beam by the radome are required.

Temperature increase due to high speed will have the greatest influence on antenna system problems. Increasing temperature will seriously weaken the structural properties of many of the dielectrics presently used in antenna and radome construction. In addition, the electrical properties of some insulating materials such as dielectric constant and loss factor, also change with increasing temperatures in many cases (see illustrations).

HF Antenna

In the case of the hf communications system the best present antennas, the isolated cap and the probe, require that laminates be structurally sound. Dielectrics must be found that are suitable by both structural and electrical standards.

Another temperature problem is the requirement for cooling the automatic impedance matching hf antenna coupler. Miniature couplers should be designed.

The antenna designer should continue to seek improved means of exciting the aircraft as an an-

tenna. A promising new approach is that of the notch antenna. A notch similar to that shown is used to couple currents in the edge of the wing. Advantages of this type antenna are its nonstructural configuration and the low voltages developed across it. Disadvantages are the difficulty of efficiently transferring power into its very low R and X_L load. This is a problem on which the electronics engineer could make a significant effort.

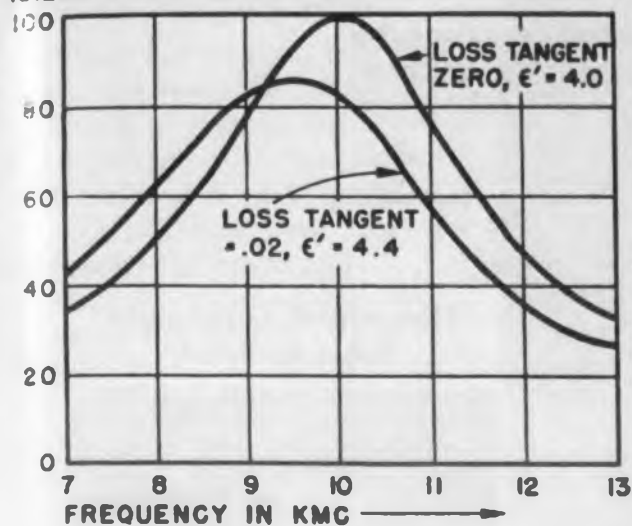
SHF Antenna

Shf or radar antenna system problems, brought on by the temperatures of high speed flight, involve changes in dielectric constant and loss factor as well as the reduced structural strength, primarily in the radome. If the dielectric constant changes 10 per cent due to the increased temperature of high speed flight, the transmission efficiency at the peak drops to 85 per cent. A change in dielectric constant causes the electrical thickness of the radome to change which may also produce angular bearing errors.

Distortion of the antenna reflector reduces the obtainable resolution by increasing the beamwidth and generating side lobes.

Work must be done toward the development of new, higher strength radome materials. This might be done by integrating metal into the radome itself in a fashion similar to concrete reinforcing. The antenna designer can attack these problems by development of antennas which do not need large dielectric radomes. For instance, arrays of small phased slots may provide equivalent radiation with much smaller dielectric radome units covering each slot. Electrical people could also devise means for detecting incipient physical failures in radome

POWER TRANSMISSION EFFICIENCY



Effect of electrical property change in radome material.

structures which could assure that a radome was in perfect condition before the initiation of a long flight. These problems were posed by F. W. Bushman, Boeing Airplane Co.

Common System Standards

In a plea for common systems standards, Howard Morgan, Bendix Aviation Corp., asked for the abolishment of the black box. Four parts of the air traffic control subsystem requiring standardizing include: *Flight Plans* Here an important standard is the method of naming the route and the altitude. *Reporting* Here an important standard is the technique of transmission of information. *Signaling* Here an important standard relates to the kind of signal which gives permissive indications to the pilot. *Surveillance* While the operation of the ground radar equipments is important, a common standard is needed for the transponder beacon for example.

Pilot's Computers

To reduce the pilot's cockpit workload, V. I. Weihle, of the Air Transport Association of America, advocated one central digital computer for large aircraft. Such a computer could perform calculations required prior to take-off, e.g. for a given weight, when will the plane leave the ground, what will the landing weight be, etc. Such a computer can supply data for "How-Goes-It Charts." Instructions for emergency operations could be supplied by such a computer. Increased knowledge of approach and landing information could also be supplied by a central pilot-controlled computer. Many navigating problems now solved on slide rule computers could be done automatically by a digital computer.



new method solves **DIFFICULT R-F NOISE** problem

Of course he's relaxed!

Faced with a new version of the same old r-f interference vs. space-weight problem, he came upon a solution that sidestepped the usual time, trouble, and expense . . . by calling on Sprague.

The perfect solution was found almost immediately among the more than four thousand filter designs already available from Sprague.

Even if his problem had required the weeks of research—special measurements and tests—Sprague field consulting service—he would be no less at ease.

With mass production facilities on both the East and West Coasts, deliveries are no problem either.

If you, too, have an interference problem, pick up your phone and call your nearest Sprague Electric Field Engineering Laboratory.

They are located at 12870 Panama Street, Los Angeles 66, California (TEexas 0-7531 or EXmont 8-2791); 224 Leo Street, Dayton 4, Ohio (ADams 9188); 347 Marshall Street, North Adams, Massachusetts (MOhawk 3-5311).

see **SPRAGUE** for filters

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New Products |

△ Products marked with a triangle are those being exhibited for the first time at the Radio Engineering Show, and include the company's booth number.



△ Transistorized Scope Pre-Amp

Million-to-one Rejection Ratio

This transistorized pre-amplifier offers a million-to-one common mode rejection-ratio, and will allow measurement of minute signals which normally would be lost in noise. Designed for use with any general purpose oscilloscope, the type 407 amplifier circuit consists of one circuit board and amplifies all input signals to the instrument by a factor of ten. There are no active elements, such as vacuum tubes in the Type 407. A compensator keeps the output constant in spite of variations in ambient temperatures.

Allen B. DuMont Labs. Inc., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

Radio Engineering Show, Booth 3201-02-03, 3301-03-05-07.

CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Printed Circuit Transformers

Molded, Plug-in

These epoxy molded plug-in, printed circuit miniature transformers are available in a wide range of electrical ratings and have been designed to meet the requirements of MIL-T-27A, Grades 2 and 5.

Microtran Co. Inc., Dept. ED, 145 E. Mineola Ave., Valley Stream, N.Y.

Radio Engineering Show, Booth 2312.

CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Traveling Wave Amplifier For X-Band



With a small signal gain of more than 20 db from 8.2 — 12.4 kmc and more than 30 db from 8.2 to 11.0 kmc, the HA-20 permanent magnet focussed travelling wave amplifier has a power output of 7.5 to 10 dbm. It weighs 3 lbs 12 ozs and measures 2 in. O.D. x 14 in. long.

Huggins Labs. Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

Radio Engineering Show, Booth 3927-3929.

CIRCLE 36 ON READER-SERVICE CARD FOR MORE INFORMATION

UHF Coax Cavity Amplifier Standard Tuning Capacitors



A new UHF coaxial cavity amplifier utilizes standard tuning capacitors. The tube designated 4X150A tetrode. Access for tube replacement is provided by an interlocked door in the front panel. The amplifier in the illustration is a four-stage linear model tuning from 300 to 400 mc with overall gain of 50 db. Models for lower frequencies are also available.

Amtron Corp., Dept. ED, 17 Felton St., Waltham 54, Mass.

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

Flameproof Connectors Teflon Insulated



Connectors now available have hermetically sealed insulation that is non-flammable and will not carbonize even under arcing. The insulating body is DuPont Teflon, molded to shape. It resists the roughest handling on assembly lines. Teflon is chemically inert, has high dielectric strength, and is serviceable from -100 to +500 F. These connectors withstand high internal pressure, humidity, mechanical shock and vibration. They will be of special interest to makers of electrical transformers, capacitors, motors, relays and other radio, radar and electronic equipment.

Joelin Mfg. Co., Dept. ED, North Haven, Conn.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Subminiature Relay

High Precision Grade

A highly precise subminiature relay in the crystal can size will be marketed under the designation MV. It will meet military specifications. Choice of solder-lug or plug-in terminals is available. The rotary action is dpdt. Temperature range is up to +125 C, contact rating 2 amp resistive at 28 v dc or 115 v ac; vibration is 10 to 80 cps at maximum excursion of 0.06 in. and 80 to 2000 cps at 20 G acceleration. Weight is 0.44 oz, dimensions 1 x 3/4 x 1/4 in. The relay is currently in quantity production.

Elgin National Watch Co., Dept. ED, Elgin, Ill.

Radio Engineering Show, Booth 2426

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

△ Printed Circuit Laminate Fluorocarbon Composition

Designated Fluoroply, a fluorocarbon-based laminate for printed circuitry complies with rigorous electrical and environmental requirements. The material can be cold punched, drilled and machined. Both volume and surface resistivity are high.

Its manufacturer also produces current pulse viewing probes, waveguide attenuators, resistive elements for T-Pad Coaxial attenuators, glass-sealed resistors, and other resistors some of which are described elsewhere in these columns.

International Resistance Corp., Dept. ED, 401 North Broad Street, Philadelphia, Pa.

Radio Engineering Show, Booth 2821-825.

CIRCLE 40 ON READER-SERVICE CARD

△ Magnetic Cores Insulated

These ring type cores are made from grain-oriented Hipersil steel in all gauges from one mil to twelve mils thick. The Polyclad core is insulated with a resin so that it is ready to receive copper windings, without taking the core before winding. The resin coating is continuous and smooth and the corners are rounded. Insulation tests have shown this coating to have a value of 2500 breakdown to ground. The type of coating used does not harm the magnetic quality of the core.

Westinghouse Elec. Corp., Dept. ED, Transformer Div., P O Box 231, Greenville, Pa.

Radio Engineering Show, Booth 1402-607.

CIRCLE 41 ON READER-SERVICE CARD

△ Epoxide Casting Resin Low Weight

This low weight epoxide casting resin is unicellular so moisture absorption is negligible. Stycast 1090 has low density, dielectric constant and dissipation factor, and room temperature operation is possible. Operating temperature is from -70 to +400 F.

Emerson & Cuming, Inc., Dept. ED, 69 Washington St., Canton, Mass.

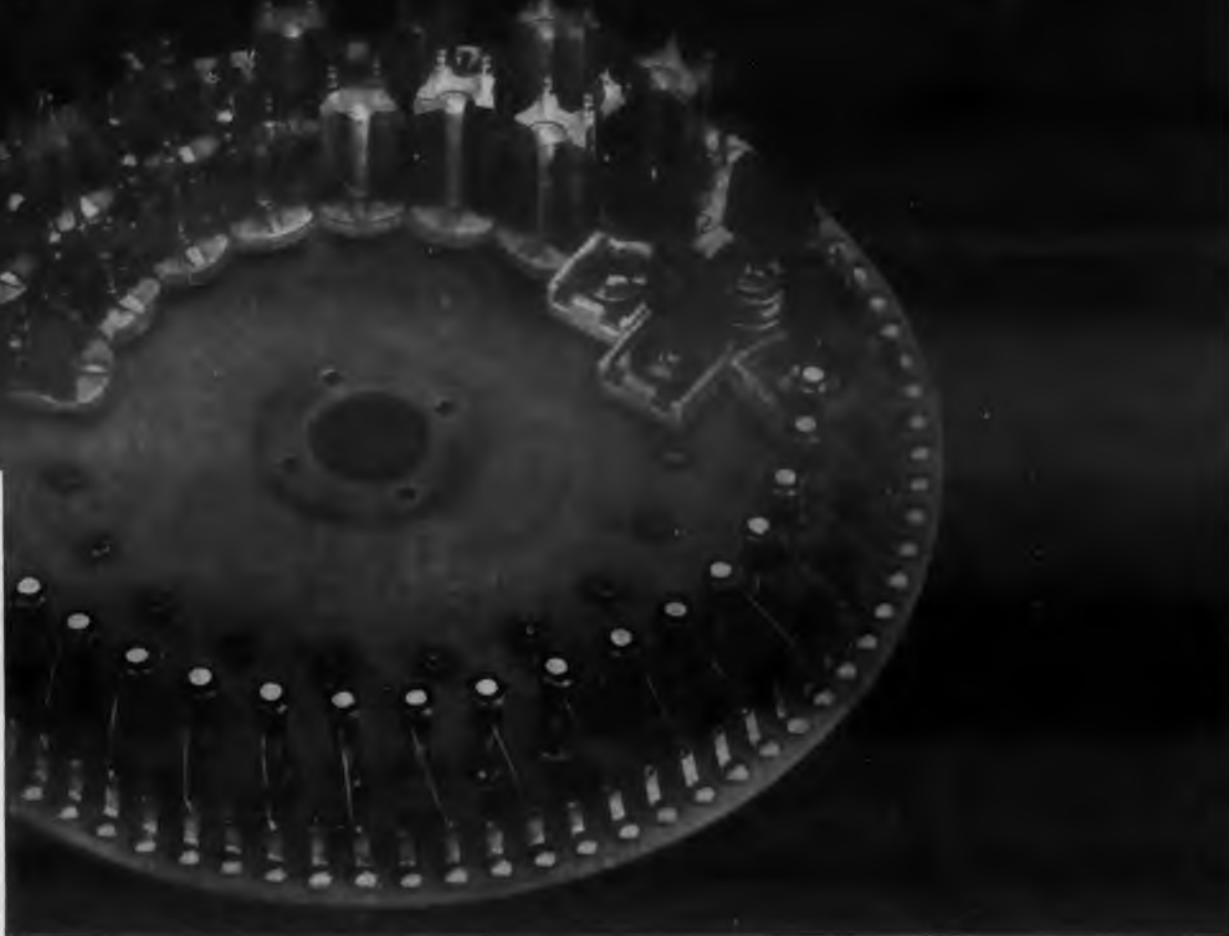
Radio Engineering Show, Booth 4404.

CIRCLE 42 ON READER-SERVICE CARD

CASE history
number 6



PISTON CAPACITORS AT WORK



trimmers achieve maximum measurement, accuracy and stability in BERKELEY frequency meters



PROBLEM: To combine functions of precision wide-range frequency meter and universal counter and timer in one compact instrument—to measure frequency from 0 to 42 megacycles with an accuracy of ± 1 cps or greater and elapsed time from 1 microsecond to 10 million seconds with a maximum accuracy of ± 1 microsecond.

SOLUTION: Berkeley engineers specified 22 model VC11RGA JFD Trimmer Piston Capacitors in the 0-42 mc. harmonic frequency turret to assure precise repeatable selection of reference frequencies. The reasons JFD Variable Trimmer Capacitors were selected? . . . Because an ultra-stable compact, trimmer capacitor was needed to afford rapid and accurate tuning capacity in the reference oscillator circuit.

RESULT: Performance so outstanding that Berkeley, division of Beckman Instruments, Inc., has continued to specify JFD Piston Capacitors in their model 5571 Frequency Meters for 3½ years.

MORAL: If you are seeking stability, shock-resistance, ultra-linear tuning and wide operating temperature range in a trimmer capacitor, you'll find the best answer at JFD.

Why don't you take advantage of JFD Piston Capacitors in solving your circuit tuning problems?

*One of the miniature and subminiature JFD Piston Capacitors now serving in printed and conventional electronic circuits. Write for literature.



ELECTRONICS CORPORATION, 1462-62 STREET, BROOKLYN 19, N. Y.

Go Forward with JFD Engineering!

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now...immediate delivery on

STABLVOLT* TUBELESS D. C. POWER SUPPLIES WITH DMR

DMR—Dual Magnetic Regulation

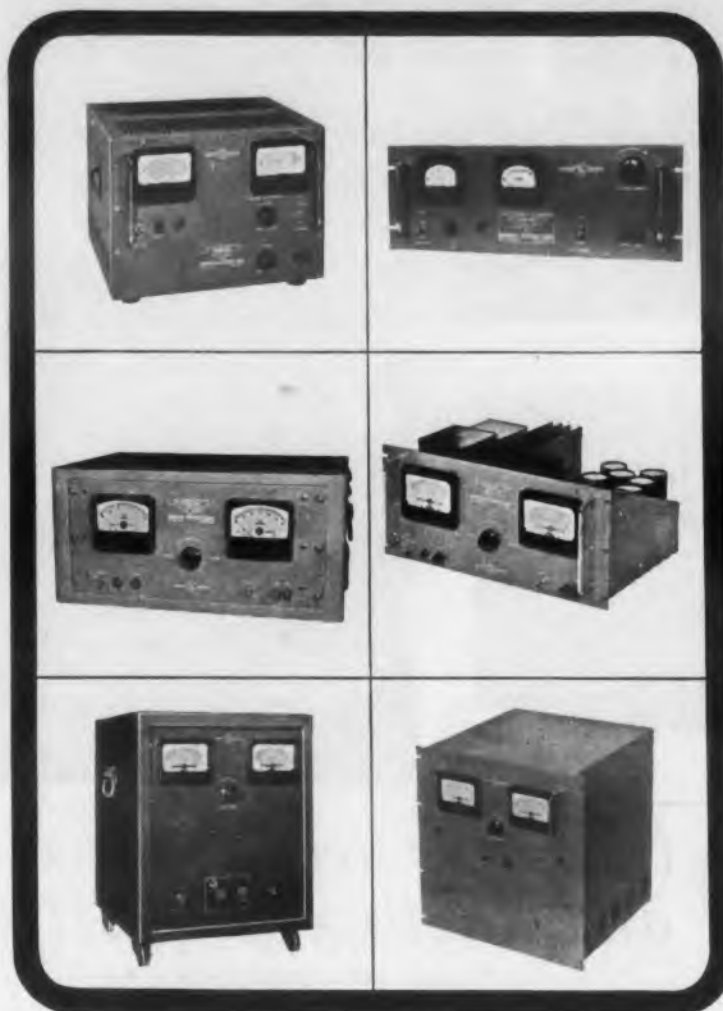
provides line transient-free output, ultra-fast response

Using two separate magnetic regulators, MRC dual magnetic circuitry eliminates the source of most trouble in d.c. power supplies, and provides regulation as close as $\pm 1/4\%$. One regulator, a high-performance flux oscillator, controls line transients and line voltage change with 25-millisecond speed; the other, a high-gain magnetic amplifier, regulates against load change. The result is exceptionally smooth, filtered d.c. output with excellent static and dynamic regulation. Use of rugged, long-life magnetic amplifiers instead of tubes and elimination of moving parts makes Stablvolt power supplies maintenance-free. Thoroughly proved in industrial, laboratory and original equipment applications. Competitively priced.

Short circuit-proof, too!

If output terminals are accidentally short circuited, a reactor limits line current, protecting power supply completely. Regular operation resumes automatically.

Select from these Stablvolt power supplies with DMR—all available now from stock. Prompt service on specially engineered units, too.



*REG. TRADE MARK

TYPE A: 200 WATT CHASSIS

MODEL †	NOMINAL RANGE VOLTS	EXTENDED RANGE AMPS.	NOMINAL RANGE VOLTS	EXTENDED RANGE AMPS.
MR-6-5	6	5	4-8	0-5
MR-6-20	6	20	4-8	0-30
MR-12-10	12	10	10-14	0-15
MR-28-5	28	5	24-32	0-7.5
MR-150-1	150	1	140-160	0-1
MR-300-0.5	300	0.5	280-320	0-0.5

TYPE A: 1000 WATT CHASSIS

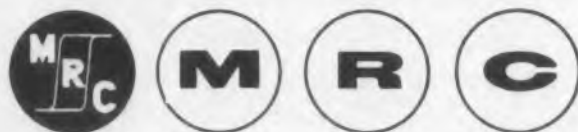
MODEL	NOMINAL RANGE VOLTS	EXTENDED RANGE AMPS.	NOMINAL RANGE VOLTS	EXTENDED RANGE AMPS.
MR-6-100	6	100	4-8	0-120
MR-12-50	12	50	10-14	0-70
MR-28-20	28	20	24-32	0-30
MR-28-40	28	40	24-32	0-50
*MR-532-15	5-32	15	3-36	0-15

*Special wide range supply 400 watt chassis

STATIC REGULATION at nominal range:
 $\pm 0.2\%$ for $\pm 10\%$ line voltage change
 $\pm 0.2\%$ for $\pm 10\%$ line frequency change
 $\pm 0.2\%$ from 10% to full load current
RIPPLE: 0.2% RMS at full load
 6 Volt models have 1% ripple
AC INPUT: 105-125, 1 phase, 57-63 cps

DYNAMIC REGULATION
LINE: $\pm 2\%$ for $\pm 10\%$ line voltage transient.
LOAD: $\pm 3\%$ for $\pm 10\%$ load current transient.
Response Time: 100 milli-seconds max. under most severe conditions of loading.

SHORT CIRCUIT CURRENT: 200% of rated load current
 † First number indicates rated voltage. Second number indicates max. current of power supply at rated voltage

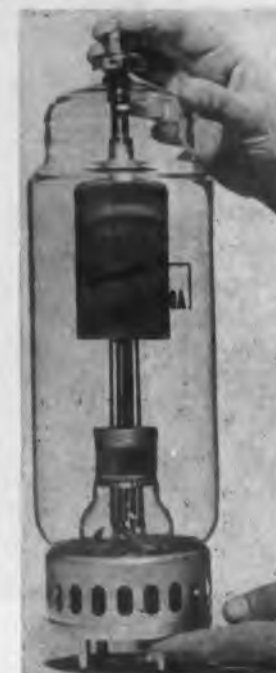


Write for complete technical data on Stablvolt power supplies

MAGNETIC RESEARCH CORP.

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CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Power Tube For Rectifier Units

The 2-450A is intended for use in rectifier units. It is a vacuum tube with a maximum dc current rating of 1 amp and a maximum peak inverse rating of 25,000 v. Maximum peak plate current rating is 8 amp. Over-all height of the 2-450A is 14 3/32 in. and the diameter is 4 1/2 in. Maximum plate dissipation is 450 w.

Eitel-McCullough, Inc., Dept. ED, San Bruno Calif.

Radio Engineering Show, Booth 2410-12.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION



30,000 V AC Supply Portable Bench Type

Designed for testing plastics and other insulating materials, and equipment requiring test potentials to 30 kv ac at 1 kva, a new portable bench type Hypot has an input of 115 v 1-phase 50-60 cps ac and a continuously variable output voltage between 0 to 30 kv ac, at 1 kva intermittent. Designated Model 4300, it incorporates a 4-1/2 in. rectifier type meter calibrated from 0 to 30 kv. The meter is connected directly across the high voltage, so the readings shown are those of the actual test voltage applied regardless of transformer regulation. Minimum weight, and a 5 ma leakage light, are other features. Model 4300 is a cabinet-type instrument; a companion unit, Model 4301, has the same features but is designed for rack mounting and connects to power unit by a 10 ft connecting cable.

Associated Research, Inc., Dept. ED, 3758 Belmont Ave., Chicago 18, Ill.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION



**Oscillograph
Pen Motor**
For Multi-Channel Systems

The Model M-133 pen motor is designed for multi-channel recording systems. It measures 4 3/4 x 1 1/4 x 3 7/8 in. and it weighs 1 1/2 lb. This pen motor has an integral mounting base which permits spacing of 1 1/4 in. on centers. A micrometer set screw is used for pen alignment to a common time axis, and a set screw is provided for pen zero adjustment. The M-133 pen motor is direct inking, with a disposable ink cartridge. The frequency response with constant current input is flat from dc to 60 cps, with a fall-off of 12 db/octave from 60 to 100 cps. Sensitivity is 20 ma rms full scale.

Massa Labs., Inc., Dept. ED, 5 Fottler Rd., Hingham, Mass.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **10 Mc
Decade Scalers**
Use No Feedback

These 10 mc Decade Scalers are designed for nuclear counting. The Model 414 fast decade scale of 1,000 has been designed to allow high-speed nuclear and other counting with long term reliability. The gated decade system does not use feedback and makes possible a decade with a large bias range and an inherent reliability approaching that of a binary.

A four neon-lamp 1-2-4-9 indication system is used to take advantage of the large on-off voltage ratio for each lamp provided by the binary light system, and hence provides an unusually reliable and accurate indication. Diode input coupling is used in each flip-flop stage in the 10 mc and 1 mc decades, and in each of the slower decades to provide maximum reliability of operation. A high capacity forced air blower system circulates air around all diodes and other critical components. A five digit electrical register which resets automatically with the scaling is included.

Electrical & Physical Inst. Corp., Dept. ED, 25 W. 33 St., New York 36, N.Y.

Radio Engineering Show, Booth 3117.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

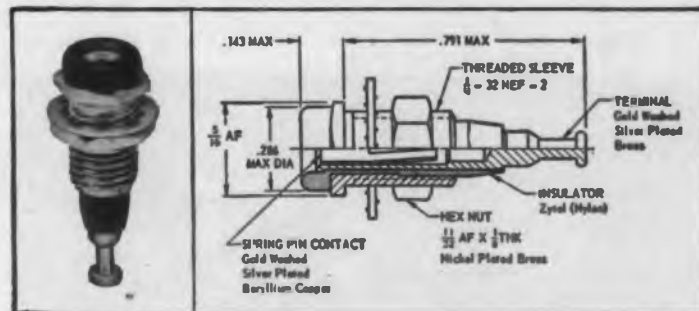
ELECTRONIC DESIGN • March 15, 1957

new...from Raytheon

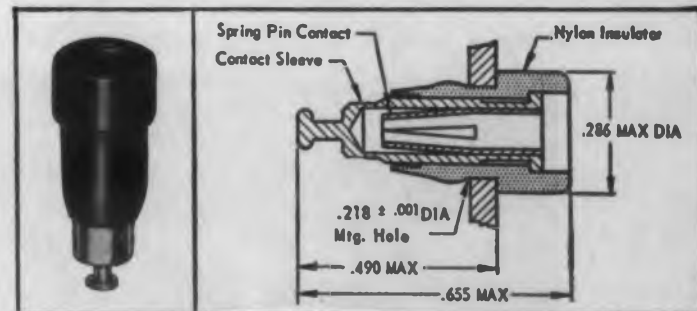
TEST JACKS

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

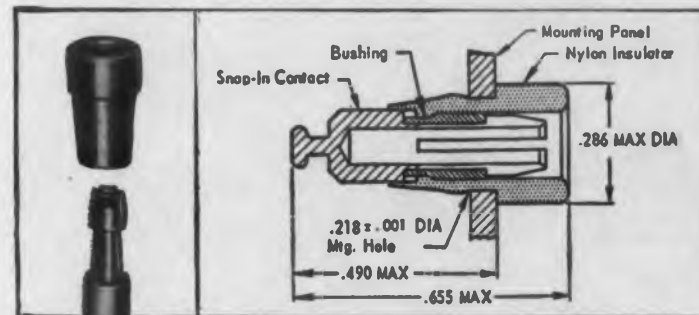
All your test jack needs from one reliable source—Raytheon. These brand new components offer a unique combination of highly desired features. Nine colors. Nylon insulators. Beryllium-copper contacts with silver-plated gold-washed solder terminals. Designed for extreme salt spray, humidity, temperature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



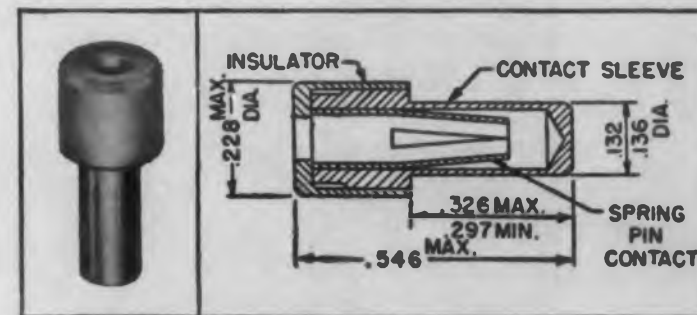
STANDARD TEST JACK
Rugged construction, superior design. Ideal for extreme shock and vibration conditions



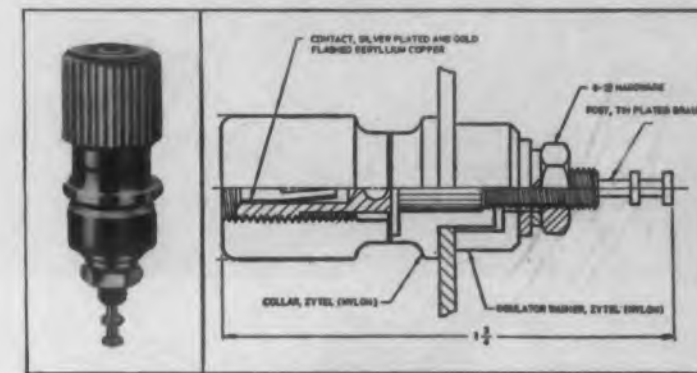
SUBMINIATURE FIXED-CONTACT TEST JACK
Fast, easy, press-fit assembly



SUBMINIATURE SNAP-IN CONTACT JACKS
Snap-in contact can be soldered to cable before insertion in mounted jack



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



5-WAY BINDING POST
Compact, high strength. Incorporates jack for banana plug or standard .080" prod. Available in black or red

See Raytheon's exhibit at Booth 2611-14 at the I.R.E. Show

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

For complete information, please write Dept. 6120



RAYTHEON MANUFACTURING COMPANY
Commercial Equipment Division
Waltham 54, Mass.

build reliability
into your product
with
OHMITE[®]
COMPONENTS

close-control **RHEOSTATS**

All-ceramic and metal, close-control rheostats for unsurpassed dependability and smoothness of operation. Ten stock sizes, 25 to 1,000 watts.

wire-wound **RESISTORS**

A wide range of dependable, fixed, adjustable, tapped, and noninductive power wire-wound resistors. Also a wide range of precision resistors.

general-purpose **RELAYS**

65 Types in four stock models. Good delivery on made-to-order relays. Contact current ratings up to 25 amps, AC or DC. Wide variety of contact arrangements. Hermetically sealed or dust-protective enclosures available.

high-current **TAP SWITCHES**

Five compact models, up to 100 amperes, AC, up to 12 taps. All-ceramic and metal construction. Silver-to-silver contacts, with self-cleaning rotor contact.

radio-frequency **CHOKES**

Single layer R.F. plate chokes and power line chokes on steatite or plastic cores. Protected by a special moisture-resistant coating.



WRITE on
Company Letterhead
for Catalog and
Engineering Manual.



Be Right with **OHMITE[®]**

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES • TANTALUM CAPACITORS

OHMITE MANUFACTURING COMPANY • 3643 Howard Street, Skokie, Illinois

Fractional HP Torque Motors

Adjustable Speed

Both 1/4 and 1/2 h.p. models are available with either geared or un-geared motors. Motor armature delivers a constant torque at a speed which is infinitely adjustable from near zero to 2400 rpm. A control head utilizes only low voltage circuits that can be installed at a point remote from either the motor or rectifier cabinet.

Servo-Tek Products, Inc., Dept. ED
1086 Goffle Rd., Hawthorne, N.J.

CIRCLE 54 ON READER-SERVICE CARD

△ Magnetically Regulated Power

400 Cycle Supply

A 400 cps power supply unit in which both voltage and frequency are regulated magnetically has been put on the market. Regulation of both frequency and voltage is within $\pm 1/10$ per cent or better. Output is 115 v ac, 10 watts, 0-90 ma.

Keystone Products Co., Dept. ED
904 23rd St., Union City, N.J.
Radio Engineering Show, Booth 292

CIRCLE 55 ON READER-SERVICE CARD

△ Miniature Pentodes

For Video Amplifiers

The 6AW8A and 6BA8A, two 9-pin miniature tubes for use in both color and black and white television receivers, are triode pentodes with 6.3 ma heaters for series-heater string circuitry. The pentode sections of both tubes are identical. The two tubes have a plate dissipation rating of 3.5 w, reduced sync pulse clipping and minimized white compression. With a transconductance of 9000 μ mhos they are intended for use as video amplifiers.

The triode section of the 6AW8A has a mu of 70 and 6BA8A triode section has a mu of 18.

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

Radio Engineering Show, Booth 1800-10.

CIRCLE 56 ON READER-SERVICE CARD

← CIRCLE 53 ON READER-SERVICE CARD

Phenolic Molding Compound

General Purpose Type

An ammonia-free phenolic molding compound, designated Durez 18441, has been introduced for use where electrical grade material of general-purpose type is required to minimize corrosion of contacts and metal inserts. It is a single-stage, wood-flour filled phenolic with a fast rate of cure, excellent insulation resistance, good finish and low gravity; and is suitable for use by compression plunger or transfer molding methods. It is applicable for production of parts wherever fast molding cycles and economy in automatic machines are requisites. Hooker Electrochemical Co., Dept. D, Box 344, Niagara Falls, N.Y.

CIRCLE 57 ON READER-SERVICE CARD

△ Flux Coating

For Printed Circuits

This material, a mixture of resin and quick drying nonblush solvents, can be applied after etching and cleaning on copper printed circuit boards. It can be applied either by brushing or spraying, and will dry in approximately 20 minutes. No. 391F Flux Coat is compatible with flux used in the final dip soldering operation.

Alpha Metals, Inc., Dept. ED, 56 Water St., Jersey City, N.J.
Radio Engineering Show, Booth 4319.

CIRCLE 58 ON READER-SERVICE CARD

△ Linear Accelerometers

Low Thresholds

The 11000 Series linear accelerometers have a standard voltage output of 2-1/2 or 10 v with a 28 v, 400 cy input. Null voltages are less than 10 mv for the 2-1/2 output. The 12000 series has a precision potentiometer output with a resolution of 500. Linearity is better than 1/2 per cent, and hysteresis is less than 1/4 per cent. Thresholds lower than .001 per cent can be achieved.

Technology Instrument Corp., Dept. ED, 531 Main St., Acton, Mass.
Radio Engineering Show, Booth 2318-20.

CIRCLE 59 ON READER-SERVICE CARD

CIRCLE 60 ON READER-SERVICE CARD >



NOW . . . ONLY 3-WEEK SHIPMENT* on General Electric's full-line of sealed relays

Improved production techniques now make it possible for General Electric to offer its complete line of standard-listed hermetically sealed relays—including the amazing micro-miniature—on only 3-week shipment from order date!

And, what's more—General Electric is equipped to provide you rapid service on samples and prototypes.

FOR ALL ELECTRONIC SYSTEMS

G-E miniature, sub-miniature, and micro-miniature relays combine small size with unusual reliability under severe temperature, shock, and vibration conditions—making them ideal for all radio, radar, fire control, navigational equipment, and industrial electronics jobs.

Though initially designed for military applications, more and more G-E sealed relays are being used for industrial jobs. Their extreme reliability and small size now are utilized by industrial designers. Resistance welding and other industrial electronic circuitry is being simplified and miniaturized with G-E sealed relays.

WIDE RANGE OF COIL RATINGS, HEADER TYPES, AND MOUNTINGS

Whatever your small sealed relay needs—you'll find the answer with one of the many forms of these three models:

Miniature: Standard, current-sensitive, and voltage-sensitive models; in 2-, 3-, or 4-pole double-throw and 6-pole normally open forms. Rated 5 amps at 28 volts d-c at 85C. 3-amp make-before-break forms and 125C forms available.

Sub-miniature: 2 amps; .651 in. in diameter, 1.6 in. long; weighs one ounce. Unaffected by vibrations of 10 to 55 cps at .12 in. maximum excursion or 55 to 500 cps at 15Gs acceleration. Withstands shock tests in excess of 40Gs. Operates in ambients of 125C.

Micro-miniature: Weighs only 0.5 oz., measures .36 in. by .80 in. by .88 in. Rated 2 amp resistive at 28 v d-c or 115 v a-c. Also available in current-sensitive models. Standard relays withstand ambients of 125C, and 20Gs acceleration at 50 to 500 cps. *Contact your G-E Apparatus Sales Office, or mail coupon. Specialty Control Dept., Waynesboro, Va.*

*Average shipment time for all standard-listed relays. Actual time: MICRO-MINIATURE (up to 100 units—2 weeks, 100 to 1000 units—4 weeks); SUB-MINIATURE (up to 100 units—3 weeks, 100 to 1000 units—5 weeks); MINIATURE (up to 100 units—1-2 weeks, 100 to 1000 units—3 weeks).

MAIL TODAY FOR G-E RELAY DATA

General Electric Co., Sect. B 792-6,
Schenectady 5, N. Y.

- Miniature—Bulletin GEA-6213
- 2PDT Sub-miniature—Bulletin 6412
- Micro-miniature—Bulletin 6346
- HAVE G-E SALES ENGINEER CALL

NAME.....
COMPANY.....
ADDRESS.....
CITY..... STATE.....

GENERAL ELECTRIC

Another
TI FIRST

true rectilinear side-by-side recording of two variables correlated to a common time base!



DUAL recti/riter

TWO-CHANNEL RECTILINEAR GALVANOMETRIC RECORDER

Now, work-saving rectilinear recording is made possible in hundreds of new industrial, laboratory, and mobile applications by the *DUAL recti/riter*. One compact instrument containing two independent galvanometers, inking systems, and "recti/rite" linkages—with a single chart drive—enables you to record two variables simultaneously and visually correlate events to an accurate common time base. No synchronizing of separate

drive systems . . . only one chart roll to handle . . . interpret data at a glance on the *DUAL recti/riter*.

Record such variables as voltage and current, wind direction and velocity, temperature and pressure, torque and speed, input and output . . . these are just a few practical applications for the *DUAL recti/riter*. You will think of many more that fit your specific needs.

Both DUAL and SINGLE recti/riters have these outstanding features:

- Easy interpretation — read data directly with a simple ruler.
- Frontal access for all controls and routine operations.
- Accuracy of $\pm 1\%$ over full $4\frac{1}{2}$ -inch scale; sensitivity of 0.45 inch/100 microamperes; pen speed $\frac{1}{4}$ -second/full scale deflection.
- Closed ink system protects ink from contamination, evaporation, spillage.
- Non-corrosive metal alloy pen writes fine line with dependable non-smearing ink flow.
- Use ac drive; 6, 12 or 28-volt dc drive; spring drive; or external drive.
- Fingertip controls give 10 chart speed changes.

For more complete information, write for respective bulletins—*Dual recti/riter CR-502*, and *Single recti/riter CR-501*.



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INCORPORATED

INDUSTRIAL INSTRUMENTATION DIVISION

3609 BUFFALO SPEEDWAY • HOUSTON, TEXAS • CABLE: HOULAB

Formerly: HOUSTON TECHNICAL LABORATORIES



SINGLE recti/riter
\$430.00

DUAL recti/riter
\$825.00

Basic unit prices —
F.O.B. Houston



READ WITH
A RULER

Epoxy Rubber Resins

Wide Range of Uses

A line of epoxy rubber resins and hardeners fulfills a variety of purposes from the impregnation of coils to service as drop hammer dies. The resins are designated No. 621, No. 623 and No. 626, and their respective hardeners are coded No. 662, No. 666 and No. 30. Cure time for 621 plus hardener 662 is 4 hours at 150 F; for 623 with hardener 666 3 hours at 150 F, but 623 also may be cured at room temperature. Cure time for 636 plus 30 is 3 hours at 212 F. Numbers 621 and 623 feature a high degree of fluidity and low surface tension, permitting bubble-free impregnation. No. 636 is a low exotherm formula, in which castings can be made of unlimited thickness, as tough as hard rubber and as flexible as vinyl; it is used not only for gaskets, sealing and potting, but also for drop hammers. No. 621 serves in the manufacture of transformers, coils, amplifiers and transistor circuits; No. 623 also has varied electronic uses including encapsulation.

Marbette Corp., Dept. ED, 379 30th St., Long Island City 1, N.Y.

CIRCLE 62 ON READER-SERVICE CARD

High Heat, High Voltage Resins

For Potting

Impregnating and encapsulating resins that withstand higher temperatures are offered under the designations Airtemp 201 and Airtemp 221. They pass the requirements for Class H insulating compounds. Ten transformer coils were impregnated with Airtemp 221 and then encapsulated in Airtemp 201. These coils resisted a test voltage of 8000 v for more than 1000 hours at temperatures up to 200 C. By contrast, a second set of transformer coils was impregnated with an amine-cured unmodified epoxy impregnant. These resisted the 8000 volt test for only 870 hours at 150 C, 48 hours at 170 C, 48 hours at 190 C and 12 hours at 200 C.

Aries Laboratories, Inc., Dept. ED, 45-33 Davis Street, Long Island City 1, N.Y.

Radio Engineering Show, Booth 411

CIRCLE 63 ON READER-SERVICE CARD

◀ CIRCLE 61 ON READER-SERVICE CARD

△ Resistors for 200 C

Withstand Oxidation, Moisture

A line of resistors designated Pyro-amic Carbon Alloy, for operation in ambient temperatures up to 200 C, has been announced. They have minimum susceptibility to oxidation and moisture changes, and in addition to their special properties possess all the inherent good qualities of conventional deposited film types. They are available in all ranges.

International Resistance Co., Dept. ED, 401 North Broad St., Philadelphia, Pa.

Radio Engineering Show, Booth 2821-2825.

CIRCLE 64 ON READER-SERVICE CARD

△ Micro-Microammeters

20 Ranges

With the Model 410 micro-microammeter, 20 ranges are available, from 10^{-3} to 3×10^{-13} ampere scale. It is used in circuits with source voltages 300 mv or more. The Model 411 has 17 ranges, from 10^{-3} to 10^{-11} ampere full scale extreme zero stability and complete freedom from range switching transients. It is used with source voltages of 10 v or more.

The Models 410-C and 411-C have a contact meter replacing the standard panel meter. A reset push-button control on the panel, output connector at the rear, and internal relay are also provided. The contact meter can sound an alarm or actuate control circuits upon rise or fall of the signal. A single-range logarithmic model, Model 412, covers six decades from 10^{-13} to 10^{-7} ampere on a six-inch mirror-scale meter. With up to 5000 μ f input capacity, the time constant is within one second on most ranges of all models. Line variations from 90 to 110 v will not upset over-all accuracy. Full-scale outputs of the 410 and 411 are 5 and 10 v respectively, each with a maximum of 5 ma. The 412 has a full-scale output of six v, one v per decade ± 20 per cent.

Keithley Instruments Inc., Dept. ED, 1415 Euclid Ave., Cleveland 6, Ohio. Radio Engineering Show, Booth 3115.

CIRCLE 65 ON READER-SERVICE CARD

CIRCLE 66 ON READER-SERVICE CARD

DU PONT

ELECTRONIC DESIGN

LATEST PROPERTY AND APPLICATION DATA ON

TEFLON

NEWS

Du Pont TEFLON® resists temperature extremes in electronic aircraft equipment

Wire insulated with TEFLON is used in new transistorized flight-control system

The transistorized PB-20 is the latest development in the field of automatic flight-control equipment. It has been specified for use in many advanced aircraft, such as the Boeing 707 jet transport. The PB-20 depends extensively on wire coated with TEFLON for reliable operation.

Tough and durable TEFLON can be used up to 500° F. and displays excellent properties at sub-zero temperatures. Thin-walled coatings on wire will not burn, melt or decompose when connections next to it are soldered. The dielectric strength and arc resistance of TEFLON are excellent. Its dissipation factor of less than 0.0003 from 60

cycles to 3,000 megacycles assures low losses in high-frequency communications equipment. Very few chemicals exist which can injure TEFLON... it is not affected by aircraft fuels, lubricants or solvents. It is inert to fungus, rot and mildew and will not absorb moisture. Articles of Du Pont TEFLON will meet the requirements of many military specifications relative to jet-aircraft applications.

You can meet the increasing demands for extreme temperature range, higher frequencies, higher voltages and greater resistance to corrosive environments by specifying TEFLON. Find out now how TEFLON can improve your products.

Lead-through bushings of TEFLON® feature hermetic sealing



LEAD-THROUGH BUSHINGS made with Du Pont TEFLON have excellent corona, arc and ohmic resistance and are hermetically sealed against gases, vapors, liquids. (Manufactured by the Joelin Manufacturing Company, North Haven, Connecticut.)

Sensitive tests with the mass spectrometer have proven that gases, conventional insulating oils, silicone oils and their vapors cannot penetrate through connectors using TEFLON tetrafluoroethylene resin as their dielectric. The bushings maintain their seal when cycled repeatedly over a temperature range from -85° F. to $+302^{\circ}$ F.

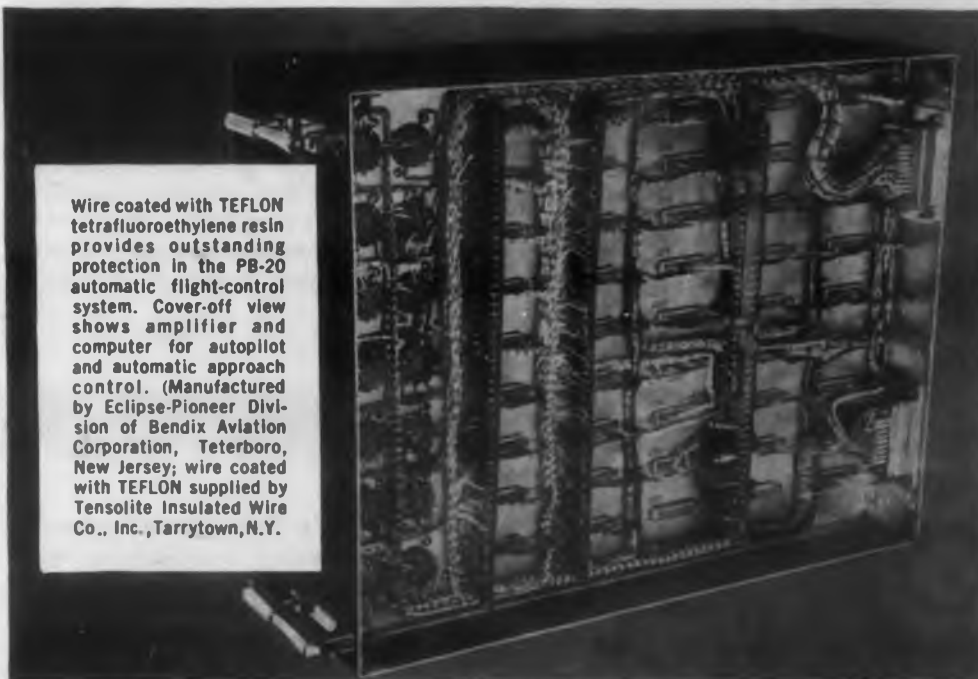
In addition, the connectors are resistant to shock. The specially prepared insulators of TEFLON provide mechanical resilience not possible with the usual rigid construction. The moisture-repellent qualities of TEFLON make it possible to use the bushings under the most adverse conditions of humidity. They conform to the applicable sections of Specification MIL-E-5272A.

Where components are subjected to a wide range of temperature, pressure, humidity and mechanical shock and vibration, Du Pont TEFLON provides outstanding performance. In your designs, too, components of TEFLON may well be the decisive factor in meeting acceptance standards.

TEFLON®

is a registered trademark...

TEFLON is the registered trademark for Du Pont tetrafluoroethylene resin, and should not be used as an adjective to describe any other product or any component part; nor may this registered trademark be used in whole, or in part, as a trade name for any product.



Wire coated with TEFLON tetrafluoroethylene resin provides outstanding protection in the PB-20 automatic flight-control system. Cover-off view shows amplifier and computer for autopilot and automatic approach control. (Manufactured by Eclipse-Pioneer Division of Bendix Aviation Corporation, Teterboro, New Jersey; wire coated with TEFLON supplied by Tensolite Insulated Wire Co., Inc., Tarrytown, N.Y.)

SEND FOR INFORMATION

For additional property and application data on Du Pont TEFLON tetrafluoroethylene resin, mail this coupon.

E. I. du Pont de Nemours & Co. (Inc.) Polychemicals Dept. Room 18315, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont TEFLON tetrafluoroethylene resin. I am interested in evaluating these materials for _____

Name _____

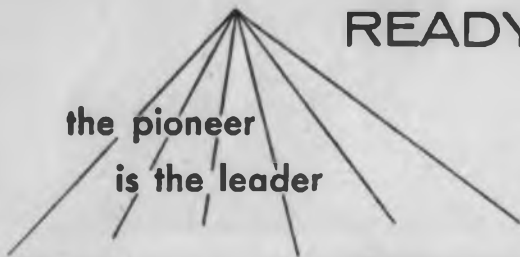
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Street _____

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Type of Business _____

In Canada: Du Pont Company of Canada (1956) Limited, P. O. Box 560, Montreal, Quebec



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is the leader

READY FOR YOU...AT THE

BOOTH

3 significant new PANORAMIC instruments

- 1 • Converts Panoramic Spectrum Analyzers to Power Density Analyzers
- 2 • Facilitates Dynamic Balance Analysis
- 3 • Offers new possibilities for miniaturization of FM/FM Telemetry Ground Stations

1

new Model PDA-1 Panoramic's Spectral Power Density Analyzer—A tremendously flexible instrument that expands the utility and versatility of Panoramic's Spectrum Analyzers from Sub-Sonic through Microwave... automatically analyzes the energy distribution of random information. Ideal for evaluating noise, vibration and other changing phenomena.

2

new Model SF-1 Panoramic's Synchronous Frequency Analyzer—A versatile, direct reading instrument that has many application possibilities... automatically tracks a frequency component derived from a rotating or oscillating source and simultaneously provides a visual plot of component frequency vs. component amplitude. Excellent for dynamic balance analysis.

3

new Model TMC-307 Panoramic's 7-Point Frequency Calibrator—Designed specifically for telemetering applications, the TMC-307 sequentially furnishes seven equally spaced frequencies per channel for all RDB channels within end limits of $\pm 7.5\%$... within $\pm 15\%$ for the upper five channels. Other end limits and spacings can be furnished. Channel and frequency point switching may be either manual or automatic. Accuracy is 0.02%. Occupying only 10½" panel space, the Model TMC-307 offers new possibilities for miniaturized ground station equipment.

Panoramic Radio Products, Inc.
15 South Second Ave, Mount Vernon, New York
Phone: Mount Vernon 4-3970 • Cables: Panoramic, Mount Vernon, New York State

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

E I.R.E. SHOW

3515-
3517

Pioneers in the field of spectrum analyzers from sub-audio to micro-wave, unparalleled sweep generator systems and highly reliable frequency calibrators, Panoramic instruments have accelerated completion of research and development projects and helped to clear production test bottlenecks.

Now, Panoramic again leads the way with these three new instruments, highly versatile and far reaching in application.

SEE these significant new instruments... get a glimpse of new equipment to come... learn how Panoramic's instrumentation for testing, checking or measuring problems can help you... in the laboratory, on the production line, or in military applications. You are also cordially invited to witness dynamic demonstrations and to discuss with our engineers technical characteristics and applications of panoramic instruments.

If you cannot attend the show, write, wire or phone for information. A Panoramic Applications Engineer is always available to discuss specific problems.



PANORAMIC
RADIO PRODUCTS, INC.

Miniature Control Used With Transducers



For use with many types of transducer or detector devices, or for direct actuation by any miniature electrical contact, a standardized, portable, miniature control unit has been developed; and is intended for inclusion in a wide variety of electronic control systems. Unit cost is lowered by reason of standardization. Essentially the control is an ultra-sensitive, heavy-duty electronic switch, which will control up to 500 w of power, either delivered at 115 v ac 60 cps or switched by internal contact. Minimum input impedance is 2 megohms. Designation is Model 6330 Controller.

Autron Engineering, Inc., Dept. ED, 1254 West Sixth St., Los Angeles 17, Calif.

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION



**△ Non-Overload
Pulse Amplifier**
High Window
Stability

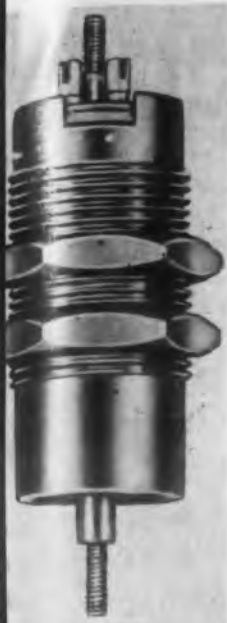
With a maximum gain of 7000 with 1 μ sec delay line clipping, and a rise time of less than 0.2 μ sec, this non-overload pulse amplifier has a linearity in the 0 to 100 v output range of better than 0.2 percent into loads greater than 1000 ohms. Its gain control range is 640:1 on the front panel.

The Model N-302 provides a stable precision differential pulse height selector based on the O'Ridge design. The discriminator has a resolving time of 1.2 μ sec, and a continuously adjustable window of 0 to 10 v, having a window stability of 1 percent of window per day at a 1 v slit. The instrument has a base line stability of less than 50 mv per day and a base line range of 0 to 100 v. Its rate dependence is less than 10 mv in window width in the range of 0 to 200,000 cps and 5 to 100 v pulse height. It can be converted to an integral discriminator by a front panel switch.

Hamner Electronics Co. Inc., Dept. ED, P O Box 531, Princeton, N.J.

Radio Engineering Show, Booth 3022.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Miniature Coil Form**
Double-Ended

This double-ended miniature coil form with space primary and secondary windings has separate tuning slugs for independent tuning of each section. The LS-14 measures 1/2 in. OD and 1-13/64 in. overall length, excluding tuning slugs. It is available with up to six terminals and mounts by means of a threaded middle section. The interior of the LS-14 is made up of powdered iron components and the main housing is nickel plated brass. The tuning cores of the unit are held in adjustment by built-in locking devices. The LS-14 is available in several different frequency ranges.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.
Radio Engineering Show, Booth 2219.

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Storage Tube**
Long Trace
Memory

This instrument combines information persistence with the features of a laboratory oscilloscope. It retains any number of tracks indefinitely at constant intensity until intentionally erased. Traces are visible in a brightly lighted laboratory and may be photographed.

The Memo-scope is available in portable and rack mounted models.

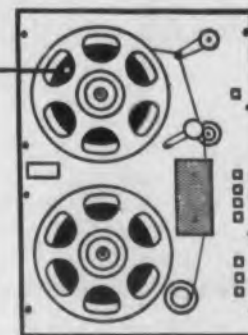
Hughes Products, Dept. ED, 11220 Hindry Ave., Los Angeles 45, Calif.

Radio Engineering Show, Booth 2801-2805.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

HYCON EASTERN introduces

RAPID ACCESS IN ANALOG DATA REDUCTION SYSTEMS



For Tape Indexing

DIGITAL TIMING GENERATOR, Model 201, generates numerically coded timing signals which are recorded on the 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.

DESIGN FEATURES

TIMING INFORMATION occupies only a part of the available bandwidth on a magnetic tape channel . . . remaining bandwidth in timing channel may be used for other purposes; e.g. to record other digital or analog data, or as a voice channel.

TAPE SPEEDS of 60, 30, 15, 7½, 3¾ or 1⅞ inches per second may be used for recording. For playback, any one of these 6 speeds or a high-speed search rate may be used. Other speeds may be incorporated as required.

TIMING TRACK contains a combination of complete time numbers in hours, minutes, and seconds together with interpolation pulses so that time can be measured with a resolution of a few milliseconds.

ADDITIONAL SIGNALS for recording, recovery and display may be assigned to arbitrary control functions in the data system.

FORWARD OR REVERSE directions may be used for tape search at either the high-speed search rate or any one of the 6 normal record play back speeds.

MOUNTS in any RETMA standard 19" relay rack.

IRE SHOW
Booths 3038 & 3039

Two companion units by Hycon Eastern provide automatic high-speed access to selected data in Ampex Recorders and similar multi-channel magnetic tape instrumentation systems.



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.

Write for Technical Bulletin TSG-O



HYCON EASTERN, INC.

75 Cambridge Parkway Dept. F, Cambridge 42, Mass.
Affiliated with HYCON MFG. COMPANY, Pasadena, California

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

ANOTHER NEW ELECTRONIC DESIGN SERVICE

Mail

Readership

Measurement

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R

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HAYDEN PUBLISHING COMPANY, INC.
19 East 62nd St., New York 21, N. Y.—TEmpleton 8-1940

Mail Readership Measurement

While other publications fight the battle of promotion, *Electronic Design* continues to improve its services for both reader and advertiser. MRM (Mail Readership Measurement), in effect since January 1, 1956, has proven to be an extremely valuable aid, both in rating individual advertisements, and in telling us which editorials you like best.

Since many of our readers are also advertisers, a special booklet has been prepared which outlines the methods, objectives, and results of MRM. Copies are available on request to the publishers.



a HAYDEN publication

• NEW YORK • CHICAGO • LOS ANGELES

ELECTRONIC DESIGN • March 15, 1956



△ **Microwave Diode**
For X-Band Circuitry

A high sensitivity microwave silicon diode for use as a low-level detector in X-band video receiver circuitry has a minimum figure of merit of 220. Theoretical tangential sensitivity is -53 dbm at 9000 mc for a receiver bandwidth of 10 mc. A dc bias of $+50$ amp is recommended. The MA-408B is interchangeable with other cartridge type diodes of the 1N23 series. An average improvement of 4 to 5 db is indicated when the MA-408B replaces 1N23C mixer crystals in low-level video circuitry. It is available in production quantities.

Microwave Associates, Dept. ED, Burlington, Mass.

Radio Engineering Show, Booth 3237-39.

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION



Switch and Balance
Balances Resistance
Bridges

In work that involves observing several related setups and going from one channel to another, this switch and balance unit saves much time and greatly reduces chance for error. Designated BSG-6, it adjusts individual bridge currents on some bridge configurations, presets bridge balance and gain for each channel when used with its manufacturer's Model BAM-1, and presets bridge balance in association with various other bridge instruments. Its dimensions are 9 in. x 9 in. x 9 in., and weight approximately 5 lb.

Ellis Associates, Dept. ED, box 77, Pelham, N. Y.

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW TO ADD TO THE Saleability OF MANY ELECTRICAL PRODUCTS

- ... Instruments
- ... Appliances
- ... Small Motors
- ... Radio, TV,
Audio Equipment

TO ENGINEERS, Stackpole Slide Switches in more than a dozen inexpensive types offer many interesting design possibilities for improving product performance.

TO BUYERS of today's instruments and appliances, the convenience of unique and attractive modern switching arrangements exerts strong sales appeal that far exceeds the modest cost involved.

Stackpole Slide Switches cover the $\frac{1}{2}$ to 3 ampere range. They vary from simple ON-OFF units to types that provide complicated inter-circuit switching in minimum space—often with less costly mountings than conventional switches. *Electronic Components Division, STACKPOLE CARBON COMPANY, St. Marys, Pa.*

STACKPOLE

S-L-I-D-E SWITCHES

New SLIDE SWITCH DATA
Stackpole Bulletin RC-10D — just out — gives complete ratings, dimensions, modifications, and other specifications for all standard Stackpole Slide Switches. Write for your copy or see your local Stackpole representative

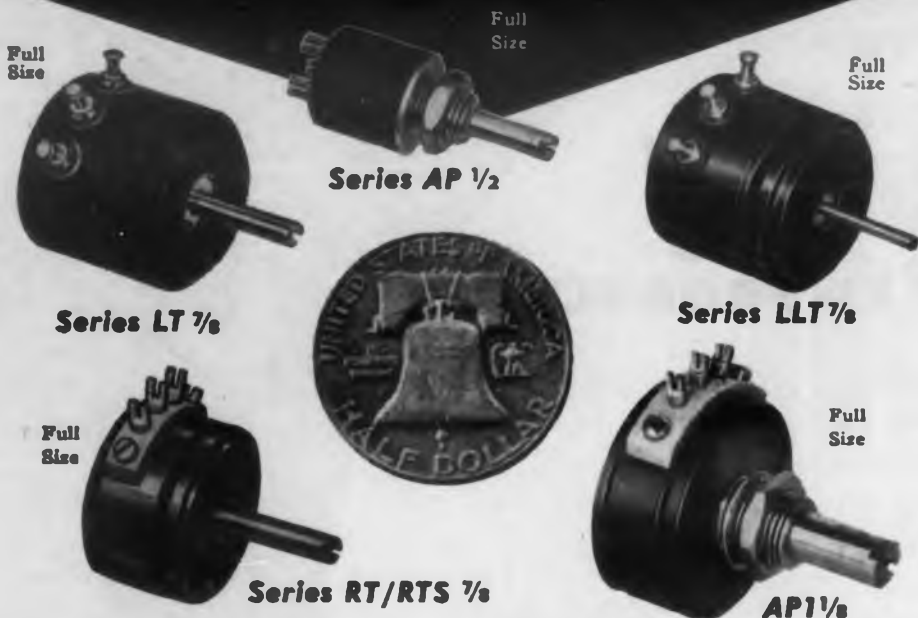
KEY TO CONTACT ARRANGEMENTS

POSITION 1	
POSITION 2	
POSITION 3	
POSITION 4	

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

when you need a
SMALLER "POT"

Try these for size and reliability...



Waters miniature and micro-miniature wire-wound precision potentiometers

are famous for accuracy, ruggedness, dependability and fast delivery in commercial and military uses. They are precision-machined, with anodized aluminum bodies, line-reamed phosphor bronze, ball or jewel bearings, centerless-ground stainless steel shafts, and gold-plated fork terminals; fully sealed and fungus-proofed. To meet your requirements Waters pots can be furnished ganged, tapped, servo or bushing mounts, with various electrical and mechanical angles, optional shaft locks, anti-rotation pins, O rings, and custom shaft or servo dimensions.

Series AP 1/2 — 2 watts continuous at 80°C; resistances 10 to 100,000 ohms, 5% tolerance standard; diameter 1/2", depth 1/2" standard, weight 1/4 ounce; fully sealed for potting.

Series LT/LLT 7/8 — One watt at 80°C; resistances 100 to 100,000 ohms, ball or jewel bearing, for use in computers, servos, and selsyns where minimum torque is required. Weight is only 1/2 ounce; MAXIMUM torque is 0.01 inch-ounce per section. Ganging to six decks, internal clamps hold 7/8" diameter. Standard linearity 0.5%, on special order 0.25% above 1K; toroidal winding allows winding angles to 360°, standard is 354°.

Series RT/RTS 7/8 — 3 watts continuous at 80°C; resistances 10 to 100,000 ohms; diameter 7/8", depth 3/8", weight 1/2 ounce; standard linearity 2%.

Series AP1 1/8 — 4 watts continuous at 80°C; resistances 10 to 150,000 ohms; diameter 1 1/8", depth 1/2", weight less than 3/4 ounce; standard linearity 1%.

Waters has advanced facilities for the design and manufacture of miniature toroidal potentiometers and windings for use in equipment of special design.

Write today for complete information on all Waters potentiometers.

Waters
 MANUFACTURING, inc.

APPLICATION ENGINEERING OFFICES
 IN PRINCIPAL CITIES

Wayland, Massachusetts
 P. O. Box 368, So. Sudbury, Mass.



CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION



**Industrial
Servo-
mechanism
For 60-Cycle
Power**

A modification of a 400-cps servomechanism originally developed for aircraft applications, a new industrial servo, designated Electrolink and designed for 60-cycle supply, has been put on the market for industrial use. Its primary industrial application is expected to be in automation in such fields as material handling, processing, packing and testing. The Electrolink combines the high response and simplicity of electrical servos with the high torque output once confined to hydraulic systems, achieving this result by means of a magnetic-powder clutch. It reaches maximum speed in 1/50 sec, and is accurate to 0.5 deg. Its three basic components are a data link, which converts manually-positioned input into error voltage; an amplifier, which processes signals from the data link and also a velocity signal derived from the servo drive; and the servo drive, which incorporates the integral generator and provides power output to the load. Weight is 16 lb.

Lear, Inc., Dept. ED, Grand Rapids 2, Mich.

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION



**Servomotor Gearheads
For Severe Environments**

Servomotor gearheads of precision quality, constructed to withstand severe mechanical and thermal environments, have been made available from stock in ratios from 10/1 to more than 4000/1. Permanently accurate mesh of motor pinion and first gear is insured by a special flush collar mounting. These gearheads are built of carefully selected materials. They have AGMA Precision Class II or Class III gear form, and ABEC-5 ball bearings. The product is 100 per cent inspected on Schoppe and Fraser gear testers. Designation is: Models G-11, G-15 and G-18 Precision Gearheads.

Feedback Controls, Inc., Dept. ED, 899 Main St., Waltham, Mass.

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION



**Beckman
Servomotor-
Rate Generator**

Snug as two bugs in their unitized stainless steel housing, motor and generator work hand-in-hand on the same shaft . . . to improve response characteristics of suffering servo systems.

Where the trouble is in the dynamics of your system components, watch this purposeful pair roll up their sleeves and go to work. The high torque-to-inertia motor, for instance, responds quickly and accurately to error signals . . . with acceleration at stall up to 100,000 radians/sec.². Signal-to-noise ratio of the linear generator is 25:1 or better. Aiding and abetting each other in their dedicated mission, they'll operate continuously at stall and at total unit temperature from -55°C to 200°C.

Right now, our corrosion-resistant, completely encapsulated Servomotor-Rate Generators are available in sizes 11, 15 and 18. (We'll soon add size 8; eventually, other sizes.) We've got descriptive literature available too. It's data file 335.

Beckman® Helipot
Corporation
Newport Beach, California
a division of Beckman Instruments, Inc.
Engineering representatives
in principal cities

956

CIRCLE 79 ON READER-SERVICE CARD

Temperature Indicator
Has 0.8 sec Full-Scale Response



Already used in aircraft from jet fighters to transports, this rugged null-balance temperature indication system features 1/3% accuracy and 0.8 sec full-scale response. The 2-1/4 in. diam. indicator houses a 13 in. moving vertical scale readable to one degree and excellent for photo-panel work. Standard scale ranges are -100 to 600 F for iron-constantan and 300 to 900 C for chromel-elumel thermocouples. Input power is 45 va at 115 v 400 cps.

Thermocouples can be grounded and long extension leads used. The high-gain amplifier provides threshold sensitivity of 15 μ v, with zero, span, and damping adjustments. Internal reference voltage is supplied by a long-life mercury cell. The indicator is hermetically sealed, and the system operates in ambient temperatures from -65 to 160 F and altitudes to 60,000 ft. Indicator size is 2-1/4 in. diam. x 9 in. long; the control unit, 3-1/4 x 3-1/2 x 7 in. Other scale ranges can be supplied. Handley Electronics, Inc., Dept. ED, 14758 Keswick St., Van Nuys, Calif.

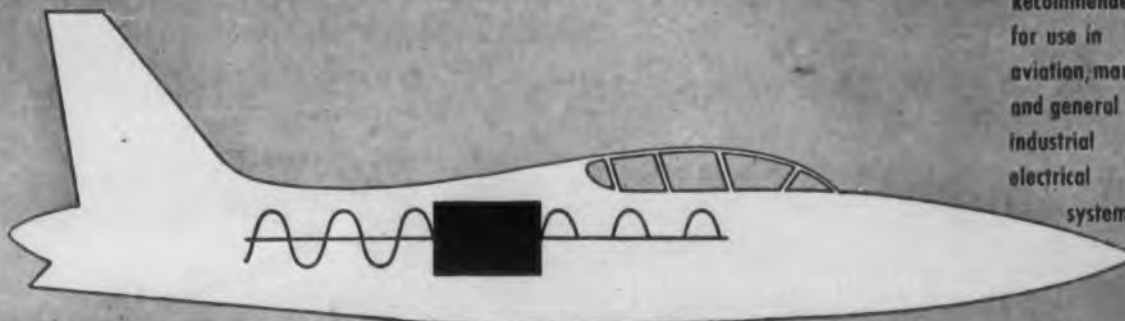
CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Curve Tracer
Has Many Laboratory Uses



The Model BCT 300 transistor curve tracer is for designing transistor circuits; comparing matching and selecting transistors; detecting anomalies; studying effects of temperature, age, normal usage and over-loading; and for detecting failures and cause. The unit is flexible and permits testing on all types in forward or reverse direction; it plots the entire family of curves on a standard laboratory dc oscilloscope. Measurements can also be made upon many other circuit components and circuits. Norden-Ketay Corp., Dept. ED, 99 Park Ave., New York, N.Y.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION



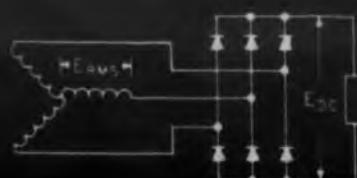
Recommended for use in aviation, marine and general industrial electrical systems.

WN-5051 and WN-5091 with maximum peak inverse voltage ratings of 50-350 v. (up to 200 amperes in bridge assemblies).

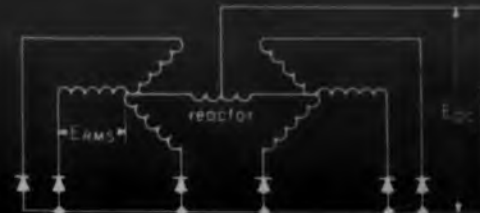
TYPICAL RECTIFIER CIRCUITS



Single phase full wave (center tap)



Three phase full wave bridge



Six phase half wave



WN-5082 with maximum peak inverse voltage ratings of 50-300v. (300 to 5000 amperes in bridge assemblies.)



For space-reducing design where large blocks of D.C. power are required.

Westinghouse SILICON^(SI) Rectifier cells pack more power in a smaller package!

Recommended for greater reliability, highest efficiency and lowest cost

For the progressive design or application engineer in power, control or electronics . . . for anyone who builds or specifies rectifier assemblies and is constantly seeking equipment design and operational improvement that:

- Provides more power in a smaller space
- Lowers installation cost
- Insures minimum maintenance
- Results in no detectable aging
- Makes possible high ambient temperature operation
- Improves A.C. to D.C. conversion efficiency

Westinghouse Electric Corporation
Semi-Conductor Division, Dept. ED
Youngwood, Pa.

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

7ET-4101

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

positive mechanical drive

for greater accuracy
in graphic data
recording

MODEL 200-A for resistance inputs

LIBRASCOPE'S UNIQUE "FLOATING GEAR TRAIN,"
and conservatively rated conventional
vacuum tube and harness circuitry
result in static accuracy of 0.1% and dynamic
accuracy within 0.5% of full scale,
at a tracking rate of 5 inches per second.

The Librascope Models 200-A and 200-B XY Plotters are engineered for accuracy, rapid response, and ease of operation. The positive mechanical drive of the Floating Gear Train eliminates lost motion, cable stretching or alignment adjustments, normally found in the cable tape or lead screw type of drive. The new, simplified plotting pen of one-piece design—used for point or continuous plotting—eliminates bottles and tubes—permits rapid changing of ink colors. Easy to load and always visible, the plotting table accepts paper up to 11" x 17". Point plotting or curved tracing is accomplished with equal ease with one-second full scale response. A variety of input accessories are listed below.



LIBRASCOPE PUNCHED CARD CONVERTER
Provides for the conversion of data read from IBM punched cards into analog signals that the MODEL 200-A Plotter can record as traces.



LIBRASCOPE PUNCHED TAPE CONVERTER
Converts the digital information read from punched paper tape into electrical signals suitable for the control and actuation of a MODEL 200-A Plotter.



LIBRASCOPE X-Y DECIMAL KEYBOARD
Consists of three-decimal bank for each axis with associated plus minus keys. Features Librascope designed positive action self-wiping contacts.



LIBRASCOPE BINARY CONVERTER
Translates X and Y coordinate information received in the form of binary signals into analog signals for automatic point plotting by a MODEL 200-A Plotter. Has a capacity of nine binary digits and a resolution of one part in 512.

Career opportunities exist at Librascope for qualified engineers, physicists and mathematicians. Learn about Librascope's new "Creative Project Development Teams." Contact Glenn Seltzer, Employment Manager.

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CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Coaxial Termination 900 to 10,000 Mc



A high power coaxial termination for the 900 to 10,000 mc frequency range, Model 369, has a power rating of 200 w average and 50,000 w peak. It is provided with heat-dissipating cooling fins.

Capable of withstanding temperatures in excess of 500 F, the terminating element is a long tapered molding of Narda-Iron which results in a vswr of 1.10 over the entire frequency range and in even distribution of the power dissipation along the length. Narda-Iron consists of powdered iron dispersed in plastic and cast to shape.

Model 369 is useful for terminating directional couplers and other devices in high power systems in actual operation or for test purposes. The termination is 11 in. long and is available with a type N female connector.

Narda Corp., Dept. ED, 160 Herricks Rd., Mineola, N.Y.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

Control panel configuration of MODEL 200-B for DC signal input

MODEL 200-A can utilize any external resistance potentiometer as an input transducer associated with each axis. Independent 10 to 1 scale expansion and origin positioning controls are provided. Facilities for external control of the pen drop solenoid and for simultaneous control of external equipment through switch closures, are provided.

MODEL 200-B, used for DC signal input, has full-scale sensitivities of five millivolts and an input impedance of 1,000 megohms in the millivolt scale ranges. Drift-free operation is assured by chopper-stabilizing the voltage inputs against an Epply standard cell reference.



READILY ADAPTABLE FOR RACK MOUNTING

Librascope XY desk model plotters are readily adaptable for mounting in standard RCA and RMA racks, for which accessory hardware is available at slight extra cost.



△ Magnetic
Forms
Flexible Plastic

This flexible ferromagnetic plastic is in rod and tape form. Rod diameter sizes are 1/8, 3/32 and 1/4 in. The tape is 1/2 in. wide and stocked in thicknesses of 4, 8, 16 and 32 thousandths of an inch. Several sizes are available in production quantities. Not a magnetic recording tape, this iron powder product is as flexible as paper and possesses good dielectric strength, constant magnetic permeability over a wide range of frequencies and good moisture and temperature resistance. Ferrotron has good magnetic and physical stability at 100 per cent relative humidity. The magnetic permeability is constant up to about 3000 mc. It has a positive temperature coefficient of both Q and magnetic permeability.

The Polymer Corp. of Pennsylvania, Dept. ED, Reading Pa.
Radio Engineering Show, Booth 4309.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Ratio Plotter
Automatic Continuous

This unit plots a vibration transmissibility curve strip chart form during a vibration test cycle. Any laboratory dynamic testing that is a function of a ratio which can be indicated by two ac voltages can be plotted automatically and continuously. These varying ac voltages are fed to the T/plotter from two transducers and are plotted as one continuous curve on a strip chart.

A range of four full-scale settings permits plotting of ratios from 0 to 2, 0 to 1, 0 to 10, and 0 to 100. Ranges for the ratio's denominator are 0 to 20, 0 to 10, 0 to 100, 0 to 200, 0 to 500 mv, and 0 to 1, 0 to 2, 0 to 5, and 0 to 10 v. Frequency response is ± 2 per cent from 5 to 2000 cps, $\pm 2\frac{1}{2}$ per cent from 2000 to 4000 cps. Chart speed is variable from 6 to 960 in. per hr. in 16 steps.

Barry Controls, Inc., Dept. ED, 935 Pleasant St., Watertown 72, Mass.
Radio Engineering Show, Booth 2534.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION



△ 400 cps
Frequency Standard
Low Distortion

The Model 1400 uses a stabilized tuning fork to generate 400 cps with an accuracy of .005 per cent. Other frequencies are available on request. A front panel control permits continuous variation of the output voltage. The distortion is less than 1 per cent in a compact unit of 6 x 9 x 6 in. Completely self-contained, it requires a power supply of 115 v, 60 cps.

Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N.Y.

Radio Engineering Show, Booth 3229.

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

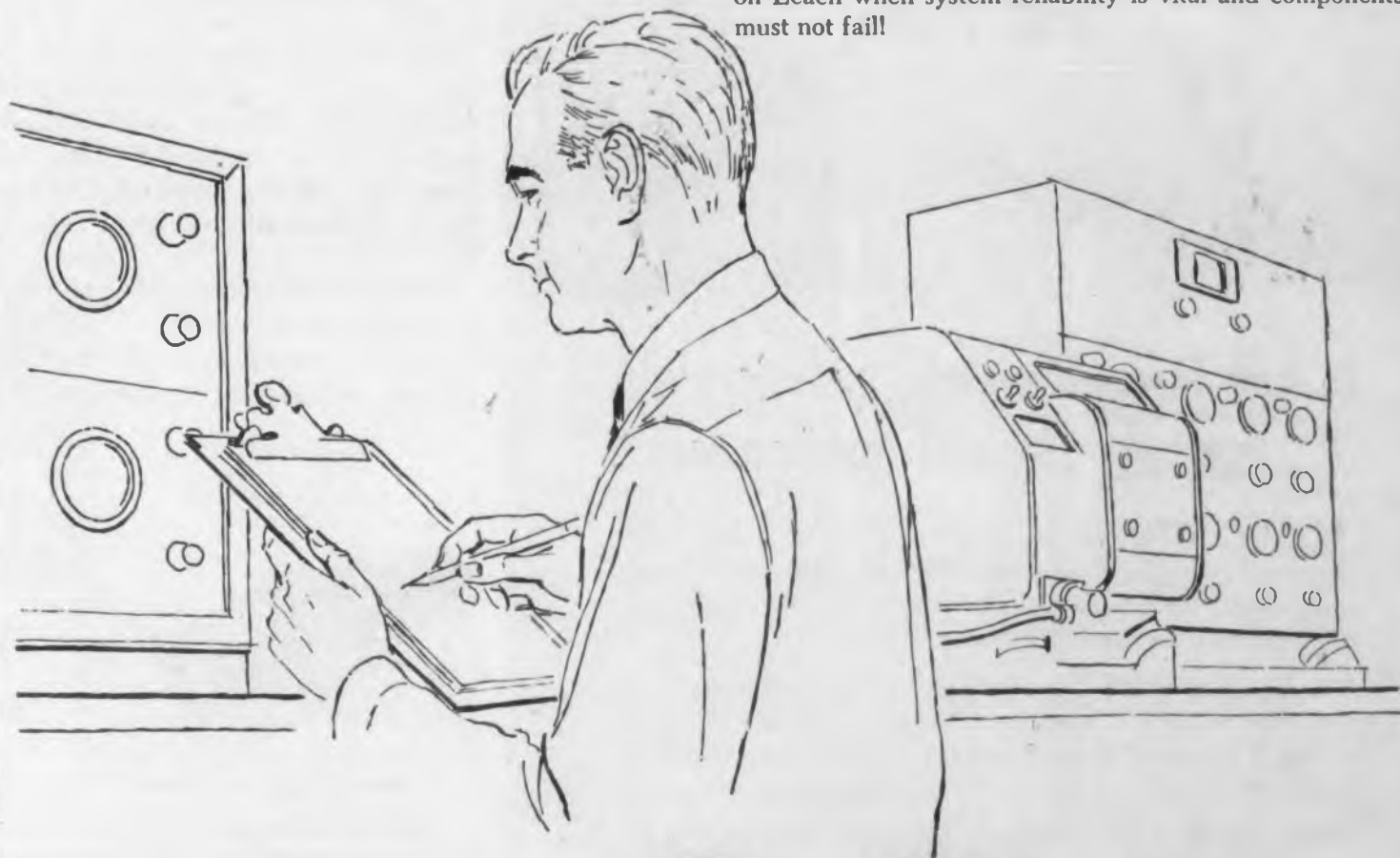
Compare LEACH before you buy

Your own tests will prove why so many critical buyers specify Leach relays

Test any Leach relay against any comparable relay on the market. You'll learn in your own laboratory why the aircraft, missile and avionic industries have learned to look for the Leach label when they're looking for:

- Resistance to greater shock and vibration
- Dependability at higher temperatures
- Space-saving design
- Outstanding reliability

That's why you find designers depending more and more on Leach when system reliability is vital and components must not fail!



Screw terminals



Potted leads



Solder terminals



Plug-in

Leach's family of relays... offering the important advantages emphasized above

LEACH CORPORATION | LEACH RELAY DIVISION

5915 AVALON BLVD., LOS ANGELES 3, CALIFORNIA

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Send for the latest Leach Relay Handbook... your best starting point when selecting any relay.



This ounce of prevention *cures* thread failures



in non-ferrous metals, plastics, etc. ... Tap-Lok, the self-tapping insert

Fabricators of aluminum, magnesium, plastics, etc., have found that Tap-Lok Inserts provide the most practical solution to the problem of increasing the thread-holding strength of comparatively weak materials.

The Tap-Lok Insert is designed as a permanent fastener in materials which are machinable but of insufficient shearing strength to sustain applied loads in threads tapped directly into them.

These internally and externally threaded bushings of steel or brass increase shear area and allow full utilization of the tensile strength of threaded fasteners in the materials in which they are used.

Their unique self-tapping feature substantially reduces assembly costs by eliminating separate tapping operations, hole preparation, secondary staking.

Used widely as original equipment, Tap-Lok Inserts are also ideal for salvage and repair of stripped threads.

Send for your free copy of our new 12 page booklet on Tap-Lok Inserts.
Also manufacturers of Groov-Pins for positive locking press fit.

GROOV-PIN CORPORATION

1125 Hendricks Causeway

Ridgefield, New Jersey

Representatives in principal cities throughout the U. S. A.

IN CANADA: Metal and Wood Fastening Devices Co., Valois, Montreal

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION





△ **Wire Tagger and Stripper**
Automatic

This machine automatically measures, cuts, strips wire leads and also attaches an aluminum identifying tag at the rate of 3000 pieces per hour. It is adjustable to cut strip wire to predetermined lengths of from 4 to 194 in. Each tag is marked and cut from a continuous roll of blank aluminum material. As the machine operates, it automatically attaches the metal identifying tag anywhere along the length of the wire at each feeding stroke, if desired, the maximum distance apart being 15 in. The attaching unit is designed to take interchangeable stamps for different markings. This machine weighs 700 lb. Its over-all dimensions are about 55 x 80 x 35 in.

Artos Engineering Co., Dept. ED, 2757 S. 28th St., Milwaukee 46, Wisc.

Radio Engineering Show, Booth 4228.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Cathode-Ray Tube**
Fast Response

Used to investigate very high speed phenomena like nuclear bombardment, this tube's response is so fast its limitation has not yet been defined. The spot velocities have exceeded the speed of light. For typical operating conditions, post-accelerator voltage of the electrostatic is 30,000 v and accelerator voltage is 7500 v. When operated at these voltages, the linear post-accelerator offers deflection sensitivities of 225 to 270 v dc per in. on the X-axis and 155 to 190 v dc per in. on the Y-axis. Number 11 phosphor is used on the 5-in. screen.

The tube has a Mumetal shield. It is 21 in. long, and under typical operating conditions the post-accelerator current is 112.5 μ a dc maximum, and focusing electrode voltage is 2000 to 3200 v. Grid No. 1 voltage is -75 to -125 v.

Allan B. Du Mont Labs., Inc., Dept. ED, 2 Main Ave., Passaic, N.J.

Radio Engineering Show, Booth 3201-03, 3301-07.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

PORTABLE

DC VTVM

has 200 microvolt sensitivity
and 10^{14} ohms input

THIS little instrument measures transistor and electrochemical potentials, voltages of charged capacitors and dc amplifiers, and voltages at the summing points of analog computers. It can be most useful in measuring low currents in semiconductors, ion chambers, and photocells. It also may be used to test insulation leakage and volume resistivity.



BATTERY-OPERATED, the Model 200B has voltage ranges of 0.008, 0.02, 0.08, 0.2, 0.8, 2, 8 and 20 volts full scale of either polarity. Accuracy is within 2%. Accessories permit measuring currents as low as 5×10^{-14} ampere, resistances above 10^{16} ohms, and voltages up to 20 kv.

DESIGN FEATURES include excellent zero stability, a polarity reversing switch, 500 hours useful battery life, and a constant zero from range to range.

DETAILED DATA on the Model 200B is now available in Keithley Engineering Notes, Vol. 4 No. 1. Your copy will be sent promptly upon request on your company letterhead.

KEITHLEY
INSTRUMENTS, INC.
12415 Euclid Ave., Cleveland 6, Ohio

CIRCLE 92 ON READER-SERVICE CARD

Engineers have always been VIP's at GPL

At General Precision Laboratory engineers are very important people indeed. They have *always* been—in this advanced electronics organization that was founded by top scientists and has been run by them ever since.

As you would expect with this type management, the basic operating policies of the Lab put continuing emphasis on availability of the most advanced equipment . . . small research teams that give every man a chance to know what he can do . . . following each other closely . . . prompt recognition.

The brilliant work of its engineers has brought the Company into front rank in little over a decade. A few notable GPL achievements: airborne navigation systems that are the most accurate in operational use today . . . stereophonic sound reproduction equipment that pumped fresh life into the motion picture industry . . . closed-circuit television systems so flexible and so simple that they find new fields of usefulness every day.

Success means growth—growth in both the size and the range of our activities. We need more engineers and scientists with a solid background in advanced electronics, creativeness and the perseverance and practical know-how that transform bright ideas into realities.

For such men we have unusual opportunities—opportunities that not only provide notable returns in pay and benefits now, but that also build lifetime careers. If you are such a man, we are interested in knowing about you—what you have done and what you hope to do. Currently, GPL seeks engineers interested in:

**Missile Guidance,
Radar Navigation
and Bombing Systems
(Doppler & Inertial)**

Research • Development • Applications
Systems Analysis • Systems Test
Administrative Engineering • Mechanical Packaging
Field Engineering • Technical Writing
Component Specification and Test
Production Follow-Up

Computers • Magnetic Amplifiers
Servos • Microwave Techniques
Pulse Circuitry • Transistorization

Write Richard D. Hoffman, Employment Manager. Interviews can be arranged for any time, including weekends. We will pay expenses of qualified applicants.

in semi-rural Westchester,
just one hour
from New York City

GPL

General Precision Laboratory
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△ Arming Solenoids
Very Compact

These arming solenoids are designated PA-1193, and meet the requirements of MIL-S-4040A and MIL-E-5272A. When the solenoid is energized by 15.5 to 28 v dc the arming pin projects. It will support a 100 lb ring-hung load. When the solenoid is deenergized the pin retracts under a 5 lb ring-hung load. Dimensions are 1.6 in. x 1.6 in. x 0.9 in.; weight 4 oz.

United Transformer Corp., Pacific Div., Dept. ED, 4008 W. Jefferson Blvd., Los Angeles 16, Calif.
Radio Engineering Show, Booth 2413, 14.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Transistors
For Audio Power

The alloy-junction transistor RCA-2N270 is intended particularly for use in large-signal audio-frequency applications, such as single-ended or double-ended power output stages and high-gain class A driver stages of radio receivers and audio-frequency amplifiers. This germanium pnp transistor has flexible leads and is hermetically sealed in an insulated metal case having a length of 0.375 in. and a maximum diameter of 0.360 in.

In class A amplifier service, a single 2N270 can deliver a maximum-signal power output of approximately 60 mw with a power gain of 34 db. In class B push-pull arrangement, two 2N270's can deliver a maximum-signal power output of approximately 500 mw with a power gain of 32 db.

The current transfer ratio of this transistor is nearly constant over the full range of the output-signal swing, even when the peak output-signal current reaches the peak collector current rating.

Radio Corp. of America, Dept. ED, Semiconductor Div., Somerville, N.J.
Radio Engineering Show, Booth 1602, 07.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCUIT

INSTRUMENTS INC.

moisture-sealed POTENTIOMETERS

keep moisture, dust, and price in line

Once you use these Model H-MS Potentiometers, you'll see why it pays to call upon CIRCUIT INSTRUMENTS for all your requirements. CIRCUIT INSTRUMENTS is big enough to engineer the latest refinements in potentiometers. But it is small enough to keep production procedures highly flexible. This means greater ease in obtaining special features . . . greater assurance of obtaining quick deliveries.



MODEL H-750-MS
POTENTIOMETER
(actual size)

EFFECTIVE SEALING . . .

The next best thing to hermetic sealing. Model H-MS more than meets JAN-R-19 moisture and humidity requirements. Its all-metal case is rolled and securely bonded at the joints. Terminals are glass sealed. The shaft is sealed by means of an "O" ring.

WIDE CHOICE . . .

Model H-MS is yours in 1/4", 1" or 1 1/2" standard case sizes . . . in 1, 5 or 10 turn design . . . with resistance values from 50 to 400,000 ohms . . . with a wide spread of tolerances . . . in 2 or 3 watts or higher . . . with many special features.

CIRCUIT
INSTRUMENTS INC.

Subsidiary of
INTERNATIONAL RESISTANCE COMPANY

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCUIT INSTRUMENTS INC.

Dept. D

P.O. Box 1438, 2801 Anvil St., North St. Petersburg 1, Florida

Send data sheets on Moisture Sealed Hermetically Sealed
Helical Servo Sub-Miniature High Temperature
High Precision Potentiometers.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____



1460 series
MOTOR OPERATED
Available SP2T thru SP6T—also DPDT and DP transfer. Frequencies thru 11,000 MC, AC or DC operation.



M1460 series
MANUALLY OPERATED
—same contact arrangement and R F head as the 1460 Series. For chassis or panel mounting.

TRANSCO

COAXIAL SWITCHES

—they simplify design of R F systems



11000 series
SOLENOID OPERATED
Miniature - SPDT
HN or Type N connectors. Frequencies thru 11,000 MC, AC or DC operation. Weight 6 oz.



SOLENOID OPERATED
Miniature - SPDT
Frequencies thru 11,000 MC. Designed for wide applications. Frequency.

PROJECT ENGINEER OPENING FOR R. & D. ELECTRONICS

Engineer on Microwave Antenna Systems with Southern California leader in Avionics. Excellent company benefits. Address inquiries to Personnel Director.

With TRANSCO switches, you can cut down the number of components in a system—one switch handles up to 6 circuits. TRANSCO switches are small, and light in weight. Each is supplied in a choice of configurations to simplify installation.

Adds versatility to a system. All channels on a TRANSCO can be operated independently, and there's a wide variety of make-and-break arrangements available. TRANSCO switches operate through 11,000 MC—a standardization which cuts your stocking requirements to only one switch for this entire R F band width.

High-efficiency switching is due to minimum insertion loss, low VSWR, and high isolation between channels. TRANSCO units are qualified to applicable military specifications. Performance has been fully confirmed in the field, where thousands of units are giving dependable service.

Technical data on any unit or the complete line sent on request. Send us your coaxial switching problems.

TRANSCO PRODUCTS, INC.
The Finest in R F System Components
12210 NEBRASKA AVENUE, LOS ANGELES 25, CALIFORNIA
REPRESENTATIVES IN MAJOR AREAS

CIRCLE 97 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Subminiature Potentiometer**
HV Breakdown

The Model C-050, a precision 1/2 in. diam. potentiometer, has a one piece nickel plated bronze case and bearing, sealed silicone fiberglass cover with end mounted terminals, and an "O" ring sealed shaft if required. The voltage breakdown between shaft and terminals is 1000 v ac. Standard electrical rotation is 320 deg, mechanical rotation is 325 deg with stop or continuous 360 deg. Standard shafts are 0.125 diam. ground and passivated stainless steel.

DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.
Radio Engineering Show, Booth 3911-13.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION



△ **Sensitive VTVM**
Dual and Differential Input

The instrument measures dc from two mv to 1,000 v with 121 megohms input resistance, and ac from below 50 cps to ultra-high frequencies. As an ohmmeter, the scale of the Type 405 is calibrated from zero to 500 with eight multiplier ranges—X1 to X10 Meg.

Either ac or dc voltages may be measured by flipping a front panel switch. The instrument can be zeroed without having to disturb the circuit being measured. Circuit ground is insulated from instrument panel ground to permit measurement of differential dc voltages. A nine-position switch on the front panel allows dc voltage measurements through calibrated ranges from 100 mv full-scale to 1000 v full-scale, with 121 megohms input resistance. The instrument measures ac from 100 mv full-scale to 300 v full-scale. A low frequency probe is useful from below 50 cps to vhf for measurements from 100 mv to 300 v. The third probe, a crystal type for wide band use, is used to measure ac from 50 cps to uhf. Measurements from 10 mv to 30 v can be obtained within this frequency range.

Allen B. DuMont Labs, Inc., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.
Radio Engineering Show, Booth 3201-02-03, 3301-03-05-07.

CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION

SANDERS Model 2 Phase Comparator



...can be used as a modulator, demodulator or switch

This compact, rugged comparator is hermetically sealed in an inert gas and packaged for mounting in a standard octal socket. Two full-wave bridge rectifiers are used to obtain a high degree of stability and balance.

As phase sensitive comparators, these units can be used to measure the amplitude or phase of an input signal with respect to a reference signal. As demodulators, DC output can be obtained either single-ended or push-pull with respect to ground. Suitable for all military applications.

SPECIFICATIONS

Frequency Response: 0 to 5000 CPS;
Max. Reference Voltage: 120V. RMS;
Max. Output Voltage: ± 50V. DC;
Dynamic Range: 46 db; **Load:** Max. 200K ohms, — Min. 20K ohms; **Input Impedance:** Approx. 200K ohms with 200K ohms load and 1:1 transformer.
Size: 1" dia. x 3"; **Weight:** 2 ozs.

Write for data sheets to Dept. ED-3



CIRCLE 100 ON READER-SERVICE CARD

IF

**PRECISION
MANUFACTURING
IS YOUR
REQUIREMENT**

... then
Boehme practical experience
in the design and
manufacture
of mechanical, electrical
and electronic products
for automation and
instrumentation can
solve your
most exacting demands.
Learn more about Boehme's
prompt, efficient, economical
service
and how readily it applies
to your needs.



O. Boehme, Inc.
Designers and Manufacturers
Communication Equipment
Precision Electro-Mechanical
Apparatus Since 1917
5 Broadway
New York 10, N.Y.



CIRCLE 101 ON READER-SERVICE CARD



**Differential Pressure
Pickup
For Corrosive Fluids**

A differential pickup in which a dry strain-gauge element is isolated from the pressurized fluid, this unit may be used with corrosive or conductive fluids. Pressure differences are transmitted from a single diaphragm through a mechanical linkage to an unbonded strain-gauge element capable of high-frequency performance. Only teflon and No. 18-18 stainless-steel parts come in contact with the pressurized fluid. Models are available for sensing pressure differentials from $\pm 1/2$ psi to ± 1000 psi at line pressures up to 2000 psi.

The output signal resulting from a line pressure of 2000 psi is less than 1 per cent of full-scale output. Resolution is better than one part in 2500. Pressure inputs are made through 1/8 in. pipe thread connections at either end of the pickup case. Standard units operate with either ac or dc excitation at 6, 12 or 15 v, with bridge resistances at 350, 600 or 800 ohms and minimum full-scale outputs of 20, 40 or 50 mv respectively. Measurements are accurate to 0.5 per cent of full scale at 70 F. Insulation resistance from pickup case to ground is 100 megohms minimum, and hysteresis is less than 0.5 per cent of full scale. Temperature range is -65 to $+350$ F.

Dynamic Instrument Co., Inc., Dept. ED, Cambridge, Mass.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION



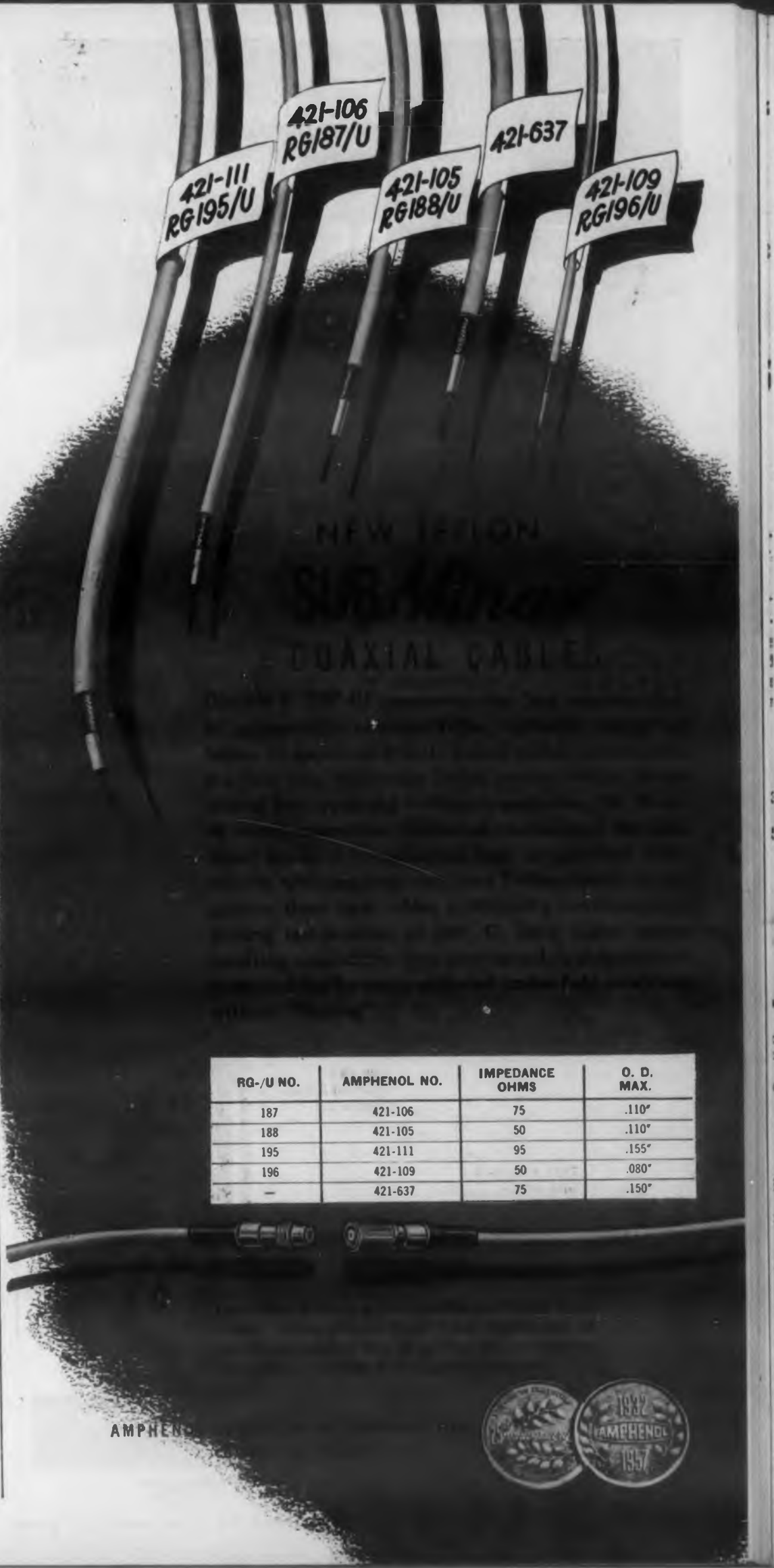
**△ Variable
Auto-Transformer
Compact**

A toroidally wound variable transformer with a maximum load rating of 165 va, the PA-1 measures 3-7/8 x 3-7/8 x 3-1/2 in. It has a maximum output current of 1.25 a and a continuously variable voltage output from 0 to 132 v ac.

Standard Electrical Products Co., Dept. ED, 2240 E. Third St., Dayton 3, Ohio.
Radio Engineering Show, Booth 3805-3807.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 104 ON READER-SERVICE CARD >



RG-/U NO.	AMPHENOL NO.	IMPEDANCE OHMS	O. D. MAX.
187	421-106	75	.110"
188	421-105	50	.110"
195	421-111	95	.155"
196	421-109	50	.080"
-	421-637	75	.150"

AMPHENOL



The Vacuum Switch Goes to Work IN HIGH VOLTAGE DC CIRCUITS



Years of experimentation and commercial usage have demonstrated that Jennings vacuum switches can interrupt many dc circuits that cannot be easily handled in any other way. They can "make" the high inrush currents that occur when capacitor banks are discharged and they can interrupt the fault currents that occur during the flashover of a power tube in a transmitter.

DC power supplies are now being switched "hot" from low power levels up to 250 kw under either normal or overload conditions. Overcurrent protection is excellent since operate times are only 4 to 10 milliseconds and deionization of the arc is extremely rapid in a high vacuum. Likewise, high voltage isolation, capacitor discharge, or safety grounding is easily accomplished with contact travels of no more than 1/8" regardless of voltage level. This makes possible solenoid actuating mechanisms that are simple in design and lend themselves to completely automatic operation.

Please send us your circuit conditions. We can suggest vacuum switches that will solve most difficult dc switching problems.

TYPE R8G
Overload Circuit
Breaker

TYPE R1G N/O
with 40 kv
insulation



TYPE RH7 85 kv
N/C Grounding
Relay



TYPE RH1G N/O
for dc interruption
up to 200 kw



JENNINGS RADIO MANUFACTURING CORPORATION • 970 McLAUGHLIN AVE.
P.O. BOX 1278 • SAN JOSE 8, CALIFORNIA

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Trimmer
Capacitor
Telescoping
Assembly

This miniature trimmer piston capacitor ranging in capacitance from 0.8 to 8.5 μf has a telescopic tuning assembly which cuts down the over-all length by nearly 50 per cent, to 9/16 in., panel mounted. It has an alloy undercoat that protects all metal parts from corrosion and permits use under extreme environmental conditions. A micro-vernier adjustment of approximately 0.7 μf per turn with no tuning reversals is provided. The VC20G uses glass dielectric cylinders processed to provide electrical properties with no derating to ± 25 C.

JFD Manufacturing Co., Inc., Dept. ED, 6101 16th Ave., Brooklyn 4, N.Y.
Radio Engineering Show, Booth 2333.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION



High Speed Relay
For DC Applications

Intended for dc applications, this relay can also be energized in ac circuits by use of selenium or other diodes. Operating time is as fast as 2 milliseconds. Type 120 is available either open or sealed into a dust cover. Contact combinations range from spst to tpdt. Power requirements may be from 0.25 to 2.5 w, depending on speed requirements. Standard coils are from 0.01 to 30 k ohms, with special windings available up to 100 k ohms.

Contact capacity of the Type 120 is 1 amp inductive to 3 amp resistive at 115 v ac or 29 v dc (a companion unit, designated Type 140, can be supplied with inductive contact capacities up to 10 amp). Dropout can be adjusted to within 85 per cent of pickup. Contacts of silver, palladium, gold alloy, etc., are available. Headers can be supplied with solder lugs, plug-in contacts, or other contacts as specified. Cans may be either round or square. The round can measures 1-1/4 in. diam x 3-1/4 in. above mounting line.

General Automatic Corp., Dept. ED, 12 Carlton Ave., Mountin View, N.J.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

STRAITS TIN REPORT

New developments in
the production, mar-
keting and uses of tin



Malaya's 780 active mines produced 62,295 long tons of tin-in-concentration in 1956, the most since 1941. Output continuing at a high level in 1957.

Straits tin is shipped from Malaya to the United States by three routes other than via Suez; so the closing of the canal has resulted in only slight delay in transit to Atlantic and Gulf ports, not to Pacific ports.

Straits, the world's best-known and most widely used grade of tin, is used in producing the tin plate for 9 out of every 10 tin cans made in the United States.

A new process for coating steel strip with tin was recently developed by the British Iron & Steel Research Association. Instead of being dipped in molten tin, the strip is passed between two rollers which convey tin from molten baths to both sides of the steel.

All of the millions of motor vehicles manufactured in the United States in 1956 contain tin—about 8000 long tons. New high-tin solders with unusually long life at temperatures as great as 223°C have been developed for use in automobile radiators having operating pressures up to 16 psi.

A newly discovered alloy of zirconium (4%) and molybdenum (1.6%) has four times the creep strength of pure zirconium at 930°F. This alloy can be readily rolled at 1470°F., and can be heat-treated to a strength of 140,000 psi.



Ask us to send you THE NEWS, a monthly publication. It will keep you posted on tin supply, prices, uses, and applications.

The Malayan Tin Bureau
Dept. 13C, 1028 Connecticut Ave., Washington 6, D.C.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

ON THE SHELF!

SINGLE SPIDER GEAR DIFFERENTIALS

by FORD INSTRUMENT



AVAILABLE IN FOUR SIZES:
1/8", 3/16", 1/4", and 5/16" Shaft Diameters

NOTE! Prices of 1/8" units have been drastically reduced.

GUARANTEED SHIPMENT WITHIN:

WITHOUT END GEARS)	TYPE
WEEK for units with set shaft lengths"	A
WEEKS for units with shaft lengths to customer specs	B
WITH END GEARS)	
WEEKS for units with stock end gears	C
WEEKS for units with end gears to customer specs	D

(SUBJECT TO PRIOR SALE)
Note: 3/16" units are not stocked with set shaft lengths.

Ford Instrument produces single spider gear differentials to highest military and commercial standards, for extreme accuracy in addition and subtraction, and in two loop applications. Even ways superior. Call or wire W. Mohr, Component Sales Division (Stillwell 0000) for prices, or check and mail coupon below, stating quantity. Data bulletin with performance curves and characteristics will be sent with the prices.



Component Sales Division ED FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION
10 Thomson Avenue, Long Island City 1, N. Y.

Please send me prices on the following:

Circle size of unit desired:

1/8" 3/16" 1/4" 5/16"

Circle category for type of units needed:
(Check two if both apply)

A B C D

I want _____ (number) units:

Name _____

Address _____

Company _____

City _____

State _____

Zip _____

CIRCLE 109 ON READER-SERVICE CARD

D-C to D-C Converter Lightweight 50 w Unit



This transidyne non-mechanical converter steps up dc voltage from 27 v to 250 v. It is used as a plate supply for receivers and transmitters, and can be useful wherever dc is needed, as in missiles and other airborne systems. Weight is only 12 oz, yet the output at 250 v is 200 ma, or 50 w. Dimensions are 2-1/2 in. in all directions. The operating principle involves conversions of dc to a square wave a-c signal, voltage step-up by a transformer, and rectification of the transformer output. Minimum efficiency is 80 per cent. Starting time is 10 milliseconds; with constant input the maximum no load to full load variation is 8 per cent. Operating ambient temperature is +85 C. Since there is nothing to wear out, no maintenance is needed.

Nader Mfg. Co., Dept. ED, 2861 Myrtle Ave., Monrovia, Calif.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Waveguide Castings For All Bands

Waveguide castings such as the rotating elbow here pictured are produced of Antioch Process aluminum to meet exacting requirements in all bands. They include directional couplers, duplexers, power dividers, antenna feed horns, rotating joints, elbows and transition sections.

Morris Bean & Co., Dept. ED, Yellow Springs, Ohio.

Radio Engineering Show, Booth 3240.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION



Specially aged and ruggedized for high-performance applications

Bendix
Red Bank

RELIABLE TUBES

FEATURING "LONG LIFE" CATHODE



The solid alumina oxide insulator, coiled heater, and sleeved heater legs combine to eliminate heater-cathode shorts and reduce heater-cathode leakage, thus providing unparalleled operating dependability.



TUBE TYPE	5838	5839	5852	5993	6106	6754
Type	6X5	6X5	6X5	6X4	5Y3	412A
Prototype	TE-3	TE-2	TE-5	TE-10	TE-22	TE-36
Bendix No.						
Class	Full Wave Rectifier Octal T-9	Full Wave Rectifier Octal T-9	Full Wave Rectifier Octal T-9	Full Wave Rectifier 9-Pin Miniature	Full Wave Rectifier Octal T-9	Full Wave Rectifier 9-Pin Miniature
Base and Bulb						
TYPICAL OPERATING CONDITIONS						
Heater Voltage	12.6	26.5	6.3	6.3	5.0	6.3
Plate Volts Per Plate	350	350	350	350	350	350
mA Load	70	70	70	70	100	100

Type	5992	6385
Prototype	6V6	2C51, 5670
Bendix No.	TE-8	TE-21
Class	Beam Power Amplifier Octal T-9	Double Triode 9-Pin Miniature
Base and Bulb		
Heater Voltage	6.3	6.3
Plate Voltage	250	150
Screen Voltage	250	—
Grid Voltage	-12.5	-2.0
Gm	4000	5000
Plate Current	45mA	8mA
Power Output	3.5W	—

HARD GLASS TUBES			
Type	6094	6384	6754
Prototype	6AQ5, 6005	6AR6	412A
Bendix No.	TE-18	TE-27	TE-36
Class	Beam Power Amplifier 9-Pin	Beam Power Amplifier	Full Wave Rectifier 9-Pin
Base and Bulb	Miniature	Octal T-9	Miniature
Heater Voltage	6.3	6.3	6.3
Heater Current	0.6 Amp.	1.2 Amp.	1.0 Amp.
Plate Voltage	250	250	350
Plate Current	45mA	77mA	—
Screen Voltage	250	250	—
Grid Voltage	-12.5	-22.5	—
Gm	4100	5400	—
Power Output	4.5W	8.5W	—
Load Current	—	—	100mA

The above three tubes incorporate hard glass bulbs for high-temperature operation (maximum bulb temperature 300°C).

Present-day military aircraft and missiles require electron tubes that are highly dependable under extremely severe operating conditions. And building such tubes is our specialty. Bendix Red Bank Reliable Tubes are rugged enough to withstand continuous vibration, varying voltages and frequent shock. For details on regular, or special-purpose, tubes to meet your specific needs, write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales and Service:
117 E. Providencia Ave., Burbank, Calif.

Export Sales and Service:
Bendix International Division,
205 East 42nd St., New York 17, N. Y.

Canadian Distributor:
Aviation Electric, Ltd., P. O. Box 6102,
Montreal, Quebec.



CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

#1 in a series . . . on
the new science of
cable-tronics



fulfillment
of the
missile task
(aircraft too)
relies on
cable

©1957 Douglas Roesch

For a missile to realize its inherent reliability factor every system component must "be in tune." The burden of sensitive and complex electronic functions multiplies the problems. The inadequacy of conventional electric cabling, using standard jacketing concepts, is now recognized. Hence there has arisen the demand for "cable-tronics"—the new systems design concept of *true electronic cable structures* to meet specific requirements.

D.R., "cable-tronic" pioneers, are equipped to custom fabricate complete systems from cable spinning through connectors... molded breakouts... metal work... fasteners... testing and assembly to your specifications or research and design systems to meet your requirements.

Write for complete facilities brochure.
Rep inquiries invited.

Engineers, investigate your future with Douglas Roesch

Douglas Roesch CABLE DIVISION
of

HALL-SCOTT
INCORPORATED

2950 NO. ONTARIO ST.
BURBANK, CALIFORNIA

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Ag-Cd Cell
Rechargeable

These silver-cadmium storage cells generally have good charge retention under varying temperature conditions. Early test installations indicate that SILCAD batteries can deliver up to 2-1/2 times more power than nickel-cadmium or lead-acid batteries.

Yardney Electric Corp., Dept. ED, 40-46 Leonard St., New York 13, N.Y.
Radio Engineering Show, Booth 2127.

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrostatic Voltmeters
Read AC and DC



Three new lines of electrostatic voltmeters with very high internal impedances are useful for both a-c and d-c measurements. The three classes differ principally in reading range and in accuracy. One group of these meters covers the ranges 0-60 v to 0-100 kv, and is accurate to 0.5 per cent. A second covers the ranges 0-150 v to 0-18 kv, with an accuracy of 1 per cent. The third group of these meters covers the ranges 0-100 kv to 0-600 kv. The first two classes are particularly recommended for reading photomultiplier tube and TV tube potentials, for detecting and measuring static charges, making ionization and capacitance measurements, testing high voltage capacitors and high voltage power supplies, etc. The third group is useful in studying high-voltage discharges, checking high potential equipment used in nuclear studies, testing transformers, etc. All except the very high voltage instruments are portable.

New England Scientific Instruments Co., Dept. ED, Box 408, Cambridge 39, Mass.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

Rectified
RELAYS
advance
Reliability



Improvements, over conventionally operated AC relays, afforded through all frequencies from 25 to 400 cycles by MAGNECRAFT full-wave rectified relays, include—

- Increased operating sensitivity
- Higher contact pressures
- Greater resistance to vibration
- Operation through much wider variation in voltage or current
- Quiet operation, free of AC hum
- Smaller size

MAGNECRAFT full-wave rectification adds nothing to mounting and wiring problems.

Tell us what you need or send for catalog.



Full wave rectified
for 60 cycles. Contact combinations to 60

MAGNECRAFT
Electric Company

3350D W. Grand, Chicago 51, Ill.

CIRCLE 116 ON READER-SERVICE CARD

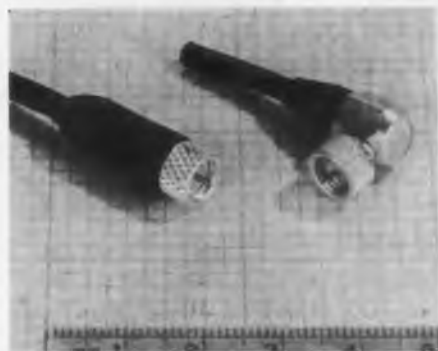
Motorized Time-Delay Switches Miniaturized



Operating on a range of dc voltages from 6 to 50 v, this line of miniaturized time delay switches is offered, built to individual specifications, and capable of performing a variety of time-delay functions. Normal time delays are from 15 to 30 seconds, with instantaneous reset when power is removed. Instantaneous reset also occurs if power is removed during a timing cycle. If power remains on at the end of a timing cycle the motor stops automatically, but switch position is maintained by a clutch. Accuracy is ± 5 per cent of total timing cycle under all conditions. Power required is 22 w; 15 for the motor and 7 for the clutch. These switches meet environmental requirements of MIL-E-5272, and can be supplied if desired to meet radio noise requirements of MIL-I-6181B. Switches are hermetically sealed. The largest of these switches measures 4-3/16 in. long by 2-9/16 in. dia.

Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton, Ohio.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Miniature Coaxial Plugs

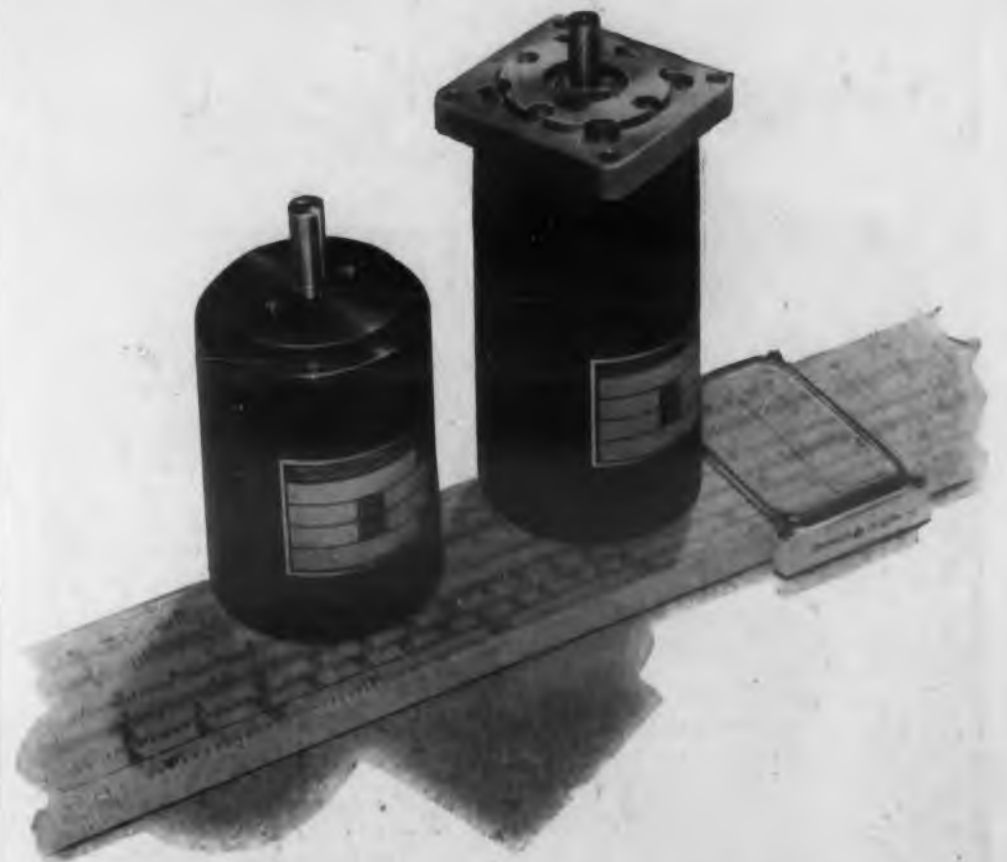
For Teflon
Miniature Coax

Designated Models 32-66 and 32-68, two new miniature plugs for the all-Teflon RG-195/U miniature coax measure 0.155 in. max O. D. They assemble to cable without special tools, and mate with all existing Microdot S-93 receptacles. Model 32-66 differs from 32-68 in having a guarded center pin.

Microdot, Inc., Dept. ED, 1826 Fremong Ave., South Pasadena, Calif.

Radio Engineering Show, Booths 2101-2103.

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION



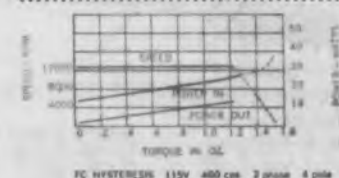
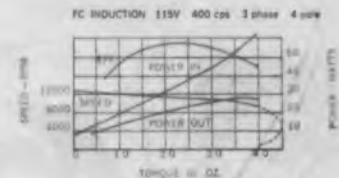
NEW A. C. MOTOR LINE GIVES YOU 10^5 STANDARD VARIATIONS

From Globe you can get fast delivery of complete miniature power systems designed around new FC motors—115 or 200 V.A.C., 60 or 400 cycles—induction, hysteresis, or dual speed rotors, wound 3 phase, 2 pole or 4 pole; 2 phase, 2 pole or 6 pole; single phase with a matched capacitor. Units are designed to meet MIL specs; operating characteristics and configuration can be modified.

Package can include integral gearing, either planetary or spur. Choose from 102 standard ratios from 4:1 to 3,000,000:1. Choose from 408 stand-

ard speeds. Gear units range in length from 1.043" to 1.953". WRITE FOR FC BULLETINS.

Globe's small AC motor packages are built around units 1.07" dia., 1.25" dia., and the newest 1.675" dia. x 2.250" long. Standard modifications in type, winding, gearing, and performance offer you millions of combinations at reasonable cost. Globe also makes D.C. governed and gear reduced motors, servo motors, actuators, timers, generators, gyros, blowers, fans, and control systems. **GLOBE INDUSTRIES, INC.** Dayton 4, Ohio



CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

No waveform distortion

from G-E Inductrol* Voltage Regulators

Unlike many other types of voltage regulators, General Electric Inductrols introduce no waveform distortion.

Featuring drift-free controls, Inductrols maintain the a-c or d-c voltage powering electronic circuits within $\pm 1\%$; are small and light.

They have long life and require little maintenance because *they use no brushes!*

For more information, write Section 425-6, General Electric Co., Schenectady 5, N. Y., or contact your G-E sales office or agent.

General Electric Trade Mark for Induction Voltage Regulators.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 117 ON READER-SERVICE CARD

A New Broad Band **Kearfott**

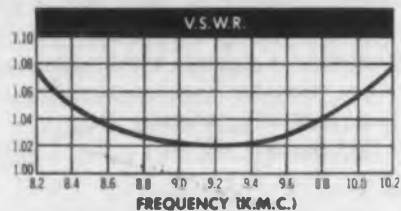
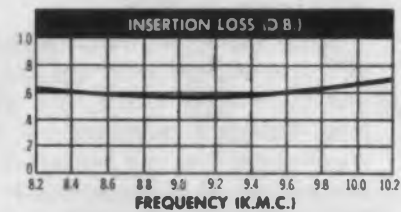
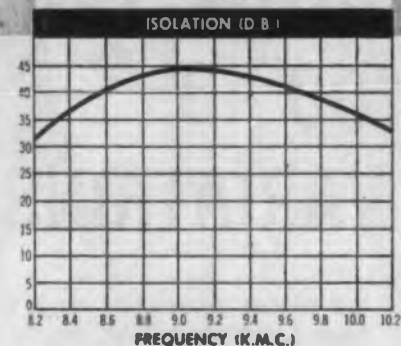
FERRITE ISOLATOR for Laboratory Test Bench Use



Model
W177-2C-1

Use this Ferrite Isolator in your microwave setup for maximum frequency stability.

Typical Performance Curves



CHECK THESE FEATURES:

Broad Band—Usable from 8.2 to 10.2 KMC

High Isolation—A minimum of 25 db over the band

Insertion Loss—Less than 1 db

Small & Compact—Only 2½ inches long—weighs only 1½ lbs.

Flanges—Cover type. Mates with UG39/U flanges. Will absorb up to 10 watts reflected power

Price—\$135.00 each f.o.b., Van Nuys, Calif.

Delivery—From stock

Order—Model W177-2C-1

For custom-made isolators for specific radar & microwave application, you can depend on the skill of the Kearfott organization.

Kearfott, Western Division, has complete facilities for waveguide production, with qualified experts to assist in solving your problems. Let us help you.

Kearfott COMPANY, INC.
LITTLE FALLS, NEW JERSEY
WESTERN DIVISION
MICROWAVE DEPARTMENT
14844 OXNARD ST. - VAN NUYS, CALIF.

For detailed information, ask for bulletins on new Ferrite Isolators and Radar Test sets.

Eastern Office:
1378 Main Ave.
Clifton, N.J.

Midwest Office:
188 W. Randolph St.
Chicago, Ill.

South Central
Office:
6115 Denton Drive
Dallas, Texas

Western Area
Office:
253 Vinado Ave.
Pasadena, Calif.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Power
Oscillator
Low Distortion

The Model 1500 can be used as a precision 400 cycle source to energize synchros, resolvers and motors. Available in mounting form it can be furnished in various other frequencies. Fifteen watts with less than 1 per cent distortion are supplied through an isolated output transformer. Three impedance taps are provided.

A front panel control allows for a continuously variable output from 0 to 120 v. The frequency is factory-set to 0.25 per cent and is maintained with high stability even with line voltage fluctuation. Power input is 115 v, 60 cps. Dimensions are 8-3/4 x 19 x 8 in.

Industrial Test Equip. Co., Dept. ED, 55 E 11 St., New York 3, N.Y.

Radio Engineering Show, Booth 3229.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

Military Type Potentiometer Weighs 1.2 oz



The DP-12 "Mil-E-Trized" Potentiometer is designed to withstand environmental vibration, shock, and ultra-high altitude. It surpasses JAN-R-19 specifications calling out Type RA-30 potentiometer requirements. It is completely hermetically sealed. Difficulty in dissipating heat from a totally enclosed resistance is overcome by close fitting of the resistance element with the die cast aluminum case. Heat is rapidly transferred to the outside of the case, providing rapid heat radiation.

Rated power is 4 w. The unit is built to provide a resistance range of 100 ohms to 40 k. Standard models have $\pm 5\%$ tolerance, but other tolerances are available. Effective rotation of the shaft is 275 ± 2 deg. Shaft torque is 6 in-oz max. Linearity is $\pm 3\%$, maximum deviation. Resolution is 0.5% max.

Shafts are available in round, flat, or screwdriver slotted styles of 1/2, 7/8, 1 1-1/4, and 2-1/2 in. long. Weighing only 1.2 oz, the potentiometer operates over an ambient range of - 55 to 125 C. It operates at 100% power to 40 C, derating to 0 to 125 deg. C. Dale Products, Inc., Dept. ED, Columbus, Neb.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

MODELS PL80
AND PM80

Differential
Pressure
Transducers
FOR
flow measurement



AT

Rocket Engine Stands
Hydraulic System Tests
Nuclear Reactors

the flow of liquids and gases is being measured by connecting Model PL80 and Model PM80 pressure transducers across an orifice.

Ranges
 ± 1 to ± 3000 psid and 0 1 to 0-3000 psid

Line Pressure Rating
5000 psig

Pressure Media
Fluids not corrosive to
Types 303 and 347 stainless steel

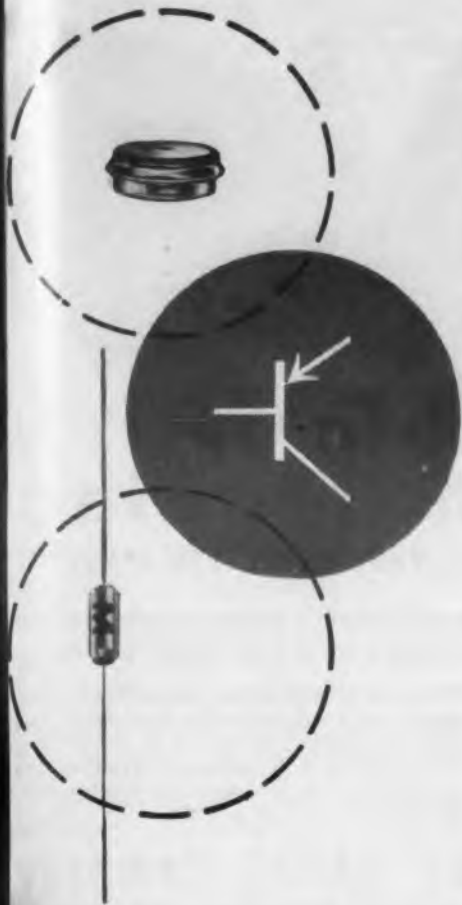
Transduction
Resistive, Statham unbonded strain gage

For additional data, please request
Bulletin Nos. PL80TC and PM80TC

Statham
LABORATORIES

12401 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE 124 ON READER-SERVICE CARD



△ Miniature Twin Diode For Switching Circuits

A 7-pin miniature type twin diode designed especially for switching in compact, medium-speed electronic computers has been announced. It requires one-third less heater power than conventional twin diodes—only 1.26 w. It is 1-5/8 in. long, and designated 6887. Design features include a cathode of special alloy which minimizes cathode interface and interelectrode leakage, and maintains emission capabilities after long standby periods; a protective shield which further reduces interelectrode leakage; and separate cathodes with individual base-pin connections for flexibility of circuit arrangements. Manufactured under rigorous controls and tests, the tube is intended to perform with high efficiency in computer switching circuits.

Radio Corp. of Amer., Tube Div., Dept. ED, Harrison, N. J.
Radio Engineering Show, Booths 1602, 1707.

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

P. R. MALLORY & CO. INC.
MALLORY

—pioneered the mercury battery—known for its constant voltage discharge rate.

—developed the smallest sub-miniature capacitors—in the broadest ranges of voltage ratings and capacitances available anywhere.

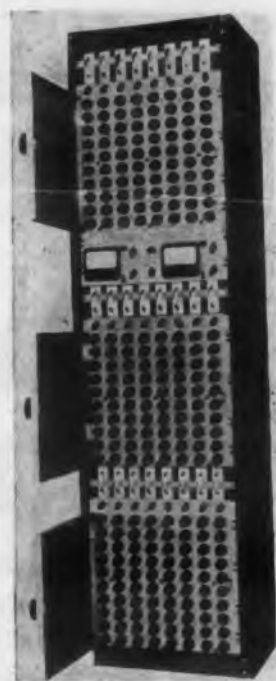
—can best supply your mercury battery and subminiature capacitor needs for miniaturized transistor circuit design and production.

Write or ask for complete technical data on Mallory mercury batteries and types TAP, TAW and TNT (tantalum) capacitors.

P. R. MALLORY & CO. INC.
Indianapolis 6, Indiana

P. R. MALLORY & CO. INC.
MALLORY

CIRCLE 125 ON READER-SERVICE CARD



Age and Life Testers For Transistors

Designed for the performance of life tests and application of aging techniques to 240 npn or pnp transistors under controllable operating conditions, this equipment has each panel section divided into eight vertical cells, each having a capacity of ten transistors. Each cell contains ten fixed precision emitter resistors (used in measuring emitter current), ten continuously variable series emitter resistors, and a plug-in unit containing ten precision resistors for providing any desired collector loads for the transistors under test. Although the system allows physical handling of ten transistors at a time, each transistor circuit is isolated, and the performance of each may be evaluated independently.

Consolidated Avionics Corp., Dept. ED, 66 Brooklyn Ave., Westbury, N.Y.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION



Here's a neat switch...

G-E GLOW LAMP PROVIDES NEW, LOW-COST CIRCUIT CONTROL

Before a G-E Glow Lamp starts, it is essentially an open circuit. When the lamp is biased to a point just below its starting voltage, the application of a pulse sufficient to raise the applied voltage to that which is required for starting causes the lamp to conduct—and the pulse to be transmitted to the other components. Apply reverse pulse and the lamp is extinguished, the circuit broken.

A Single G-E Glow Lamp May Serve As A:

RELAXATION OSCILLATOR • LEAKAGE INDICATOR
SWITCH • VOLTAGE REGULATOR • VOLTAGE INDICATOR



If you'd like more information on the amazing G-E Glow Lamps, send today for your free copy of the folder, "G-E Glow Lamps for Pilot and Indicator Use". Write: General Electric Co., Miniature Lamp Dept. ED-3, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

ELCO
SCREWS

*Elco
Screws
are
Good
Screws*

... Ask a man who has used them

REMEMBER ELCO



PHILLIPS SCREWS

ELCO is one of the prominent sources for all types of "Phillips" Recessed-Head Screws. At ELCO particular care is taken to maintain the standardized specifications of the distinctive Phillips recess — for best performance and lowest handling cost on your assembly line. Many ELCO-PHILLIPS Screws are stocked for immediate delivery. Write for our stock list.

WOOD SCREWS
MACHINE SCREWS
MACHINE SCREW NUTS
TAPPING SCREWS
THREAD-CUTTING SCREWS
PHILLIPS AND SEMS SCREWS
PIPE PLUGS
STOVE BOLTS
CAP SCREWS
LAG SCREWS
DRIVE SCREWS
SPECIAL SCREWS
COLD HEADED PRODUCTS



ELCO TOOL AND SCREW CORPORATION
1948 BROADWAY • ROCKFORD, ILLINOIS

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Pulse Generator Calibrates Nuclear Instruments



Offering laboratory-level precision in a portable case, this pulse generator checks and calibrates radiation spectro-meters, linear amplifiers and other nuclear instruments. Its output rise time is 7 millimicroseconds and exponential delay 300 microseconds, approximating the output characteristics of radiation detectors. Output voltage is variable from 10 v to 1 μ v by means of a step-type attenuator and a 10-turn potentiometer. Repetition rate is fixed at 60 pps. Drift rate is less than 0.005 per cent per hour.

Weight of the pulse generator is 9 lbs. Dimensions are 6-5/16 in. x 10-1/16 in. x 6-11/16 in. Power requirement is 39 w, 115-125 v 60 cps.

Franklin Electronics, Inc., Dept. ED, Bridgeport, Montgomery City, Pa.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION



Electric Impulse Counters Both AC and DC

Two types of remote electric impulse counters have been announced, both of them for either direct or alternating current. Type Sodeco TCeBZ4E is a four-digit model, and Sodeco TCeBZ5E is a five-digit model. These counters have manual push-button resets and can register up to 25 impulses per second. Direct current voltage and wattage requirements are: 4 to 220 volts; 1 to 1.5 watts up to 10 impulses per second, 6 to 6.5 watts up to 25 impulses per second. Alternating current voltage and wattage requirements are 12 to 220 volts; 3 to 3.5 watts at up to 10 impulses per second, 6 to 6.5 watts up to 25 impulses per second. The four-digit model measures 2-1/6 x 1-3/8 x 1-3/4 in. The five-digit model measures 2-1/16 x 1-5/8 x 1-3/4.

Landis & Gyr, Inc., Dept. ED, 45 W. 45 St., New York 36, N.Y.

CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION



Another New Variac Handles over 1 1/4 KVA

Maximum Current 11 Amps. • Rated Current 8.5 Amps
Output Voltage 0 to 115 Volts, 60 Cycles

The new Type W5L VARIAC is a redesign of the popular Type W5, the core being wound with larger wire and the output voltage limited to a maximum equal to the line voltage. This construction provides an increase in power rating of 365 va over the Type W5. A large number of VARIAC applications do not require the over-voltage output. For these uses the Type W5L is a distinct advantage. Price: Type W5L VARIAC \$17.50

GENERAL RADIO Company

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

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 920 S. Michigan Ave. CHICAGO 3
8055 13th St., Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA
1000 N. Seward St. LOS ANGELES 38 1182 Los Altos Ave., Los Altos, Calif. SAN FRANCISCO

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW 1957 CATALOG

Latest complete facts
on cathodes, disc cathodes,
glass sealing
tubing—their
characteristics,
uses, variety

Superior Tube Company's complete line of cathodes and other electron tube components in a single catalog. Many new facts not in last year's edition. Properties of the new CATHALOYS,* plus 19 other alloys fully covered. A detailed reference for electron tube designers on cathode materials, types of cathodes, fabricated tubular parts, and glass sealing alloys. Write for free copy, Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

*Cathaloy: Reg. T.M. Superior Tube Co.

Superior Tube

The big name in small tubing
NORRISTOWN, PA.

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.—an affiliated company making precision metal stampings and deep-drawn parts.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

UHF Variable Attenuator For RG 98/a Waveguide



Attenuator FXR Type No. M174A covers the frequency range of 50 to 75 kmc and is calibrated to 50 db of attenuation. Maximum calibration error is 0.1 db or 2 per cent of reading,

whichever is greater. Transmission loss is less than 0.5 db and is not included in the calibration. The instrument makes possible direct attenuation readings over the full bandwidth of the RG 98/a waveguide with a speed and accuracy not previously possible. A catalogue sheet giving complete specifications, and a complete catalog showing the entire line of FXR precision microwave test equipment, will be sent by the manufacturer on request.

Frank R. Cook Co., Dept. ED, Electronics and Ray Division, 26-12 Borough Pl., Woodside 77, Long Island, N. Y.

CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

Don't forget to mail your renewal form to continue receiving ELECTRONIC DESIGN.



Power Supply Miniature Ag-Zn Cell

A silver-zinc battery having a long shelf life, this power supply is shipped in dry condition, carries its own electrolyte supply inside the sealed case. In response to a momentary electrical signal, the fluid is transferred to the battery cells, producing full power output within 1/2 sec. The unit pictured produces 8 v at 700 w for 2 minutes. It weighs 1-3/4 lb and measures 2-1/8 x 3-1/8 x 5 in. Other models are available, with voltage outputs up to 500 v and current outputs up to 1000 amp.

Frank R. Cook Co., Dept. ED, ElectroChemical Div., 98 S. Sante Fe Dr., Denver 23, Colo.

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

NEWS ABOUT VARIAN STALOS *

HIGH STABILITY

*Frequency stabilized local oscillators

without electronic components

Here's a line of High Q cavities offering commercially practical frequency stabilized local oscillators utilizing direct cavity stabilization. These Varian Stalo cavities provide a high degree of short time frequency stability.

As an example, with the combination of a VA-1280B cavity and VA-201B klystron, a short term frequency stability of approximately one part in 10^9 has been achieved. The stabilization factor of the cavity is completely independent of the oscillator fluctuations or external disturbances — an important advantage over stabilization systems utilizing the feedback principle. Elimination of all electronic components except the klystron oscillator also affords greater reliability and longer life.

Varian Stalo Cavities, in models for C-band through K_a-band, offer stabilization factors (ratio of oscillator modulation sensitivity to modulation sensitivity of the stabilized oscillator) from 15 to over 100. Important applications include stabilization of signal sources in high power klystron transmitters... airborne uses in conjunction with receiver local oscillators... laboratory and test applications. Used with Varian's new highly stable reflex klystron oscillators, Varian Stalos provide stability comparable to that of many crystal controlled oscillators.

The combination of a VA-1281B cavity and a VA-201B reflex klystron will provide excellent long term stability. A long term stability of approximately ± 1 Mc, over a 100°C ambient temperature range, can be achieved with a well-regulated power supply.

Cavities designed to meet specific requirements are available on special order. Complete Stalo packages are also available including power supply and klystron, with single-knob control over a limited tuning range.

Visit the Varian Exhibit
at the 1957 I. R. E. Show —
Booths 2530-2532.

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KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION



X-Band Stalo Cavity VA-1280B
Shown with VA-201B klystron

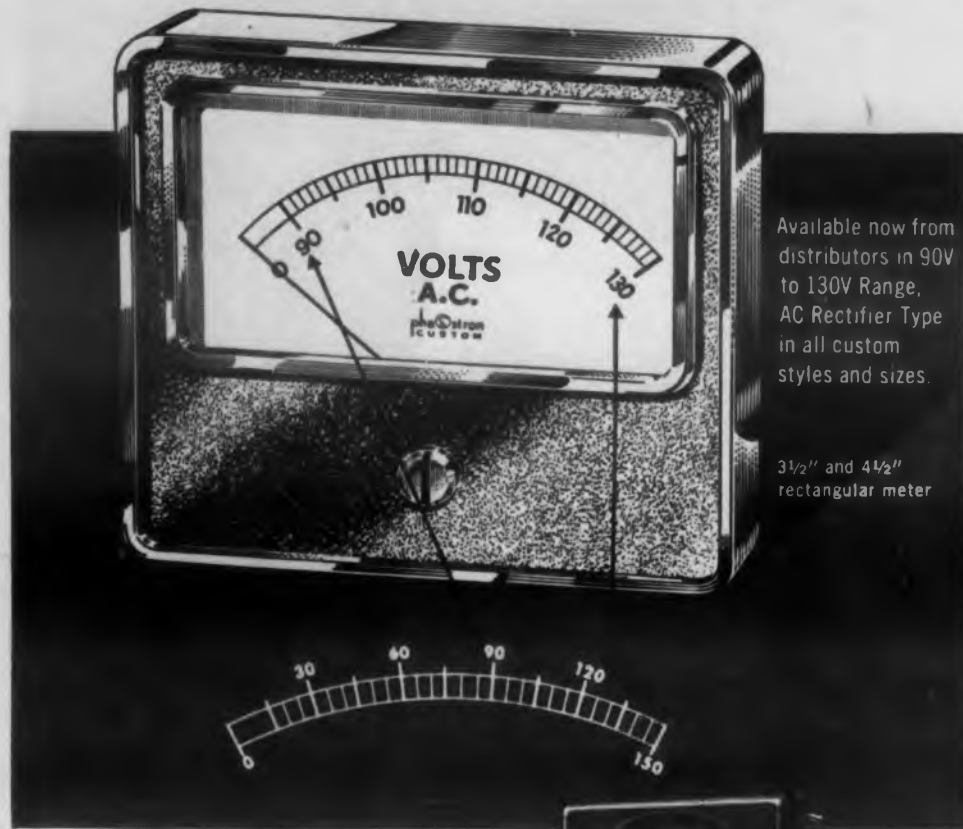


X-Band Stalo Cavity VA-1281B
Shown with VA-201B klystron

COMPLETE TECHNICAL DATA
AND SPECIFICATIONS are now
available.

Your inquiry is cordially invited.

NEW PHAOSTRON EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range, AC Rectifier Type in all custom styles and sizes.

3 1/2" and 4 1/2" rectangular meter

NOW!... all the time-tested proven Phaestron features... PLUS UP TO TEN TIMES GREATER READABILITY for greatly increased accuracy!

Phaestron has squeezed down that under 90V portion of the scale, where you don't need it, and expanded the section where you need it most—between 90 and 130V. Precisely calibrated 1 volt scale increments provide greater reading accuracy. Wide frequency range—linearity—true rms reading and Phaestron craftsman construction.

Phaestron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.



2 1/2" or 3 1/2" square meter



6" rectangular meter



2 1/2" or 3 1/2" round meter

PHAOSTRON

PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Null
Detector
Good Sensitivity

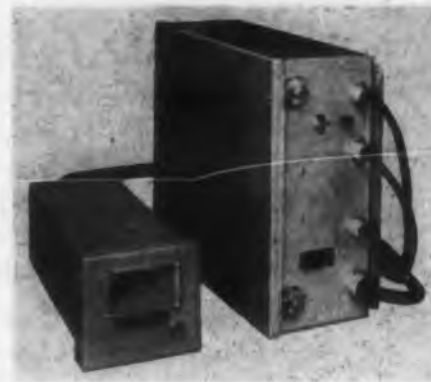
The Model 60B is battery operated. It is well shielded against external fields and is suited for Schering and other bridges. The sensitivity is 3 μ v for 1 per cent deflection. Built-in tuned circuits permit a sharp balance when the null is complicated by harmonics.

Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N.Y.

Radio Engineering Show, Booth 3229.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Servo Indicator Accurate To 0.1 % of Span



Eliminating errors of parallax and interpolation, this Model 143 servo indicator reports its results on a mechanical counter. It reads millivolt changes developed by force, flow, weight or temperature transducers, and is particularly applicable to the measurement of forces developed by resistance bridge transducers and impeller type pickups. Typical installations at present are in measuring fuel flows and jet engine thrusts.

The Model 143 utilizes a continuous null balance servo in a cable-connected two-case instrument. It comprises a measuring circuit, a damping network, an amplifier, a converter, a balancing motor, a slide-wire and a digital counter; and a power supply for use when necessary. Accuracy is ± 0.1 per cent of span. Digital roll is limited. Design of the instrument and its circuitry is flexible and can be modified to meet specific requirements.

The remote case measures 18 in. x 12 in. x 4 in.; the panel mounted case measures 6 in. wide, 5-3/8 in. high and 14-5/8 in. deep.

Gilmore Industries, Dept. 5011-ED, 5713 Euclid Ave., Cleveland 3, Ohio.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

to solve
"insoluble"
problems...



EXPLORE

the unique properties of

PRECIOUS METALS

Precious metals are finding extraordinary applications in industry and the laboratory, even to the extent of providing answers for many long-standing problems. Electroplating offers an efficient method of exploring and exploiting such characteristics as the unique and diverse properties of gold, which are not found in combination in any other form. Technic Inc. equips you with controlled electroplating apparatus and solutions that eliminate variables, assure precise performance reproducible as often as required.

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Electroplating Systems • Germanium Diode Rectifiers • Turbomatic Agitators • Electroplating Barrel Units • Automatic Technic Timers

TECHNIC BIBLIOGRAPHY

"Electroplated Gold"; "Precious Metal Electroplating Data: Gold, Rhodium, Palladium, Platinum, Silver, Nickel"; "Electroplated Platinum"; "Electroplated Palladium"; "Electroplated Rhodium"; "Analysis of Gold & Gold Alloy Solutions".

Write for authoritative Technic publications, many containing data assembled nowhere else. We serve as consultants on experimental projects as well as on regularized operations. Consult us without obligation.



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39 Snow Street, Providence, R. I.

JACKSON 1-4200

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Doing it Yourself?



It's Easier to Standardize on

Jeffers R.F. Choke Coils

You can eliminate tedious, expensive hand assembly from miscellaneous forms and wires by using completely assembled standard Jeffers R. F. choke coils. You will save time, labor and money by stocking the broad range of Jeffers coils just as you do resistors, capacitors and other similar electrical components.

Jeffers coils are made of highest quality materials... using insulated copper wire windings encased in husky molded jackets. All windings are soldered to leads... no chance of shorted end turns.

Enjoy the benefits of superior, standardized components in your circuits. Jeffers Electronics offers you a full line of R. F. choke coils with a complete range of inductance values... ready for immediate delivery. Write today for our specification sheets.

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discs • brushes • molded notched* coil forms
battery carbon • graphite plates and rods
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CIRCLE 141 ON READER-SERVICE CARD



△ Insulation Tester

High Voltage Precision

Continuously variable from 1 to 15 kv in one range, this tester has an output resistance of 100 megohms. The wide range of leakage resistances covered by the Model T-4 makes it possible to perform not only breakdown tests but quantitative measurements. All measurements are performed with direct current. It has integral provision for operation from 6, 12 or 24 v dc sources.

Transitron, Inc., Dept. ED, 186 Granite St., Manchester, N.H.

Radio Engineering Show, Booth 3912-14.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION



Proximity Pickup

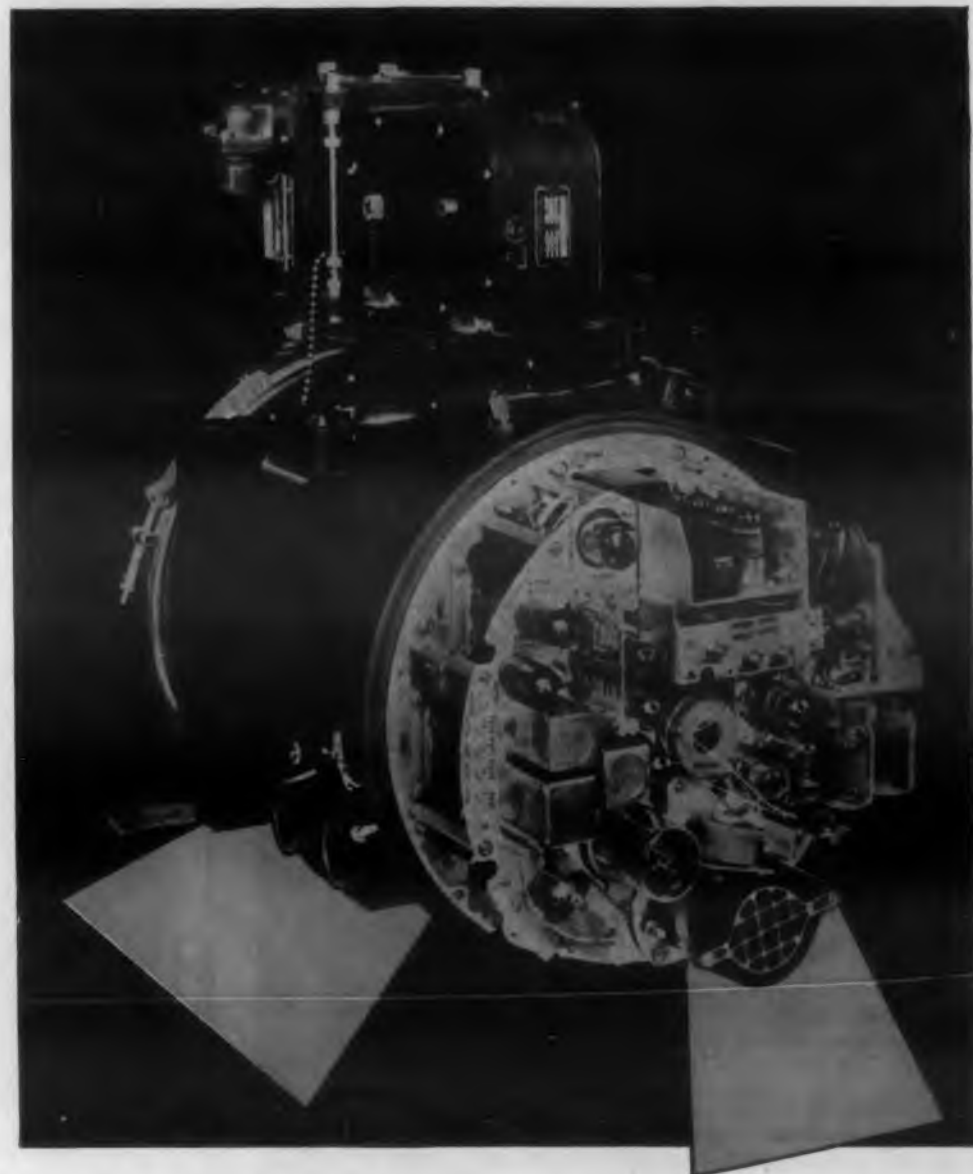
Detects Metals

The Model 4901-RAC transducer operates on a principle similar to a military mine detector and can utilize the proximity of metals to control circuits, operate batch counters, switch machinery, and the like. Signal input is through a 3-pin "AN" type connector; output is drawn from a standard electrical plug. The output also features an ac convenience receptacle wired through an internal relay to supply 115 v ac up to 60 w. The relay is spdt with contacts rated at 5 amps, 115 v a-c non-inductive load, which can operate up to 600 times per minute. Dimensions are 2-5/8 in. x 4-5/8 in. by 8 in. The instrument can be used as either a portable or an installed device.

The same maker also offers a control unit, Model 4901-AN, which provides dc pulses for use with electronic counters, recording devices, oscilloscopes and similar equipment.

Electro Products Laboratories, Inc., Dept. ED, 4500 N. Ravenswood Ave., Chicago 40, Ill.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION



Joy Fans HELP LICK HIGH VOLTAGE ARC-OVER IN AIR-BORNE RADAR UNIT

WHEN MOTOROLA designed this 10 inch air-borne radar indicator to operate at 60,000 ft. they eliminated high voltage arc-over by pressurizing the unit. But this created excessive heat.

TO DISSIPATE HEAT an air-to-air heat exchanger, using three Joy Axivane fans was built in. Two external fans blow outside air between two plates separated by aluminum tubing. Another Joy fan, sealed inside the pressurized radar unit circulates hot inside air thru this tubing.

THESE JOY FANS must operate in the wide temperature range of -55°C to +125°C... tough treatment.

Joy has over 250 models and 1300 designs of these high performance fans ready to solve your toughest air-moving problem... be it electronic cooling, de-icing and defogging or ventilation. Write Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

Write for FREE Bulletin 143-57

JOY...EQUIPMENT FOR AVIATION...FOR ALL INDUSTRY

WSW 1 6415-143



Ground Power Units



Portable Lighting



Electrical Connectors



Vaneaxial Fans

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

Eliminate bulky dynamotors
& vibrator power supplies

with **UNIVERSAL DC-DC
ALL-ELECTRONIC
POWER CONVERTERS**

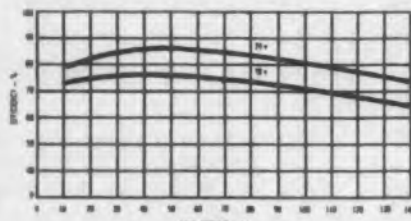
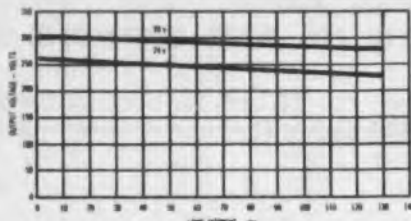


Mod. No.: 240/28/130ma

UAC high efficiency power supplies solve size, weight, vibration and shock problems in hundreds of Airborne, Military, Laboratory, and Commercial applications. Standard DC to DC units to 150 Watts; custom units can be made up to 500 Watts or to 100,000 volts. DC to AC and AC to DC units also available, including unusual input-output combinations such as: 28 VDC; input; 115 VAC output 115 VAC, 400 cps, 3 phase input; 250 VDC regulated output

Non-regulated Universal Transistorized Power Converter for transceivers, transmitters, receivers, and other navigational and communications equipment requiring a B+ supply.

Mod. No.: 240/28/130ma
Input: 28 volts DC
Output: 240 volts DC
Output current: 130 milliamperes
Ripple: 0.1%
Regulation: This is a non-regulated supply; however, + or - 2 1/2% can be included.
Temperature: Ambient range -55°C to 85°C
Shock: Will withstand up to 500 g's.
Size: 4 1/2 x 2 1/2 x 2 3/4 nominal.
Weight: Approximately 2 lbs.



Write, wire, phone your power supply requirements on current production today.

Dept. ED3



**Universal
Transistor Products Corp.**

50 BOND STREET • WESTBURY, L. I., N. Y. EDgewood 3-3304

See UAC Power Supplies and UAC portable electronic and nucleonic instruments at our

BOOTH 3940-3942 NEW YORK IRE SHOW MARCH 18-21

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION



△ Power
Supply

Constant
Frequency

This airborne missile alternator and electronic control supplies constant frequency 115 v 400 and 2400 cycle power to within ± 1 per cent.

Thompson Products, Inc., Dept. ED, Electronics Div., 2196 Clarkwood Rd., Cleveland 3, Ohio. Radio Engineering Show, Booth 2527-31.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION



Rotary Test Accelerator
Applies Up To 250 G's

This rotary test accelerator accommodates objects up to a 5-in. cube, and can apply as much as 250 g's acceleration to masses up to 3 lb. A removable, 20-in. diam rotating table has accurately spaced circular graduations 1/4-in. apart. It contains groups of tapped holes by which as many as four test objects and balanced weights may be mounted on the top surface. The objects can be viewed under test through a plastic window at the top of the accelerator.

An auxiliary magnetic pickup is provided for precise speed measurement by means of external frequency measuring equipment. Speed range is 0-1000 rpm; acceleration range 0-250 g at nominal 9-in. radius; maximum load rating 3 lb; speed control is afforded by a 10-turn helical potentiometer with separate vernier potentiometer, and speed indication is provided to an accuracy of 2 per cent by a tachometer generator and meter. Power at 220 v, single-phase 60 cps ac is required. Eight bronze slip rings, faced with coin silver and with three silver graphite brushes per ring, provide test circuits. The accelerator is 2 ft 8-3/4 in. high, 2 ft 10 in. deep and 2 ft wide. Designation is Model C-1-A. Uses include not only testing suitable assemblies, but also calibrating other accelerometers.

Schaevitz Machine Works, Dept. ED, Camden, N.J.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION



specify
standard

FLEXLOC

SELF-LOCKING NUT

FLEXLOC
DESIGN FEATURES

- one-piece, all-metal construction
- resilient locking section
- controlled locking torques
- lock and stop nut in one
- every thread carries its full share of load

DO YOU KNOW? Standard FLEXLOCS improve the finish rough bolts. They smooth rough threads. And the locking threads on all-metal FLEXLOCS are not chewed up when used on rough bolts. FLEXLOCS are stocked by authorized industrial distributors in a full range sizes from #0 to 2". Write Bulletin 866. STANDARD PRESS STEEL Co., Jenkintown 12, Pa.

STANDARD PRESSED STEEL

FLEXLOC LOCKNUT DIVISION

SPS
JENKINTOWN PENNSYLVANIA

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION



ARNOLD TOROIDAL COIL WINDER

sets up quickly... easy to operate...
takes wide range of wire sizes

SPECIFICATIONS:

- Min. finished hole size: .18 in.
- Max. finished toroid O.D.: 4.0 in.
- Winding speed: 1500 turns/min.
- Wire range: AWG 44 to AWG 26
- Dual, self-checking turns counting system
- Loading (wire length) counter
- Core range: 1/4" I.D. to 4" O.D. to 1 1/2" high

LABORATORY USE

- Change wire and core size in 45 sec.

PRODUCTION USE

- 1500 turns per minute
- Insert core and load in 20 sec.

write or telephone for literature

ARNOLD MAGNETICS CORP.
4615 W. Jefferson Blvd., Los Angeles 16, Calif.
REpublic 1-6344

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Engineers! write for valuable new
SERVO MOTOR Information

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6 data filled
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Dimensional Drawings
Characteristics Charts
Performance Data
Complete
Specifications

Write for your free copy of G-M Servo Motor Booklet
7. Contains all-new technical data including selec-
tion of gear trains and motors; derating effects of
temperature, control phase impedance and G-M's new
push-type Servo Motor construction.

Write
day!

copy sent
postpaid.
no obligation.

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This is a
photosensitive
resistor... actual size



Called a Kodak Ektron Detector, the photosen-
sitive substance is lead sulfide, and it can be laid
down in any pattern.

Signal response extends
from 0.25 microns in the ultra-
violet to 3.5 microns in the in-
frared with maximum sensitiv-
ity at 2.2 microns in the infrared.

They are available in com-
plex and exact arrays and
patterns.

Signal-to-noise ratio is excellent, particularly in the infrared.

Vibration doesn't affect them.

Elements can be extremely small in size.

Get the details on Kodak Ektron Detectors, write for a
booklet to: Military and Special Products Sales,

WESTMAN KODAK COMPANY
Rochester 4, N. Y.

Kodak

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

1957 ELECTRONIC DESIGN • March 15, 1957



△ Potenti-
ometer Servo
Self-Balancing

This self-balancing electronic potentiometer
servo-mechanism is designed to be built into a user's
equipment. When used with a Bristol amplifier, in-
put transformer, and Syncoverter dc ac inverter,
the Dynamaster Servo-Mechanism forms a complete
self-balancing dial indicator. The unit is available as
a potentiometer or as an ac bridge. Dial indicator
speeds of 1 sec, 3 sec, and 4-1/2 sec are offered, and
one blind set alarm switch can be furnished. The
unit can also be supplied with a retransmitting slide-
wire.

The Bristol Co., Dept. ED, Waterbury 20, Conn.
Radio Engineering Show, Booth 3932.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

*This is the time of our annual
subscription renewal.*

Teflon Contact Sockets
Press-Fit, Color Coded Units

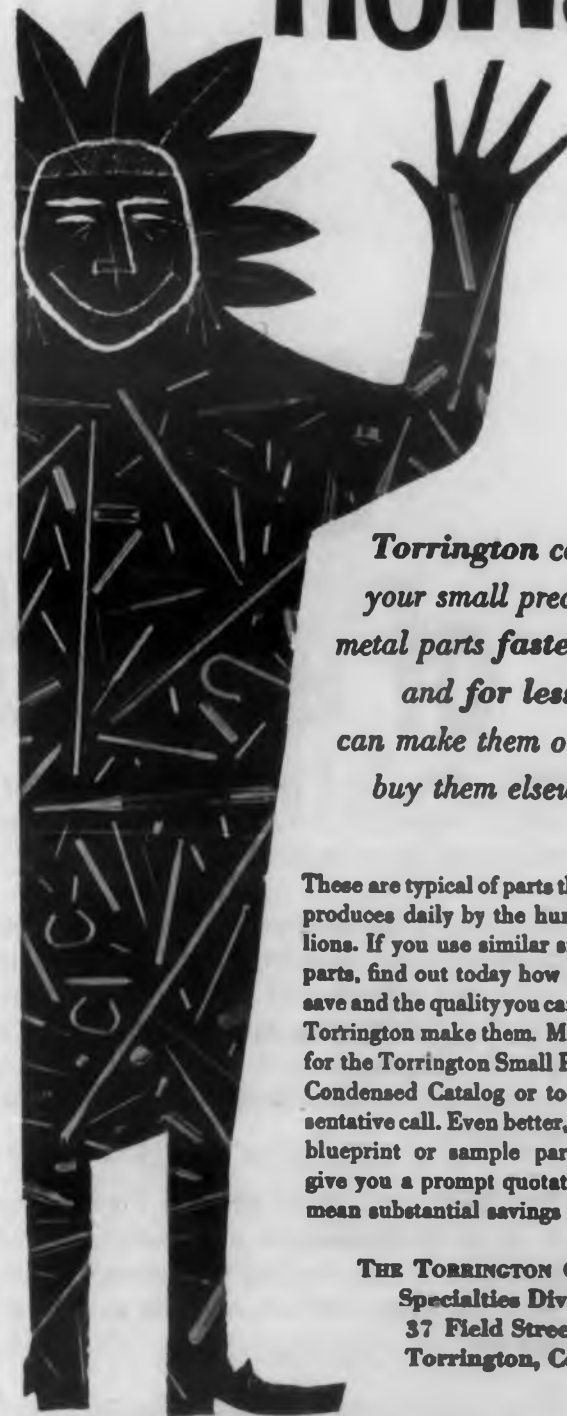


These color-coded "Press-Fit" miniature contact
sockets to take the popular 0.080 in. test probes
have been added to this firm's line, making sockets
available for three different probe sizes: 0.040,
0.050, and 0.080 in. The Teflon bushing or insulator
body measures only 0.185 in. diam. with 0.218 in.
diam. front face, permitting spacing as close as
1/4 in. between centers.

The contact receptacles are rugged and positive,
and have beryllium-copper silver-plated-with-gold-
flash contact members. They are simply pressed
into a chassis hole for a rigid, secure, permanent
installation. For color-coding purposes, receptacles
come in eight RETMA colors, with coloring
throughout the Teflon body. Companion color-
coded plugs are also available. Sealectro Corp.,
Dept. ED, 186 Union Ave., New Rochelle, N.Y.

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HOW...



*Torrington can make
your small precision
metal parts faster, better
and for less than you
can make them or
buy them elsewhere*

These are typical of parts that Torrington
produces daily by the hundreds or mil-
lions. If you use similar small precision
parts, find out today how much you can
save and the quality you can get by letting
Torrington make them. Mail the coupon
for the Torrington Small Precision Parts
Condensed Catalog or to have a repre-
sentative call. Even better, send a sketch,
blueprint or sample part and we will
give you a prompt quotation which will
mean substantial savings to you.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street
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**TORRINGTON
SPECIAL METAL PARTS**
Makers of Torrington Needle Bearings



The Torrington Company - Specialties Division
37 Field Street, Torrington, Conn.

- Please send the Torrington Small Precision Parts Condensed Catalog.
- Please have representative call.
- Please send a quotation on enclosed sketch, blueprint, part.

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

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION



One of a kind

Among the many requirements for heat elements in industry today are those demanding virtually one-of-a-kind design.

Since such requirements normally cannot be met by loom weaving, Safeway technicians fabricate odd-shaped elements individually. Circles, half circles, cutouts, tapers and compound shapes are just a few of the elements fabricated in this fashion and produced in quantity.

Insulation, too, must provide for the characteristics of specialized applications. Safeway produces a wide variety of elements insulated with neoprene rubber, silicone rubber or reinforced plastics.

If you have a problem that requires heat, let Safeway engineers study your requirements and—without obligation to you—submit an appropriate recommendation.

For your copy of a fact-filled folder, write to:

Safeway **HEAT
ELEMENTS
INC.**

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Special Laboratory Benches

Added to Standard Line



Special laboratory benches, built to customer specifications with air, gas or vacuum cocks, electric outlet, or other departures, are now a standard item. The steel benches offer

substantial savings, and can be designed for any use in which there is need for a customized, rather than a standard bench.

The standard line's flexibility permit custom treatment. Storage space in the benches is enclosed with sliding doors. Storage shelves are adjustable on 2 in. centers and were built to a special width to provide clearance for, and access to, plumbing.

Hallowell Div., Standard Pressed Steel Co., Dept. ED, Jenkintown, Pa.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

Have you sent us your subscription renewal form?

High Temperature Pot

1.5 W at 150 C



By use of special materials and alloys in resistance elements and in winding drums Giannini has produced a high-temperature addition to their Spiralpot line of infinite - resolution, slide-wire

precision potentiometers. Designated Model 85177A, the new pot is rated 1.5 w at 150 C. Standard and special models are available. The standard models have resistance values of 50, 100, 150, 200 and 250 ohms per turn, and come in ten-turn units. The special models are available in resistance values as low as 2 ohms per turn and have shaft rotations from 1 to 10 turns. Available linearities are 0.1 per cent and 0.05 per cent.

G. M. Giannini & Co., Inc., Dept. ED, 918 E. Green St., Pasadena, Calif.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

Langevin

8 Watt Audio Amplifiers



Featuring 4 Interchangeable Input Panels

Designed for high quality sound systems, Langevin Type 138 Series low noise, low distortion Amplifiers feature self-contained power supply and plug-in type connectors. Taps on the output transformer for the entire 138 Series permit matching at 3.2, 6.4, 16, and 600 ohms. Small and compact, the 138 Series Amplifiers measure only 3 1/8" wide 5" high, and 13" long in a 16 gauge cold rolled steel chassis.

MAXSON MAKES IT

Specifications

Harmonic Distortion: All Models < 2.0% 30-15 KC across 6.4 ohm tap at +39 dbm

138-G (includes a preamplifier input for microphones)

Source Impedance: 30, 150, 250, 600 ohms

Gain: 96 db 600 ohms input — 600 ohms output at 1 KC

Output Noise: —63 dbm below full output

Response: ± 1.5 db 30 to 15,000 cps

138-K (includes a preamplifier equalized for G.E. or Pickering type pickups)

Source Impedance: 6800 ohms

Gain: 75.3 db bridging 600 ohms at 1 KC

Output Noise: —52 dbm below full output

138-L (includes a preamplifier input for high impedance microphones or crystal pickup)

Source Impedance: 1 megohm

Gain: 77 db bridge 600 ohms at 1 KC

Output Noise: —63 dbm below full output

Response: ± 1.5 db 30 to 15,000 cps

138-M (includes an input panel designed for bridging or cueing)

Source Impedance: 150, 600, 5,000, 20,000 ohms

Gain: 58 db 600 ohm input — 600 ohm output at 1 KC

Output Noise: —76 dbm below full output

Response: ± 1.0 db 30 to 15,000 cps

Complete specifications for 138 Series available upon request. Write: Audio Dept. 3.



MAXSON INSTRUMENTS

47-37 Austell Place
Long Island City 1, New York

Division of the W. L. Maxson Corporation

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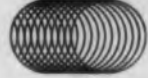
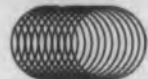
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Environmental Effects on Precision Potentiometers

BY ALBERT W. GREEN
Research Engineer
Helipot Corporation

AND KEITH S. SCHULZ
Research Laboratory Supervisor
Helipot Corporation

Presented at the 1956 WESCON

Beckman

Helipot Corp., Newport Beach, Calif.
a division of Beckman Instruments, Inc.

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TEST CLAMPS

—Lock Like A Vise!
—Easily And Quickly Attached!
—When Attached—STAY PUT!



Handy For:

- Clamping Waveguides.
- Test Instruments.
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- Connecting Portable Equipment.
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In Large Quantities?

We have in the past engineered special clamps for electronic applications. Your inquiry is invited. No obligation.

Yes, hundreds of uses. Attached in a jiffy. Just a slight twist of the large finger-tip safety knob exerts tremendous pressure for heavy current conduction on constant and intermittent duty. Available with solder and solderless lugs in 7 sizes 0 to 300 Amps.

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Power Supply 1.5 Ampere

The 1.5 amp Model C-1500 series has an 8-3/4 in. over-all panel height. Three models are available: the Model C-1580 with 0 to 200 v dc, 0 to 1500 ma; the Model C-1581 with 125 to 325 v dc, 0 to 1500 ma; and the Model C-1582 with 325 to 525 v dc, 0 to 1500 ma.

Lambda Electronics Corp., Dept. ED, College Point, N.Y.

Radio Engineering Show, Booth 2436-38.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION



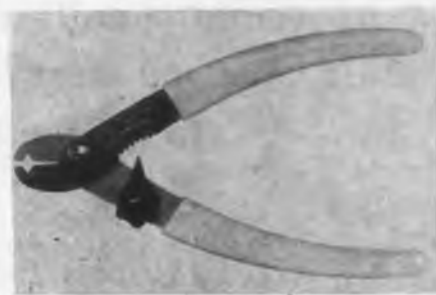
Ceramic Disc Capacitors High Q, Stability

Five types of lightweight, low-cost ceramic capacitors are available. The five types of capacitors are: temperature compensating, ac line filter, general purpose, general by-pass, and extended T. C. Characteristics include high Q, high insulation, high stability, low power factor, low drift and low inductance.

Electra Mfg. Co., Dept. ED, 4051 Broadway, Kansas City, Mo.

Radio Engineering Show, Booth 2338

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION



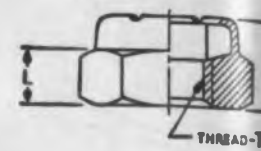
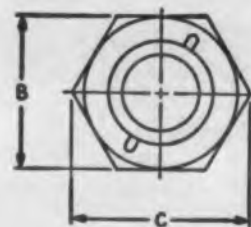
Lead Stripper Has Safeguard

This wire stripper and cutter has a 7-stop gauge which adjusts to the correct wire size. It strips and clips all wires ranging from 14 to 26 gauge. Made of heat-treated tool steel, it has ground cutting edges and a heavy insulated grip.

Walsco Electronics Mfg. Co., Dept. ED, 3225 Exposition Place, Los Angeles 18, Calif.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

MINIATURE SELF-LOCKING NUTS Sized for electronic applications



PART	RANGE OF SIZES			
	A	B	C	L
Sizes 00	.065	.111-.107	.123	.045
Thru 4-48	.110	.190-.183	.210	.070

Now miniature ELASTIC STOP® nuts are available for use in many types of instruments, electronic equipment, missiles and related products where space limitations and need for precise adjustment require a very small, self-locking fastener. Nylon inserts make them vibration-proof and re-usable. Simpler and less expensive to install and adjust than double nuts. For design information write:

Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J., Dept. N23-357

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!

Unlimited Phasing with Extreme Compactness



Phasing clamps available on three sizes of Gamewell RL-270A Blue Line Precision Potentiometers

This special Gamewell Phasing Clamp design has two important extras: Extreme compactness and High Temperature compatibility. Check these features...

- Only 3/8" depth per section
- Continuous service up to 150C available
- Stainless steel clamps give unlimited phasing
- Large number of taps, limited only by physical spacing
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linearity distortion • Will withstand High "G" and operation under severe vibration • Three styles of mounting: Servo, Bushing and 3-hole bushing • Available in ball or sleeve bearing shafts as specified • Coast in models RL-270A-1 1/2; RL-270A-2 and RL-270A-3. More information, prices and delivery available from Gamewell representatives or write: THE GAMEWELL COMPANY Newton Upper Falls 64, Mass.



PRECISION POTENTIOMETERS
SPECIAL I
Send for New Gamewell Catalog on complete list.

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Where can you use VARFLO?

(the highly flexible Class B Sleeving and Tubing that ticks Class A in performance—equals it in price)



MORE FLEXIBLE—can be bent, even tied in knots, without cracking or crazing.

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LONGER LASTING—at high temperatures— withstands hundreds of hours at 300°F.

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MORE STABLE—retains its elastic value when pulled back during soldering.

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Cuts Inventory, too! Superior to Class A insulation in performance—yet on a par with it in price—Varflo Sleeving and Tubing can be used economically for all Class A and Class B installations. This low-cost adaptability of Varflo enables many of our customers to achieve substantial savings in inventory. Available in NEMA Grades A-1 and B-1 tubing and Grade C-2 sleeving.

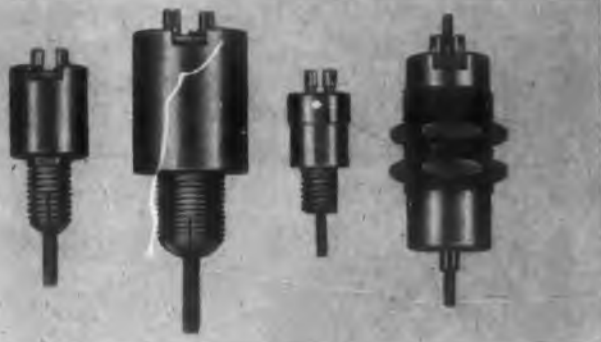
Perhaps Varflo can solve your insulating problems. Describe them in a letter—no cost or obligation for our recommendations.

Send for **FREE Test Samples**

514 W. Court St., Rome, N. Y.

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Miniaturized . . . Ruggedized . . .
and whether you buy one or thousands
of these Shielded Coil Forms you get
CTC Reliability



Shown approx. 4/5 actual size

Shielded Coil Form Data: Highly shock-resistant, mechanically enclosed. Mount by single stud. Single layer or pie-type windings to your specifications. S-9, 1/16" x 1/2"; LS-10, 5/8" x 1 1/16"; LS-11, 1/16" x 1 1/32"; LS-12 (square for printed circuits), 1/2" x 1/2" x 1/2"; LS-14 (double-ended version of S-9, with separate tuning slugs), 1/2" x 1 5/16". Ideal for use in IF strips, or as RF coils, oscillator coils, etc.

For samples, information, prices write Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

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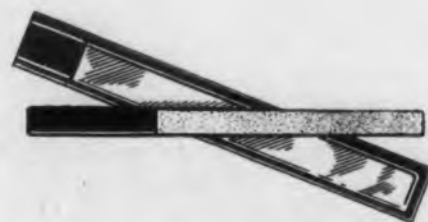


Delay Line
6000 μSec

This solid ultrasonic delay line will provide delays of 6000 μsec. The Polyplane design permits the use of smaller quartz blanks, and results in a general reduction of spurious response and low band-pass ripple.

Sturup, Inc., Dept. ED, 50 Silver St., Middletown, Conn.

CIRCLE 188 ON READER-SERVICE CARD FOR MORE INFORMATION



Contact Burnisher
Nonresidual

Designed for burnishing precious metal contacts, this device leaves no residue. Both sides of the blade have an abrasive surface, and the plastic handle is an insulator. Over-all length is 3 in. with 2 in. abrasive surface, 3/16 in. width by 0.007 in. thickness.

P. K. Neuses, Inc., Dept. ED, W. Euclid and Dwyer St., Arlington Heights, Ill.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION



Subminiature Relays
Withstand -65 to 125 C
Ambient

"CPL" Relays are for application where low and high temperatures are a major factor. Hermetically sealed or open, they are available in spdt or dpdt in contact ratings to 5 amp resistive at 28 v dc, 115 v ac, or 3 amp inductive. Qualification test is to MIL 6106 A.

Ambient range is -65 to 125C. Minimum operating life expectancy is 50,000 cycles. The relays withstand 10 G's at 10 to 500 cps. Rated for continuous duty, they have a fused ten finish and Mylar insulation. Pacific Relays, Inc., Dept. ED, 12027 Vose St., North Hollywood, Calif.

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10,000
now in use
throughout
the world



MV-17C
DC-VTVM

100 microvolts to 1 KV-DC.

For Sensitivity And
 Ultimate Reliability Choose
 the Millivac MV-17 C DC-VTVM

Millivac established its leadership in the field of sensitive DC VTVM's in 1948 when we introduced the world's first high impedance millivoltmeter for DC, the MV-17 A, forerunner of the present MV-17 C. It had a lowest range of 0-1 mV, at 6 megohms input impedance. Since then we have steadily improved our DC meters. Our latest model, the MV-27 C, is 4 times more sensitive than the original instrument (0-250 uV, 6 meg).

These instruments are available in portable or rack-mounted form, also with or without circuitry to drive recorders, with or without insulated dummy ground as well as for regular 60 cps line operation or for odd line frequencies (50 cps-500 cps, 117V).

Over 10,000 of these meters are now in general use throughout the world. If you are not yet familiar with the MV-17 C or MV-27 C, write for complete literature.

Tomorrow is our yesterday

MILLIVAC INSTRUMENT CORP.

BOX 997, SCHENECTADY, N. Y.



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RESOLUTION

500 microvolts at any output voltage

RANGE

1.02 to 1012 volts

REGULATION

.005% line or load

STABILITY

.005% short term;
.01% per day



See it!
Booth 3047
I.R.E. Show

Mod. 301C
\$995.00

all in one great new JF power supply

JF
Electronic Tools
For Industry

Here in one compact unit are 1000 volts of precisely regulated DC power. Current range of 0 to 400 milliamperes meets virtually every laboratory application. Output may be left floating, positively or negatively grounded. Output voltages may be set rapidly and accurately by five conveniently placed, easily read calibrated controls.

Accuracy and stability are assured by matched precision wire-wound sampling resistors which reference output voltage against a standard cell.

Further precision is achieved with chopper stabilized amplification. Uniform printed circuitry, adequate ventilation, conservatively designed and unconditionally guaranteed transformers all contribute to long, dependable operation.

Unit may be rack or bench mounted. The swing-out front panel gives complete accessibility to all circuit components. All tubes are instantly accessible from the rear.

Write for complete data.

JOHN FLUKE MFG. CO., INC., 1111 W. Nickerson St., Seattle 99, Wash.

CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

Services for Designers

Stamped Tube Socket

For Printed Circuits

A unique tube socket presents a new service design approach to printed circuits in view of automation requirements. The Fastex Stamped Tube Socket, expressly designed for printed circuit boards, is produced with a center slug which joins the prongs during shipping and assembly. During assembly, this slug is stamped out, creating the prongs necessary for the retention of the tube. The cost of this tube socket installed is approximately half the cost of existing sockets. The socket features uniformly controlled contact retention, small size socket both vertically and diametrically, and short lead lengths suitable for high frequency usage. Cool in operation, it is light weight, an ideal for automation, surpassing requirements RETMA specs. Other features of the Tube Socket include a minimized inter-circuit capacitance removing bulk. Any contact or contacts may be readily grounded if desired. Designs are now on drawing boards available for the 7, 9, and the 11 pin tubes, for either "copper up" or "copper down" boards.

This tube socket is now in production for a leading manufacturer of radio sets. The socket which will be displayed at the I.R.E. Show (Booths 422 and 4233) will be suited for his particular requirements. All other sockets would have to be individually designed to meet specific requirements and information should be obtained by writing to the Chief Engineer, Fastex Division of Illinois Tool Works, 195 Algonquin Road, Des Plaines, Illinois. Patents are currently pending on all designs of the



ELECTRONIC DESIGN • March 15, 1964

NEW!

Regulated
POWER SUPPLY

MODEL TM25

0 to 150 Volts D.C. - 2 Amps.

RIPPLE: 0.03% at Maximum Load.
REGULATION: LINE, $\pm 1\%$ for Line Change of $\pm 10\%$ from nominal 115 V. LOAD, Less than 4% for Load Change of zero to F.L., at Maximum Output Voltage and Nominal Input.
Request Bulletin No. 250

Other OPAD Standard Power Supplies

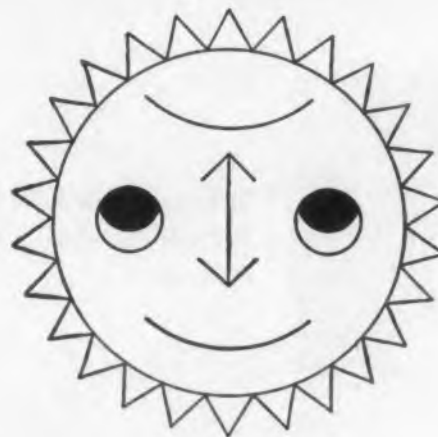
Model	Output	Ripple at Max. Load	Request Bulletin No.
KM75	0-30 V.D.C. @ 5 Amps.	0.5%	No. 93
KM81	0-30 V.D.C. @ 10 Amps.	1%	No. 96
KM88	0-28 V.D.C. @ 20 Amps.	1%	No. 100
KM95	0-32 V.D.C. @ 40 Amps. 0-64 V.D.C. @ 20 Amps.	1%	No. 103

IMMEDIATE DELIVERY

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69-16 MURRAY STREET • NEW YORK 7, N. Y.
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The tragic fact, our doctors tell us, is that every third cancer death is a needless death... twice as many could be saved.



LET'S LOOK AT THE BRIGHTER SIDE

Many thousands of Americans are cured of cancer every year. More and more people are going to their doctors *in time*... To learn how to head off cancer, call the American Cancer Society or write to "Cancer" in care of your local Post Office.

American Cancer Society

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION



Cover Story: Shakeproof printed circuit tube socket. After shipping and assembly, center slug is stamped out.

...t, and other interesting electrical applications currently being designed using this same method of assembly.

Custom Delay Lines

With Complete Lab Report

A designer and manufacturer of standard and custom-built lumped and distributed constant delay lines, offers a complete laboratory report with every delay line prototype. The ESC Corp., 534 Bergen Road., Palisades Park, N.J., makes a report which includes the customer's electrical requirements, a list of the test equipment used, so that test procedures are reproducible; a series of photo-oscilloscope films indicating input and output pulse shape and output rise time; and evaluation of photographs, and conclusions which cover all pertinent electrical characteristics.

This report is used as a guide for redesigning samples and re-evaluating requirements. It also serves as an additional production check. More information can be obtained by writing the company.

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Collates and Binds

An extra pair of hands for publishers of technical manuals or publications is offered by Hecto Products, Inc., 110 West 17th St., New York 11, N.Y. This firm will collate and bind for last minute requirements of technical publications. A complete duplicating department turns out clean, fast, and well matched books.

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How will tape wound core users be affected by new size standards?

If toroidal core winding is a familiar sight in your plant, you'll welcome news that standard sizes for tape wound cores have been proposed by the A.I.E.E.* You are going to benefit from a high in consistency of core performance, brought about by our being able to concentrate on your most important sizes.

Magnetics, Inc. is now stocking all of the proposed standard core sizes in both aluminum and phenolic core boxes for immediate delivery. Consistency of core performance is increased because each size is made in large lots taken from the same alloy batch and dry hydrogen anneal. They all bear our exclusive Performance-Guarantee.

You can find all specifications for these AIEE-standardized tape wound cores in Catalog TWC-102, a new publication

which, incidentally, is the most comprehensive tape wound core text published anywhere by anybody. Your copy of this Catalog-Design Manual may be obtained by writing on your letterhead to *Magnetics, Inc., Dept. E-34, Butler, Pa.*

MAGNETICS Inc.

*Paper 57-206, Proposed Size Standards for Toroidal Magnetic Tape Wound Cores. Report of the Magnetic Amplifiers Material Sub-Committee, at the 1957 Winter General Meeting, A.I.E.E.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable... Versatile...
for temperature
testing up to
600° F.

Statham
MODEL
TC-4
TEMPERATURE
TEST CHAMBER

For ambient temperature tests in the LABORATORY or on the PRODUCTION LINE, the Model TC-4 Temperature Test Chamber is ideal. The wide operating range of the Model TC-4 Test Chamber, from -65°F to +600°F, affords great versatility in testing applications. Interchangeable extra trays may be ordered for greater convenience and elimination of loading delays.

RANGE: -65°F to +600°F.
HEATER: Two 750 watt finned strip heaters.
COOLANT: Dry ice, 15 lbs. capacity.
CONTROL: Adjustable thermostat and selectable heat inputs.
LOAD CAPACITY: 600 cubic inches of test materials.
POWER: 115V, 15 amp., 50-60 cycle.
OVERALL SIZE: 48" x 16½" x 12".
WEIGHT: 62½ lbs.

\$700.00
F.O.B.
LOS ANGELES

Statham
DEVELOPMENT CORPORATION
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Los Angeles 64, California

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

BIRTCHEr TOP-TAINERS

FOR THE MILITARY-APPROVED
METHOD OF SECURING TUBES
AND COMPONENTS AGAINST
SEVERE SHOCK AND VIBRATION

Even severe shock and vibration can't loosen the new stainless steel Birtcher TOP-TAINERS, yet they can be removed for maintenance with a slight upward pull on the locking tab. Available in a wide range of single and double post modifications for all tubes and cylindrical components ranging from 7/8" to 2-5/16" in diameter, and in post heights from 2-1/2" to 4-5/8". Write for catalog and specifications.

THE BIRTCHEr CORPORATION

INDUSTRIAL
DIVISION

4371 Valley Blvd.,
Los Angeles 32, Calif.

Write
for
catalog

CIRCLE 207 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Portable Volt-Ohmmeter 208

Small sized portable electronic volt-ohmmeter having curved plastic face designed to lie flat in normal use is described in form 415 just released.

The brochure lists the special design features and specifications of this single-unit, multi-function range selector, which is color coded to facilitate use and speed selection. All dc ranges are zero-center design for use with complex circuit arrangements.

It further states that no batteries are required for this equipment—not even for ohmmeter section, and it comes complete with leads, single unit a-c-d-c probe and instruction book. The Hickock Electrical Instrument Co., 10525 Dupont Ave., Cleveland 8, Ohio.

Digital VTVM 209

Information about the portable Model 400 Digital Multimeter is presented in a bulletin of four pages. The main features and applications of this digital VTVM are described and its specifications are listed. With the help of a diagram, the unit's operation is briefly explained. Photographs illustrate the text. Franklin Electronics, Inc., Bridgeport, Montgomery Co., Pa.

Electronic Testing Equipment 210

Special and general purpose electronic testing equipment and precision communications products are listed in a catalog of 36 pages. Complete descriptions, photos, specifications and performance data are given for over 50 different equipments. Included are soft and hard tube pulse modulators, tube testers and checkers, power supplies, pulse and trigger generators, crystal frequency synthesizers, ultra-stable harmonic generators, frequency measuring devices, hi-pot sets and wire and cable testers. Manson Labs., Inc., 207 Greenwich Ave., Stamford, Conn.

Permanent Magnetic Alloy 211

"The Newest of the Alnicos, ALNICO 5Cb" is a four-page discussion of a recently developed permanent magnet alloy. The bulletin, DMF-3, describes the material, its physical properties and its dimensional limitations. A graph shows a typical dc magnetization and energy product curve. There is also a description of the comparative properties of standard permanent magnet materials. Thomas & Skinner, Inc., 119 E. 23rd St., Indianapolis, Ind.

Electronic Test Instrument 212

Expanded scale voltmeters and frequency meters, synchro tester, vacuum tube voltmeters, oscillators, resistance bridge power supplies, wide band amplifier WWV receiver and decade inductor are described in catalog S-57-Jan. 57.

This four-page, two-color illustrated booklet explains in full detail the specifications and features of 10 different models. Beckman Instruments Inc., Shasta Div., P.O. Box 296, Station A, Richmond, Calif.

Environment Equipment 213

Various types of environment simulation equipment custom made to meet the special test requirements of military suppliers are presented in a four-page brochure. The equipment is illustrated, with captions giving its function, the customer for whom it was made and pertinent technical data. Among the examples shown is a battery chamber designed for a one shot series of Grand Central Rocket's third stage rocket motor for the Project Vanguard satellite. Also of interest is a large, explosion-proof high-temperature chamber designed for the B. Goodrich Co. Mantec, Inc., Custom Division, 126 Maryland St., El Segundo, Calif.

Encapsulating Resins

214

Technical bulletin No. 18 describes physical and electrical properties of filled epoxy resins for room temperature encapsulation of electronic and electrical components.

Also, the bulletin contains pertinent information on successful methods for proper encapsulation work. The technical bulletin discusses the function of the filler in epoxy compounds and its contribution to the conductivity, shrinkage and thermal expansion of the casting. Available epoxy-resin/filler combinations are listed, with important physical and electrical properties, such as viscosity, pot life, hardness, heat conduction, dielectric constant, power factor loss factor at several frequencies.

Elements of proper mold design, such as simplicity, accessibility, venting, mold materials and use of release materials are also included. Smooth-On Mfg. Co., 572 Combs Ave., Jersey City 4, N.J.

Transistor Equipment

215

Specifications, illustrations, and prices for a variety of transistor and tubeless equipment are presented in a catalog of 8 pages. Coded No. 9-30-56, the booklet lists transistor test equipment, transistor application power supplies, transistorized regulated dc power supplies, transistor packaged circuits, and miniaturized power supplies. Electronic Research Associates, Inc., 69 E. Centre St., Nutley, N.J.

Radiation Monitoring System

216

A line of remote area radiation monitoring systems has been described in form of a four-page bulletin, printed in two parts, illustrated with photographs of the electronic control unit, plug-in station units, and sensing elements. It also gives information relative to uses, typical applications and complete specs. Victoreen Instrument Co., 66 Hough Ave., Cleveland 3, Ohio.

Refractometers

217

To describe eight refractometers for laboratory, pilot plant, and process control applications, Bulletin R 1000 has been issued. The 8-page booklet illustrates and describes the operation of the optical servo system used. It lists applications, sensitivities, ranges, and other engineering data. Photographs are shown for all units. Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia 40, Pa.

Phenolic Molding Compound

218

Data on a medium-impact phenolic molding compound is contained in an illustrated pamphlet of 4 pages. Complete physical properties of the compound are listed: specific gravity, flexural and tensile strength, shrinkage, water absorption, and others. Molding technique, including preheating, mold temperature, and curing time, is briefly discussed. The pamphlet also covers finishing operations and shelf life. Hooker Electrochemical Co., Durez Plastics Div., No. Tonowanda, N.Y.

Data Handling System

219

Bulletin describing a data handling system has just been released. It indicates that the system includes, among other items, high speed gated counters, digital tape to electric typewriter converter and magnetic shift register.

The illustrated bulletin explains that the features of such a system are: high speed storage on magnetic tape; playback into electric typewriter or serial IBM summary punch and continuous time readout. Berkeley Division Beckman Instruments Inc., 2200 Wright Ave., Richmond 3, California.

Subcarrier Oscillators

220

A four-page pamphlet describing subcarrier oscillators has been released. It provides complete engineering specifications and application data on this component for standard FM-FM telemetering systems.

The pamphlet is illustrated and gives mounting details and also the features of the oscillators which are designed to operate in conjunction with transducers having varying d-c voltage type output. Hoover Electronics Co., 3640 Woodland Ave., Baltimore 15, Md.

Laminated Plastics

221

Bulletin containing information about rolled copper-clad laminated plastics for printed circuits has been released. The illustrated bulletin describing in detail the specifications and test ratings of these laminates which meet both military and NEMA standards.

It also indicates that rolled copper is supplied in thicknesses of 0.0014, 0.0028 and 0.0042 in. for weights of 1, 2 and 3 oz. psf. Taylor Fibre Co., Norristown, Pa.

at Booth **4415** I.R.E.

NEW from
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Low cost MOTORS for special use

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CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION

**high-current
d c power
supply has
fast response**



Model 3 - 1.5MB

This regulated 1½-ampere unit has a recovery time of 0.4 milliseconds NL to FL... 0.25 milliseconds FL to NL. It is used with computers, and quick-response laboratory and production testing applications. Model 3-1.5MB is in production, and moderately priced. Write for literature.

specifications

OUTPUT VOLTAGES
0-300 VDC @ 1500 Ma, continuously variable without switching. This output is floating. Bias voltage: 0-145/155 VDC @ 5 Ma max., continuously variable. External output: 6.3 VAC @ 10 amps, center tapped.

REGULATION:
For 300-volt/1500 Ma output: 100 MV change NL to FL. For line voltage of 105 to 125 VAC (at 300-volt/1500 Ma output): 0.15% change in output voltage.

RIPPLE
For 300-volt/1500 Ma output, ripple and internal noise are below 3 Mv RMS.

dressen-barnes

DRESSEN-BARNES CORP., 250 N. Vinado Ave., Pasadena 8, Calif.

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NEED TUBE CRADLES?

You Specify . . . We'll Satisfy



Augat cradles are life-savers for your sub-miniature tubes, resistors and capacitors. They hold components firm and steady and provide definite assurance of long life against shock and vibration.

You can order Augat cradles in many types, diameters ranging from .175 to one inch, normally made from 1065 hardened steel cadmium plated, beryllium copper alloy 25 heat treated and silver plated or heat treated silver magnesium nickel. Special finishes may be obtained to your specifications.

If your requirements are not listed in our catalog, write us for information on cradles made to your specifications.

AUGAT BROS. INC.

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MINIATURE TRANSFORMER CATALOG

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Montague Radio Supply
- Washington, Tacoma
C & G Radio

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramics Coating

226

Information and engineering data compiled on various products made with ceramics is described in 20-page illustrated catalog No. 57 now available.

A chart complete with mechanical, physical and electrical properties makes the job of selecting correct materials for specific application an easy job. The catalog gives a complete description of each of the materials available as well as the physical, mechanical and electrical properties. Star Porcelain Co., 34 Muirhead Ave., Trenton 9, N.J.

Spaghetti Tubing

227

Flexible thin-walled and spaghetti tubing made with teflon is described in form 564.

The bulletin states where ambient temperature is high, and components grouped, the tubing has a continuous service temperature of 500 F.

Characteristics, properties of flexible thin-walled and spaghetti wire insulation tubing, sizes and price list are included in the bulletin. Sparta Manufacturing Co., Dover, Ohio.

Oscillograph Modifications

228

Two modifications for Type 5-119 recording oscillographs are announced in Supplement 1 of Bulletin 1536B. The 2-page illustrated text covers a design which permits absolute timing, and one which eliminates the dangers of explosive atmospheres. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Stainless Steel Fasteners

229

Stainless steel AN fasteners are listed in a catalog of 12 pages. The booklet describes government specification aircraft bolts, slotted and Phillips machine screws, flat and round rivets, and washers. Illustrations, stock sizes, principal dimensions, and explanations of part and dash numbers are given for each item. Allmetal Screw Products Company, Inc., 821 Stewart Ave., Garden City, N.Y.

Pressure Pickup Repair Service

230

The procedures for a pickup repair service are outlined on a 2-page illustrated sheet. The bulletin, No. 1572, gives standard charges for three classes of repairs. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Dry Batteries

Engineering Handbook Section 4A, the subject of "Batteries for Transistors, Radio and Electronic Applications," which consists of 11 engineering bulletins, has been released.

Individual specification sheets on physical dimensions of the batteries and charts showing discharge characteristics and potentials are included.

The bulletin features metal clad, sea-in-steel construction which is used on several of the unit cell batteries (including Leak Proof "D," "C" and "AA" sizes). F. O-Vac Co., 212 E. Washington Ave., Madison 10, Wis.

Cold Flowing Metal Forms

Typical parts produced by cold flowing various metals into tubular forms of all sizes and shapes is described in brochure now available.

The brochure explains how the process eliminates machining, burring, polishing and honing, in addition to having practically no scrap materials, and forming part in one piece where formerly several components were required. This process has found application in many industries. Claude C. Slate Co., 1733 Flower St., Gardendale 1, Calif.

Coaxial Directional Couplers

Data sheet covering complete line of 10, 20, and 30 db coaxial directional couplers, 225 to 4,000 megacycles, has been released.

Photographs, charts, power ratings, specifications, and prices are included in data sheet. It also includes such features as broad-band coaxial directional couplers which provide flat coupling over full octave frequency range with low VSWR. New Corp., 160 Herricks Rd., Mineola, N.Y.

Buying Used Machinery

"How To Buy A Used Machine Tool" is a primer for the used machinery buyer. Written in question and answer form, the booklet covers most aspects of used machinery purchase. It goes into such questions as what test equipment to bring with you; the things to look for when inspecting a used tool; the pros and cons of buying as-is; reconditioned or rebuilt equipment and the guarantees that come with each type of purchase. S & S Machinery Co., 53rd St., Brooklyn 32, N.Y.

Probe**235**

The Model 229 precision RF Probe, tunable over a frequency range of 900 to 18,000 Mc is described in a data sheet. The price, specifications, and special feature details of the instrument are presented along with a photograph. Waveguide and impedance standards recommended for use with the probe are also mentioned. The Narda Corp., 160 Herricks Rd., Mineola, N.Y.

Boron Carbon Resistors**236**

Boron carbon resistors rated at 1/2, 1, and 2 watts are described in Bulletin B-6b. The 4-page booklet presents comprehensive data on the construction, characteristics, applications, and performance of these film type precision resistors. Drawings, graphs, and photographs illustrate the text. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Metal-Cleaning Equipment**237**

Specialized metal-cleaning equipment and engineering services are described in a 4-page booklet. Illustrations show company facilities and spray washers, rotary drum washers, and agitating, pickling, and drying units. Construction features are specified in detail. Solventol Chemical Prods., Inc., 2841 Second Blvd., Detroit 3, Mich.

Epoxy Resin Systems Chart**238**

The physical and electrical properties of epoxy resin systems have been outlined in a summary chart. Listed are 25 different systems and the basic properties of each. The chart cites information such as the average pot life of the resin in a 100 gram mass at 80 F, viscosity in centipoises at 80 F before and after addition of hardener, physical properties of cured samples at 80 to 85 F, volume resistivity, dielectric constant and dissipation factor. Permacel Corp., New Brunswick, N.J.

Color Display Generators**239**

Form 660 is devoted to the Model 660 white dot-bar color display generator. The illustrated 2-page sheet lists special design features and technical specifications. It also enumerates available standard tubes readily used with the crystal-controlled generator. The Hickok Electrical Instrument Co., 525 Dupont Ave., Cleveland 8, Ohio.

Electronic Counters**240**

Short Form Catalog No. SF-1 describes electronic counting, timing and controlling instruments.

Details are given including the application, specification, and features of each of the models. Among those described are: decade and preset counters, frequency-period and totalizing counters, a time interval meter and universal counter-timers.

The illustrated catalog indicates some of the optional features. Computer-Measurements Corp., 5528 Vineland Ave., No. Hollywood, Calif.

Oscillograph Supply**241**

Bulletin 1570 has been issued to describe the Type 3-131 26 v dc power supply for airborne oscillographs. The 2-page sheet is illustrated with photographs and a schematic diagram. A list of specifications is provided in the text. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Air Measurement Instruments**242**

Combustion-testing and air measurement instruments are presented in Bulletin 138. Gas pressure manometers, oil flow graduates, sling psychrometers, air velocity meters, filter gauges, recording thermometers, and pressure point testers are some of the units listed. The 2-page sheet provides drawings, descriptions and prices for all items. General Scientific Equipment Co., 7516 Limekiln Pike, Philadelphia 50, Pa.

Hermetic Seal Terminals**243**

Type LT hermetic seal terminals are listed in Bulletin LT-1. The 4-page booklet contains comprehensive data covering construction, applications, specifications, properties, designations, dimensions, and installation suggestions. Detailed charts and diagrams are also provided. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Portable Drafting Instrument**244**

A portable drafting instrument which has its own drawing board is described in a 4-page folder. The literature points out the uses and advantages of the tool along with its price. Several drawings are provided for illustration. Lloyd Tool Corp., P.O. Box 647, 1620 N. Broadway, Burbank, Calif.

marion**ELECTRICAL
INDICATING
INSTRUMENTS****WHERE ELECTRONICS MEETS THE EYE**marion electrical instrument company
Grenier Field, Manchester, New Hampshire

CIRCLE 294 ON READER-SERVICE CARD FOR MORE INFORMATION

**Compact, Practical Gauges For
Moderately Reduced Pressures
DUBROVIN VACUUM GAUGES****Far More Sensitive Than Mercury Manometer • Two Sensitivities Available
Range: 0.2 mm To 20 mm of Hg • Pyrex-Brand or Soft-Glass Construction**

The Dubrovin Gauge consists of a stainless-steel cylinder, of small diameter and closed at one end, floating vertically in mercury with its open end submerged and with the air evacuated from the chamber thus formed. The outer tube, in which the cylinder and mercury are enclosed, is of glass mounted in a metal frame and connected to the vacuum line. An adjustable scale on the metal frame is read by an indicator at the top of the floating cylinder.

It indicates the pressure continuously, may be left in the system indefinitely, and is not damaged if the line is suddenly opened to atmospheric pressure. It is simple to install and convenient to use. A typical application for which it has proved especially convenient is the filling of tubes with gas at a specified pressure, as in the luminous-tube industry. It is useful wherever a sensitive gauge of this range is needed.

Cat. No.	Pressure Range mm of Hg	Magnifying Factor	Merc. Req'd. Lbs.	Material of outer tube	Mounting	Each
1451C	0.50 to 20	6	1	soft glass	Table	\$47.50
1451D	0.50 to 20	6	1	Pyrex Brand	Table	47.50
1451G	0.50 to 20	6	1	soft glass	Wall	47.50
1451H	0.50 to 20	6	1	Pyrex Brand	Wall	47.50
1451E	0.2 to 20	9	2 1/4	soft glass	Table	55.00
1451F	0.2 to 20	9	2 1/4	Pyrex Brand	Table	55.00
1451J	0.2 to 20	9	2 1/4	soft glass	Wall	55.00
1451K	0.2 to 20	9	2 1/4	Pyrex Brand	Wall	55.00

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Whatever your delay line requirements, from prototype to large scale manufacture of production units, Brew offers you the design-engineering experience and complete facilities to supply your most exacting specifications.

Brew Delay Lines are custom made to your requirements and are available covering an extremely wide range of characteristics. A Laboratory Report accompanies every prototype showing your specifications and the characteristics of the prototype.

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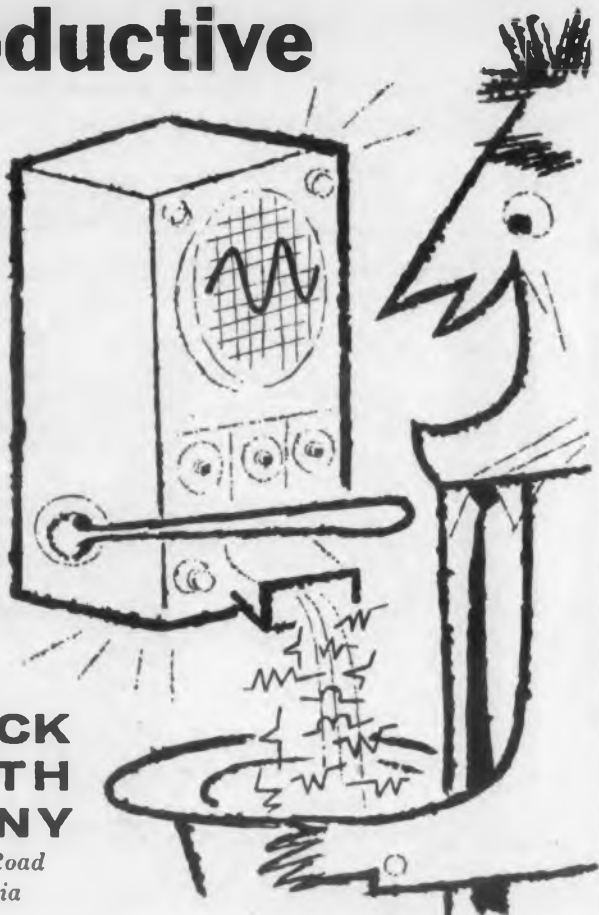
CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

How to make your CRO more productive

You do a lot of scanning on your CRO. That means a lot of fiddling with sweep controls to keep the display stable. Such fiddling distracts you from your dedicated aim. It also consumes time.

End this waste in one swoop with a SWEEP-SYNC. Hooked up to your CRO, it adjusts automatically every time you change frequency. You get an ideal display throughout continuous scanning. You never lose the display of a preset number of cycles. With no controls to twiddle, you can concentrate on productive work, and get much more done.

SWEEP-SYNC applications include sine wave, pulse, and square wave testing. Unit is only 4" wide. Write for literature.



**CHADWICK
HELMUTH
COMPANY**
472 East Duarte Road
Monrovia, California

CIRCLE 245 ON READER-SERVICE CARD FOR MORE INFORMATION

Machine Tool Tape Control System 246

Twelve-page booklet describing the principles and mode of operation of the tape control system for machine tools has been released.

A system for the numerical control of machine tools through medium of magnetic tapes is explained which comprises a planning desk, high-speed special purpose computer, and a machine control unit. The booklet describes and illustrates the technique for preparing and checking data, entering the data into the planning desk, and operating the machine control unit where this tape then serves to control servomotors on the machine tool, guiding the tool through the necessary motions in three dimensions simultaneously to produce complex curves. Electronic Control Systems, Inc., 2136 Westwood Blvd., Los Angeles 25, Calif.

Illuminated Magnifier 247

Twelve-page bulletin describing various types of illuminated magnifiers is now available. It is required by those who use precision instruments for high magnification inspection work, such as examination of industrial finishes, metals and metal products, glass, photographs, etc.

It is complete with illustrations of all the battery and electrically powered models, with detailed descriptions of each model's range of application to a variety of inspection jobs.

The bulletin features an exploded view of the basic component parts, illustrating how the parts may be inter-changed between models to allow an even wider range of usage. For specialized inspection jobs, special attachments such as 4-1/2 and 7 power achromatic, pen microscope, electric reader and the flaw finder are also described; as well as accessories and two models of a better moistener. E. W. Pike & Co., Inc., 492 North Ave., Elizabeth 3, N.J.

System Test Equipment 248

A 22-page brochure LP 3528 designed to explain the philosophy of system test equipment for military electronic systems, is available.

This illustrated booklet presents complete application information and design concepts of specific "GO-NO-GO" testing devices used in conjunction with an existing analog bombing system.

It is advantageous in large military electronic systems such as radar, data handling missile guidance, and fire control, and it can also be used in production testing, at the maintenance depot, or can be used in the field, since it is rugged and designed for that purpose.

The brochure includes typical applications for testing complete systems and checking components within a system. It shows the economic advantages of this advanced approach to electronic testing. Link Aviation, Inc., Industrial Sales Dept., Binghamton, New York.



The Curtiss-Wright "SNAPPER"

NEW CONCEPT... ADVANCED DESIGN
IN THERMAL TIME DELAY RELAYS

- Eliminates chatter with snap action
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- Wide ambient range (-65°C +100°C)
- For military, commercial and industrial applications
- Metal envelope (7 or 9 pin) miniature or (8 pin) octal
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Controlled signal delays—up to 10 microseconds—become accurate and practical with G-E Delay Cable, which can now be released to the industry.

Developed for defense purposes, and recognized as a basic device for establishing input lag, this Distributed Constant Delay Cable weighs only ½ ounce per foot and can bend on a 2-inch radius.

This offer is for experimental use, and is limited to five feet maximum per person. Please order through coupon to expedite handling. *General Electric Co., Specialty Electronic Components Dept., Auburn, N. Y.*

Mr. James Gallagher
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Specialty Electronic Components Dept.
Section 2337, Auburn, N. Y.

Send me _____ feet of Distributed Constant Delay Cable, with related data. Remittance at \$1 per foot is enclosed.

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CIRCLE 250 ON READER-SERVICE CARD

Time Switch 251

Bulletin NR-226 describes seven-day time switch which provides for presetting a different program of operations each day of the week. Series V21000 are used for controlling heating systems, air conditioning systems, lights and fans on a weekly schedule.

The advantages of the time switch are given and timings can be varied for each day's needs. ON-OFF operations can be as close as two hours any day or night, or operations can be completely skipped on any desired day or days.

Among the features stated in the bulletin are manual control with automatic reset, plated parts for long life, easy-to-add trippers, and five convenient knockouts.

That models for 20 amp./125 v or 15 amp./250 v are available. International Register Co., 2624 W. Washington Blvd., Chicago 12, Ill.

Battery for Telephone Industry 252

A catalog, Form 5928, describing new type EWA battery for telephone service has just been released. The catalog highlights the development of the battery's positive plates, constructed of a blend of lead, antimony and silvium, which assures long battery life and protection against corrosion.

Among the features of the catalog are the battery's lightweight, heat resistant, shock absorbent polystyrene jar; battery elements suspended from ledges molded within the container walls.

One-, two- and three-cell units are illustrated, and the catalog contains tables showing their rated capacities, dimensions, weights and other data. A full-page cutaway photograph shows details of the cell construction. Exide Industrial Div., Electric Storage Battery Co., Box 8109, Philadelphia 1, Pa.

Heating & Refrigeration Systems 253

The manufacture of specialized heating and refrigeration systems for military and transport users are described and illustrated in a 4-page folder recently published.

The bulletin includes space heaters for mobile and portable military shelters for radio, radar and guided missile control and maintenance installations; heaters for starting internal combustion engines in trucks, generator sets at sub-zero temperatures, and an unpowered open-flame torch for a wide range of sub-zero applications, used by the Armed Forces. The torch can be lighted with a match and operated on conventional fuels at temperatures down to 90 below zero.

Also featured are a complete line of gasoline and LP-gas heaters and mechanical and controlled dry ice refrigeration systems, for civilian use. Hunter Mfg. Co., 30525 Aurora Road, Solon, Ohio.

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CIRCLE 254 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW TO BOOST A BLIP...

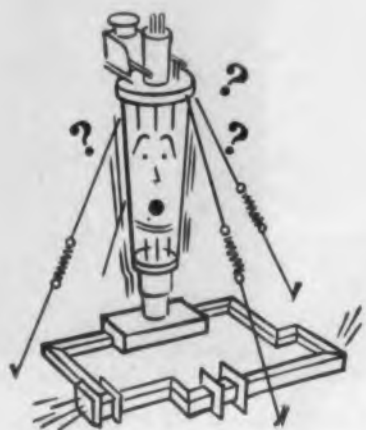
you could



make your dish a "spectacular"



... perch it on a peak



... go "king-size" tube-wise



pour on the coal

... and

But... why do it
the hard way when

cool
YOU CAN DO IT WITH "E"s

... and get a signal that really sings ...
in smaller space ... for pennies instead of
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changing your existing system or equipment.

The 1N23E at X and C band and the
1N21E at S and L band provide
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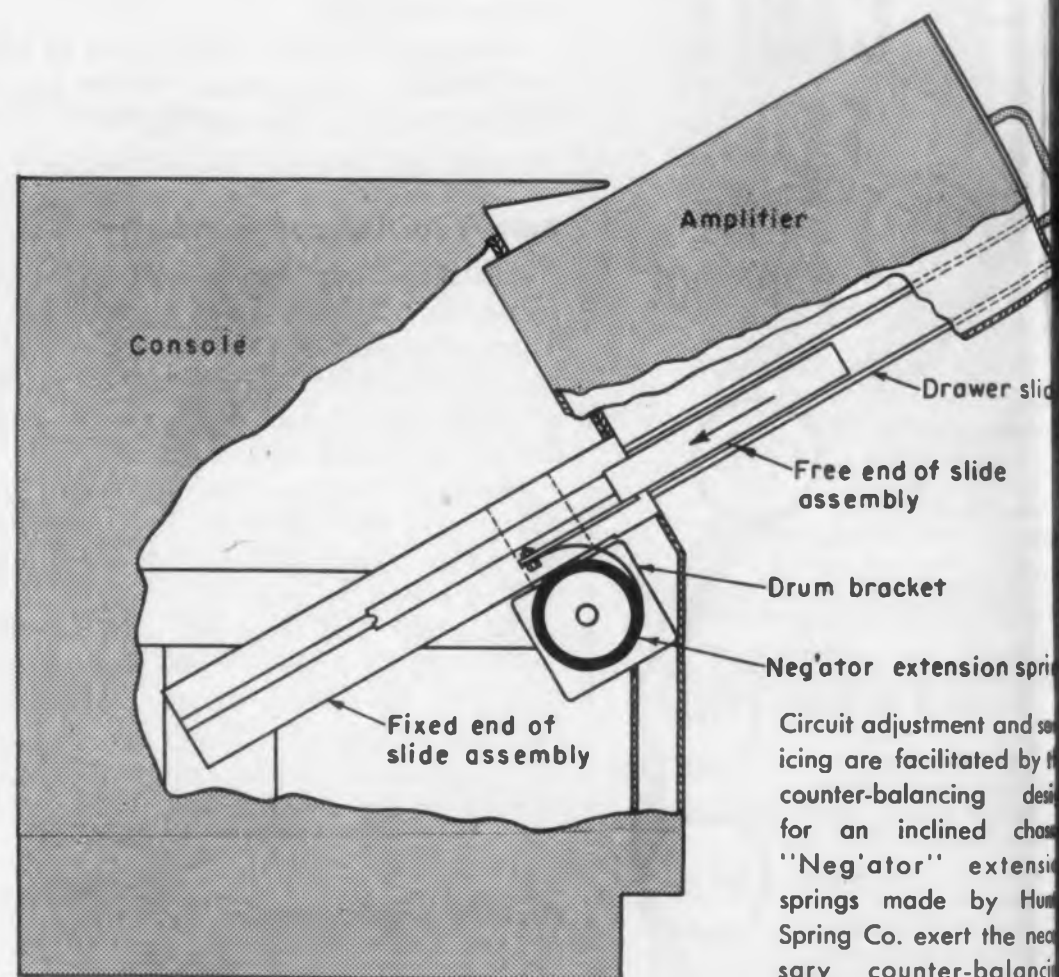
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CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Design

Balancing An Incline Ch



Circuit adjustment and servicing are facilitated by the counter-balancing design for an inclined chassis. "Neg'ator" extension springs made by Hummer Spring Co. exert the necessary counter-balancing forces.

Using the design shown, a 48 lb amplifier chassis is mounted on a 30 deg inclined plane in an RCA console. The amplifier will remain fixed in any location along its slide track for adjustment or service.



e chassis

At the Radio Corporation of America in Camden, N. J., the knotty problem of counterbalancing the resultant load of heavy but delicate electronic equipment, supported on inclined ballbearing slides in console application, has been simply solved by the design shown.

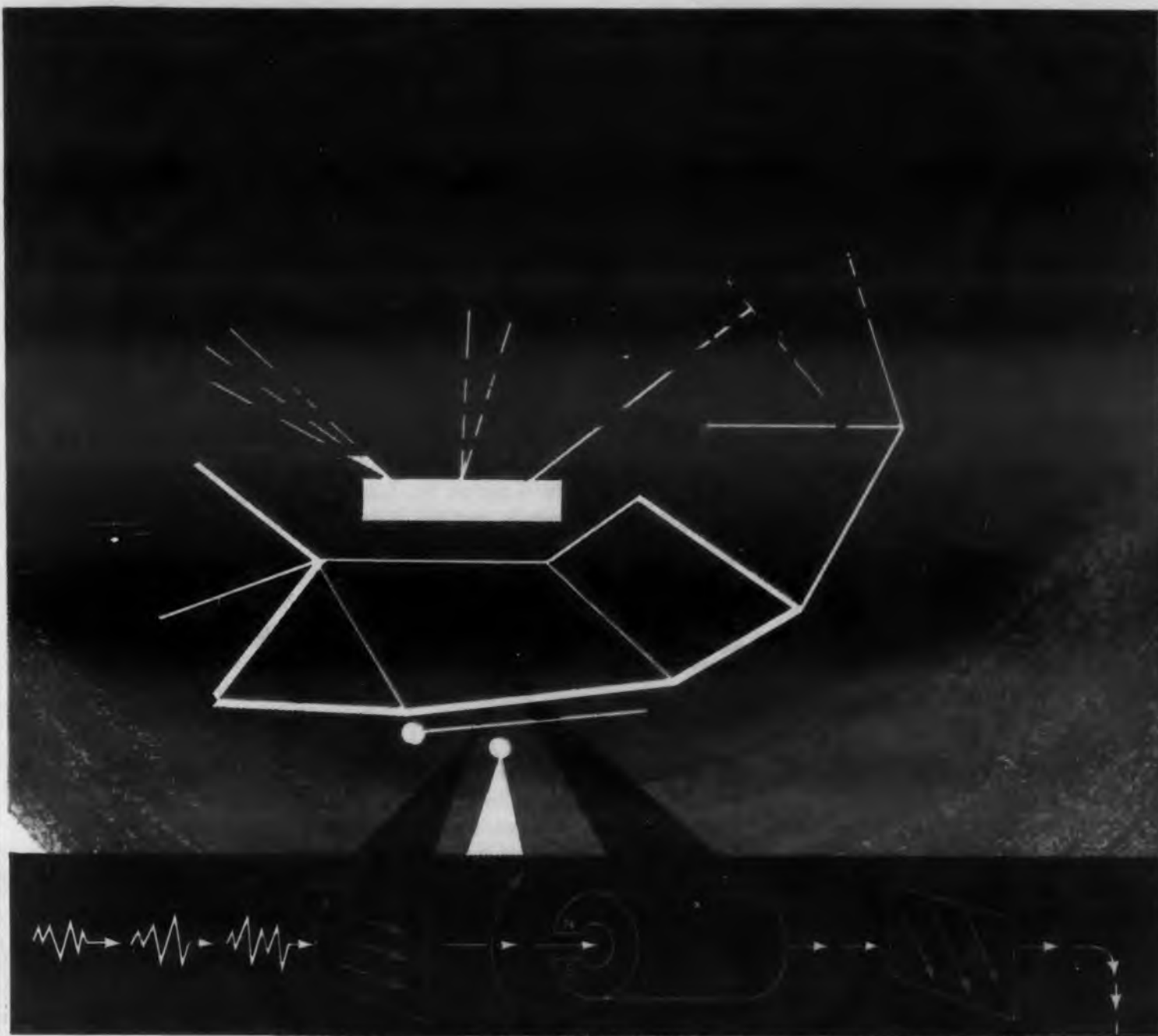
The slides are mounted in RCA's console at 30° from the horizontal and support the chassis, which weighs 48 lb. Since the resultant load parallel to the slides is approximately 24 lb, and each independent "Neg'ator" spring exerts 14 lb, or a total of 28 lb throughout the entire excursion of 17 in., there is an excess spring force of 4 lb.

The spring force acts to assist withdrawal of the chassis; holds it in place when it has been withdrawn any distance; and prevents it from crashing down the incline to a sudden, jarring halt.

The Neg'ator springs are prestressed strips of spring steel, manufactured by the Hunter Spring Company, Lansdale, Pa. They normally form a tight coil. As the free end of the band is withdrawn from the drum, it exerts a constant force, independent of the length of extension, in attempting to recoil.

In the console, the drum supporting the spring is attached to the fixed end of each slide assembly as shown; and the free end of the coiled spring and drum are bolted to the free end of the slide. Only 1/2 in. in dia when fully coiled and 1/2 in. wide, the spring and drum are sufficiently compact to be mounted in the limited space between the chassis and the cabinet. As the amplifier is pulled out, the springs recoil, exerting a total unvarying force of 28 lb with the remaining 4 lb overcoming friction in the mechanism. If the amplifier is released while in its "pulled-out" position, the springs will "float" it into place. As it is returned into the cabinet, the restraining force they exert prevents too rapid return and the possibility of a jolting stop.

The photograph shows the actual inclined chassis—amplifier—at RCA, in its withdrawn position.



in radar load isolators, too

CRUCIBLE PERMANENT MAGNETS

give maximum energy... minimum size

Special applications, such as radar load isolators, demand compact but powerful magnet assemblies. And this is but one of the many places where the *consistently higher* energy product provided in Crucible Alnico magnets pays off.

These Crucible Alnico permanent magnets can be sand cast, shell molded, or investment cast to exact size, shape or tolerance requirements... and in any size from a mere fraction of an ounce to hundreds of pounds.

The design and production of permanent magnets has been a Crucible specialty ever since Alnico alloys were discovered. It's one of the good reasons why so many people bring their magnet applications to Crucible. Why don't you? *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE

first name in special purpose steels

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**STAINLESS STEEL
FASTENINGS**
RIGHT-OFF-THE-SHELF[®]
for immediate delivery

STAINLESS STEEL

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- Socket, Set & Cap
- Nuts, Washers
- Machine Screws
- Sheet Metal Screws
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- Pipe Fittings
- Dowel, Taper, Cotter Pins
- AN Drilled Fillisters
- Stud Bolts

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The right amount of solder every time when you use Kester Solderforms in your assembly operation. Produce better looking and more efficient products as well as greatly increase speed of manufacturing.

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CIRCLE 258 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Design

Hi-Voltage Insulator Bushings

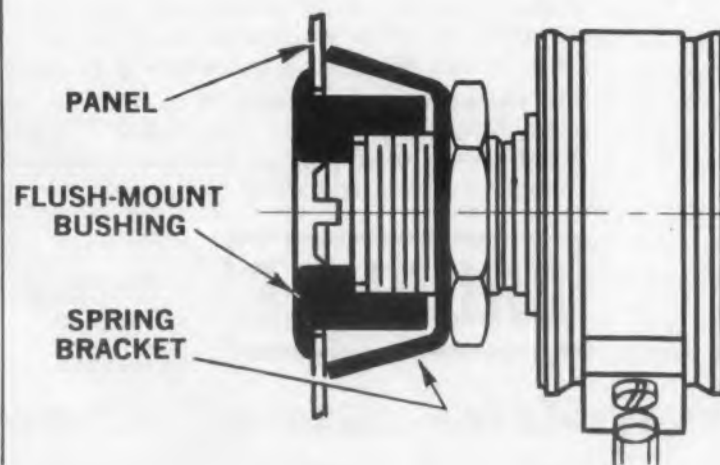
Eitel-McCullough of San Bruno, Calif. has successfully concluded a series of important tests for the use of epoxies in cable-to-air and cable-to-oil terminations involving tests in the 150 kv range. Cast bushings involving a filled epoxy and "Epocast" Safety Hardener D-40 were molded and slowly cured in the 140 to 160 F range. The bushings measured 36 in. in height and weighed approximately 90 lb. Outdoor insulator bushings are under active study by Mr. L. Franklin of Components for Research of Palo Alto, Calif., who assisted in the design sub-contracted from Eitel. This development is considered quite important. Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif. will gladly supply further information.

Flush Mounting For Controls

Providing a no-tamper, sealed, panel installation, the arrangement shown is a simple method of mounting controls on panels. Trimmer condensers, switches, tuned coils, and potentiometers, for instance can be mounted so that slotted shafts are flush or recessed to prevent tampering or accidental misadjustment. Developed by Waters Manufacturing Inc. of South Sudbury, Mass., this device consists of two parts: a narrow-flanged bushing with internal thread to fit the shaft bushing of the mounted device, and a spring bracket that applies force between the mounted device and the back of the panel.

The Waters "Pot-Hook" mounts in a 9/16 in. hole for a control with a 1/4 in. shaft or in a 7/16 in. hole for a control with a 1/8 in. shaft. The standard unit is designed for use on up to 1/8 in. thick panels.

In addition to the plain "Pot-Hook" shown in the photograph, the device can be furnished with a rubber "O" ring and neoprene gasket, providing a panel seal. It can also be provided with a setscrew to lock the shaft from the front, with a unique ball arrangement to prevent marring of the shaft.



Smaller Size, Lighter Weight Offered by New Sola Harmonic-Neutralized Regulator

Improved design of Sola Harmonic-Neutralized Constant Voltage Transformers (Type CVH) now provide up to 60% size reduction and 54% lighter weight. Also offered by the new design is greatly-reduced external field—far lower than that of any other stock, static-magnetic voltage regulator.

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Ideas for Design

Bearings Need No Lubricant

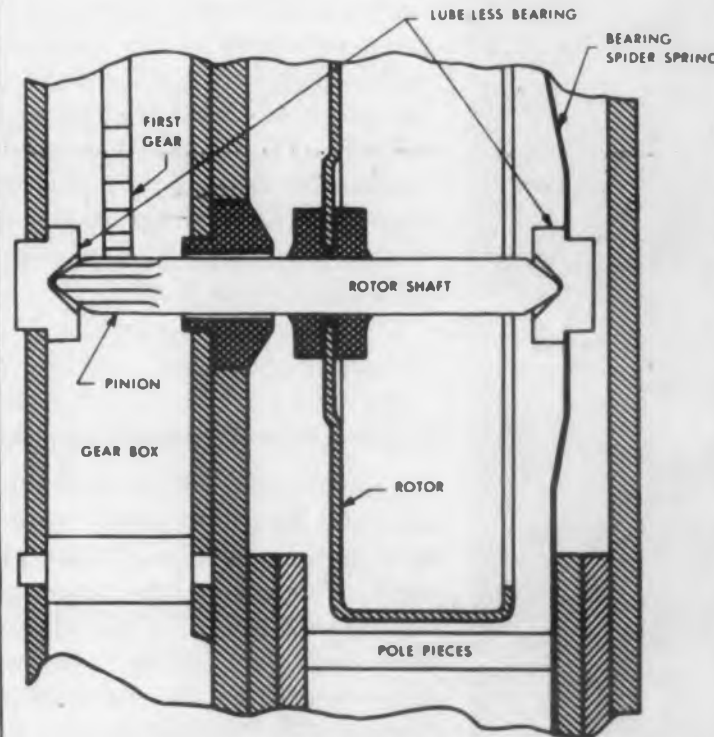
No lubrication is necessary for the bearings of new synchronous motor specifically designed for incorporation in timers subjected to temperatures up to 150 F. This is a development of the Lux Clock Manufacturing Co., Waterbury, Conn.

Since no lubricant is present in the bearings, this design eliminates the formation of gummy residues — primary cause of failure in timer motors required to operate in the presence of heat.

Rounded ends of the rotor shaft ride in cup-shaped bearings, with a specially designed spider spring mount taking up end play on pivots. This exclusive Lux development assures constant torque output and continuous accurate positioning of the rotor pinion in relation to the first gear. In addition, wear- and-noise-producing shaft vibration is completely eliminated.

First pinion is cut integrally with the rotor shaft, eliminating any possibility of pinion rattle. This design also makes possible a small pitch diameter which permits a low feet per minute speed and a slower speed of the gear reduction unit.

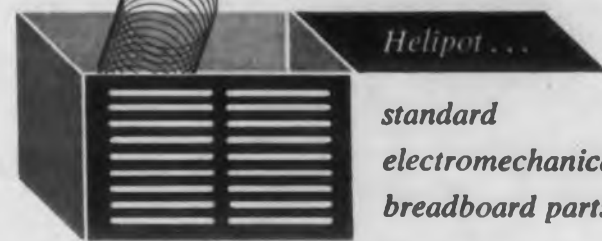
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WEIGHT: 1 lb.

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Report Briefs

Silicon Power Rectifiers

This quarterly progress report describes work on the development of design and production techniques for silicon power rectifiers to replace rectifiers using selenium. According to specifications, the rectifiers were to possess a d-c output of 75 ma in half-wave rectifier service, or 150 ma in a full-wave circuit, with a maximum peak inverse voltage rating of 300 v in the temperature range -55 to 125 C. Development of rectifiers of generally better characteristics, particularly in peak inverse voltage rating, is reported. Processes described are said to be feasible for quantity production of the devices. The illustrated report also describes electrical and environmental testing procedures. *PB 121274 Quarterly Report, D. Bakalar, H. G. Rudenberg, R. Hall and L. Huff, Transitron Electronics Corp. for Signal Corps Supply Agency, OTS, U. S. Dept. of Commerce, Washington 25, D. C., Oct. 1955, 49 pp. \$1.25.*

Radar Beacon-Sharing

In the course of the Model II radar performance evaluation, procedures for beacon-sharing were developed and operationally tested. The method is based on time sequential beacon interrogation programmed by suitably tuning the radar's 82-kc master oscillators, and permits a single beacon to be tracked by several unsynchronized radars without mutual interference. The report describes the underlying principles of the beacon-sharing techniques and indicates their advantages in comparison with the previously used schemes of radar operations at AFMTC. *PB 122383 Model II Radar Performance Evaluation: Radar Beacon-Sharing, A. E. Hoffmann-Heyden, USAF, Order from Library of Congress, Washington 25, D.C., Jan. 1956, 50 pp, Microfilm \$3.30, Photocopy \$7.80.*

Information Transmission Aspects

A general analysis is given of certain features of signals and how information can be extracted from them in the presence of noise. The coherence properties of signals and the processes of selectivity that can be used to extract the signal from the noise are discussed. *PB 123439 Certain Aspects of Coherence, Modulation and Selectivity in Information Transmission Systems, S. Goldman, Syracuse University, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Nov. 1955, 41 pp, Microfilm \$3.30, Photocopy \$7.80.*

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Helical Coupling System

A theory of power coupling between concentric, contra-wound sheath helices has been presented by Kompfner and further amplified by Wade. A modification of this theory is presented in the light of experimental results, in order to give a more accurate picture of the conditions for complete power transfer from one helix to the other. The problem of matching a helix to a coaxial line is investigated. A procedure is developed by which the impedance of a helix within a shield may be matched to a coaxial line. A complete coupling, capable of use on a traveling-wave tube or backward-wave oscillator, is designed and tested. *PB 122976 Helical Coupling System, Allan J. Lichtenberg, MIT, Order from Library of Congress, Washington 25, D.C., Oct. 1954, 29 pp, Microfilm \$2.70, Photocopy \$4.80.*

Astronomy Antenna Studies

The search for compact, high-gain, broad-band antennas continues through the report period. Tests of 90 and 120 degree corner reflectors, possessing sides $3/4$ wavelengths long, show that these wider antennas have more favorable E-plane patterns than the 60 degree reflector studied during the first report period under this contract. *PB122374 Antenna Studies for Radio Astronomy, James W. Warwick and Palmer W. Carlin, Colorado University, Order from Library of Congress, Washington 25, D.C., Mar. 1956, 19 pp, Microfilm \$2.40, Photocopy \$3.30.*

Delay Lines

The inductance of a line is known to decrease with frequency. The stray capacitance between turns is actually in parallel with the inductance of a turn. This forms a parallel circuit which can help offset the variation of inductance with frequency. In the multilayer case the stray capacitance is increased many times. From these principles, design equations are developed for the multilayer line. *PB 122052 Self-Compensated Multilayer Distributed Constant Delay Lines, William S. Carley, NOL, Order from Library of Congress, Washington 25, D.C., Oct. 1954, 49 pp, Microfilm \$3.30, Photocopy \$7.80.*

Communications Single-Sidebands

This bibliography is an attempt to record the classified and unclassified literature on the subject. The period covered is 1921 to July 1956. *PB 111837 Single-Sidebands In Communication Systems, A Bibliography, Mildred Benton, NRL, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Sept. 1956, 105 pp, \$2.75.*

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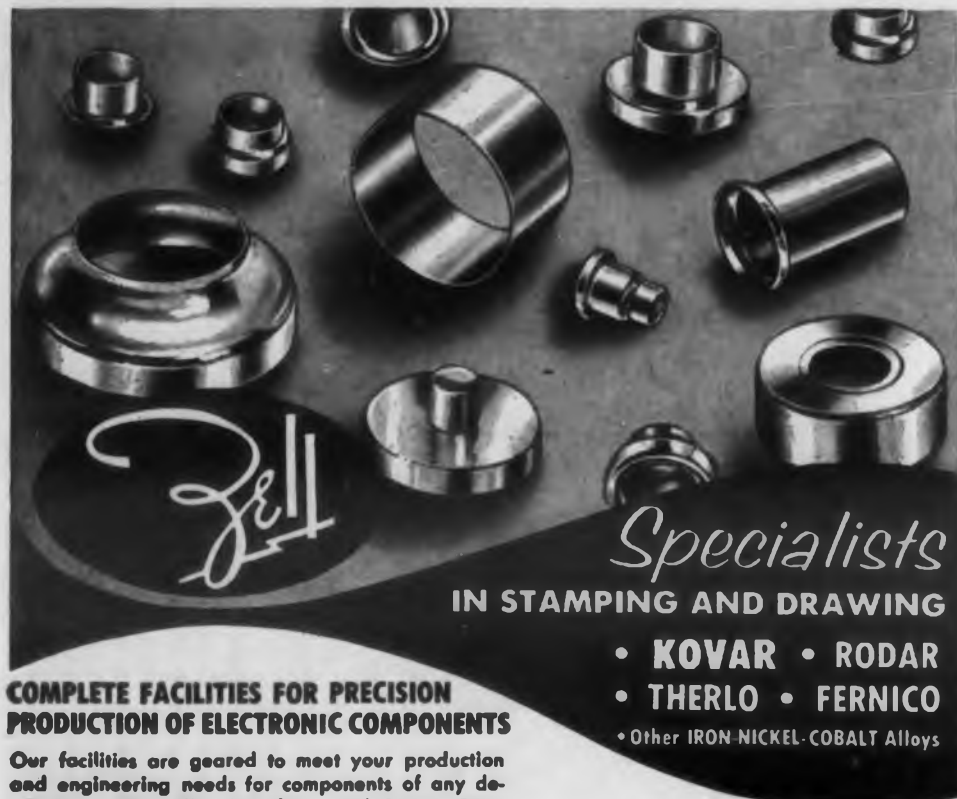
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Blocking Oscillator Circuit

Patent No. 2,748,282. A. A. Gorski. (Assigned to Philco Corp.)

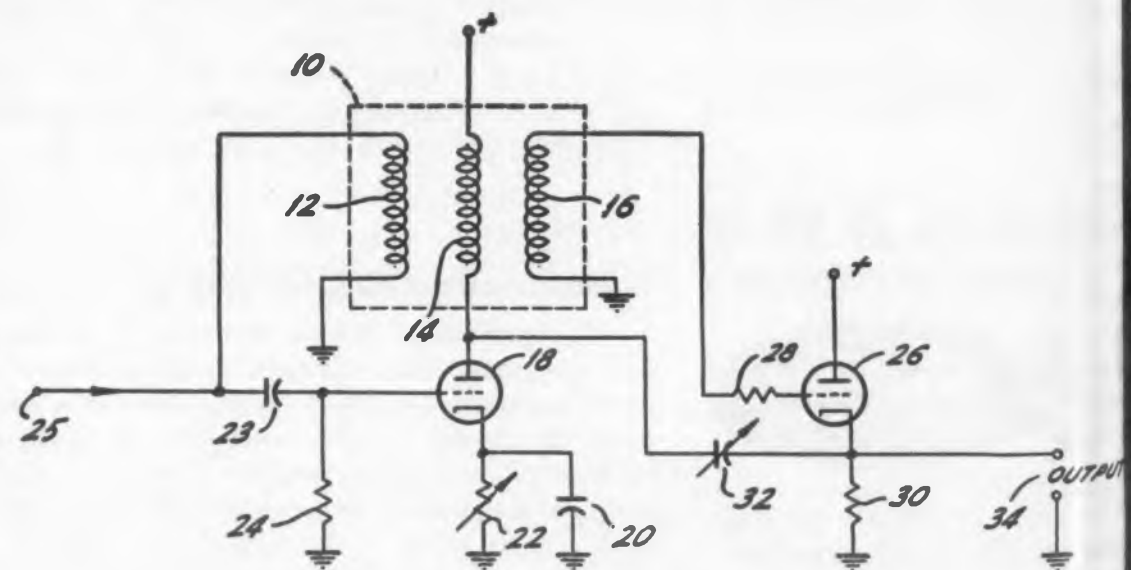
Blocking oscillators are commonly used either as free-running pulse generators or controlled in which event an input signal initiates the change in the condition of stability to generate each output pulse. Prior oscillators of this type generate pulses of short duration. The duration of the pulse is dependent primarily upon the magnetizing inductance of the transformer used and secondarily on the capacity of the condenser coupling the transformer with the control grid of the first tube. The magnetizing inductance of the transformer can be adjusted or changed only to a limited extent with the result that the adjustment of the duration of pulses is limited. It is desirable too, to have substantial control of the length of the interval between pulses. The circuit illustrated provides independent control of both the pulse duration and the space duration and the control extends over a wide range.

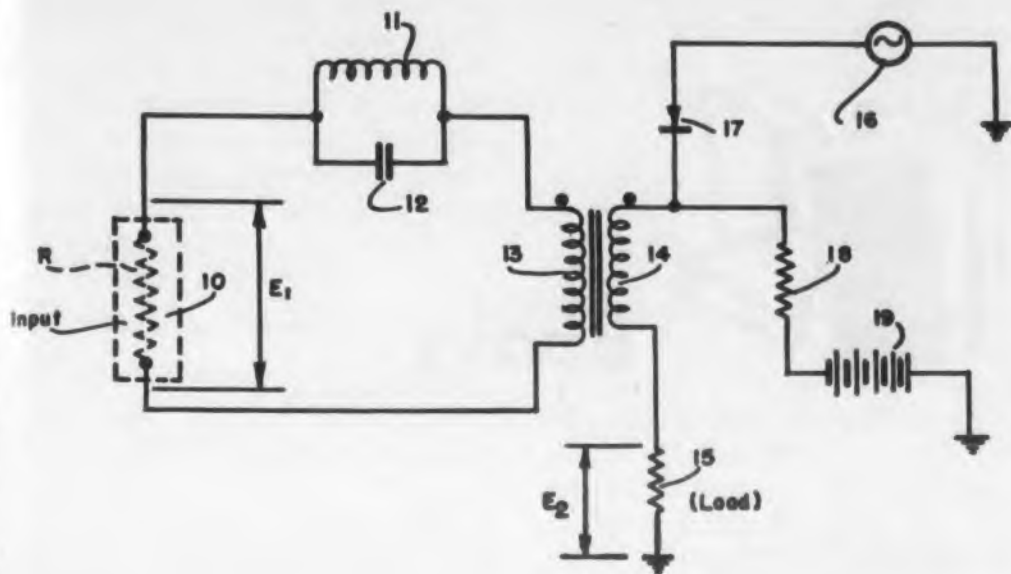
The circuit and its components are clearly illustrated in the figure. Transformer 10 has a winding 14 in the anode circuit of the tube 18 which is coupled to its control grid by the winding 12. A second secondary

winding 16 couples the anode winding of the control grid of the second tube 26. The duration of the spacing between the generated pulses is determined by the time constant of the input circuit and by the potential of the cathode of the tube 18, making the cathode resistor 22 adjustable. The potential on the cathode may be varied to independently control the space duration or time interval between pulses.

The tube 26 is a cathode follower tube which feeds back a positive pulse through the capacitor 32 to the anode of the tube 18. This increases the time for the tube 18 to reach current saturation and thereby increases the duration of the pulse. This increase in pulse duration is at least ten times that of the usual blocking oscillator circuit. By adjusting the value of the capacity of capacitor 32, the width or duration of generated pulse may be adjusted at will, as much as several hundred microseconds.

The circuit illustrated may be free-running or it may be controlled by an input pulse applied to the terminal 25. The output is taken from the terminals 34 across the cathode resistor 30 of the cathode follower tube 26. The patent also illustrates a more complex blocking oscillator circuit for more precise control of the generated pulses.





Flop Circuit

Patent No. 2,749,451. R. P. Talambiras. (Assigned to Sperry Rand Corp.)

A flip-flop circuit of the saturable core type is described and illustrated in the patent. The circuit uses well known components and also comprises components having a high degree of reliability. This is important for computers which use a great many units and the failure of one component can and does materially affect the results of the computer. The circuit illustrated secures a high degree of reliability dispensing with the use of vacuum tubes or equivalent elements which may burn out. The input may be a resistor 10 across which an input potential or control signal is applied. The input circuit includes a parallel resonance circuit 11, 12 which is resonant to the frequency of a high frequency source 16. The input circuit also includes the winding 13 of a saturable reactor in series with the resonant circuit. It is desirable that the hysteresis loop of the reactor be approximately a rectangle.

The output is taken from across a resistor 15 which resistor is in series with a second winding 14 of the saturable reactor, a rectifier 17 and the source of high frequency oscillations. An additional source of negative remanence for the saturable reactor is provided by the battery 19 which provides current through the resistor 18 and the winding 14.

Without an input signal, the core of the reactor operates within the area of the hysteresis loop in which area the effective impedance of the windings is high. The

positive portions of the high frequency oscillations from the source 16 induces a current in the winding 13 and the input circuit which charges the condenser 12. During the negative portions of the high frequency waves, the capacitor discharges and with the additive negative remanence of current from the battery 19, drives the magnetization of the core in a negative direction and in an amount approximately equal to that of the positive flux from the positive portion of the high frequency wave.

If a positive input signal is applied at the input terminals of substantial duration relative to the high frequency oscillations, progressively lesser currents are generated in the winding 13 and the discharge current of capacitor 12 becomes less. The positive portions of the high frequency therefore drives the core progressively to saturation and the impedance of the winding 14 decreases with the result that an output potential or signal appears across the resistor 15. Upon termination of the input signal, the saturable reactor continues to remain saturated and output signals continue to appear across the output resistor. To terminate the output signals, a negative pulse of substantial duration is applied to the input terminals which progressively restores the saturated core to its initial unsaturated condition whereupon the output signals cease.

The patent discloses a modified circuit in which the d-c source 19 and resistor 18 is dispensed with in the output circuit, as shown in the figure. A battery is then provided in series in the input circuit. For rapid transition of the circuit from its two conditions of stability the resistors may be made smaller and the capacity of the capacitor 12 is increased.

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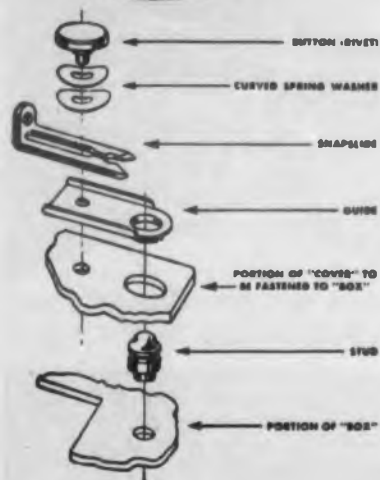
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SPECIFICATIONS

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IF bandwidth.....	300 kc
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Noise figure.....	11 db, maximum
IF rejection.....	Not less than 70 db
Image rejection.....	Not less than 40 db below 130 mc; 30 db minimum at any frequency.
FM output.....	0.15 volt per kc deviation (Approx.)
AM output.....	12 volts for 10 uv input modulated 30% at 1000 c.p.s. (Approx.)
Squelch.....	Operates on monitor circuit



Books

RCA Receiving Tube Manual

Radio Corp. of America Tube Div., Harrison, N.J., Harrison, N.J., 352 pages, 75¢.

Revised, expanded, and brought up to date, this manual contains technical data on more than 575 receiving tubes. It covers black-and-white and color television tubes, picture tubes, and tubes for series-string applications. Basic theory and application information are set forth in simple style. A receiving-tube classification chart is arranged to facilitate selection of types according to family class, functions, and filament or heater voltages. Technical data on picture tubes are tabulated in a Characteristics Chart.

Proceedings of the Conference on Radio Interference Reduction, Vols. I and II

Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill., 690 pages, \$6.00.

In these volumes, all the papers presented at the 1954 and 1956 Conferences on Radio Interference Reduction are collected. The material covered should interest both manufacturers and research development engineers. There are articles devoted to measurements, design techniques, practical suppression measures, and component development. Equipment and systems covered encompass radio and radar, aircraft and missiles, vehicles, and electrical devices.

Electronic Tubes, Circuits, and Devices

Lewis G. Blevins. Universal Scientific Co., Inc., 1102 Shelby St., Vincennes, Ind., 620 pages, \$4.50.

Designed to familiarize students with electronic fundamentals and their practical application, this text is the third of a series. It explains radio transmitting and receiving principles, radar and television principles,

and the fundamentals of industrial electronic controls. The book is profusely illustrated with photographs, schematics, and graphs.

Television Engineering Handbook

Edited by Donald G. Fink. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y., 1496 pages, \$18.00.

Prepared by thirty-three experts in twenty special fields, this handbook covers the entire subject of television technology giving basic fundamentals as well as practical design data for transmitters, receivers and networks. It is a unified compilation of all the quantitative data required to design and operate television equipment anywhere in the world. The book has been edited to achieve four principal aims: to be as detailed and comprehensive as a single volume of manageable size can be; to treat monochrome and color systems on a completely equal footing; to cover the systems and standards not only of the United States but of the British, French, and European (C.C.I.R.) groups as well; and, in the particularly important field of television receivers, to provide detailed design data for every portion of typical receivers, monochrome and color, based on practice current at press time. This last objective has resulted in a chapter of 258 pages, the combined efforts of seven engineers, and virtually a textbook in itself.

Prepared in simple and concise style, the book is a comprehensive and ready source of technical information needed every day by engineers and technicians. Standard Color, Amplification, Synchronization, Transmitters, Receivers, and Cables—but a few of its twenty section headings. Much of the material appears for the first time in technical literature. The whole field

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color television has been brought up to date. In this section, complete circuit diagrams of the latest 21-inch color televisions have been provided. There is also new material on colorimetry, video waveforms and spectra, the design of wideband amplifiers and the design of deflection systems. This index contains 4500 entries, and the illustrations number 1159.

Operations Research, Armament, Launching
 by **Rayson Merrill, Harold Goldberg and Robert H. Helmholtz. D. Van Nostrand Co., 120 Alexander St., Princeton, N.J., 508 pages, \$10.00.**

The third of a series dealing with the principles of guided missile design, this volume analyzes three components of the guided missile system. The technologies of operations research as a decision-making tool, armament design as it relates to target destruction, and launching system design means for achieving initial flight are actively covered.

Operations Research shows how Armed Forces requirements derive from legal obligations and missions, tells how missiles are developed on a teamwork basis with industry, and details the technique of opera-

tions research as the modern basis for decision-making. Sample problems show how missile operational requirements are derived, how performance specifications are set, how competitive weapon systems are evaluated, and how plans for initial employment are made.

The Armament section explains how to design a missile warhead and fuse to destroy its target. It first examines factors affecting design requirements: target characteristics, the dynamics of target and missile at intercept, demands of the guidance and propulsion systems, and logistic, economic, and safety considerations. Here types of warheads, fuses, and safety and arming devices are described and analyzed.

The Launching section treats the booster assemblies, catapults, and airborne and surface launchers that are used. It discusses the relationship of their design to the launching vehicle and its tactical environment, and to other missile features such as guidance, propulsion, and safety. The section also points out analytical methods for determining missile travel on the launcher and during boost phase, and for relating launching dispersion to "capture" by the guidance system.



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What the Russians Are Writing

J. George Adashko

Contents of Radiotekhnika I Elektronika, No. 6, 1956

Recent issues of this periodical, published by the USSR Academy of Sciences show an increasing emphasis on the theoretical-physics aspects of electronics, and devote less space to design features. Although most of the content of this publication is of interest to workers in all phases of electronics and to most of our readers, we shall delete from our future abstracts papers of interest primarily to physicists.

A large portion of this issue is devoted to papers delivered at the Scientific Conference on Radio Electronics, organized by the USSR Ministry of Higher education and held in Gor'ki on January 16-20, 1956. The topics covered were radio astronomy, propagation of radio waves, and the physics of ultra-high frequencies. Abstracts of many of these papers are included in a translation of the program of this conference, available on request from Morris D. Friedman, Inc., 572 California Street, Newtonville, Mass. The following are the abstracts of the articles believed to be of interest to our readers.

MICROWAVE SYSTEMS

Molecular Generator, N. G. Vlasov, 6 pp, 3 figs, 2 tables.

Microwave oscillations are produced here by interaction between electromagnetic fields and a beam of ammonia molecules in excited state. Such generators have been in use for some time as frequency standards, and are theoretically accurate to within 10^{-10} , although reflections in the microwave components and dispersion near the absorption line reduce the practically-obtainable accuracy to an order of 5×10^{-8} . These two factors are considerably reduced in the design described in this article by eliminating various reflection and by narrowing the spectral lines employed through the use of molecular beams.

The generator consists of three principal parts: source of molecular beam, sorting system, and resonator. A molecular beam, 10^{18} mol/sec in approximate intensity is produced with a copper-foil grid. The sorting system consists of a quadrupole capacitor. Mole-

cules in the upper inversion level are acted upon in this capacitor by elastic forces that cause oscillation of the molecules. The cavity resonator is designed for the E_{001} mode so as to eliminate Doppler broadening of the spectral line. The schematic diagram of the entire setup is shown in Fig. 1.

In many problems of this nature it is not essential to know the absolute value of the frequency, but to maintain the frequency constant over certain intervals of time. The molecular generator is particularly suitable for such applications, for the frequency remains constant as long as the resonator setting can be kept constant. Under such conditions, experimental accuracies on the order of 10^{-12} were obtained for short periods. This may eventually make possible an experimental verification of the general theory of relativity (see paper by C. H. Townes, *J. Appl. Physics*, 1951, 22, 1365).



Fig. 1: Diagram of molecular generator arrangement. 1—beam source, 2—grid, 3—diaphragm cooled with liquid nitrogen, 4—electrodes of quadrupole capacitor, 5—resonator, 6—waveguide.

Diode Noise Generator for Three-Centimeter Band, S. I. Averkov, V. I. Anikin, D. M. Bravo-Zhivotovski, A. V. Gaponov, M. T. Grekhova, V. S. Ergakov, V. A. Lopyrev, M. A. Miller, and V. A. Fliagin, 14 pp, 13 figs.

Discussion of a noise generator used for measurement purposes, in which the noise is produced by shot effect in a coaxial diode. To increase the generator efficiency, the diode is connected to a high-impedance slotted line, which comprises one of the arms of a waveguide-slotted-line tee coupling. The article considers the operating range of the equipment and the

noise-power spectrum, which is linearly adjustable by varying the anode current of the diode.

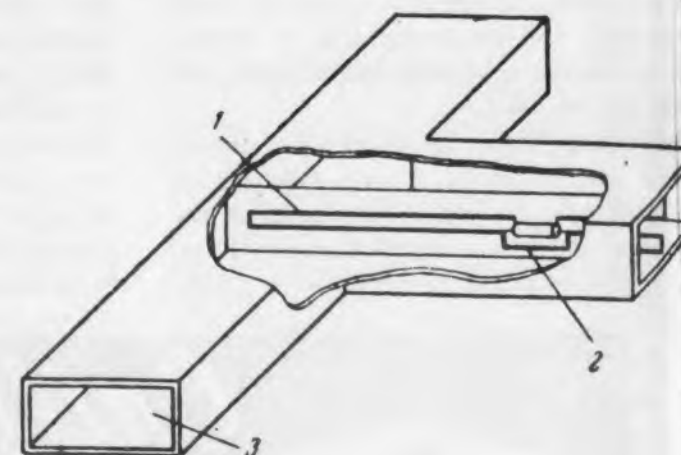


Fig. 2: Noise diode connected to waveguide slotted-tee coupling. 1—slotted line, 2—diode, 3—operating waveguide channel.

TUBES AND THERMIONICS

Concerning One Type of Self-Excitation of Space Charge in Unslotted Magnetrons, M. I. Kuznetsov, 4 pp, 4 figs.

Theoretical paper, showing that when certain relationships are satisfied between the parameters that determine the operating conditions of a plane unslotted magnetron, the equations of motion of the space charge can be reduced to the equations of a ray system. Reports on experiments that establish that the space charge of the magnetron is capable of self-excited stable oscillations at a frequency that depends only on the operating conditions.

Synchronization of Reflex Klystron, I. I. Minakov, N. V. Stepanova, 4 pp, 2 figs.

The non-autonomous synchronous modes of a klystron under the influence of a low external voltage having a frequency close to the natural frequency of the klystron are investigated theoretically and experimentally. The synchronization of the klystron oscillations

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One of the more recent research developments of Dow Corning is a silicone rubber with glass-like transparency.

The new rubber, Silastic* Type K Interlayer, shows exceptional promise as a center layer in "safety glass" windshields on supersonic aircraft. Whereas conventional safety glass interlayers soften, bubble and lose shear strength at the high temperatures generated by supersonic air speeds, the new Silastic material retains full strength and clarity at temperatures ranging from -65 to over 350 F. No. 117

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Accuracy Of Timer Assured With Silicone Damping Fluids

Exhibiting remarkably little change in viscosity at temperatures ranging from -70 to over 400 F, silicone fluids have helped engineers design greater dependability into many modern instruments. One interesting new application is found in the "Timelok" manufactured by the Euclid Electric & Manufacturing Company, Madison, Wisconsin.

An integral timing device for controlling d-c motor starters and controllers, Timelok relies on the consistent damping force of Dow Corning 200 Fluid to provide long time accuracy despite temperature variation.

The Timelok timer consists basically of a steel piston inside a hermetically sealed cylinder filled with Dow Corning 200 Fluid. When a coil is energized, magnetic flux pulls the piston through the silicone fluid.

To quote Euclid engineers, "Fraction-of-an-inch movement of a piston within a chamber of silicone fluid constitutes the simplest form of mechanism possible and contributes to the long life of the timer. Silicone fluid offers a distinct advantage over the best petroleum oils because of its very low change in viscosity with varying temperatures. The fluid is also extremely stable and will not break down to form gummy or solid substances."

Timeloks are available in time intervals ranging from 0.2 to 10 seconds, depending on the viscosity of the 200 Fluid employed.

Each can be further adjusted manually in a 6 to 1 ratio and all are interchangeable within any contactor.



Euclid designers have always relied exclusively on silicone fluids for dependable damping. They are so confident of the reliable operation of every Timelok that they have a standing offer to replace without cost any timer that fails to outlast the contactor with which it operates. No. 118

ALL NEW — 1957 GUIDE TO DOW CORNING SILICONES is a twelve page, fact-filled catalog which briefly describes the silicone products of interest to most industries. Containing latest data and information, the guide is designed expressly to help you enjoy the advantages, profits, and savings made possible through imaginative use of these unique engineering materials. No. 119

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SILICONE ENAMEL SURVIVES 1000 F IN SPACE HEATER TESTS

A mishap during a recent high temperature test on space heater finishes dramatically emphasized the superiority of silicone based paints and enamels.

The top surface grill of the space heater being tested was finished with an enamel formulated with a modified Dow Corning silicone resin. "Cooler" areas of the unit—sides and front—were coated with an organic paint.

During the heat test, an oven thermostat failed. Temperatures soared to an estimated 1000 F where they stayed for several hours before the trouble was discovered. By then, the following changes had taken place:

- (1) The organic finish was completely destroyed. All trace of the binder was gone and the dry pigment still adhering to the surface brushed off on contact. The metal under the organic finish had turned blue-black.
- (2) In contrast, the grill finished with a silicone resin finish still retained 95% of its original coating. The finish was still well bonded and no noticeable change of color had taken place.

Comparative tests on special panels later confirmed these findings in the laboratory. After 5 minutes exposure to 800 F, the organic finish had lost all of its binder; after 30 minutes at the same temperature, the silicone finish was still firmly bonded, showed only moderate color change, and still provided maximum protection. No. 120

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is shown to be represented effectively by the equation for a system with derivative feedback, and consequently the frequency of the self-excited oscillations depends on the reactive component of the electron advance. It is shown that the shape of the amplitude and the width of the synchronization band depend substantially on the transit angle. The experimental results (see Fig. 3 for the test setup) agree well with the theoretical analysis.

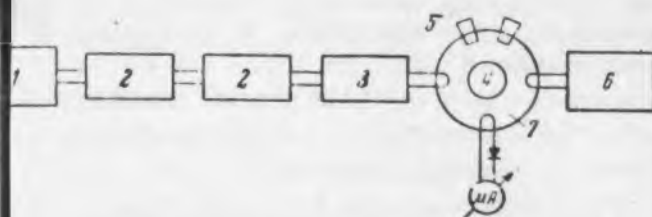


Fig. 3: Block diagram of experimental setup. 1—hf generator, 2—attenuators, 3—calibrating line, 4—klystron, 5—plunger, 6—wavemeter, 7—resonator.

Space Report on Measurements of the Input Electron Admittance of Tubes with Plane Electrodes, A. I. Kostienko, 5 pp, 5 figs.

Report on measurements of the input electron admittances of lighthouse diodes and triodes used for centimeter waves. Indicates some of the causes of discrepancies between the deductions obtained with the single-velocity approximation and the experimental results. Refers to many American articles.

Reverse Grid Current of the GI-12B Metal-Ceramic Tube, N. K. Gordenko, 3 pp, 2 figs.

Certain specimens of uhf metal-ceramic triodes exhibit reverse-grid current flow occasionally, when operated in the oscillation mode (i.e., the d-c component of the grid current reverses). This article proposes a pulse method for the investigation of this phenomenon and describes the experimental setup and procedures. The results show that as a rule the reverse current is due to secondary emission from the grid.



Me an Editor?

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WOULD YOU BE HAPPIER IN EDITORIAL WORK THAN IN STRAIGHT ENGINEERING?

We can tell you fairly precisely if your background has given you training appropriate for an editorial post on *ELECTRONIC DESIGN*. Frankly, it's hard to identify or isolate your real interests. We try to in our interviews. We might be able to determine if you'd be happier passing along design information than doing design. You could be successful at both but happier with one.

We do know that our editors who have switched from design engineering to design editing are more satisfied than before.

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Experimental Investigation of Backward-Wave Tube Employing a Bifilar Helix. V. P. Kirushin, 7 pp, 6 figs.

Report on experiments with backward-wave tube the bifilar helix of which is matched on the collector end with the aid of a bituminous-graphite wedge. The tube operates over a continuous band from 4.08 to 3.2 cm, the applied voltage ranging from 3400 to 20,000 V, delivers up to 80 mw at an efficiency reaching 20 per cent. A study was made of the effect of reflection from the ends of the tube on the operating frequency and on the starting current, and analysis of the test results shows that reflections are equivalent to increasing the effective length of the tube. Reference is made to articles on the subject by H. Heffner (*Proc. IRE*, 1942, 6, 930-937), P. K. Tien (*ibid.*, pp 1137-1143), and Grow and Watkins (*ibid.*, 1955, 43, 7, 848-856).

ANALYSIS

On the Theory of Spectral Line Width of Radio-Frequency Generators and its Measurement, Using the I. L. Bershteyn Method. V. S. Troitski, 13 pp. **Measurement of the Spectral Line Width of a Klystron Generator Operating at 3.2 cm.** V. S. Troitski, V. Khrulev, 7 pp, 7 figs.

ANTENNAS

Investigation of Antenna Installation by Using Cosmic Radiation Sources with Finite Dimensions. O. A. Boguslavtsev, A. P. Molchanov, P. V. Olianuk, L. I. Ponomarenko, 5 pp. 3 figs.

Discussion of a possible use of cosmic radiation sources for the investigation of the directivity pattern of antenna arrays. It is shown that radio waves from the sun and the moon can be used to study parabolic antennas with a 3.7 degree principal lobe to an accuracy better than 1 per cent.

ATMOSPHERIC PROPAGATION OF RADIO WAVES

On the Theory of Radiowave Scattering by Stray Irregularities. G. S. Gorelik, 9 pp, 1 fig.

Beyond-the-horizon propagation of uhf waves has revived interest in Rayleigh's classic theory of scattering, originally used by him to explain the blue color of the sky. This problem was treated by Booker and Gordon ("A Theory of Radio Scattering in the Troposphere," *Proc. IRE*, 1950, 38, 4, 401-13), by Rice ("Statistical Fluctuations of Radio Field Strength beyond the Horizon," *Proc. IRE* 1953, 41, 274-281) and by several Russian investigators. This article discusses the problem from the point of view of the theory of turbulent diffusion, in which the velocities of the irregularities are considered as stationary random processes. A connection is established between the time correlation function of the scattered field and certain statistical characteristics of the stray irregularities.

Diffusion in the Ionosphere. B. N. German, 12 pp.

Theoretical analysis of the diffusion of charged particles in a weakly-ionized gas in the presence of

T molecules, allowing for the effect of the earth's magnetic field. General expressions are obtained and used to estimate the diffusion "lifetime" of the irregularities in the ionosphere.

Investigation of the Fine Structure of the Ionosphere, using the Frequency-Separation Reception Method. D. Gusev, S. F. Mirkotan, 4 pp, 1 fig.

Reports on the theoretical and experimental results of investigations on frequency distribution of the fading of the amplitude of a unit signal reflected from the ionosphere. Certain conclusions are drawn concerning the dimensions of small-size altitude irregularities of the ionospheric layer.

Phase Method for Registering Large Irregularities in the Atmosphere, V. D. Gusev, L. A. Drachev, 5 pp, 1 figs.

Gives the first results of measurements of the phase difference of a signal reflected from the F_2 ionosphere layer. Munro ("Travelling Disturbances in the Ionosphere," *Proc. Roy. Soc.* 1950, 202, 1069, 208) and Bramley ("Direction-Finding Studies of Large-Scale Ionosphere Irregularities," *Proc. Roy. Soc.* 1953, 220, 1140, 39) were first to investigate the irregularities in the F layer, which extend horizontally for 50-500 km and move horizontally with an average velocity on the order of 150 m/sec. Neither employed the phase-difference methods described here, for which several advantages are claimed by the authors.

GUIDED WAVES

Propagation of Modulated Wave in a Medium having Strongly Pronounced Dispersion, S. I. Averkov, V. Ia. Gladov, 4 pp, 1 fig.

Brief description of apparatus and of experimental results of conversion of periodic amplitude modulation into frequency modulation when signals are transmitted through dispersing media. The experiments were made with a H_{10} wave propagating in a rectangular (10 x 23 mm) waveguide, and the author prefaces the experimental discussion with a brief theoretical analysis. Refers to article by P. S. Rogell, "Modulation Conversion in Wave Guides," *J. Appl. Phys.*, 1950, 21, 7, 629.

Effect of Small Irregularities on Propagation of Electromagnetic Waves in Periodic Structures, V. I. Bespov, A. V. Gaponov, 13 pp, 8 figs.

Discusses the effect of random irregularities on the propagation of electromagnetic waves in transmission lines having longitudinal periodicity. Equivalent circuits are introduced to reduce the problem to one involving a second-order difference equation with random coefficients, solved with the aid of perturbation methods. Equations are obtained for the dispersion of the reflection coefficient at the input of the inhomogeneous section of the line. Corrugated and interdigital delay lines are analyzed by way of examples.

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Design of Wide Band Transistor Amplifiers

E. Brenner

WIDE BAND transistor amplifiers are, in the present state of the art, those which have a band width exceeding about 20 kc (in the sense that the band width exceeds $(1-\alpha_0) \cdot f_a$, where α_0 is the current amplification factor and f_a is the upper frequency at which α has fallen 3 db from α_0).

This paper deals with approximate formulas for the frequency response of emitter-coupled amplifiers. A transistor figure of merit which corresponds to the g_m/C ratio for tubes is also defined.

The equivalent circuit of a transistor amplifier stage in the emitter connection is shown in Fig. 1. Fig. 2

shows a multi-stage amplifier terminated into the resistive load R_a . The capacitance $1/\omega \cdot r_e$ and the increased emitter resistance in Fig. 1 make the equivalent circuit independent of the operating point although the emitter resistance is a function of temperature and emitter current.

The exact expression for the voltage gain of one stage, terminated into the conductance $G_a (=1/R_a)$ is given by

$$K = - \frac{1}{[(h_{22} + G_a)/S] - h_{12}}$$

where $S = h_{21}/h_{11}$. The h parameters of the transistor may be deduced from the equivalent circuit of Fig. 1 by means of the following definitions:

- $h_{11} = [V_1/I_1] V_2 = 0$ short circuit input impedance
- $h_{12} = [V_1/V_2] I_1 = 0$ open circuit voltage ratio
- $h_{21} = [I_2/I_1] V_2 = 0$ short circuit current gain
- $h_{22} = [I_2/V_2] I_1 = 0$ open circuit output conductance

Substitution of the appropriate parameters in Eq. 1 results in a complicated, complex expression which can be shown to have, with good approximation, the form

$$K = -V_0 \cdot \frac{1}{1 + j \frac{f}{f_1}} \cdot \frac{1}{1 + j \frac{f}{f_2}}$$

where

$$V_0 = \frac{1}{r_{1B} G'_a}; G'_a = G_a + g_D/(1 - \alpha_0) \left. \begin{array}{l} r_{1B} = r_e + r_b(1 - \alpha_0) \end{array} \right\}$$

$$f_1 = \frac{f_a}{\frac{G'_a + \omega_a C_c}{G'_a} \cdot \frac{r_b}{r_{1B}} + \frac{\omega_a (C_c + C_e)}{G'_a}}$$

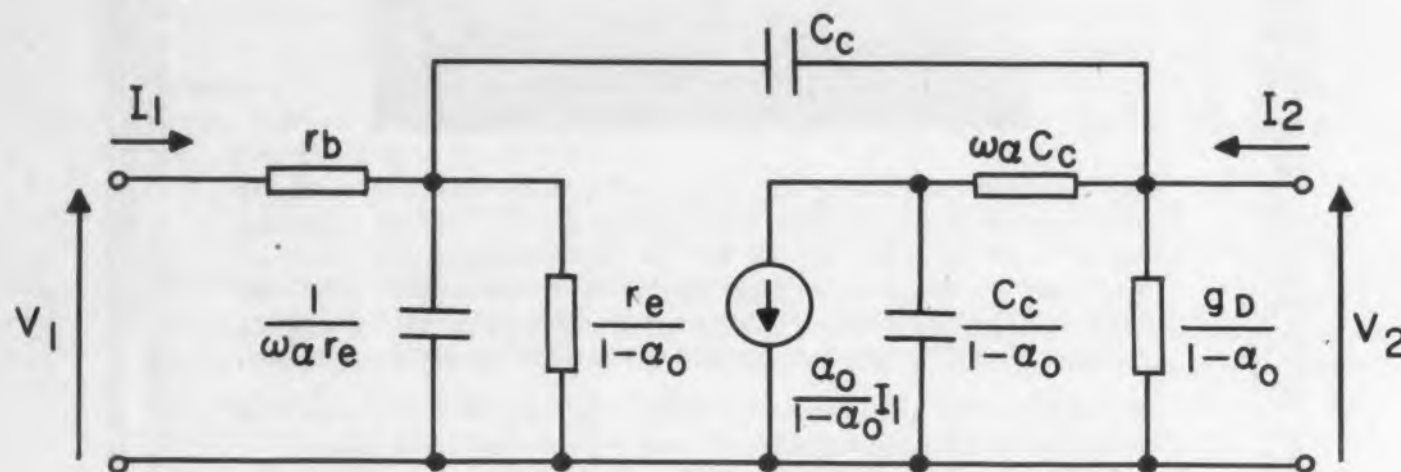


Fig. 1: Equivalent circuit containing frequency-independent elements for one stage.

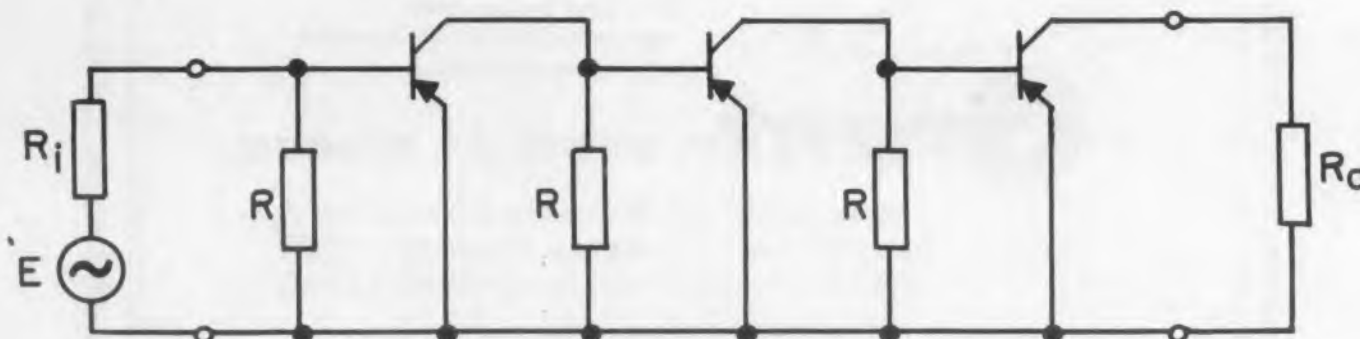


Fig. 2: Basic circuit of multi-stage transistor amplifier.

$$f_2 = \left[\frac{G'_a + \omega_a C_c}{\omega_a (C_c + C_s)} + \frac{r_{1B}}{r_b} \right] \cdot f_a \quad (5)$$

C_s = stray capacitance

In Eq. 2 $f_s > f_2$; f_2 is dependent principally on the decrease of S with the frequency (diffusion time) and depends on the influence of C_c and C_s . A convenient representation of Eq. 2 is given by the log-magnitude graph shown in Fig. 3. Good experimental agreement with such an asymptotic graph is cited in the paper.

The voltage gain of one stage in a multi-stage amplifier composed of identical stages is given by Eq. 2 where subject to the practical approximations

$$r_b G'_a \ll 1, \text{ and } r_b \omega_a C_c \ll 1$$

the corner frequencies are given as

$$f_1 \approx (1 - \alpha_0 G'_a r_{1B}) \cdot f_a \quad (4a)$$

$$f_2 \approx 1/[2\pi r_b (C_c + C_s)] \quad (5a)$$

The gain-band width product is shown to be

$$V_0 \cdot f_1 = \frac{f_a}{1 + (r_b + r_e) \omega_a C_c} \quad (6)$$

the figure of merit for a transistor is then given by

$$T = \frac{1}{\frac{1}{\omega_a} + (r_b + r_e) C_c} \quad (7)$$

for high frequency transistors (such as the Raytheon N114/CK762) a good approximation for the figure of merit is

$$T \approx \omega_a \text{ or } V_0 f_1 \approx f_a \quad (7a)$$

The paper also treats dissimilar stage amplifiers and the input stage by the same method.

Abstracted from an article by G. Meyer-Broetz and T. Felle, Nachrichtentechnische Zeitschrift, Vol. 9, No. 1, Nov. 1956, pp. 498-503.

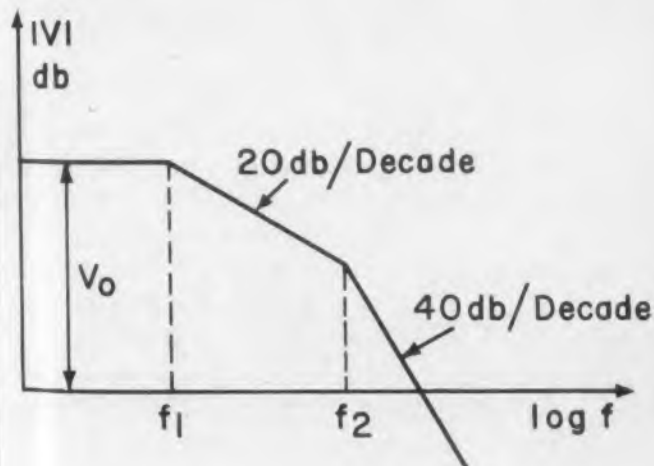


Fig. 3: Frequency response approximated through asymptotic log-magnitude graph (resistive load). V_0 , f_1 , f_2 are defined in (3), (4) or (4a) and (5) or (5a).

Microwave Frequency Meters

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WAVEGUIDE ABSORPTION TYPE I cavity is mounted on the broad face of waveguide. The transmission indication is secured by a crystal loop monitor located opposite the input coupling loop. (Type illustrated)

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WAVEGUIDE TRANSMISSION TYPE III cavity is the same as Types I and II but waveguide is used for input and output coupling.

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Models 7010- 3	7000 to 10000 MC	RG-51/U
Models 5882-1, 2, 3	5800 to 8200 MC	RG-50/U
Models 4458-1, 2, 3	4400 to 5800 MC	RG-49/U

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Abstracts

Measurement of Core Losses

A NEW technique for determining ferromagnetic core losses at high flux densities has been developed at the National Bureau of Standards. It consists of analyzing an a-c bridge circuit and applying a correction term for the effect of the harmonic components of the exciting current. This correction term arises because the ferromagnetic material absorbs energy at the fundamental frequency and returns a portion of the energy at harmonic frequencies.

For measurements at low flux densities and at high frequencies, the bridge method has been used successfully for many years. However, at inductions above 10 to 12 kilogausses in non-oriented silicon steels or 16 to 18 kilogausses in oriented silicon steels, experience has shown that core loss results obtained with the bridge method differ considerably from those obtained with a wattmeter using strip samples in an Epstein frame. The difference increases rapidly with the increase in induction. The bridge method always indicates larger power losses.

The discrepancies between results obtained at high flux densities by the two methods have been correctly attributed to harmonic components in the exciting current. However, previous attempts to obtain agreement between the two methods have been unsuccessful.

This investigation provides a method for obtaining a harmonic correction term for the bridge, resulting in excellent agreement between bridge and wattmeter even when the flux density is high.

In this study, a Maxwell-Wien circuit was used for convenience, although the results obtained can be applied to any type of bridge that can measure the impedance of an iron-cored coil. In the circuit of (a), an iron-cored coil forms the primary winding of an Epstein test frame which contains strip samples of the material the core loss of which is to be measured. The product arms of the bridge are high-quality resistors; the balancing arm consists of a variable capacitor and resistor in parallel. The power source is an electronic oscillator and amplifier whose output voltage has a negligible amount of harmonic distortion. The detector for the

Core Losses at High Densities

bridge balance is a high-quality wave analyzer connected to the fundamental frequency. This wave analyzer is also used to determine the fundamental and harmonic voltage drops across a known resistor in series with the Epstein frame.

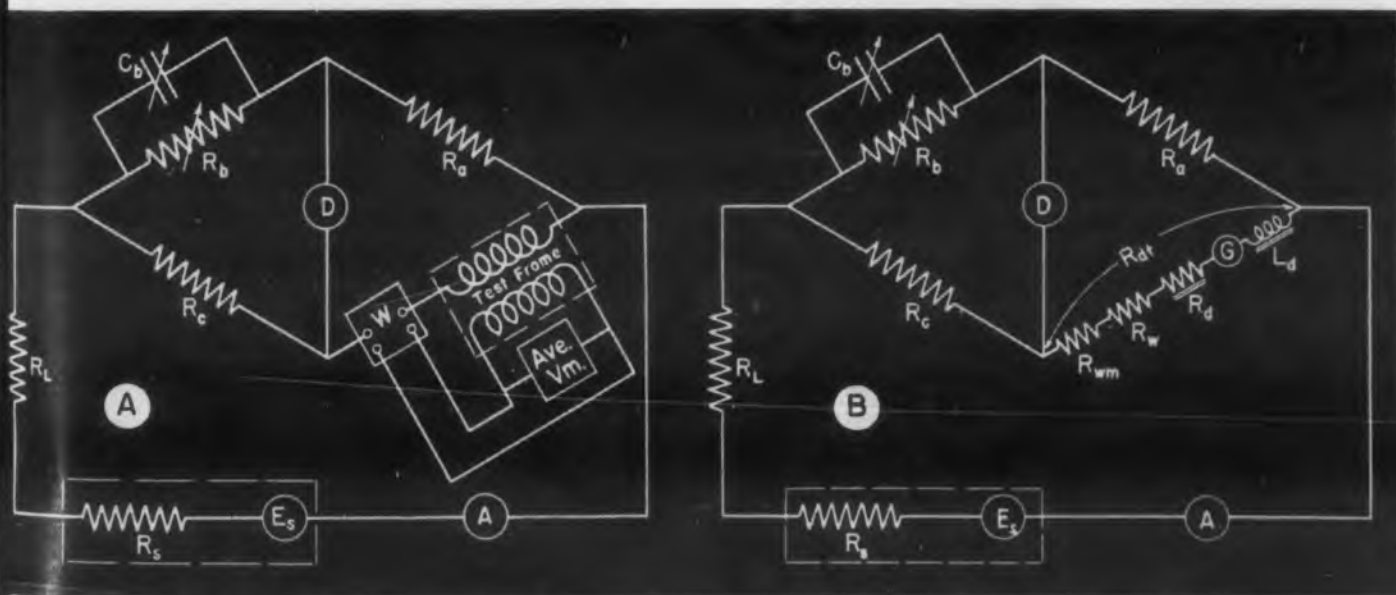
Analysis of the bridge circuit when one arm contains a non-linear impedance shows that the equivalent circuit of the non-linear impedance may be represented as consisting of energy dissipating elements plus energy delivering elements, and that the resistance of that part of the circuit external to the four arms of the bridge, which includes the impedance of the power source, must be taken into consideration when calculating the power loss in the iron-cored coil. See (b).

By applying these results, it can be shown that the power dissipated in the iron core is the difference between the apparent power delivered to it by the source at fundamental-frequency current and the power dissipated in the resistive elements of the circuit due to harmonic-frequency currents. The latter power is called the "harmonic" power term and must be determined in order to obtain the

power dissipated in the iron core. The harmonic power term is small in cases where the harmonic currents are small, but at high flux densities this term may be several times as large as the actual power dissipated in the iron core. This error may occur with any method that determines core loss in terms of the in-phase component of impedance at fundamental frequency, including bridges and alternating-current potentiometers.

Since the wattmeter method is accurate at power frequencies and is believed to measure the true core loss even with a distorted current, a wattmeter, inserted as shown in (a), was used as a reference standard for comparing the results obtained with the bridge method. Excellent agreement between the results of measurements with the two methods was obtained for inductions as high as those for which the wattmeter is considered to be accurate.

Abstracted from Investigation of an Alternating-Current Bridge for the Measurement of Core Losses in Ferromagnetic Materials at High Flux Densities, by I. L. Couter and W. P. Harris, J. Research NBS 57, 103 (August 1956) RP 2699.



A Maxwell-Wien bridge circuit for measuring core loss, using an Epstein test frame is shown in (a). The wattmeter in the bridge arm is used for a reference standard, permitting direct comparison between the wattmeter and bridge methods. The equivalent circuit is shown in (b).

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CIRCLE 293 ON READER-SERVICE CARD FOR MORE INFORMATION



Fig. 2. The sounder of the tone-ringer circuit—receiver is shown in palm of hand and double tube resonator appears above.

DEVELOPED in Bell Telephone Laboratories, a transistor-operated tone ringer may replace the conventional telephone bell and provide a more pleasing tone and superior performance. Shown here is a circuit together with a brief description of its operation.

Main advantage of the new ringer circuit is its lower voltage operation. Present bells use 90 v at 20 cps. Other functions planned for the telephone also lend themselves better to low voltage low power transistor circuitry.

Circuit Requirements

In the new design, sound output had to be equal or superior to that of the conventional ringers, and acceptable to the public. Also, the ringing signal should be within the voltage and frequency range normally provided for speech transmission, in order not to impose any additional requirements on the transmission system. It was also desirable that eight party, full selector ringing be available so that each user on an eight-party line would hear only the ringing signal of his own telephone and none other. It is also necessary that the eight-party selectivity not require any ground connection at the users telephone, since ground connections normally provide a path for the introduction of unwanted noise into the telephone line.

How It Works

Each party on a multiple party line is assigned one of various frequencies between 478 and 1000 cps. When desired to ring, the assigned frequency is sent out from a central office at about a +8 dbm level. This signal excites a resonant circuit in the tone ringer which drives the transistor amplifier. The amplifier output is converted to sound by use of a small loud-

speaker or "sounder." The tone is given a distinctive character by interrupting the ringing voltage, and thereby the tone, about twelve-times per second.

Although several types of tone-ringer circuits are possible, they are all similar, and one of the most typical, Type-P, is described here.

Schematic

The tone-ringer circuit is shown in Fig. 1. The inductor $L1$ and capacitors $C1$ and $C2$ form a parallel resonant circuit that determines the operating frequency. Any of the eight frequencies can be selected by the installer by making the right coil-tap and

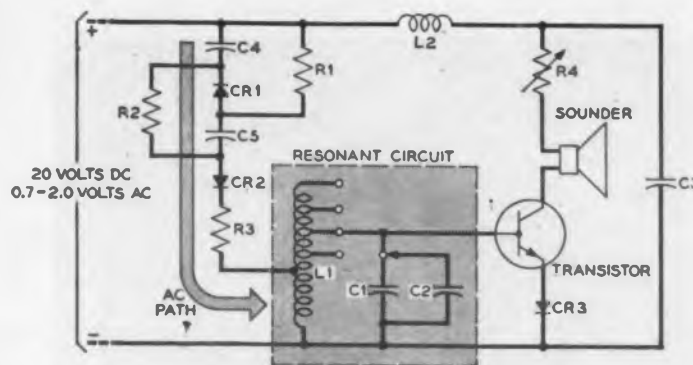


Fig. 1. One of several possible tone-ringer circuits; different coil and capacitor taps indicated in the shaded area provide resonance to one of eight frequencies.

capacitor connections in the set. The ringing signal reaches the resonant circuit through a chain of components that includes diodes $CR1$ and $CR2$ and resistor $R3$. Consider the diodes first in their low impedance state, so that the controlling impedance of the chain is $R3$, (8200 ohms). Near resonance, the impedance of the resonant circuit is high compared with $R3$ and most of the ringing signal is available to drive the resonant circuit. Positive peaks of the voltage wave of the base of the transistor are thus greater than the sum of the forward breakdown voltage of the transistor and diode $CR3$. A pulse of current then flows through the transistor, and its collector is driven to saturation

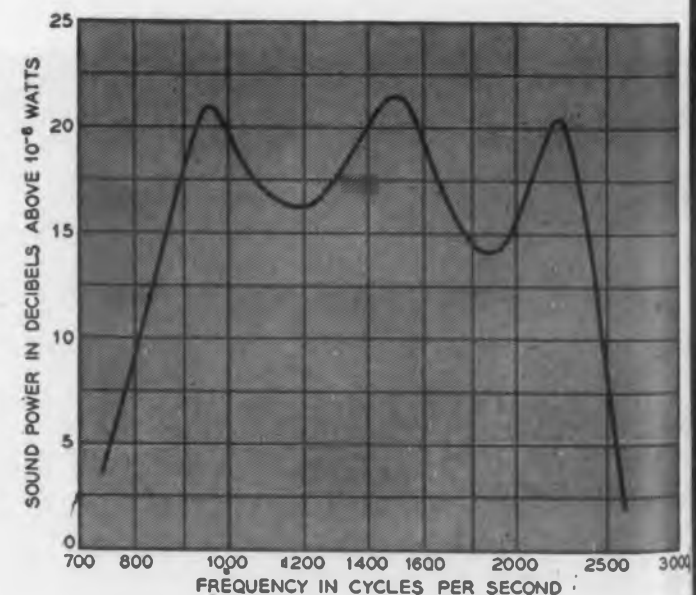


Fig. 3. Frequency response of the sounder—the three peaks result from the telephone-type receiver and the two acoustic resonator sections.

These pulses of current also flow through the sounder and generate the ringing tone. If R_4 is added in the collector circuit, it absorbs some of the available power, and the sound level is reduced. Volume control is provided by making this resistance variable.

When the signal frequency differs widely from the resonant frequency, the impedance of the resonant circuit is low compared to R_3 and the voltage developed at the base of the transistor is not sufficient to produce current in it. The ringer will then remain silent. Since ringer frequencies are only 10 per cent apart, the change in resonant circuit impedance is not itself sufficient to give adequate selectivity when maximum signal voltage is present on the line. It is therefore necessary to regulate the current that can flow through the input circuit. This is the function of CR_1 and CR_2 . A 60-microampere direct current flows through these diodes via R_1 , R_2 , and R_3 . If peak signal current is less than 60 microamperes, the diodes have a low impedance and negligible effect on ringer operation. However, when the signal current tends to exceed this level, the net current in one or the other diode is driven to zero and the diode blocks. The maximum signal current is a clipped sine wave, approaching a square wave, with 60-microampere amplitude. When the signal frequency is within two per cent of the resonant frequency, this current is sufficient to generate a tone of the same power as that of a conventional ringer. However, at the frequencies of the adjacent parties, it will not activate the transistor, and the tone ringer remains silent.

The sounder is shown in Fig. 2 consisting of a modified telephone-type receiver coupled to a double-tube acoustic resonator. It achieves good efficiency over the frequency band from 850 to 2400 cps. Although most signalling frequencies are below this band, pulses of current delivered by the amplifier to the sounder are rich in harmonics. These harmonics are converted into sound, permitting the use of smaller resonators than would be required to radiate the fundamentals. The sound energy is also placed in a range which is less likely to be masked by background noise. The tone still sounds low in pitch, however, because the ear and brain partially restore the missing fundamental.

How It Sounds

There is no resemblance between the sound emitted from the tone-ringer and that of a familiar telephone bell. However, a 2-second ON, 4-second OFF repetitive cycle has been retained. Field tests so far have indicated that acceptability of the tone-ringers has been equal to or superior to that from conventional bell ringers in the four major factors of concern—audibility, clarity, distinctiveness and acceptability. Frequency response from the sounder is shown in Fig. 3.

Abstracted from an article in Bell Laboratories Record, June 1956, page 201, Entitled "The Tone Ringer" by F. L. Crutchfield and J. R. Power.

PROBLEM #2



Design a miniaturized 400 cycle filament transformer for airborne operation. Transformer to operate in an ambient temperature ranging from -55°C to $+100^{\circ}\text{C}$. The maximum allowable temperature rise to be 60° over ambient. Dimensions cannot exceed $2\text{-}7/8"$ high, by $2\text{-}7/16"$ wide, by $2\text{-}1/2"$ long, nor can the weight exceed 2 pounds. The primary source to be 115V, with primary insulation for 500 V RMS hipot. An electrostatic shield is required between the primary and secondary. The secondary is required to deliver 10 amperes at 5 V, (C.T.) $\pm 3\%$, have a total maximum capacitance of 60 micromicrofarads to other windings, shield, and core, and be able to stand a high potential test of 21,000 V, RMS, @ 60 cycles. Construction to be in accordance with applicable parts of MIL-T-27, grade 2, Class B. The above are given as maximum dimension and minimum performance requirements, greatest possible improvement in size, weight and performance requested.

SOLUTION BY PEERLESS

Filament transformer, Fosterite Impregnated	
Primary:	115V, 380 to 1600 cps Hipot at 1000V, RMS, 60 cps
Electrostatic shield grounded to core.	
Secondary:	5V, C.T., $\pm 1/4\%$ @ 10 amp. Hipot at 25,000V, RMS, 60 cps for one minute Distributed capacitance to other winding, shield and core: 50 micromicrofarads.
Temperature Rise:	30°C
Ambient temperature range:	-55°C to $+100^{\circ}\text{C}$
Weight:	12 ounces
Dimensions:	H: $2\text{-}1/4"$ + $3/8"$ terminal W: $2\text{-}3/16"$ L: $2\text{-}1/2"$

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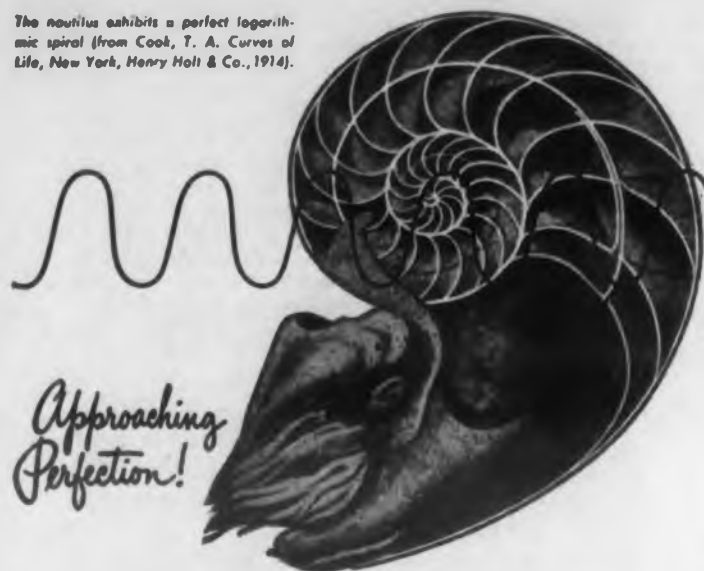
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Berkeley	NEWS NOTES
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CIRCLE 285 ON READER-SERVICE CARD FOR MORE INFORMATION

Standards and Specs

Sherman H. Hubelbank

Standards Labs

NBS CIRCULAR 578, SUGGESTED PRACTICES FOR ELECTRICAL STANDARDIZING LABORATORIES

A number of basic principles are given that experience has shown to be important in the operation of private standardizing laboratories. Types of standard apparatus are classified, and schedules appropriate for their intercomparison and for their checking at the National Bureau of Standards are suggested. This circular indicates the recommended procedures and schedules for the calibration testing of electrical instruments and measuring apparatus used in the range of frequency from 0 to 30 kilocycles per second. Copies of circular may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. for 15 cents per copy.

Cancelled Specs

The military have announced that the following specs have either been cancelled or superseded:

- MIL-A-18123 (SHIPS), ATTENUATION MEASUREMENTS FOR ENCLOSURES, ELECTROMAGNETIC SHIELDING, FOR ELECTRONIC TEST PURPOSES, METHOD OF (Superseded by MIL-STD-285)
- MIL-A-18150 (AER), GENERAL SPECIFICATION FOR ACOUSTICAL NOISE LEVEL IN NAVAL AIRCRAFT (Superseded by MIL-A-8806 (ASG))
- MIL-M-18314 (AER), CARBON, HAND-HELD MICROPHONE, Superseded by MIL-M-2714A
- MIL-C-5623, CAPACITORS; PAPER FOIL, POWER, 115-VOLT ALTERNATING CURRENT 400 TO 2400 CYCLES
- MIL-T-12254, TUBE, ELECTRON, TYPE 5963
- MIL-T-12535, TUBE, ELECTRON, TYPE 1L6
- MIL-T-12680, TUBE, ELECTRON, TYPE 6CB6

Meeting Proceedings

PROCEEDINGS OF THE FIFTH ANNUAL STANDARDS ENGINEERS SOCIETY MEETING

Included in these proceedings are 24 papers by experts from government, industry, and trade associations on the following subjects: decimal dimensioning; standardization in the nuclear energy field; dynamic standardization for the median company; metals standardization; drawing practice standardization; management standards; screw thread standards; standardization in the Department of the Army; anti-friction bearing standardization. Copies may be obtained from the Standard Engineers Society, Publications Committee, P.O. Box 281, Camden 1, N.J. for \$3.75 (\$3.00 for SES members).

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Standards are Everybody's Business

The Proceedings of the Seventh National Conference on Standards have recently been published. This 100-page manual contains such material as: management's views on chemical industry standards; dollar savings through standards—case histories; the problem of steel specifications; why are standards everybody's business?; and the urgency of standardization for atomic energy. Copies of this manual are available from the American Standards Association, 70 E. 45 St., New York 17, N.Y., for \$4.00 per copy.

Conveyors

ASA B75.1-1956, CONVEYOR TERMS AND DEFINITIONS

This publication was submitted to ASA by the Conveyor Equipment Manufacturers Association. It is a dictionary of conveyor terms. Copies of this publication are available from the American Standards Association, 70 E. 45th St., New York 17, N.Y.

Transformers

MIL-T-27A, TRANSFORMERS AND REACTORS

On November 28, 1956 a meeting of Service representatives was held to clarify the interpretations of the dielectric strength and flammability test procedures and requirements to be used. The interpretations tentatively agreed upon at this meeting are to be used until such time as an amendment can be promulgated to place the new wording officially into the spec. Copies of the interim interpretations can be obtained by requesting Bulletin 160-1/2 from the Armed Services Electro Standards Agency, Fort Monmouth, N.J.

Insulated Wire

WADC TECHNICAL REPORT 56-108, STUDY, STANDARDIZATION OF SPECIFICATIONS FOR INSULATED WIRE

This study covers a comprehensive survey of the military requirements for single conductor, insulated, copper wire. Included in the report are two most valuable tables. One table groups military specs by compound; the other table lists the physical property requirements of insulating and sheathing compounds. Copies of this report are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

Cable

MIL-C-3432A, CABLE, FLEXIBLE AND EXTRA FLEXIBLE, 300 AND 600 VOLTS, AMENDMENT 1, 29 NOVEMBER 1956

A typographical error has been corrected as follows: Change to (2/16S-4/12-2/8) over "Number and size of conductors and ground wires"; and to SJ over "Shielding." The wording in paragraph 4.5.4, item g, line 1 has been clarified to read "measurement is made."

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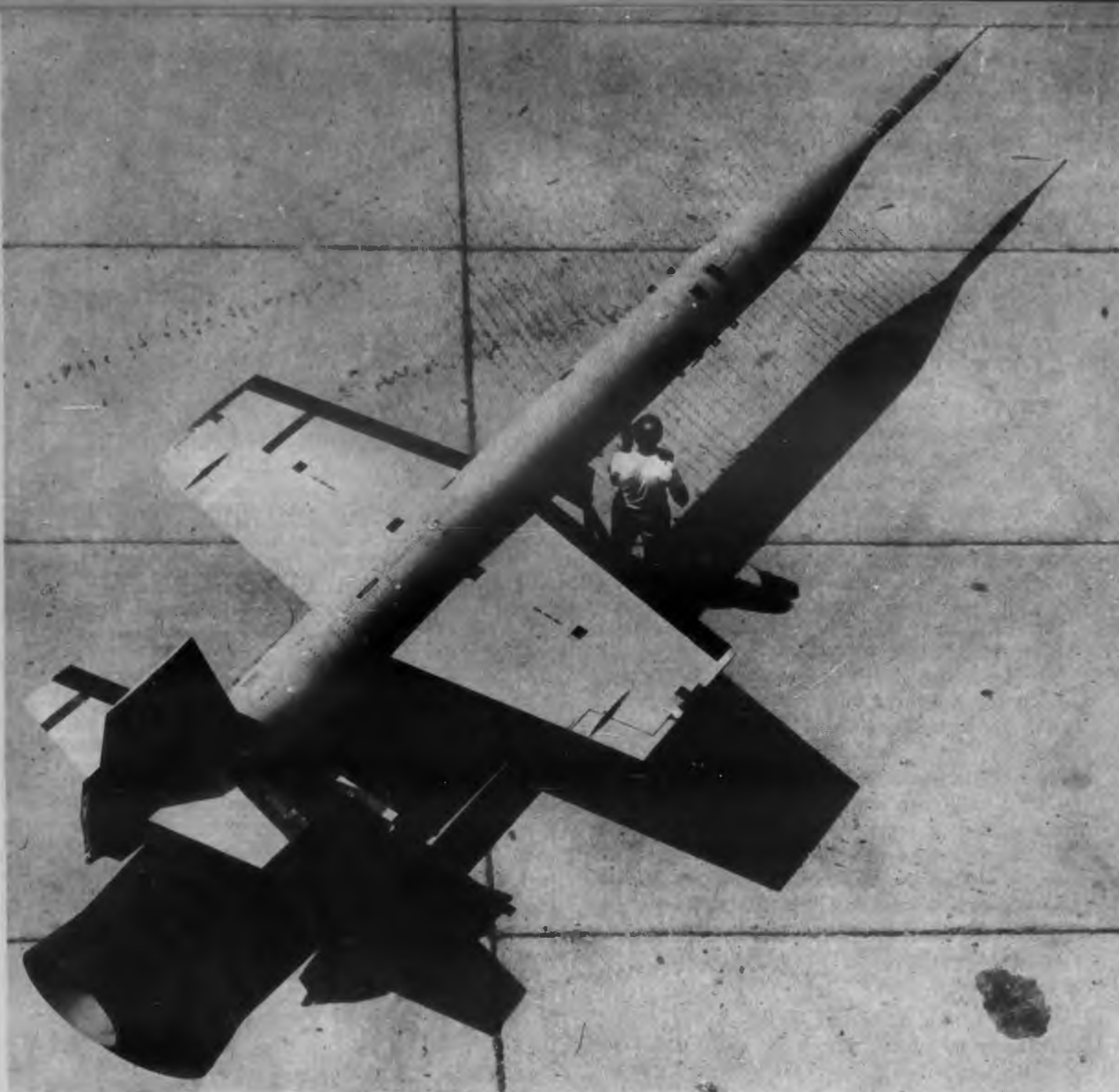
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Standards and Specs

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Radar Indicators

MIL-I-17209 (SHIPS), INDICATORS, RADAR, NAVAL SHIP AND SHORE: GENERAL SPECIFICATION FOR, AMENDMENT 2, 2 OCTOBER 1956

The requirements for trigger outputs and video outputs have been modified. The requirement for repetition rates for the trigger input pulse has been deleted.

Connectors

MIL-C-5015C, CONNECTORS, ELECTRIC, "AN" TYPE, 8 OCTOBER 1956

Superseding MIL-C-5015B, this spec covers "AN" type electric connectors, plugs, and receptacles. An example of the AN designation used to identify connectors meeting this spec is AN3100A-18-5P (C).

JETEC Publications

JETEC has announced that the following publications have been recently published:

JETEC 3B, SUMMARY OF REGISTERED CRYSTAL DIODES, AUGUST 1956, \$2.00

JETEC 5A, INDEX OF ELECTRON TUBES IN THE "5500" SERIES, SEPTEMBER, 1956, \$2.00

JETEC 6A, SUMMARY OF REGISTERED TRANSISTORS, SEPTEMBER, 1956, \$2.00

Copies of these publications may be obtained from the RETMA Engineering Office, 11 West 42nd Street, New York 36, N.Y.

RETMA Standards—Revisions

The following RETMA standards proposals are being circulated for comment. Although the official comment period may have expired, you are encouraged to contact the RETMA Engineering Department, 11 West 42nd Street, New York 36, N.Y., if you are vitally interested.

S.P. 523, PROPOSED ADDITIONS TO RS-168, DIMENSIONAL AND ELECTRICAL CHARACTERISTICS DEFINING RECEIVER TYPE TUBE SOCKETS

Data sheets for 40 miniature sockets for printed circuits of the seven and nine pin type included in this proposal, which supersedes S.P. 463.

S.P. 522, REVISION OF STANDARD REC-107A, CERAMIC DIELECTRIC CAPACITORS, CLASSES 1 AND 2

This proposal supersedes S.P. 479.

S.P. 521, ADDITION TO REC-113-D, VIBRATORS FOR AUTO RADIOS

Proposed electrical and mechanical requirements for 12-volt type vibrators are covered in this proposal.



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RESEARCH AND DEVELOPMENT



PILOT LINE PRODUCTION



FINAL ASSEMBLY



TESTING IN SCREEN ROOM

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Some of the techniques used have made possible an increased range for given levels of transmitter power and reliability of communications. Others have provided specific advantages in very long distance communications or in operational situations requiring unique signaling capabilities. Developments in navigation systems have resulted in new equipment that is suitable for the guidance of aircraft at long ranges from their bases.

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for engineers
and scientists
in these fields of
communications
activities:

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Transistorized video and pulse circuitry
Airborne receivers
Reconnaissance systems
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The Ramo-Wooldridge Corporation

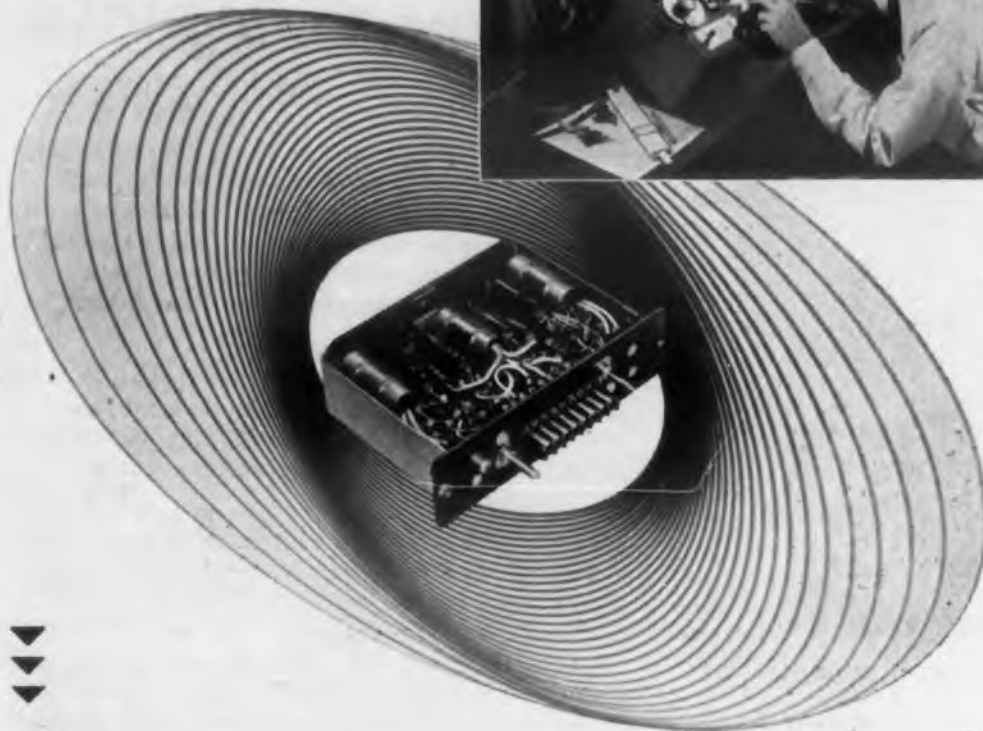
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All modern U.S. and many

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We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley



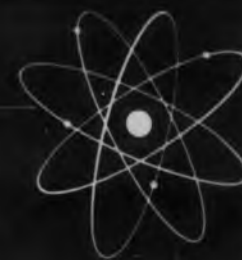
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FOR **NEW**
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ELECTRONICS AND AVIONICS DIVISION

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- Liaison Engineers (electronics background)

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At Stewart-Warner Electronics...in Chicago IMPORTANT WORK and GOOD LIVING

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Chicago's Lake Front



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If you think this may be the combination of career factors you have been seeking, write today to A. D. Arsem, Manager of Engineering and Research, Stewart-Warner Electronics, 1301 N. Kostner Ave., Chicago 51, Illinois.



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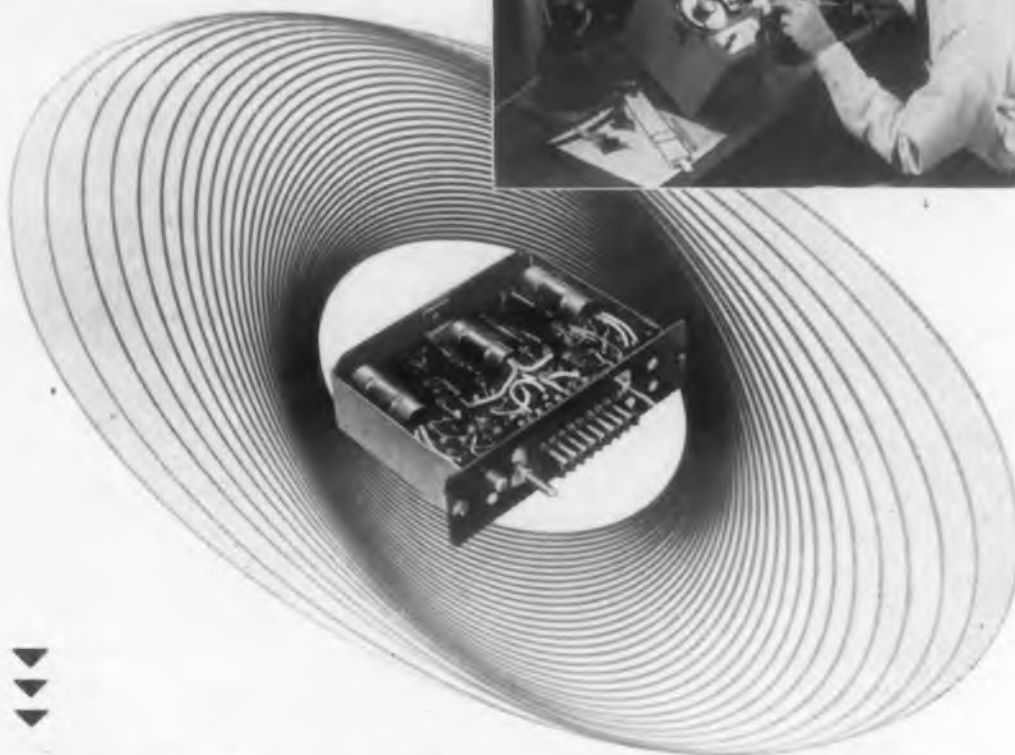
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Teamwork at S-W



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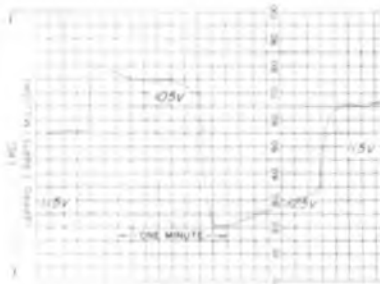
Positions now open for both junior and senior engineers in microwave tube design and development. The work is challenging, advancement opportunities unlimited, and benefits liberal.

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Frequency stability vs. line voltage; 150 MC oscillator



SPECIFICATIONS

Accuracy: Identical to that of basic counter used.

Printing Rate: Controlled by counter, 5 lines/sec. max.

Digit Capacity: 11 digits per line.

Driving Source: Parallel entry staircase voltages derived from standard digital frequency counters such as Hewlett-Packard types. Staircase descends from +135 v to +55 v as the count progresses from 0 to 9. Internal impedance of staircase source should be approximately 700,000 ohms.

Print Command Signal: 1 μ sec or greater, positive or negative pulse, 15 volts p-p or greater.

Paper Required: Standard 3" roll or folded paper

Line Spacing: Single or double, adjustable.

Analog Signal: Any three consecutive digits may be selected by selector switch. Output is function of selected digits. For example, if consecutive digits were 3, 8, and 6, output voltage would be 38.6 millivolts or 0.386 ma.

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Weight: Net 60 lbs. Shipping 100 lbs.

Accessories Available: 1052-24, 3" folded paper, 48/carton.

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*Data subject to change without notice
Price f.o.b. factory*

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Continuous digital record
for your frequency counter!

Prints 11-digit information
at 5 lines per second

Controlled by electronic or
mechanical devices

Direct print-out from
all -hp- counters

Analog output for strip-chart
recorder

Expanded scale; full scale can
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Frequency counter accuracy

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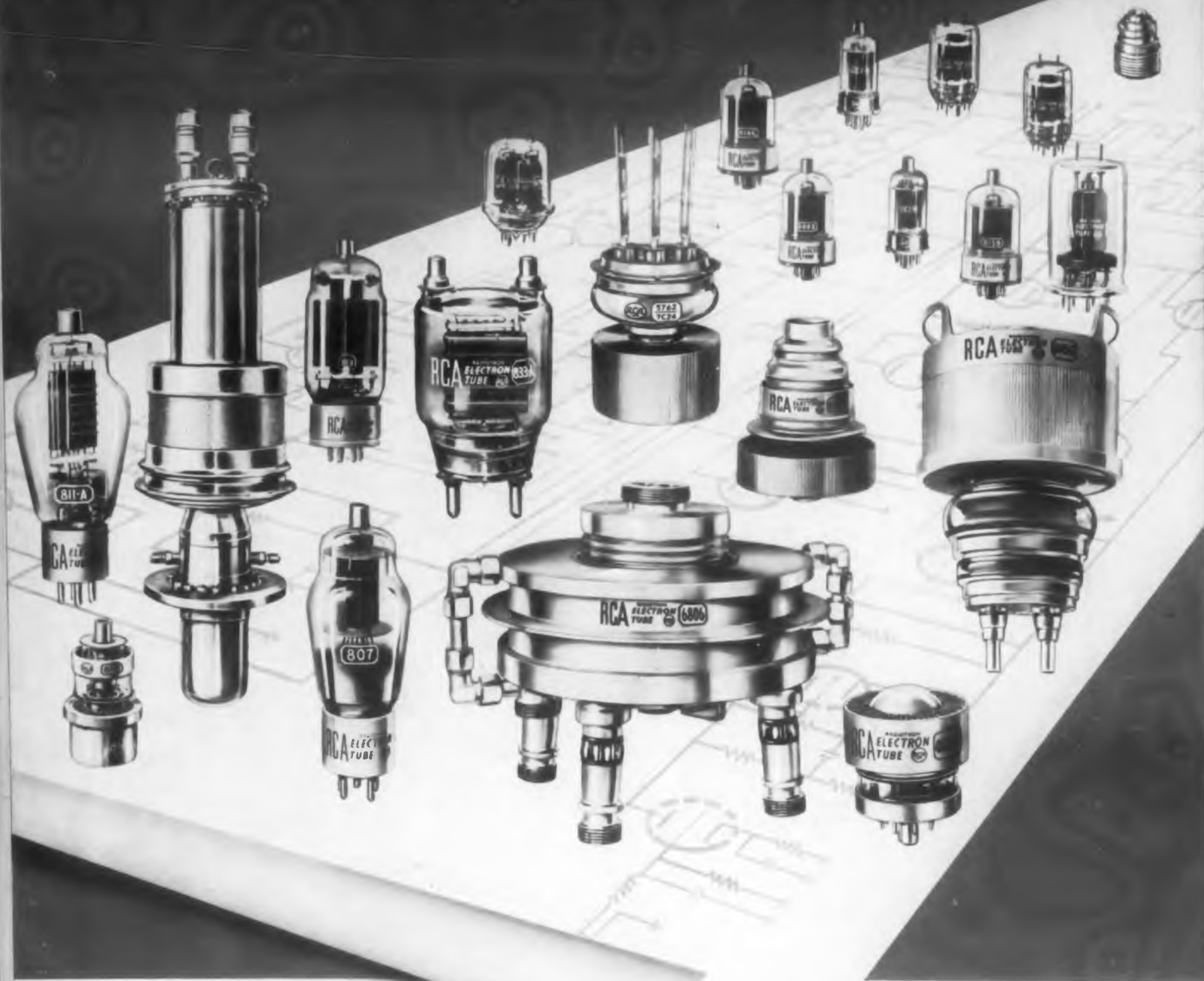
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