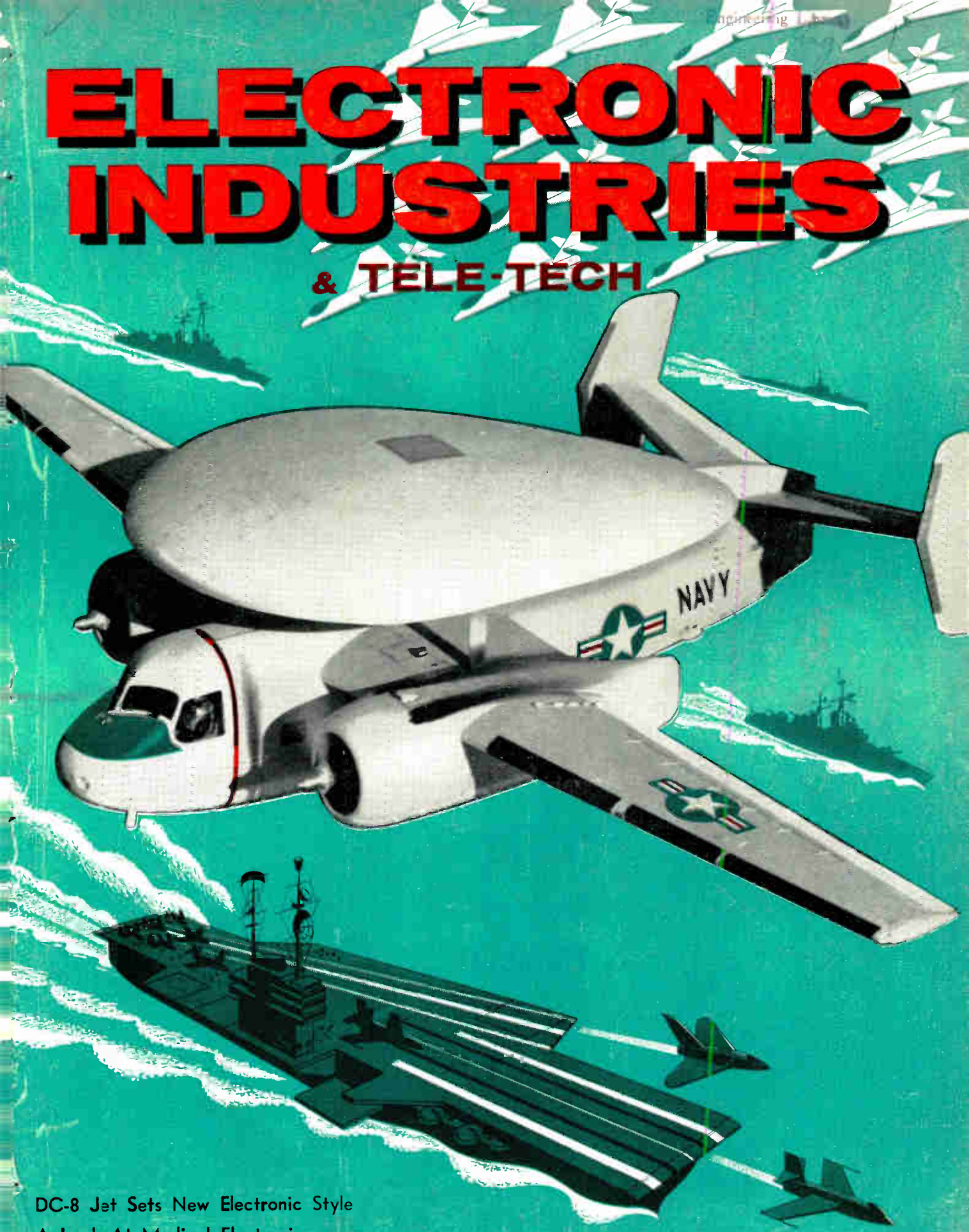
ELECTRONIC INDUSTRIES

& TELE-TECH



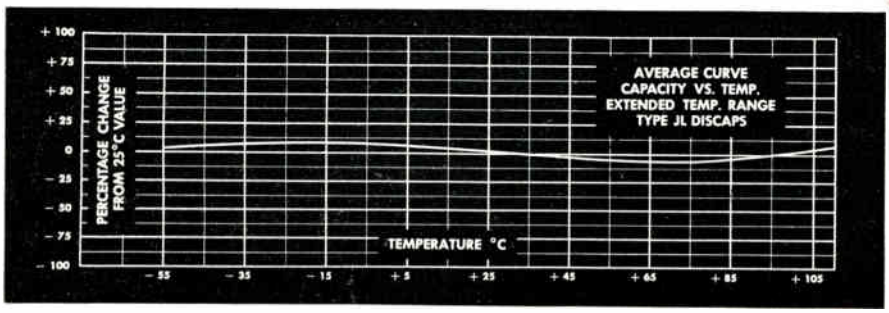
DC-8 Jet Sets New Electronic Style

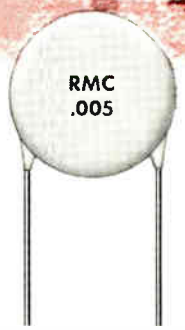
A Look At Medical Electronics . . .

May • 1957

A Chilton Publication

"Temperature Stable"





RMC Type JL DISCAPS

For applications requiring a capacitor with stability over an extended temperature range specify RMC Type JL DISCAPS. Between −55°C and +110°C these DISCAPS exhibit a capacity change of only ±7.5% of capacity at 25°C. Type JL DISCAPS are the ideal cost saving replacement for paper or general purpose mica capacitors. Write today on company letterhead for complete information.

SPECIFICATIONS

LIFE-TEST: As per RETMA REC-107-A
POWER FACTOR: 1.5% Max. @ 1 KC (initial)
POWER FACTOR: 2.5% Max. @ 1 KC (after humidity)
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
CAPACITY TOLERANCE: ±10% ±20% at 25° C

DISCAP
CERAMIC
CAPACITORS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

ELECTRONIC INDUSTRIES
& TELE-TECH

Vol. 16, No. 5 **May, 1957**

FRONT COVER: The WF-2, an Airodynamic prototype of a new early warning aircraft, has been test flown successfully by Grumman Aircraft Company. Developed for the U. S. Navy, the WF-2 is a modification of the TF-1 Trader Passenger-Cargo Aircraft and has encased in the large housing atop the fuselage the latest type Radar antenna. The WF-2 is suitable for operation from all attack aircraft carriers and is equipped for all-weather flight. It is a four-man, five place aircraft.

MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

EPA NBP

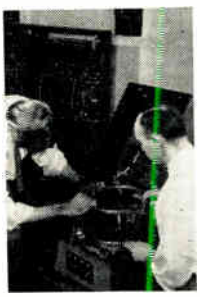
Jet Age Electronics 56

Douglas Aircraft engineers have designed a brand new "electronic look" into their DC-8 jet airliner. Highlights are a new power plant and streamlined wiring.

Electrons & Medicine 60

Most important, and fastest growing—but not yet profitable—field is medical electronics. Here is a report on the progress and problems.

Predicting Shock Effects 62



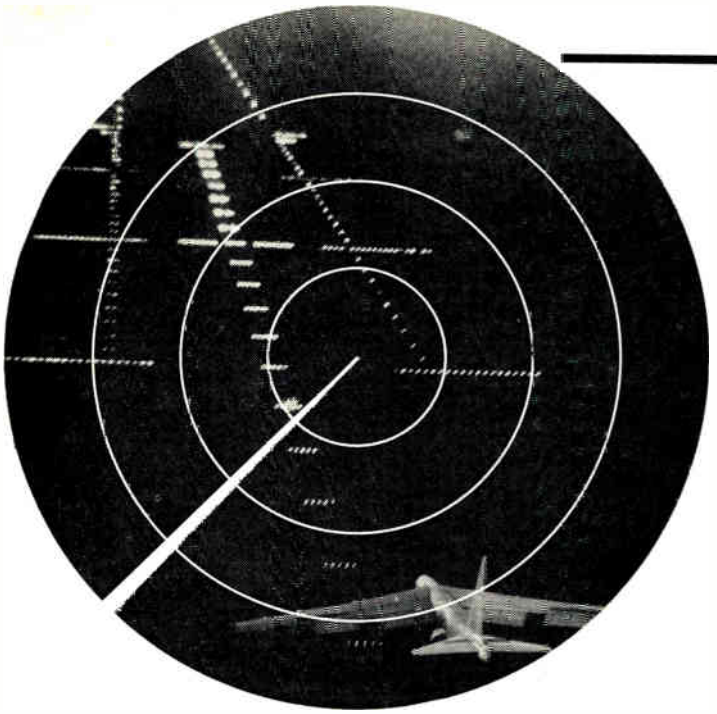
Shock conditions can be converted into electrical analogs and analyzed by a computer to provide design specifications for vibration isolaters.

Checking the Phone Cable 80

Unique Corona-proof meters built to withstand 4,000 v. check the currents in the North Atlantic telephone cable. Here are the construction details.

ELECTRONIC INDUSTRIES & Tele-Tech, May, 1957, Vol. 16, No. 5. A monthly publication of Chilton Co. Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila., Pa. Accepted as controlled circulation publication at Phila., Pa. 75¢ a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $5.00; 2 yrs. $8.00; 3 yrs. $10.00. Canada 1 yr. $7.00; 2 yrs. $11.00; 3 yrs. $14.00. All other countries 1 yr. $10.00; 2 yrs. $16.00.

RADARSCOPE



NEW APPROACH-LIGHTING

Twenty-three Sylvania Strobeacons emit timed, high-intensity flashes in this new approach lighting system at March AFB, California.

GUIDED MISSILES COST during coming fiscal year will total more than $2 billion. For 1958, about 35 per cent of USAF procurement money will go for missiles; aircraft and missiles are expected to split 50-50 by fiscal 1961.

PRIVATE INITIATIVE can be given much credit for our present favorable position in missiles compared with the Soviet Union, says Maj. Gen. Samuel R. Bretnall. The former Assistant Chief of Staff for Guided Missiles, U. S. Air Force, points out that "one of the pioneer aircraft companies in the field had considerable foresight," and carried on high cost missile research with its own money for a full year before receiving Air Force support.

HI-FI TREND? One midwest mfr's. representative has announced withdrawal from the Hi-Fi field with the comment that the trend is away from the bits and pieces that could be gathered together by the tone-sensitive and technically inclined Hi-Fi enthusiast and that the market is now dominated by customers who want simple combinations and consoles.

STANDARDIZED VOCABULARY for the electronic industries was discussed by engineers, patent counsel, market analysts, personnel managers, and technical information specialists at the Industry Advisory Conference on Electronic Information in Washington, D. C. Conference, sponsored by Information for Industry, Inc., Washington, D. C., attempted to establish criteria needed in establishing a much-needed standardization of the vocabulary used by the electronic industries.

MANPOWER TASK FORCE, assigned by a Presidential Committee, will visit "clinic areas" to encourage more efficient use of America's engineering talent. The task force, headed by Dr. Eric A. Walker, President of Penn State Univ., will work with the Engineers Joint Council, local engineering societies, educators, and industry to determine the most successful techniques for effective conservation of engineering manpower. Suggested clinic areas include Cleveland; Cincinnati; Philadelphia; Los Angeles; Lowell, Mass.; York, Pa.; Tulsa; Wilmington, Del.; and Seattle.

TOLL TV TEST decision is expected this month. Present indications are that FCC will approve tests of one or more Toll TV systems. The big questions now are: where, when, and which system will be tested. Three major Toll TV systems being proposed are International Telemeter's "Telemeter," Skiatron Electronics & Television's "Subscriber-Vision," and Zenith Radio's "Phonevision."

SPARE PARTS REDUCTION is a major feature of the new "Common Component" receiver developed for the military by Packard-Bell. Set uses only one type of tube and requires only seven spare parts types—one tube, three resistors, and three capacitors.

TOWARD WALL TV

Westinghouse's Dr. John W. Coltman tests a new electronic device in which a weak source of light controls the much greater brightness of the large electroluminescent "Rayescent" panel in the background.

TEFLON SURPASSES MICA for capacitors according to research at Balco Research Laboratories for Wright Air development center. Teflon capacitors are reported to have met or exceeded all but one requirement for replacement of mica capacitors (Spec. MIL-C-5A) under temperatures from —60° to 200°C. The single exception was r-f current rating, which could not be applied to metal-cased units because of overheating. Two reported obstacles to general use of Teflon capacitors as replacements for mica units were stabilization of capacitor elements and encasement for radio-frequency operation.

NEW VHF FM NETWORK is being established by Sweden's Royal Board of Telecommunications as a result of ever-increasing congestion in the low and medium-frequency broadcasting bands. Orders have been placed for twelve 5-KW FM VHF Marconi transmitters. One transmitter has already been put into operation at Ostersund. Norway, too, is establishing a VHF system with eleven transmitters.

HIGH RELIABILITY has become one of the hottest subjects within the Air Force and the aircraft industry. The trend in contracts is toward "Cradle-to-Grave" responsibility for reliability of a product, exhaustive testing-to-failure of developmental and early production models, increased samplings during production, and an accurate determination of "mean time to failure"—with perhaps a guarantee of this lifetime for parts, components, and systems. With present efforts to make drastic reductions in lead time for missiles and planes, component reliability has become an essential key to success or failure of new equipment.

TV AUTOMATION and tape recording are certain to alter the staff requirements of TV operations. Replacement of kinescope recording by magnetic tape recording techniques has already led to contract revision talks between NBC and the National Association of Broadcast Employees and Technicians. It is expected that final staff requirements will not be established until further experience is gained both with present video tape recording techniques and with improved recorders expected to be available from Ampex Corp. Ampex indicates that their recorders are soon expected to include features specifically designed to permit automatic operation.

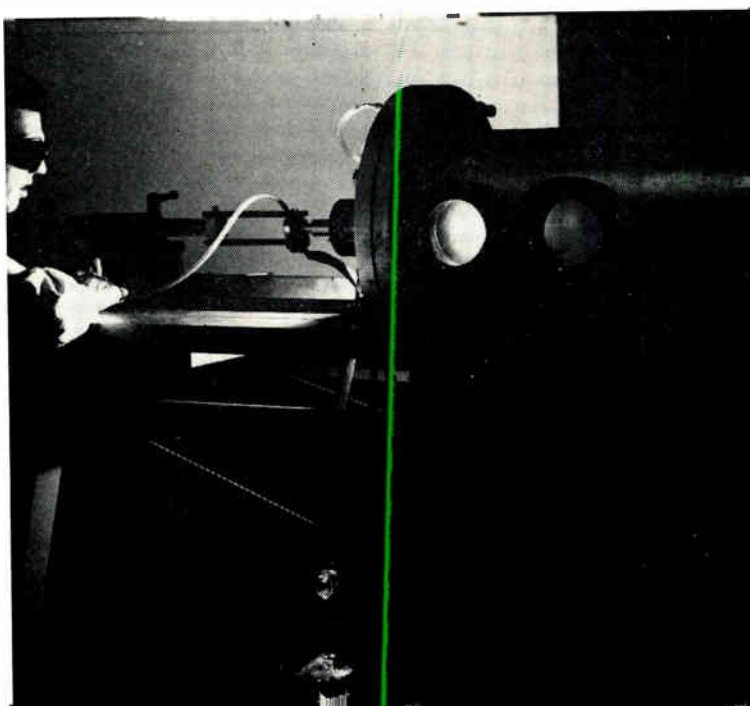
1,000,000° temperatures has been attained in the laboratory. This important step toward the controlled fusion reaction is the latest of a series of announcements which indicate steady progress toward our goal of power from the hydrogen fusion reaction. Multi-million degree temperatures, and some sort of containing force field must be achieved to make this goal possible. Progress with the "magnetic bottle" has been announced in recent weeks, and this latest announcement of high temperature research raises the hope that scientists of Project Sherwood and the Atomic Energy Commission are well on the way to practical fusion power.

EDUCATION

SCIENCE TEACHING RESERVOIR of large proportions exists in the many retired scientists and college teachers who are not now permitted to teach in public schools because they lack the "Education" courses considered essential by professional educators. Present system, in effect, discourages the very persons who would be best fitted to raise the professional dignity of science teaching as a career. Among several suggestions made by the American Society for Engineering Education, reporting at the request of the President's National Committee for the Development of Scientists and Engineers, is that those responsible for teacher certification be encouraged to waive the requirements temporarily for those qualified in the sciences but lacking some or even all of the presently required courses in teacher training. This would permit the high schools to turn to valuable new sources of science teaching talent. It would also permit having industries share their staff members to help teach science in high schools, a plan already successful in some communities.

25,660° F TEMPERATURES

New research tool at GE's Missile and Ordnance Systems Dept. is this water-stabilized arc which can generate up to 25,660° F temperatures for high temperature and high velocity research.



MILITARY DESIGNERS

SPRAGUE

AXIAL-LEAD POWER RESISTORS ARE NOW AVAILABLE TO MEET ALL CHARACTERISTICS OF MIL-R-26C

When you want a lot of power in the smallest possible package—you'll be greatly interested in the Sprague Blue Jacket Resistor Type 151E——one of the smallest 3-watt resistors ever made. In Mil-R-26C it is designated as RW59.

Military designers find Sprague vitreous enamel Blue Jackets Type RW57 (5-watt) and RW58 (10-watt) Characteristic G and V resistors, extremely useful for point-to-point wiring on terminal boards.

When vibration is a factor in equipment, Sprague's Koolohm Resistors are designed to solve your mounting problem. They mount directly to chassis with a wrap-around clamp and still withstand a ground test voltage of 10,000 volts.

Sprague Koolohm Resistors have compiled an outstanding service record in military equipment for more than 15 years. Axial-lead Koolohms, encased in a ceramic shell are designated RW55 (5-watt) and RW56 (10-watt) Characteristic G resistors.

The Sprague family of axial-lead resistors offers a complete range of sizes, ratings and characteristics to meet your requirements. They're designed to give you the stability and the physical and atmospheric protection you want. Write for Engineering Bulletins. ★ ★

SPRAGUE ELECTRIC COMPANY • 233 MARSHALL ST. • NORTH ADAMS, MASS.

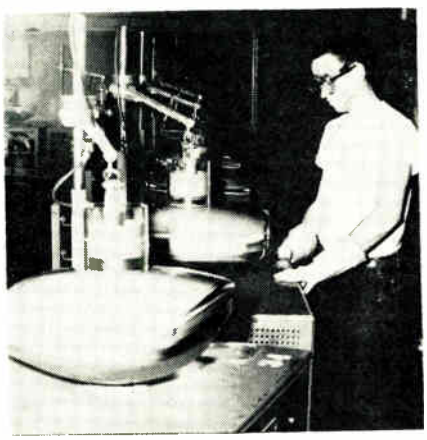
Circle 2 on Inquiry Card, page 101

As We Go To Press...

RCA 110° Production Goes Into High Gear

In anticipation of the industry-wide trend to 110° picture tubes, the RCA cathode-ray tube plant at Marion, Ind. last month swung into volume production of their new 21-in., straight-gun, aluminized, 110° tube, the 21CEP4. Production rate was initially 1,000 per day, with plans for 3,500 per day by mid-summer. At the same time, RCA Components Division, Findlay, O., announced mass production of companion items for the new CRT, a 110° deflection yoke and a newly designed flyback.

The new tube, which will also be produced in 17-in. and 24-in. models, features a neck diameter of 1⅛ in. and "baseless" construction in which the pins protrude directly through the button stem glass base. The 21-in. model



Unique RCA-developed instrument controls aluminizing process on new picture tubes.

is 5 11/16 in. shorter than its 90° counterpart.

The small neck diameter brings the electron beam closer to the deflection coils and makes it possible to get the wider sweep with only 15% increase in deflection power.

RCA officials are most enthusiastic over the focussing efficiency of the new tube, for which they credit an improved focussing lens and a unique pre-focus system. Image sharpness is retained over the entire screen area and the focussing is relatively insensitive to voltage variations.

NAVY MISSILE

The Sparrow III, an air-launched guided missile for Navy fighters, will augment the Sparrow I missile now in use with the fleet. The new missile was developed by the Raytheon Manufacturing Company, Boston, Massachusetts.

Westinghouse Eyes Hi-Fi Market

R. H. G. Mathews is Manager of Westinghouse's newly formed High-Fidelity, Radio-Phonograph Department of the Television-Radio Division, Metuchen, N. J.

Westinghouse is making a serious entry into the quality high-fidelity field. They are building up an engineering, production, sales, and service organization to produce and service a line of high-fidelity phonographs and radio phonographs in this rapidly growing market. The completely automated plant at Metuchen, N. J., is expected to be able to produce units at extremely competitive prices.

Mr. Mathews comes to Westinghouse from Magnavox, where he has served variously as Director of the High-Fidelity Division and Assistant to the Vice President and General Manager, Television-Radio-Phonograph Division.

Du Mont Redesigns TV Plant

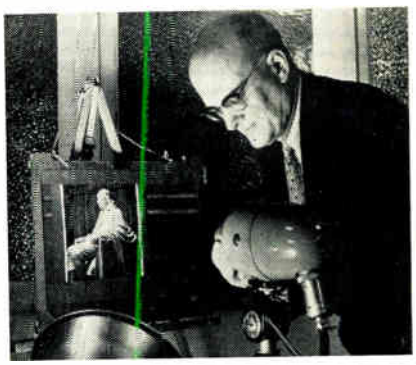
A complete redesign of manufacturing facilities for production of Du Mont television receivers, high-fidelity equipment, and radios is being effected at the Allen B. Du Mont Laboratories, Inc., plant in East Paterson, N. J.

The production techniques to be employed in the new plant will represent extensive use of mechanized methods, and material handling, as well as built-in production quality assurance.

Narrow Band TV Tests Successful

The Bell Telephone system recently demonstrated a narrow band TV system developed in cooperation with General Precision Laboratory Inc., Pleasantville, N. Y., and Dage Television Division of Thompson Products Inc.

The new system uses a bandwidth of only 250 kc and can be transmitted over standard telephone



C. Raymond Kraus, Bell Telephone Transmission Engineer, adjusts TV camera for narrow band transmission demonstration.

cable facilities up to distances of 10-15 miles.

Although the lowering of frequency results in less resolution, pictures are of such quality to be useful for a variety of industrial applications.

The Bell system has only some 15,000 video conductor miles as compared with approximately 235 million miles of ordinary cable conductors suitable for the narrow band TV system.

MORE NEWS ON PAGE 10

for electronic and avionic devices

STEMCO® THERMOSTATS

give you more of what you want most

FEATURES such as snap or positive-action . . . various terminal arrangements or mounting provisions . . . different temperature ranges—there's a *standard* type Stemco thermostat for your *special* needs. That means you cut down on lead time, research and development costs, tooling and production inventory. Specify Stemco and you get *better thermostats, faster and for less* than you can make them or buy them elsewhere.

SIZE and weight are particularly important in avionic and electronic applications. And here Stemco thermostats score, too. Their compactness and lightness give a better product without sacrificing performance.

ECONOMY of mass production of many standard Stemco types with literally hundreds of terminal arrangements and mounting provisions means your product costs less to make.

AVAILABILITY of most types is good. Design is flexible for your special applications, tooling is in existence for short-term delivery. If heat control is your problem, Stemco thermostats can provide the answer.

AA-4092

**Refer to Guide 400 EO for U.L. and C.S.A. approved ratings.*

STEVENS *manufacturing company, inc.*
Lexington and Mansfield, Ohio

TYPE A*
Semi-enclosed

lated, electrically in-pendent bimetal disc es fast response and k, snap-action control. eration from –10° to 0°F or higher on special r. Various mountings terminals. Average ing 6½ amps at 115 Us AC, 4 amps at 230 lts AC and 28 volts DC. e Bulletin 3000.

TYPE A*
Hermetically sealed

Electrically identical to semi-enclosed Type A. Temperatures from –10° to 300°F. Various enclosures and mountings, including brackets, available. For appliance, electronic, apparatus applications. Bulletin 3000.

TYPE C
Hermetically sealed

Electrically identical to semi-enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Turret terminals or wire leads. Request Bulletin 5000.

TYPE C
Semi-enclosed

Small, positive-acting. Electrically independent bimetal strip for operation from –10° to 300°F. Rated at approximately 3 amps, depending on application. Terminals and mountings to customer specifications. See Bulletin 5000.

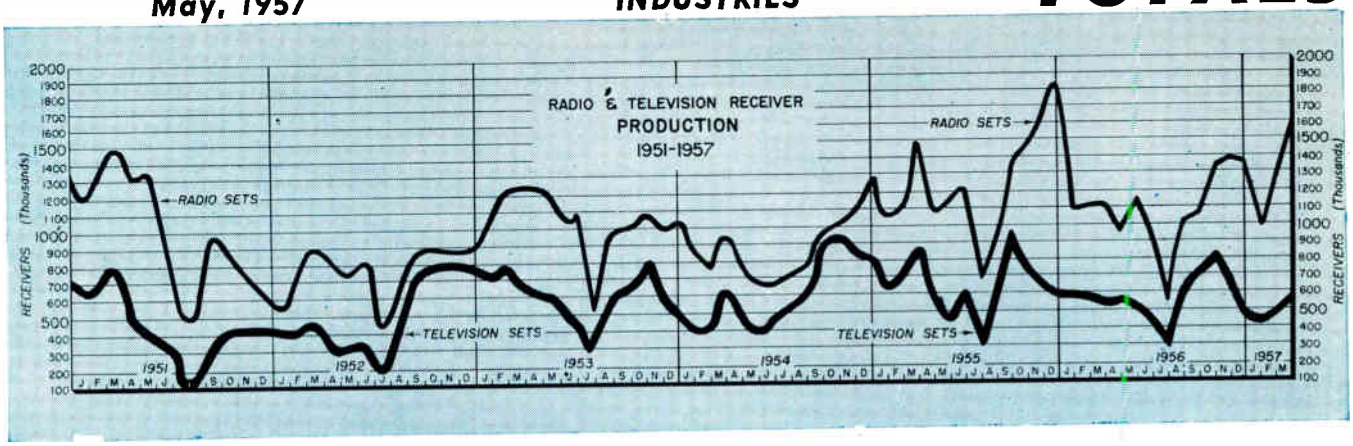
TYPE M*
Semi-enclosed

Electrically independent bimetal disc type for appliance and electronic applications from –10° to 350°F. Rating: 8 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. Virtually any type terminal. Bulletin 6000.

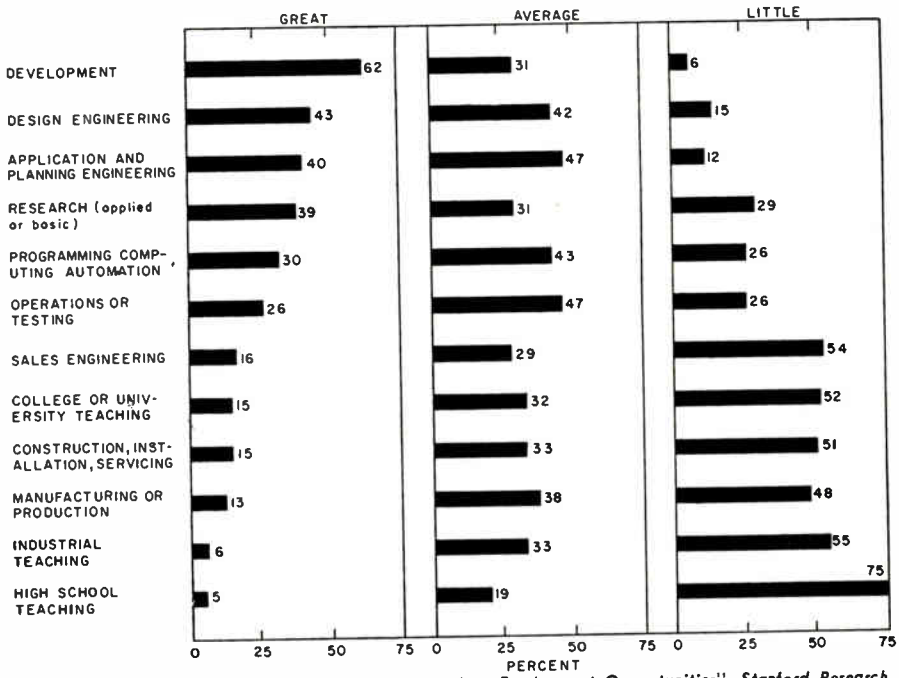
TYPE M*
Hermetically sealed

Electrically same as semi-enclosed Type M. Can be furnished with pin or solder-type terminals, with leads and various mounting brackets. Write for Bulletin 6000.

® STEMCO THERMOSTATS



COLLEGE STUDENTS POSITION PREFERENCE



"Opinions of Electrical Engineering Graduates Regarding Employment Opportunities", Stanford Research Institute. Copyrighted by Eta Kappa Nu Assoc.

ELECTRONIC NOTES

The FCC, through its Field Engineering and Monitoring Bureau's 24 district and 5 sub-offices, conducted 9,016 1st class radiotelephone operator examinations in the last fiscal year, and during that period issued 4,556 licenses and 8,059 renewals.

The radio-electronics-television industry has increased in size by 15% in 1956 and is expected to increase another 10% in 1957. The industry reached approximately $5.9 billion mark for 1956 in terms of production and sales. With revenues from distribution, servicing and broadcasting added, the figure nears $12 billion.

Portables are expected to lead the radio field this year with a 40% increase as sales of one million transistorized sets is anticipated.

Transistor production is expected to reach 22 million units for the year 1957.

The 1957 construction program of the operating telephone and telegraph companies is expected to approach the $3 billion mark.

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in March, 1957.

Amplifiers	2,741,977	Intercom Equipment	191,717	Recorders & Accessories	553,893
Amplifiers, Audio	154,743	Interference Blanker Group	141,089	Recorder-Reproducer Sets	307,440
Analyzers	51,358	Kits, Modification	1,171,521	Recorders, Tape	185,243
Analyzers, Spectrum	397,660	Kits, Radar Modification	198,708	Rectifiers	44,289
Antennas & Components	63,126	Meters, Frequency	53,395	Relay Assemblies	259,248
Batteries, Dry	2,678,920	Meters, Noise & Field	25,000	Relays	366,180
Batteries, Storage	577,594	Meters, Ohm	88,887	Reproducers	500,000
Cable Assemblies	156,164	Meters, Watt	65,703	Resistors	26,133
Calibrators	379,812	Microwave Equipment	215,000	Semiconductor Diodes	35,692
Capacitors	142,314	Modulators	171,500	Speakers	112,399
Computers & Accessories	1,535,187	Oscillators	96,741	Switches	246,454
Connectors	124,008	Oscilloscopes	54,570	Telemetering Equipment	317,921
Co-ordinate Data Equip.	208,800	Power Supplies	1,117,161	Teletype Equipment	41,312
Facsimile Equipment	82,435	Power Supplies, Dynamotor	718,824	Test Bridges	82,725
Filters	25,292	Radar Equipment	63,645	Testers	1,525,890
Filters, R. F.	81,500	Radiac Equipment	41,598	Test Sets	249,890
Fire Control Equip.	2,338,000	Radio Beacon Sets	25,957	Transformers	27,166
Headsets & Handsets	333,504	Radio Direction Finders	408,393	Tubes, Electron	2,105,673
Identification Sets	143,732	Radio Receivers-Transmitters	23,703,851	Tuner, R. F.	30,700
Indicators	1,125,235	Radio Sets	161,387	Waveguide & Accessories	74,965
Indicators, Radar	10,873,550	Radio Transceivers	134,175	Wire & Cable	1,749,450
Insulators	25,888	Radio Transmitters	41,895	X-Ray Equipment	92,116

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Now...an accomplishment so far reaching it will change the sights of all rectifier users

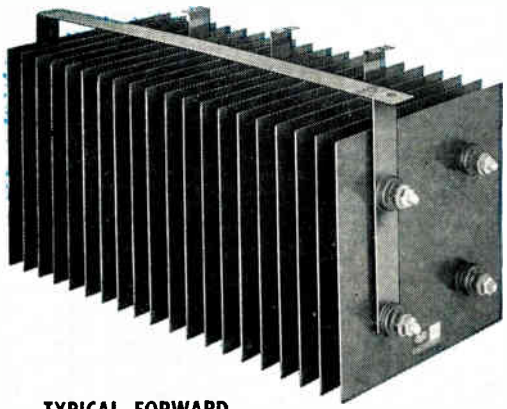
RADIO RECEPTOR'S improved new vacuum process

* PETTI-SEL

** High Current Density*

Industrial type SELENIUM RECTIFIERS

Developed by the famous Siemens Organization of West Germany and now manufactured by Radio Receptor Co. in the U. S. A.



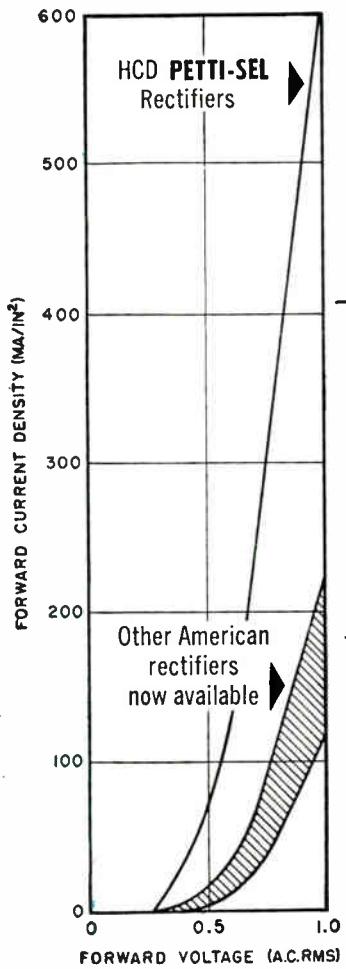
Estimated life 100,000 hours

Much smaller cell sizes than conventional units of the same ratings

Lower forward voltage drop

Suitable for high temperature applications

TYPICAL FORWARD CHARACTERISTICS

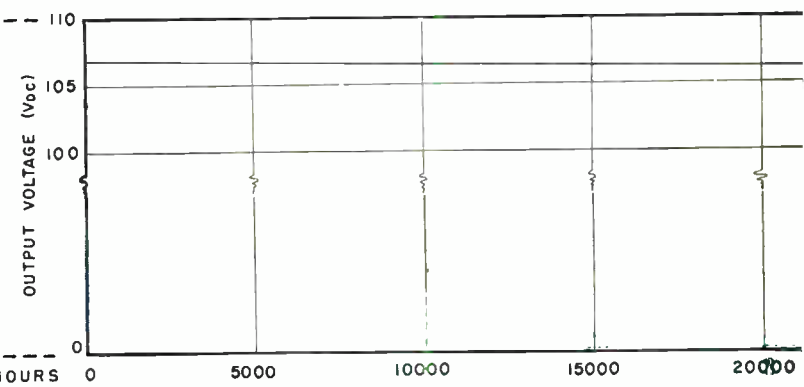


Far smaller in size than other rectifiers of the same current ratings, the new Radio Receptor HCD Petti-Sel units are manufactured under laboratory controlled conditions with fully automatic machinery, assuring new standards of product uniformity.

Field experience extending over several years with these rectifiers indicates an estimated life of 100,000 hours. This is largely attributable to the special process requiring no artificial barrier layer. Low forward voltage drop and low aging rate make the new Petti-Sel Rectifiers applicable to magnetic amplifiers and other control applications.

TYPICAL AGING CHARACTERISTIC

Cell size 4" x 4", single phase bridge (4-5-1-B) operated at 130 volts AC input, 8 amperes DC output current, resistive load, 35° C ambient temperature.



Watch for further announcements of unique developments on these history-making rectifiers. If you would like our new bulletin as soon as it is available, write today to Section T-5-R.

Semiconductor Division

RADIO RECEPTOR COMPANY, INC.

Subsidiary of General Instrument Corporation

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Radio Receptor Products for Industry and Government: Selenium Rectifiers • Germanium Diodes Thermatron Dielectric Heating Generators & Presses • Communications, Radar & Navigation Equipment

As We Go To Press . . .

Radio-Dispatched Tankers

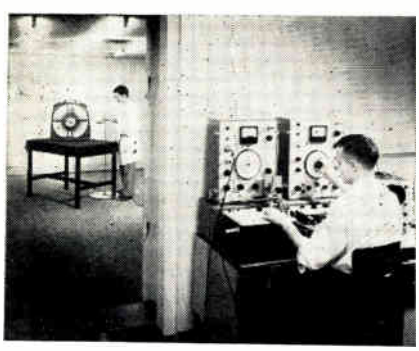
Two-way radio has brought increased efficiency and speed to the refueling of Navy planes at the NAS, Alameda, Califarnia.

Carrier Landings Made Automatic

A highly mobile combination of radio and radar forms the Bell Automatic Carrier Landing System now being tested by the U. S. Navy. The system was developed under Bureau of Ships contract and built by Bell Aircraft Corporation.

Radar locates the airplane and determines its altitude and position in relation to the carrier deck. An electronic computer does the rest, sending the necessary course corrections to the device which directs the airplane into the desired flight pattern. The system takes into account the carrier's movement the instant the plane is to touch the deck. If the airplane is not in the best attitude for a safe landing, or if a sudden swell alter the ships movement, the ACLS automatically sends the airplane around for another attempt.

SOUND TEST



Engineers test an Arvin fan for sound wave buildup and "harmony" in the new acoustical laboratory of Arvin Industries, Inc., Columbus, Indiana. The anechoic chamber rests on its own concrete slab, but is also insulated from it by special acoustical pads.

MORE NEWS ON PAGE 15

ELECTRONIC SHORTS

▶ **The House Armed Services sub-committee will make a new investigation of profits in the aircraft industry. Last year, profits of plane manufacturers were investigated by the sub-committee and it was concluded that the manufacturers were not receiving excess profits on their defense contracts. The profits of plane engine manufacturers and the subcontracts of airplane manufactures for such items as armament and engines are the subjects of this new investigation.**

▶ A price increase of $50 on table and console model television sets has been put into effect by Sylvania Electric Products, Inc.

▶ **Although the first Boeing 707 did not cross this continent until March, Pan American Airways has been flying them across the Atlantic since last October and from New York to Caracass, Venezuela, almost as long. The PAA airplanes, however, are only imaginary, but the schedules they fly are real and the data compiled from their operation are accurate. The ghost flights, using the same course, altitude, speed, and times, as if they were the real thing, are part of a program to prepare for actual flights with Boeing 707 transports.**

▶ Dr. S. Fred Singer of the Physics Department of the University of Maryland has predicted that small, high-altitude rockets will shortly become commonplace university research tools for investigating the stratosphere. He said they may prove even more useful than the rubber balloons now used.

▶ **A system which integrates air speed, mach. number, angle of attack, and altitude, correcting electronically for inherent instrument error and the static error of the aircraft itself, will be standard instrumentation on the new Convair 880. Known as KIFIS (Kollsman Integrated Flight Instrument System,) it is being included in all proposals for jet airliners by Convair.**

▶ New communications and navigations equipment, using printed circuitry and transistors, was developed primarily for jet flight and meets airline performance standards. The equipment is so light and compact it can be used in the smallest twin-engine business planes.

▶ **A new gyro compass, six to fifteen times more accurate than those in general commercial and military use and, at least twice as precise as special purpose military equipment weighing three times as much, is known as the C-11 gyrosyn. The 21-pound system is a development of the Sperry Gyroscope Co.**

▶ The Dept. of Defense has been presented a detailed report of RETMA programs now being used to alleviate severe, current engineering manpower shortages. The report was made by the manpower committee of the RETMA industrial relations department under the chairmanship and guidance of Grayson Swailes, of Hughes Aircraft Co.

▶ **Some 40,000 sq. mi. of the wild and desolate country of Baffinland, much of which is north of the magnetic pole, will be mapped this summer by the Photographic Survey Corp. of Toronto. The firm will obtain lattice photographic coverage of the area on the most northerly commercial mapping expedition to be performed for the Canadian Government. Shoran (short range navigation) capable of precision better than 25 ft in 100 mi., will be the primary equipment of the expedition. The government's Shoran-control survey of Canada's northland was begun in 1947 by the Canadian Geodetic survey.**

▶ A 3-yr. union contract stipulating a 6% wage increase, improved vacation pay, average earnings for holiday pay instead of base earnings, 3 days pay when a death occurs in the employee's immediate family, improved vacation pay for those on layoffs or on leave of absence, has been signed by CBS-Hytron Management and the International Electrical Worker's Union, AFL-CIO. This is the first contract signed between the firm and the union, which became the bargaining agent for the production workers last summer.

A pot you can bet on

When you're playing with a hot system and the stakes are high . . . raise !

Raise as high as 150° C . . . and HELIPOT® series 5000 precision potentiometers will still operate continuously with 1 watt dissipation.

Although it's only 1/2 inch in diameter and weighs but 0.3 ounce, on this pot you can bet the limit. You'll hold the winning hand with these five high cards off the top of the Helipot deck :

- stainless steel construction
- excellent linearity (±0.25% best practical, ±0.5% standard)
- 15,000 to 50,000 ohms standard resistance range
- one-piece housing
- all-metal card for uniform heat dissipation

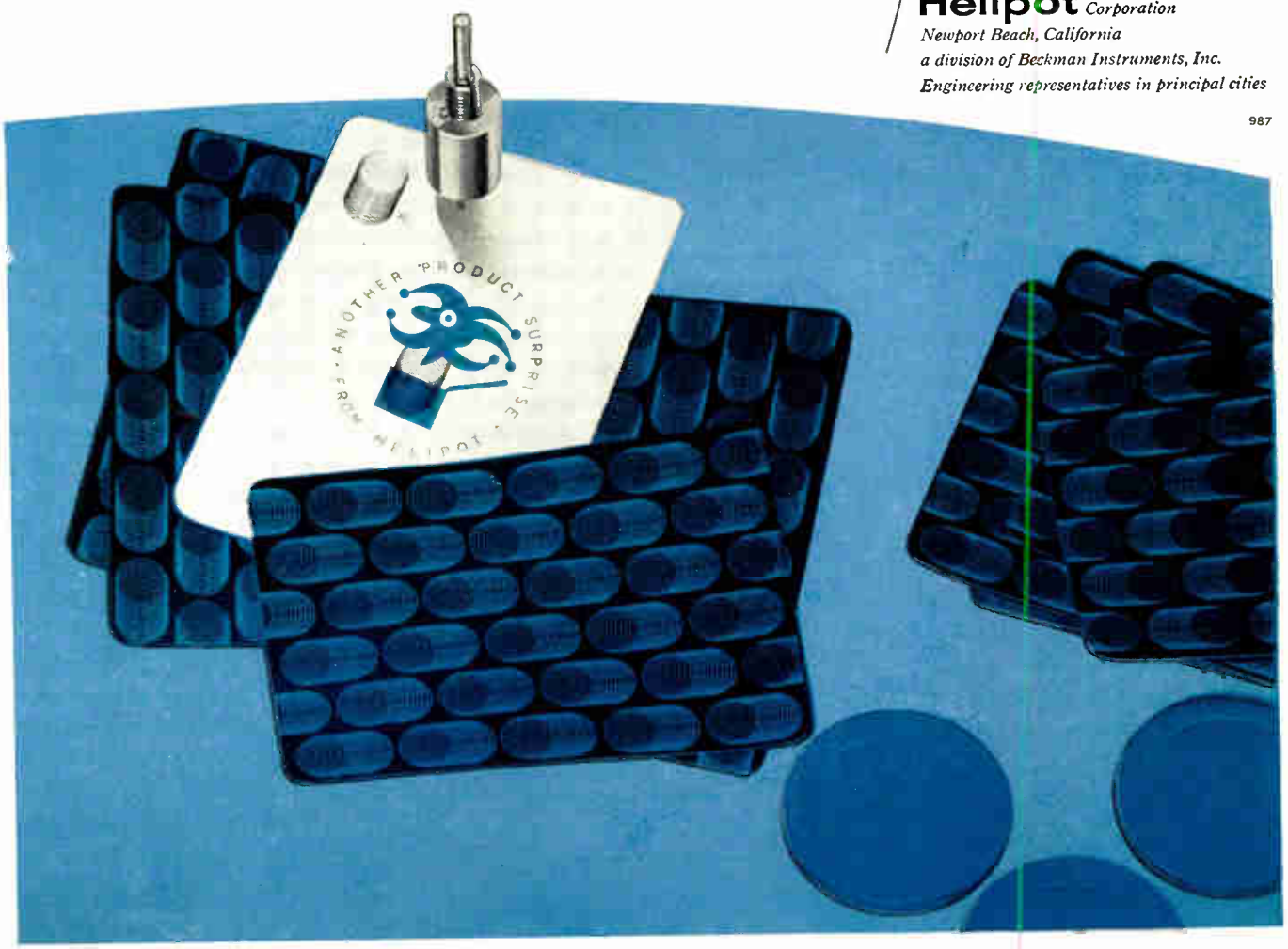
When the chips are down, these three standard models will strengthen your hand : the bushing-mount precision 5001, the servo-mount precision 5002, the trimming-type 5016.

There's a house full of specs the series 5000 meets or beats: JAN-R-19(7), MIL-E-5272A, NAS-710, MIL-R-12934A, MIL-E-5400, MIL-R-19518, MIL Std 20.

The straight inside story on the new series 5000 is available in data file 524.

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

987



for
airborne
radar

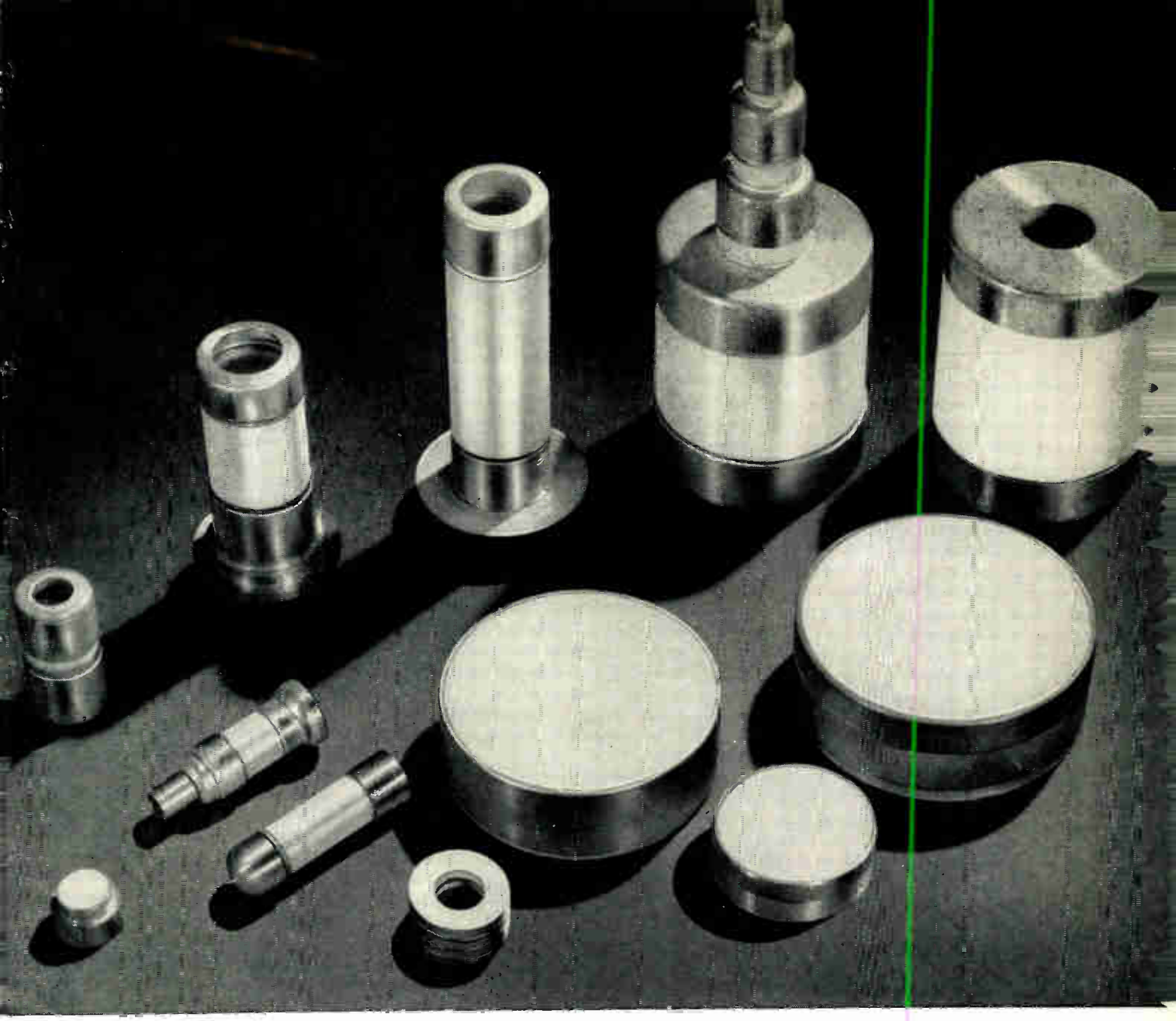
DuMont Miniaturized Radar Tubes

Du Mont compact, high-resolution radar tubes save space and weight, and permit full use of miniaturization techniques in airborne and other portable radar receivers.

Available in 3" to 12" screen sizes. Magnetic or electrostatic focus and deflection. Nine-pin miniature base.

DU MONT® Industrial Tube Sales, ALLEN B. DU MONT LABORATORIES, INC., 2 Main Ave., Passaic, N. J.

Circle 7 on Inquiry Card. page 101



Why your ceramic-to-metal seals need
RAYTHEON R-95 HIGH-ALUMINA CERAMIC

Fundamental to the problem of reliable seals is a reproducible ceramic body. And equally basic to the quality of the ceramic body are these essential characteristics:

1. Vacuum tightness
2. Sure thermal shock resistance
3. Reliable mechanical properties
4. Dependable electrical properties
5. High temperature characteristics
6. Economical fabrication
7. Uniformity—from lot to lot—in each of the above

Raytheon's R-95 ceramic meets every one of these exacting demands, consistently!

Ceramic parts manufactured from Raytheon's R-95 high-alumina are available, either alone or as hermetic ceramic-to-metal assemblies, in accordance with your specifications. The assemblies can be soldered into your production in your own plant.

Send sketches or drawings outlining dimensions and tolerances, together with operational conditions. We will be pleased to supply information and help on any of your ceramic needs.

Write for complete specification sheet. No cost or obligation, of course.

RAYTHEON MANUFACTURING COMPANY

RAYTHEON

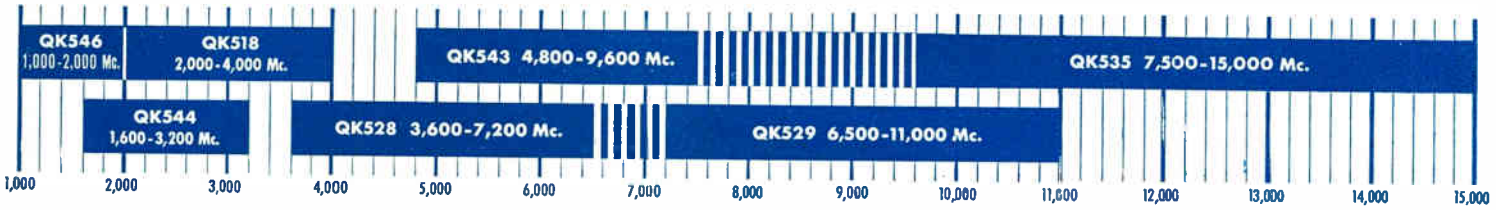
Excellence in Electronics

Ceramic Sales

Waltham 54, Massachusetts

Circle 8 on Inquiry Card, page 101

VOLTAGE TUNABLE



QK518 specifications

Frequency: 2,000-4,000 Mc.

Rapid electronic tuning by varying delay line voltage from 150-1,500 Volts.

Power output: 0.1 to 1 watt.

Complete with compact permanent magnet.

Approximate maximum dimensions: 10" long, 4⅜" high, 4⅞" wide.

NEW Raytheon Backward Wave Oscillator Series for wide, rapid electronic tuning—1,000 Mc. to 15,000 Mc.

The tubes in this revolutionary new line of Raytheon Backward Wave Oscillators give you four outstanding performance advantages:

1. Electronically tunable over an *extremely* wide range of frequencies
2. Frequency insensitive to load variations
3. High signal-to-noise ratio
4. Can be operated under conditions of amplitude or pulse modulation

These new tubes are finding fast-growing applications in microwave equipment, including radar and signal generators.

Write today for free Data Sheets on this series of Backward Wave Oscillators. We'll also be happy to answer any questions you may have on this new line.

Excellence in Electronics

RAYTHEON

RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-95, Waltham 54, Mass.

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

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Picture Tubes, Transistors, Ceramics and Ceramic Assemblies

Circle 9 on Inquiry Card, page 101

As We Go To Press . . .

Small Rockets for Universities

Dr. S. Fred Singer, of the physics department of the University of Maryland, predicts that small, high-altitude rockets will shortly become commonplace university research tools for investigating the stratosphere and says they may prove even more useful than the rubber balloons now used.

Maryland, in collaboration with Republic Aviation Corporation, designed the Terrapin high-altitude sounding rocket, a 200-pound midget consisting of a modified ABL Deacon first stage and a Thiokol T-55 second stage which is becoming a work-horse for upper atmosphere experiments. The Terrapin, in line with university requirements, is a low-cost vehicle that has the great advantage of being a "launch-it-yourself" rocket.

State universities of Colorado, Iowa, Michigan and Utah are among the schools conducting high-altitude rocket research into many important phenomena; cosmic rays, solar radiation, micrometeors, the earth's magnetic field, the day airglow and night airglow, the aurora, magnetic storms and many others.

72 TARGETS IN 3-D

A radar track-while-scan system, which automatically tracks up to 72 targets in three dimensions, has been developed by the Westinghouse Electric Corporation's electronic division, Baltimore, Md. This is a hybrid digital-analog system in which error sensing is a completely analog function accomplished under the control of digital computer which computes, controls and displays information on all 72 tracks.

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period May and June that are of special interest to electronic engineers

April 27-May 2: SAMA Annual Meeting, sponsored by SAMA; White Sulphur Springs, W. Virginia.

April 29-May 3: 81st Semi-Annual Conv., sponsored by Society of Motion Picture & TV Engineers; at Shoreham Hotel, Wash., D. C.

May 1-3: Electronic Components Symp., sponsored by IRE, AIEE, RETMA, WCEMA; at Morrison Hotel, Chicago.

May 7-9: Meeting the Challenge of Electronics in Aviation, sponsored by Radio Technical Commission for Aeronautics and IRE; at the Ambassador Hotel, Los Angeles.

May 7-9: 11th Annual Frequency Control Symp., sponsored by U. S. Army Eng'g Labs.; at Berkley-Carteret Hotel, Asbury Park, N. J.

May 9-10: Annual Meeting, Covering Ferrites Devices, sponsored by IRE Microwave Theory & Techniques Grp.; at the Western Union Auditorium, N. Y.

May 12-16: 111th Annual Meeting, sponsored by the Electrochemical Society; at the Hotel Statler, Washington, D. C.

May 13-15: National Aeronautical & Navigational Conf., sponsored by IRE; at the Dayton-Biltmore Hotel, Dayton, Ohio.

May 14-15: Industrial Nuclear Technology Conf., sponsored by Armour Research Found.; at Museum of Science and Industry, Chicago.

May 15-17: Annual Conv., sponsored by RETMA; at the Sheraton Hotel, Chicago.

May 15-17: I. C. A. Convention, sponsored by Industrial Communications Association; in Atlantic City, N. J.

May 16-18: 8th Annual Conf. and Conv., sponsored by American Inst. of Industrial Engineers; at Hotel Statler, New York.

May 19: Annual Meeting, sponsored by the NEDA; at the Conrad Hilton, Chicago.

May 20-22: Armed Forces Communication & Electronics Assoc. Conv. & Exhibits, sponsored by IRE; at the Sheraton Park Hotel, Washington 8, D. C.

May 20-23: Electronics Parts Distributors Show; at the Conrad Hilton Hotel, Chicago.

May 20-24: Design Engineering Show; at the Coliseum, N. Y.

May 23-25: Spring Meeting, sponsored by the Acoustical Society of America; in New York City.

May 22-24: 11th National Convention, sponsored by the American Society for Quality Control; in Detroit.

May 26-29: 49th Annual Convention, sponsored by the National Association of Electrical Distributors; at the Sheraton Park Shoreham Hotels, Washington, D. C.

May 27-29: National Telemetering Conf., sponsored by AIEE, ISA, IAS; at the Hotel Cortez, El Paso, Texas.

June 4-6: 6th Annual Convention & Trade Show, sponsored by the National Community TV Assoc., Inc.; in Pittsburgh, Pa.

June 6-7: 1st Annual Conf. on Production Techniques, sponsored by the IRE; at the Willard Hotel, Washington, D. C.

June 6-8: Annual Meeting, sponsored by the National Society of Professional Engineers; at the Statler Hotel, Dallas, Tex.

June 10-11: 2nd Symposium on Applied Reliability, sponsored by RETMA; at the Hotel Syracuse, Syracuse, N. Y.

June 14: Conference on Plastics for Electronics, sponsored by the Society of Plastics Engineers; at the Lowell Inst. of Tech., Lowell, Mass.

June 16-21: Annual Meeting, sponsored by the American Society for Testing Materials; at Chalfonte-Haddon Hall, Atlantic City, N. J.

June 17-19: 1st National Meeting, sponsored by IRE Military Electronics Group; at the Sheraton-Park Hotel, Washington, D. C.

June 17-20: Summer Annual Meeting, sponsored by IAS; in Los Angeles.

June 19-21: 12th National Meeting, sponsored by The Association for Computing Machinery, Inc.; at the University of Houston, Houston, Tex.

June 24-28 Summer General Meeting, sponsored by the AIEE; in Montreal, Quebec, Canada.

June 27-July 1: Electronics in Automation, sponsored by the British IRE; at the Univ. of Cambridge, London, England.

Abbreviations:

AIEE: American Inst. of Electrical Engrs.
IAS: Inst. of Aeronautical Sciences
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
NEDA: National Electronic Distributors Association
RETMA: Radio-Electronic-Television Manufacturers Assoc.
SAMA: Scientific Apparatus Makers Assoc.
WCEMA: West Coast Electronic Manufacturers Assoc.

Electronic Industries' News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

RECONNAISSANCE SYSTEMS LABORATORY, a new organization of the Electronic Systems Div. of Sylvania Electric Products, Inc., will be engaged in R & D work on new techniques and electronic systems for intercepting radio signals.

ELECTRONICS DIV., BUSINESS AND DEFENSE SERVICE ADMINISTRATION has organized an Industry Advisory Committee on Semiconductor Devices to advise the BDSA and the government of its mobilization planning activities.

KOLLSMAN INSTRUMENT CORP., Elmhurst, N. Y., has been granted a $26-million contract by the USAF for the production of a new and revolutionary automatic astro compass, which will increase the strategic effectiveness of high-speed, long-range aircraft.

AMERICAN GELOSO ELECTRONICS, INC., with headquarters in Manchester, N. H., and a temporary New York office at 393 West End Ave., has been established as the North American sales division of Societa per Azioni Geloso, of Milan, Italy. Head of the new firm is Samuel J. Spector, who founded Insuline Corp. of America.

A. B. DU MONT LABS is completely redesigning its manufacturing facilities for production of TV receivers, high fidelity equipment, and radios.

MAGNETICS, INC., has announced the formation of its new division, Control, and the division's initial line of 22 standard reactor assemblies. This is a major move to spur use of high permeability magnetic devices for industrial control.

EL-TRONICS, INC., has announced the purchase of Warren Plastics Corp. and its subsidiary, Cropp Engineering Div. of Warren, Pa.

TECHNOLOGY INSTRUMENT CORP., Acton, Mass., has completed its $.5 million addition to its modern plant in Acton. This latest expansion is expected to increase production capacity by as much as 100%.

PIC DESIGNS CORP., formerly of Lynbrook, N. Y., has moved into its new plant at 477 Atlantic Ave., East Rockaway, N. Y.

BALDWIN - LIMA - HAMILTON CORP., Cambridge, Mass., has received shipment of a Beckman 101 System; a new, completely transistorized special purpose analog computer designed for ballistic-missile research.

SIMPLEX EQUIPMENT CORP., Bloomfield, N. J., has been made a subsidiary of General Precision Laboratory, Pleasantville, N. Y.

DAYSTROM NUCLEAR, a Div. of Daystrom, Inc., has established a nuclear reactor center in West Caldwell, N. J. Here college and university faculty members from throughout the country can be trained in the peacetime use of nuclear reactors.

SYLVANIA ELECTRIC PRODUCTS, INC. has formed a Semiconductor Div. Charles W. Hosterman, who headed the former Electronics Div., has been appointed general manager of the new division.

RESEARCH & ADVANCED DEVELOPMENT, DIV., Avco Mfg. Corp., has started work on a $15 million research and development center at Wilmington, Mass. The new center is expected to be in full operation by mid-1958.

GE's HEAVY MILITARY ELECTRONIC DEPT. has leased a building comprising approximately 100,000 sq. ft. of floor space as a move towards expanding its operations in Utica.

BOMAC LABORATORIES, INC., Beverly, Mass., is building a new, million dollar plant at its Route 128 site which will virtually double the company's present engineering and manufacturing facilities.

MID-WEST

LELAND ELECTRIC CO. DIV., AMF CO., has leased the 140,000 sq. ft. plant formerly owned by Standard-Thompson Co. in Dayton, Ohio. The move was to consolidate production facilities for Leland's aircraft products.

BENDIX AVIATION CORP., COMPUTER DIV., established a regional office at 919 N. Michigan Ave., Chicago. The new office will handle the rapidly increasing demand for Bendix G-15D general purpose electronic computers throughout the midwest.

HOFFMAN SEMI-CONDUCTOR DIV., HOFFMAN ELECTRONICS CORP., has expanded its facilities 50% by the recent completion of its new building adjacent to its present facilities at 930 Pitner Ave., Evanston, Ill. The new building will be almost completely devoted to research and development.

MAGNAVOX CO. has announced an immediate addition, more than doubling the size of its Jefferson City, Tenn., plant. The new addition makes a total of a ¼-million sq. ft. for this plant.

AMERICAN GAGE & MACHINE CO. has acquired the 37-yr.-old Standard Transformer Co. of Warren, O., manufacturers of tranformers for public utilities in sizes from light pole to 10,000 KVA.

JOHN OSTER MFG. CO., AVIONIC DIV., Racine, Wisc., has opened an eastern office located at 237 N. Main St., Hempstead, N. Y., and a western office located at 5333 Sepulveda Blvd., Culver City, Calif. Irving G. Epstein and Ward S. Carlson are eastern and western managers, respectively.

FOREIGN

TEXAS INSTRUMENTS LTD., Kempston Rd., Bedford, 50 mi. north of London, has been formed by Texas Instruments Inc. The new firm is a wholly owned subsidiary and will manufacture and sell semiconductor products in the United Kingdom. The Semiconductor-Components Div. has opened a marketing office in Ottawa, Canada, at 53 Queen St.

IBM DE VENEZUELA, Caracas, inaugurated the first electronic data processing center in Latin America. The center will be an important addition to IBM's operations in Venezuela.

MARCONI'S WIRELESS TELEGRAPH CO., LTD., Chelmsford, Essex, has received an order to the approximate value of £200,000 for the supply of a complete TV station to Poland. It will be the biggest in that country.

RADIO CORP. OF AMERICA has shipped a million-dollar color TV caravan to Japan to bring to the people of that country the first color TV demonstrations to be seen in the Far East.

WEST

PACKARD-BELL COMPUTER CORP. has been established as an affiliate of Packard-Bell Electronics Corp. The new facility, located at 11766 West Pico Blvd. in West Los Angeles has launched a research and development program in the digital computer field.

AMPEX AUDIO, INC., is the name of a new firm established by Ampex Corp. It is a completely integrated subsidiary company, devoted exclusively to Ampex products. Phillip L. Gundy will be President of the new firm.

SEMI-CONDUCTOR DIV., MOTOROLA, INC., has announced a new line of medium powered transistors. The new units fill a gap in the power spectrum which formerly existed in the 100 mw. to the 350 mw. range.

RAMO-WOOLDRIDGE CORP. has placed into operation a new data reduction center for rapid conversion of telemetered test data into forms suitable for engineering analysis.

ZENITH PLASTICS CO., Gardena, Calif., a 3M subsidiary, expects to complete work on its new $300,000 electronic test facility by early summer. The new installation will be used to test radomes.

SYSTEMS DIV., G. M. GIANNINI & CO., INC., has announced the opening of its new plant at 1902 W. Chestnut St., Santa Ana, Calif.

PHYSICAL MEASUREMENTS CORP. is the name of a recently formed new electronics firm whose objective is to provide instruments and systems to measure basic physical phenomena.

STAVID ENGINEERING, INC., Plainfield, New Jersey, research development and production company, has opened a West Coast office in Los Angeles, Calif. This new office is headed by Mr. Zachary K. Geanes and is responsible for territory west of the Mississippi.

DATRAN ELECTRONICS is now an integrated division of Mid-Continent Mfg., Inc. The division was formerly a wholly-owned subsidiary, Datran Engineering Corp. It will now operate in newly constructed facilities at 3615 Aviation Blvd., Manhattan Beach, Calif.

RYAN AERONAUTICAL CO. has started construction of a new ½-million dollar engineering and laboratories building. The huge 2-story, 340 ft. long structure will contain a complex network of laboratory equipment and instruments for use in all phases of testing.

AEROJET-GENERAL NUCLEONICS, San Ramon, Calif., has announced that they are making available to industry, colleges, and the medical field a nuclear reactor training program.

BERKELEY DIV., BECKMAN INSTRUMENTS, INC., has started a $1.5-million expansion program that will triple production capacity and increase plant personnel by nearly 1,000. Ground breaking for the first unit of the project is scheduled for this month.

ARNOUX CORP., Los Angeles, recently occupied 2 newly completed buildings, adding 15,000 sq. ft. to their existing plant facilities. The new space acquisition is aimed at increasing production to keep pace with a sharp increase in sales of the firm's standard electronic instrumentation products.

Centralab 1922 1957 35 YEARS

Since 1922, industry's No. 1 source of standard and special electronic components

VARIABLE RESISTORS

Miniature

Radio and TV

Transistor Circuits

Wirewound

Military

ELECTRONIC SWITCHES

Miniature Rotary

Rotary-Action Flat

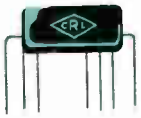
Rotary Power

Lever-Action

Slide

TRANSISTOR AMPLIFIERS

Single-stage



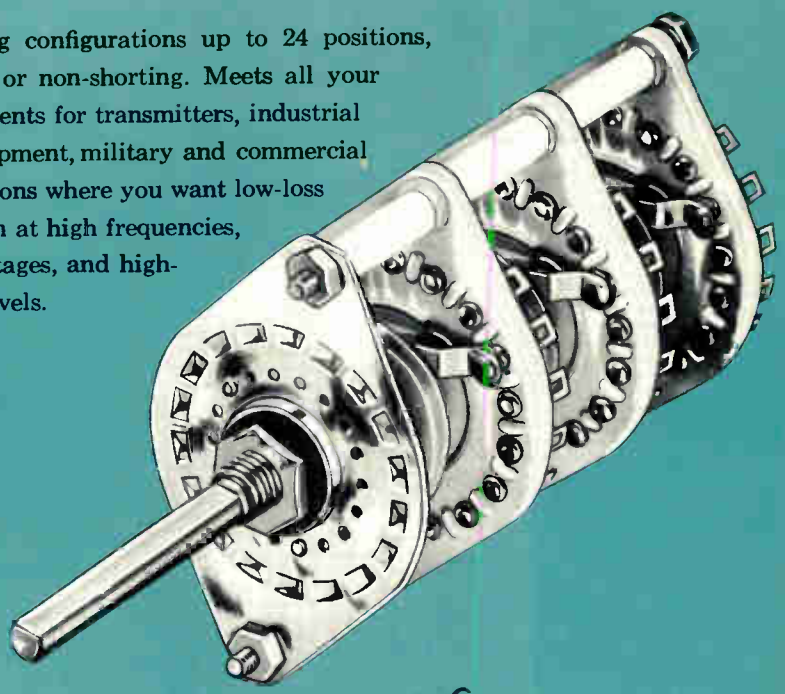
Four-stage

Handles a Kilowatt with ease

Centralab Series PA-230 Rotary Power Switch

The most versatile multiple-circuit rotary power switch available

Switching configurations up to 24 positions, shorting or non-shorting. Meets all your requirements for transmitters, industrial test equipment, military and commercial applications where you want low-loss operation at high frequencies, high voltages, and high-power levels.



Designed for **ruggedness, accuracy, long life**

- Sections are Grade L-5 Steatite Voltage breakdown, 3000 volts R.M.S. between critical parts.
- Ball-bearing index insures positive positioning.
- Square rotor shaft, combined with mating Monel driver, provides rotational accuracy throughout length of switch.
- Coin-silver contacts, for excellent current-carrying characteristics.

Customer's problem: Needed 540 contact combination.

Solution: This 30-section Centralab Series PA-230 switch.

Centralab can solve *your* switch problems.

Centralab

A DIVISION OF GLOBE-UNION INC

962 E. Keefe Ave.
Milwaukee 1, Wis.

In Canada:
804 Mt. Pleasant Roa
Toronto, Ontario

Continued on next page . .

Smallest, most versatile, multiple-circuit rotary switch

Centralab Series 100

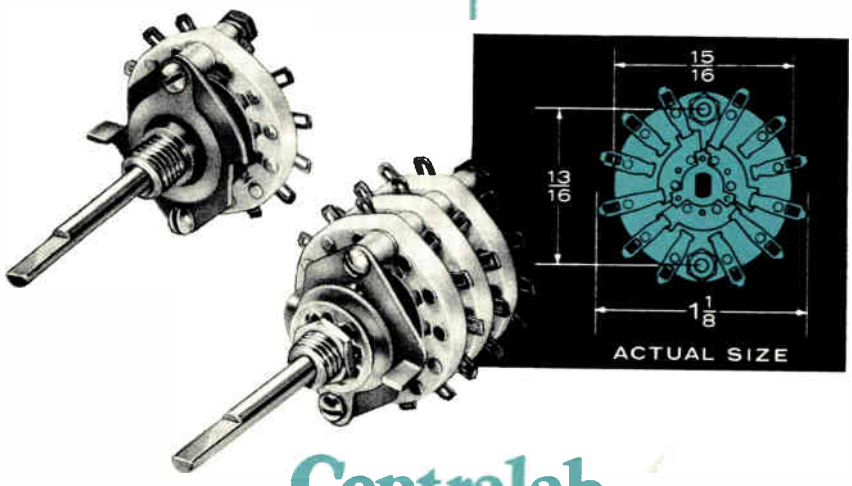
An ultra-small switch that measures less than 1" in diameter — weighs less than an ounce — yet has the electrical rating of larger, heavier switches.

Available up to 12 positions. Make and break, resistance load, .5 ampere at 6 volts d.c.; 100 milliamperes at 110 volts, a.c.; current-carrying capacity, 5 amperes.

Ideal for band switching in subminiature electronic equipment, transistor circuits, aircraft instruments, and guided missiles.

Features not found in phenolic-type switches

- Maximum voltage flashover
- High Q — Low loss
- Minimum inter-circuit capacity
- Maximum circuit flexibility



Centralab

A DIVISION OF GLOBE-UNION INC.
962 E. Keefe Ave.
Milwaukee 1, Wis.
In Canada:
804 Mt. Pleasant Road
Toronto, Ontario

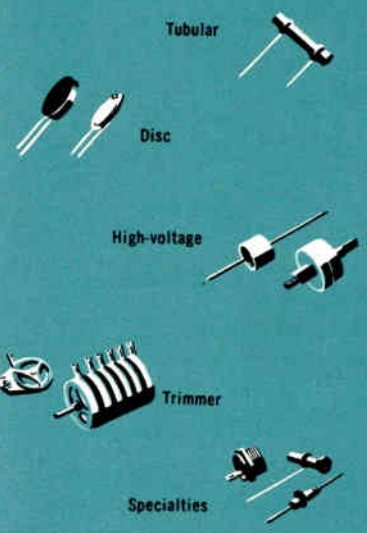
New 36-page Switch Catalog

Provides specifications on the complete line of CRL switches capable of handling power from a kilowatt to a microwatt. Write for this catalog today.

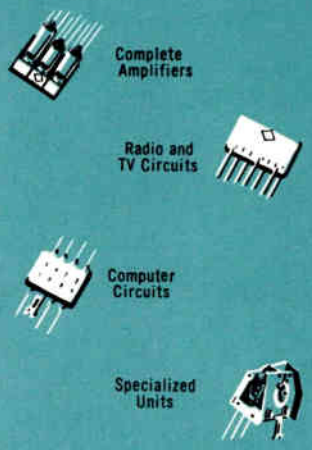
. . . continued from preceding page

Centralab 1922 CRL 1957 35 YEARS

CERAMIC CAPACITORS



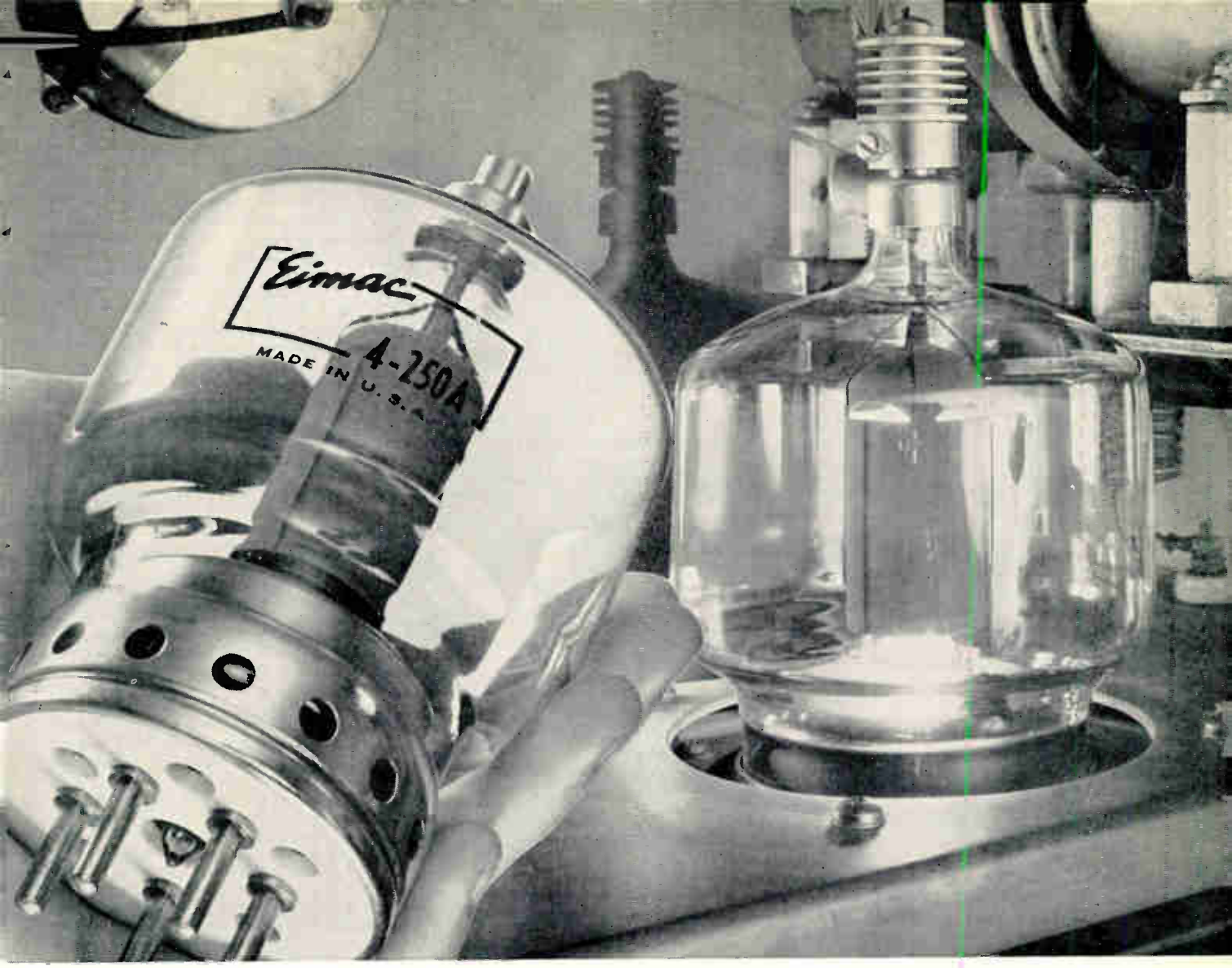
PACKAGED ELECTRONIC CIRCUITS



ENGINEERED CERAMICS

Hundreds of standard components are carried in stock by your nearby Centralab distributors.

Discuss your special requirements with the Centralab representative.



22,000 hours without a tube failure

Eitel-McCullough
San Bruno, Calif.
Gentlemen:

"Just thought you might like to know that I have had to replace one of your 4-250A's in our FM transmitter today. This tube had 21,972 hours and 19 minutes on it. Its mate, installed at the same time, is still running strong."*

Ed Howell
Technical Supervisor
WMIX, Mount Vernon, Illinois

*Its mate, from recent reports, is still running strong after *25,000* hours of service.

Eimac tubes have always been "front runners" in the field of commercial broadcasting. In fact, Eimac development, design and production, have opened new vistas in all fields of electronic design, from glass tubes to ceramics—from simple triodes to complex klystrons. Engineers, in increasing numbers, have discovered that Eimac delivers the big three: quality—longevity—performance!

Additional information on Eimac's complete line of tubes for broadcasting and communications is available from our Application Engineering Department.

EITEL-McCULLOUGH, INC.
SAN BRUNO CALIFORNIA
Eimac First with power for FM

Eimac

EIMAC 4-250A
Class—C FM
(Frequencies below 110MC)

D-C Plate Voltage	4000 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	—225 volts
D-C Plate Current	312 ma
D-C Screen Current	45 ma
D-C Grid Current	9 ma
Screen Dissipation	22.5 watts
Grid Dissipation	0.46 watts
Peak R.F. Grid Input Voltage	approx. 303 volts
Driving Power	approx. 2.46 watts
Plate Power Input	1250 watts
Plate Dissipation	250 watts
Plate Power Output	1000 watts

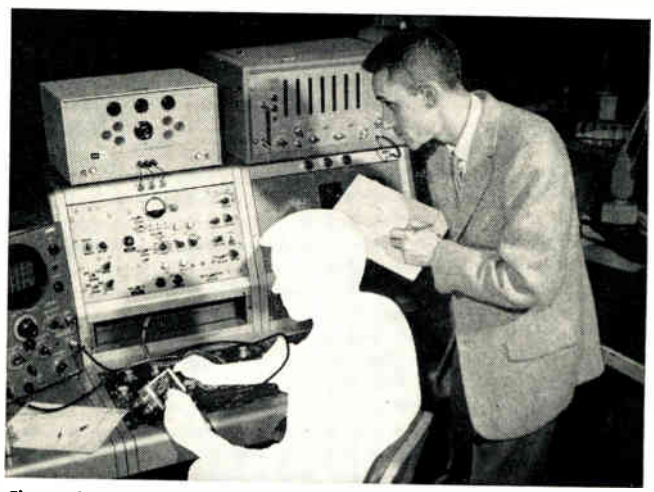
Where do you belong in IBM Military Products Division?

Challenging jobs like

Military Products Division's tremendous growth opens up challenging career opportunities to engineers and scientists in all these fields:

- Circuit Development
- Components
- Cost Estimating
- Digital and Analog Systems
- Electronic Packaging
- Electronics
- Field Engineering
- Heat Transfer
- Human Engineering
- Inertial Guidance
- Installation
- Mathematics
- Mechanical Design
- Optics
- Physics
- Power Supplies
- Programming
- Reliability
- Servo-Mechanisms
- Systems Planning and Analysis
- Technical Publications
- Test Equipment
- Transistors

Creative Mechanical Engineer: Previous to his latest promotion, this engineer worked on accelerometers, inertial devices, cooling units, servo-mechanisms and new techniques of gearing for subminiature computer units which will key future development of military weapons. Associates investigated new concepts in magnetic recording and number display devices, and read-out printers. *Do you belong here?*



Electronic Test Equipment Engineer: Also promoted, this man formerly provided instrumentation to test advanced airborne bombing and navigational computers. He analyzed test specifications, selected and designed test equipment; originated test procedures. Opportunities exist in systems, manufacturing, tool and cost engineering, product improvement, and automation research. *Do you belong here?*

Component Engineer: This man's job entailed the selection, evaluation, development, and application of electronic component parts, or building blocks, used in airborne bombing and navigational systems. Engineers and physicists will find stimulating opportunities here to engineer on precision analog components, gyros, accelerometers and analog-to-digital converters. *Do you belong here?*

Inertial Systems Engineer: Before his recent promotion, this man performed technical analysis, design and development of inertial guidance equipment. He specified and supervised development to determine the performance, configuration, design, and operation of inertial and missile guidance equipment. Opportunities for mathematicians, physicists, E.E.'s and M.E.'s. *Do you belong here?*

these are now open!

Organized only 19 months ago, IBM Military Products Division has grown enormously. At Owego, N.Y., IBM designs and manufactures advanced airborne analog and digital computers for Air Force bombing-navigational equipment. At Kingston, N.Y., IBM builds the world's largest electronic computers for Project SAGE, part of our nation's giant defense net.

The electronic computer field offers engineers and scientists one of the best ground-floor career opportunities today. Economic experts rank the electronic computer in importance with automation and nucleonics in growth potential. Sales at IBM, the recognized leader in this fast-growing field, have doubled, on the average, every five years since 1930. Engineering laboratory personnel has quintupled in the past five years alone. $19,000,000 was spent on research and new product development in 1956.

As a member of IBM Military Products, you enjoy the stability and security of the IBM Corporation, plus the opportunity to progress in any other IBM division. The "small team" system assures recognition of individual merit. Promotions open up frequently through rapid expansion. Company-paid benefits set standards for industry. No wonder the rate of personnel turnover at IBM is less than one-sixth the national average!

For the facts about an engineering career with IBM Military Products Division, just write, outlining background and interests, to:

R. A. Whitehorne,
Mgr. of Engineering Recruitment, Dept. 4605
International Business Machines Corporation
590 Madison Avenue, New York 22, N.Y.

Where would YOU like to work for IBM?

This map points out key IBM plants and laboratories, including the Military Products facilities at Owego and Kingston, N. Y. Limited openings available at many flight test bases and SAGE computer sites across the nation.

IBM MILITARY PRODUCTS

DATA PROCESSING • ELECTRIC TYPEWRITERS • MILITARY PRODUCTS • SPECIAL ENGINEERING PRODUCTS • TIME EQUIPMENT

Tele-Tips

AT THE NUCLEAR CONFERENCE we stood before a massive array of dials, knobs and recorders—the control room for a nuclear reactor. One of our neighbors voiced our own thought, "What do all these dials mean?" A young engineer, apparently well-informed, leaned over and whispered confidentially, "It means they're scared to death that the thing is going to run away from them."

TV PRICES hit rock bottom in Mt. Vernon, N. Y. last week. Sets were given away free. It was all a sales gimmick by a local appliance dealer. By giving the sets free with the purchase of an air conditioner, he solved his two most pressing problems. He moved his backlog of TV sets and got a big jump on the air conditioner season.

COLOR TV will be a tremendous success if RCA can breathe half of the enthusiasm into the public that they have generated in their employees. Most of the second and third echelon RCA executives we meet seem to have their own color sets and without exception they are completely sold on the value of color both in performance and reliability.

MUSICAL CHAIRS designed by Stereo Products Co., Severna, Md. have a speaker mounted in each wing to provide stereophonic reproduction of high fidelity music.

CRT MANUFACTURERS are now taking steps to date-code their tubes with indelible markings. Surprisingly, the job is not nearly as simple as it seems. Almost any marking or indentation affects the working of the tube. One of the largest manufacturers begins this month to date-code his tubes by a marking on G_1.

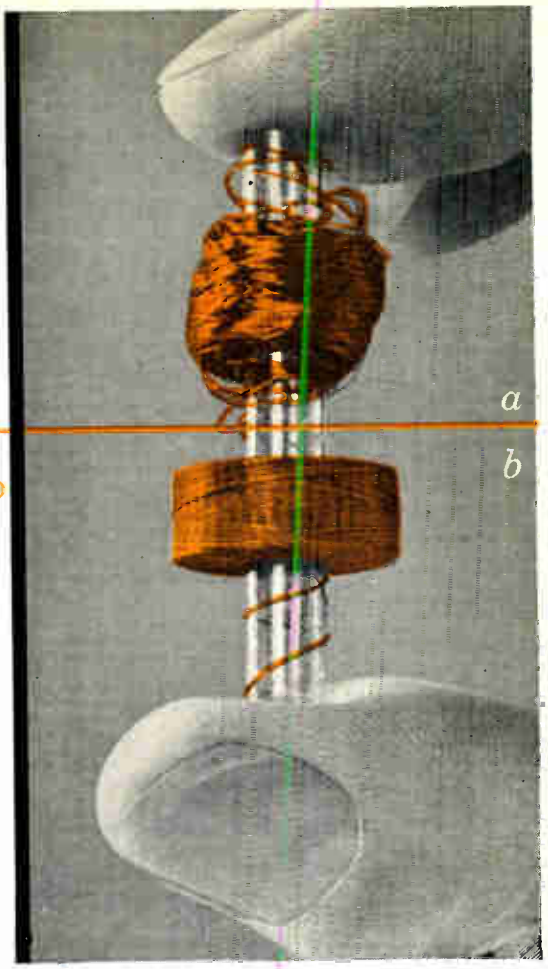
HIGHWAY HI-FI. Highway officials in the Chicago area are experimenting with a rough sur-

(*Continued on page* 26)

If you have this problem, investigate

GRIP-EZE®

—an example of Phelps Dodge's realistic approach to Magnet Wire research



THE PROBLEM: To develop a solderable film-coated wire without fabric for winding universal lattice-wound coils without adhesive application.

THE SOLUTION: Phelps Dodge Grip-eze—a solderable film wire with controlled surface friction for lattice-wound coils that provides mechanical gripping between turns and keeps wire in place.

EXAMPLE: Coils wound with (a) conventional film wire; (b) Grip-eze. Note clean pattern of Grip-eze as compared to fall-down of conventional film wire.

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

FIRST FOR LASTING QUALITY —FROM MINE TO MARKET!

PHELPS DODGE COPPER PRODUCTS CORPORATION

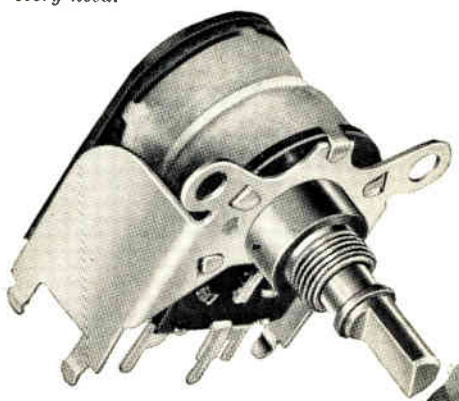
INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

Circle 14 on Inquiry Card, page 101

Mallory Printed Circuit Type Controls Now Available With Push-Pull Line Switch

Check this modern, fingertip operated line switch for your new product design—it's available now in printed circuit type controls to fit every need.



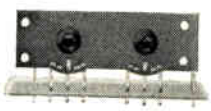
Now your printed circuit assemblies can be turned on and off the new way—PULL, it's on, PUSH, it's off—giving your design an extra, modern merchandisable touch. There are other features, too. Equipment can be turned on independent of volume control rotation—no more groping for the correct setting while it warms up—no more accelerated wear on the lower end of the volume control resistance element.

Mallory's push-pull line switch* features a unique principle in switch contacts. Heart of the unit is a free floating ring of Mallory contact alloy. This ring is self-aligning—rotating slightly with each use so that new contact surfaces are constantly being presented and wear is evenly distributed. (Only the ring carries the switched current—never the actuating pin or spring.) Service life is prolonged—switch action is clean and sharp!

Investigate these Mallory printed circuit type controls with the new push-pull line switch for your new printed circuit radio, television or electronic component design. A wide range of mechanical and electrical specifications to fit every need . . . including current ratings suitable for auto radios, color and monochrome TV. Low actuating forces suitable for small radio sets are also available. This same switch action is also available on conventional controls.

**Patent applied for*

Solve Problems—and Save



Also available—new, low-cost secondary controls, mounted singly or in multiples on phenolic strips. Another Mallory contribution to the rapidly advancing art of printed circuitry.

Missile Guidance Systems

Experience and facilities for electronic subassemblies. Write for descriptive brochure.

Expect more . . . get more from

P.R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

Circle 15 on Inquiry Card, page 101

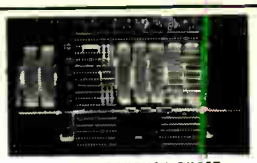
THEY'RE CHECKING VIDEO EVERYWHERE

WITH THE FAMOUS TELECHROME INCORPORATED

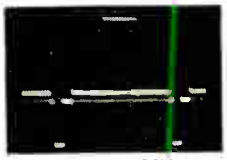
Model 1003-B

PORTABLE VIDEO TRANSMISSION TEST SIGNAL GENERATOR

★ Completely self contained ★ Portable ★ Multi-frequency burst ★ Stairstep ★ Modulated stairstep ★ White window ★ Composite sync ★ Regulated power supply.

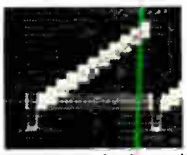


MULTI-FREQUENCY BURST AMPLITUDE vs FREQUENCY. Check wide band coaxial cables, microwave links, individual units and complete TV systems for frequency response characteristics without point to point checking or sweep generator.



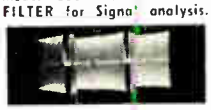
WHITE WINDOW

LOW & HIGH FREQUENCY CHARACTERISTICS. Determine ringing, smears, steps, low frequency tilt, phase shift, mismatched terminations, etc. in TV signals or systems.

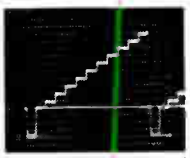


STAIRSTEP SIGNAL modulated by crystal controlled 3.579 mc for differential amplitude and differential phase measurement. Checks amplitude linearity, differential amplitude linearity and differential phase of any unit or system.
Model 1003-C includes variable duty cycle stairstep (10-90% average picture level).

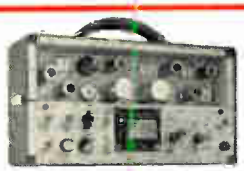
Model 608-A HI-LO CROSS FILTER for Signal analysis.



MODULATED STAIRSTEP signal thru high pass filter. Checks differential amplitude.



MODULATED STAIRSTEP signal thru low pass filter. Checks linearity.



1004-A VIDEO TRANSMISSION TEST SIGNAL RECEIVER for precise differential phase and gain measurements. Companion for use with 1003-B.

1S21-A OSCILLOSCOPE CAMERA—Polaroid type for instantaneous 1 to 1 ratio photo-recording from any 5" oscilloscope.

TELECHROME INCORPORATED

DELIVERY 30 DAYS

Literature on the above and more than 100 additional instruments for monochrome and color TV by TELECHROME are available on request.

The Nation's Leading Supplier of Color TV Equipment
88 Merrick Road Amityville, N. Y.
AMityville 4-4446

Circle 16 on Inquiry Card page, 101

Tele-Tips

(*Continued from page* 22)

faced strip in the neighborhood of stop sign intersections. The rumble as the car passes over the strip makes motorists more observant, and, in addition, affords better stopping conditions.

CANADIAN ENGINEERS are considering a proposal to federate all national and provincial engineering bodies into "one body to speak for all engineers."

TIME has again arrived for the Eta Kappa Nu's selection of the Outstanding Young Electrical Engineer, this time for 1956. Qualifications are that the engineer must be less than 35 years of age and have BA degree in electrical engineering from a college in the U. S. or Canada within ten years prior to May 1, 1957. Nomination forms may be obtained from A. B. Zerby, Exec. Secy., Eta Kappa Nu Assoc., P.O. Drawer 447, Dillsburg, Pa. Nominations must be returned to Mr. Zerby not later than May 31, 1957.

LOUDSPEAKER THIEVES that plague the drive-in movies will be surprised by a new special alarm patented last month.

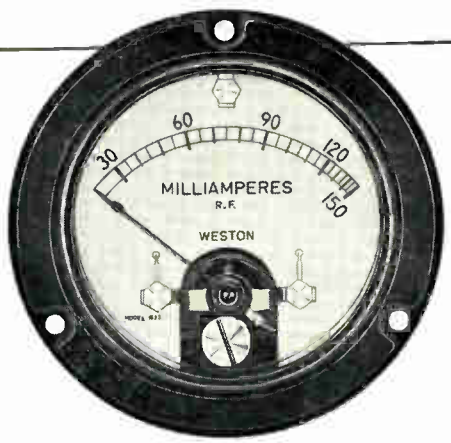
HOW FAST is fast? Rookie pitchers reporting to the spring training camp of the Kansas City Athletics this year had to convince not only the manager but a speed meter as well. The Athletics were using an Admiral Radarscope speed meter to determine scientifically the speed of the pitched ball. Manager Lou Boudreau said that Athletic scouts will be carrying the speed meters with them to Athletic tryouts all during the season. How old-time fans will react when they start referring to pitchers as "80-mph" we can only guess.

TV PHOSPHOR producing division of Sylvania has turned out more than 5,000,000 gallons of high-purity potassium silicate since 1949. This is enough phosphor material for 50,000,000 TV picture tubes.

time tested shock mount

The critical moving coil in Weston ruggedized instruments is insured against shock damage by these shock absorbing springs in back of each jewel bearing . . . another Weston ruggedized *first!*

The entire instrument movement is then cradled on a shock mount of specially formulated rubber . . . assuring continuous dependable operotion in severest service.



A DAYSTROM UNIT

WESTON
Ruggedized
PANEL INSTRUMENTS

Equipment builders can't afford to compromise on instrumentation where service requirements call for instruments that will function dependably under severe impact, shock, moisture or temperature extremes. That's why *approved* Weston ruggedized instruments are so widely preferred. Their sound basic design . . . the *extra* values built-in . . . have proved their superiority under the most rigorous field conditions, providing unmatched performance that more than justifies their cost.

Expanded facilities now make Weston ruggedized instruments readily available for A-C or D-C needs in a variety of sizes and ranges. For the complete story, consult your local Weston representatives, or write . . . WESTON Electrical Instrument Corp., Newark 12, N. J.

Circle 18 on Inquiry Card, page 101

Books

The Cathode Ray Oscilloscope

By J. Czech. Published 1957 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1. 340 pages, xii pages. Price $8.50.

This book brings to the reader the results of experience over two decades with a wide range of practical problems involving the oscilloscope. It describes in great details the construction, use, and applications of the instrument. Over 600 original oscillograms, all the work of the author, give a remarkable impression of its capabilities.

The text covers, in an extremely lucid manner, theory and design techniques relating to modern oscilloscopes, and ample information is provided on ways of using the instrument.

Many valuable practical hints, extensive references and a good index are useful features of the book, which includes directions for building a simplified oscilloscope, a high precision instrument, and a simple time base expansion unit.

Progress in Semiconductors, Vol. 1

By Alan F. Gibson, Ph. D. Published 1956 by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. 220 pages, vii pages. Price $8.00.

First in an annual series, launched to keep pace with development in semiconductor research, the coverage of this book will be international in scope, surveying all aspects of semiconductors including applications of semiconductor devices, and designed for specialists as well as those working in allied fields.

Eight specialists inaugurate the series with the following papers: Recent Advances in Silicon, The Germanium Filament in Semiconductor Research, Theory of the Seebeck Effect in Semiconductors, The Electrical Properties of Phosphors, The Design of Transistors to Operate at High Frequencies, Photo-Magneto-Electric Effect in Semiconductors, and Field Effect in Semiconductors.

While the editors feel that germanium and silicon will inevitably occupy a great portion of the papers, their aim is not restrictive. Other important aspects of semiconductor research, such as luminescence, and the photographic process and photoconductivity will also be studied.

Handbook of Electronic Measurements, Vol. I and II

Edited by Moe Wind. Published 1956 by Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N. Y. 879 pages total. Price $15.00 per set.

An authoritative handbook of electronic measurements, designed to fill the critical need for concise and com-

(*Continued on page 30*)

Having your ups and downs?

. . . if they involve Wire Wound Resistors

DALOHM has the answer!

All Dalohm products are carefully designed and skillfully made to assure you of supreme quality and dependability, plus the widest versatility of application.

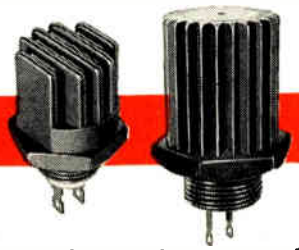
Outstanding examples of the Dalohm line are these miniature, silicone-sealed, wire wound resistors.

You Can Depend On

DALOHM Ω ®

FOR THOSE TIGHT SPECIFICATIONS

TYPE PH

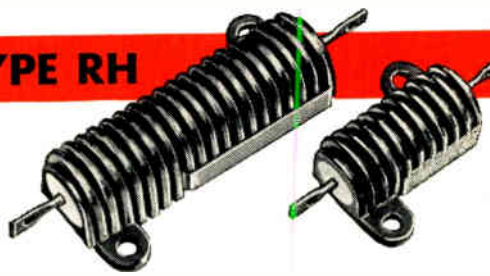


These Dalohm resistors combine high power rating with sub-miniature design. High heat dissipation and protective covering are achieved with vertical-finned black anodized aluminum housings. Vertical single hole panel mounting is provided by integral threaded base and lock nut. Ruggedized construction assures dependability under the most extreme conditions.

- Completely welded construction from terminal to terminal
- Silicone sealed for absolute protection against moisture, shock and salt spray
- Three wattages and sizes: PH-25, 25 watts; PH-50, 50 watts; PH-100, 100 watts
- Resistance values from 0.1 ohm to 60K ohms, depending on type
- Tolerances from 0.05% to 3%

Ask for Bulletin R-33

TYPE RH



Another Dalohm resistor that resolves power and space problems in tight specifications. Black anodized finned housing provides protection and maximum heat dissipation. Mounting lugs provided for horizontal mounting.

- Completely welded construction from terminal to terminal
- Silicone sealed for absolute protection against moisture, shock and salt spray
- Three wattages and sizes: RH-25, 25 watts; RH-50, 50 watts; RH-250, 250 watts
- Resistance values from 0.1 ohm to 100K ohms, depending on type
- Tolerances from 0.05% to 3%

Ask for Bulletin R-21C

JUST ASK US

You are invited to write for the complete catalog of Dalohm precision resistors, potentiometers and collet-fitting knobs.

If none of our standard line fills your need, our staff of able engineers and skilled craftsmen, equipped with the most modern equipment, is ready to help solve your problem in the realm of development, engineering, design and production.

Just outline your specific situation.

DALE PRODUCTS, Inc.

1304 28th Avenue Columbus, Nebraska, U.S.A.

- In Canada: Charles W. Pointon, Ltd. 6 Alcina Ave. Toronto, Ont.
- Export Dept: Pan-Mar Corp. 1270 Broadway New York 1, N. Y.

Circle 20 on Inquiry Card, page 101

Books

(*Continued from page 28*)

plete sources of information in the field of electrical engineering.

The editor, a Research Assistant Professor of Electrical Engineering at the institute, has prepared the handbook under the sponsorship of the General Engineering Laboratory of the Rome Air Development Center, Griffis Air Force Base, Rome, N. Y.

Written in 18 chapters by 17 authorities, eminent in the field for their work on the topics assigned to them, the handbook, in 2 volumes, has more than 600 photographs, tables, and charts.

The handbook offers up-to-date, conveniently collated information on electronic measurements and combines basic exposition with practical information. It presents a compendium of measurement methods, categorized according to frequency, from dc through the microwave region. Complete descriptions and illustrations of necessary equipment are given and orders of accuracy and physical magnitute indicated.

Each chapter describes in detail the better known and more readily applicable techniques of electronic measurement concerning the particular quantity under consideration. Where it has been considered necessary and desirable, extended theoretical treatment is given. A comprehensive bibliography is appended to each chapter. The introductory section provides a historical introduction to the problem of electromagnetic measurements, defines units and standards, and presents a complete review of electromagnetic theory from the standpoint of the problem of measurement.

Books Received

Pictorial Microwave Dictionary

By Victor J. Young and Meridith W. Jones. Published 1956 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11. 110 pages, paper bound. Price $2.95.

English-Russian, Russian-English Electronics Dictionary, TM 30-545

Published 1956 by Dept. of the Army, Washington 25, D. C. 944 pages. Price $3.50. May be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.

Tube Selection Guide, 1956-1957

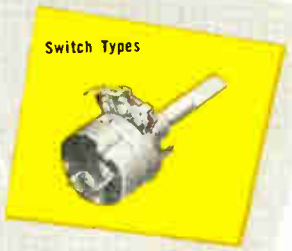
Compiled by Th. J. Kroes. Published 1956 by Philip's Technical Library, Eindhoven, Holland. Orders can be placed through any bookseller. Text is presented in English, French, German, and Spanish.

Frequency Modulation

By L. B. Arguimbau & R. D. Stuart. Published 1956 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 103 pages. Price $2.00.

A Glossary of Electric Terms, Financial and Technical

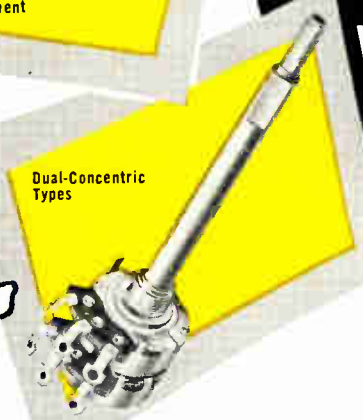
Published 1956 by Edison Electric Institute, 420 Lexington Ave., New York 17. 47 pages, xiii pages, paper bound. Price $0.50.



OVER 300 BASIC TYPES...

countless STANDARD modifications

for TV, Radio, Audio, and Instrumentation jobs.



STACKPOLE

VARIABLE composition RESISTORS

NEW!

TECH DATA ON ALL STANDARD TYPES & MODIFICATIONS. Write for Bulletin RC-10B or see your local Stackpole representative.

Electronic Components Division

STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

In Canada: CANADIAN STACKPOLE LTD., 550 Evans Ave., Etobicoke, Toronto 14, Ont.

for low voltage power supply...

SANGAMO
Type DCM
Electrolytic Capacitors

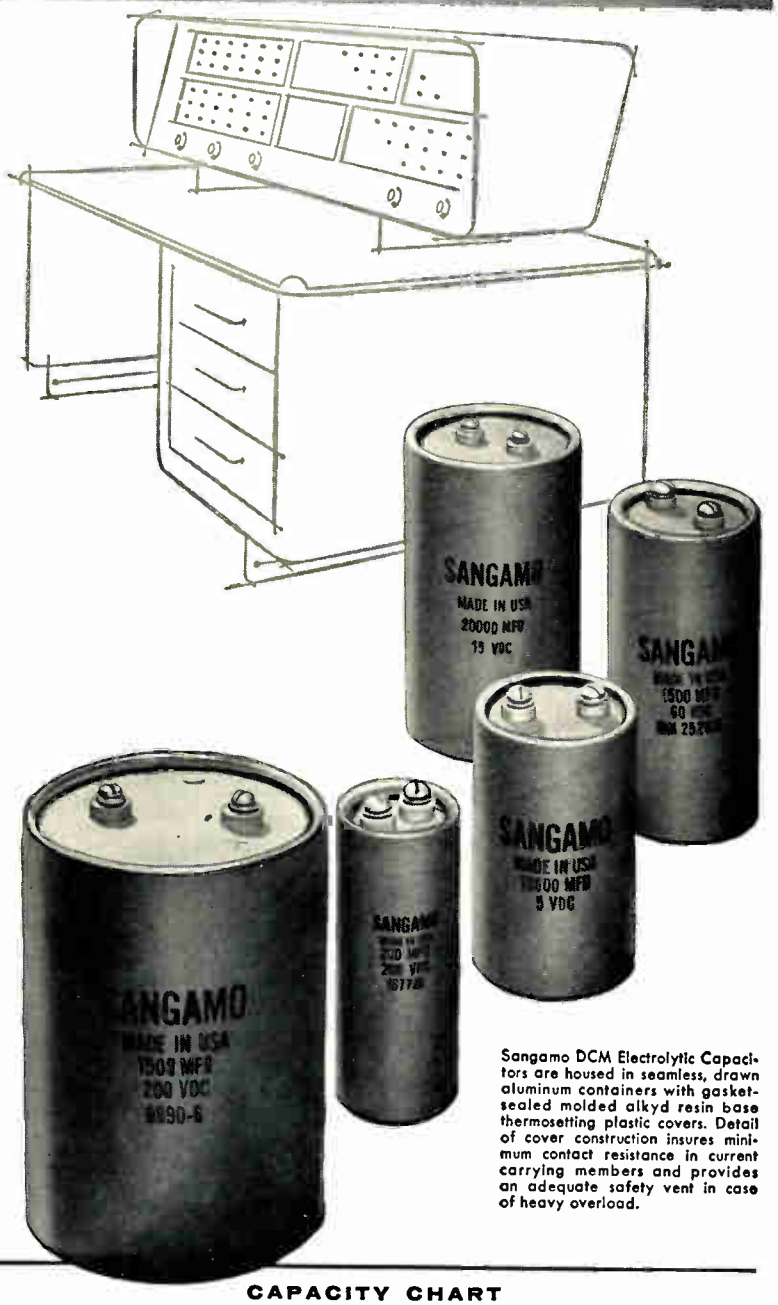
In computers, calculators, electronic controls, and related equipment—wherever *capacity stability with long life* is a must—count on Sangamo Type DCM Electrolytic Capacitors.

They minimize ripple voltage and insure steady, stable DC voltage. They save space by eliminating any need for heavy, bulky choke components with their substantial and often-varying load voltage drops.

Maximum Voltage Rating: 450 VDC

Sangamo DCM Electrolytic Capacitors provide exceptionally low equivalent series resistance . . . assure extremely high capacity for case size in low voltage ranges . . . and are specially designed to permit high ripple current without overheating. They can be supplied in maximum energy content rating of 80-watt seconds in voltage ratings from 15 to 450 VDC. Maximum capacity value of 33,000 mfds. can be supplied at 15 WVDC.

Write to-day for your file copy of Sangamo Engineering Bulletin TS-114.



Sangamo DCM Electrolytic Capacitors are housed in seamless, drawn aluminum containers with gasket-sealed molded alkyd resin base thermosetting plastic covers. Detail of cover construction insures minimum contact resistance in current carrying members and provides an adequate safety vent in case of heavy overload.

SANGAMO
Electric Company
Electronic Components Division
SPRINGFIELD, ILLINOIS

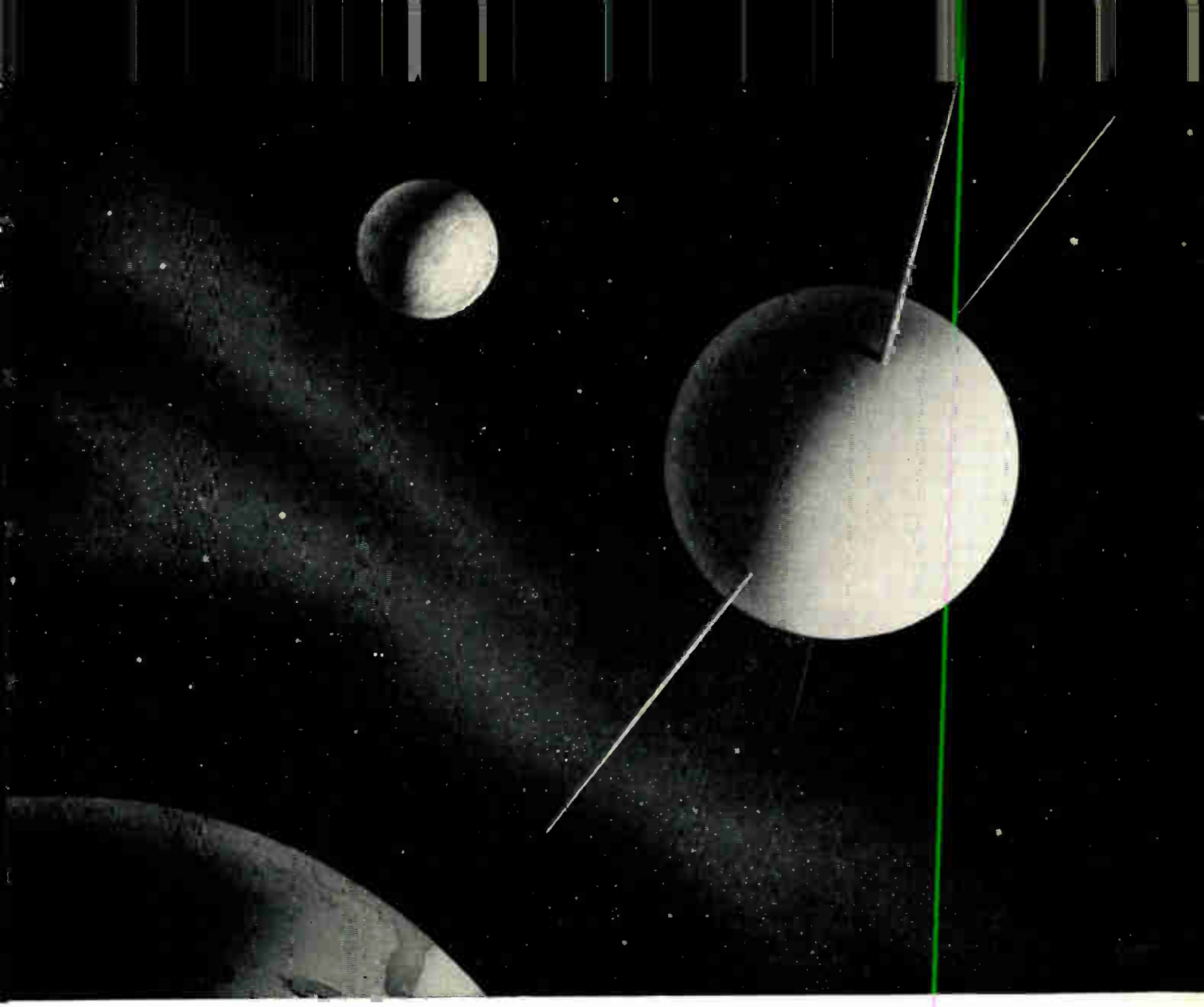
CAPACITY CHART

Rated Voltage DC	Surge Voltage	Max. Cap. in 2⅛ x 4⅝ Can	Max. Cap. in 2⅝ x 4½ Can	Max. Cap. in 3⅛ x 4½ Can
15	20	12,500	20,000	25,000
30	40	9,000	15,000	20,000
50	75	4,800	8,000	10,000
100	125	2,000	3,500	5,000
150	175	1,500	2,500	3,500
200	250	1,000	1,500	2,500
250	300	800	1,250	1,750
300	350	700	1,000	1,500
350	400	600	1,000	1,250
400	475	400	500	1,000
450	525	350	400	800

For additional capacity and voltage combinations, write us.

SG67-1

Circle 23 on Inquiry Card, page 101



recording the "man-made moon" on extra-precision audiotape®

EARLY in 1958 there will be a "new moon" in the sky — a 22-inch sphere circling the earth at a speed of 18,000 mph. Unlike our real moon, this one will be able to "talk" to Earth. And engineers from Army Ordnance Ballistic Research Laboratories at Aberdeen Proving Ground, Maryland will study these messages to learn new facts about our solar system.

This "moon-talk" — radio signals emanating from precision instruments inside the satellite — is so vital that it will be tape recorded for later analysis, interpretation and preservation. The highest standards of reproduction must be met. There can be no distortion, voids, or other imperfections.

The tape chosen was extra-precision Type EP Audiotape.

The highest professional standards of quality and uniformity extend throughout the *entire Audiotape line*, making it the best selection for *any* recording application.

Whether you are an engineer recording highly technical information or a neophyte placing his first reel on a tape recorder, Audiotape will speak for itself. It is now available in *five different types* to meet every recording need and every tape budget. ®trademark

For complete information on the earth satellite recording project write us for a free copy of the December issue of Audio Record.

AUDIO DEVICES, Inc.

444 Madison Avenue, New York 22, N.Y.

Offices in Hollywood — Chicago Export Dept., 13 E. 40th St., New York, N.Y.

MISSILE SYSTEMS ELECTRONICS

Activities at Lockheed Missile Systems Division laboratories in Palo Alto cover virtually every field of electronics related to missile systems. Inquiries are invited from those who desire to perform research and development of a most advanced nature.

Here staff members discuss a laboratory model of an airborne component of a guidance system. Left to right: Dr. R. J. Burke, telemetering; E. A. Blasi, antennas; K. T. Larkin, radar and command guidance; Dr. S. B. Batdorf, electronic division head; Dr. H. H. Leifer, solid state; S. Janken, product engineering.

Lockheed

MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION

PALO ALTO • SUNNYVALE • VAN NUYS

CALIFORNIA

a low-cost cure for high-voltage headaches!

THE NEW MOTOROLA 60-VOLT POWER TRANSISTOR

for military & industrial use

- Reliable Operation With High Junction Temperatures
- More Stable With Heat Cycling
- Better Current-Handling Capacity
- Exceptional Gain
- Now Available in Quantity

ACTUAL SIZE

SUGGESTED APPLICATIONS OF THE NEW MOTOROLA MN-21

- DC converters and other switching service
- All audio amplifiers, including push-pull
- Motor controls
- Power supply regulators
- Line voltage regulators
- Servo amplifiers
- Fuel injection systems

Wherever high-voltage power transistors are required!

CHECK THESE TYPICAL CHARACTERISTICS OF THE MOTOROLA MN-21

V_{CB} MIN.	V_{CE} BASE OPEN	V_{CS} $I_C = 2A.$ $I_B = .2A.$	B $I_C = 1A.$ $V_C = 4V.$	G_{FE} MHOS	SWITCHING TIME	THERMAL RESISTANCE
80 V.	60 V.	.6 V.	55	1.2	50u SEC.	1 °C/WATT

Collector rating of 10 Watts with mounting base at 80° C.

SAMPLE ORDER—4 FOR $24.00

For full technical information concerning this and other performance-proven Motorola semiconductor devices, write, wire or phone.

"DEPENDABLE QUALITY—IN QUANTITY"

MOTOROLA SEMICONDUCTORS

MOTOROLA, INC.
5005 E. McDOWELL
PHOENIX, ARIZONA

Other Motorola Quality Products Include:


High-Power Audio Transistors


High-Voltage Power Transistors


Silicon Radio-TV Rectifiers


Medium-Power Transistors

Circle 26 on Inquiry Card, page 101

Industry News

Robert Sackman was elected General Manager of the Ampex Corp. in Redwood City, Calif. Previously, he headed a Department of Defense research and development branch devoted to recorders and data-processing systems.

E. A. Link has been elected to the newly-created post of Vice-Chairman of the Board and also to the executive committee of General Precision Equipment Corp. Mr. Link's new status reflects the increasing activity and responsibility which he is assuming in affairs relating to planning in automatic aerial navigation, flight control, and air traffic control.

E. A. Link

J. C. Kyle

James C. Kyle is now filling the position of Asst. Director for Engr'g of the Transducer Div., Consolidated Electrodynamics Corp. Mr. Kyle joined Consolidated in 1955, after 12 yrs. as a physicist and research specialist with the Ames Aeronautical Laboratory at Moffett Field, Sunnyvale, Calif.

Charles L. Stoup is now filling the new position of Field Service Manager for AMP, Inc.

E. M. Siegel is now Sales Manager of Loral Electronics Corp.

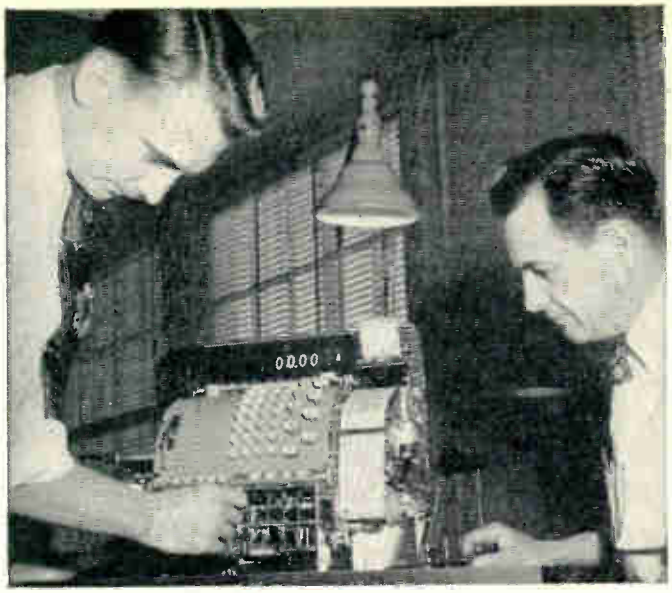
Edward A. Altshuler has been named Manager-Merchandising and Market Research for American Electronics, Inc.

B. Lazich has assumed Directorship of Filtors, Inc. Research and Engineering Div.

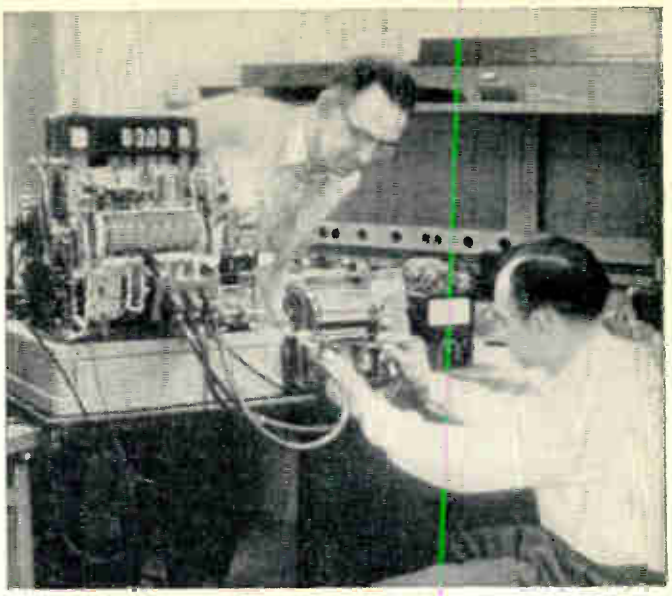
Franklin P. Hinman has become Operations Manager of the Cathode Ray and Power Tube Departments of Westinghouse Electric Corp.'s Electronic Tube Div., Elmira, N. Y.

Lewis F. Millett now heads the Radar Development Dept. of the Research Laboratories Div. of Bendix Aviation Corp. He has been active in the research and development of microwave equipment, missile guidance systems, and radar, for the past 13 years.

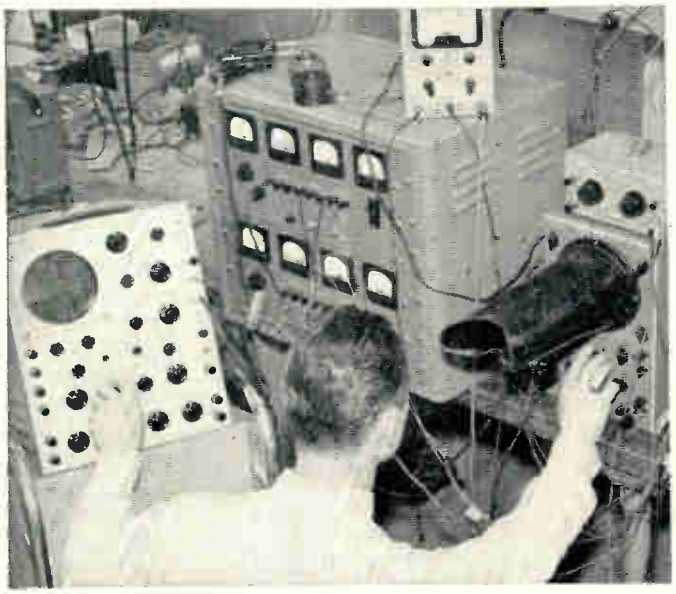
Continued on page 42)



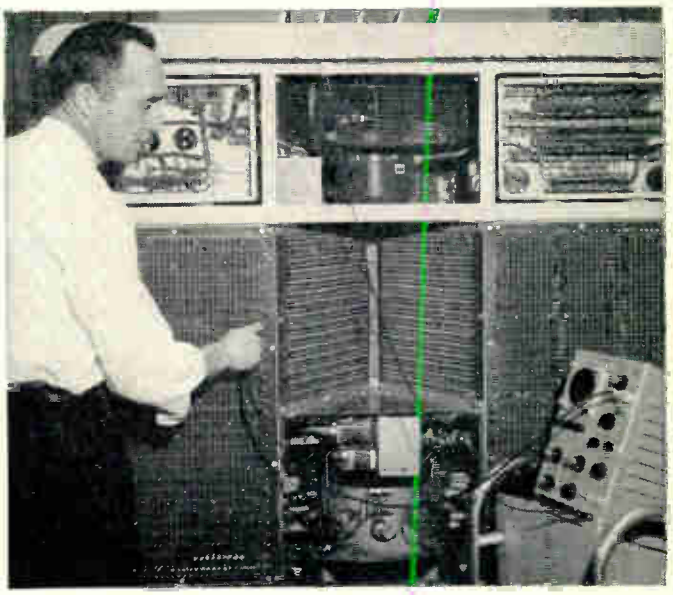
MECHANICAL ENGINEERS are using their skills in the design and development of new mechanisms required for business machines and for those mechanical products which are associated with electronic data processing equipment.



ELECTRO-MECHANICAL ENGINEERS are constantly faced with the problems of capturing information from the various input devices and converting this information into a usable form for subsequent use in data-handling equipment.



ELECTRONIC ENGINEERS enjoy an unparalleled freedom in the development of new types of circuitry and components which are necessary to maintain leadership in the competitive field of record-keeping automation.



COMPUTER ENGINEERS backed by the company's computer research since 1938 are developing an economical, flexible digital computer to meet the requirements of all record-keeping applications.

ENGINEERING UNLIMITED

AT ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS

If you are looking for a challenging opportunity with an established company which has tripled its sales in ten years—one that offers excellent starting salaries as well as permanent positions . . .

Act at once! Send resumé of your education and experience to Employment Department, Technical Procurement Sec. L, The National Cash Register Company, Dayton 9, Ohio.

NCR

THE NATIONAL CASH REGISTER COMPANY

Circle 28 on Inquiry Card, page 101

You've doubled the demand for HIPERSIL CORES...

now Westinghouse doubles production capacity

Anticipating mushrooming expansion of both industrial and defense electronics, Westinghouse has doubled its production facilities for Hipersil® cores. A good indication of the increased usage of Type "C" Hipersil cores is the findings of a recent survey . . . *more than 35% of all military transformers under 2 kva now use Hipersil cores.*

Among the new applications in components being constantly added are many specifications that can be met only by Hipersil cores, with such unique properties as:

- Oriented grain direction, with 100% coincidental flux.
- Highest permeability, lowest loss.
- 100% active in carrying flux.
- Lowest possible core volume and weight for high-temperature transformers.
- Greater mechanical, electrical and magnetic stability.

It is these properties that make the Hipersil core the foundation for better transformers—smaller, lighter, more efficient—at lower cost.

So again at Westinghouse the increased demand for a superior product has led to expanded production facilities. Enlarged facilities mean one-plant availability of a complete line of Hipersil cores—from 0.001 to 100 lbs.—in a full range of gauge thicknesses for all frequencies. Three stocking locations . . . Boston; Greenville, Pennsylvania and Los Angeles . . . mean you get better service.

Westinghouse also makes a complete line of Hipermag* cores and Hiperthin* cores for any electronic applications.

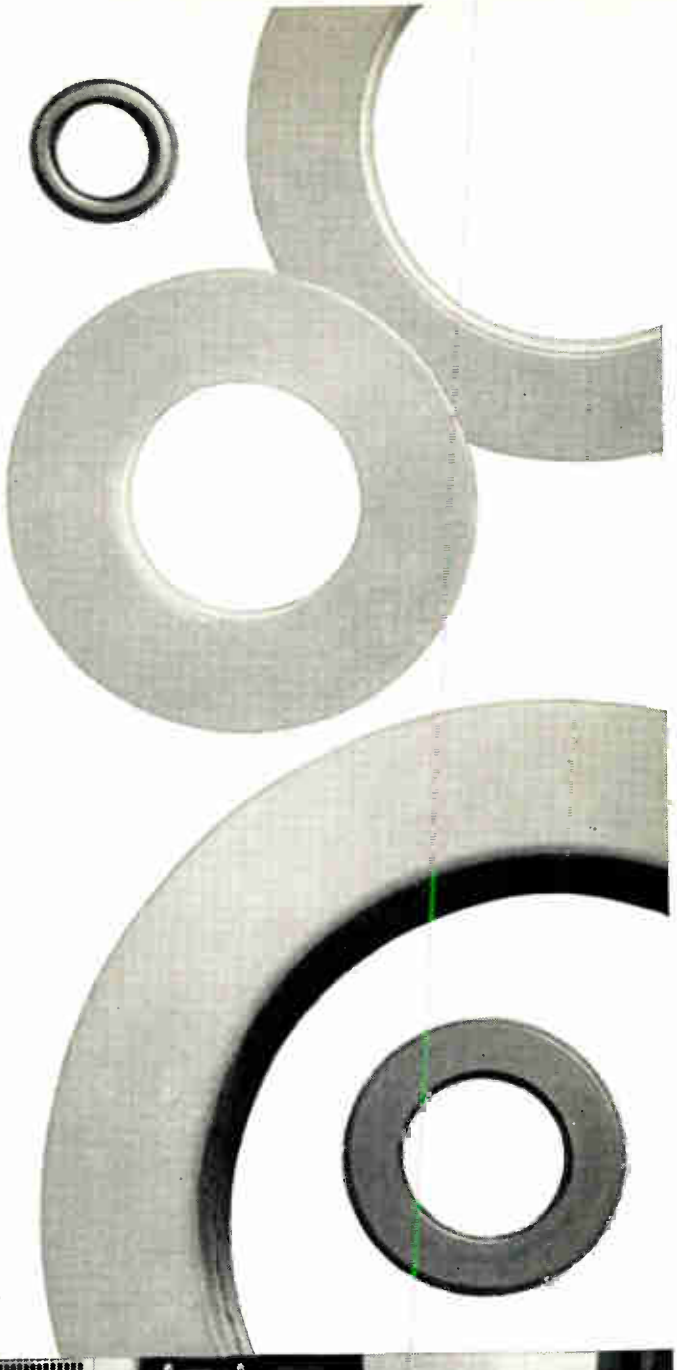
Want a prettier profit picture? Send for the *Type "C" Hipersil Core Design and Application Manual.* Write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. *Trade-Mark

J-70798

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

You can now get...

Hipermag* cores that slash magnetic amplifier rejects up to 75%



The greatest single advance in giving you reactor cores of such proved reliability is the new Roberts Dynamic Test—an exclusive Westinghouse development. Using the constant-current flux-reset method, this test literally measures magnetic properties of the core under simulated operating conditions in half-wave, saturable reactors. The Roberts Test is the only method that offers practical performance-matched cores required for high-precision magnetic amplifiers.

You get data on (1) peak flux density, (2) peak differential permeability, (3) loop squareness and (4) d-c control magnetizing force at four points on the dynamic B-H curve. Test values can be used directly as constants in amplifier design.

The Roberts Test actually eliminates core testing and matching in your plant—performance is now predictable. Westinghouse cores assure you, as never before, of the performance you design into your product.

Also available is a full line of Hipersil® and Hiperthin cores for electronic applications.

Call your Westinghouse representative or write, Specialty Transformer Department, Westinghouse Electric Corporation, P. O. Box 231, Greenville, Pa.

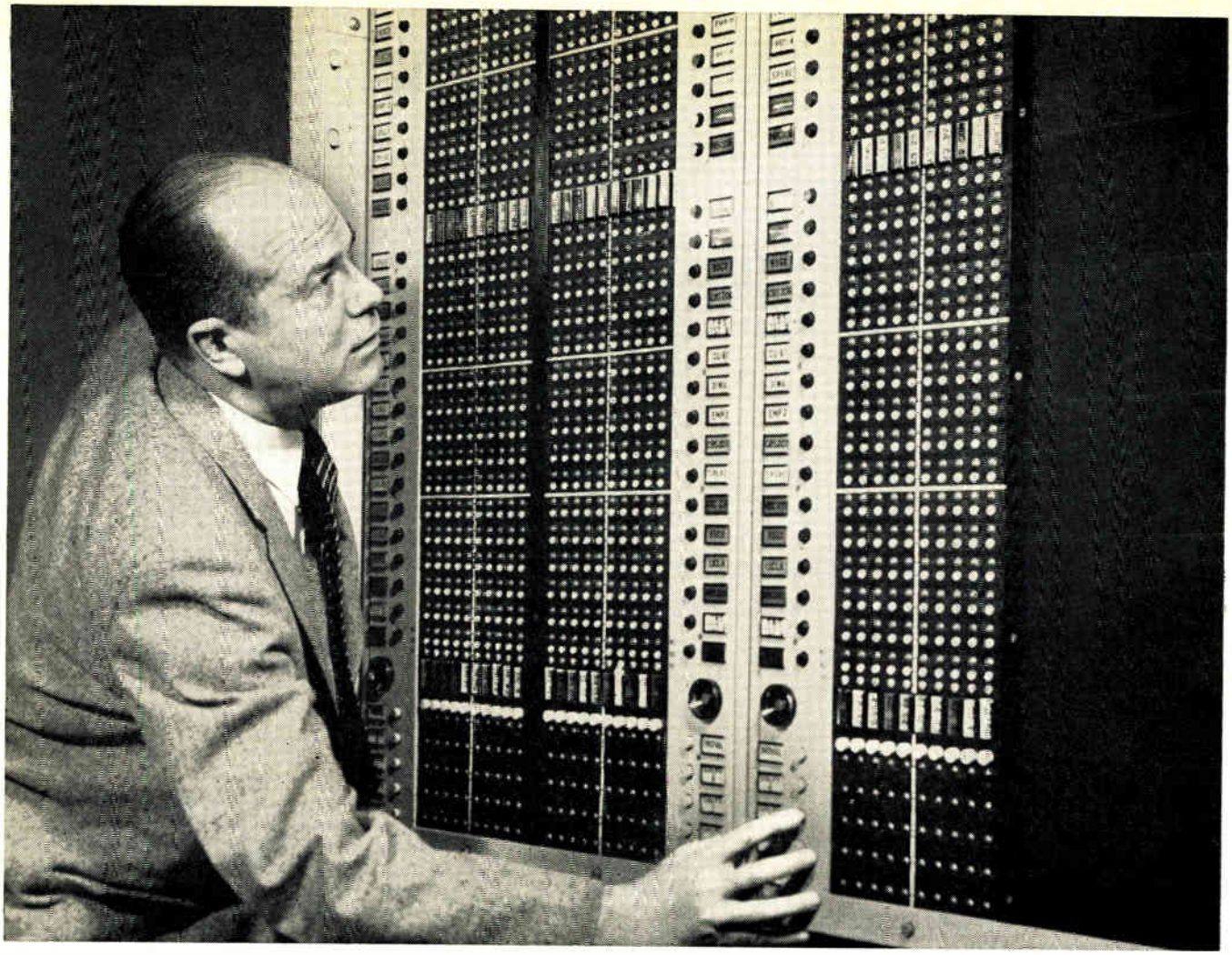
*Trade-Mark

J-70796

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

Westinghouse

Production line Roberts Test and performance matching at Westinghouse eliminate costly and complicated testing at your plant.



Bell Laboratories engineer Cyril A. Collins, B.S. in E.E., University of Washington, demonstrates new TV switching control panel for black and white or color. Complex switching connections are set up in advance; in a split-second a master button speeds dozens of programs to their destinations all over the nation. Special constant-impedance technique permits interconnection of any number of broadband circuits without picture impairment.

Telephone science speeds TV enjoyment

Telephone science plays a crucial part in your TV entertainment. An interesting example—one of many—is the latest TV switching center developed at Bell Telephone Laboratories.

Switching centers control the transmission of programs which come to your local TV station over Bell System facilities. To be available exactly on cue, programs must be switched at high speed and with very great accuracy.

To create the new switching center Bell Laboratories engineers borrowed from the switching control art which handles your dial telephone calls. They developed a special control panel which puts complex switching patterns within the easy grasp of one man. By pushing buttons, he sets up—and double-checks—forthcoming network changes far ahead of time. On cue he presses a master button which sends the programs racing to their respective destinations around the nation.

To connect the broadband circuits, the Laboratories engineers developed a new video switch which operates on a constant-impedance principle. The new switch permits the interconnection of any number of circuits, without the slightest impairment of transmission quality.

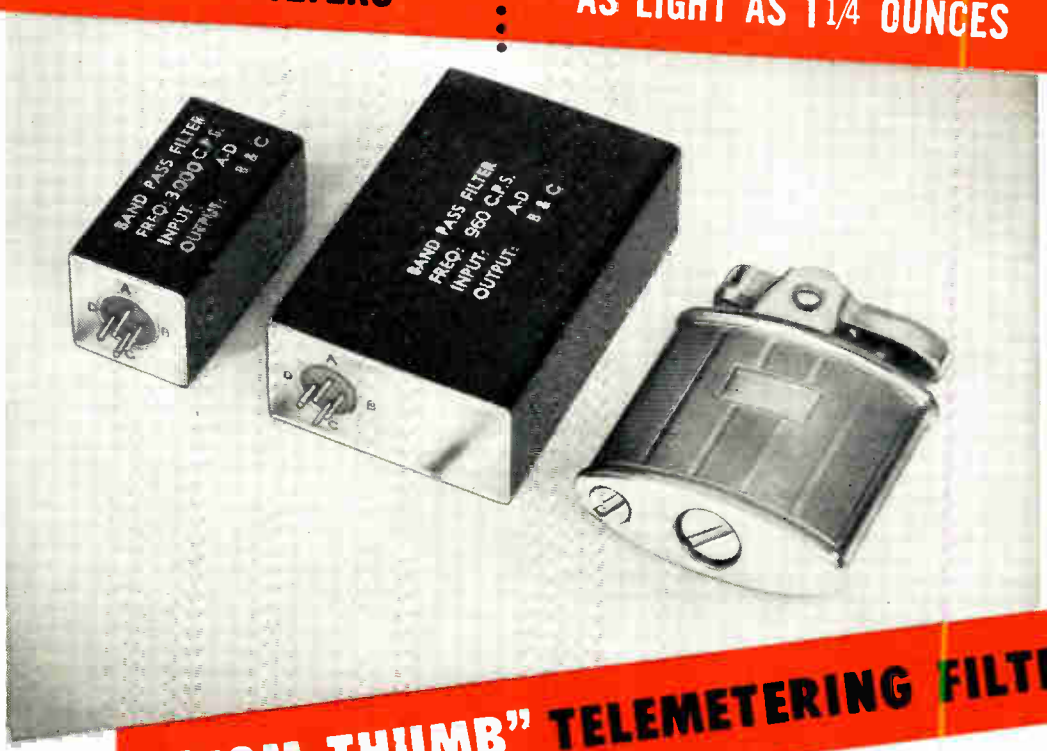
Thus the technology which serves your telephone also works for your TV enjoyment.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Burnell SUBMINIATURE FILTERS

AS SMALL AS 3/4" x 3/4" x 1 3/8"
AS LIGHT AS 1 1/4 OUNCES



"TOM THUMB" TELEMETERING FILTERS

CHAN. #	FREQ.	IMP. 100K P/N	B. W.	SIZE	WT.
1	400 cps.	S-60001	±7½%	¾ x 1½ x 2¼ H	4 oz.
2	560 cps.	S-60002	±7½%	¾ x 1½ x 2¼ H	4 oz.
3	730 cps.	S-60003	±7½%	¾ x 1½ x 2¼ H	4 oz.
4	960 cps.	S-60004	±7½%	¾ x 1½ x 2¼ H	4 oz.
5	1300 cps.	S-60005	±7½%	¾ x 1½ x 2¼ H	4 oz.
6	1700 cps.	S-60006	±7½%	¾ x 1½ x 2¼ H	4 oz.
7	2300 cps.	S-60007	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
8	3 KC	S-60008	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
9	3.9 KC	S-60009	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
10	5.4 KC	S-60010	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
11	7.35 KC	S-60011	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
12	10.5 KC	S-60012	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
13	14.5 KC	S-60013	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
14	22 KC	S-60014	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
15	30 KC	S-60015	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
16	40 KC	S-60016	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
17	52.5 KC	S-60017	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
18	70 KC	S-60018	±7½%	¾ x ¾ x 1⅜ H	1¼ oz.
A	22 KC	S-60019	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
B	30 KC	S-60020	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
C	40 KC	S-60021	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
D	52.5 KC	S-60022	±15%	¾ x ¾ x 1⅜ H	1¼ oz.
E	70 KC	S-60023	±15%	¾ x ¾ x 1⅜ H	1¼ oz.

Designed and tested to specification ±MIL-T 26985

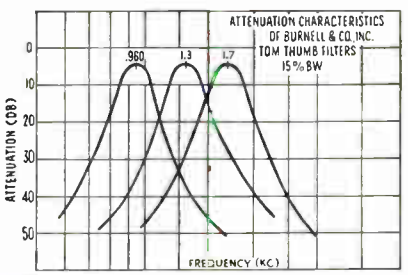
Supplied in two principal case sizes:

1. For RDB channels 1 through 6, case size is ¾ x 1½ x 2¼ inches high; weight: 4 ounces.
2. For channels 7 and up, case size is ¾ inches square and 1⅜ inches high; weight: 1¼ ounces.

These cases are generally equipped with a 4-pin plug to match the small Winchester socket.

ATTENUATION CHARACTERISTICS

Impedance: 100 K ohms in and out.
Insertion loss: less than 6 db.
At ± 7.5% band width is less than 3 db.
At ± 25% band width is greater than 15 db.
At 1.75 f attenuation is 40 db or more.
At .57 f attenuation is 40 db or more.



Burnell & Co., Inc.

Dept. T57 45 WARBURTON AVENUE • YONKERS 2, N. Y. • YONKERS 5-6800

PACIFIC DIVISION • 720 MISSION STREET • SOUTH PASADENA, CALIFORNIA • RYAN 1-2841

Circle 32 on Inquiry Card, page 101

Industry News

(*Continued from page* 36)

Jacob Reichert is now filling the post of Manager of the Dayton, Ohio, office of the Edison Instrument Div. of McGraw-Edison Co. Mr. Reichert was formerly Project Engineer at Wright-Patterson AFB in Dayton.

Frederick G. Miller has become Manager of Field Service Operations for Datamatic Corp., Newton Highlands, Mass. A specialist in computer projects with the USN, he was chief of the computer section responsible for installation, operation, and maintenance of the Mark II and Mark III giant "brains" developed at Harvard University.

C. William Miller has joined the executive staff of Volkert Stampings, Inc. Before taking this special assignment, Mr. Miller was associated with the Philco Corp. in various capacities for 15 years.

C. W. Miller

J. M. Johnston

Joseph M. Johnston is now filling the post of Operations Superintendent of both instruments and components with the Victoreen Instrument Co. Mr. Johnston was previously associated with El-Tronics, Inc. as both Chief Engineer and Operations Manager.

Charles H. Godschall, Manager, Tooling and Tool Engineering, Government and Industrial Div., Philco Corp. was presented the Distinguished Service Award by Asst. Sec. of the Navy Fogler, for outstanding work in the development of a new underwater weapon.

Dr. Thornton C. Fry, a mathematician well known in both academic and industrial fields, has been appointed Senior Consultant for Remington Rand Univac.

L. M. Skelton, a member of the Engineering Consulting Div., Kester Solder Co. of Chicago and Newark, N. J., has been permanently transferred to California. Mr. Skelton goes to the West Coast after many years of extensive contact with all types of

(*Continued on page* 46)

THE STANDARD OF COMPARISON FOR OVER 20 YEARS

HIGH FIDELITY TRANSFORMERS

FROM STOCK... ITEMS BELOW AND 650 OTHERS IN OUR CATALOGUE B.

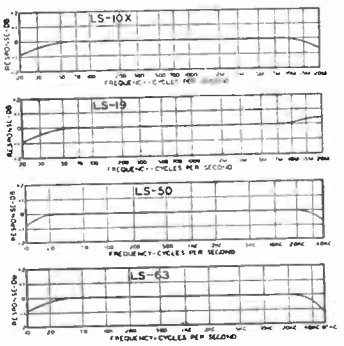
TYPICAL UNITS

LINEAR STANDARD series

Linear Standard units represent the acme from the standpoint of uniform frequency response, low wave form distortion, thorough shielding and dependability. LS units have a guaranteed response within **1db. from 20 to 20,000 cycles.**

Hum balanced coil structures and multiple alloy shielding, where required, provide extremely low inductive pickup.

These are the finest high fidelity transformers in the world. 85 stock types from milliwatts to kilowatts.



LS-10X Shielded Input
Multiple line (50, 200, 250, 500/600, etc.) to 50,000 ohms . . . multiple shielded.

LS-19 Plate to Two Grids
Primary 15,000 ohms.
Secondary 95,000 ohms C.T.

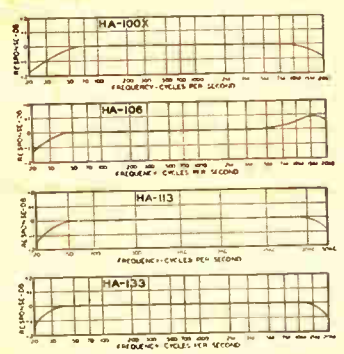
LS-50 Plate to Line
15,000 ohms to multiple line . . . +15 db. level.

LS-63 P.P. Plates to Voice Coil
Primary 10,000 C.T. and 6,000 C.T. suited to Williamson, MLF, ul.-linear circuits. Secondary 1.2, 2.5, 5, 7.5, 10, 15, 20, 30 ohms. 20 watts.

CASE	LS-1	LS-2	LS-3
Length	3⅛"	4-7/16"	5-13/16"
Width	2⅝"	3½"	5"
Height	3¼"	4-3/16"	4-11/16"
Unit Wt.	3 lbs.	7.5 lbs.	15 lbs.

HIPERMALLOY series

This series provides virtually all the characteristics of the Linear Standard group in a more compact and lighter structure. The frequency response is within 1 db. from 30 to 20,000 cycles. Hipermalloy nickel iron cores and hum balanced core structures provide minimum distortion and low hum pickup. Input transformers, maximum level +10db. Circular terminal layout and top and bottom mounting.



HA-100X Shielded Input
Multiple line to 60,000 ohm grid . . . tri-alloy shielding for low hum pickup.

HA-106 Plate to Two Grids
15,000 ohms to 135,000 ohms in two sections . . . +12 db. level

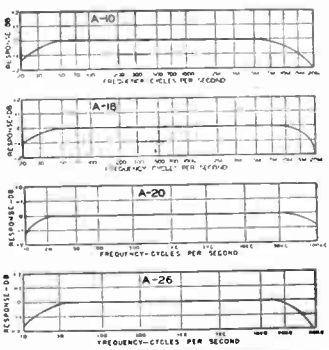
HA-113 Plate to Line
15,000 ohms to multiple line . . . +12 db. level . . . 0 DC in primary.

HA-133 Plate (DC) to Line
15,000 ohms to multiple line . . . +15 db. level . . . 8 Ma. DC in primary.

Case	H-1	H-2
Length	2⅜"	3-9/16"
Width	1-15/16"	2-13/16"
Height	3⅛"	3½"
Unit Weight	2 lbs.	5 lbs.

ULTRA COMPACT series

UTC Ultra Compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. The frequency response is within 2 db. from 30 to 20,000 cycles. Hum balanced coil structure plus high conductivity die cast case provides good inductive shielding. Maximum operating level is +7db. Top and bottom mounting as well as circular terminal layout are used in this series as well as the ones described above.



A-10 Line to Grid
Multiple line to 50,000 ohm grid.

A-18 Plate to Two Grids
15,000 ohms to 80,000 ohms, primary and secondary both split.

A-20 Mixing Transformer
Multiple line to multiple line for mixing mikes, lines, etc.

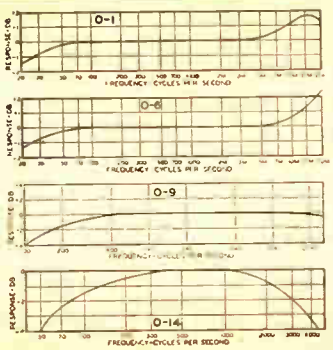
A-26 P.P. Plates to Line
30,000 ohms plate to plate, to multiple line.

A CASE

Length	1½"
Width	1½"
Height	2"
Unit Weight	½ lb

OUNCER series

UTC Ouncer units are ideal for portable, concealed service, and similar applications. These units are extremely compact . . . fully impregnated and sealed in a drawn housing. Most items provide frequency response within 1 db. from 30 to 20,000 cycles. Maximum operating level 0 db. These units are also available in our stock P series which provide plug-in base. The 0-16 is a new line to grid transformer using two heavy gauge hipermalloy shields for high hum shielding.



0-1 Line to Grid
Primary 50, 200/250, 500/600 ohms to 50,000 ohm grid.

0-6 Plate to Two Grids
15,000 ohms to 95,000 ohms C.T.

0-9 Plate (DC) to Line
Primary 15,000 ohms, Secondary 50, 200/250, 500/600.

0-14 50: 1 Line to Grid
Primary 200 ohms, Secondary .5 megohm for mike or line to grid.

OUNCER CASE

Diameter	⅞"
Height	1-3/16"
Unit Weight	1 oz.

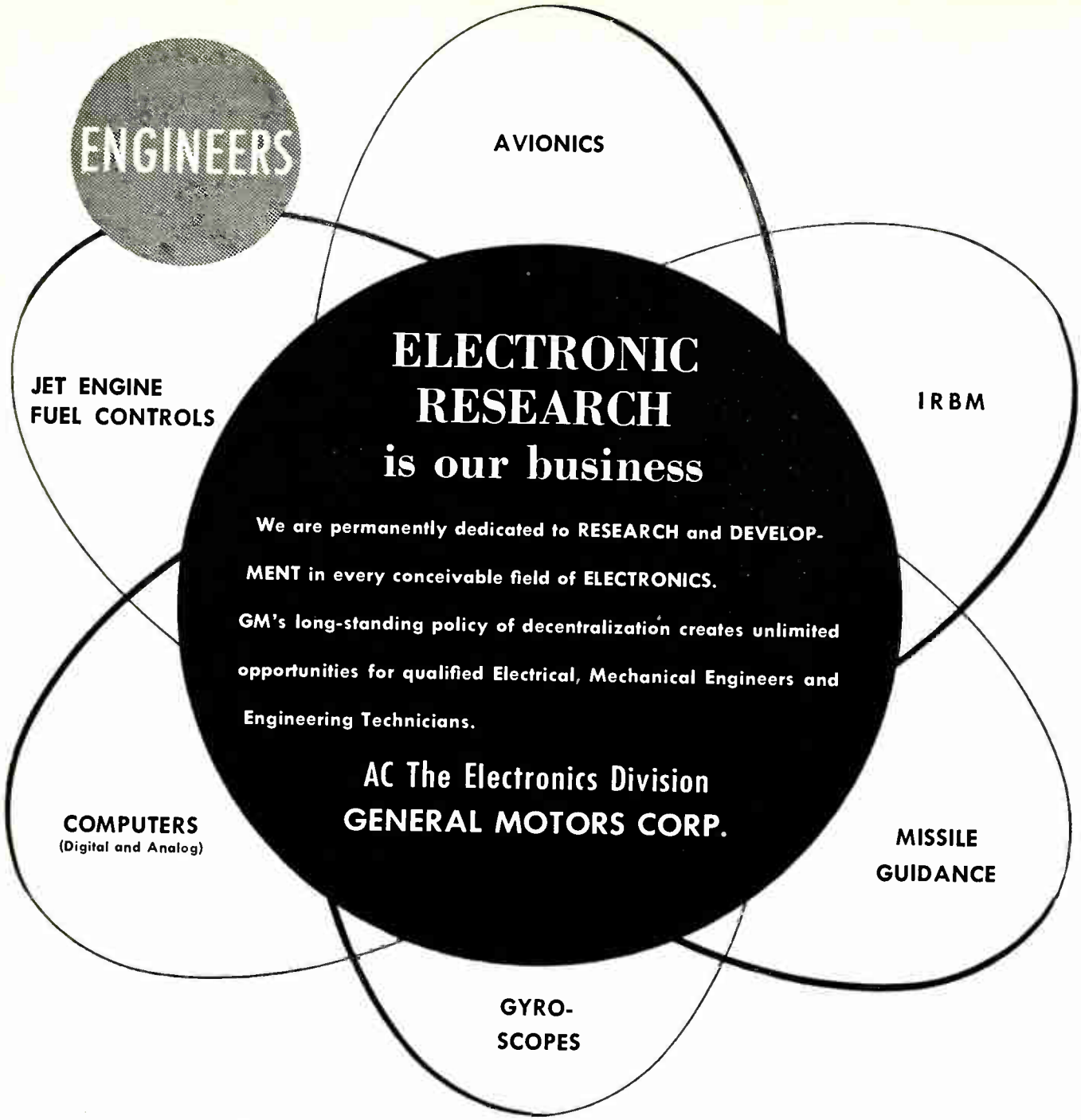
SPECIAL UNITS TO YOUR NEEDS

If you manufacture high fidelity gear, send your specifications for prices

UNITED TRANSFORMER CO

150 Varick Street, New York 13, N. Y. EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y. CABLES: "ARL

PACIFIC MFG. DIVISION: 4008 W. Jefferson Blvd., Los Angeles, Cal.



New plant (225,000 square feet) now being built in a Milwaukee suburb. This and our present plant will house the ELECTRONICS DIVISION—Milwaukee of the General Motors Corporation.

Your future is assured (if you can qualify) in this lovely cool, southern Wisconsin city where every conceivable living and cultural advantage, plus small town hospitality is yours for the asking. Send full facts today about your education, work background, etc. Every inquiry treated in strict confidence—and you will hear from us by return mail.

For Employment Application — Mr. Cecil E. Sundeen, Supervisor of Technicol Employment

AC THE ELECTRONICS DIVISION
GENERAL MOTORS CORPORATION
Milwaukee 2, Wisconsin Flint 2, Michigan

B&A "ELECTRONIC GRADE" CHEMICALS

REDUCE IMPURITIES TO NEW LOWS!

Here are chemicals made to entirely new standards of purity – chemicals made especially for use in manufacture of semiconductors. Metallic and other undesirable impurities are held to maximum limits as low as one part in ten million!

These exceptionally pure B&A "Electronic Grade" Chemicals have been developed to fulfill the exacting requirements of the electronic industry. It is natural that they should come from B&A. For Baker & Adamson is America's foremost producer of laboratory and scientific chemicals, and has worked in close partnership with the electronic industry since its earliest days.

Listed here are the B&A "Electronic Grade" Chemicals now offered in small package sizes. They are readily available from convenient stock locations, together with many other B&A "Electronic Grade" Chemicals produced in bulk for use in TV tube and receiving tube manufacture. Additional special high-purity chemicals can be custom-made to meet your needs.

Write for free booklet! Contains information on electronic chemicals for semiconductors, tubes, printed circuits; sulfur hexafluoride for gaseous insulation; selenium metal and selenides; metallic oxides and salts for ferrite production. Lists exact specifications for many "Electronic Grade" Chemicals. Write for your copy today!

"Electronic Grade" Chemicals for Semiconductors:

Acetone
Acid Hydrofluoric, 48%
Alcohol Methyl, Absolute (Methanol)
Acetone Free
Alcohol Propyl, Iso
Carbon Tetrachloride
Ether, Anhydrous
Hydrogen Peroxide, 3% Solution
Hydrogen Peroxide, 30%
Hydrogen Peroxide, 30% "Stabilized"
Sodium Carbonate, Monohydrate
Trichloroethylene

Many other B&A chemicals commonly used for semiconductor production are available in Reagent A.C.S. or other high-purity grades.

BAKER & ADAMSON®
"Electronic Grade" Chemicals

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

75 YEARS OF LEADERSHIP IN CHEMICAL PURITY
B'A 1882-1957

Offices: Albany* • Atlanta • Baltimore* • Birmingham* • Boston* • Bridgeport* • Buffalo* • Charlotte* • Chicago* • Cleveland* • Denver* • Detroit* • Houston* Jacksonville • Kalamazoo • Los Angeles* • Milwaukee • Minneapolis • New York* • Philadelphia* • Pittsburgh* • Providence* • St. Louis* • San Francisco* Seattle • Kennewick* and Yakima (Wash.) In Canada: The Nichols Chemical Company, Limited • Montreal* • Toronto* • Vancouver* *Complete stocks carried here.

Circle 36 on Inquiry Card, page 101

Industry News

(*Continued on page 42*)

solder-consuming industries in the Middle West, especially the electronic producer.

Kenneth R. Johnson is now Vice-President in charge of the Home Products Div. of Packard-Bell Electronics Corp. The move was designed to strengthen the company's planned expansion program.

Hugh P. Moore was elected a member of the Western Electronic Show and Convention Board of Directors. Mr. Moore replaces Gramer Yarbrough, who recently resigned from Elgin Electronics Div. to form his own electronics representative firm.

Malcom Ross has been elected President of General Transistor Western Corp. Mr. Ross is a veteran of over 25 yrs. in the electronics industry and has served in various executive capacities.

M. Ross

S. F. Arn

Sam F. Arn has been appointed General Sales Manager of Gertsch Products, Inc. Mr. Arn, in this newly-created position, will direct the national sales efforts of Gertsch representatives, and will set up a West Coast direct sales organization for the company.

Julius Dorfman has been named Manager of the Special Tubes Sales for Raytheon Mfg. Co.'s Receiving and Cathode Ray Tube Operations. He will be responsible for sales of such devices as voltage regulators, radiation counter tubes, reliable subminiature and miniature tubes, thyratron tubes and ruggedized tubes.

David Dibner is now serving as Military Products Engineering Manager for the Omaton Div. of the Burndy Corp., Norwalk, Conn.

Richard A. Roeser is now serving as head of the Good-All Mfg. Co.'s advertising department. The component manufacturer is located in Ogallala, Nebraska.

Industry-wide acceptance of super-durable E-I hermetically sealed terminals has made necessary further expansion of production facilities. The new plant in Murray Hill, New Jersey is one of the most modern in the electronics industry. New equipment, improved processes and larger capacity will make it possible to expand customer service on standard E-I terminals and custom seals.

Other E-I facilities will continue to serve the industry at Irvington-On-Hudson, New York. Complete research laboratory where technicians are constantly at work anticipating future design problems.

for the Pioneer Producer of

COMPRESSION SEALS*

Specify E-I for performance *plus* in commercial and military service:

- Compression Seals
- Multiple Headers
- Sealed Terminals
- Condenser End Seals
- Threaded Seals
- Transistor Closures
- Miniature Closures
- Color Coded Terminals

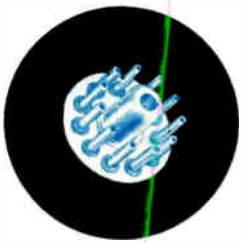
ELECTRICAL INDUSTRIES

MURRAY HILL, NEW JERSEY

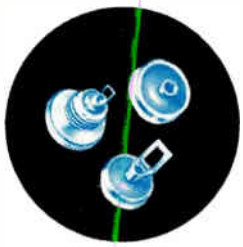
A Division of Philips Electronics, Inc.

NOW—a new and expanded plant...

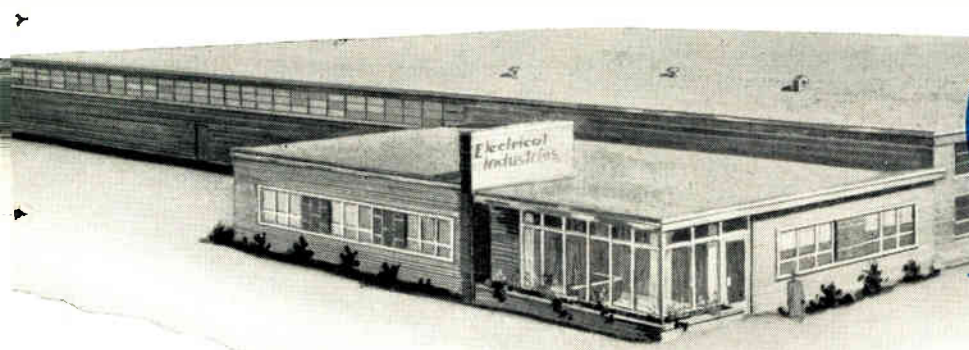
E-I Single Lead Terminals and Multiple Headers
Super rugged, compression terminals available in standard types to meet practically any requirement. Custom designs to specifications.



E-I Hermetically Sealed Plug-in Connectors
Keyed and gaged for use with RETMA octal type sockets. Available for vibrator, chopper, lock-in and noval sockets.



E-I End Seals for Tubular Closures
Completely strain-free. Afford a permanent hermetical seal for condensers, resistors and other tubular-type components.



E-I Transistor Closures, Custom Terminations
For transistors and other components requiring hermetic sealing. Available complete with closures or customer's parts sealed if required.

*Canadian Pat. 523,390; British Pat. 734,583
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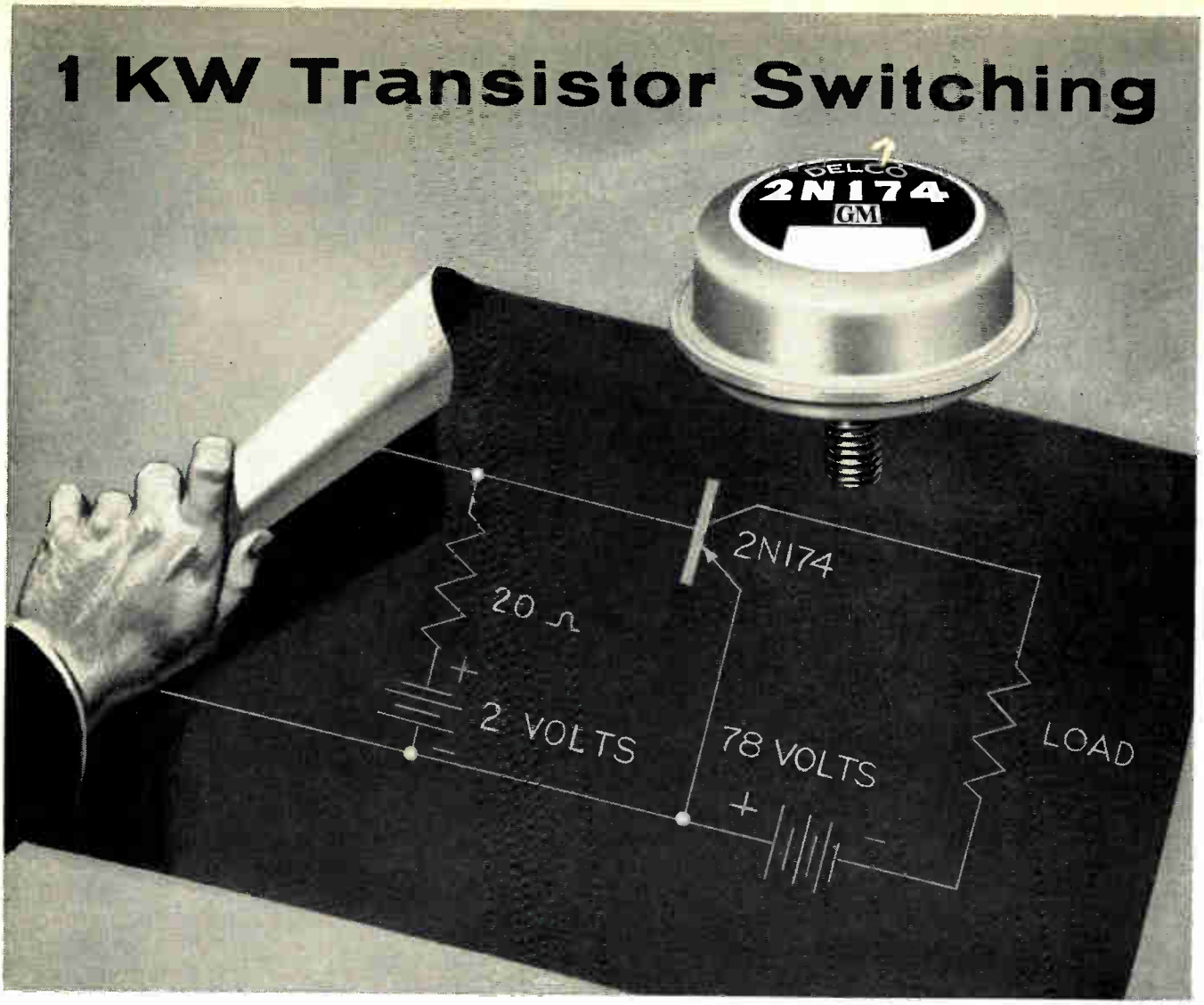
1 KW Transistor Switching



Industry's Highest Power Transistor

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

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

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

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

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

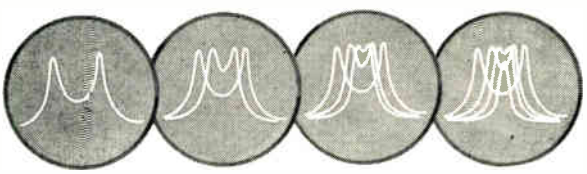
Power Switching Characteristics	
Switching Power	1000 watts
Current in "on" position	13 amperes
Input Control Power	1 watt
Power Gain	30 db
Dissipation in "on" position	8 watts
Switching time	60 microseconds

DELCO RADIO DIVISION OF GENERAL MOTORS
KOKOMO, INDIANA

Circle 39 on Inquiry Card, page 101

The oscilloscope that holds traces indefinitely

HUGHES 104 MEMO-SCOPE* OSCILLOSCOPE



SINGLE OR SUCCESSIVE writings can be retained as permanent transients by the 104 MEMO-SCOPE Oscilloscope until intentionally erased. Stored traces may be almost instantaneously erased by front panel push button or external switch.

THE 104 MEMO-SCOPE Oscilloscope is available in the portable model (illustrated in shock test application), 13″ wide, 14″ high, 20″ deep, or in rack-mounted model with standard 14″ × 19″ relay panel. Optional plug-in preamplifiers are available for increased flexibility.

TYPICAL APPLICATIONS

Study of transient electrical phenomena.
Presentation of tube or transistor characteristics without necessity of repetition.
Display of frequency response curves without the need of a repetitive sweep generator.
Spectrum analysis.
Shock testing.
Detection and measurement of relay bounce or contact noise.
High-speed or low-speed X-Y plotting.
Investigation of transient behavior of power supply regulation.
Study of camera shutter curves.

Now you can leisurely view, analyze and compare electrical phenomena lasting no longer than microseconds or minutes...without resorting to photography!

The new Hughes-developed MEMO-SCOPE instrument is a self-contained storage-type oscilloscope which combines the distinct advantage of information retention with the features of a superior quality laboratory oscilloscope.

Because of the high visibility of its brilliant displays, the MEMO-SCOPE Oscilloscope can be used in a well-lighted room without the aid of a viewing hood...where single transients or any number of successive waveforms may be studied at will and photographed as desired.
A hinged camera mount swings photographic apparatus aside for direct-display views.

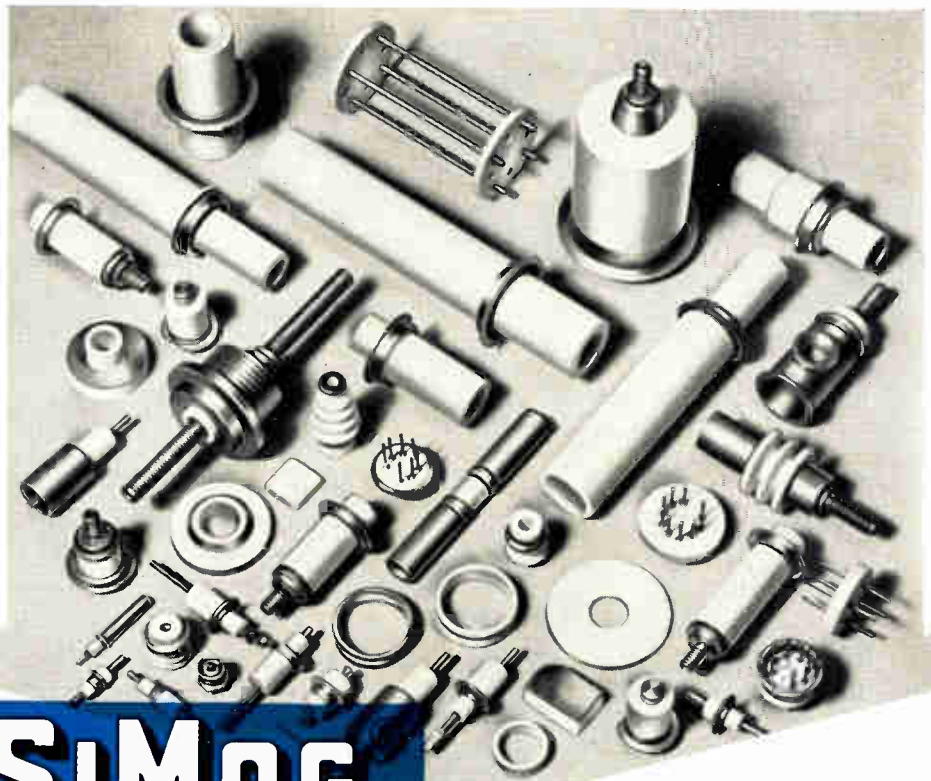
For additional information or demonstration of the new Model 104, write to HUGHES PRODUCTS • MEMO-SCOPE OSCILLOSCOPE
International Airport Station, Los Angeles 45, California

**Trademark of Hughes Aircraft Company*

HUGHES PRODUCTS

Circle 40 on Inquiry Card page 101

dependable



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Hi-Temp Hermetic Seals

Rugged, low-loss AlSiMag Alumina ceramics permanently bonded to appropriate metals to produce superior high temperature seals.

Outstanding electrical and mechanical characteristics over wider temperature and frequency ranges.

Excellent heat shock resistance. High softening temperatures. Vacuum tight. Improved glaze with superior surface resistivity. Greater impact and tensile strengths. Resistant to chipping and spalling. Precision tolerances.

Complete facilities for volume production. Uniform . . . piece to piece. Standard or custom designs. To assure optimum performance of the latter, our engineers cooperate in establishing proper specifications and configurations. Low temperature metal-ceramic combinations available.

For complete information on AlSiMag Metal-Ceramic Seals for either low or high temperature applications, send blueprint with planned installation and operating temperatures, electrical requirements or other relevant data.

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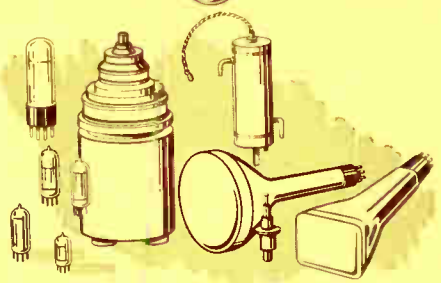
TUBE DESIGN NEWS

GENERAL ELECTRIC

RECEIVING * POWER * CATHODE RAY



7329 G-E 5-Star 6414's in IBM SAGE Computer Still Show No Opens, Shorts or Mechanical Defects after 3000 Hours Service

This huge computer, only a small part of which is illustrated, was engineered and built by IBM to serve as heart of the Semi-Automatic Ground Environment (SAGE) air defense system. G-E 5-Star 6414's in the computer had a perfect record of NO opens, shorts or mechanical defects.

No shorts, no opens, no mechanical defects . . . this is the history of 7329 5-Star 6414's that have performed in excess of 3000 hours in IBM's first XD-1 computer, engineered and manufactured for the experimental sub-sector of the USAF SAGE system.

"Out of electrical tolerance" has been the sole removal cause. In contrast: 17% of removals of another twin triode of earlier design tested in this giant computer, have been for one of the three reasons above—shorts, opens, mechanical defects—any one of which can render a tube inoperative.

General Electric's 5-Star 6414 was one of the first high-reliability tubes developed expressly for computers . . . just as G.E. previously had pioneered special tubes for commercial computers.

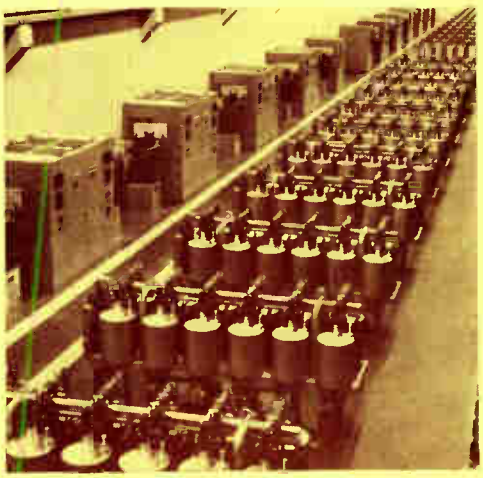
Experience not found elsewhere enters into the design, manufacture, and testing of the three General Electric 5-Star, and seven commercial computer types now available. Ask any office on the next page for further information!

Special G-E Welding Technique Makes Possible Pumpless Ignitrons with Sealed-for-Life Vacuum

General Electric pumpless ignitrons are helping industry convert a-c to d-c more economically than ever before. A continuous welding process developed by G.E. seals off the vacuum inside the tubes permanently. No pumps are needed once the tubes are installed. Doing away with vacuum pumping equipment gives cleaner installations, and leads to important savings.

One of a long series of G-E ignitron advancements, pumpless ignitrons are a General Electric "first". Today G.E. builds and offers types with the highest ratings in the field—fully able, in multiple groupings, to meet the power requirements of aluminum producers and others who are massive users of d-c.

(Continued on Page 2, Column 1)



LEFT: a continuous air-tight weld of ignitron covers to tanks is formed by rotating the big tubes in motorized jigs. RIGHT: showing a large rectifier installation of G-E pumpless ignitrons. Note the clean layout, free from vacuum pumping equipment, headers, gages, and connections. Eliminating these components saves substantially in equipment, power, and maintenance costs.

Improvements in G-E Horizontal-Amplifier Tubes Assure Full Picture Sweep, Lengthen Tube Life

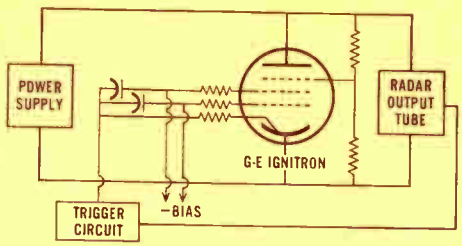
Superior sweep of G-E horizontal-amplifier tubes under low-line-voltage conditions, is demonstrated on screen at right. Large plate size and special finned or dimpled construction; advanced cathode processing; these and other features give improved performance. Tubes, moreover, are tested at factory for zero-bias plate current and plate-to-screen current ratio.

By continuously upgrading tube performance, General Electric contributes to the acceptance of today's TV sets in a market which is ever more exacting as to picture quality.

No group of G-E tubes has been improved more extensively than horizontal-amplifier types. Plate areas have been enlarged to cut plate and screen emission, causes of shrinking raster and distorted image . . . finned or dimpled plate design lessens danger of "snivets" . . . new, advanced cathode-processing techniques make for better low-line-voltage operation.

Design improvements that increase tube service life and stabilize performance include specially-processed screen grids to dissipate more heat . . . new beam plates which prevent glass deterioration from bulb bombardment . . . mica slots and mica spraying that combat inter-element leakage and arcing.

Rigid General Electric performance tests and life tests promote uniform quality for all horizontal-amplifier tubes that are built and shipped.



Trigger circuit goes into action whenever radar output tube receives an overload—actuates the ignitron, which instantly becomes a current bypass ("crowbar") in order to short out the threatened tube.

"Crowbar" Circuit Featuring G-E Ignitron Protects Radar Output Tubes From Overload Damage

Valuable use is being made of General Electric ignitrons to shield costly radar output tubes from overload damage. The ignitron is triggered to short out the tube in the event of a dangerous power surge. Such action, of course, must be virtually instantaneous—and an ignitron operates with split-second rapidity, far faster than any conventional switch.

Moreover, an ignitron will conduct current in the large amounts called for by overload protection. Type GL-6228/-506, used increasingly for this work, conducts up to 60,000 amp—yet will not fire until triggered at 65,000 v. This high hold-off voltage assures that normal variations in power will not cause circuit interruptions.

For low-power radar and broadcast stations, General Electric's GL-5630 Ignitron is a more economical, and equally popular, "crowbar-tube" investment.

Pumpless General Electric Rectifier Ignitrons

(Continued from Page 1)

A typical grouping of twelve General Electric 20-inch pumpless ignitrons, for example, will furnish up to 5000 kw of d-c power at 850 v. See the listing of 20-inch and 16-inch sizes under "New Tube-Product Briefs" at right. Consult further with any General Electric office below.

NEW TUBE-PRODUCT BRIEFS

Receiving Tubes

25EC6. New G-E beam power pentode for TV. Horizontal sweep type for 110-degree-deflection picture tubes. High performance at low line voltages. Physically shorter than 25CD6-GB, and has controlled heater warm-up for 600-ma series-string circuits.

Power Tubes

GL-6963, GL-6964. New General Electric 16-inch pumpless ignitrons for power rectification. Single-grid and double-grid respectively. Sealed-for-life vacuum.

GL-6965, GL-6966. New G-E 20-inch pumpless ignitrons, for power-rectification service. Single-grid and double-grid, with sealed-for-life vacuum.

Cathode-Ray Tubes

3ACP1, 3ACP7, 3ACP11. New G-E 3-inch flat-face C-R types for radar and oscilloscope applications. Electrostatic deflection and focus. Post-acceleration gives maximum deflection sensitivity with a high degree of brightness. Deflection structure is electrostatically shielded—this improves beam accuracy and minimizes interaction.

EASTERN REGION
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(N.Y.C.) WIsconsin 7-4065, 6, 7, 8

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General Electric Company, Tube Sales
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Chicago 41, Ill.
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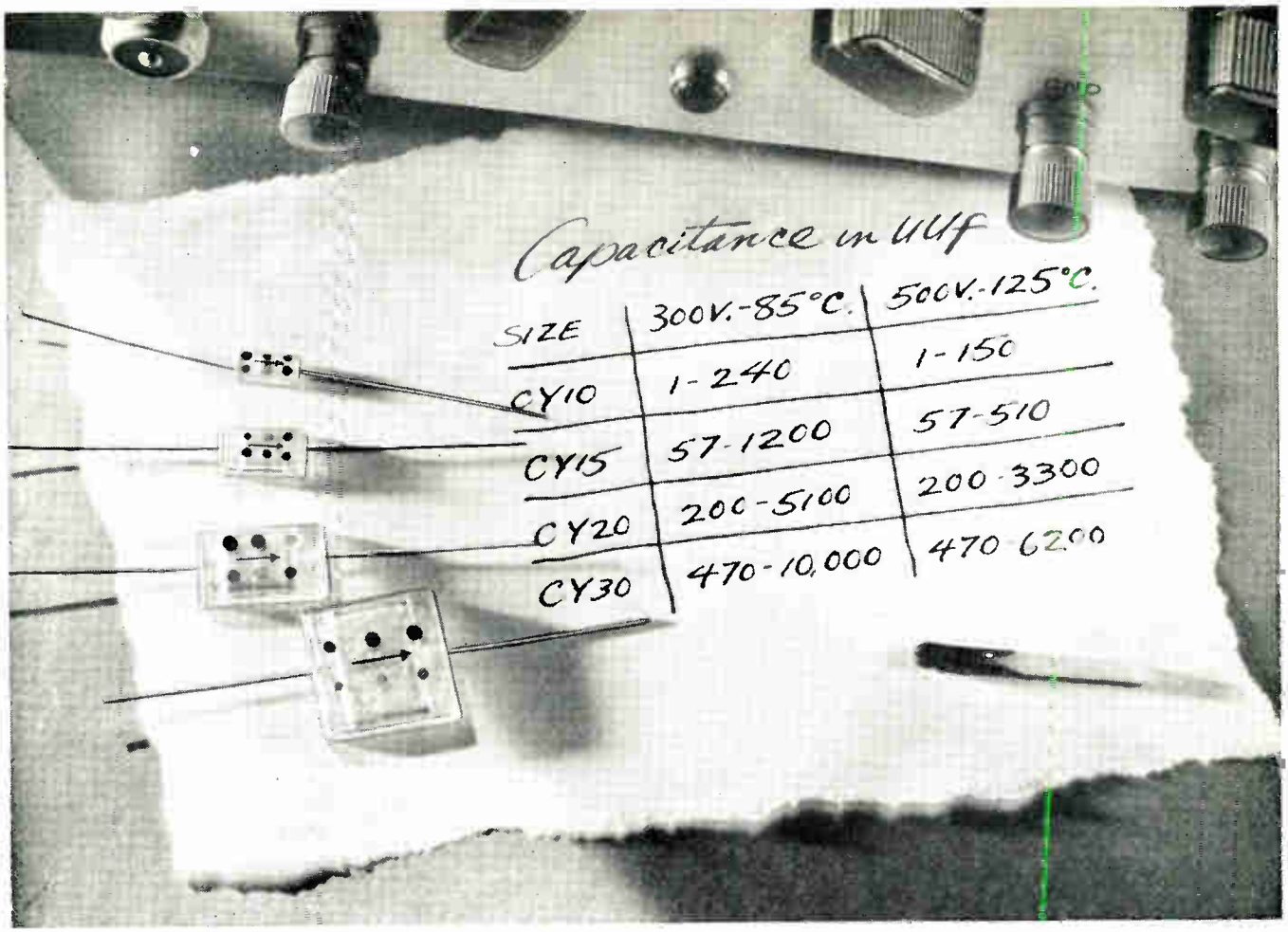
162-1C5

ELECTRONIC COMPONENTS DIVISION, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.



uuf for *uuf*, the smallest, most stable, fixed capacitors you can buy—Here's why...

These are *glass* capacitors—probably as much as one-third smaller than those you're used to; certainly much lighter.

Though made with glass, they are *not* fragile. In fact, the layers of glass dielectric, the metal foil plates and the leads are fused into a surprisingly rugged, inseparable unit.

This unusual construction, developed at Corning offers you these advantages:

Small size, light weight. If you're at work on guided missiles, fire controls, computors, and similar devices, you can cut valuable ounces and inches from your assemblies with these capacitors. See table above for some indications.

Exceptional stability. After a load life test at 50% more than rated voltage at 85° C., the average change in capacitance of these units is less than 0.4% after 1,000 hours, less than 0.6% after 10,000 hours.

Very low drift. This drift is so slight that it's generally within the normal error of measurement. Taking MIL-C-11272A as a standard, capacitance drift is less than 0.1% or 0.1 *uuf* (whichever is greater).

Predictable, retraceable TC. The difference in TC between any units at any given temperature is less than 15 ppm/° C. It is well within the limits of 140 ± 25 ppm/° C. from −55° C. to +85° C. and referred to 25° C.

Low loss. Even at elevated temperatures, the dielectric loss is relatively low. Dissipation factor at 1 kc. and 25° C. is about 0.055% and independent of capacitance.

Capacitance in uuf

Size	300 V. —85° C.	500 V. —125° C.
CY10	1-240	1-150
CY15	57-1200	57-510
CY20	200-5100	200-3300
CY30	470-10,000	470-6200

Bulletin shows performance charts. Bulletin CD-1.00 contains charts and other data on these capacitors. Circle this magazine's service card for a copy or write us direct at Corning.

Ask for information on these other Corning Capacitors:

Medium Power Transmitting—CY60 and CY70. Ideal for mobile RF transmitters.

Canned High Capacitance—Provide the advantages of rugged glass design to your specifications.

Subminiature Tab-Lead—Up to 90% less volume compared to pigtail types. To your specifications.

Special Combinations—The performance and benefits of glass in infinite shapes, sizes and leads. To custom order.

Other electronic products by Corning Components Department: Glass Film Type Resistors*, LP, LPI, H, R, N, S, HP and Water Cooled Styles. Direct Traverse and Midget Rotary Trimmer Capacitors*. Metallized Glass Inductances, Delayline Coil Forms, Bushings, Enclosure Tubes, Rectifier Tubes and Attenuator Plates. **Distributed by Erie Resistor Corporation*

Corning means research in Glass

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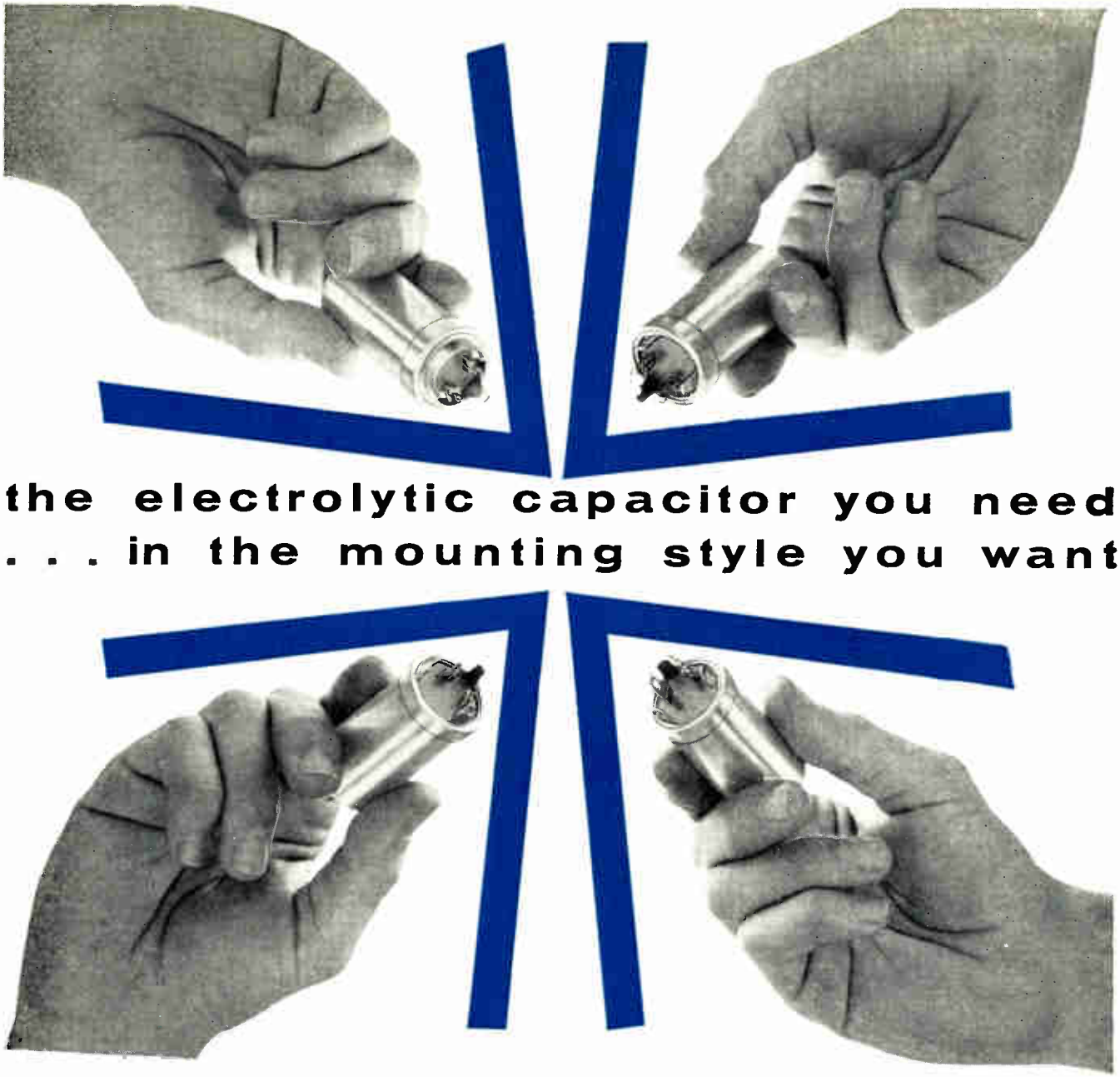
Electronic Components Department



the electrolytic capacitor you need . . . in the mounting style you want

You can get Sprague self-mounting electrolytic capacitors in every one of the four standard combinations of terminals and mounting rings.

The Sprague DFP series of electrolytics includes not only the time-tested Type 25D Twist-Lok® design, but also three new styles intended for printed wiring boards—the Type 28D Push-Lok★ with its snap-action mounting lugs and circular ground ring, the Type 26D snap-action terminal design, and the Type 27D with terminals designed for wire-wrap production wiring techniques.

You will find the complete story on these dependable capacitors for entertainment electronics and allied applications in a new Sprague Engineering Bulletin. Write for your copy today to Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

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

★Trademark

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TRANSISTORS • INTERFERENCE FILTERS • HIGH TEMPERATURE
MAGNET WIRE • PULSE NETWORKS • PRINTED CIRCUITS

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ELECTRONIC INDUSTRIES
& TELE-TECH

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

Microwaves and U. S. Growth

The news that the Federal Communications Commission will soon be re-examining frequency allocations in the 25-890 Mc band as well as those above 890 Mc is extremely important. Such a review has not been conducted since 1944. In the light of technical progress made since that time, this action affords an opportunity to arrange for more efficient utilization of the spectrum. We commend Commissioner Craven on his review suggestion.

We think this also would be an appropriate time to review the FCC ruling which forces the use of common carrier facilities instead of permitting the use of privately-owned *beamed* microwave systems. It is fully understood that common carrier facilities are needed in communication as in other fields by the general public.

In recent years this ruling has caused considerable unfavorable comment throughout the industry largely because toll costs to the user turn out to be considerably higher than amortizing a privately owned system and because the common carrier facilities available often are much more restrictive.

The present FCC ruling tends to prevent wasteful use of precious frequencies and to minimize interference from too many stations on the air. On the other hand the policy tends to hamper national industrial growth.

As business organizations expand throughout the country their internal communications problems expand with them . . . and these problems are not always readily solvable by the available common carrier facilities. Today, aside from telephone, telegraph and teletype communications, organizations may also have need for closed circuit TV and/or data transmission systems.

Privately owned microwave relay systems will handle all these services for an owner simply through the purchase of additional terminal equipment. Interference problems are greatly reduced because of the narrow beam used in transmitting microwave frequencies from point to point. Privately owned equipment can be readily amortized and hence offers important economic advantages to the user.

We believe this issue to be a matter of degree. We also believe that there is enough at stake in the way of national industrial growth and in the best interests of all to warrant a further review of FCC ruling in this connection.

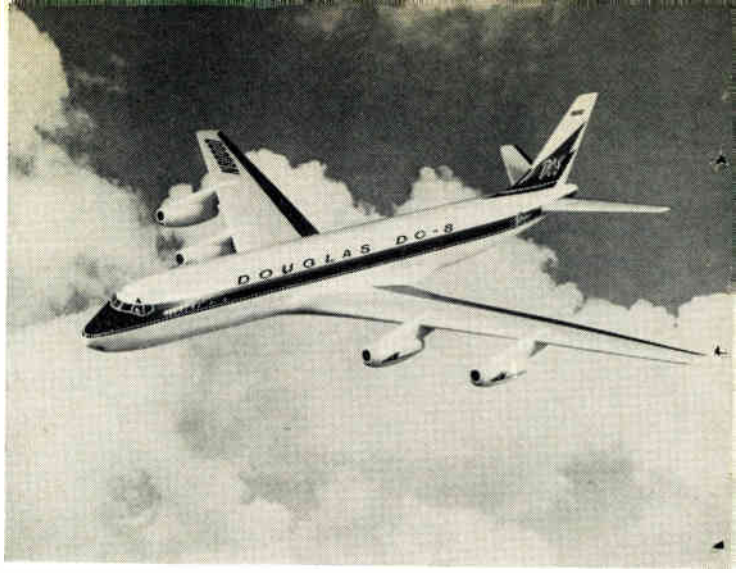
Automatic Broadcasting

The new trend in broadcasting is toward automatic station operation. Over one third of our radio stations are using some form of automation right now. The FCC so far has approved this mode of operation only for stations of less than 10KW and employing non-directional antennas.

Modern transmitters are now designed for remote operation. Tedious recording of data, such as meter readings, radio currents fed to various elements of a directive antenna system, plate input power can now be taken over by automatic recording equipment. Studio programming can be made semi or completely automatic as desired.

What about the level of the audio fed to the transmitter? There is coming into use, with the peak limiting amplifier, a constant level or "average" limiting amplifier which is effective in providing a full level of modulation.

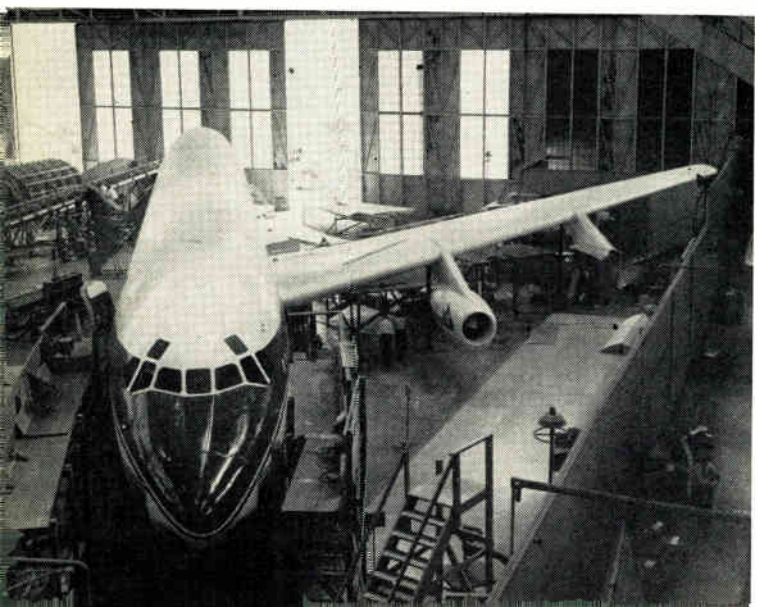
We do not have the approval of FCC for automatic operation of high power directional stations, but the data is being accumulated and it is hoped by NARTB, manufacturers, and broadcasters that approval is not far away. The turning over of manual operations to electronic robots will release highly trained personnel for better jobs in work requiring decisions.



A new high voltage power plant and streamlined wiring are the highlights of the redesigning job done by Douglas engineers.

DC-8 Sets New Electronic Style

By JOHN E. HICKEY, JR.
Assistant Editor
ELECTRONIC INDUSTRIES & Tele-Tech



WHEN the Douglas Aircraft Company went into the planning stages of their first commercial jet airliner, the DC-8, they were faced with many electronic problems. An aircraft flying at better than 600 mph revives problems which were thought once to have been adequately solved. These deal with interconnecting methods, equipment weight, ease of servicing and antenna drag and location.

New Type Power Plant

Basic to the whole problem was the choice of a power plant. For many years the 28 v. system has been a fixture in commercial airliners, but its use has put a heavy burden on other components of electronic equipment, notably on connectors, wiring and power supplies. After much deliberation, the DC-8 designers decided on a 115/200 v., 3 phase, 400 cps system that provides a great deal of flexibility and significant economies in components. The use of four 20 kva constant frequency generators meant that more than 90% of the electrical circuits would require less than 10 amperes for operation.

With the use of a higher voltage and lower current, it then became possible to reduce the size of wire and connectors. However the smallest contact size in the AN series of connectors is rated at 20 amperes. Such large, heavy connectors could hardly be considered for the DC-8 so a survey was initiated to find environment-free miniature aircraft connectors with contacts rated at 10 amps or less. None were found to exist.

Even at the earliest stages of this planning, the Douglas engineers sensed that the changes they were incorporatng in the DC-8, particularly the trend to

higher-voltage, lower-current operation, might very well be eventually adopted by the aircraft industry as a whole. This greatly influenced the approach that was taken on the connector problem.

Connector Development

In the usual procedure the prime contractor—here it was Douglas—would write the design specification and prepare outline control drawings, and throw the contract open to bidding. In this case, however, Douglas felt that the industry-wide significance of a new connector design, coupled with the high potential sales if the design was adopted, called for direct development by the connector manufacturer, at the manufacturer's own expense. Douglas would draw up the requirements and from there on the responsibility would be the connector manufacturer's, except the testing, which of course, would be done by Douglas also.

All the connector manufacturers commented favorably on the requirements set down by Douglas and all expressed a desire to develop a connector for the DC-8. But only one, the Deutsch Co. of Los Angeles, was willing to undertake the development and tooling program on their own capital. The connector which is described here is their product. Two additional firms have since delivered prototypes to Douglas, but their design has not had final approval.

The specifications which Douglas laid down for the connector were:

1. Quick disconnect
2. Positive lock without safety wiring
3. Coupling seal before lock
4. Visually inspectable for correct assembly and installation
5. Moisture seal
6. Vibration dampener
7. Corrosion resistant
8. Operation up to 250 degrees fahrenheit
9. Unaffected by altitude pressure variations
10. Wire comb
11. Wire support
12. Continuous dielectric separation—no voids
13. Closed entry contacts to accommodate AN wire guage 22 through 18.
14. No wet process involved
15. Good serviceability
16. Elimination of soldered connections (provision for taper terminations)
17. All of the components necessary for complete assembly delivered in a clear, sealed, dated package
18. Non-conducting exterior surface
19. Operating force always in direction of plug travel
20. Coupling and/or contact seal before electrical contact
21. Multiple insert "clocking".

Connectors meeting these specifications would be exceptionally useful for many reasons. They would cut down on installation time, afford savings in weight and space, make equipment more easily serviced, reduce shock hazards and increase equipment reliability.

The space reduction is due to a greater number of terminations per area. The connectors would be small

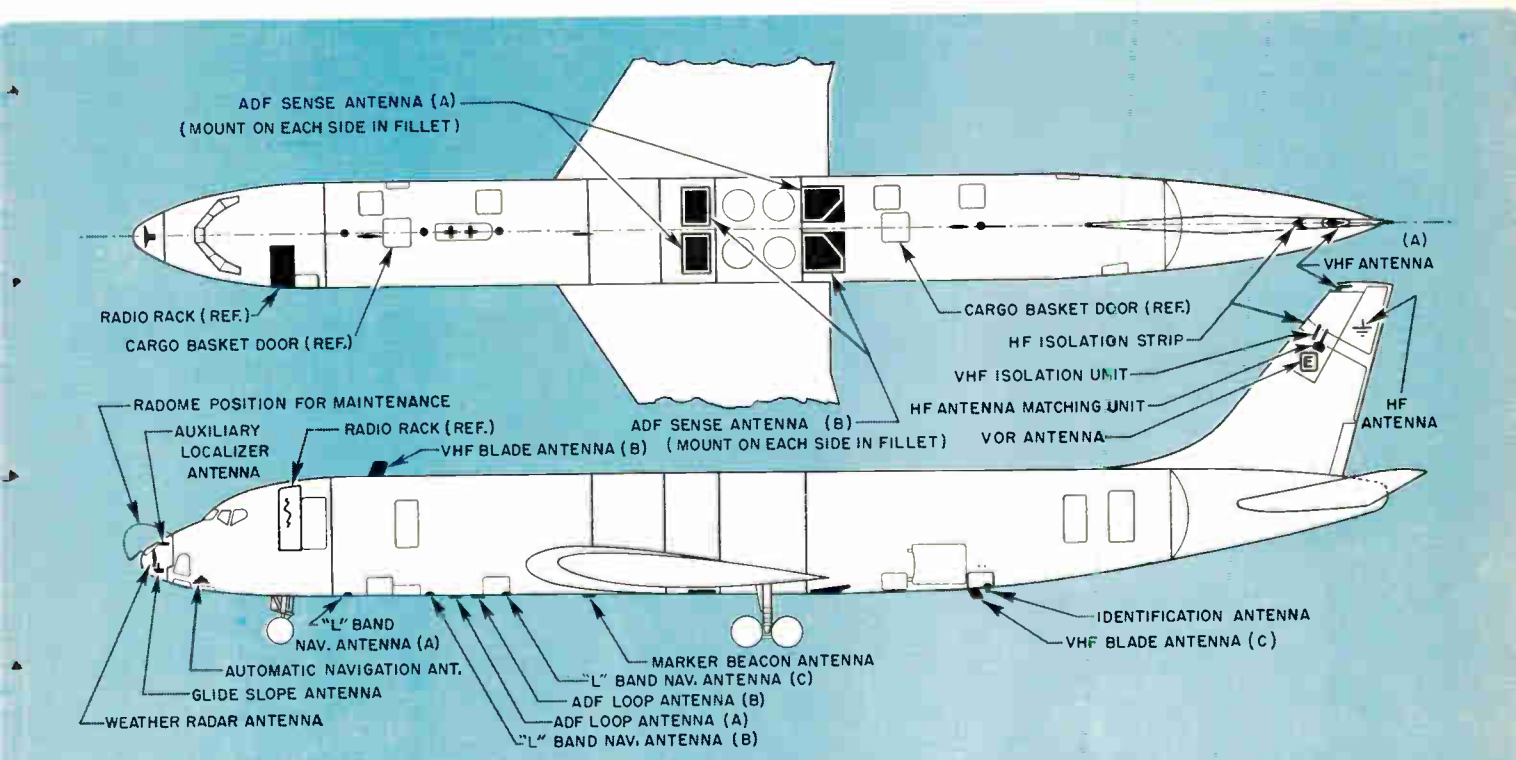


Fig. 1: The locations of the antennas are shown. Most of the antennas are flush mounted. Note that the tail cap is insulated from the air frame.

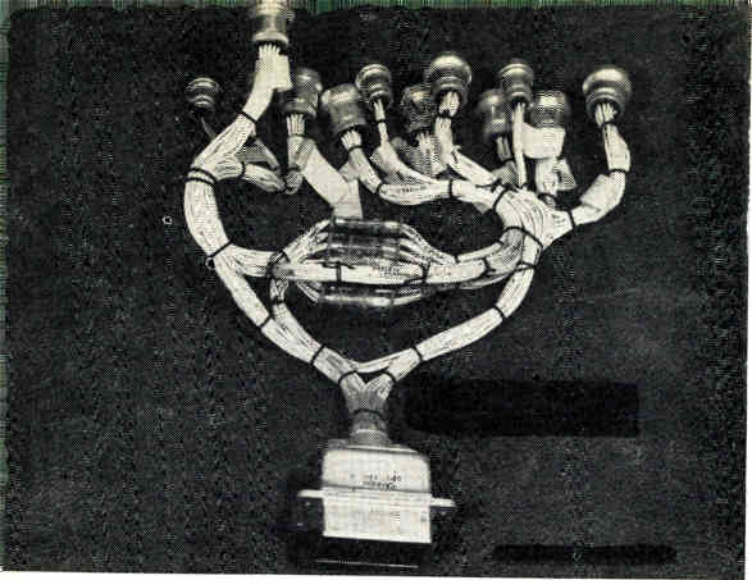


Fig. 2: A typical VOR interconnecting assembly

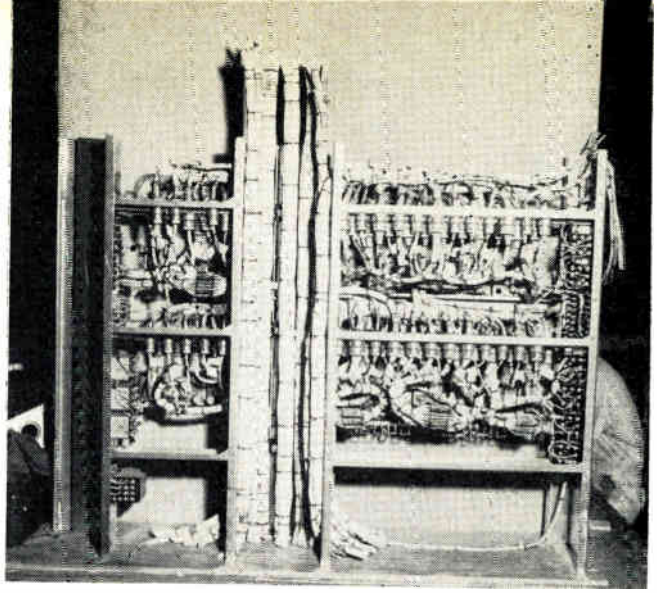


Fig. 3: A temporary mock-up shows use of connectors

DC-8 Avionics *(Continued)*

enough to accommodate more connections per unit area than a terminal strip and therefore provide a tremendous weight saving. Second to reliability, weight saving is always uppermost in an aircraft engineer's mind. It has been estimated that a weight reduction of 10 pounds on a weight-restricted trans-Atlantic flight would be worth $7,000 a year to an airline.

Eliminating Down-Time

Making servicing easier means less down-time for the aircraft. Servicing personnel merely have to disconnect the plug rather than disconnect wires from terminal boards. This saves time in replacing defective units and also eliminates any possible wiring errors. The use of wires and connectors would also facilitate bench testing.

Since voltages in excess of 50 v. can be a personnel hazard every precaution must be taken to keep exposed hot conductors to a minimum. Terminal strips are at a decided disadvantage when compared to environment-free connectors, since they have to be covered during operation. Furthermore, during maintenance checks on an energized system, the covers would be removed, exposing the maintenance personnel to hazards of unprotected conductors. These connectors would insure an environment-free installation.

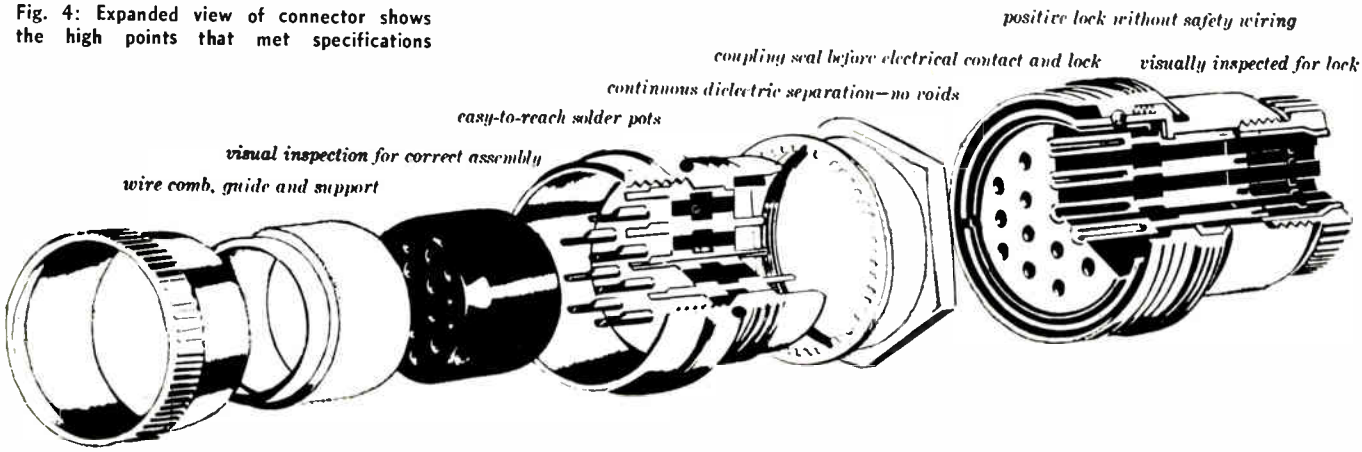
Terminal boards are subject to short circuits from loose metallic objects such as washers, nuts, shavings, etc. The connectors on the other hand are corrosion resistant to water, fuels, oils, and other liquids; they are sealed from moisture caused by condensation due to rapid descent; they are temperature resistant to 250°F and may be pressure sealed for altitudes to 60,000 feet without electrical property effects and have positive locking mechanisms. The electrical contacts are sealed from possible volatile gases, hence they eliminate possible explosions while fueling.

Conducting Connector Tests

At Douglas, tests were begun on the miniature electrical connectors received, to determine whether they met the requirements of high speed, high altitude, ac system aircraft. A modified AN class E connector was used as a control to compare the miniature connector performance with that of an existing AN type environment-free electrical connector. The paragraph designations in parenthesis are from MIL-C-5015B for reference purposes.

1. *Contact Engagement and Separation Forces* (4.5.14)—The force, in ounces, required to either engage or separate pins and sockets was measured on a sample lot of 25 mated contacts. The contact force was determined with sockets both in and out of the insert.

Fig. 4: Expanded view of connector shows the high points that met specifications



2. *Resistance of Contacts* (4.5.7) — The electrical resistance of each pair of contacts, mated, was determined by measuring the potential drop in mv. across the assembled contacts while carrying 5a. at an ambient temperature of 60°F to 80°F. Test was repeated using 10 a. and the temperature rise recorded after stabilization.
3. *High Potential* (4.5.2)—Voltage was gradually applied to the connectors at the rate of approximately 500 v. each second between the two closest contacts and between the shell and the contacts closest to the shell, stopping for one minute intervals at 1000, 2000 and 2800 volts. Any voltage which caused breakdown before reaching 2800 v. was recorded.
4. *Insulation Resistance* (4.5.8)—The insulation resistance of the connectors was measured between the two closest contacts and between the shell and the contacts closest to the shell. Measurements were made using 1000 v. and an electrification time not exceeding 2 minutes. The tests were conducted at 60°F to 80°F.
5. *Durability* (4.5.12)—The connectors used for the Resistance of Contacts Test were subjected to 500 cycles of insertion and withdrawal similar to that which they would encounter in service at a rate not exceeding 600 cycles per hour. After each 100 cycles the connectors were inspected. After 500 cycles, the plugs and receptacles were examined for evidence of defects and given the Resistance of Contacts Test.
6. *Contamination*—a. Tap water was poured over the mating end of the plugs and receptacles. They were then shaken dry by hand, the plug and receptacle mated and again subjected to the High Potential Test.
   b. Same as "a" except aircraft wash down water drippings were used.
   c. The face of the socket contact insert was wiped with a rag soaked in used engine oil and wrung dry, thus leaving a light film of oil on the insert surface. The plug and receptacle were mated and the connector assembly again subjected to the High Potential Test.
7. *Altitude, Temperature and Humidity* (4.5.3) — a. Connectors were placed in an environmental chamber and subjected to 6 cycles of various environmental sequences. Alternate rows of contacts, including both outer rows, were conducting 1000 volts RMS and the other rows and the shell were grounded. Care was taken to seal the ends of the wires outside the chamber to prevent breathing through the conductor. Any breakdown or arc-over was recorded.
   b. The environmental sequences were repeated for an additional 6 cycles after removing certain wires and placing nylon sealing plugs in the vacated grommet holes. All nylon plugs were symmetrically distributed in the outer ring of grommet holes. The wire attached to some of the plug specimens had a ¼ in. of insulation stripped off in the area either inside or outside of the environmental chamber. The purpose of this was to determine if allowing atmosphere to breathe through the conductor effected the connectors' performance.
8. *Vibration* (4.5.10 and 4.5.20) — Connectors were subjected to vibration according to Procedure II of Specification MIL-E-5272A. All connector contacts were conducting 100 ma. during every phase of the vibration tests and any evidence of reduced contact pressure, contact opening or physical damage was recorded.
9. *Corrosion* (4.5.6)—Connectors were subjected to salt spray corrosion in accordance with the procedure defined in MIL-E-5272A with one exception: The duration of the test was increased from 50 hrs to 1000 hrs. The coupling mechanism was operated every 24 hours and any visual or operational deficiencies recorded.
10. *Dirt and Mud Impregnation* — Connectors were subjected to the following sequence of environmental conditions. The coupling mechanism was checked for deficiencies following each condition.
    a. Connectors submerged in MIL-L-7808 jet engine oil at 150°F for 6 hours.
    b. They were placed in the dirt collecting chamber of a vacuum cleaner and device operated until full.
    c. Connectors were placed in a bucket of mud and agitated to work the mud into the coupling mechanism.
    d. Connectors were baked in an oven at 150°F for 3 days until the mud in the coupling mechanism was completely dried.

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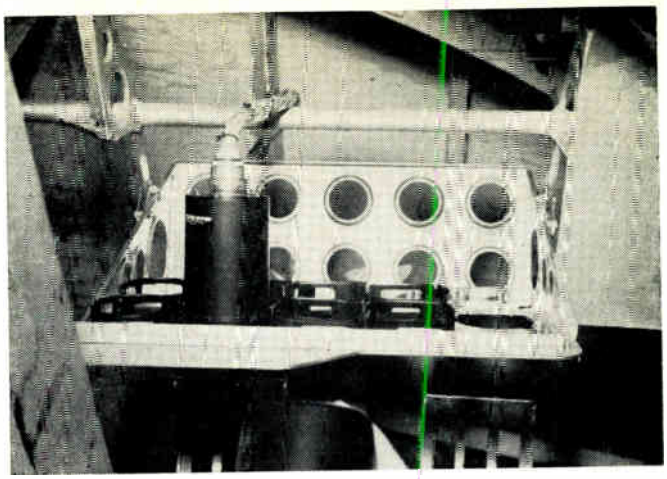


Fig. 5: Mock-up shows how easily instruments may be removed

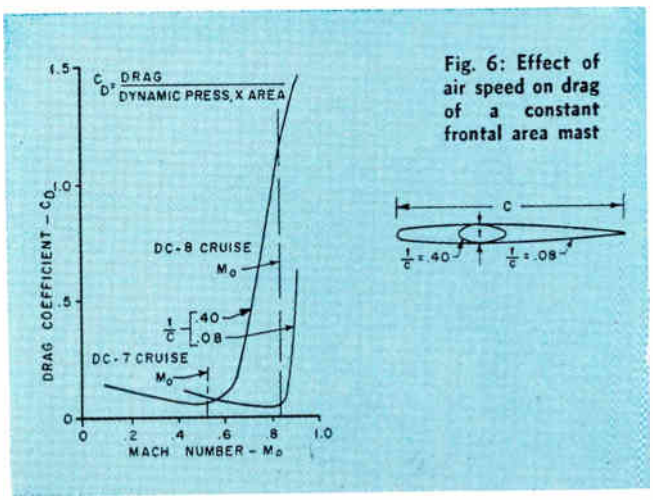


Fig. 6: Effect of air speed on drag of a constant frontal area mast

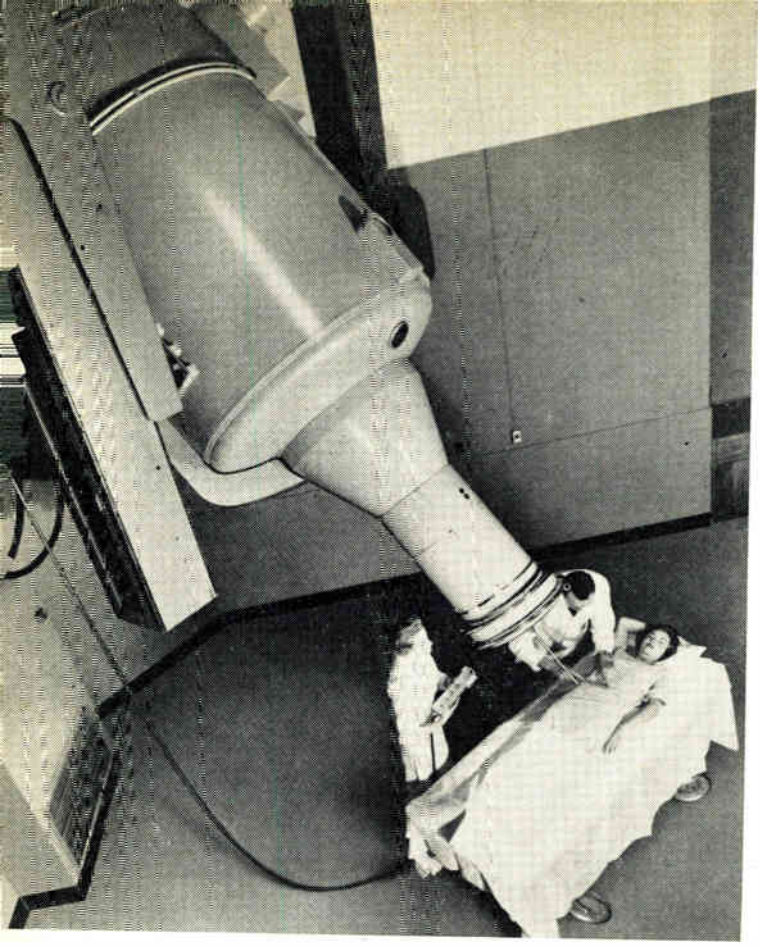


Fig. 1: A General Electric 2-million volt therapy unit installation.

Research is being directed primarily toward diagnostic tools, with all the body processes being examined for conversion into electrical analogs.

By RICHARD G. STRANIX
Assistant Editor
ELECTRONIC INDUSTRIES & Tele-Tech

What Electronics is Doing

A FEW months ago the Institute of Radio Engineers went out of its way to upset one of its longest standing traditions. For the first time memberships in the Professional Groups were thrown open to individuals not members of IRE. The move had one express purpose, to attract medical doctors into the PG on Medical Electronics.

The field of medical electronics is today at a very curious stage. Interest in the subject is very high. The IRE Professional Group alone numbers approximately 1600 members and its counterpart in the AIEE is also well-attended. Additional bio-physics groups in the fields of biology and medicine, including a council under the American Medical Assoc., bring the total of active members to approximately 5000. And this figure does not include the various activities being carried on in universities around the country.

But despite this high level of interest from educators, physicians and engineers, medical electronics faces a rather slim existence for some years to come.

Fig. 2: Three types of phonocatheters which are used for acoustic mapping within heart.

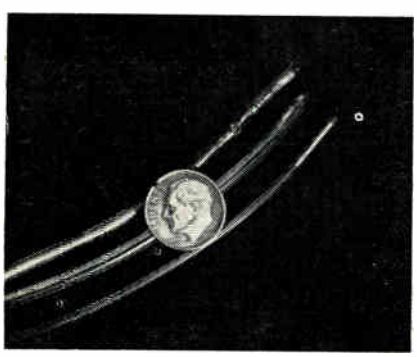


Fig. 3: Electronic auscultation now provides selective amplification of faint heart beats.

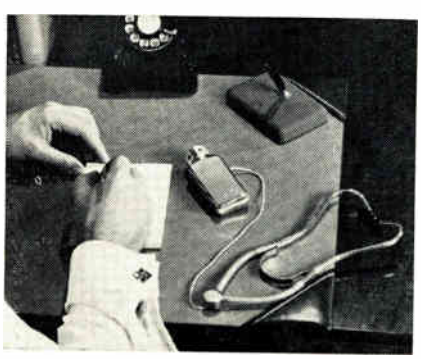
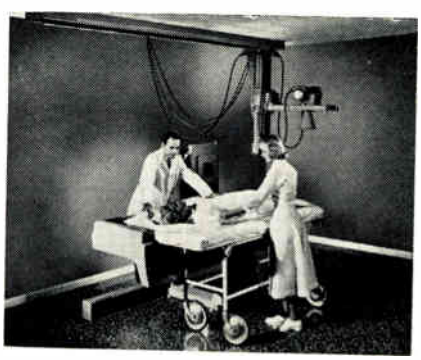


Fig. 4: New diagnostic X-ray unit supplies full-range performance for a min. investment.



The reason is simple—money. Where electronic manufacturers talk in terms of thousands of pieces of equipment, the medical circles talk in terms of hundreds, sometimes dozens. When Dr. George Z. Williams, Chief of the Clinical Pathology Dept., National Institutes of Health (N.I.H.), Bethesda, Md., approached R.C.A. some time ago on the possibility of manufacturing a special vidicon sensitive to ultraviolet light, R.C.A. asked in turn how soon they could expect to get back their initial investment. A year? two years? three years? They are producing the tube now, and they estimate that it will be close to five years. Few firms can afford such an unattractive business investment.

In every phase of medical electronics the story is the same. Research is limited to the largest laboratories, the best equipped universities, the most prosperous industrial firms, and, perhaps naturally—since there is little private capital available—the government.

The Rockefeller Institute, New York 21, N. Y., another pioneer in the field, has just announced the development of the "radio pill," a FM transmitter capsule which can be used in the study of gastrointestinal disorders. See Figs. 6 & 10.

The Job Ahead

A great missionary task lies ahead for those already active in the field. The interest of the physician, who presently is not sure whether these new developments fall within his domain or not, must be aroused. Beyond this, the electronics engineer must be impressed with the importance of this new field, for although he is probably more inclined to be interested, he is sorely uninformed of the potentialities of the medical field.

for Medicine . . .

It is interesting to note that there are as many branches in medicine as in electronics. If the branches of medicine were plotted as the ordinate and electronic branches as abscissa, and each area of joint activity was indicated, we would have, not a curve, but an almost completely darkened area. The transmission line specialist could be working with the pathologist, neurologist, and bacteriologist. Though these coordinated groups may be small, they do none the less indicate definite activity.

Large concerns in the industry must be encouraged to continue research on suitable advanced instrumentation. This will entail quite a job of selling because the program is of necessity long range—a long period before profits can be realized. It is hoped that the smaller companies will be imbued with the research spirit when the field is a little more established.

A strong program exists to have colleges arrange their curricula to include a combined medical, or biological, and electronic background for engineers. As yet, this program has not been too successful. However, it will eventually succeed because the government is showing a very strong interest.

In much the same manner as nucleonics mushroomed, so now is medical electronics. We are all familiar with the way in which electronic engineers were recruited for the former field. It is anticipated that there will be as great, if not a greater, demand in the newer field . . . but, admission will be permitted only to those who have a supplementary background in medicine or biology.

Already Accepted

Electronics, of course, is not completely new to the field of medicine. X-ray equipment has long been standard in even the general practitioner's office, and the electrocardiograph is rapidly becoming equally familiar. The present research is pointed in the same direction, toward devices that will provide quick and certain indications of body conditions, particularly for the diagnostician. Scientists working in the field believe that, with the proper transducers and equipment, all of the body processes are capable of being translated into electrical analogs.

In the case of the neurologist, he is already working

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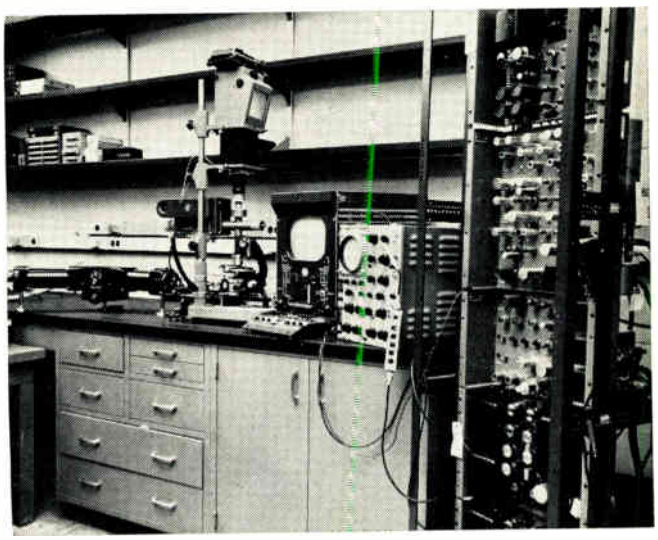

Fig. 5 (above): U-V light source, quartz microscope, u-v sensitive vidicon, and closed-circuit TV monitor enables study of living cells.

Fig. 6 (below): Dr. Zworykin (left), Rockefeller Inst. & Dr. Farrar, N. Y. VA Hosp., demonstrate the "radio pill," an FM xmtr which passes through the intestinal tract and broadcasts pressure changes.

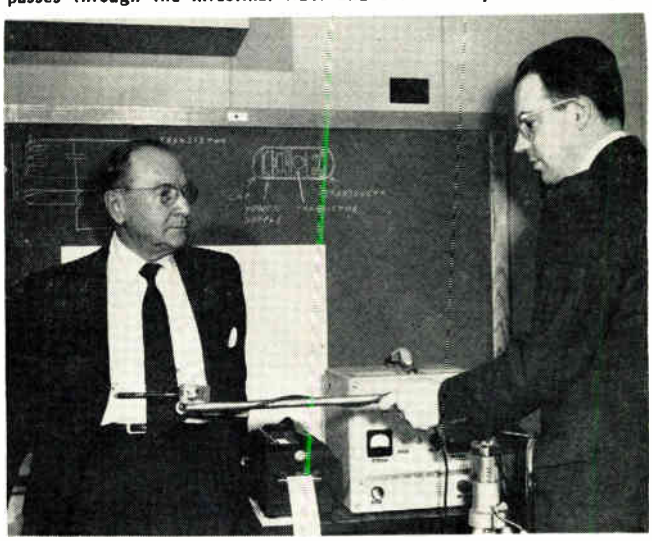

Fig. 1: A record of the aircraft's landing shock, traced on a transparent screen, is set on the drum of the function generator.

Shock Design

An analog computer can be used to help select isolator characteristics for different applications involving shock or vibration. Recordings of actual environmental conditions drive an analog function generator for the analysis.

By CHARLES E. CREDE

Vice President
Barry Controls Inc.
Watertown, Mass.

C. E. Crede

GOVERNMENT specifications play an important role in evaluating the suitability of vibration and shock isolators for conventional applications. Where unusual environmental conditions exist or a particular result is desired, a procedure to predict the performance of the isolators is useful. If the environment is characterized by shock or irregular vibration, it is not possible to define the environment by numerical parameters. A time history of some physical characteristic, inscribed on any oscillogram or magnetic tape, is then needed. It is possible to determine optimum isolator characteristics in a rational manner using the procedure described below.

The System

The system being investigated is shown by the schematic diagram in Fig. 2a where x indicates the displacement of the airframe structure and y indicates the displacement of an equipment of mass m attached to the airframe. The stiffness k and damping coefficient c define the physical characteristics of the isolator. The differential equation of motion of the mass m is written as follows:

$$my'' = c\,(x' - y') + k\,(x - y) \qquad (1)$$

Letting the relative motion of y with respect to x be represented by a new variable $\delta = x - y$, equation (1) is rewritten as follows:

$$mx'' = m\,\delta'' + c\,\delta' + k\,\delta \qquad (2)$$

Block Diagram

Equation (2) may be expressed in block diagram form as shown in Fig. 2b. In this figure, the blocks indicated by J perform the operation of integration, those indicated by C perform the operation of multiplication by a constant given in parentheses below the block, and those indicated by A perform the operation of addition of several quantities. All operations take place in the direction indicated by the arrows. The environment is defined by x'' which is, in effect, multiplied by the coefficient m to obtain the input mx'' to the analog computer. The output my'' is converted to the desired response acceleration y'' by dividing by the constant m used initially to convert x'' to mx''.

Electrical Analogy

The electrical analogy method consists of employing electrical quantities corresponding to the variable terms in Eq. (2), and performing the indicated integration, multiplication, or addition of these electrical quantities in the order indicated by the block diagram of Fig. 2b. The input to the computer is a voltage proportional to x'', the excitation acceleration. Where x'' is an irregular function and is described by a trace on an oscillogram, a special function generator which generates a voltage proportional to the ordinate on the acceleration-time diagram is used to obtain the required voltage.

A schematic view of the function generator is shown in Fig. 3. It is comprised basically of an oscilloscope, a transparent drum on a turn table, and a photo multiplier tube. The record which is being studied must be traced with a heavy dark line on transparent material and then attached to the transparent drum. The record is rotated in front of the oscilloscope screen, and the photo multiplier tube causes the beam of the cathode ray tube to follow the dark line of the record as it is rotated in front of the tube. Fig. 1 is a photograph of the analog computer and function generator.

Example

The method of determining optimum characteristics of isolators is illustrated by the following example: Assume that it is desired to find the isolators best suited for protecting equipment during the landing of a P-80 fighter aircraft. This example is chosen solely because adequate oscillograms are available to define the landing shock and serve as an example. The same technique has been successfully applied to the selection of isolator characteristics to protect equipment against the shock created by gunfire on a B-47.

Acceleration

A record of acceleration as a function of time, as measured in a P-80 aircraft, is shown by the lower oscillograms in Fig. 4. The upper oscillograms show the response of damped, linear single-degree-of-freedom systems to the landing shock shown in the lower oscillograms, as obtained by electrical analogy. The ordinate parameter on each oscillogram is acceleration while the abscissa parameter is time. If the damping in the system is small, the response acceleration becomes directly proportional to the deflection of the isolator for any given natural frequency. This assumes that the force transmitted by the damper is negligible, a reasonable approximation for the small degrees of damping being considered here.

Damping

In classical mechanics, damping is generally assumed to be viscous and the damping of any system is defined in terms of a critically damped system. That is, a system whose damping is 10% of critical damping is said to have a damping ratio of 0.1. Such a system has a transmissibility at resonance of approximately five under conditions of steady-state vibration. An alternate method of defining the damping is to designate the transmissibility at resonance. Using

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Fig. 2: A schematic representation of the vibration isolation system.

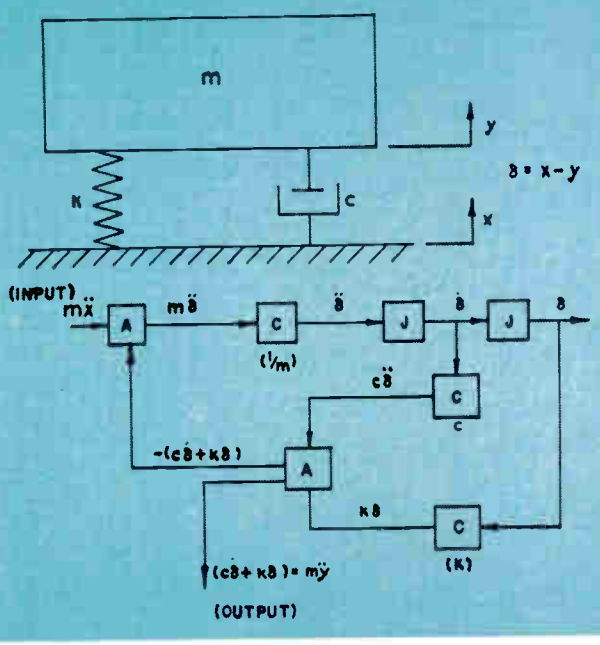
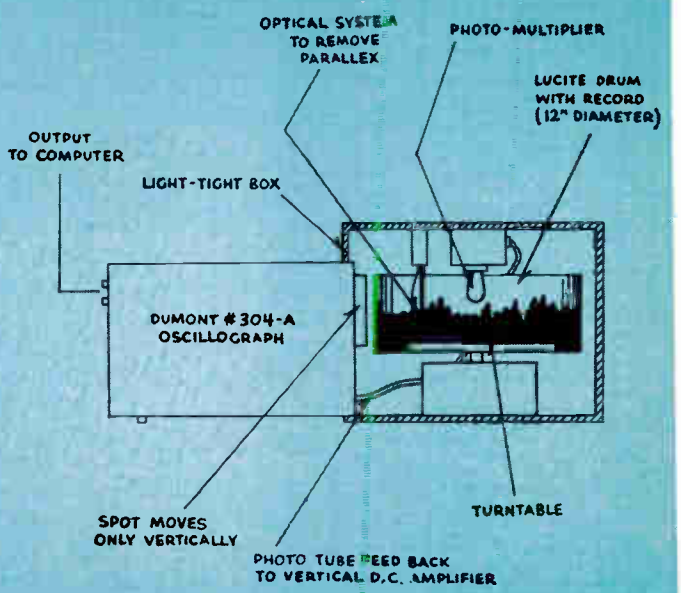


Fig. 3: Schematic view of the function generator.



Calculating R-C Amplifier Supply Voltages

The trial and error method is eliminated by assuming that the tube "constants" are actually constants and that the input signal always swings the tube from cutoff to zero grid-to-cathode voltage

By SID DEUTSCH

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Part One of Two Parts

THIS article is concerned with the calculation of resistance-coupled amplifier supply voltages. For the most general case, a non-sinusoidal input signal is applied to the amplifier grid and capacitively-coupled outputs are taken from both the plate and cathode terminals.

For a triode, it is desired to find the fixed bias and plate voltage supplies such that the input signal will swing the tube from cutoff to the zero grid-to-cathode voltage condition.

For a pentode, it is desired to find the screen voltage supply in addition to the fixed bias and plate voltage supplies. If the stage employs cathode bias instead of fixed bias, it is desired to find the cathode resistor value.

The conventional method of design involves the construction of load lines on the E_{pk}-i_p characteristic curves of the tube. The construction can become quite involved when capacitively-coupled outputs are taken from both the plate and cathode terminals. In addition, prior assumptions must be made regarding the quiescent bias, screen, and plate voltages.

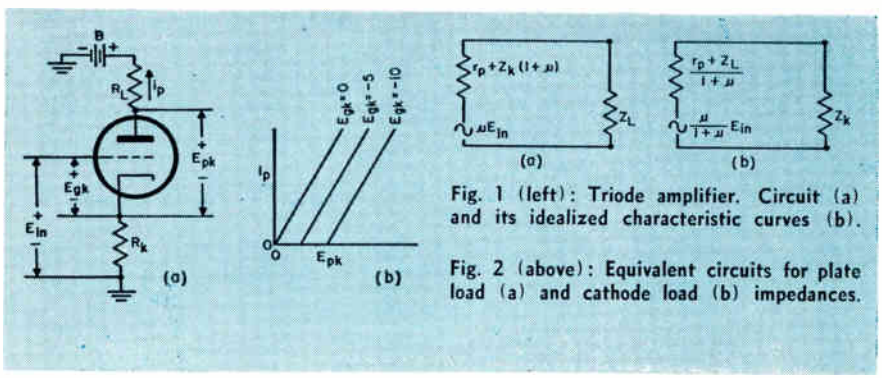

Fig. 1 (left): Triode amplifier. Circuit (a) and its idealized characteristic curves (b).

Fig. 2 (above): Equivalent circuits for plate load (a) and cathode load (b) impedances.

In this article, the trial-and-error procedure is avoided by assuming that the tube "constants" are actually constants and that the input signal always swings the tube from cutoff to zero grid-to-cathode voltage. Both assumptions can lead to excessive distortion; to avoid this possibility, it is merely necessary to multiply all of the calculated supply voltage values by some reasonable constant. For example: if the calculations indicate a fixed bias value of 10 v. and a plate supply value of 60 v., one might actually employ a fixed bias of 16.7 v. and a plate supply of 100 v. The multiplying constant can thus be used to "round off" the plate supply value in addition to the avoidance of distortion.

The triode design equations that are developed herein have been used for several years in almost every conceivable type of resistance-coupled application. Circuit behavior has justified the use of idealized equations except where low plate supply voltages are employed. With low plate voltage, the ac plate resistance is considerably higher than the nominal tube manual value. It is recommended that plate supply values (and also screen

supply values, in the case of pentodes) be ≧ 100 v. for conventional tubes.

The pentode design equations have not been extensively applied because of the economy of dual triodes for resistance-coupled applications.

List of Symbols

All of the symbols are defined in the illustrations, except for the following:

E_{gpp} = peak-to-peak grid voltage swing ($E_{gn} + E_{gp}$)
G_k = grid-to-cathode voltage gain
G_p = grid-to-plate voltage gain
i_{po} = average value of plate current
i_{so} = average value of screen current
k = ratio of plate current to screen current
m = ratio of plate-to-cathode voltage to screen-to-cathode voltage at the positive peak of grid voltage swing (E_{pkp}/E_{skp})
r_p = ac plate resistance
r_s = ac screen resistance
R_g = capacitively-coupled plate load resistance
R_o = capacitively-coupled cathode load resistance
μ = grid-to-plate amplification factor
μ_s = grid-to-screen amplification factor
Z_k = cathode load impedance (R_k in parallel with R_o)
Z_L = plate load impedance (R_L in parallel with R_g)

Triode Amplifier

The characteristic curves of an idealized triode are shown in Fig. 1b. A simple application of geometry yields

$$i_p r_p = E_{pk} + \mu E_{gk} \qquad (1)$$

In addition, for Fig. 1a,

$$E_{gk} = E_{in} - i_p R_k \qquad (2)$$

and

$$B = i_p R_L + E_{pk} + i_p R_k \qquad (3)$$

Eq. 1 to 3 then yield

$$i_p = \frac{B + \mu E_{in}}{r_p + R_L + R_k (1 + \mu)} \qquad (4)$$

The grid-to-plate gain is the derivative of the voltage across R_L with respect to E_{in}. If R_L and R_k are replaced by the impedances Z_L and Z_k, one obtains

$$G_p = \frac{\mu Z_L}{r_p + Z_L + Z_k (1 + \mu)} \qquad (5)$$

Similarly,

$$G_k = \frac{\mu Z_k}{r_p + Z_L + Z_k (1 + \mu)} \qquad (6)$$

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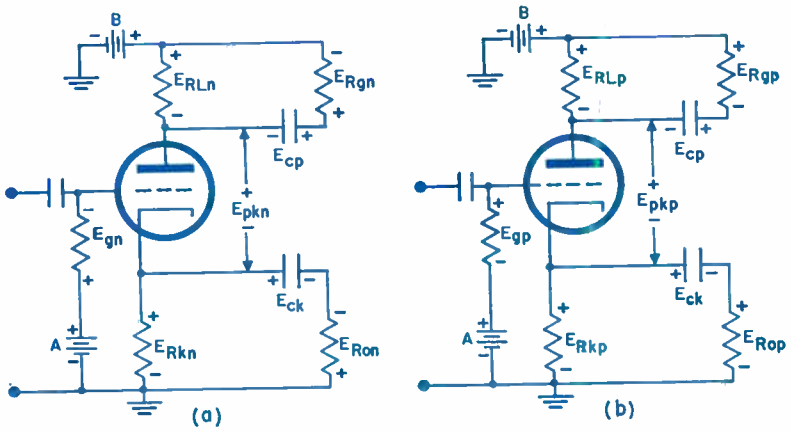
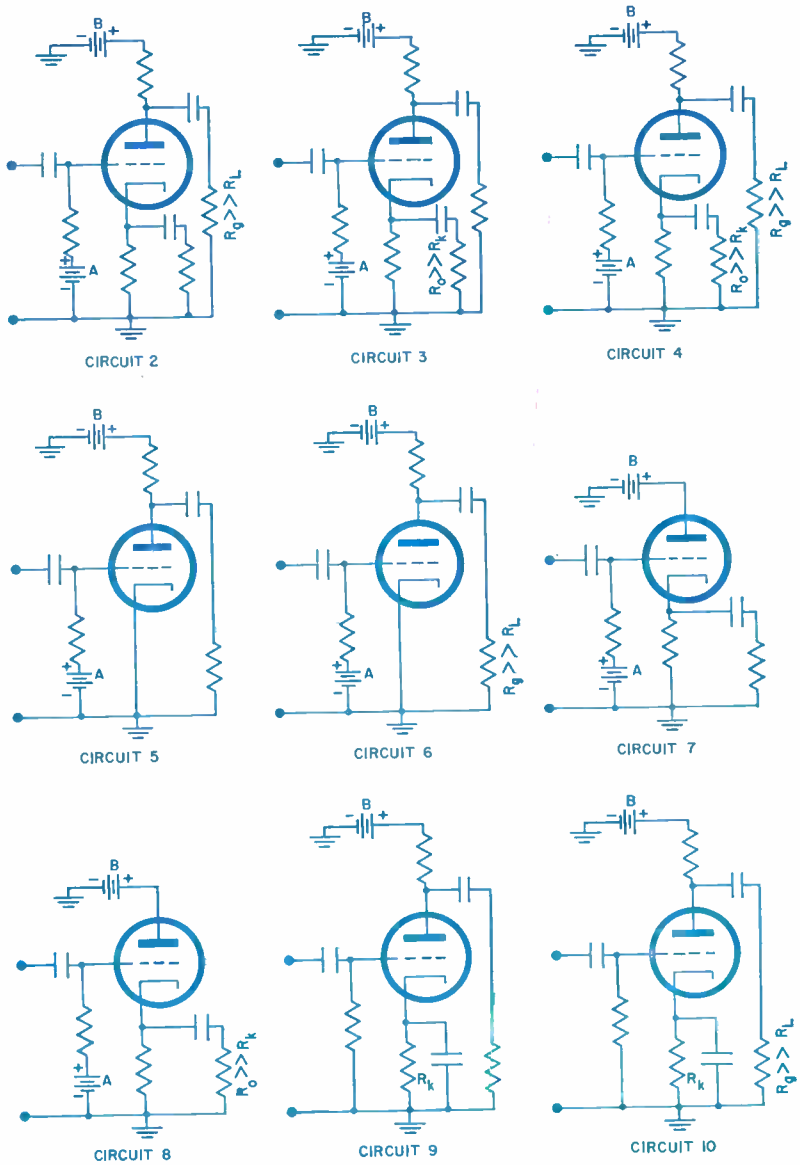


Fig. 3 (above): Generalized triode amplifier at cutoff (a), at zero grid-to-cathode voltage (b).

Fig. 4 (below): Nine other amplifier circuits that can be derived from that shown in Fig. 3.



When aircraft of varying speeds follow a common straight-in approach path the landing rates are severely limited. This new design would shorten the common path by having aircraft approach the runway from various angles, depending on their landing speeds.

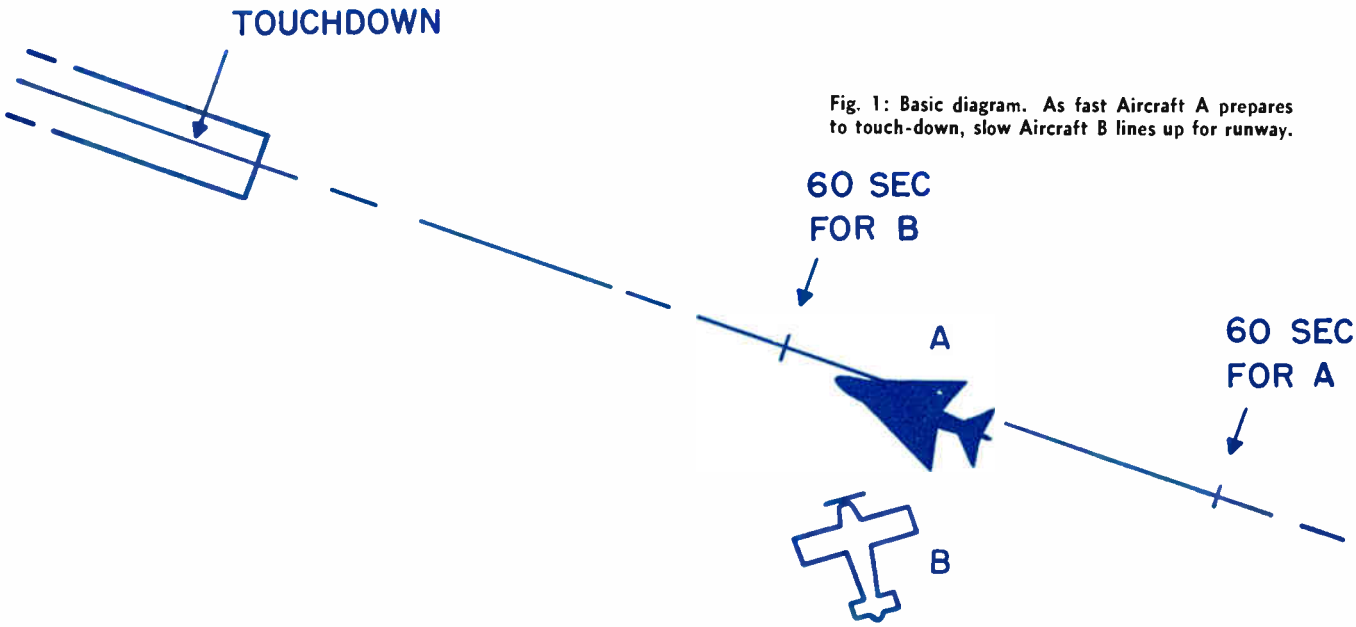


Fig. 1: Basic diagram. As fast Aircraft A prepares to touch-down, slow Aircraft B lines up for runway.

Approach System For High Landing Rates

By F. H. BATTLE, Jr.

Airborne Instruments Laboratory Inc., Mineola, N. Y.

IN view of current predictions of a continued expansion in flight activities during the next few years, it would be well to prove in advance, if possible, whether present-day procedures and equipment can be extended and modified so as to serve future needs.

It is not difficult to show that, for final approach and landing under instrument conditions, new procedures will be needed, at least part of the time. The equipment to be used for final-approach navigation must be compatible with these new procedures, and this will require the design of new models of the present-day systems—ILS and GCA—or the design of an entirely new final-approach system. In either case, all foreseeable operational requirements should be stated, preferably in numerical terms, before detailed equipment specifications are written.

The objectives of this discussion are: first, to show that present-day IFR final-approach procedures can not fully meet the future operational requirements of the Air Force—and the future requirements of civil aviation appear to be similar in this respect; second, to describe some desirable changes in IFR approach procedures; third, to analyze a type of final-approach course which conforms with these modified procedures —and which should, therefore, allow high landing rates; and, fourth, to draw one or two conclusions regarding the extent of airspace coverage by final-approach aids that it would be useful to provide.

General Requirements

The Air Research and Development Command of the Air Force, through its Traffic Control, Approach and Landing Systems Team (TRACALS), has formulated some general operational requirements for the type of

final-approach navigational system that they hope to be using within a few years. One of these general requirements is that the system permit high sustained landing rates—as a goal, two landings per minute on a single runway—by aircraft using intermixed approach speeds between 60 knots and 230 knots.

TRACALS has pointed out that the difficulty in meeting this requirement arises from the necessity for all aircraft to follow a common path, just before and just after landing. The common path includes the final approach, during which alignment with the extended centerline of the runway is established; and roll-out along the runway, during which speed is decreased until a turn-off can safely be made. During these operations, neither vertical nor lateral separation of aircraft can be provided, so that longitudinal separation must be established in advance. But if several aircraft are simultaneously approaching on a common path at different speeds, their separations are constantly changing, and there is obviously a maximum length of common path that can be tolerated.

For example: if a 60-knot aircraft is required to land 30 seconds after a 120-knot aircraft, their common path is limited to a maximum of one mile before touchdown, which is covered by the faster plane in 30 seconds, and by the slower one in 60 seconds; of course, they have to start with zero separation in this case, which is unthinkable, so that in practice less than one mile of common path could be allowed. Situations like this are preferably avoided by changing the order of landing, but they cannot be avoided indefinitely when peak densities occur with intermixed traffic. The only way to sustain a high landing rate, capable of handling tomorrow's volume of traffic, is to reduce the length of approach path that is common to all types of aircraft. (It should be noted, in passing, that it will be necessary to shorten the common path after touchdown, as well. Serious consideration of landing rates in the order of two aircraft per minute per runway assumes the provision of high-speed turn-offs on the ground.)

The need for a short common path is one that present-day procedures and equipment would fail to satisfy. As they are now used, ILS and GCA provide only for a straight-in approach, as nearly as it can be made, over the extended centerline of the runway. But in order to shorten the common path, all aircraft should avoid the centerline until as late in the approach as possible. In this way, they will prolong the opportunity, during initial approach, to pass and be passed by aircraft of different speeds. (This method of expediting the landing rate is often used under VFR conditions, whenever the traffic controller requests a short turn-on to final approach.)

Approach Procedures

A mixture of traffic with approach speeds ranging from 60 knots to 230 knots cannot safely be landed, in random order, at 30-second intervals, because the necessary turn-on distances would be too short. However, if some minor control of the landing order is granted, such a mixture of traffic could be landed safely with a sustained average interval of very nearly 30 seconds. The only practical way to accomplish this.

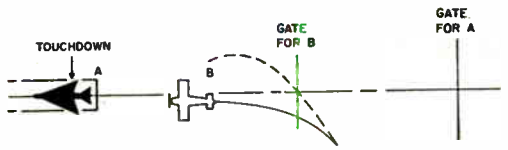


Fig. 1A: Sequel to Fig. 1. A on the runway and B preparing to touch down.

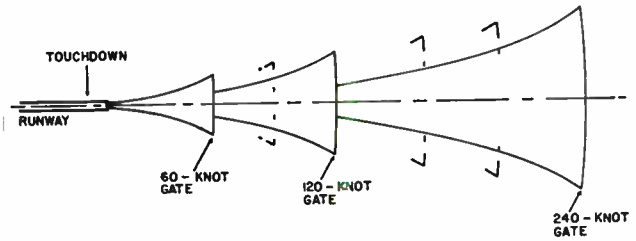


Fig. 2: Speed determines the angle of approach for the aircraft.

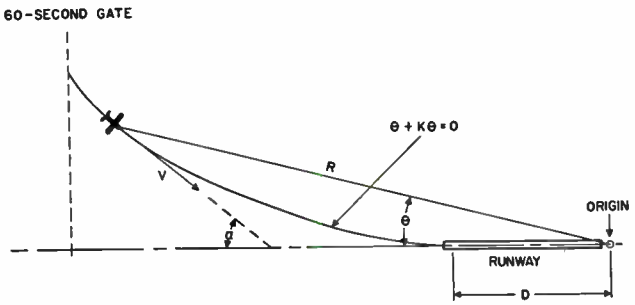


Fig. 3: Curved path approaches runway asymptotically

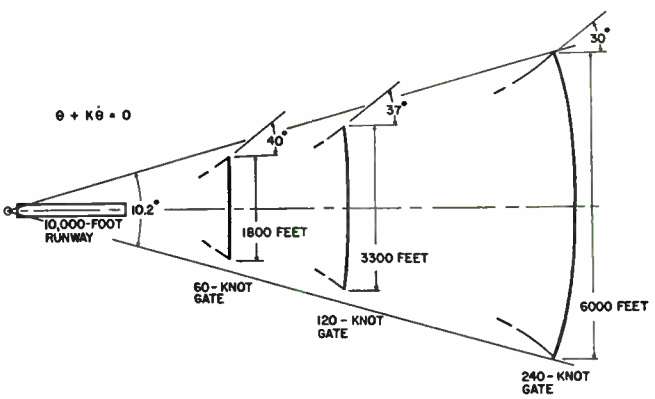
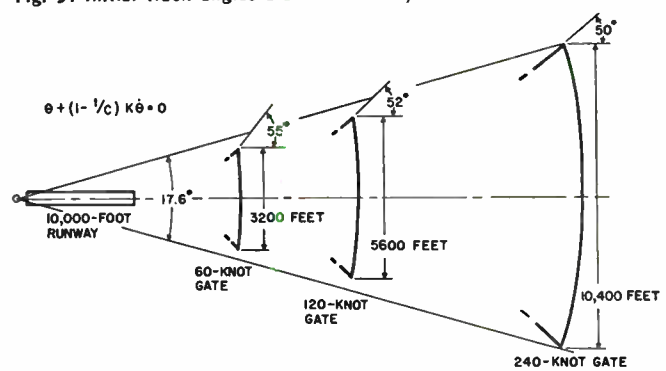


Fig. 4: Width of approach gate varies with aircraft speed.

Fig. 5: Initial track angles are increased by 15%.



Approach System *(Continued)*

with conventional aircraft, is by careful refinement of the short turn-on technique. This involves taking advantage of aircraft characteristics—in particular, their maximum safe rates of turn—so that the common path, near the extended runway centerline, can be limited to about one minute of flight time.

For analytical purposes, it is convenient to consider the region wherein lateral or vertical separations are still reliable as the initial-approach zone; and to define the final approach as including only the common portion of the approach paths followed by various aircraft. The initial-approach and final-approach zones are separated by the final-approach gate, which is located at the approximate distance from touchdown at which lateral separations become inadequate for safety. This is an over-simplified picture, since the actual separation between two aircraft at any time is three-dimensional; but the approximation is on the safe side.

In Fig. 1, A is a fast aircraft on final approach, and B is a slower aircraft just turning onto final. At the first moment illustrated, the separation between A and B must be at least equal to some minimum required for safety; but less than a minute later, when A reaches touchdown, B must be well into its final approach. With so little time-to-go remaining, safety requires that B is now flying very nearly over and parallel to the centerline. This means that an aircraft turning onto final approach cannot be permitted to overshoot, as shown by the dashed-line course, since there is too little time in which to correct a large error; instead, the final-approach procedure must tolerate and encourage a considerable displacement from the centerline by an aircraft entering the final-approach gate. Wide gates must be served by the final-approach system, and navigational guidance must be provided along curved final-approach courses.

Fig. 2 illustrates a family of final-approach zones appropriate to various approach speeds. For each speed, the course followed in the last minute before touchdown will lie within a region shaped like a funnel. The mouth of each funnel is the final-approach gate for a particular approach speed, and the sides are defined by the outermost approach courses that can safely be used at that speed.

The length of each approach funnel is determined by the approach speed and the allotted time, for which 1 min. is suggested. The width of each funnel, at the gate, depends on the safety rules that are used in specifying the outermost courses. The size and shape of the region containing the entire family of approach funnels are also functions of gate width; and since this is the region that should be served by future instrument-approach systems, some numerical estimates of gate width will be derived.

The changes in approach philosophy that are suggested by the foregoing discussion are these:

(1) The long, straight-in approach should be avoided;

(2) The target for initial-approach navigation and scheduling should be a wide gate about 1 min. from touchdown; and

(3) Curved final-approach courses, of the type provided by flight directors, should be used exclusively.

The latter two points should be enlarged upon slightly, since they will influence the choice of control equations.

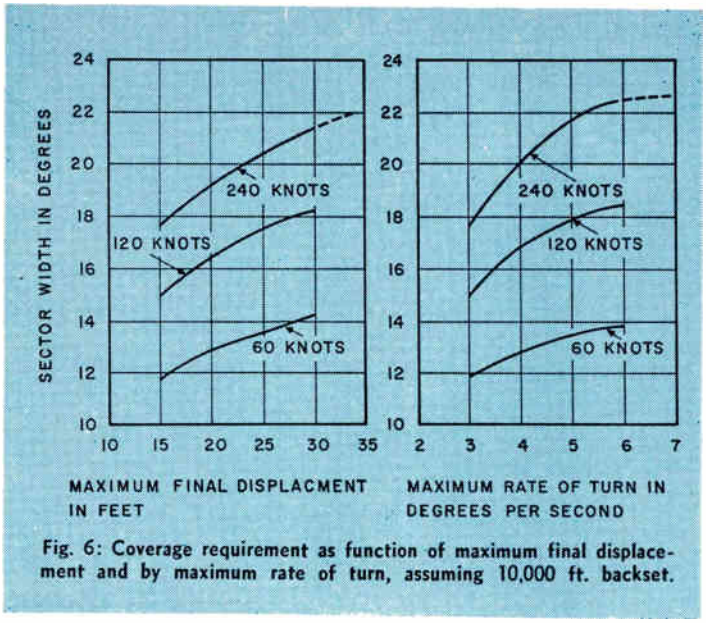


Fig. 6: Coverage requirement as function of maximum final displacement and by maximum rate of turn, assuming 10,000 ft. backset.

The width of final-approach gate could be based on the aircraft separation required just outside the gate, and certainly a minimum width is defined by that consideration. However, if even wider gates can be provided, without undue cost or complication of the final-approach facilities, they will ease the burden of navigational precision during initial approach, and will better accommodate emergency situations. For that reason, emphasis will be placed not on the minimum gate widths that must be provided, but on the maximum that it would be useful to provide.

Wide final-approach gates will allow a large displacement from the extended runway centerline, with only 1 min. to go. This will require a short, smooth turn-on continuing into the final approach itself, and allowing no time for course-bracketing maneuvers. The need for such maneuvers is automatically minimized with flight-director systems, such as the Zero Reader and the Integrated Flight System, since they can provide a family of optional courses of which one is as good as any other—provided only that a safe approach is possible from the initial position of the aircraft, and that the navigational data are accurate. The only new requirement imposed by the short turn-on technique is that precise navigational data be provided, and utilized, over a wide sector of airspace. The question of how wide that sector should be will now be examined.

The analysis to follow will be limited to the horizontal projection of final-approach paths; although

(*Continued on page* 147)

Snapshots at 60,000 RPM

Tomorrow's auto engines will be smaller, lighter, and more compact due to research on high speed rotor bursting strength. Electronic probes detect the start of a fracture and trigger flash photographs

To make automobile engines smaller, lighter, and more compact for the same horsepower output, it is necessary to go to higher engine speeds. Thus in experimental power plants such as the gas turbine engine, rotational speeds of 500 revolutions per second are frequently employed and much greater speeds are envisioned. The maximum permissible speed is limited by the mechanical strength of the moving member.

The Scientific Laboratory of the Ford Motor Company has been making extensive studies of ultimate strength by rotating rotors at progressively higher speeds until failure occurs. Since the forces in a complex rotor cannot be calculated with certainty, performance must ultimately be determined by studying the rotor fracture from the moment it begins to the time when total fracture occurs.

In the past, studies of fracture origin and growth have been greatly hampered by the fact that the exact time of failure could not be ascertained. If continuous 16 mm motion picture photographs were to be taken of a high speed rotor, film would be used at a phenomenal rate of 1 mile per second in order to obtain a satisfactory data.

Engineers of the Ford Scientific Laboratory have recently announced a new method for obtaining photographs of a test rotor an instant before it bursts. This novel method consists of inducing an electrical signal into the rotor and having it transmit a signal back to a nearby receiver the moment failure commences. The received signal is processed and used to trigger a high intensity light source for producing the photograph.

Bursting of typical rotors occurs at rotational speeds of about 1000 revolutions per second, corresponding to peripheral speeds of about 1200 mph. To stop the motion without blur, exposures of one two-millionth of a second are used. Because of the extremely short exposure, a peak light intensity of 50 to 100 million candlepower is required to obtain a suitable photograph.

The new method of electronic detection has been highly successful in permitting the photographing of incipient rupture of high speed rotors. Scientific data obtained from the photographs is being used to evaluate the effects of geometry, alloy composition, and heat treatment.

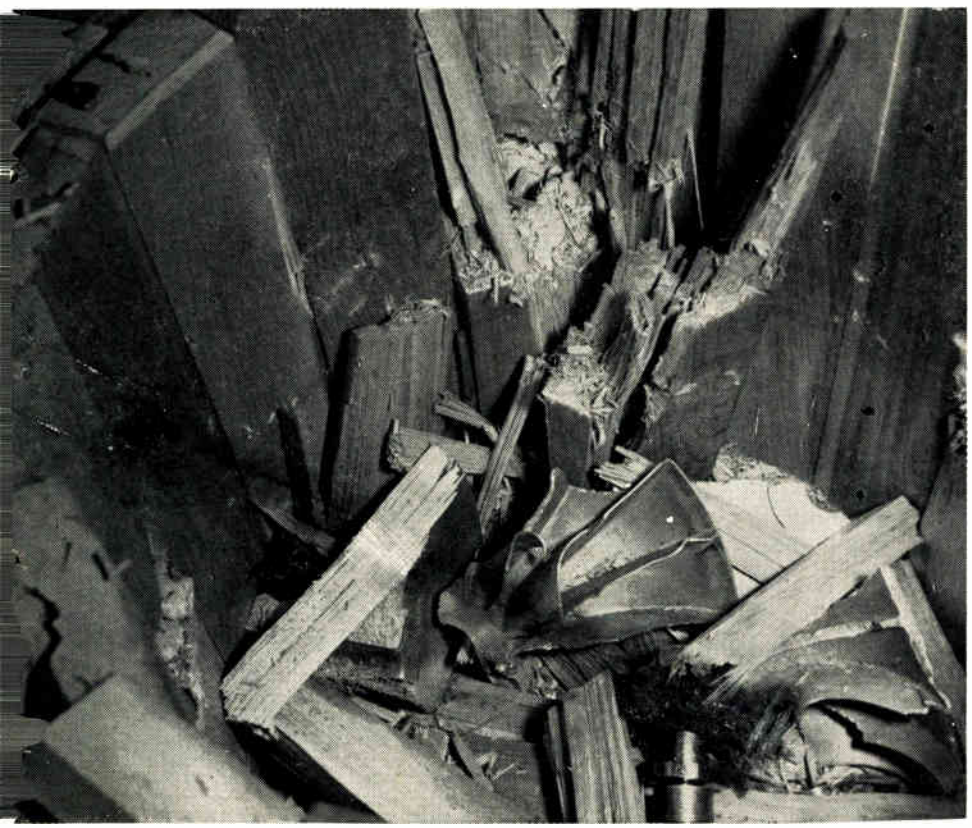


Fig. 1: The tremendous energy stored in the high speed rotor can be appreciated from this picture, which shows the destruction in the protective test chamber upon failure of the rotor.

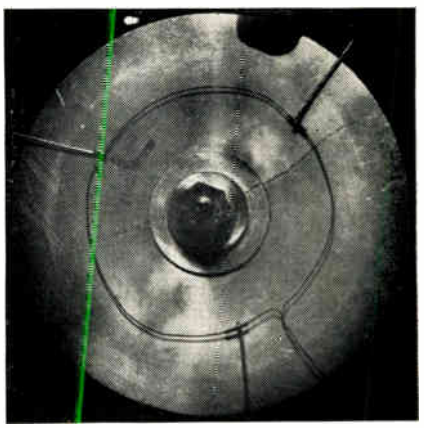


Fig. 2: A typical photograph of a ten inch diameter rotor taken an instant before complete failure. In the figure, two radial cracks progressing outward from the center are clearly discernible as though the rotor were actually motionless. The loop antenna used to sense the crack can also be seen.

Record turnout of engineers and avionic executives is expected for the three-day conference at Dayton's Biltmore Hotel.

IRE Avionic Show At Dayton, May 13-15

The annual show of the avionic industries, the "National Conference on Aeronautical Electronics," gets under way at Dayton's Biltmore Hotel on Monday, May 13, with more than 80 exhibitors and a technical program of approximately 100 papers.

A great deal of effort has gone into the very elaborate technical papers program which will be one of the features of the show. In addition to the attraction of outstanding engineers and executives as moderators of the various sessions, time is also being given to a question-and-answer session following each meeting so that those attending will be certain to go away with a clear conception of the subject presented.

The technical sessions will be held in the Main and Junior Ballrooms of the Biltmore Hotel and also in the Engineers' Club.

The three-day conference will have morning sessions from 9 to 12 noon, and afternoon sessions from 2 to 5 PM. The banquet and ball will be held on Tuesday, May 14, at 6:45 PM.

Saul Weismann,
President, National Conference on Aeronautical Electronics

Monday Morning—May 13

EQUIPMENT APPLICATIONS I

Moderator: Mr. Michael Glass, Hughes Aircraft Company
Main Ballroom—Dayton Biltmore Hotel
Operation of an Electronic Component Parts Application Unit, J. P. Francis, Glenn L. Martin Company
Establishment and Results of a Comprehensive Component Reliability Program, C. G. Walance, Hughes Aircraft Company
Analysis of Electronic Parts Application, William Barron, Bell Aircraft Corporation
Component Application Engineering at RCA, R. H. Baker, Radio Corporation of America
Management Support of Components Applications Organizations, James H. Allen, Bendix Aviation Corporation

Monday Morning—May 13

COMPONENT PARTS—VACUUM TUBES

Moderator: Dr. Walter Knecht, ARDC
Junior Ballroom—Dayton Biltmore Hotel
The Wamoscope, A New Micro-Wave Display Device, R. G. E. Hutter and D. E. George, Sylvania Electric Products, Inc.
A 300-Watt Stacked Ceramic Tetrode for Airborne Transmitters, Willis B. Foote, Eitel-McCullough, Inc.
Vacuum Tubes for 500°C Envelope Temperature and High Vibration Applications, John W. Wyman, Bendix Aviation Corp.
The Amplitron, A New Type Micro-Wave Amplifier Tube for High Power, Broad Band Equipment Application, William C. Brown, Raytheon Mfg. Co.
Half-Tone Display Storage Tube with Magnetic Deflection, M. E. Craig, RCA Tube Division
C. W. UHF Traveling Wave Power Amplifier of Extended Band Width, Dr. Walter Harmon, General Electric

Monday Morning—May 13

NAVIGATION I

Moderator: Mr. D. G. C. Luck, Radio Corp. of America
Engineers Club—Auditorium
Application of Automatic Dead Reckoning Equipment to Current Problems of Air Navigation, Henry R. Walcott, Eclipse Pioneer Div., Bendix Aviation Corp.
The Nature of Doppler Velocity Measurement, Dr. F. B. Berger, General Precision Laboratory
Precision Azimuth Reference Systems for Aerial Navigation, A. J. Shapiro, Kearfott Company, Inc.
Inertial Navigation Performance Characteristics, Robert W. Wedan, Minneapolis-Honeywell Co.

List of Exhibitors—1957

Radio Corp. of America
Hughes Aircraft Co.
General Electric Company
Collins Radio Company
Ford Instrument Co.,
Div. of Sperry Rand Corp.
W. L. Maxson Corp.
Daven Company
Cubic Corporation
General Precision Labs., Inc.
North American Aviation, Inc.
Bird Electronic Corp.
Robinson Aviation, Inc.
Alfred Crossley & Associates
Gruen Watch Company
Superior Electric Co.
G. H. Leland, Inc.
Hoffman Laboratores, Inc.
Micro Switch
Bomac Laboratories, Inc.
Emerson Radio & Phonograph Corp.
S. Sterling Company
Motorola Communications & Electronics
Filtron Company, Inc.
Sylvania Electric Products, Inc.
Lewyt Mfg. Corp.
Kay Electric Company
Aircraft Radio Corporation
General Radio Co.
Abrams Instrument Company
The Satullo Company
Raytheon Mfg. Company
J. R. Dannemiller Associates
Airtron, Inc.
Mycalex Corp. of America
M. P. Odell Company
Century Electronics & Instruments
Amphenol Electronic Corp.
Polarad Electronics Corp.
Surprenant Mfg. Co.
WacLine, Inc.
Ed Magee
Tensolite Insulated Wire Co., Inc.
Thomco Electronic Co.
Institute of Radio Engineers
Bendix Aviation Corp.
Federal Telecommunication Labs.
G. M. Giannini & Co., Inc.
Admiral Corporation
Bernard L. Michaelson
Crosley Div., AVCO Mfg. Corp.
Ramo-Wooldridge Corp.
Sperry Gyroscope Co.,
Div. of Sperry Rand Corp.
Narda Corporation
Tektronix, Inc.
Hoover Electronics Co.
Cleveland Metal Specialties Co.
CGS Laboratories, Inc.
Harvey Teplitz Co.
Sprague Electric Co.
Lavoie Laboratories
General Mills, Inc.
Hycon Mfg. Co.
Servomechanisms, Inc.
Summers Gyroscope Co.
California Technical Industries
International Business Machines, Inc
Globe Industries, Inc.
Eitel-McCullough, Inc.
Arma Div., American Bosch Arma Corp.
Philco Corp.
Stromberg-Carlson Co.
Avion Div., ACF
Tower Engineering Co.
Packard-Bell Company
Radiation, Inc.
Sanders Associates, Inc.
Westinghouse Electric Co.,
Air Arm Division
Burroughs Corp.

Avionic products of more than 80 manufacturers will be on display.

Doppler Navigation, William J. Tull, General Precision Labs.
Self-Contained Navigation and the Common System, Nathaniel Braverman, C & N Laboratory, WADC

Monday Afternoon—May 13

EQUIPMENT APPLICATIONS II

Moderator: Mr. A. M. Okun, Bell Aircraft Corporation
Main Ballroom—Dayton Biltmore Hotel
Evolution of a Coordinate Indexing System for Use in Parts Application, A. J. Chippendale, Convair Division, General Dynamics
Connector Design and Development to Meet Advanced Application Requirements, Ted A. Thompson, Douglas Aircraft Company
An Airborne Atomic Frequency Standard, J. J. Bagnall and J. H. Holloway, National Company
A One-Kilowatt Airborne Radio-Frequency Power Amplifier, James B. Humfeld, Hughes Aircraft Company
Depot Test Equipment Concepts, David B. Dobson, Radio Corp. of America
Some Design Factors for the Magnetron-Isolator Combination, Ray A. Krogh, Litton Industries

Monday Afternoon—May 13

COMMUNICATIONS

Moderator: Mr. Ludlow B. Hallman, WADC
Junior Ballroom—Dayton Biltmore Hotel
Some New Horizons in Communications, George H. Scheer, Jr., WADC
The Synchronous Detector, Raymond J. Lutze, General Electric Company
Kineplex, N. L. Doelz, Collins Radio Company, Burbank, Calif.
LABIL, A Light Aircraft Binary Link, Watson F. Walker, Stromberg-Carlson
Some Aspects of Digital Transmission of Data, Siegfried Reiger, Air Force Cambridge Research Center, Lawrence G. Hanscom Field

ELECTRONIC EQUIPMENT

Moderator: Brig. General E. R. Tetzing, USA Ret.
Engineers Club—Auditorium
A 90 db Logarithmic Response Video Pulse Amplifier, Charles E. Wilson and Arthur H. Zefting, Stromberg-Carlson
Compensation Network Design as Applied to Transistor Feedback Amplifiers, T. Eugene Smith, Texas Instruments, Inc.
The Design of Transistor Intercommunication Systems for Military Aircraft, Guy S. Rambie, Jr., Texas Instruments, Inc.
A High Performance Transistor-Regulated Power Supply, T. A. Weil and B. Erdman, Raytheon Mfg. Company
Biased Chokes for Improved Swinging Choke Action, T. A. Weil, Raytheon Mfg. Company
The Valentine Antenna, Edwin M. Turner, WADC

NAVIGATION II

Moderator: Thomas A. Kouchnerkavich, Civil Aeronautics Authority
Engineers Club—Auditorium
Some Aspects of Vortac, Sven Doddington, Federal Telecommunication Lab., Inc.
Radio Position Fixing by Low Frequency Composite Wave Measurement, Ben Alexander and Mrs. Stella Hyman, Federal Tele. Labs., Inc.
Delrac—A Long-Range Aid to Navigation, Dudley H. Taller-Bond, Decca Navigator System, Inc.
Light Weight Digital Computers, John Mover, Weapons Guidance Laboratory, WADC
Radio Positions Fixing by Low Frequency Groundwave Phase, Winslow Palmer, Sperry Gyroscope Company

Tuesday Morning—May 14

MANAGEMENT I—RESEARCH

Moderator: Mr. Oliver H. Winn, General Electric Co.
Junior Ballroom—Dayton Biltmore Hotel
Planning of Research Work at Westing-

(*Continued on page* 120)

Radioactive materials provide a handy means of measuring thickness for the continuous process industry. Technique is based on absorption and/or reflection of materials to radiation.

Beta Gauge Checks Steel Thickness

By O. H. BAUSCHINGER, Y. M. CHEN
Electronics Div., Curtiss-Wright Corp.
631 Central Ave., Carlstadt, N. J.

and F. H. LONDON
Airborne Instrument Laboratory Inc.
160 Old County Rd., Mineola, N. Y.
(formerly Curtiss-Wright Corp.)

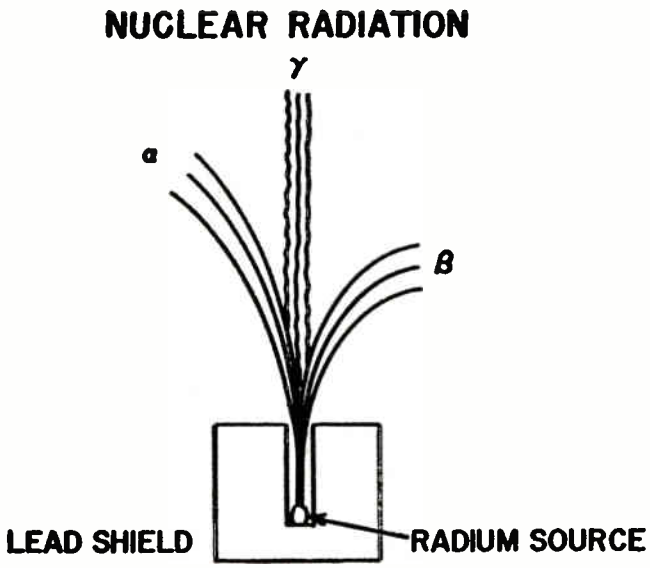


Fig. 1: The three types of radiation: alpha (α), beta (β), gamma (γ).

THE present-day trend in the continuous process industry such as the paper, sheet metal, rubber, and plastics industry is towards high speed process machines. Manufacturing paper at a rate of 1000 fpm or sheet steel at 30 mph is not uncommon. This means that if the material exceeds its tolerances for even a short period of time a large quantity will have to be rejected. Hence continuous monitoring and controlling of the process is necessary.

Now arises the problem how to monitor a strip process continuously.

Radioactive materials provide us with very good means to gauge continuous processes accurately without touching the material. The measuring process is usually based on the absorption and/or reflection properties of materials to a specific radiation.

Basic Principles

The radioactive materials can come either from natural radioactive elements such as Radium, Uranium, Thorium or artificially in nuclear-reactor pro-

Fig. 2: Beta rays have a continuous distribution of energy. Maximum energy of a particular isotope determines the range of penetration.

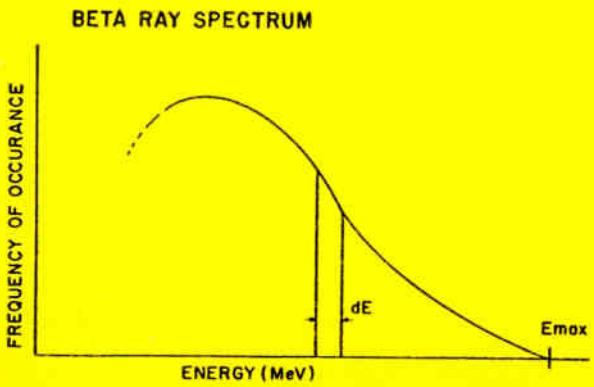
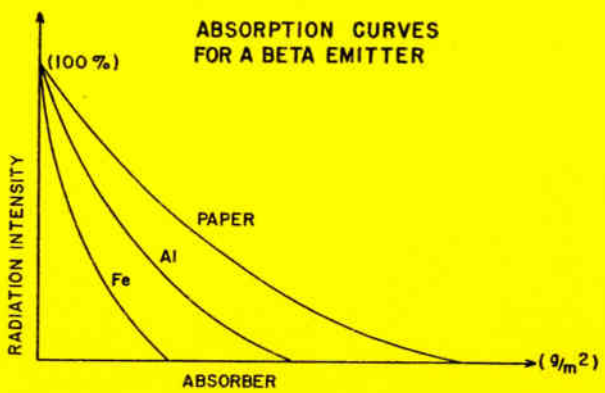


Fig. 3: Absorption in certain materials is an ionization phenomena and a loss of energy due to inelastic collisions with electrons.



O. H. Bauschinger

Y. M. Chen

F. H. London

duced radio isotopes. There are 3 distinct types of radiation: alpha, beta and gamma rays. See Fig. 1.

Alpha (α) particles are helium nuclei which carry a double positive charge and are ejected from certain atoms with very high velocity. The distance that the particles will travel is determined by the velocity with which they leave the nuclei. They will be all stopped in a few centimeters of air. Because of their very small penetrating power, alpha particles have only a very limited practical use in radiation thickness gauges.

Gamma (γ) rays are electromagnetic waves which are emitted from nuclei in excited state. Since there are definite energy levels in the nucleus, gamma rays are emitted with discrete energies. They have the largest penetrating power and are therefore used in thickness gauges for steel and other dense or thick materials.

Beta (β) particles have a single charge identical to that of an electron and have the same mass as an electron. They are ejected from the nuclei at a velocity which approaches that of light. They have a continuous distribution of energy ranging from zero to a maximum, as shown in Fig. 2. The maximum energy is a characteristic of the particular radioisotope and determines the range of penetration.

There is a relatively large number of β emitters available over a wide range of maximum energies (See Table 1) and therefore the majority of radiation gauges use β emitters, especially in paper, plastic, flooring and thin metals industry. Another important

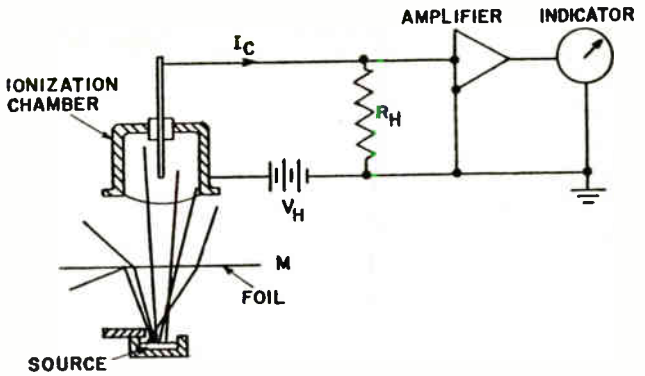


Fig. 4 (above): The radiation which enters the chamber causes ionization of the gas. The ionized particles are proportional to M thickness.

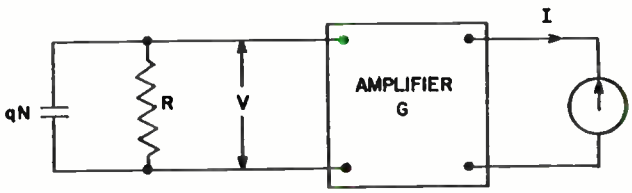


Fig. 5 (above): Beta gauge circuit. An RC circuit represents the ionization chamber and the high ohmic resistance in its simplest form.

Fig. 6 (below): Electrically similar to the absorption gauge, the backscatter gauge is used to measure thickness of a thin applied layer.

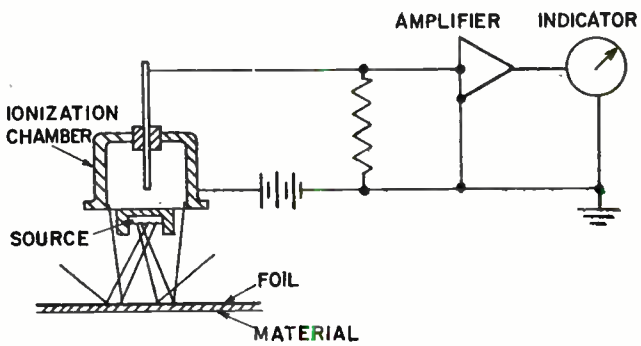
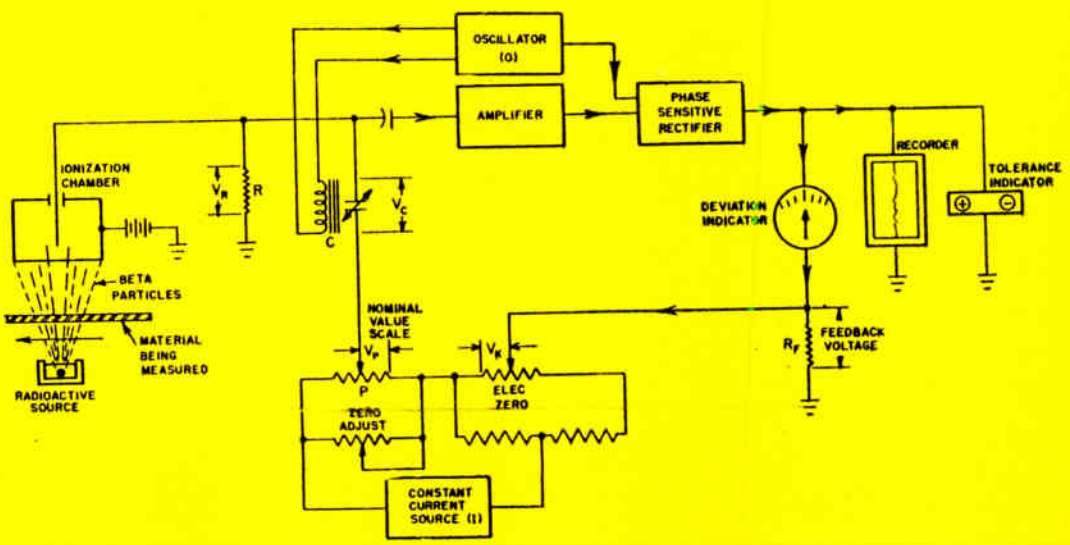


Fig. 7: The overall block diagram of a radiation gauge. Since the vibrating capacitor and the detector are driven from the same source, any drift in frequency will not cause a gain change.



Beta Gauge *(Continued)*

factor in the choice of the isotope is its half life. This is the time it takes for a radioisotope to decay to one half of its original activity. If the half life is in the order of days or a few months the isotope is not suitable for industrial application.

Absorption

The process of absorption of β particles in a certain material is mostly an ionization phenomena and a loss of energy due to inelastic collisions with electrons. In addition there are scattering effects and the production of Bremsstrahlen. However, it is possible to express the absorption process with sufficient accuracy by the following equation

$$I = I_o e^{-\mu x} \qquad (1)$$

where I_o = the intensity of radiation emitted by the radioactive source, I = the intensity which penetrates the material, μ = absorption coefficient for the particular material used and x = density thickness (or thickness) of the material. Fig. 3 shows some typical absorption curves.

Gauge Principles

The basic principles on which the radiation gauges operate are quite simple.

Fig. 4 shows the basic absorption gauge principle. A radioactive source S is placed on one side of the material to be measured. On the other side is a radiation detector, in general, a gas filled ionization chamber which has very thin windows permitting the entry of radiation.

Between the inner electrode of the ionization chamber and the outer shell is a potential V_H in series with a high ohmic resistor R_H. Depending on the thickness of the material M, part of the radiation emitted by source S will be absorbed by the material (some of it will be scattered or reflected) and the rest will enter the ionization chamber.

The impinging radiation will cause ionization of the gas proportional to the amount of radiation entering the detector. The ionized particles will be collected by the electrodes resulting in ionization current I_C which will flow through resistor R_H developing a voltage across it.

This voltage in turn is proportional to the amount of radiation entering the chamber, hence proportional to the thickness or weight per unit area of the material M to be measured.

Again we can write the following equation:

$$N = N_o e^{-\mu x} \qquad (2)$$

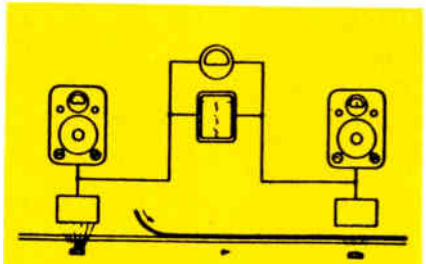


Fig. 8: Some measurements require 2 gauges.

The response in the detector to the β particles
where, N = the response without absorber
μ = absorption coefficient
x = density thickness of the absorber.

Eq. 2 shows an exponential response which is not strictly true, especially since there is a definite thickness for which all radiation is absorbed. However, it is a very good approximation in the working range of the β gauge.

In its simplest form, the ionization chamber with the high ohmic resistance can be shown as a simple RC circuit (Fig. 5). Each β particle entering the chamber will give rise to q number of charges, depending on the energy of the β particle which then will flow in the RC tank circuit. The average current is then qN. The average voltage in the RC circuit is

$$V = qNR \qquad (3)$$

substituting for N from Eq. 2,

$$V = qRN_o e^{-\mu x} \qquad (4)$$

The voltage V is applied to a dc amplifier which has an indicating meter or a recorder at its output. If the transconductance of the amplifier system is G (in amps/volt), then the current I at the output is

$$I = GV = GqRN_o e^{-\mu x} \qquad (5)$$

The above is a very general equation for a direct reading radiation gauge.

Deviation Gauge

In most cases a deviation type of gauge is more desirable and for automatic control it is a necessity. In a deviation gauge we introduce a predetermined voltage in reversed polarity to that of the ionization chamber output. This preset voltage is the equivalent of the desired density thickness of the material to be measured.

Thus, if the indicator of the gauge reads zero the correct material thickness is being manufactured and deviation from zero will

(*Continued on page* 140)

Table 1

RADIATION SOURCES

Radioisotopes	Half Life (Years)	Max. Beta Energy (mev)	Gamma	Beta Half Thickness In Aluminum (mg/cm²)
Promethium-147	2.6	0.22	none	5
Krypton-85	9.4	0.7	weak	24
Thallium-204	4.0	0.76	none	27
Strontium-90	20.0	2.2–from Y-90 daughter	none	150
Ruthenium-106	1.0	3.5–from Rh-106 daughter	present	270
Cs-137	37.0	0.51	0.662 from Ba-137 daughter	20
Ra-226	1600 in equilibrium with its daughter product	daughter products emit beta particles with various maximum mev.	1.8	

Wide variations in dielectric constant are found in aircraft fuels. These affect calibration of the capacitance systems used in aircraft fuel measurement. Here is a tester which can check fuel-gages for all aircraft.

Electronic Fuel-Gauge Tester

By P. BISHOP
General Radio Co., Cambridge, Mass.

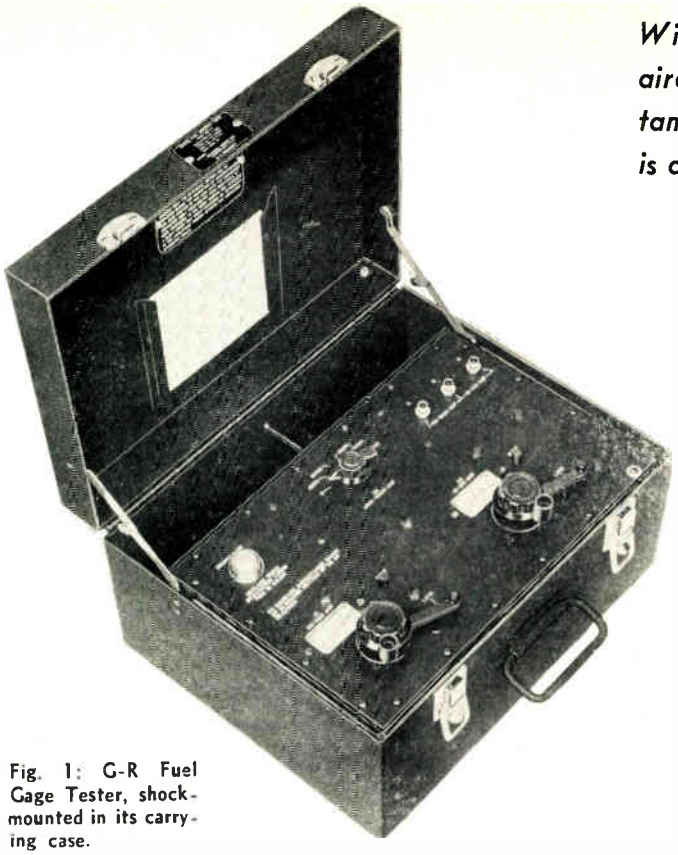


Fig. 1: G-R Fuel Gage Tester, shock-mounted in its carrying case.

THE vital importance of reliable readings by fuel gages for aircraft is self-evident. Every gage must be carefully adjusted in each new airplane, and checks for reliability must be made at routine intervals thereafter. The need for an up-to-date fuel-gage calibrator has been created by the advent of jet propulsion, for new fuels, differing in composition from those used by piston engines, have obsoleted older calibration devices.

Gage Design

Today's high-grade fuel gage employs a three-terminal capacitance-sensing element located in the airplane fuel tank. The actuating means is the variation in capacitance caused by the replacement of air dielectric between the capacitor plates by aircraft fuel. In common practice, a 400-cycle transformer bridge (Figure 2) is used to transform the change in capacitance to a reading on the fuel indicator located on the aircraft control panel. A phase-sensitive motor drives the fuel-gage needle. The motor simultaneously adjusts the position of a balancing potentiometer across one arm of the bridge, making this a self-balancing null device.

Fuel Properties

This highly reliable capacitance gage for aviation gasoline could be simply designed to give accurate weight indications because of a fortuitous set of circumstances. Not only is there little variation of physical and electrical properties among *gasolines* arriving from different refineries, but the effect of thermal expansion is compensated by the change in dielectric constant which occurs with temperature. Consequently, the calibration of the gasoline gage is essentially independent of temperature and fuel. Jet fuels, on the other hand, are not all identical in physical and electrical properties, nor does the cancellation of the effects due to temperature necessarily take place. Compensation is required, and a capacitor must be added to the fuel gage to adapt it for use with jet aircraft. Hence the compensated gage used in the jet is a refinement of the uncompensated capacitance gage usually found in propeller aircraft.

The recently developed General Radio Type P-579 Fuel-Gage Tester is designed for calibrating fuel-

(*Continued on page* 152)

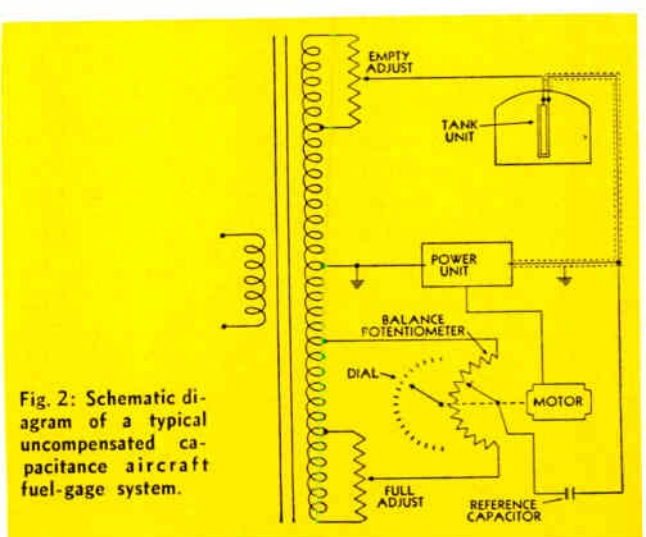


Fig. 2: Schematic diagram of a typical uncompensated capacitance aircraft fuel-gage system.

What's New . . .

"Hustler" Data System

One of the many "Systems" designed for Convair's new B58 "Hustler" is the test data recording and reduction system. Telemetering is not involved in this system, produced by Victor Adding Machine Company, Chicago, Illinois. Instead, FM information is recorded on a 30-track, 3,000-foot, 1½-inch magnetic tape for a maximum of 40 minutes per reel. 25 tracks are used for data, which includes a voice channel. 4 tracks are used for reference signals for error correction, for timing and calibration markers, and for addressing the data on the tape with real time coding. 1 track is a spare.

Modulators

Commercially available FM modulators of the resistance bridge controlled, voltage controlled, or inductance controlled variety may be used with carrier frequencies at the RDB channels 8 to 13. As many as 6 carriers may be multiplexed onto each tape track. Standard inputs are used to calibrate the airborne modulators.

Data Reduction

The ground reduction system uses the calibration information to automatically correct errors due to zero drift and sensitivity changes in system components. The ground system also corrects errors due to changes of tape velocity by both mechanical and electronic devices. Function generators correct nonlinear transducer curves to linear outputs.

Demodulators

24 demodulators and an audio channel will produce outputs for each playback pass of the tape. The demodulator outputs will drive oscillographs or strip chart recorders directly. At the same time, any one output may be fed to an analog to digital converter. The converter will digitize up to 1,000 samples per second and store the digitized information on an IBM 727 tape

(*Continued on Page* 124)

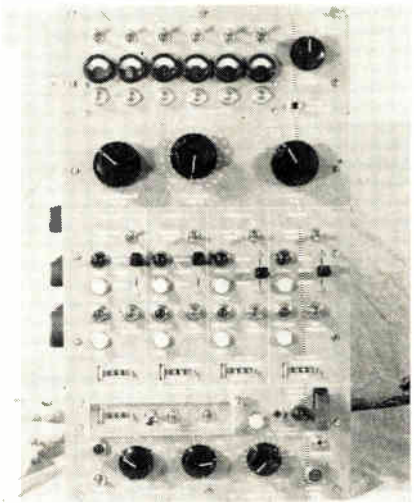
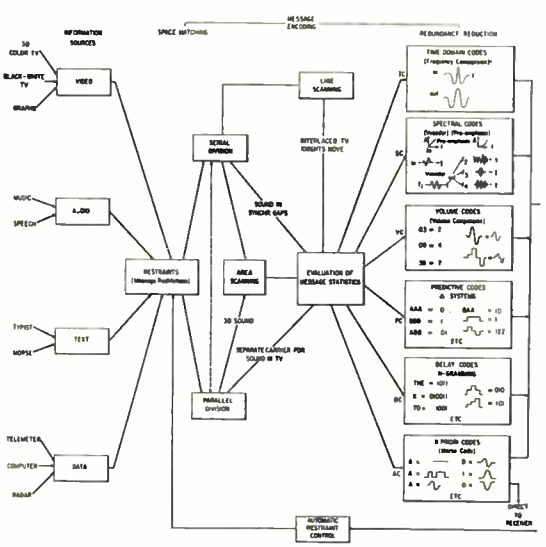
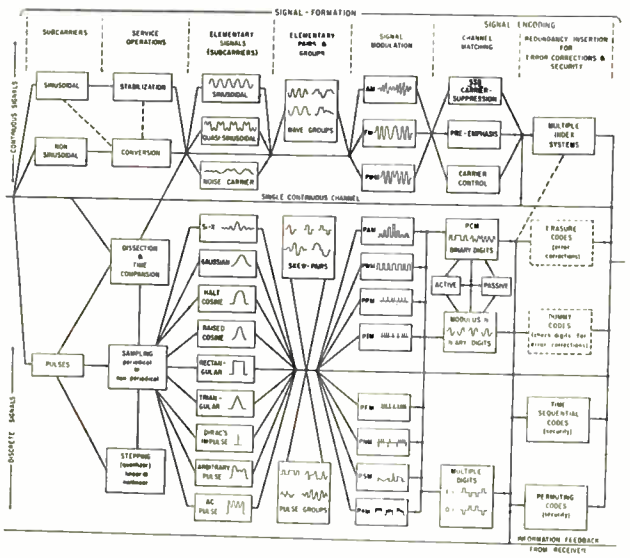


Fig. 1: The Victor Control and Monitor Unit. Automatic on and off times may be set for the operating cycle of a Transport Unit with the controls at the bottom of the panel.

Fig. 2: The Tape Transport Unit contains the tape handling mechanism, a bias oscillator, mixing network, signal monitoring circuit, and remote control circuitry.

COMMUNICATIONS DOMAIN: These four charts, compiled by Dr. Richard Filipowsky of Westinghouse's Electronics Div., summarize all the





Dark Horse in TV Field

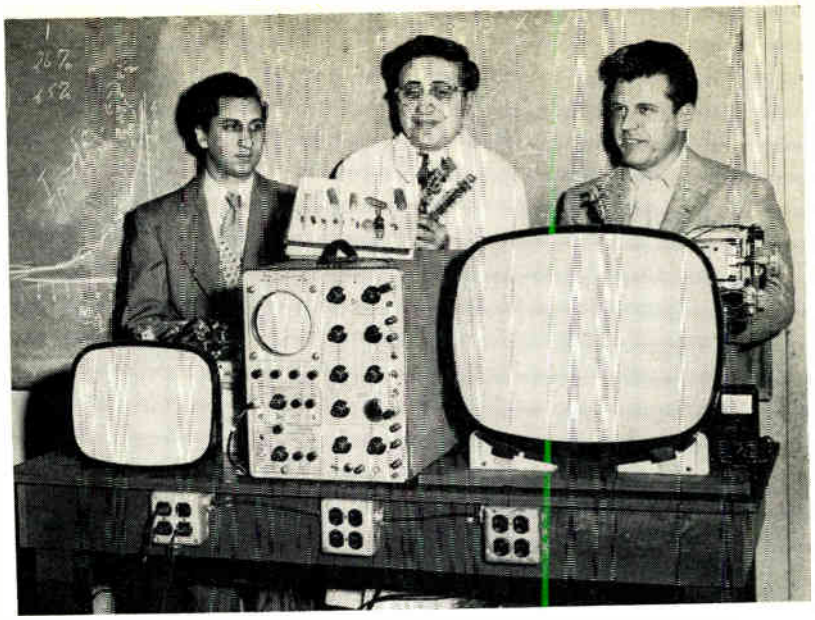
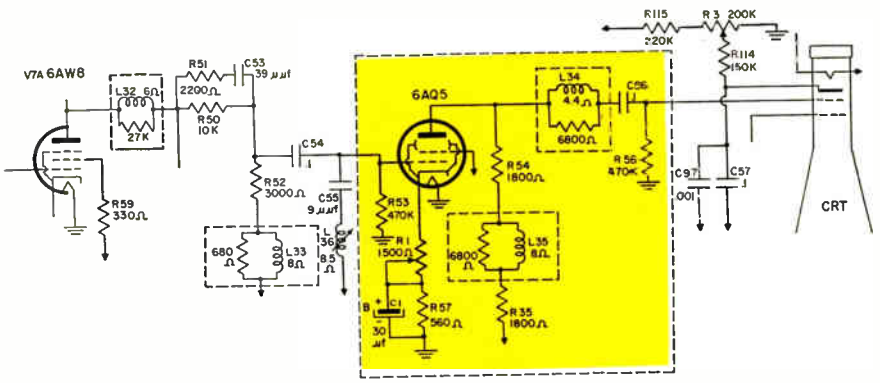


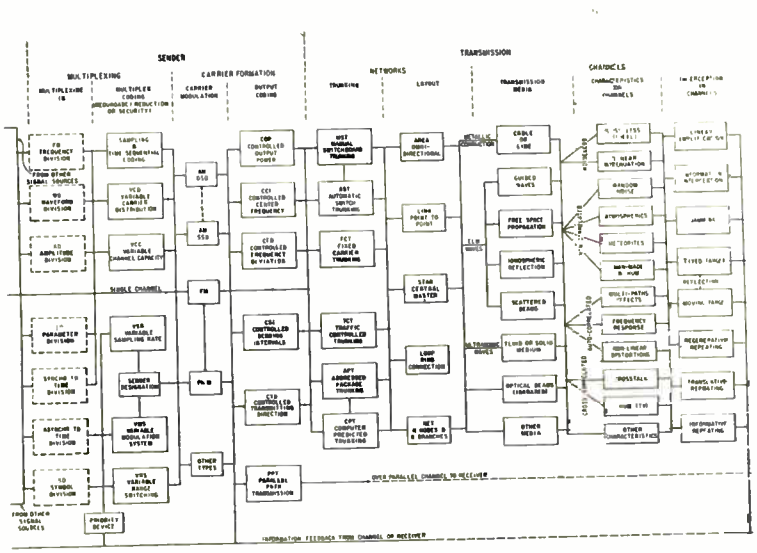
Fig. 2: Multi-Tron President Nicholas Glyptis (center) displays circuit elements eliminated by use of "Pure Signal" tube in TV sets.

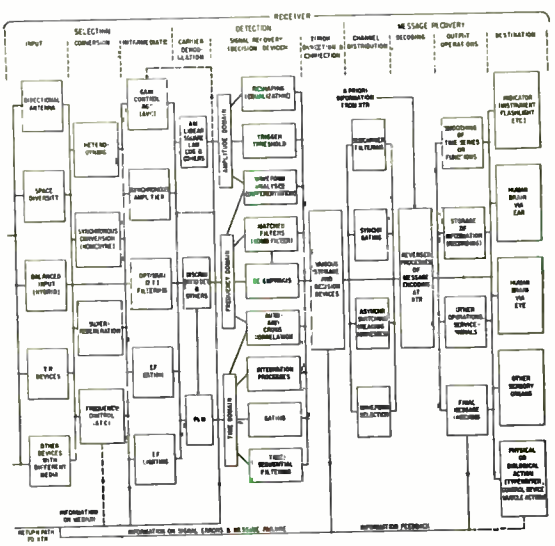


A basic design change in the cathode ray tube has been announced by Multi-tron Laboratory, Chicago, Illinois. The new tube, called the "Pure Signal" detector, is claimed to eliminate the need for the video amplification circuitry section in any current TV chassis—eliminating 22 components without changing picture quality or operating characteristics.

Recently, Multi-Tron President Nicholas Glyptis told EI Editors, "The multiple beam design feature is a basic research problem that we have been investigating for the past six years. It is unique in that it provides a 5/2 power operation due to its double modulating characteristics rather than the normally well-known 3/2 power. At this time, we cannot go into more detail about the basic functions and operations of this principle than to say that there will be a family of charactron tubes emanating from it, and that it is not limited to the cathode ray tube family."

important factors that need to be considered for a system analysis and synthesis when designing an efficient communications system.





New Radio Beacon For Light Planes

A new technique for airborne direction finding has been used in the "Talking Beacon" developed by Air Associates, Inc., Teterboro, N. J. The new equipment transmits a spoken bearing over a narrow, revolving beam which can be picked up on a standard airborne communcations receiver. The beacon can be received more than 50 miles away, depending on altitude.

In an experimental model of the Talking Beacon, produced for the Army Electronics Proving Ground, Fort Huachuca, Ariz., three VHF transmitters are duplicated by three UHF transmitters. Transition from VHF to UHF and vice versa is a simple operation.

Designed for continuous operation, the beacon can broadcast in the frequency range of 118 to 136 MC, or, on UHF, from 236 to 272 and from 354 to 400 MC. Effective reception is more than 50 miles—much more at high altitudes.

Above the enclosure which houses the transmitting equipment are 3 separate antennas fastened to an 18-ft mast which turns at the rate of two rpm.

Fig. 1: The three antennas are mounted on the beacon body which rotates at two rpm.

Fig. 2: The "Talking Beacon" is contained within a compact truck body; the antenna folds and stores within the body for transportation to a new location.

As the antennas revolve, a voice gives the direction of the beam at 15-second intervals or every 20 degrees. A pilot flying between 2 beams will pick up both and can judge his proximity to each within 3 degrees by the relative strength of their reception. When he is on one beam he will hear it loud and clear. The two at his flanks will come in very weakly.

By tuning in on two stations, he can use simple mathematics to find his exact position as well as distance from the nearest airport.

Two transmitters are 5-watt units and energize two uni-directional narrow pattern antennas mounted back to back on the mast. These transmitters broadcast the voice bearing. A 50-watt transmitter furnishes a continuous masking tone and a station identification signal in Morse code.

The figure-eight pattern of the masking tone is so designed that quiet prevails in the direction of the voice broadcast. All 3 transmitters operate on the same frequency through use of a common crystal-controlled exciter.

The beacon's truck body construction makes it easily transportable. The antennas disassemble to be stowed inside while the unit is being moved. Total weight is less than two tons. On location, the beacon can be set up quickly without a land survey or complicated procedure. The antenna array is built to withstand winds up to 60 mph.

Automatic Radar Performance Monitor

A big improvement over previous radar set test methods is possible with the Radar Performance Monitor designed and fabricated by Airborne Instruments Laboratory, Mineola, N. Y., under a development contract by the USAF Rome Air Development Center at Griffiss AFB, Rome, N. Y. This new equipment permits continuous monitoring of power, VSWR, relative tuning, and noise factor—while the set is in operation. With relatively minor modifications, the performance monitor can be installed in existing radar sets. All that is needed is a section of transmission line to permit installation of a bidirectional coupler, a jack at which to tap off some intermediate frequency voltage, and AFC test point jacks.

Description

The performance monitor consists of three main parts: a power monitor with VSWR provisions, a relative tuning indicator, and a continuous noise factor indicator. The developmental model was designed for Radar Set AN/FPS-3.

Since the AN/FPS-3 does not have a rotating microwave frequency joint which would allow both the transmitter and preamplifier to be housed together in the operations room, these components are located on the antenna support structure and rotate with the antenna. The monitor, therefore, had to be designed with two cabinets, one to include the circuitry necessary for making measurements and inserting signals at the antenna (remote cabinet) and one to make measurements and provide signals at the operations room (local cabinet).

Power is measured within 15 per cent accuracy: noise figure is measured within ± 0.5 db at 9 db and ± 1 db at 15 db. The relative tuning indicator has a green area to indicate detuning of the local oscillator within 100 kc and a red area to indicate detuning beyond 100 kc.

Average transmitter power is measured by using a self-balancing temperature-compensated bolometer bridge developed by Rome Air Development Center.

To compensate for changes in ambient temperature, a compensating resistor with a temperature coefficient of resistance similar to that of the bolometer is used as one arm of the bridge. Since an identical compensating resistor cannot be fabricated, a zero-set control has been furnished in both cabinets for zeroing the power meter. Zero setting should be necessary once a day normally: more often if a large change in temperature occurs.

Since the standing wave depends upon the ratio of forward power to reflected power, the power monitor described above, with the aid of a directional coupler to sample reflected power and appropriate switching circuitry, is used to obtain a direct reading of voltage standing wave ratio.

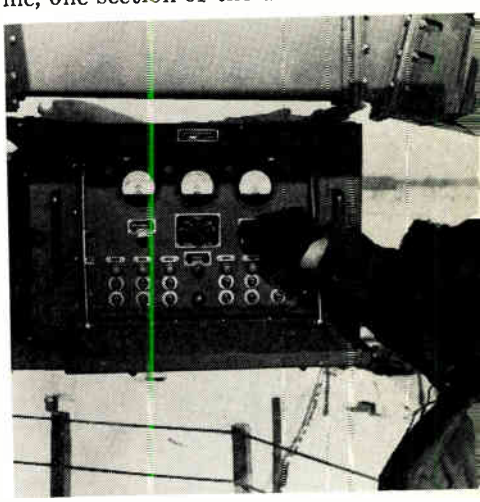
Noise Figure

The noise figure of the receiver is measured continuously, whether the transmitter is firing or not. A known amount of noise is added to the noise of the receiving system through a 20-db directional coupler located in the antenna feed line. This noise is obtained from an argon gas discharge noise tube whose output can be considered a constant multiple of the ideal noise in the transmission line. Since the added noise is a known amount, it increases the noise output of the receiver by a known amount. The ratio of the noise output with the added amount to the noise output under normal operation is an indication of the noise factor of the receiver.

A gate generator is synchronized to the trigger of the radar system. This gate generator fires the noise diode during that period when no radar range is being displayed and extinguishes the noise tube prior to the next transmitter pulse. The noise diode is fired ON during alternate sweeps in order to establish the reference level of the average noise in the receiver.

Relative Tuning

Two convenient test points are available on the AN/FPS-3 for monitoring the relative tuning of the AFC discriminator. At these test points the response of the two tank circuits of the capacitance-coupled Travis discriminator can be checked. If the input to the discriminator is exactly 30 mc, the response of both sections is equal, and therefore, the d-c voltages at these test points are equal. If the input to the discriminator varies from 30 mc, one section of the discriminator will respond more than the other so that the voltages at the test points will be unequal.



Antenna unit of the radar monitor.

In the performance monitor both of these test points are sampled by a chopper. The difference is then amplified and presented on a meter marked off with a green area and a red area. If the meter indicator is within the green area the local oscillator is detuned no more than 100 kilocycles and is within operating tolerance. If the indicator is in the red area, this value is exceeded indicating unacceptable performance.

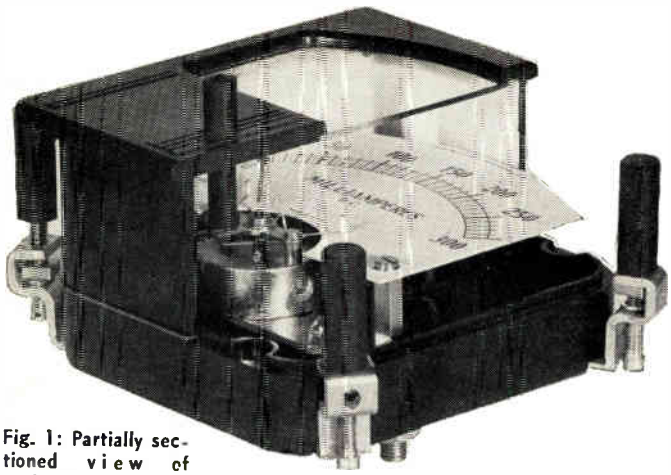


Fig. 1: Partially sectioned view of model 746 milliammeter, showing large spacing from scale to the window

Special sensitive meters were developed to monitor the high voltage power supplies for the North Atlantic Cable. Corona noise, shielding, and safety are important factors in the design

Corona-Proof Meters Check Atlantic Cable

By J. H. MILLER
Vice-President, Weston Electrical Corp., Newark, N. J.

J. H. Miller

The new transatlantic telephone cable represents a major advance in the art of long-distance communication and a truly magnificent gesture of confidence in the vacuum tube. Since all of the power used by the amplifiers in one cable comes from a single direct current of 225 ma, maintaining that current at its optimum value is of major importance.

Power Supplies

The voltage drop across each of the 51 amplifiers in each of the two cables from Clarenville, New Foundland; to Oban, Scotland; is about 55 volts. The total drop across all of the amplifiers in series and the IR drop in the cable itself comes to about 4000 volts. Half of this voltage is supplied at each end of the cable.[1]

Meters

Realizing the importance of accurately measuring the cable current, somewhat special metering equipment was installed capable of accurate measurement, good readability, and a high degree of reliability along with auxiliary equipment for periodically checking the calibration. Since the instruments operate some 2000 volts above ground and even more at times of severe earth potential disturbances, the requirements for shielding, insulation, protection of personnel, and the elimination of radio noise caused by corona, all complicated the problem.

Milliammeter

The primary measuring instrument selected was the Weston Model 315 d-c laboratory portable instrument. Instead of its usual mounting in a mahogany case, the

heavy bakelite front carrying the shielded mechanism, was mounted vertically on a large melamine control panel. Figure 3 shows one of the control bays with both a milliammeter and a voltmeter of this type. Figure 2 shows the instrument as it was furnished with the long bakelite zero corrector arranged to extend through the auxiliary glass plate which furnished a considerable degree of protection.

Physical Construction

These instruments incorporate the latest version of the core magnet type of construction which, in itself, is inherently shielded against the effect of extraneous magnetic disturbances. Mounted in a steel cup electrically connected to the moving system, additional magnetic shielding as well as electrostatic shielding is attained. The metal scale plate is also connected to the mechanism itself effectively eliminating any electrostatic attraction on the pointer from adjacent grounded metal parts. As a result of all of these precautions no discernible effects of high potential could be noticed with the instrument as much as 5000 volts d-c above ground.

Design

Since a high degree of readability was desired on the milliammeter, it was furnished as a suppressed zero millivoltmeter for connection across an external shunt. For good accuracy in a vertical position a much higher than normal torque was deemed necessary. There was no objection to a loss of as much as 1 volt, and calculations indicated about 500 mv would give some three times normal torque and would allow for good temperature compensation. For simplicity the scale was made to read 150 to 300 ma, with the instrument alone adjusted to 300-600 mv at its terminals. Taking a current of 20 ma full scale, this gives a resistance of 30 ohms, amounting to 12 mw full scale or 6.75 mw at the 225 ma initial working point. Since the copper moving coil has a resistance of only about 2 ohms, the temperature compensation is excellent. The ratio of torque to weight is quite high and the damping is just under critical.

The leads from the meter to the shunt were specified to have a maximum resistance of 0.05 ohms. A mean value of 0.025 ohms was allowed for in the 30 ohm adjustment; use of the maximum resistance shunt leads would give less than 0.085% error. Since, at 300 ma full scale, 20 ma would flow into the instrument with 280 ma in the shunt, the resistance of the shunt is 2.143 ohms, and all of the shunts were so adjusted.

Calibration

Suppressed zero instruments are normally frowned upon by instrument designers, since without a free zero, spring set over long periods cannot be detected. However arrangements were made here to disconnect each instrument from its shunt at stated periods and actually check its calibration as a millivoltmeter against a standard cell and a network, the calibration at 225 ma equal to 450 mv, and amounting to a single point potentiometer with an appropriate null reading galvanometer.

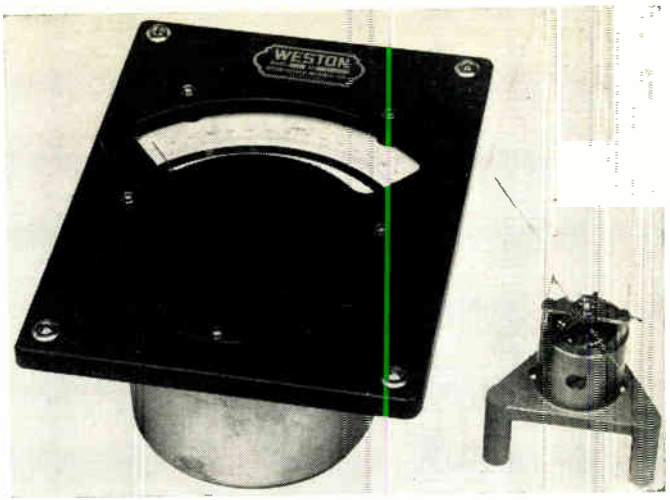
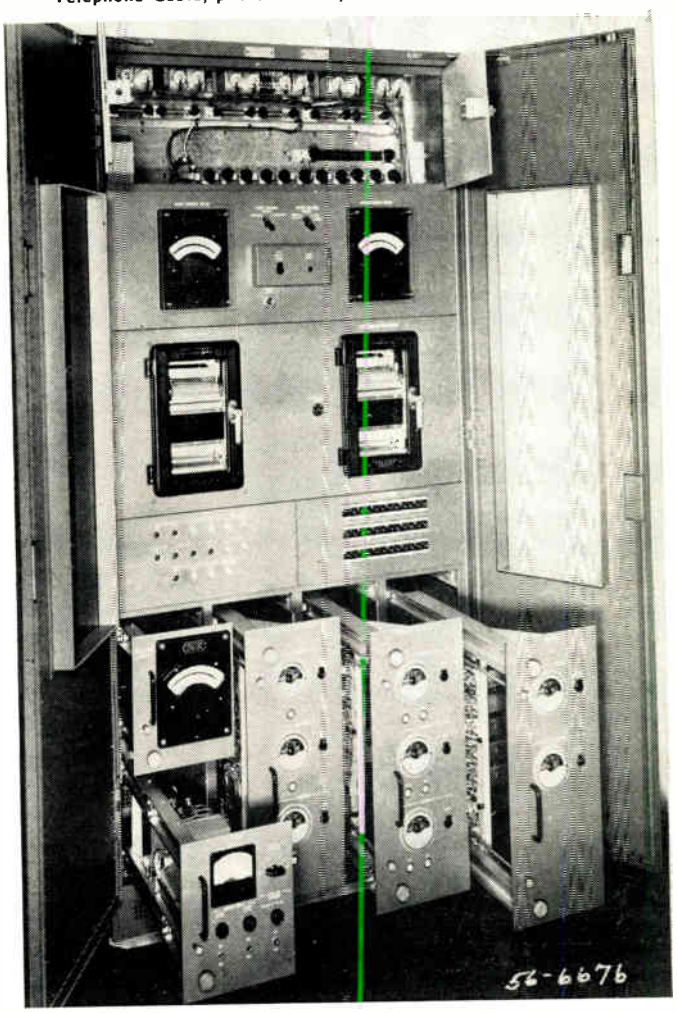


Fig. 2: The Model 315 Milliammeter used to measure the main cable current, with a separate view of the core mechanism

On the assumption that the shunt would remain fixed, this, then, allows for checking the absolute accuracy of the instrument at any time, minor variations being corrected by a slight movement of the zero corrector at the calibration point, 225 ma on the instrument scale. Actual checks so far in use indicate that the several instruments in each circuit are holding calibration to better than the expected ¼ of 1%;

(*Continued on page* 108)

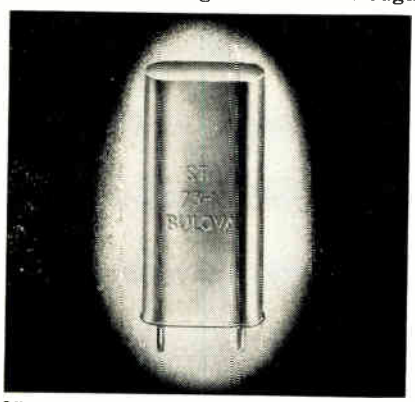
Fig. 3: One of the power supply control bays to the North Atlantic Telephone Cable, photo courtesy Bell Telephone Laboratories



New Products . . . for the Avionic Industry

QUARTZ CRYSTAL

A stable, frequency determining element for missiles, aircraft and other applications of extreme environmental conditions is available. ST-73X has a range of 16 KC through

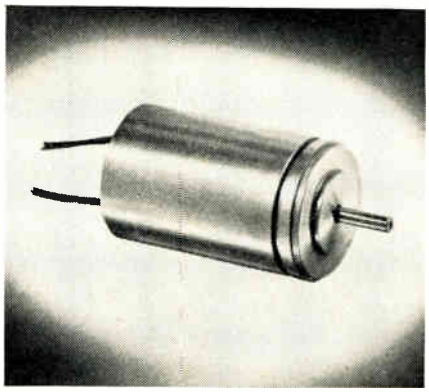


350 KC. Lower frequencies possible in holders of different configurations. Shock and dynamic vibrations tests per MIL-T-5422, MIL-E-5272 and MIL-E-5400 were met. Storage temperatures over a range of -65°C. to +135°C. can be coupled with an operation range of -55°C. to+100°C. Low excursions of frequency (±.015-%) over this range. Bulova Watch Co., Electronic Div., Woodside 77, N. Y.

Circle 45 on Inquiry Card, page 101

SYNCHRO

A synchro with −65°F to +400°F operating temperature range has been developed. The unit has 250 hour life at +400°F. An unusual lubrication method and a special alloy for elec-

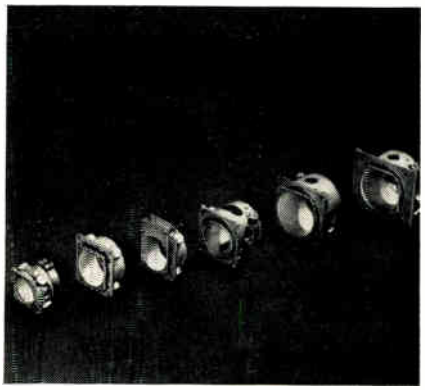


trical connections are being used to successfully withstand the extreme heat. Type 11-4133-01 is a size 11 torque transmitter synchro with 115 v 400 cycle input. Accuracy is ±15%, null voltage 175 mv, stator output 90 volts and phase shift 6.5°. Designed for use with jet engines and for other extremely high temperature applications. John Oster Mfg. Co., Racine, Wis.

Circle 47 on Inquiry Card, page 101

SHOCK MOUNTS

The K130 design has been extended to over 45 available models. All models in this series are basically a radial cushion center - of - gravity mounting system engineered to meet specific vi-

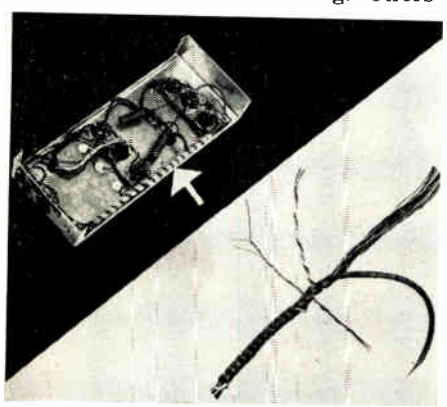


bration and shock control requirements. Vibration and shock requirements meet with military specifications MIL-E-5272, MIL-C-172B, and MIL-E-5272A. Dimensions and load ratings vary from 1.8 in. dia. to 8.5 in. dia. and 0.5 lbs. to 50 lbs. respectively. Installation of mounting systems is simplified by 4 pre-spaced holes. Robinson Aviation Inc., Teterboro, N. J.

Circle 49 on Inquiry Card, page 101

CABLE HARNESS

It is designed to simplify the harnessing of loose wires into neat cables. Made from polyethylene tubing in ¼ in. and ⅜ in. diameters, and cut into a spiral pattern, it will wrap easily around loose wires to make cables in any dia. up to 2 in. Wires may be pulled out at any position. Spiral Wrap is available in 3 colors, white, red, and blue for color coding. Offers

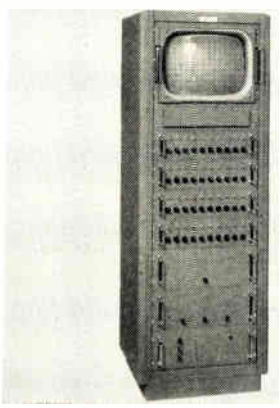


great flexibility, whether used in prototype lab work or mass production. Initially low in cost and saves hours of labor. Illumitronic Engineering, 680 E. Taylor, Sunnyvale, Calif.

Circle 46 on Inquiry Card, page 101

BAR GRAPH OSCILLOSCOPE

The model DC-40BG may be used for observation, at a single glance, 40 separate signals simultaneously. The instrument's 17 inch CRT provides a vertical bar graph, 9 x 12 inches, consisting of 40 vertical lines. Line height is a linear function of signal amplitude and lines, regardless of height. The accuracy is increased by use of a CRT transparent overlay hav-

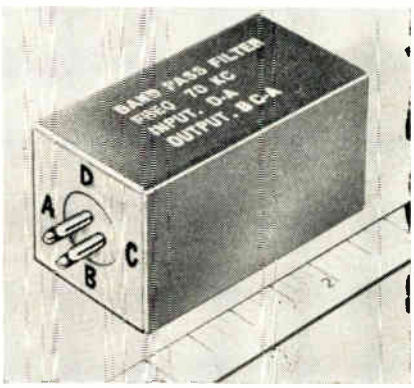


ing 100 evenly spaced lines, with every tenth line of double width, and 40 vertical channel identification lines. Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

Circle 48 on Inquiry Card, page 101

TELEMETERING FILTERS

Subminiature, lightweight telemetering filters for missile applications are now available. The small size of these filters is 2 cu. in. or less per unit. Telemetering filters for channels 1 through 6 are 1.562 x 0.75 x 1.187 in., weight is 71 gr. Channels 7 through 18 are 1.375 x .75 x .75 in., weight is 36 gr. Completely cast in an epoxy-filled resin, all units are



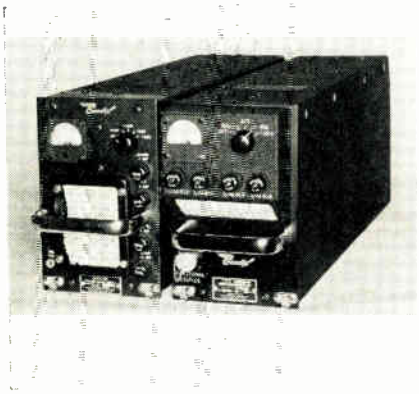
hermetically-sealed and meet MIL specifications for immersion shock and environmental tests. Aerovox Corp., Pacific Coast Div., 2724 Peck Rd., Monrovia, Calif.

Circle 50 on Inquiry Card, page 101

New Products . . . for the Avionic Industry

WEATHER RADAR

A new lightweight airborn weather radar transmitter-receiver is available. The transmitter-receiver is contained in a single ½-ATR package and weighs 26.0 pounds. The new

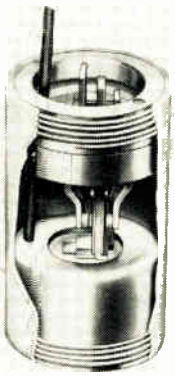


unit still retains all of the basic features of the present X-band RDR-1 airborne radar system, including 150-mile range. The transmitter, designated the RDR-1D, can be integrated with the present systems. With the ½-ATR synchronizer-power supply. the total rack space required for a complete system is 1 ATR. Bendix Aviation Corp., Baltimore 4, Md.

Circle 51 on Inquiry Card, page 101

MINIATURE VIBRATOR

A new miniaturized vibrator measuring 1¼ in. x 3/4 in. in dia. and weighing 1½ oz. has been developed. The 1900 series vibrator was designed to meet extreme requirements for re-



liability and environmental conditions. Satisfactory operation after shocks of 9,000 G. and up. It operates at ambient temperatures from —60 to +100° C. and features a new wear-resistant alloy contact. It is a 400 cycle full wave interrupter type, and can deliver up to 20 w. for short periods. P. R. Mallory & Co. Inc., 3029 E. Washington St., Indianapolis 6, Ind.

Circle 53 on Inquiry Card, page 101

TEMPERATURE MEASUREMENT

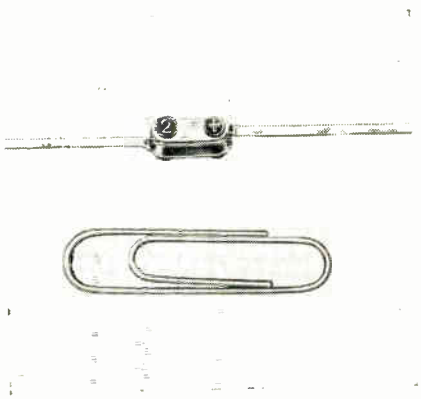
This multichannel temperature instrumentation system is designed to operate directly into airborne telemetering and magnetic tape systems. Models are offered in 7, 14, and 20

channel capacity. Power requirements are 115 V., 400 cps. No vacuum tubes or transistors are employed. Power consumption on 20 channel model is less than 20 watts. System stability is within 1%. Dimensions of 20 channel model are 7 x 4¼ x 3 in. Total weight is 5½ lbs. Arnoux Corp., 11924 W. Washington Blvd., Los Angeles 66, Calif.

Circle 55 on Inquiry Card, page 101

SELENIUM RECTIFIER

The Siemens dwarf, a 5 ma. half-wave rectifier, will handle up to 125 vac. with a resistive load. About a fourth as long as a paper clip, it weighs .015 oz. In a black plastic body with flat pigtail leads, it's inexpensive and withstands vibration and shock. They are available only in half-waves, but several units may be connected for other circuits. They can

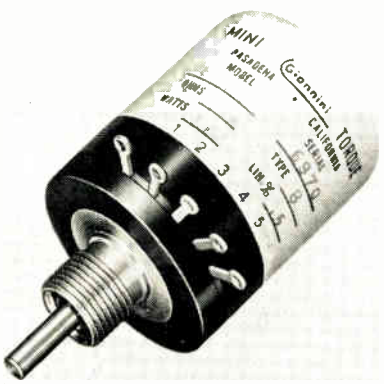


be used for test instruments, computers, control circuits, bias supplies, relays and applicators like transistor power supplies. Radio Receptor Co. Inc., 240 Wythe Ave., Brooklyn 11.

Circle 52 on Inquiry Card, page 101

POTENTIOMETER

A 0.003 oz in. torque has been achieved in the model 85151 minitorque potentiometer. The 1 in. dia. precision instrument features a heavy duty 0.125 in. stainless steel shaft mounted on miniature shielded ball bearings. Brush and coil wear is retarded by low contact pressure. The shaft may be threaded, have milled flats, keyways, etc. Available in re-

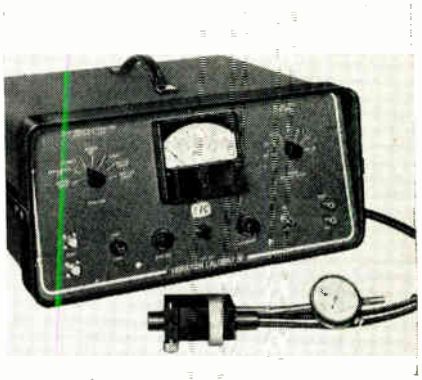


sistance ranges from 100 to 100,000 ohms, it has been constructed to withstand high vibration and acceleration. G. M. Giannini & Co., Pasadena, Calif.

Circle 54 on Inquiry Card, page 101

VIBRATION CALIBRATOR

A vibration calibrator utilizes a non-contacting probe and measures vibrations of 10 to 20,000 cps with amplitudes of 20 to 20,000 microinches. Model 501, will measure, with accuracy of ±5%, vibration amplitudes of non-magnetic metals, Minimum surface dia. is ⅞ in., can be used on magnetic metals by cementing a piece of copper or aluminum



foil 0.01 in. thick and 1 in. in dia. to the surface under the transducer. Weighs 30 lbs. Tel-Instrument Electronics Corp., 728 Garden St., Carlstadt, N. J.

Circle 56 on Inquiry Card, page 101

New Products . . . for the Electronic Industries

CRYSTAL FILTERS

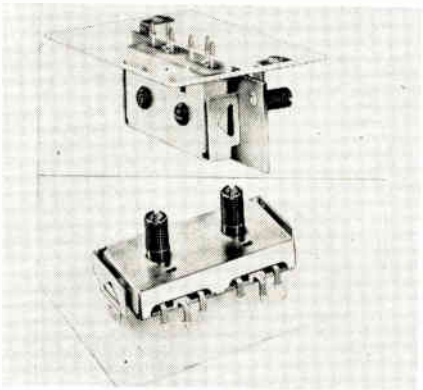
A standard line of i-f band-pass crystal filters for single conversion receivers in the HF and VHF bands are available. Model 2215 KA is designed for voice utilizing a 2800

cycle 6 db band-width. Model 2215 KB has a band of 250 cycles and is primarily for CW reception. Units are interchangeable and may be cascaded. Features are: smooth pass band, no spurious responses, reduced "Birdies" and cross modulation, CW and phone filters interchangeable, single conversion and SSB reception. Hycon Eastern, Inc., 75 Cambridge Parkway, Cambridge 42, Mass.

Circle 57 on Inquiry Card, page 101

VARIABLE RESISTOR

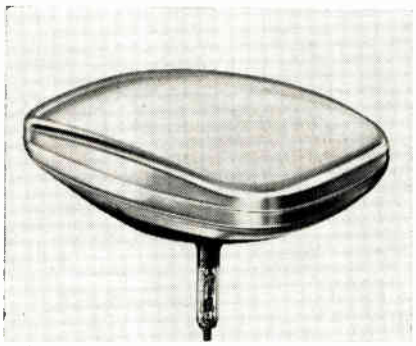
Series U52 is a 2-section side-by-side variable resistor which snaps instantly into place on printed circuit panel or on separate supporting bracket without need for mounting



hardware or additional operations. Compact design requires minimum panel space and reduces handling costs. ¼ in. dia. molded phenolic shafts for finger or screwdriver adjustment are available in 3 styles. Range is 250 ohms thru 10 megohms and rotation angle 300° ±5°. Available for black & white TV, color TV, and other electronic applications. Chicago Telephone Supply Corp., Elkhart, Ind.

PICTURE TUBE

The black & white TV picture tube has an overall length of 12-9/16 in. and a weight of 10 lbs. In addition to its wide deflection angle and short length, the 17BZP4 has a neck di-

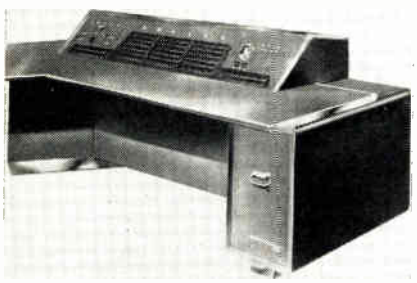


ameter of 1⅛ in. This small neck diameter makes possible the use of a deflecting yoke having high deflection sensitivity, and permits deflection of the beam through the wide deflection angle with only slightly more power than is required to scan a tube with 90° deflection. Deflection angle is 110°. Ion-trap magnet is eliminated. Radio Corporation of America, Harrison, N. J.

Circle 60 on Inquiry Card, page 101

TRANSISTORIZED COMPUTER

The TRANSAC, Type S-1000, is a large scale electronic computer designed for scientific application in research labs., various industries, and universities. The transistor circuitry eliminates bulky insulation and heavy power supply equipment. Generating comparatively little heat, the S-1000 requires a small fraction of air conditioning equipment normally re-

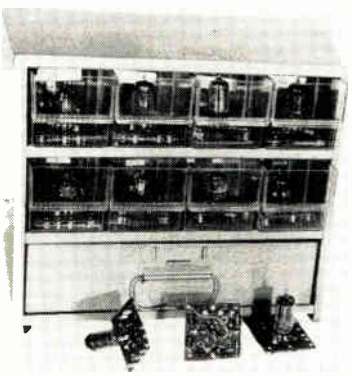


quired. It entails no installation work or special wiring and may be plugged into existing 110 v. 60 cycle outlets. Castors make it highly mobile. Philco Corp., 4700 Wissahickon Ave., Phila.

Circle 58 on Inquiry Card, page 101

CIRCUITS KIT

23 one-tube, unitized circuit assemblies, closely adhering to N. B. S. "Preferred Circuit" design are available. Each DYNAMOD circuit is assembled on an etched card. Includes tube and special terminals. Connections are made by special connectors and cords. Components can be changed without damage to the unit. Kit consists of storage case, breadboard,

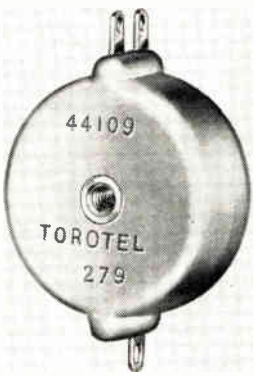


power distribution unit, connector cords, manual, blank circuit cards, and 23 modular circuits. Dale Boison Co., 2928 Nebraska Ave., Santa Monica, Calif.

Circle 59 on Inguiry Card, page 101

TOROIDS

A new series of molded toroids is now available, They are cased in a molding compound which has successfully met government specifications covering the complete range of sizes and types. These new coils are offered with one to five sturdy terminals, as required, and have either a clear bushing or threaded center to permit easy quick stacking. Q values



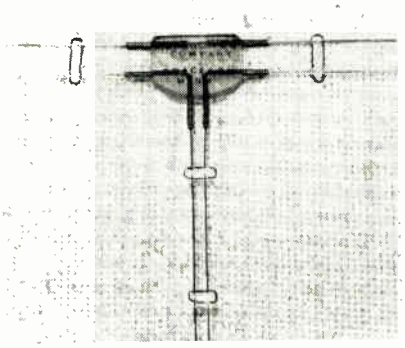
from 30 to over 250 are available, and inductance values up to 17.5 hy are stocked for prompt delivery. Torotel, Inc., 11505 Belmont, Hickman Mills, Mo.

Circle 61 on Inquiry Card, page 101

New Products . . . for the Electronic Industries

POLYSTYRENE ROD

Precision extruded polystyrene rod for application to open-wire transmission lines as well as to tapered line sections is now available. Close extrusion control assures strain-free



styrene rods. Absence of strain is important since any strain or air bubble may cause breakdown of the transmission line spacer. Rods are currently employed as spacers with No. 18 copperweld conductors which permit 200 ft. of unsupported spans. Styrene rod can be supplied in any desired length to meet needs. Anchor Plastics Co., 36-36 36th Street, Long Island City, N. Y.

Circle 62 on Inquiry Card, page 101

STUDIO CAMERA

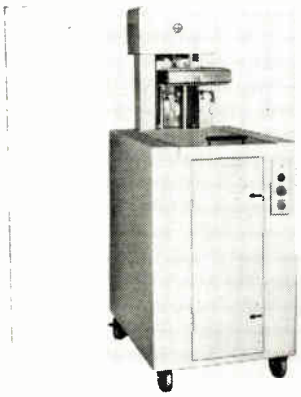
The 7 in. studio camera, model ASC-7, is a compact accessory which enables the camera operator to direct and focus the light image on the vidicon pickup tube. The video signal from the camera is presented on a 7 in. CRT in the rear of the viewfinder housing. Focus is accomplished by adjusting a side control which moves the camera with respect to the

lens. The deflection circuits are self-contained. High voltage for the CRT 2nd anode is obtained from the horizontal output transformer. KinTel, 5725 Kearny Villa Rd., San Diego 11.

Circle 63 on Inquiry Card, page 101

SOLDERING MACHINE

The dip soldering machine has a capacity of 120 units/hour and requires only one operator. Angle and depth of immersion of the work in solder are adjustable. Dwell time may

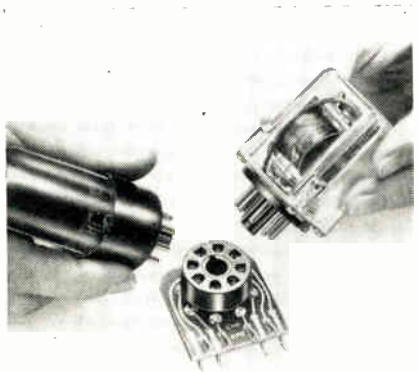


be set from 0 to 57 sec. in 0.5 sec. increments. Solder temperature is automatically maintained. It is equipped with an automatic dross skimmer and a vibrator unit which removes excess solder. The machine is 24 in. wide and 32½ in. deep and overall height is 61 in. It is mounted on sturdy casters and weighs 350 lbs. Electric Products Corp., 322 State St., Santa Barbara, Calif.

Circle 64 on Inquiry Card, page 101

RIGHT-ANGLE SOCKET

A right angle octal socket, suitable for GT type octal tubes and octal base relays and coils, is being manufactured. It is mounted on a laminate base with a printed circuit supplying the circuitry to socket and component. Base material is 3/32 in. XXXP phenolic and copper pattern is .0027 on 2 sides offering a current carrying capacity of 15 a./connection. Base

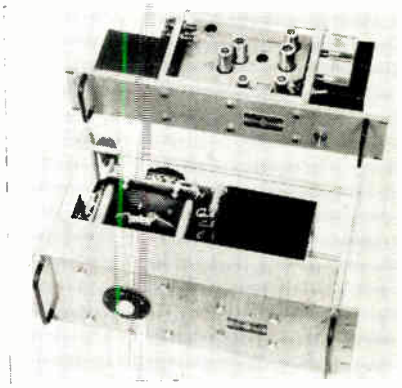


material and copper pattern of the sockets can be altered in size and dimension to meet specifications. Cleveland Metal Specialties Co., 1783 E. 21st St., Cleveland 14, Ohio.

Circle 65 on Inquiry Card, page 101

VOLTAGE REGULATOR

Designed to meet the requirements of MIL-E-4158A, the 1570-ALS15 automatic voltage regulator is offered for use in military or critical industrial applications. Emphasis has



been placed on flexibility, ease of maintenance, reliability, and long life. Regulator is supplied to handle a maximum of 6 kva at 115 v. with input line variations of ±10%. Accuracy of output voltage is ±0.25% for the 6 kva connection. Frequency range is 55 to 65 cycles or 45 to 55 cycles, as selected by a switch. General Radio Co., 275 Mass. Ave., Cambridge 39, Mass.

Circle 66 on Inquiry Card, page 101

TOROID WINDER

The model D toroid coil winder is a complete unit. The machine includes automatic forward and reverse 360° plus (or any segment thereof) rotating device, positive counter, power dereeler, built-in loading device, and 3 shuttles. The capacity of these shuttles is approximately 60 feet according to the wire sizes employed. Full tension control is maintained through-

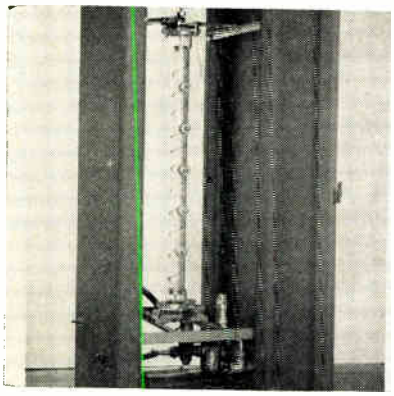
out the winding cycle. Over-all height is 14½ in.; width, 17¾ in.; depth, 11 in.; shuttle diameter, 4 in. and speed is 0-200 plus rpm. Electro Devices, Inc., 580 Main St., Wilmington, Mass.

Circle 67 on Inquiry Card, page 101

New Products . . . for Communications

DUMMY LOAD

Available with fixed resistances from 5 to 200 ohms, the model G6A dummy load can be supplied with tapped resistances. A 0.1 ohm non-inductive monitoring resistor is in-

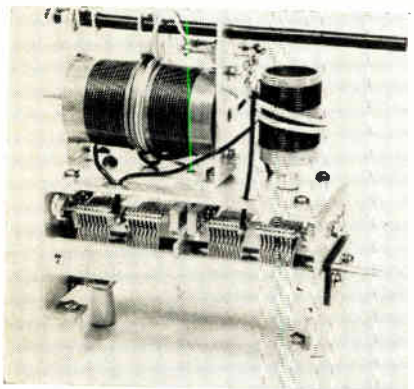


cluded for measuring pulse current. Using water as a coolant, the load can dissipate up to 50 kw average power with 9 gpm of water flow and a 21°C water-temp. rise. Peak power capability is 100 megawatts. Weighing 30 lbs. (less cabinet), the size is 49 in. x 3 in. od glass tube with 5 in. dia. flanges. Levinthal Electronic Prod. Inc., 612 Stanford Industrial Park, Palo Alto, Calif.

Circle 170 on Inquiry Card, page 101

MULTI-BAND TANK

The MB-40DL tank is intended for use in grid circuits with approx. 20 w. input and in final plate circuits of transmitters when the power input to the stage does not exceed 40 w. loaded. The tuning range is from 3.2 to 9.0 MC and from 12.0 to 34.0 MC. Sufficient overlap for the amateur bands is provided to allow for differences in capacity due to layout, tubes, etc. Tuning these frequencies is obtained

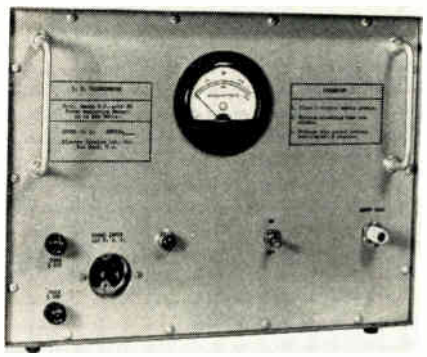


by turning dial to proper setting. A vernier dial is calibrated from 0 to 100 with 180° rotation. National Co., Inc., 61 Sherman St., Malden 48, Mass.

Circle 171 on Inquiry Card, page 101

RF CALORIMETER

This direct reading r-f calorimeter, with frequency range of dc to 4000 MC and power measuring range of 10 to 150 w., is of the constant flow type. It does not use flow meters,

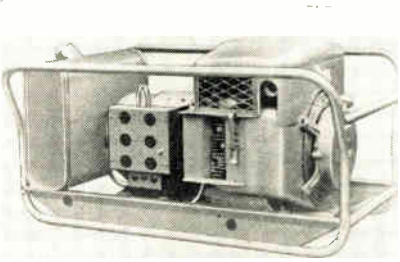


or thermometers and does not require any flow adjustment. The only control is the on-off switch for the constant flow system. Power is read directly on the meter. Accuracy is 5%. Power supply: 105-120 v. 60 cps 60 watts. Other calorimeters covering the range dc to 12,000 MC, coaxial and waveguide are available. Electro Impulse Laboratory, 208 River St., Red Bank, N. J.

Circle 172 on Inquiry Card, page 101

DC ELECTRIC PLANT

Lightweight, portable 5 kw. dc generating plant is currently available. Prime mover is a two-cylinder opposed, 4-cycle, air-cooled, gasoline engine, Model CCK. This engine is rated at 12.9 H. P.; designed for smooth running, heavy-duty, economical electric plant operation. The all-climate generator is direct connected to the engine for positive, permanent alignment. Of drip-proof design, it



is rated at 5,000 w 115 vdc. Weight of the unit is 315 lbs. D. W. Onan & Sons Inc., 2515 University Ave. S. E., Minneapolis 14, Minn.

Circle 173 on Inquiry Card, page 101

FM RECEIVER

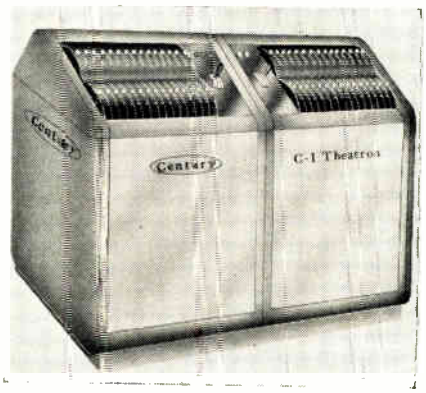
A fully transistorized, 10-oz. instrument designed to provide personalized extensions of several miles for radio systems now operating on the 150 MC. band has been developed.

Featuring printed circuitry, the pocket - size double superheterodyne FM receiver incorporates its own antenna and loudspeaker. It measures 2-3/4 in. x 1 in. x 6-½ in., and operates with self-contained flashlight-type mercury batteries and is carried in the pocket in an "on" position, enabling the carrier to hear all messages. Radio Corporation of America, Camden 2, N. J.

Circle 174 on Inquiry Card, page 101

LIGHTING CONSOLE

An all-electronic, compact 2-scene preset console provides for proportional dimming and proportional cross fading with finger tip operation, uses thyratron tubes. The system has 30 all electronic dimmers of 2000 w. capacity or 22 of 1000 w. capacity and 8 of 4000 w. capacity; a wall mounted 72 circuit patch panel is included, as well as provisions for 3 non-dim circuits. A throw-over switch is in-



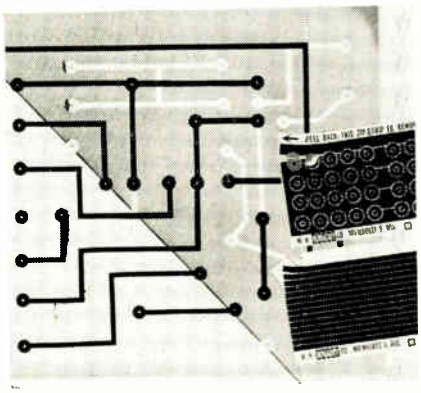
cluded so that some of the stage dimmers serve the dual purpose of houselight dimmers also. Century Lighting Inc., 521 W. 43rd St., New York, N.Y.

Circle 175 on Inquiry Card, page 101

New Products ... for the Design Engineer

DRAFTING AID

Printed circuit layout time is cut with these "Black 'N White" drafting aids. The 2-colored, pre-cut, self-sticking shapes are used for making layouts on clear or translucent film

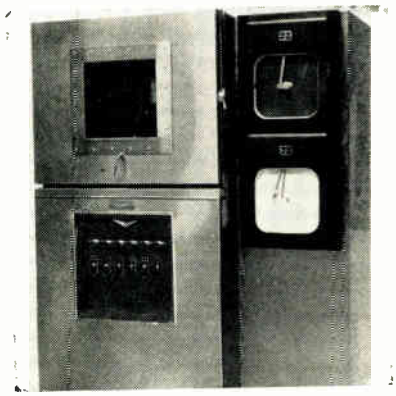


or cloth. Circuitry is laid out on both sides of the sheet. Pre-cut shapes and terminal strips made from the photographic tape have a snow-white adhesive side and a jet-black, non-reflective top side. Inkless prototypes and master layouts are "drawn" quickly. Angles, curves, ellipses, circles can be made. W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 9, Wis.

Circle 176 on Inquiry Card, page 101

TEST CHAMBER

Humidity test chamber simulates environmental conditions throughout the temperature range of 0°F to +200°F and 5% to 98% relative humidity. Controls include 12" diameter wet & dry bulb recorder, controller and programmer. Better than +20°F control tolerance is maintained. The model H8 has a test volume of 8 cubic feet and interior dimensions are

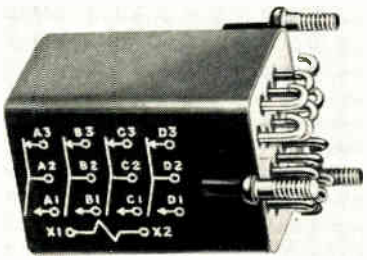


30 x 20 x 24 in. Low air velocities are maintained throughout the test space. Surpasses Military Specifications MIL-E-5272A, MIL-STD-202, MIL-T-27A and others. Environmental Equipment Co., 369 Linden St., Brooklyn 27.

Circle 177 on Inquiry Card, page 101

RELAY

A 10 amp., 4 pole relay has been developed to meet the more rigid requirements of vibration, shock and temperature of the latest MIL specifications. The specifications of the CH

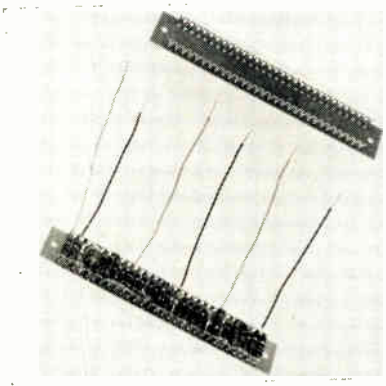


relay are as follows: contact rating 10 amp. resistive at 30 vdc. and 115 v. 400 cps, overload 60 amp.; coil 26.5 vdc, 170 ohms; temp. −65°C to +125°C; vibration 30 g to 2000 cps; operating shock 100 g; weight 5 oz. Military Specifications: Meets test conditions of Mil-R-5757B, Mil-R-6106A, Mil-R-25018. Allied Control Co. Inc., 2 E. End Ave., New York 21, N. Y.

Circle 178 on Inquiry Card, page 101

STRIP PACKAGING

A new concept in electronic component packaging, the process uses a phenolic board with continuous metal terminals automatically inserted. These terminal connections are automatically cut out in accordance with the required circuitry leaving connecting jumpers where needed. Components and lead-off wires are then easily inserted in the terminal strips,

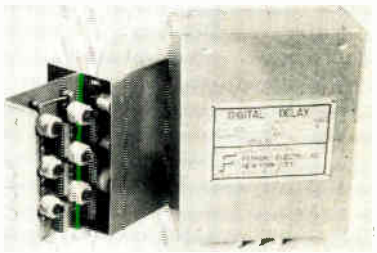


either automatically or manually, without costly lead preparations. Spacing of the metal strips may be varied. Is practical for high or low annual production requirements. Erie Resistor Corp., Erie, Pa.

Circle 179 on Inquiry Card, page 101

LATTICE NETWORKS

A lumped constant electromagnetic network specifically developed and designed for digital storage, uses only 1.2 elements per bit and provides stable characteristice without

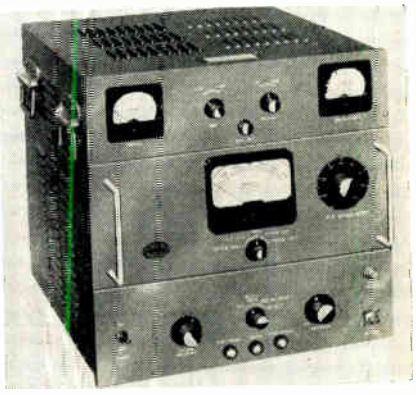


extreme tolerances on the individual elements. Hermetically sealed units will operate over a wide temperature range. Can be supplied for any capacity up to 30 bits at digit rates up to 5 MC for operation over a temperature of −20°C to +70°C. Can be grouped for series or parallel operation with rapid access. Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.

Circle 180 on Inquiry Card, page 101

SWEEP GENERATOR

The electronic sweep generator, model ESG, provides complete coverage from 1,000 to 15,000 MC at 60 cps with a power output of from 10 mw. to one watt, with 7 interchangeable oscillator units. The instrument is designed for fast dynamic testing of microwave systems and components, such as receivers, amplifiers, preselectors, hybrid junction jammers, inter-



cept equipment, beacons, antennas, T/R tubes, crystal mounts, fixed and tunable filters and complete radar and microwave systems. Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

Circle 181 on Inquiry Card, page 101

WASHINGTON News Letter

STRESS MOBILE RADIO TASKS—The FCC, in the annual consideration of its appropriation by Congress, placed greater emphasis than ever before on its responsibilities for the mobile radio and microwave services under its Safety and Special Radio Services Bureau. The FCC funds hearings before the Senate and House Appropriations Committees featured presentations by the Radio-Electronics-Television Manufacturers Association and the American Trucking Associations, in addition to those of the Commissioners and top bureau officials. These groups spoke in support of additional funds for this FCC activity so that applications can be processed on a 30-day basis instead of the 90 days contemplated in the FCC's budget request. RETMA Executive Vice President James D. Secrest and RETMA Mobile Radio Manager Carroll White appeared before the Senate Committee April 12 just as they had before the House body, and the ATA called on the Senate group's members to urge additional mobile radio funds.

SUBSCRIPTION TV MUDDLE—Congress and the FCC are centering attention on policies for subscription television, but the situation is so muddled that no clear cut solution of the controversial method of video program dissemination can be seen so far. Because toll TV proponents have lined up some potent Congressional support, the problem for the FCC is most complex and fraught with political hurdles. At our press deadline, the FCC feels the best course is to authorize testing on a nationwide basis with spot trials in large and small markets; and to hold a hearing on the details of pay-TV operations to aid in its policy determinations for the service.

NO MILITARY PLANS YET—Most authoritative governmental sources informed Electronic Industries' Washington Bureau there was no foundation for a leading article early in April in a radio-broadcasting publication that a formal request has reached the White House from the military—probably through the Joint Chiefs of Staff—asking that President Eisenhower preempt low band vhf television spectrum space for military purposes. The article asserted television channels 2-6 were in jeopardy and that it would affect 200-odd television stations which would have to be moved to uhf. A top official of the Office of Defense Mobilization told our news bureau that a check by him showed "no request" is pending at the White House from the Joint Chiefs of Staff. The article intimated that the frequency needs of jet aviation and forward scatter had to be taken care of through the channels 2-7 space.

RETMA NAME CHANGE—The proposal decided at the recent Washington board of directors meeting of the Radio-Electronics-Television Manufacturers Association to change its name to Electronics Industry Association is to be presented to the organization's annual convention in Chicago this month. The plan to change the association's name to one more adequately representing the industry's present-day scope has been considered by the RETMA Organization Committee, headed by Paul V. Galvin, Board Chairman of Motorola and World War II President of the Association.

BDSA ELECTRONICS—The Electronics Division of the Business Defense & Services Administration is to have a Deputy Director of the Division nominated from industry through the Radio-Electronics-Television Manufacturers Association to serve for six-month tours of duty. The division coordinates government-industry cooperative plans for mobilization of the radio and electronics manufacturing industry in the event of an emergency. In addition, under the proposal of BDSA Administrator H. B. McCoy the RETMA member companies are to furnish around a dozen young executives for 10-day training programs with BDSA so they will be ready to take over posts with the division in case of war.

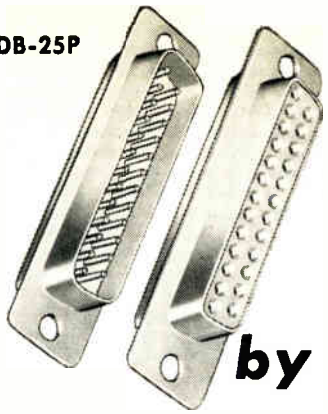
FCC'S NON-BROADCAST PROBLEMS—Growth of forward scatter and microwave operations, and increasing interference situations, present special problems to the FCC's Safety and Special Radio Services Bureau. The Bureau's leadership told E. I.'s Washington news correspondent that the use of frequencies between 25 and 50 megacycles for long distance "scatter" communications is a paramount concern, and a subject which will have a high place on the agenda of the 1959 international radio conference at Geneva. The upcoming microwave hearing is a question of "unusual complexity" not only from the technical standpoint but because of the need of "evaluation of the economic consequences that may flow from widespread use" of private systems. Excellent accomplishments in the interference field have resulted from the self-help groups organized by radio engineers in different cities and areas.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

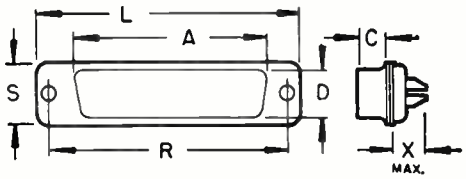
☆ CANNON D SUB-MINIATURE, DPA and DPX SERIES

CONNECTORS by CINCH



D SUB-MINIATURES:

Standard Pin and Socket Inserts.



size	A	C	D	L	R	S	X	weight
DA-1SP	1 1/64	15/64	23/64	1 17/32	1.312	31/64	5/16	.013
DA-1SS	1 3/32	15/64	5/16	1 17/32	1.312	31/64	5/16	.014
DB-2SP	1 9/16	15/64	23/64	2 5/64	1.852	31/64	5/16	.023
DB-2SS	1 33/64	15/64	5/16	2 5/64	1.852	31/64	5/16	.031
DC-37P	2 13/64	15/64	23/64	2 23/32	2.500	31/64	5/16	.035
DC-37S	2 11/64	15/64	5/16	2 23/32	2.500	31/64	5/16	.035
DD-50P	2 7/64	15/64	15/32	2 5/8	2.406	39/64	5/16	.035
DD-50S	2 5/64	15/64	27/64	2 5/8	2.406	39/64	5/16	.040
DE-9P	45/64	15/64	23/64	1 13/64	.984	31/64	5/16	.011
DE-9S	41/64	15/64	5/16	1 13/64	.984	31/64	5/16	.012

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More than thirty years experience in the design and manufacture of standard electronic components insure Cannon Connectors by CINCH to be of the highest quality materials, fabricated to specifications to maintain consistent quality of product; highest standards throughout all operations.

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Shell, including flange — steel or brass; Finish — Cadmium plate or Irridite. Contacts — No. 20, 5 ampere rating — Copper base alloy, gold plate finish.

Insert arrangements — 5 plus coaxials in 9, 15, 25, 37 and 50 contacts.

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Polarization — Keystone cornered shell.

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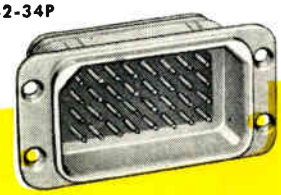
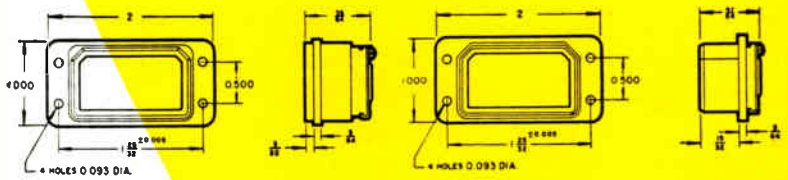
DPA 32-34P



DPA 32-33S

DPA CONNECTORS:

Shell with retaining plate. Pin and Socket Inserts.



Send for illustrated Catalog No. 157 with details of "D" Sub-Miniature, "DPA" and "DPX" Series.

DPX CONNECTORS:

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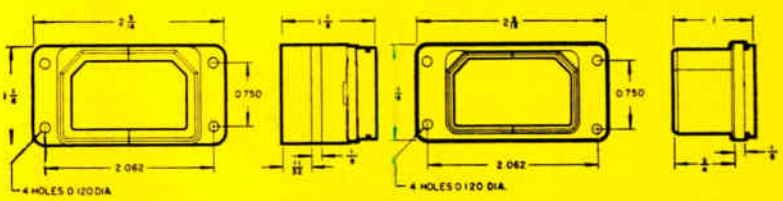
DPX 23-34P

DPX 23-33S



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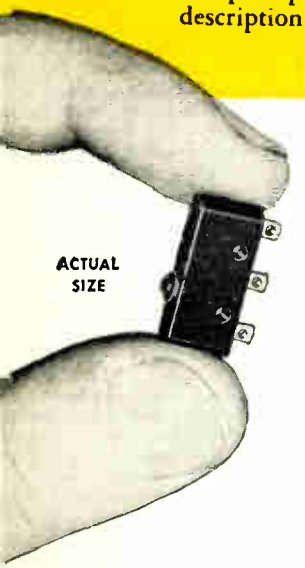

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S.P.D.T., 1 circuit; 5 amps, 125/250 v. AC Operating force 150 grams max. Exceptionally vibration-resistant. Special model E4-7 is stabilized for — 65° to + 350° F. operation.

Write for data sheet EG-5


Push Button Actuator

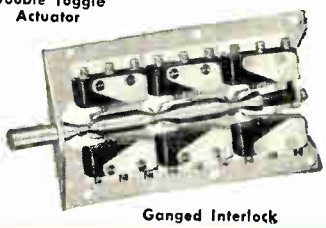

Toggle Actuator (Momentary or Constant Contact)


Double Toggle Actuator


Roller Leaf Actuator


Leaf Actuator

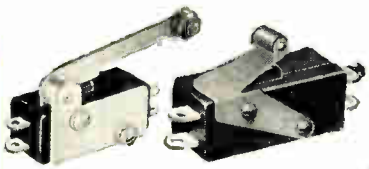

Extension Leaf Actuator

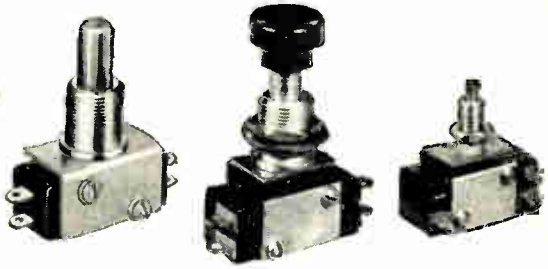

Ganged Interlock

TYPE S SWITCHES Series S1

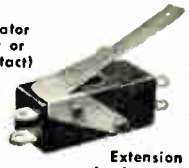
S.P.D.T., 2 circuit; 10 amps, 125/250 v. AC/ 30 v. DC. Ind. Screw or solder terminals on ends or one side of switch. Also available with reset button at bottom of switch or in Type S-100 Make-Before-Break Series where switch completes a new circuit before interrupting old one.

Write for data sheet STG-5

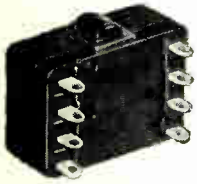

Roller Lever Actuator — Roller Actuator


Push Button Actuators (Various button sizes available)


Toggle Actuator (momentary or constant contact)


Extension Leaf Actuator


Special Push Button Actuator designed for fire control system

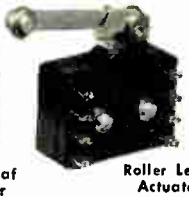


Write for data sheet DG-5

DOUBLE-POLE SIMULTANEOUS ACTION TYPE D-8

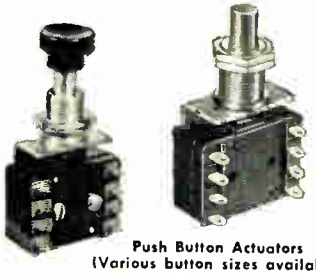
D.P.D.T., 4 Circuit
15 amps, 125/250 v. AC.
10 amps, 30 v. DC Ind.
Eight terminals and four separate circuits which operate simultaneously permite switch to reverse 3-phase motors, replace expensive relays, etc.


Roller Leaf Actuator


Roller Lever Actuator


Leaf Actuator


Extension Leaf Actuator


Push Button Actuators (Various button sizes available)

HERMETICALLY-SEALED DOUBLE-POLE SWITCH

Write for data sheet HJG-5


Type J2-4


Toggle Actuator for J2-4

D.P.D.T., 4 circuit 10 amps, 125/250 v. AC/30 v. DC.

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ANTENNAS, PROPAGATION

DC-8 Sets New Electronic Style, by J. E. Hickey, Jr. "El. Ind." May 1957. 2 pp. The new high voltage power plant and streamlined wiring are highlights of the redesigning job done by Douglas engineers on the DC-8 commercial jet airliner.

New Design in TV Broadcast Antennas, by M. S. Siukola and G. A. Kumpf. "El. Ind. Op. Sect." May 1957. 3 pp. A new "Traveling Wave Antenna" for the VHF Band is described which features mechanical simplicity, improved pattern characteristics, and high power handling capacity.

The Gain of a Directional Short-Wave Receiving Antenna with Back-Scatter, by B. Beckmann and K. Vogt. "Nach. Z." Feb. 1957. 2 pp. Gain measurements at directional receiving aerials by means of long distance reception in the presence of back-scatter have led to the conclusion that the back-scattered radiation is essentially a coherent one.

An Experimental Dual Polarization Antenna Feed for Three Radio Relay Bands, by R. W. Dawson. "Bell J." March 1957. 18 pp. Problems of coupled-wave transducers operating over a three to one frequency band are explored and usable solutions suggested. The authors describe experimental models for feeding the horn-reflector antenna for two polarizations for waves in the four, six, and eleven kmc radio relay bands.

The Effect Of The Form Of The Structural Function For The Permittivity Inhomogeneities of Air Upon Long-Range Tropospheric Propagation Of Ultra-High-Frequency Radiowaves, by V. N. Troitsky. "Radio Tekhnika i Elektronika," Jan. 1957. 3 pp.

Expressions are derived for the median magnitude of the field intensity and for the possible transmission band in the case of long-range tropospheric propagation of ultra-high-frequency waves. The effect of the form of the structural function upon the magnitude of the field intensity and upon the magnitude of the distortion is analyzed.

The Frequency Band Occupied In The Transmission Of Pulses, by M. S. Gurevich. "Radio Tekhnika i Elektronika," Jan. 1957, 6 pp.

The paper examines the energy distribution of pulses over the frequency band. Numerical values are determined for the width of the frequency band occupied during the transmission of pulses. Conclusions are drawn regarding the special features of pulses which are shaped in various ways; such an analysis is made from the point of view of the pulse energy distribution over the frequency band.

The Ionospheric Attenuation of Hectometer Waves (550 to 1600 kc) "Nach. Z.", Jan. 1957.

The results of various nighttime measurements carried on during the last 22 years are compiled. All measurements are reduced to a radiated power of 1 kw and a quarter-wave length vertical antenna.

The Coupling Impedance of Tape Structures, by P. N. Butcher. "Proc. BIEE." March 1957, 11 pp. In addition to the titled subject, the author discusses briefly the use of the tape structures in traveling wave tubes for the millimeter wave bands.

A Theoretical Study of Propagation Along Tape Ladder Lines, by P. N. Butcher. "Proc. BIEE." March 1957. 8 pp. Dispersion curves are calculated by single-ridge, double-ridge, single-T-section, and double-T ladder lines in which the rungs of the ladder are thin tapes.

Very-Low-Frequency Propagation and Direction-Finding, by F. Horner. "J. BIEE." March 1957. 8 pp. This is a study of propagation of 16 kc radio waves and an assessment of the polarization errors to be expected in taking bearings on lightning flashes at similar frequencies. Further measurements have been taken to provide information on the reflecting properties of the ionosphere at 16 kc.

Distributed Amplifiers As Antenna Multi-Couplers, by E. T. Pfund, Jr. "El." April 1, 1957. 4 pp. Electronic devices for connection of several receivers to one antenna are described.

AUDIO

Acoustics of Large Orchestral Studios and Concert Halls, by T. Somerville and C. L. S. Gilford. "Proc. BIEE." March 1957. 13 pp. The effects of shape on the subjective acoustic qualities of a large enclosure are examined with reference to a large number of concert halls and music studios, and a comparison is made, in particular, between concert halls of the traditional type and those which have been built during the last few decades. It is concluded that the modern trend toward directing the early reflections during the back of a concert hall, although it may improve the hearing of speech, has an adverse effect on the quality of music.

A Musical Instrument for Deaf-Mute Children, "Phil. Tech." Feb. 10, 1957, 3 pp. Breath-driven steel reeds produce the sound in miniature instruments with piano-keyboard controls. Electronic amplifiers boost the sound level to a point where deaf children can sense the vibrations, thus introducing them to sensations of sound, music, and indirectly, speech.

CIRCUITS

AFC Circuit Cures Military Design Ills, "Industrial Laboratories," March 1957, 2 pp. This is a description of the NBS-derived preferred afc circuit.

REGULARLY REVIEWED

AEG Prog. AEG Progress
Aero. Eng. Rev. Aeronautical Engineering Review
Ann. de Radio. Annales de Radioelectricite
Arc. El. Uber. Archiv der elektrischen Uebertragung
ASTM Bul. ASTM Bulletin
Auto. Con. Automatic Control
Auto. El. The Automatic Electric Technical Journal
Avto. i Tel. Avtomatika i Telemekhanika
AWA Tech. Rev. AWA Technical Review
BBC Mono. BBC Engineering Monographs
Bell Rec. Bell Laboratories Record
Bell J. Bell System Technical Journal
Bul. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Comp. Computers and Automation
Con. Eng. Control Engineering
E. & R. Eng. Electronic & Radio Engineer
Elek. Elektrichestvo
El. Electronics
El. & Comm. Electronics and Communications
El. Des. Electronic Design
El. Energy. Electrical Energy
El. Eng. Electronic Engineering
El Eq. Electronic Equipment
EL. Ind. ELECTRONIC INDUSTRIES & Tele-Tech
El. Mfg. Electrical Manufacturing
El. Rund. Electronische Rundschau
Eric. Rev. Ericsson Review
Fern. Z. Fernmeldetechnische Zeitschrift
Freq. Frequenz
GE Rev. General Electric Review
Hochfreq. Hochfrequenz-technik und Elektroakustik
IBM J. IBM Journal
Insul. Insulation
IRE Trans. IRE Transactions of Prof. Groups
Iz. Akad. Izvestia Akademii Nauk SSSR
J. BIRE. Journal of the British Institution of Radio Engineers
J. ITE. Journal of The Institution of Telecommunication Engineers
J. IT&T. Electrical Communication.
J. UIT. Journal of the International Telecommunication Union
Nach. Z. Nachrichtentechnische Zeitschrift
NBS Bull. NBS Technical News Bulletin
NBS J. Journal of Research of the NBS.
Onde. L'Onde Electrique
Phil. Tech. Philips Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers
Proc. BIEE. Proceedings of the Institution of Electrical Engineers
Proc. IRE. Proceedings of the Institute of Radio Engineers
Radiotek. Radiotekhnika
Radio Rev. La Radio Revue
RCA. RCA Review
Rev. Sci. Review of Scientific Instruments
Rev. Tech. Revue Technique
Syl. Tech. The Sylvania Technologist
Tech. Haus. Technische Hausmitteilungen
Tech. Rev. Western Union Technical Review
Telonde. Telonde
Toute R. Toute la Radio
Vak. Tech. Vakuum-Technik
Vide. Le Vide
Vestnik. Vestnik Svyazy
Wire. Wld. Wireless World

For more information, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request by writing to "Electronic Sources" Editors. ELECTRONIC INDUSTRIES & Tele-Tech, Chestnut & 56th Sts., Philadelphia 39.

International ELECTRONIC SOURCES

New Temperature-Compensation Method for Oscillators, by F. Mueller. "E. Rund.", March 1957. 6 pp.

The resistance variations of a thermistor are transformed by a reactance tube, either connected as inductance or capacitance, into temperature-variation compensating impedance variations.

A Half-Wave Bridge Magnetic Amplifier, by W. Gregson. "El. Energy." March 1957. 7 pp. This article describes a fast acting servo amplifier which accepts either an ac or dc signal voltage, and delivers into a load unidirectional pulses of current whose polarity is dependent upon the phase or polarity of the input voltage.

Designing Transistor Circuits—D-C Amplifiers, by R. B. Hurley. "El. Eq." March 1957, 5 pp. Mr. Hurley presents some practical design considerations of transistor circuits.

Silicon Diode Application Notes, by A. Bergson. "El. Des." March 1, 1957. 4 pp. Characteristics of fundamental rectifier circuits with resistance loads are presented in tabular form. The article discusses forward power dissipation, thermal charcteristics, surges, and overloads of silicon diodes.

A Two-Phase Low Frequency Oscillator (Part 1), by E. F. Good. "El. Eng." April 1957. 6 pp. The described circuit provides means of generating an oscillation of stable amplitude and low harmonic content, and with a loop gain of exactly unity for an oscillation of a given amplitude. An incidental advantage cited is that two outputs are available with 90° phase difference. The circuit is built around a two-integrator loop.

Report on Power Transistors For Converters, by B. Reich. "El. Des." March 15, 1957. 2 pp. Power transistors from eleven manufacturers were tested to determine the present status of power transistors for converter circuits. Mechanical and electrical reliability were the chief concern of the investigators. Major conclusion is that the effects of poor moisture seals are still a major problem to the transistor industry.

Minimizing Incidental Frequency Modulation in Amplitude-Modulated UHF Oscillators, by G. Schaffner. "Proc. IRE." April 1957. 7 pp.

A Series-Parallel Transistor Combination, by M. A. Lloyd. "El. Eng." April 1957. 1 p. A transistorized voltage regulator circuit is described. The test circuit proved capable of maintaining 6.3 v over a current range of 0-2 amps. The circuit contains five transistors and uses a reference battery.

Oscillators Not Affected by Loads, by E. Frisch and W. Herzog. "Nach. Z." Jan. 1957. 4 pp. Conditions for a feedback path which result in an oscillator independent of its load impedance are presented. Experiments with this type of oscillator are reported, a general theory is developed, and a bridged-T feedback network is discussed in some detail. Frequency deviations do not exceed 0.16% for a capacitive load, 0.08% for a resistive load, and 0.35% for an inductive load.

Air-Drop System Broadcasts Message, by F. C. Fischer, A. A. Gerlach, and D. S. Schover. "El." March 1, 1957. 3 pp. This describes the amplifier, tape reproducer, and loudspeakers used in a parachute-braked drop from an aircraft. A minimum of three minutes of intelligible speech over a half-mile diameter area on the ground is provided.

A Transistor Pre-Amplifier for the Magnetodynamic Pick-Up, by C. Huber and J. Rodrigues de Miranda. "Phil. Tech." Feb. 4, 1957. 5 pp. A single transistor pre-amplifier conforming with good approximation to the "American-Standard Response" curve is described. It is designed primarily for use with the newly announced Philips magnetodynamic pick-up.

Amplitude Modulation of Microwaves by Tunable Transmission Waveguide Filters, by M. H. N. Potok and J. Barbour. "J. BIRE." Feb. 1957. 11 pp. Amplitude modulation of microwaves can be obtained by shifting the passband of a transmission filter by the modulating signals. A linear response and a bandwidth over 4 kc at 9,000 mc have been obtained using similar components and circuits.

Development of a Medium Power L-Band Traveling-Wave Amplifier, by L. W. Holmboe and M. Ettenberg. "IRE Trans. PGED." Jan. 1957. 4 pp. Design and performance of a high-gain medium power TWT amplifier are described. Powers up to 7 watts at 15% efficiency have been achieved.

Millimicrosecond Blocking Oscillators, by J. MacDonald Smith. "El. Eng." April 1957. 3 pp. The design of millimicrosecond blocking oscillators is discussed. The theory of the circuit is outlined and expressions for the pulse width and rise-time are derived.

High-Speed Gating Circuit Using the E80T Beam Deflection Tube, by L. Sperling and R. W. Tackett. "IRE Trans. PGED." Jan. 1957. 5 pp. This paper describes a high-speed gate circuit for an information sampling system employing the E80T beam deflection tube comparative simplicity, reliability, and minimol signal beam through advantages of this circuit.

Gate Tube Generates Interleave Pulse Chain, by D. Kushner. "El." April 1, 1957. 2 pp. A time measuring interleave pulse generator is described. Design and construction are discussed.

The Gain and Bandwidth Characteristics of Backward-Wave Amplifiers, by M. R. Currie and D. C. Forster. "IRE Trans. PGED." Jan. 1957. 10 pp. The design of backward-wave amplifiers to yield specified pass band characteristics is discussed. Simple charts are developed which facilitate the design of procedure. Experimental results are correlated with theory. A specific design example is given.

Music Pulse Analyzer Rejects Voice Signals, by R. L. Ives. "El." April 1, 1957. 3 pp. An electronic circuit is described which is capable of distinguishing between the heavily damped waves characteristic of speech and lightly damped musical tones. The device can be used to discriminate against speech in any language, and pass only music. A circuit diagram of this speech rejector is included.

A Square Wave Converter with Feedback Control of Mark-to-Space Ratio, by J. B. Earnshaw. "El. Eng." April 1957. 4 pp. The device will operate with repetitive input waveforms which are not necessarily sinusoidal, and is extremely stable under variable operating conditions.

COMMUNICATIONS

Packaged Selectivity, "G-E Ham News." March-April 1957. 4 pp. This article describes use of a mechanical i-f filter to obtain narrow bandwidth in communications receivers. The circuit described is intended for substitution in place of the first i-f tube of existing receivers without any under-chassis changes.

Locating Radio Repeaters. "Motorola Newsgram." Nov.-Dec. 1956. 2 pp. This is a discussion of locations suitable for repeaters in the mobile communications field.

Comparison of Split Channel FM and Single Sideband for Land Mobile Services, by A. A. Macdonald. "IRE Trans. PGVC." Dec. 1956. 8 pp.

Recent Developments in Four-Wire Switching of Long-Distance Telephone Circuits, by I. Molnar. "Auto. El." Dec. 1956. 17 pp.

The Application of Transistors to AM Broadcasting Receivers, by B. F. C. Cooper. "J. BIRE." Feb. 1957. 12 pp. It is shown that with a single ended class A output stage, a minimum of six transistors is needed to be competitive with existing four tube portable receivers. For class B, meeting similar competitive standards, seven transistors are required. Problems encountered in the design of components for a transistorized circuit are considered in some detail and the design of an experimental receiver is described.

Sensitivity Considerations in Microwave Paramagnetic Resonance, Absorption Techniques, by G. Feher. "Bel J." March 1956. 36 pp. Several specific systems are analyzed and the results verified by measuring the signal-to-noise ratio with known amounts of a free radical.

Optimizing Airborne Electronic Equipment, by S. Hubelbank. "El. Des." Mar. 15, 1957. 2 pp. The author discusses the highlights of Air Force general specifications for the design of airborne electronic equipment, MIL-E-25647, which is currently being distributed.

A New Carrier System for Rural Service, by R. C. Boyd, J. D. Howard, Jr., and L. Pedersen. "Bell J." Mar. 1957. 42 pp. Transistors, miniaturization, and modern methods of assembly are combined to create a new telephone carrier system suitable for rural service.

The New Portable Picture Transmitter D-770, by A. A. Kirchel and P. W. Sieber. "Muirhead Technique." Jan. 1957. 3 pp. The basic principles and operating features of a 35-pound portable wire-photo transmitter are reviewed.

The Detectability of Fading Radiotelegraphy Signals in Noise, by H. B. Law. "Proc. BIEE." March. 1957. 11 pp. An ideal receiver for binary synchronous telegraphy is defined as one that interprets each element of a received signal with a minimum probability of error. The author's analysis leads to a mathematical specification for the ideal diversity receiver and thus provides a starting point for the design of practical receivers.

Application of 8-Channel Open-Wire Carrier Telephone Systems in Brazil, by A. W. Ewen and H. J. B. Nevitt. "Eric. Rev.," 1956, No. 3. 10 pp. Considerations leading to the choice of this type ZAA 8 carrier system for additional facilities between São Paulo and other cities in Brazil are set forth. The performance is reviewed; the characteristics of the open-wire lines available were tested, and their applicability to the ZAA 8 system discussed. Actual system performance is reported.

Superregenerative Transistor Transceiver, by W. F. Chow. "El." Apr. 1, 1957. 3 pp. Theory and practical design considerations are discussed for a 52-mc transistorized transceiver. A forced-quench superregenerative detector circuit is used for reception.

The Signal Slant Bar Noise Performance Rating of Receivers for Long-Distance Synchronous Radiotelegraph Systems Using Frequency Modulation, by H. B. Law. "Proc. BIEE." Mar. 1957. 6 pp. Experimental results supported by theory indicate that the error liability after regeneration of the output of a limiter-discriminator frequency-modulation radio telegraph receiver, when fed with steady signals, plus noise, can be described in terms of a simple exponantial relation involving a single parameter, which characterizes the receiver performance.

Aircraft Radiophone Speeds Communications, by B. R. Rashkow. "El." Apr. 1, 1957. 5 pp. System requirements for aircraft radiophone communications are discussed in general terms.

International ELECTRONIC SOURCES

Data Link May Start Vortac-Type Battle, by P. J. Klass. "Aviation Week." Apr. 1, 1957. 6 pp. A description of the Tacan-Vortac data link, and a discussion of probable merits of the system.

An Investigation of a Spectra of Binary Frequency-Modulation Signals with Various Build-Up Wave Forms, by J. W. Allnatt and E. D. J. Jones. "Proc. BIEE." Mar. 1957. 6 pp. It found that a straight-line waveform is the best that can be employed for the transition between a mark and space frequencies in frequency-shift radio telegraphy, since this waveform involves the minimum occupied bandwidth for a given total build-up time.

Practical Experience in the Operation of Crossbar Exchanges in the Rotterdam Zone, by F. W. van der Haer. "Eric. Rec.," 1956, No. 3. 7 pp. This is a report on automatization of the telephone exchanges in progress in the Rotterdam zone. Particular attention is given to maintenance requirements, considerably reduced for crossbar exchanges as compared to step-by-step exchanges. Two fault statistics and one table showing traffic observations are included and discussed.

Telesignalling Equipment in a Modern Hospital, by A. Trägardh and J. Kamp. "Eric. Rev.," 1956. No. 3. 10 pp. The installation of a patients' calling system, a supervisory system for infants' wards, various signalling systems, a paging system, and a sound distribution system in a modern Danish hospital is described. The special performance features of these various facilities are set forth.

Ultra Sonic Tracer Follows Tagged Fish, by P. S. Trefethen, J. W. Dudley, and M. R. Smith. "El." Apr. 1, 1957. 5 pp. A capsulated, transistorized, ultra-sonic transmitter is clipped to the back of a fish. 132-kc ultrasonic pulses from the transmitter are detected by automatic ultra-sonic tracking and ranging equipment in a launch. The initial stimulus for this equipment was the need to obtain detailed information about fish behavior in relation to dams.

Frequency Diversity in the Reception of Selectivity Fading Binary Frequency — Modulated Signals, by J. W. Allnatt, E. D. J. Jones, and H. B. Law. "Proc. BIEE." Mar. 1957. 13 pp. Ideal receiver consideration, experimental demodulation units, and results of laboratory tests of this method as applied to long-distance radio telegraphy are reported.

Sub Miniature Beacon for Guided Missiles, by M. Cohen and D. Aranay. "El." Apr. 1, 1957. 4 pp. A transistorized S-band transpondor is described which was designed to provide echo to missile-tracking radars. The transponder operates in the frequency range from 2,700 to 2,950 mc. Design, circuitry, and operating consideration are discussed

COMPONENTS

How to Select Transistor Switches for Magnetic Memories, by W. A. Helbig and W. G. Rumble. "El. Eq." Mar. 1957. 4 pp.

An S-Band Coaxial Load, by L. W. Shawe. "Proc. BIEE." Mar. 1957. 2 pp. The design, construction, and performance of a coaxial load is described. The load utilizes tapered polythene sections and iron-loaded Marco resin.

Microwave Film Resistors, by B. Rosen and R. Saul. "El. Des." Mar. 1, 1957. 2 pp. A review of application requirements, construction, and operating characteristics of film resistors at microwave frequencies.

Shock Design, by C. E. Crede. "El. Ind." May 1957. 3 pp. Recordings of actual environmental conditions drive an analog function generator in this shock-mount design technique.

Corona-Proof Meters Check Atlantic Cable, by J. H. Miller. "El. Ind." May 1957. 3 pp. Special sensitive meters were developed to monitor the 2,000-volt power supplies of the North Atlantic Cable. Corona noise, shielding, and safety were important factors in the design.

IRE Standards on Piezoelectric Crystals—The Piezoelectric Vibrator: Definitions and Methods of Measurement, 1957. "Proc. IRE." March 1957. 6 pp.

Reliable Precision Wirewound Resistor Design, by J. S. Galbraith. "IRE Trans. PGCP." Dec. 1956. 4 pp. A comparison of old and new designs and a discussion of some of the factors which influenced new precision resistor designs is given.

A Resonant-Cavity Filter for the S-Band, by A. A. L. Browne. "Proc. BIEE." Mar. 1957. 3 pp. A resonant-cavity filter for the range 7.9-11 cm is described.

Small Ballasts for Fluorescent Lamps. "Phil. Tech." Feb. 10, 1957. 3 pp. Heat transfer and internal loss problems are discussed with a view to reduction of the size of lamp ballasts without degrading performance. Polyester resin is used in some ballasts cited as having favorable characteristics.

Potential-Minimum Noise in the Microwave Diode, by A. E. Siegman and D. A. Watkins. "IRE Trans. PGED." Jan. 1957. 5 pp. An analysis of the potential-minimum region in the microwave diode is presented which predicts the amount of noise convection currents at the potential minimum under conditions present in guns of low-noise traveling wave tubes and klystrons.

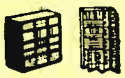
Choosing an Angular Position Pickoff, by A. J. Dinzer, Jr. "Auto Con." Mar. 1957. 5 pp.

A Survey of Factors Limiting the Performance of Magnetic Recording Systems, by E. D. Daniel, P. E. Axon, and W. T. Frost. "Proc. BIEE." Mar. 1957. 11 pp. The article examines the nature and magnitude of departures from the ideal performance of a magnetic recording system, and discusses the improved properties required in the various elements if the ideal performance is to be more closely approached.

Users Guide for Static Switching Components. "Auto. Con." March 1957. 5 pp.

Mechanized Production of TV Wiring Boards, by J. Markus. "El." April 1, 1957. 6 pp. In this article, Mr. Markus describes each of the major steps followed by one major producer of etched wiring boards for TV receivers.

Design Considerations for Broad-Band Ferrite Coaxial Line Isolators, by B. J. Duncan, L. Swern, K. Tomiyasu, and J. Hannwacker. "Proc. IRE." April 1957. 8 pp. This paper describes some of the results of a method for generating a microwave H-Vector circular polarization in coaxial lines.



COMPUTERS

Binary Block Coding, by S. P. Lloyd. "Bell J." March 1957. 20 pp. This paper investigates a certain problem in combinatorial analyses which arises in the theory in error correcting coding.

A Transistor Gating Matrix for a Simulated Warfare Computer, by W. H. MacWilliams, Jr. "Bell Rec." March 1957. 6 pp. This article describes what is believed to have been the first working application of transistors. In it, early point contact types were used to perform a circuit function essential to a laboratory simulated warfare computer which was used to simulate the action of a warship's guns in fending off an enemy air attack.

Error-Free Electronic Integration, by H. Wittke. "E. Rund." March 1957. 2 pp. The phase and amplitude error introduced into a four-terminal integrating circuit are compensated by a subsequent two-stage amplifier introducing feedback. The theory of this circuitry is considered and the design considerations for an actual circuit are set forth.

A System for General-Purpose Analog Digital Computation, by W. F. Bauer and G. P. West. "Journal of the Association for Computing Machinery." January 1957. 6 pp. The authors describe a computer system in which an analog computer and a digital computer are linked together in order to secure the advantages of each without the attendant unique disadvantages of each type of computer.

A High-Speed Data Processing System, by M. L. Klein, R. B. Rush, and H. C. Morgan. "El. Eng." April 1957. 6 pp. The high-speed digital data system described can hold up to 4,800,000 eighteen-bit words on magnetic tape; data obtained from 100-input analog signals at a rate of 10,000 words per second. Information is recorded digitally on the tape along with source identification and time. This tape can be played back through the system into two IBM 727 tape units and is compatible with the IBM EDPM 704. System accuracy is .1 per cent with 100 mv full-scale input.

The 'Bizmac' Digital Data Processing System, by J. C. Hammerton. "El. Eng." April 1957. 7 pp. An outline of the system and component functions.

Counters Select Magnetic Drum Sectors. by A. J. Strassman and R. E. King. "El." April 1, 1957. 3 pp. A means of signal addressing is described.

Counters for X-Ray Analysis, by P. H. Dowling, C. F. Hendee, T. R. Kohler, and W. Parrish. "Phil. Tech." Feb. 10, 1957. 14 pp. The authors describe the design and counting mechanism of a Geiger counter, a xenon- or kryptron-filled proportional counter, and scintillation counter which are available as interchangeable detectors for the "Norelco" X-ray goniometer. The different detectors are compared and discussed.

Basic Logic Circuits for Computer Applications, by G. W. Booth and T. P. Bothwell. "El." March 1, 1957. 5 pp. A group of functional transistor circuits suitable for use as logical building blocks in general digital computer applications is discussed. Characteristics important to computer operation are considered for these circuits.

E R A (An Electronic Reading Automaton). "El. Eng." April 1957. 2 pp. This is a description of an electronic reading machine which can "read" normally typed or printed characters and provide an output which can be used directly for the input to a computer thus obviating the need for preparing punched cards or tape. It must be programmed for each particular typeface. This is a report of developmental work.

Optical Aspect System for Rockets, by J. E. Kupperian, Jr., and R. W. Kreplin. "Rev. Sci." Jan. 1957. 6 pp. The authors describe an aspect system involving two surfaces of directions, one a cone and one a plane. By determining the special relationship between these surfaces a unique solution of the rocket aspect is obtained. A simplifying computer for reduction of the aspect data is described.

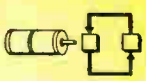
International ELECTRONIC SOURCES

Junction Transistor Counters, by A. W. Carlson. "El. Des." March 1, 1957. 3 pp. Included is a discussion of the basic transistor flip-flop circuit, and discussion of several gate circuits suitable for use with counters.

Simplified Calculations for Servo Function Generators, by H. E. Harris and Rawley D. McCoy. "El. Des." March 1, 1957. 3 pp. Tap-to-tap loading and terminal-to-end loading of tapped servo potentiometers is discussed. A method of calculating the padding resistance to produce the desired functions is described.

An Improved Fading Machine, by H. B. Law, F. J. Lee, R. C. Looser, and F. A. W. Levett. "Proc. BIEE." March 1957. 7 pp. The machine described obtains fading by combining six components in random phase. The machine simulates propagation by up to three paths with a spread of up to two milliseconds in path-time delay.

An Accumulator Unit for a Dekatron Calculator, by R. Townsend and K. Camm. "El. Eng." Feb. 1957. 7 pp. Articles describe techniques for use of Ericsson type Dekatron tubes (tubes capable of counting in both directions by glow transfer) in addition, subtraction, decade transfer and storage functions. The theory of operation of the Dekatron as applied to the application is followed by descriptions of the detail circuitry involved. Sensing of nines and zeros is used in accomplishing the carry. Basic addition or subtraction time is 550 μsec.



CONTROLS

They Had to Throw the Book Away, by E. R. Hinz. "Industrial Laboratories." March 1957. 6 pp. Instrumentation and control of VTOL aircraft are discussed in general terms.

Approximate Determination of Partial-Slip Periodic Modes in Relay Control Systems, by Iu. V. Dolgolenko. "Auto. i. Tel." Jan. 1957. 23 pp. The paper examines a feedback control system in which a relay element with a symmetrical characteristic is the amplifier contral element under conditions where the relay is encompassed by internal feedback. It is shown that in order to determine partial-slip symmetrical periodic modes in such a system (i.e., periodic modes which are such that a slip mode obtains for the movement of the relay system during a portion of a half-cycle), it is possible to apply the approximate method of harmonic balance if the amplifier block (which consists of the relay, an amplifier, and the feedback which encompasses them) is considered to be a nonlinear member.

The Effect of the Differentiation and Integration of Fluctuations Upon the Average Number of Overshoots, by V. I. Tikhonov. "Radiotekhnika i Elektronika," Jan. 1957. 5 pp. The variation in the average number of overshoots is computed for the conditions which obtain when normal fluctuations are subjected to differentiation and integration with a certain weight.

Stability of Linear Pulse Systems with Variable Parameters, by G. P. Tartakovsky. "Radiotekhnika i Elektronika." Jan. 1957. 8 pp. This paper demonstrates how the stability conditions governing pulse systems with constant parameters can be extended to apply to systems with variable parameters. In order to analyze the stability of a "variable" system having pulse feedback an equation is derived for its transfer function. The postulates which are developed are illustrated on the basis of a system with pulse feedbaek under conditions of pulse-frequency modulation.

Ground-Controlled Drone Tests Missiles, by F. Warren and C. Cordon. "El." March 1, 1957. 2 pp. A summary of automatic control and remote guidance system requirements for the Firebee turbojet drone target aircraft is presented.

The Slip Mode in Relay Systems Which Are Designed for Automatic Control, by Iu. I. Neymark. "Avto. i Tel." Jan. 1957. 7 pp. This paper establishes the conditions under which slip movement arises or ceases in a relay system. The conditions governing the stability of this movement and its resistance to disruption by external effects are also established. The analysis is based upon using the integral form for the equations of movement of the system. Detailed analysis is made of the simplifying assumptions which lead to an idealized concept of slip movement.

The Dependence of the Null Displacement of a Magnetic Null-Element Upon Fluctuations of Supply Voltage, by A. M. Pshenichnikov. "Avto. i Tel." Jan. 1957. 3 pp. The paper examines the null displacement of a magnetic modulator which is being used in the capacity of a null-element under conditions where the supply voltage fluctuates. The methods for diminishing and compensating the null displacement are analyzed.

Servomechanism for the Regulation of Blood Pressure, by N. Sager, J. H. Waite, J. W. Poppell, and W. S. Howland. "Rev. Sci." Jan. 1957. 3 pp. The infusion rate of vasopressor or vasodepressor substances can be controlled by a blood-pressure controlled servomechanism. Although the system is inherently nonlinear, it is stable when operated with restricted gain.

INDUSTRIAL ELECTRONICS

Snapshots at 60,000 RMP. "El. Ind." May 1957. 1 p. High speed rotor tests are made possible by an electronic detection of incipient rotor rupture. A flash exposure is then set off.

Beta Gauge Checks Steel Thickness, by O. Bauschinger, Y. M. Chen & F. H. London. "El. Ind." May 1957. 3 pp.

Precise Heat for Growing Silicon Crystals, by E. T. Davis, W. B. Alden, and F. H. Wyeth. "El." Feb. 1, 1957. 4 pp. An r-f-heated induction crucible for drawing silicon crystals is controlled by an industrial recorder-controller acting through saturable core-reactors controlling the r-f energy. Control is within 0.25° at 1,400° C.

INFORMATION

Some General Aspects of the Sampling Theorem, by D. L. Jagerman and L. J. Fogel. "IRE Trans. PGIT." Dec. 1956. 8 pp. The sampling theorem is recognized as an interpolation formula. Starting from the Lagrange Polynomial, this theorem is developed under conditions which are of broader applicability than those usually stated.

The Axis-Crossing Intervals of Random Functions, by J. A. McFadden. "IRE Trans. PGIT." Dec. 1956. 5 pp.

Determination of Redundancies in a Set of Patterns, by A. Glavazky. "IRE Trans. PGIT." Dec. 1956. 4 pp.

Reading Rates and the Information Rate of a Human Channel, by J. R. Pierce and J. E. Karlin. "Bell J." March 1957. 20 pp. The provocative observation is made by the author that human channel capacity (measured by having people read words as fast as they were able to) is approximately 40-50 bits/sec. and telephone and television channel capacity is about 50,000 bits/sec. and 50,000,000 bits/sec. respectively.

Rectification of Two Signals in Random Noise, by L. L. Campbell. "IRE Trans. PGIT." Dec. 1956. 6 pp. The spectrum of the output of a half-wave rectifier is derived for an input which is the sum of random noise and two sinusoidal signals of different frequencies, and finally, the output signal-to-noise ratio of an ssb detector is calculated as a function of the input sign-to-noise ratio, when the sideband amplitude is one-half the carrier amplitude.

Information Rate of a Human Channel, by J. R. Pierce and J. E. Karlin. "Proc. IRE." March 1957. 1 p.

A Note on the Maximum Flow Through a Network, by P. Elias, A. Feinstein, and C. E. Shannon. "IRE Trans. PGIT." Dec. 1956. 3 pp. This note discusses the problem of maximizing the rate of flow from one terminal to another, through a network which consists of a number of branches, each of which has a limited capacity. A theorem is evolved and applied to solve more general problems.

On the Shannon Theory of Information Transmission in the Case of Continuous Signals, by A. N. Kolmogorov. "IRE Trans. PGIT." Dec. 1956. 7 pp.

On Noise Stability of a System with Error-Correcting Codes, by V. I. Siforov. "IRE Trans. PGIT." Dec. 1956. 7 pp.

Two Inequalities Implied by Unique Decipherability, by B. McMillan. "IRE Trans. PGIT." Dec. 1956. 1 p.

MATERIALS

Measurement of Dielectric and Magnetic Properties of Ferromagnetic Materials at Microwave Frequencies, by W. Aulock and J. H. Rowen. "Bell J." March 1957. 22 pp. Some experimental techniques are discussed which permit measurement of the magnetic and dielectric properties of ferrite materials in the microwave region by observing the perturbation in a cylindrical cavity due to insertion of a small ferrite sample. A short description of instrumentation for cavity measurements at 9,200 mc is given, and experimental results of disc measurements are reported for a low-lost BTL ferrite and several disc diameters.

High-Temperature Properties of Tungsten which Influence Filament Temperatures, Lives, and Thermionic Emission Densities, by R. N. Bloomer. "Proc. BIEE." March 1957. 5 pp.

Thin Tungsten Wire for Small Radio Valves, by L. Schultink and P. G. van Zanten. "Phil. Tech." Feb. 4, 1957. 7 pp. This article gives some details regarding the manufacture of thin tungsten wire and deals with a number of the requirements which it has to satisfy.

Noble Metal Wire for Precision Potentiometers, by A. Cohn. "El. Des." March 1, 1957. 3 pp. Physical and electrical characteristics of the noble metals are considered from the standpoint of potentiometer use. Such factors as noise and corrosion resistance, and protective enamels are also discussed.

MEASURING & TESTING

What Electronics is Doing for Medicine, by R. G. Stranix. "El. Ind." May 1957. 3 pp. This is a survey of a field of great interest to the electronic equipment manufacturers. What can be done, and what needs to be done by electronic devices in the field of medicine is thoroughly discussed.

Electronic Fuel-Gage Tester, by P. Bishop. "El. Ind." May 1957. 2 pp. This is a tester designed to check calibration of dielectric-type fuel gages for a variety of aircraft fuels.

Hustler Data System. "El. Ind." May 1957. 2 pp. The data recording system and the ground data reduction equipment used for B-58 "Hustler" tests are described.

A Standard for Q and L. "The Notebook." Winter, 1957. 3 pp. Construction details and electrical characteristics of commercially available "Q" and "L" standards are discussed.

Laboratory Test Equipment for Synchronous Regenerative Radiotelegraph Systems, by C. G. Hilton, H. B. Law, F. J. Lee, and F. A. W. Levett. "Proc. BIEE." March 1957. 7 pp. The authors describe development of error-counting test equipment in which signals passing through a system under test are compared with perfect signals direct from the signal source. The equipment covers a wide range of telegraph speeds and has proved to be a powerful tool in investigations of system behavior and in development work. It is suggested that the performance of regenerative systems should be specified in terms of element-error liability instead of telegraph distortion.

The Rapid Measurement of Iron Loss in Rings, by T. M. Palmer. "El. Energy." March 1957. 2 pp. A method of measuring loss and exciting current in rings and other stampings is described which is sufficiently simple and rapid for production testing.

Dynamic Methods of Testing Semi-Conductor Rectifier Elements and Power Diodes, (Part 1), by A. H. B. Walker and R. G. Martin. "El. Eng." April 1957. 8 pp. Practical dynamic testing requires special instruments for accurate measurement of dynamic forward voltage and dynamic reverse current; suitable electronic instruments are described.

Measuring Corona from Radioactive Point. by R. W. Hendrick, Jr., F. C. Martin, and S. Chapman. "El." March 1, 1957. 2 pp. An investigation of atmospheric electricity is described, including the use of sensitive recording equipment for currents down to .001 μa.

A Coaxial Standing-Wave Detector for the S-Band, by L. W. Shawe and G. W. Fynn. "Proc. BIEE." March 1957. 3 pp. A description is given of a coaxial standing-wave detector designed primarily for routine testing of coaxial components over the wave band 7.9-11 cm.

An F-M Multichannel Pulse-Height Analyzer, by J. T. Russell and H. W. Lefevre. "Nucleonics." Feb. 1957. 2 pp. The unique feature of the pulse-height analyzer described here is the manner in which channelizing is accomplished.

Test Apparatus for the 16000-cycle Charge Indicator, by W. Herlitz. "Nach. Z." Jan. 1957. 4 pp. A rugged test apparatus avoiding amplification and relying on a rectifier, involving only one scale (−2.0 to +3.2 nepers) and operating within a temperature variation of between 0° and 30°C, is described. Impedance matching, 16 kc band-pass filter, temperature compensation, and suitable scale compression for the instrument are discussed.

Techniques of Signal Generator Inspection, by L. O. Cook. "The Notebook." Winter, 1957. 4 pp. The author discusses some of the testing and calibrating procedures used in testing test signal generators at the factory. Various types of signal generators are considered.

Solar-Flare Detection for IGY, by R. H. Lee. "El." March 1, 1957. 4 pp. Equipment used, and characteristics of Solar-flare phenomena are discussed. Receivers operating at 27 kc and 18 mc are coordinated to detect D-layer disturbances in the ionosphere.

Sweeper Determines Power-Gain Parameter, by W. N. Coffey. "El." March 1, 1957. 3 pp. A comparison method of determining the Alpha-cutoff frequency and the product of ohmic base resistance and collector-base junction capacitance is described.

Device for the Measurement of Very Small Inductances, by H. Brand and E. Schuon. "El. Rund." March 1957. 3 pp. The measurements are based on the resistance transformation method. An ideal arrangement is discussed and the effects of capacitances are considered. An apparatus designed for 80 cm waves is described and results are graphically shown.

Dual-Triode Tester Measures Tube Balance, by R. L. Ives. "El." March 1, 1957. 2 pp. The instrument described is designed to indicate the degree of matching of static, dynamic, or both characteristics of dual triode tubes.

Testing of Thyratrons, by R. Huebner. "El. Rund." March 1957. 2 pp. This second installment of the article deals with a special circuit arrangement to simulate actual operating conditions. A capacitor-discharge circuit is used for the measurement of the ionization and deionization times. Mercury filled tubes are studied.

Logarithmic Amplifier Measures Noise, by J. D. Wells. "El." April 1, 1957. 3 pp. The significant feature of the noise measuring system for atmospheric radio noise on communications frequencies is the use of a logarithmic transformation to reduce the range of noise amplitudes to a value within practical limits. Circuitry for the logarithmic conversion is described in detail.

Wide-Range Analizer Traces Precise Curves, by E. F. Feldman. "El." March 1, 1957, 4 pp. The author describes the use of a swept heterodyne spectrum analizer as an indicator for a sweep generator. The composite instrument described can be used to measure attenuation characteristics of frequency-selective networks.

An Instrument for Relative Measurements of Variable Magnetic Fields, by I. S. Shpiegel', M. D. Raizer and E. A. Miae. "Radiotekhnika i Elektronika." Jan. 1957. 9 pp. The paper describes an instrument which is capable of making relative measurements of magnetic fields which are weakly inhomogeneous and which vary in time. The device makes use of the phenomenon of nuclear magnetic resonant absorption. The instrument measures the resultant field distribution while taking into account the residual magnitization field.

Continuously Indicating Precision Magnetometer, by G. W. Green, R. C. Hanna, and S. Waring. "Rev. Sci." Jan. 1957. 5 pp. When an alternating current is passed through a flat coil, suspended in a magnetic field so its equilibrium position is coplanar with the field and so it can oscillate about an axis in the plane of the coil perpendicular to the field, the system behaves as an inductance in series with a condenser of capacity inversely proportional to the square of the magnetic field. This principle has been applied to the measurement of magnetic fields—with a precision of one percent using simple auxiliary apparatus. With some elaboration, the range 1 to 12 kilogauss can he measured and stabilized to within .01 percent.

Measurement of Noise Factor in Centrimetric Radar, by N. N. Patla. "J. ITE." Dec. 1956. 6 pp. Two practical methods for measurement of noise factor in centrimetric radar receivers are described. The first applies to the i-f amplifiers (30-60 mc), and the second applies to the mixer followed by the i-f amplifier (3000-10,000 mc). Detailed calculation of overall noise factor of the crystal mixer followed by an i-f amplifier is presented.

Oscillograph for Observation and Photography of Microwave Electrical Signal Patterns, by A. M. Tchernouchenko. "Vide." Sept.-Oct. 1956. 10 pp. A resonator of the slit hole type, strongly coupled with the energy input and output, was used as a deflecting system. For broadening of the range of the oscilloscope and an increase in sensitivity, traveling-wave systems were used.

Flight-Test Instrumentation for Vertical Take-Off Aircraft, by E. R. Hinz and R. A. Fuhrman. "Aero. Eng. Rev." Feb. 1957. 7 pp. Each of the flight regimes of the vertical take-off aircraft hovering, transition, and conventional flight—presents its own instrumentation requirements, and the final solutions must be compatible with minimum weight requirements.

Field Test Set for "Packaged" Amplifiers, by J. W. Balde. "Bell Rec." Feb. 1957. 4 pp.

Automatic Testing is Good Business, by L. E. McCabe. "IRE Trans. PGANE." Dec. 1956. 5 pp. The author proceeds from the premise that automatic testing can be economically applied in the military electronic equipment business even though it is characterized by small production quantities, complexity of product, and rapid evolution of design changes.

A Pulse Method for Measuring the Intermediate Layer in Oxide Cathodes, by A. Lieb. "Nach. Z." Feb. 1957. 2 pp. The paper describes a method for measuring the electric values in intermediate layers which grow in the cathodes of amplifier valves.

A Multiple-Channel Oscilloscope for Electrophysiology, by P. E. K. Donaldson. "El. Eng." Feb. 1957. 6 pp. Article discusses the cost economy of standard techniques of obtaining multi-channel oscilloscopes, concluding that the voltage comparator technique using a vertical sweep and intensity modulation is most economical for multi-channel use. Circuitry for building an eight channel unit having a response from dc to 1.5 kc is described, and some typical results reproduced.

A Valve-Voltmeter for Synchro Testing, by D. L. Davies. "El. Eng." Feb. 1957. 6 pp. Article discusses a new type analyzing voltmeter for measuring the characteristics of synchros in the null balance position. It is designed to measure both amplitude and phase of the residual signal in the synchro in addition to its frequency characteristics. Both block diagrams of the operation of the instrument and detail circuit diagrams are provided.

Bridge for Accurate Measurement of Ferroelectric Hysteresis, by H. Diamant, K. Drenck, and R. Pepinsky. "Rev. Sci." Jan. 1957. 4 pp. The new instrument described here presents an undistorted display of ferroelectric hysteresis loops even in the presence of relatively high conductivity. An important feature of the bridge is that measurements are independent of the frequency and wave form of the applied voltage.

Selective Admittance-Measuring Set for use at Medium Frequencies, by D. D. Crombie. "E. & R. Eng." Jan. 1957. 5 pp. The extremely selective instrument developed for measurements of admittance was intended particularly for measurements on medium frequency aerials. A resonance method of determining the unknown admittance is employed, and the selectivity necessary to remove interference is obtained by using a homodyne voltmeter.

International ELECTRONIC SOURCES

Chronograph Times Supersonic Models, by W. J. Kerwin. "El." April 1, 1957. 4 pp. Accurate measure of very small intervals with available electronic counters is made possible by measuring the lag between receipt of the start pulse and the time of the first count and similarly the lag between the stop pulse and the last count indicated.

Rotating Probe Electrometer, by J. C. Devins and S. I. Reynolds. "Rev. Sci." Jan. 1957. 3 pp. A new type of scanning electrometer is described which is capable of measuring the charge on areas as small as 0.3 cm^2 at a rate fast enough to show changes in charge distribution on a dielectric surface within intervals of the order of 30 msec. The minimum charge density measurable is about 0.6×10^{-9} coulomb cm^{-2}.

Transistor Null Detector Has High Sensitivity, by C. D. Todd. "El." Feb. 1, 1957. A four-stage, transistorized, high-frequency audio amplifier is used as a sensitive null indicator.

RADAR, NAVIGATION

New Radio Beacon For Light Planes. "El. Ind." May 1957. 1 p. A small transportable radio beacon is described which, by means of an integrally mounted antenna, transmits spoken bearings. Signals can be received on ordinary aircraft communications equipment.

Approach System for High Landing Rates, by F. H. Battle, Jr. "El. Ind." May 1957. 4 pp. This new design would shorten the common approach path by having aircraft approach the runway from various angles, depending on speed.

Automatic Radar Performance Monitor. "El. Ind." May 1957. 1 p. An automatic monitor is described which measures receiver noise factor, power, and relative tuning.

Improved Keep-Alive Design for TR Tubes, by L. Gould. "Proc. IRE." April 1957. 4 pp. New information is presented on the cause of crystal impairment in crystal receivers used with pulse radar systems. A new keep-alive design based on this information is described.

Beacon Antennas for Guided Missiles, by W. E. Barrick and D. L. Brannon. "El." March 1, 1957. 3 pp. Three-element S- and X-band antenna arrays are shown to give better coverage and fewer small nulls than any other array up to twelve elements for missiles ranging from 4 to 48 inches in diameter.

Integrated Instrument System, by C. F. Fragola and C. J. Hecker. "IRE Trans. PGAP." Dec. 1956. 4 pp. Through a discussion of the symbolic and pictorial approaches to providing the ideal flight instrumentation, the present trend toward combining the two approaches is explained.

Azimuth Errors of the TACAN System, by De Witt T. Latimer, Jr. "IRE Trans. PGAP." Dec. 1956. 7 pp. TACAN azimuth error data are presented in such form as to allow separation of the site error from the total system error, giving an indication of the azimuth accuracy of the TACAN equipment.

Pencil and Paper Calculation of Noise Level in Superheterodyne Radar Receivers, by D. W. Haney. "IRE Trans. PGAP." Dec. 1956. 4 pp. The rms noise level may be determined from the second detector output as a function of receiver input for any common type of second detector even though its response is not exactly quadratic. The method is justified mathematically, and in a practical application the noise level of a 600 mc receiver is determined as 11.2 microvolts (referred to input).

Infrared Challenges Radar's Monopoly, by P. J. Klass. "Aviation Week." March 4, 1957. 6 pp. This article is a general review of the infrared field. The present status and possible future applications of infrared are discussed.

Doppler Navigation . . . How it Works, by W. J. Tull. "El. Eq." March 1957, 2 pp.

Diffraction of Microwaves by Tandem Slits, by L. R. Alldredge. "IRE Trans. PGAP." Oct. 1956. 10 pp. With microwave techniques, it is not difficult to show that in the aperture near an edge of a conducting screen the electric field differs greatly from the incident field and on the shadow side of the screen the magnetic field is not zero near the edge—thus the classical Kirchoff theory cannot be correct.

Slot Admittance Data at K_a Band, by M. G. Chernin. "IRE Trans. PGAP." Oct. 1956. 5 pp. The author presents admittance data obtained by the moving-lossy-short technique on transverse edge slots in RG-96/U waveguide. Experimental procedure and results are described.

SEMICONDUCTORS

Transistor Junction Temperature as a Function of Time, by K. E. Mortenson. "Proc. IRE." April 1957. 10 pp. An analysis of the heat flow in transistors is presented which enables one to determine the variation of junction temperature with time for a given transistor excitation.

On Base-Width Modulation and the High-Frequency Equivalent Circuit of Junction Transistors, by J. Zawels. "IRE Trans. PGED." January 1957. 6 pp. The affect of base-width modulation on the exact small-signal, high-frequency equivalent circuit of E-M-P (and N-P-M) junction transistors is examined. It is shown that base-width modulation does not in fact necessitate the introduction of new elements, but changes the magnitude of one element. The discussion has considerable bearing on theories of the small-signal, high-frequency behavior of junction transistors which have appeared over the last few years.

A New Semiconductor Photocell Using Lateral Photo Effect. by J. T. Wallmark. "Proc. IRE." April 1957. 10 pp. In this article it is shown that a non-uniform illumination gives a lateral photovoltage parallel to the junction in addition to the transverse photo voltage.

Boosting Transistor Switching Speed, by R. H. Baker. "El." March 1, 1957. 4 pp. This article summarizes transistor properties which affect the response time in switching circuits and discusses basic circuits for obtaining maximum energy conversion efficiency.

The Tetrode Power Transistor, by J. T. Maupin. "IRE Trans. PGED." Jan. 1957. 5 pp. Design and application considerations for the tetrode power transistor are reviewed. Present limitations and future possibilities are discussed.

The Spacistor, A New Class of High-Frequency Semiconductor Devices, by H. Statz and R. A. Pucel. "Proc. IRE." March 1957. 8 pp. As a result of research into means of extending semiconductor amplifier usefulness to higher frequency ranges, new devices are suggested which use processes in the space-charge regions of reverse-biased junctions, and feature a third injecting contact to the space-charge region.

A Junction Transistor for Kilowatt Pulses, by N. H. Fletcher. "Proc. IRE." March 1957. 1 p.

Tetrajunction Transistor Simplifies Receiver Design, by R. J. Farber, A. Proudfit, K. M. St. John, and C. R. Wilhelmsen. "El." April 1, 1957. 4 pp. An experimental transistor is described in which the emitter of one unit and the collector of the other are parts of the same germanium region. Promising receiver application possibilities are described. Lowered cost is a possibility.

The Effect of Collector Capacity on the Transient Response of Junction Transistors, by J. W. Easley. "IRE Trans. PGED." Jan. 1957. 9 pp. A theory of voltage breakdown of cylindrical p-n junctions, with applications by H. L. Armstrong.

Some Basic Physical Properties of Silicon and How They Relate to Rectifier Design and Application, by G. Finn and R. Parsons. "IRE Trans. PGCP." Dec. 1956. 4 pp.

TELEVISION

Keyed Video Signal Generator, by A. J. Baracket. "El. Ind." May 1957. 3 pp. A variable-frequency sine wave phase-locked to an input sync pulse or trigger, as well as additional test signals, are used to check components and complete television systems without disabling clamps and dc restorers. Frequency response and waveform can be determined in minutes.

Dark Horse in TV Field. "El. Ind." May 1957. 1 p. A new cathode ray tube is described which is claimed to provide amplification sufficient to eliminate the video amplifier stage of TV sets.

On Video Mixing in TV Studio Equipment, by F. Brunner. "Rundfunk." Vol. 1, No. 1, 1957. 5 pp. The problems involved in the design of video mixing facilities are considered. The Austrian installation is described.

A Phasemeter for the Video-Frequency Range, by E. Legler. "Rundfunk." Vol. 1, No. 1, 1957. 4 pp. The phase angle to be measured is transferred to a fixed frequency, measured by a phase discriminator and transformed into a voltage proportional to its value. The measuring range is from 0.3 to 10 mc. The instrument and its performance are set forth.

Television Outside Broadcasts Over Transportable Radio Links, by G. Schuett. "Rundfunk." Vol. 1, No. 1, 1957. 5 pp. The installation of the German Federal Post Office is described. Design as well as economic considerations are taken into account.

Simple Sync Circuits Time ITV Systems, by H. A. Manoogian. "El." March 1, 1957. 5 pp. Mr. Manoogian reviews four simplified systems which can be used in ITV since pulse-time requirements are less severe in non-broadcast applications.

InterCarrier Failure Rings Alarm, by K. Atwood. "El." March 1, 1957. 2 pp. A television carrier failure alarm is described which functions by heterodyning the picture and the sound carriers and detecting the 4.5-mc intercarrier signal to indicate normal operation. Failure of either of the carriers or failure of the monitor itself will activate the alarm. A circuit diagram is included.

Efforts of the CCIR to find European Standards for Color TV, by F. Kirschstein, J. Mueller and K. O. Schmidt. "Nach. Z.", Jan. 1957. 8 pp.

In an effort to find suitable standardization, the Committee visited the U. S., England, Holland and France. The experiences particularly in this country are described. No final standard has been set at a subsequent meeting and a further meeting is scheduled for the Spring of 1958.

International ELECTRONIC SOURCES

On the Picture Quality in Particular of TV Pictures, by W. Kroebel and F. Below. "Rundfunk." Vol. 1, No. 1. 1957. 5 pp. Tests to establish the recognisability of a picture detail are proposed. This may be based on the size of the object with the contrast between the object and its background as a variable. The percentage of errors, in terms of the size of the object, is represented as an exponential function.

On an Objective Method for the Determination of the TV Picture Quality, by F. Below, W. Kroebel, and H. Springer. "Rundfunk." Vol. 1, No. 1., 1957. 5 pp. The properties of the eye in distinguishing small objects on a television screen have been investigated and the experimental results are reported. A method objectively determine the parameters determining the picture distinctness is suggested. Experimental confirmation is expected.

Measurements in Connection with an Investigation of the Picture Quality of Television Systems in the Case of Moving Objects, by F. Arp and H. Baumeister. "Rundfunk." Vol. 1, No. 1, 1957. 5 pp. A test is described in which moving circular discs of varying size and contrast are observed. The recognisability is established by observers and their errors are evaluated.

On the Equipment and Operational Organization on Television Studios, by K. Thoem. "Rundfunk." Vol. 1, No. 1. 1957. 7 pp. The present types of studio equipment are described and the various requirements during a television show are explained. Experiences gained by the "Hessischer Rundfunk" with various types of cameras are reported.

A Method to Prevent Image Orthicon Burn-In, by J. T. Wilner. "IRE Trans PGBTS." Feb. 1957. 4 pp. Mechanical oscillation of the lens board of a TV camera at a very slow rate, plus electrical cancellation of the resulting horizontal motion is accomplished by simple modification to the mechanical detent and the horizontal centering circuit of the camera. The end result is to minimize burn-in on image orticon tubes by as much as 90 per cent.

Portable TV Station for Remote Pickups, by L. E. Flory et. al. "El." Feb. 1, 1957. 8 pp. A largely transistorized portable TV camera-transmitter system is described. Experimental pickup tube has half-inch diameter and is three inches long.

Stagger-Tuned Transistor Video Amplifiers, by V. H. Grinich. "IRE Trans. PGBTR." Oct. 1956. 4 pp. The author discusses the application of Bruun's design method for common-emitter amplifiers to the design of Buttersorth maximally-flat stagger-tuned filter amplifiers.

The Use of a Mobile Television Monitoring Unit in an Enforcement Program, by R. L. Day. "IRE Trans. PGS TS." Feb. 1957. 4 pp. Equipment and techniques used in FCC mobile TV monitor units are described.

Measurement of Service Area for Television Broadcasting, by R. S. Kirby. "IRE Trans. PGBTS." Feb. 1957. 8 pp. The author, from NBS Boulder Labs., presents a proposal that the present definition of television service in terms of iso-probability contours be abandoned. A new definition of service area, first proposed by Norton and Gainen in 1950, is recommended in its place. This provides a much more useful measure of service and makes the estimating techniques more tractable.

Two-Terminal Video Couplings, by D. G. Sarma. "J. ITE." Dec. 1956. 11 pp. Critically damped two-terminal video interstage coupling networks have been studied. Some infinitely complex two-terminal networks having good monotonic transient response are derived and a number of practical networks of low orders of complexity suggested. Third and fourth order coupling impedances for optimum transient response have been obtained.

Ultrasonic Gong Controls TV Sets, by R. Adler et al. "El." March 1, 1957. 6 pp. Transmitting and receiving equipment for remote control of home TV sets are described in detail. Ultrasonics in the vicinity of 40 kc are used.

Monochrome Slides Broadcast Color, by E. L. Covington. "El." March 1, 1957. 3 pp. The standard color subcarrier reference burst is phase-split to produce color combinations from monochrome slides. Distributed-constant delay lines were devised and are described. In use, the system converts whites into one color, and the greys into the color 180 deg. from that of the whites. High contrast slides with sharp transitions of brightness are most suitable.

Performance of the A2A Video Transmission System, by R. W. Edmonds, "Bell rec." March 1957. 4 pp. This is a description of a new broadband wire-transmission system designed to meet requirements necessary for the transmission of monochrome and color television. It provides video transmission of frequencies up to 4.5 mc over balanced pairs of conductors designed for such use.

Falsification of TV Image Gradation by Screen Illumination, by R. Suhrmann. "E. Rund.", March 1957. 3 pp.

Either increased basic luminosity or room lightening may cause a falsification of the image gradation on a television screen. Simple compensating measures are introduced.

Implications of Phase Precompensation in a Television Transmitter on the Shape of the Radiated Signal, by A. van Weel. "J. BIRE." Feb. 1957. 6 pp.

Results of the VIII Convention (Warsaw 1956) on Black-and-White TV, by J. Mueller. "Nach. Z.", Jan. 1957. 4 pp.

The three test signals for television signals accepted at this convention are described; they relate to testing 1) the transient behavior in the medium and upper frequency range, 2) the transient behavior in the low frequency range, and 3) measurement of non-linear distortion as a function of the image contents. Standards for TV lines are presented. Various other revisions are reported.

Design of Final Video Stages, by G. Foerster. "E. Rund.", March 1957. 3 pp.

The maximum obtainable grey gradation steps as well as the internal resistance of the TV receiver high-voltage source is considered of importance in this connection. It is concluded that a video control voltage of 55 v peak value is adequate for most conventional tubes.

Reduction of Co-Channel Television Interference by Precise Frequency Control of Television Picture Carriers, by W. L. Behrend. "IRE Trans. PGBTS." Feb. 1957. 9 pp.

$$\Delta G = \Delta G/en_i \mu p \delta$$

THEORY

Calculating R-C Amplifier Supply Voltages, by S. Deutsch. "El. Ind." May 1957. 8 pp. The trial and error method can be eliminated by assuming that the tube "constants" are actually constants and that the input signal always swings the tube from cutoff to zero grid-to-cathode voltage. First of two parts.

Ion, Proton Power Space Travel Hope. "Aviation Week." March 4, 1957. 4 pp. This is a report on the three day Astronautics Symposium in San Diego. The possibilities of ion or photon propulsion were discussed.

Selecting the Best One of Several Binomial Populations, by M. Sobel and M. J. Huyett "Bell J." March 1957. 40 pp.

A Theory of Voltage Breakdown of Cylindrical P-N Junctions, with Applications, by H. L. Armstrong. "IRE Trans. PGED." Jan. 1957. 2 pp.

Load Lines In Transistor Amplifier Design, "Research Worker," Sept.-Oct. 1956. 3 pp. The article shows, by illustrative examples, how to use the load line technique in transistor amplifier design.

Applications of the Hall Effect, by T. R. Lawson, Jr. "El. Eq." March 1957, 2 pp. The author gives a general explanation of the Hall effect and discusses applications of the effect.

The Equivalent Circuit of the Transformer and Induction Motor, by D. Harrison. "El. Energy." March 1957. 4 pp. The exact practical equivalent circuits of the transformer and induction motor are derived from the usual exact circuits, by simple circuit theory.

An Elimination Technique for Certain Impedance Equations, by C. D. Allen. "El. Eng." April 1957. 2 pp. A set of linear simultaneous equations of a type which frequently arises in the analysis of linear networks is considered. A short method of performing the elimination necessary to obtain the impedance equations of the network is proved.

Aeronautical Electronics Problems. "El. Des." March 15, 1957. 3 pp. A report of problems and trends in airborne electronics discussed at the annual meeting of the Institute of the Aeronautical Sciences.

High Frequency Oscillations in Electron Beams Which Have A Periodically Varying Velocity, by P. V. Bliokh. "Radio tekhnika i Elektronika," Jan. 1957. 12 pp.

The interaction between a compensated electron beam located in a periodic longitudinal electric field and electromagnetic waves is examined by the kinetic equation method. A dispersion equation is obtained in a small-signal approximation, and this equation is used to determine the instability conditions for the beam.

The Determination of Pressure, Coefficients of Capacitance for Certain Geometries, by D. W. McCall. "Bell J." March 1957. 11 pp. The author considers pressure coefficients of capacitance of parallel plate capacitors subjected to one-dimensional and hydrostatic pressures and of cylindrical capacitors subjected to radial compression. Derivations are given which apply to systems in which the dielectrics are isotropic, elastic solids.

Emission Of Electrons From Complex Surfaces, by P. V. Timofeev. "Radiotekhnika i Elektronia," Jan. 1957. 7 pp.

The paper is devoted to the photoeffect and to the secondary and autoelectronic emission of complex surfaces. The various properties of complex emitters are examined. The results of experimental investigations are compared with the existing concepts concerning the mechanism of emission from complex emitters. New information is given concerning the processes which go on in given emitters.

Synthesis of TCHEBYSHEFF Parameter Symmetrical Filters, by A. J. Grossman. "Proc. IRE." April 1957. 20 pp. Within this paper is a presentation of step-by-step procedures to be followed in the design of filters comprising electrically symmetrically reactive (lossless) networks. Emphasis is placed on the use of rapidly converging series in the computations in place of eliptic function tables.

Stability of a Cylindrical Electron Beam in Nonsinusoidal Periodic Magnetic-Focusing Fields, by D. C. Buck. "IRE Trans. PGED." Jan. 1957. 6 pp. The Theory of Mendeal, Quote, and Yocum is extended to include experimental and analytical examination of magnetic fields whose axial variation is periodic but non-sinusoidal.

International ELECTRONIC SOURCES

On Resonance in Infinite Gratings of Cylinders, by S. N. Karp and J. Radlow. "IRE Trans. PGAP." Oct. 1956. 8 pp.

RLC Transfer Function Synthesis, by E. C. Ho. "IRE Trans. PGCT." Sept. 1956. 3 pp.

Colour as a Vector. "E. & R. Eng." Feb. 1957. 4 pp. Some comments on historic and modern concepts of color, with bearing on color TV.

Dilemmas in Transmission-Line Theory, by R. A. Chipman. "E. & R. Eng." Feb. 1957. 4 pp. The customary approximate formulae for the characteristics of transmission lines are shown to lead to an error of 100% in the calculation of the resistive component of the impedance of an electrically-short section of line terminated in a short-circuit. It is shown that, in some cases, the conjugate load may receive more power than the non-reflective load. Simple, but exact, expressions are derived for the propagation constant and the ratio of reactance to resistance.

Theory of Dipole Orientation Process in the Dielectric Based on the Concept of a Visco-Elastic Model—Part I, by S. Sharan. "J. ITE." Dec. 1956. 9 pp. It has been shown that the process of dipole orientation in a dielectric may be likened to the mechanical behavior of a visco-elastic element consisting of an ideal spring in parallel with an ideal dash pot. The elasticity of the spring and the viscosity of the dash pot are different from the ordinary macroscopic elasticity and viscosity of the material, and expressions for these phenomenological quantities have been derived from molecular kinetics.

A Theorem Concerning Noise Figures, by A. G. Bose and S. D. Pezaris. "IRE Trans. UGCT." Sept. 1956. 7 pp. A theorem is formulated and proof offered which determines the greatest lower bound of the single-frequency noise figure of a general system consisting of "n" amplifying devices and passive coupling elements. According to the theorem, this lower bound is equal to the noise figure of an optimum system using a selected one of these amplifying devices.

Synthesis of Tchebycheff Impedance-Matching Networks, Filters, and Interstages, by G. L. Matthaei. "IRE Trans. PGCT." Sept. 1956. 10 pp.

Particle Accelerators—Large Proton Synchrotrons, by P. Lapostolle. "Onde." Dec. 1956. 10 pp. After a brief résumé of the role of particle accelerators in nuclear physics, the various types of apparatus which have been constructed up to the present time are successively considered. The principles of the various accelerators are considered in roughly chronological order, and while the actual equipments arising from these principles are described, the author has illustrated the logical progress of inventions, which have recently led to the construction of the most modern machines, the large proton synchrotrons.

Gyrators and Non-Reciprocal Systems, by M. Prudhon. "Cab. & Trans." Jan. 1957. 8 pp. The object of this study is to determine the conditions necessary for obtaining a linear four-terminal network containing only passive elements and gyrators, and having different attenuations in either transmission direction. Some examples of simple linear networks are given which constitute non-reciprocal devices, i.e. showing a practically infinite attenuation in one of their transmission directions.

Analytical Approaches to Local Oscillator Stabilization, by W. Y. Pan and D. J. Carlson. "IRE Trans. PGBTR." Oct. 1956. 8 pp. The analytical approaches to local oscillator stabilization in general and the special considerations at uhf are fully illustrated with two types of commercial television tuners. It is suggested that the same general approaches and considerations can be utilized to stabilize local oscillators for other applications.

TRANSMISSION LINES

Transmission Characteristics of Inclined Wire Gratings, by O. J. Snow. "IRE Trans. PGAP." Oct. 1956. 5 pp. Small diameter parallel wires were imbedded in thin plastic sheets and located closely before an antenna dish receiving plane wave X band energy. Experimentation showed need for a more precise theory to include the effect of varying input impedance to predict approximate amplitudes as well as sharp transmission dips of smaller magnitude.

Factors Affecting Attenuation of Solid Dielectric Coaxial Cables Above 3000 Megacycles, by J. R. Hannon. "IRE Trans. PGCP." Dec. 1956. 7 pp.

TUBES

A low-Noise Traveling-Wave Tube Amplifier for the 4000-Mc/s Communications Band, by D. H. O. Allen and J. M. Winwood. "J. BIRE." Jan. 1957. 11 pp.

The Use of Getters in Magnetrons, by I. P. Zijlstra. "Vide." Sept.-Oct. 1956. 3 pp. Vast improvements in aging and elimination of the need for "seasoning" magnetrons after shelf life are reported as a result of gettering.

An Experimental Cold Cathode Magnetron, by J. R. M. Vaughan. "Vide." Sept.-Oct. 1956. 7 pp. Back bombardment of the cathode from the space charge can be utilized to produce the increased emission required to operate microwave pulsed oscillators as the wavelength is reduced.

Practical Millimeter Magnetron Considerations, by L. W. Roberts and R. S. Briggs. "Vide." Sept.-Oct. 1956. 6 pp. Important considerations in the design of a new magnetron are discussed.

A Low Noise High Power Klystron Oscillator of Great Reliability, by G. A. Espersen. "Vide." Sept.-Oct. 1956. 10 pp. This is a discussion of the development and performance of the most recent model of the Philips high power tuneable klystron oscillators.

Operation and Application of the Retarding Field Oscillator at Millimeter Wavelengths, by C. J. Carter, W. H. Cornett, Jr., and M. O. Thurston. "Vide." Sept.-Oct. 1956. 5 pp.

Broad-Band Traveling Wave Tubes for Wavelengths of 2-3 Cms., by D. H. O. Allen. "Vide." Sept.-Oct. 1956. 7 pp. The author discusses the application of established ideas to higher frequencies and the development of practical traveling wave tube amplifiers.

A 4,000 Mc Low-Noise Traveling-Wave Tube, by P. F. C. Burke and W. J. Pohl. "Vide." Sept.-Oct. 1956. 7 pp.

Characteristics of a Strophotron Oscillator of 10 Cm. Wavelength, by T. S. Robinson. "Vide." Sept.-Oct. 1956. 11 pp. In this multi-reflex klystron, accurate control is possible over the time electrons spend in the interaction space in the presense of the r-f field. Results are higher efficiency, broader bandwidth, and smaller thermal frequency shifts than occur in reflex klystrons.

Electrolytic Tank with Current Leading Elements for Studying Space Charge Distribution in Electron Tubes, by V. S. Loukochkov. "Vide." Sept.-Oct. 1956. 10 pp.

Gas-Filled Voltage Stabilizers, by F. A. Benson. "E. & R. Eng." Jan. 1957. 5 pp. The effects of tube parameters on noise characteristics have been studied, and the results of the work are presented and discussed in this article.

Study of Noise in Traveling-Wave Tubes, by A. S. Tagher. "Vide." Sept.-Oct. 1956. 10 pp.

Series-String Tubes, by R. M. Hughes. "El. Des." Feb. 15, 1957. 2 pp. Circuit design considerations for using series-string tubes are discussed.

U. S. GOVERNMENT

Research reports designated (LC) after the price are available from the Library of Congress. They are photostat (pho) or microfilm (mic.), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

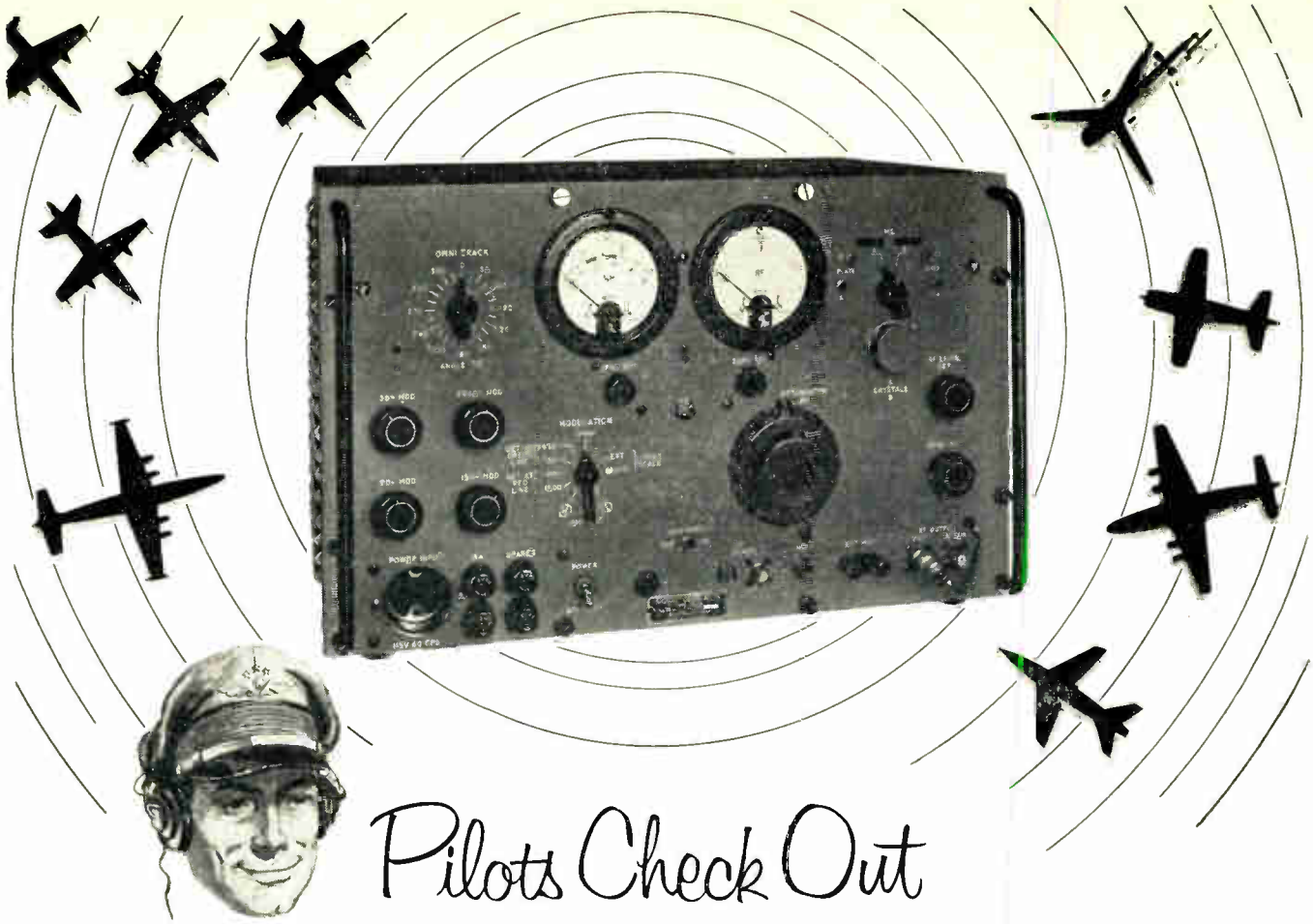
When an agency other than LC or OTS is the source, use the full address included in the abstract of the report. Make check or money order payable to that agency.

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Precision Potentiometers Approaching Infinite Resolutions, by M. Bialer and T. T. Crow. USAF. Feb. 1956. 19 pp. photo, diagrs., graphs. 50 cents. (OTS) (PB 121530). Three basic methods are in use today for producing precision potentiometers which have resolution approaching "infinite resolution." These methods are slide-wire types, various film types, and conductive plastics (which may be considered a type of film). The various advantages, disadvantages, methods of measurement, and some characteristics of each are discussed.

Development of an Automatic Sonar Transducer Test Set Using a Pulse Modulated Signal, by W. D. Nupp and M. Barron. U. S. Naval Air Development Center, Johnsville, Pa. July 1955. 48 pp. photos, diagrs., graphs. Mi $3.30, ph $7.80. (LC) (PB 123001). The development of a laboratory test set was undertaken to provide quick automatic plotting and recording of the directivity and frequency response characteristics of sonar transducers. This unit allows a reading of only the direct received signal. Undesired reflected waves and signal build-up transients are eliminated by gating the receiver in synchronism with the transmitted pulse.

Development of Isolators for Heavy Airborne Electronic Equipment, by L. C. Lindblom. United States Rubber Co. Mar. 1955. 36 pp. photos, drawings, graphs. $1. (OTS) (PB 121317). Models of six isolator design variations were evaluated for isolation efficiency and shock absorption characteristics at room temperature. All evaluations were confined to designs which utilized a steel coil spring in conjunction with a dry friction damper for isolating vibration amplitudes and a siicone pad for absorbng shock accelerations. This resulted in a basic design which was adaptable with a maximum number of interchangeable parts into five different load ranges.



Pilots Check Out

NAVIGATION RECEIVER ACCURACY

ARC Type H-14A Signal Generator Checks Omni/Localizer Equipment

ARC's H-14A Signal Generator provides a simple and dependable means of checking *omnirange* and *localizer receivers* in aircraft on the field, by sending out on the hangar antenna a continuous test identifying signal that blankets the field. Tuned to this signal, individual pilots or whole squadrons can quickly test their own equipment. Voice can be transmitted simultaneously with signal. The instrument will check 24 omni courses, omni course sensitivity, operation of TO-FROM meter and flag-alarms, left-center-right on 90/150 cps localizer, receiver frequency calibration, reciprocal course accuracy, and receiver output. The H-14A is also widely used for making quantitative measurements on the bench during receiver maintenance. Input power is 160 watts, 115 volts 60 cps.

The H-16A Standard Course Checker measures the accuracy of the indicated omni course in ARC's H-14A or other omni signal generator to better than ½ degree. It features a built-in method of checking its own precision.

ARC's Type H-12 Signal Generator (900-2100 mc) is equal to military TS-419 U, and provides a reliable source of CW or pulsed rf. Internal circuits provide control of width, rate and delay of internally-generated pulses. Complete specifications on request.

Dependable Airborne Electronic Equipment Since 1928

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Miniaturized Automatic Direction Finders • Omni/Loc Receivers • Course Directors • UHF and VHF Receivers and Transmitters
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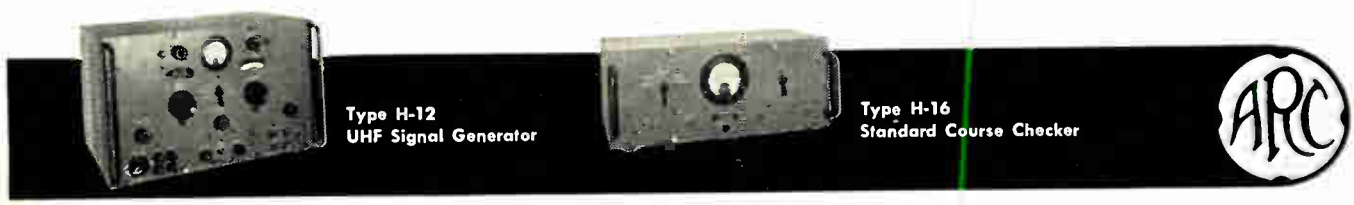


MICROWAVE PROGRESS

Signal Sources and Receivers

What a tankful of gasoline is to the automobile, the klystron tube is to the microwave system—a reliable and efficient power source.

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.

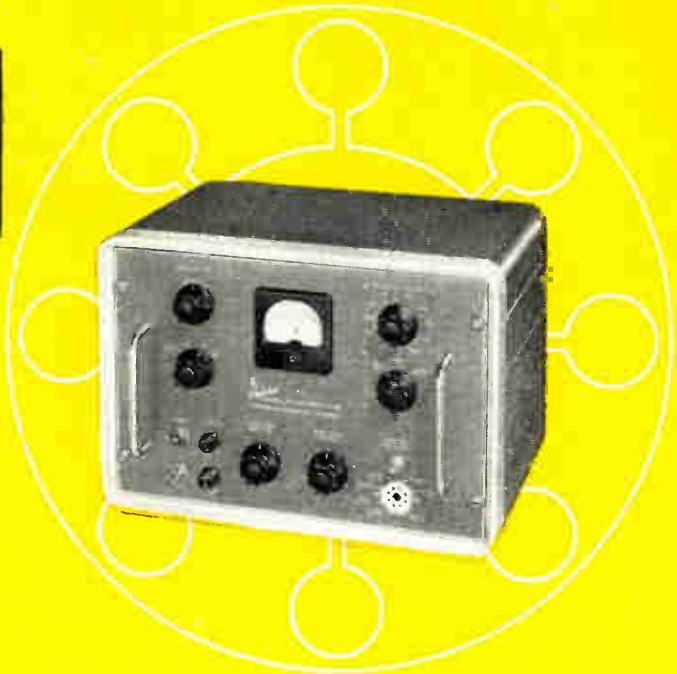
The coaxial cavity is most often used for broadband oscillators since its principal mode is the *TEM*. This permits greater frequency coverage than either the *TE* or *TM* modes of rectangular waveguide sections.

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-4.



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 600	0 to 65	Ripple: < 5mv RMS
	Reflector	Continuously variable 0 to −900	50 μa max.	Ripple: < 10mv RMS
	Filament	6.3	2 amperes	±3% center tapped

	Type	Frequency Range (cps)	Nominal Voltage (volts)	Rise Time (microseconds)	Decay Time (microseconds)	
Modulation	Square Wave	400 to 2000	0 to 90	<10	<10	Clamping circuit maintains top of square wave within 2 V of cw reflector voltage.
	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-4.

Polytechnic Research and Development Co., Inc.

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

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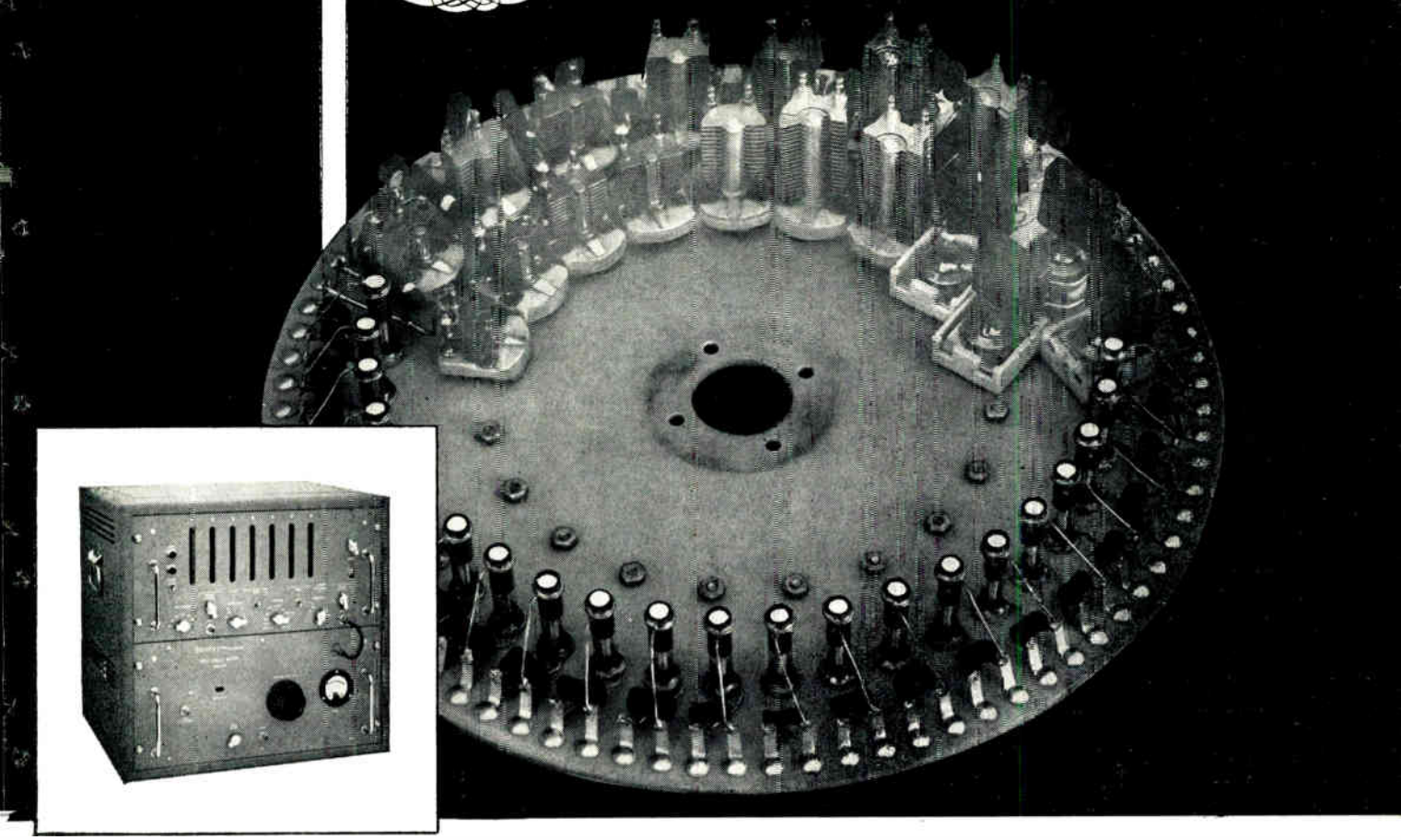
CASE history number 6

JFD Electronics

PISTON CAPACITORS AT WORK



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

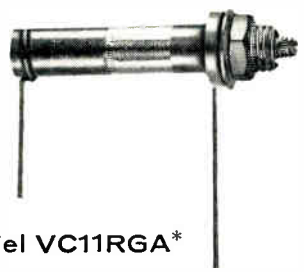
PROBLEM: To combine functions of precision wide-range frequency meter and universal counter and timer in one compact instrument—to measure frequency from 0 to 42 megacycles with an accuracy of ±1 cps or greater and elapsed time from 1 microsecond to 10 million seconds with a maximum accuracy of ±1 microsecond.

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.

actual size



Model VC11RGA*

(1-10 mmf-glass dielectric-invar rotor)

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.*

JFD ELECTRONICS CORPORATION, 1462–62 STREET, BROOKLYN 19, N. Y.

Go Forward with JFD Engineering!

Circle 73 on Inquiry Card, page 101

Personals

Frank G. Daveler has been recently appointed to Division Manager, Computer Components Div., for the International Resistance Co. of Phila.

Dr. Alfred Prommer and **Dr. Ronald Dell** have recently joined the staff of Varian Associates, Palo Alto, Calif.

James R. Welch has been named Manager of Application Engineering for Eitel-McCullough, Inc., in San Bruno, Calif.

Morton S. Levin has been appointed Director of Engineering for Datascan Inc. He was associated for five years with the Tung-Sol Electric Co. where he served as head of the Electrical Equipment R & D dept.

M. S. Levin

O. C. Bowers

Orrin C. Bowers has been appointed Chief Engineer of BJ Electronics. Mr. Bowers was formerly Projects Manager of the Electronic Instrumentation Div. of Ramo-Wooldridge Co.

J. J. Gano and Associates of Cambridge, Mass. are consulting engineers specializing in power systems for electronic equipment. This service bridges the field between the industrial power engineer and the electronic circuit designer. It covers power generation, conversion, distribution and control.

Reginald A. Young is now Manager of Receiving Tube Plant of Sylvania Electric Products, Inc. in Mill Hall, Pa.

Joseph W. Halina has joined Federal Telecommunications Labs., Palo Alto, as a senior member of the technical staff with responsibilities for systems and circuit design.

Boyd E. McKnight has been named Senior Applications Engineer for the Davies Labs., Div. of the Minneapolis-Honeywell Regulator Co. in Beltsville, Md.

Paul O. Frincke has been named Director of Video Service Engineering for the Ampex Corp. of Redwood City, Calif.

Max Enderlin has been appointed Chief Engineer of the Semiconductor Div., Federal Telephone and Radio Company, a Div. of IT & T.

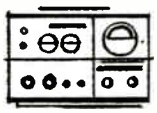
Now! Simplify pulse-forming circuits with new Westinghouse **WL-6954**

Designed for:

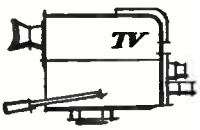
Guided Missiles

Airborne Communications

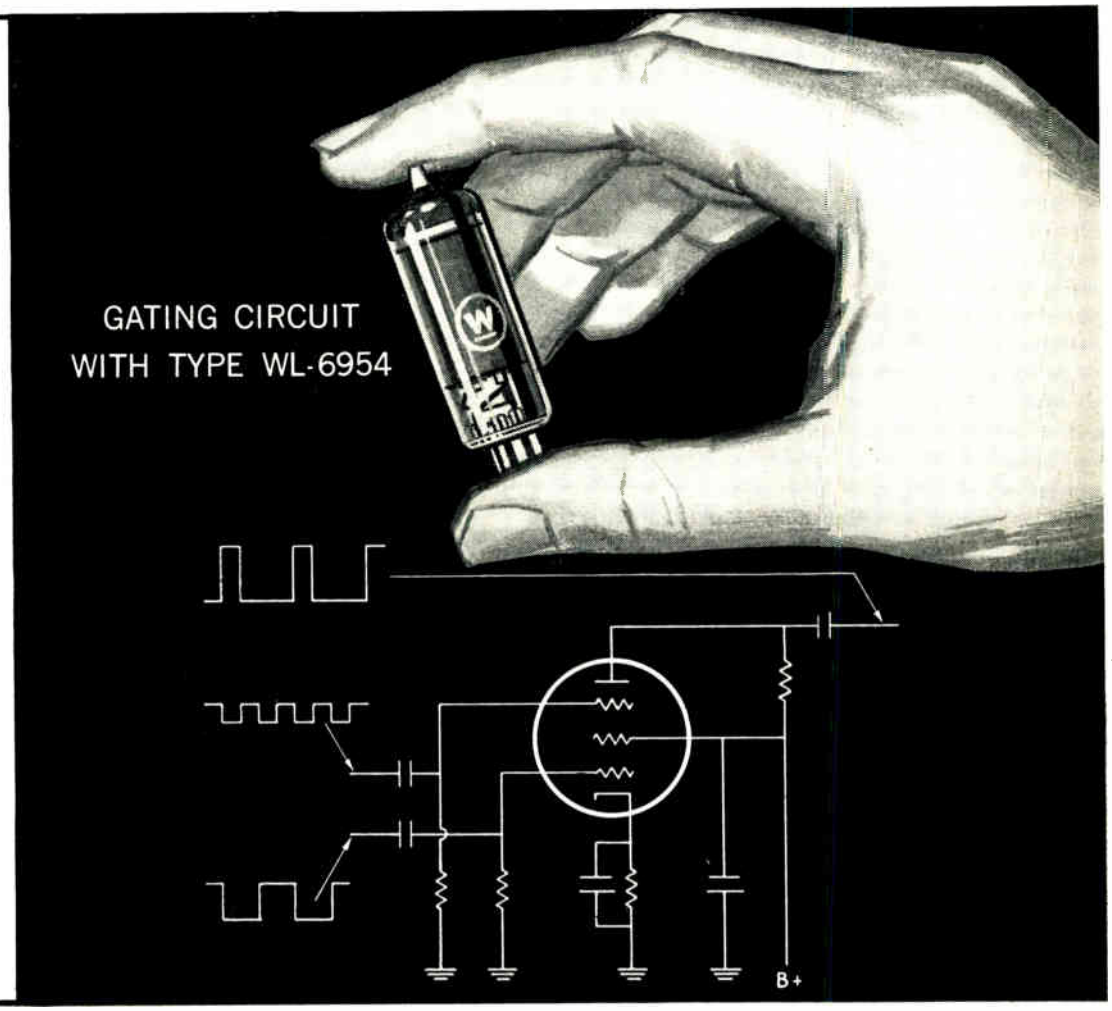
Radar



Test Equipment



Closed Circuit TV



NEW SHARP CUT-OFF DUAL-CONTROL PENTODE OFFERS EXCEPTIONALLY HIGH TRANSCONDUCTANCE

The new Westinghouse WL-6954 is a 7-pin miniature pentode designed for application in Military and Industrial equipment as a gating, coincidence, mixing or delay tube.

Built to high standards of reliability, it meets MIL-E-1C vibration test specifications. It permits simplification of pulse-forming circuits and has the advantage of high transconductance from Grid 3 to Plate.

The WL-6954 is available in production quantities for immediate delivery. It's one more reason why—when you want highest quality tubes for Military or Industrial purposes—you'll find it wise to check Westinghouse.

SAMPLE ORDERS INVITED! IMMEDIATE DELIVERY.

YOU CAN BE SURE...IF IT'S

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Commercial Eng. Dept., Electronic Tube Div.
Westinghouse Electric Corp., Elmira, N. Y.

Please send me complete data on your new WL-6954 pentode.

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COMPANY_____

ADDRESS_____

ED-5-1

Circle 75 on Inquiry Card, page 101

Meters

(*Continued from page* 81)

checks within 1/10 of 1% have been reported.

Shunt

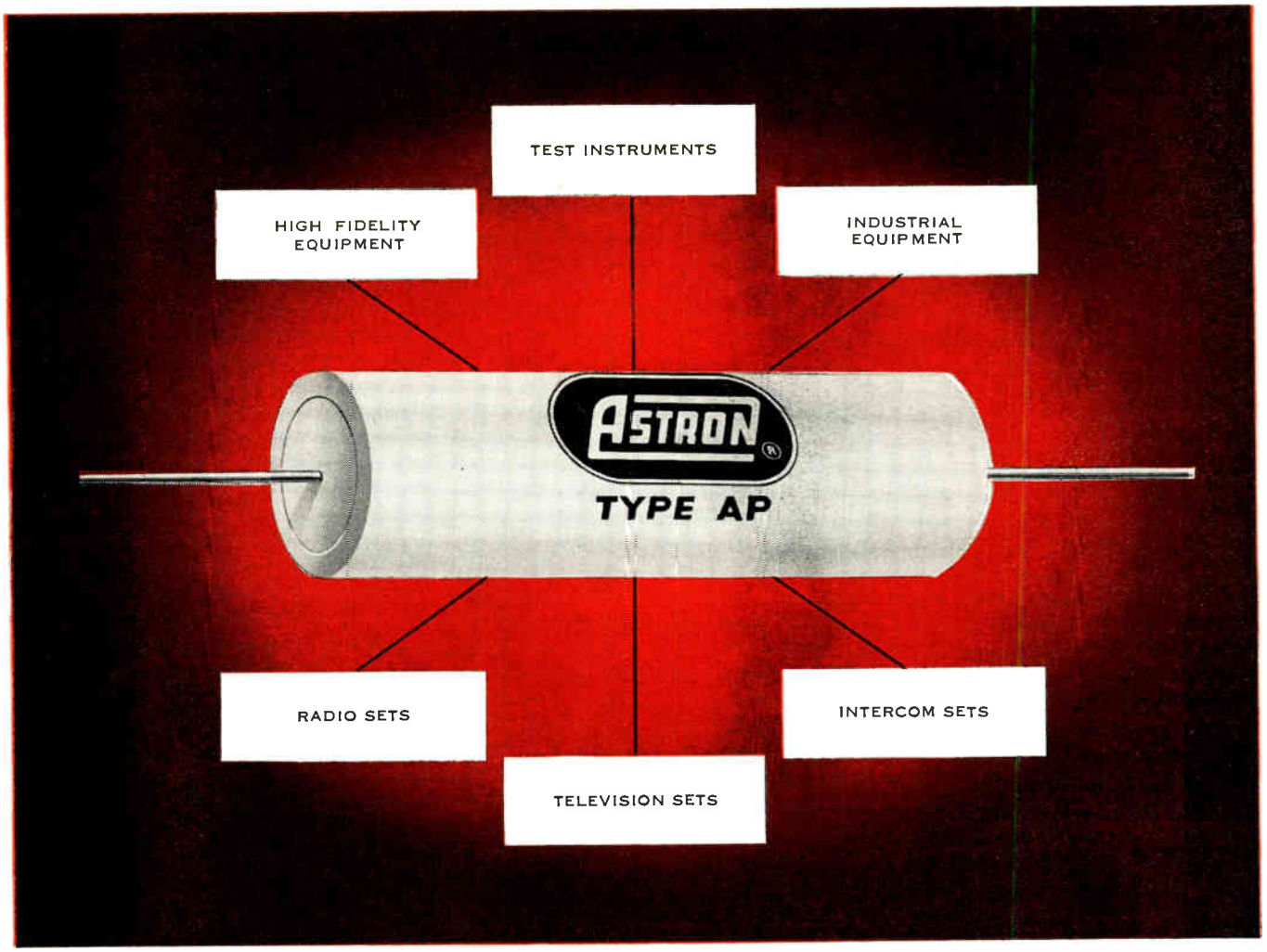
The shunt resistance element was made of well-aged manganin and of a wire size which would carry 5 amp. without degradation. Mounted under a bakelite plate in an otherwise shielded metal box these shunts have so far proved very stable and should remain within 1/10 of 1% for long periods of time.

The high voltage instrument with a range of 0-3000 volts, although of secondary importance to the instrument measuring the main current, was also of the same type but adjusted for 1 ma full scale. And even though arranged to be used in the grounded side of the circuit exactly the same precautions were used as to shielding and protection. The high voltage resistor for 3000 volts was made in a 6000-volt tubular resistor form, again to give ample margin and thus allow for safe operation in the rare cases where the so-called "trouble voltage," due to superimposed earth potentials, might rise considerably above the 3000 volt value.

Monitors

The 4-in. square monitoring instruments for the various sections of the power supply were not required to be highly accurate, and the 1% nominal accuracy was deemed sufficient. However, many of the milliammeters were in circuits having a high potential to ground which might, in some instances, be as high as 3000 volts. In these smaller instruments leakage distances are considerably less than in the larger type previously mentioned and, again for both safety against breakdown and protection to personnel it was apparent a somewhat special design was needed. Mounting of a standard instrument on a metal panel with 3000 volts between the mechanism and the panel indicated that breakdown would not occur but that the electrostatic effect was considerable, the pointer moving away from its normal position by several divisions.

(*Continued on page* 110)



ASTRON'S NEW SUPER-TIGHT STEATITE CONSTRUCTED

CERAMIC CASED PAPER CAPACITORS

for economy and dependability

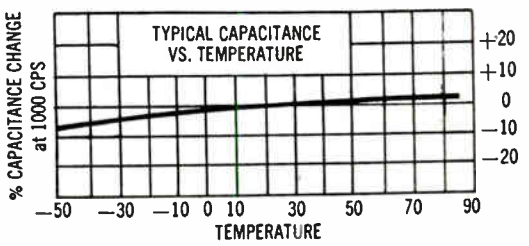
New Astron Ceramic Cased Paper Capacitors, Type AP, are designed to fill electronic equipment manufacturers' needs for high performance capacitors at competitive prices.

Non-melting cement compound end-seals and wire terminals are firmly bonded to tough steatite ceramic tubing — leads are safely locked in place — a completely impregnable shield against humidity and temperature.

These non-inductively precision-wound paper tubulars are oil impregnated and operate continuously with exceptionally long life and minimum capacitance change. Low power factor and high insulation resistance over the entire range of —40° C to +85° C, and extreme stability make Astron Type AP a dependable unit for the most critical operation. Ten separate production tests plus a 100% final inspection guard against costly rejects.

Available in standard voltage ratings from 200 to 1600 WVDC.

WRITE TODAY FOR COMPLETE TECHNICAL AND ENGINEERING DATA — ASTRON BULLETIN AP-100.



ASTRON
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PECKVILLE, PENNSYLVANIA

Circle 77 on Inquiry Card, page 101

(*Continued from page* 108)

Accordingly a somewhat special combination was made, using the standard case but with a deep base. Again a core magnet type of mechanism, available in a smaller size, was chosen and mounted rather deep in the base which allowed for placing the scale plate nearly an inch back from the glass window.

Fig. 1 shows a cut-away section of the instrument which has been called Model 746. Although the scale was a relatively long distance from the window the assembly proved quite readable and appeared to be a simple solution to the need for high voltage instruments. Breakdown proved to be well over 10,000 volts. All of the d-c instruments of the 4-in. size were built in this manner and also included an extra long zero corrector which could be extended through the additional protecting glass plate on the face of the control panel.

Corona Effects

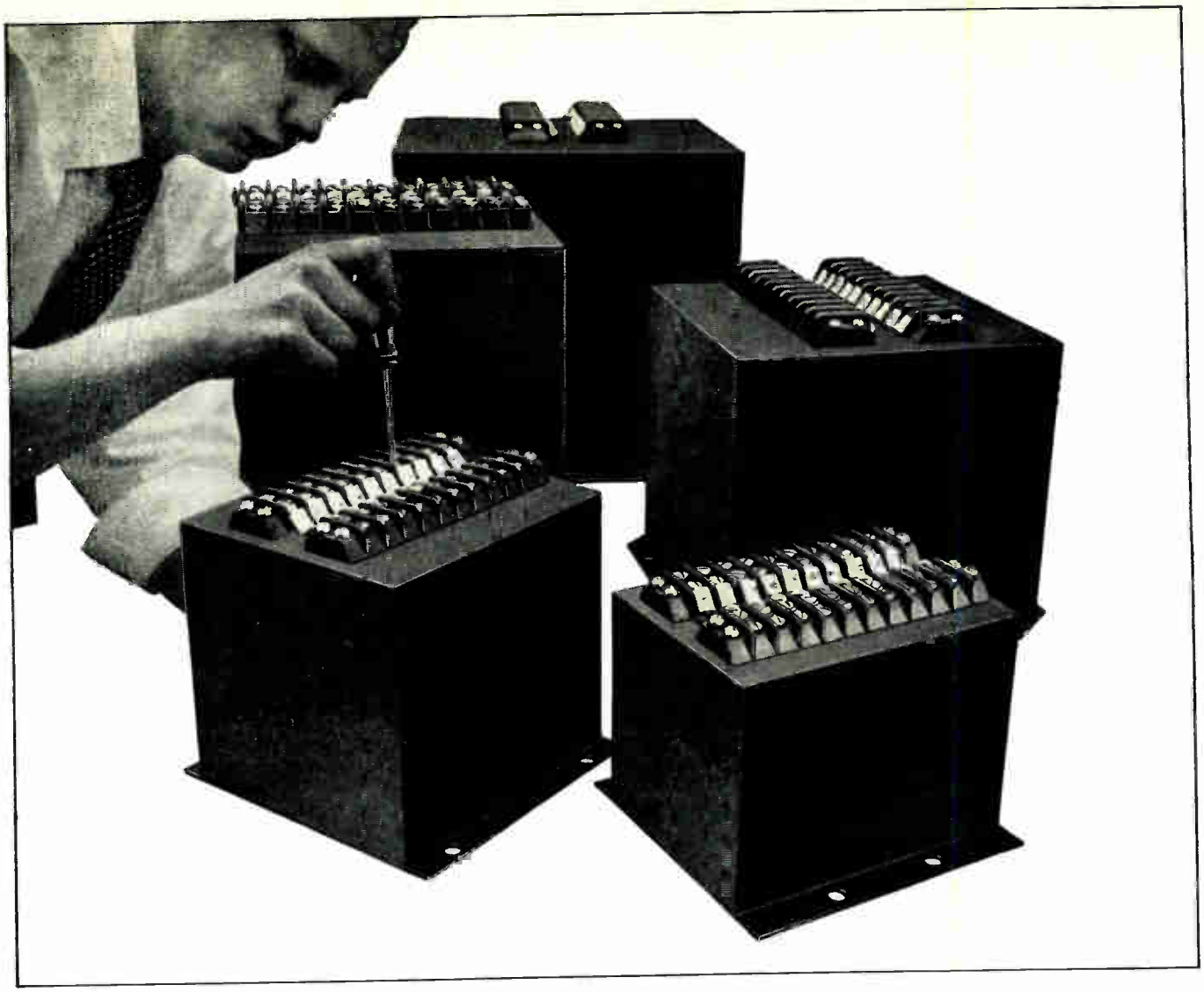
During power equipment panel tests by the engineers of the Bell Laboratories, it was found that some of the gear was producing radio noise when excited with the very pure d-c at 3000 volts. Apparently there was an invisible corona discharge from points in the equipment.

Anti-Corona Measures

Since the instruments were causing a part of this radio noise, it was necessary to round off the edges of all items which were within an inch or so of ground potential. This necessitated great care in making all soldered joints to eliminate any points of solder emerging. The corners of the scale plates were rounded off and the shields around the shunts, normally made of perforated metal, were carefully reworked to eliminate points at ground potential as well. This rounding of all live parts and elimination of points is an unusual requirement in the field of measuring instruments but appeared necessary to obtain the optimum end results.

Reference

1. "Power Feed Equipment for the North Atlantic Link," by G. W. Meszaros and H. H. Spencer, *Bell System Technical Journal*, January 1957.



Now--CONTROL offers you standardized saturable reactors

If you're a design engineer who would be delighted with industrial components which are sensitive and, under normal operation, last virtually forever with no maintenance or servicing, then you'll welcome CONTROL's *standard* lines of saturable reactors.

With CONTROL reactor assemblies and magnetic amplifiers, you know complete physical and operating characteristics —a copy of our Catalog R-10 awaits your request. And, delivery is fast because sub-assemblies of these units are stocked, awaiting your control-winding specifications.

CONTROL reactors are available for both 120- and 240-volt 60-cycle operation. There are eleven standard sizes in each voltage range. They have extremely high gain. Six ampere-turns control nearly 2,000 watts in the largest size. Power outputs range from 50 to 2000 watts, with only 2 ampere-turns required for control of the smallest units.

In addition to higher gain, smaller exciting current, and fewer ampere-turn characteristics, CONTROL reactors have a 40 to 1 cut-off ratio. They are totally enclosed so that the high performance toroidal cores used are protected, and the entire assembly has the ruggedness required for long life.

CONTROL offers the same convenience of standardization in use of high permeability magnetic devices that you've enjoyed with other components. Add to this convenience ruggedness and freedom from maintenance which is unmatched, and you'll welcome CONTROL to your design picture. Write for complete details and literature today. *CONTROL, Dept. TT-37, Butler, Pennsylvania.*

Reliability begins with CONTROL

A DIVISION OF MAGNETICS, INC.

Circle 79 on Inquiry Card, page 101

News of Reps

REPS WANTED

A leading manufacturer of program timers and rectilinear potentiometers for military and industrial applications, including guided missiles. Several territories are available to reps to handle this company's products. (Ask for R5-1)

Robert Smith, 59 Verndale, Brookline, Mass., was appointed sales rep in the New England territory for the Pentron Corp.

Frank A. Emmet Co., Los Angeles will represent Dilectron, Inc., Monrovia, Calif. a div. of Gudeman Corp., in Southern California, Arizona and Southern Nevada.

Al Engelman Co., 3205 Crump Ave., Memphis, Tenn. has been named the new Mid-South reps for ORRadio Industries.

Frank C. Knickerson Co. is now sales reps in the South for Filtors, Inc., Port Washington, N. Y.

Robert J. Marcy and Fred J. Neidig, formerly of Langevin Manufacturing Corp., announced the opening of their new office as manufacturers reps, They are known as M & N Associates, 1776 Broadway, New York 19, N. Y.

Carl E. Holmes Co., Los Angeles and San Francisco, Calif. has been appointed as Western sales reps for the Semiconductor Products Div. of United States Dynamics Corp., Boston, Mass.

William G. Tuscany, formerly Assistant Manager for printed circuits at Centralab, joined **Erwin I. Aaron and Associates, Inc.** manufacturers reps in Milwaukee, Wisconsin and Minneapolis, Minnesota.

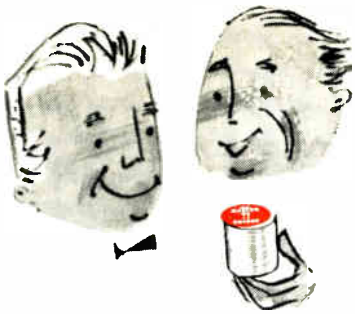
McDowell - Replingshafer of 1103 E. Armour Blvd., has been appointed reps for Karr Engineering Corp., of Palo Alto, Calif. in Missouri and Kansas as well as Eastern Nebraska.

Jack Geartner Co., 823 86th St., Miami, Fla., has been appointed reps for the General Ceramics Corp. in Florida.

Avionics Liaison Boeing Field, Seattle, Wash., is now reps in the Pacific Northwest for Dynamics Research Associates.

United Service Associates, Inc., 1700 K St. N. W., Washington, D. C., will represent Robinson Aviation, Inc. in Washington, Baltimore and Hagerstown, Maryland areas.

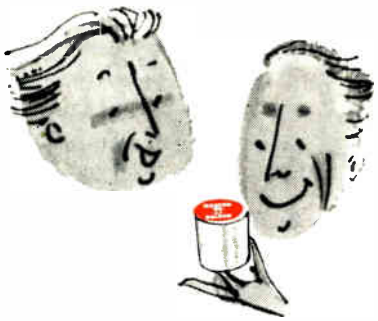
W. H. Connors Co. are representing the Merrit Coil & Transformer Corp. of Chicago in RETMA designated territories No. 26 and 27A.



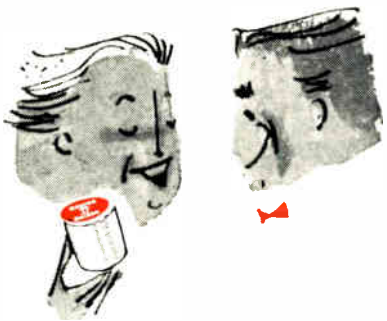
"We are sold on Kester '44' Resin-Core Solder, Jim. It's the fastest acting solder we have ever seen."

"Been using Kester Flux-Core Solder for almost half a century, Tom; nothing like it."

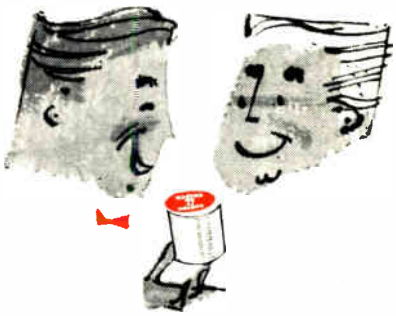
"Kester Solder spools are always marked with the exact alloy, Joe; no code markings."



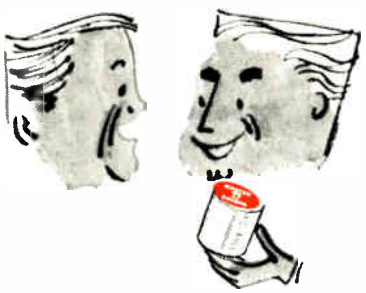
"Nothing like Kester Solder, Fred, for keeping costs in line."



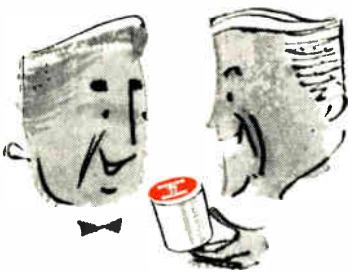
"Our girls swear by Kester, Bert; they claim soldering is much easier."



"Kester 'Resin-Five' Core Solder is the choice for our production, Paul."



"Our work goes much faster now, Bill, since we switched to Kester Solder."



"We had a tough soldering job, Harry, but Kester engineers licked it in a hurry."

SEND TODAY for your free copy of the Kester book, "Solder . . . Its Fundamentals and Usage" . . . 78 pages of technical information.

HOW THE WORD GETS AROUND

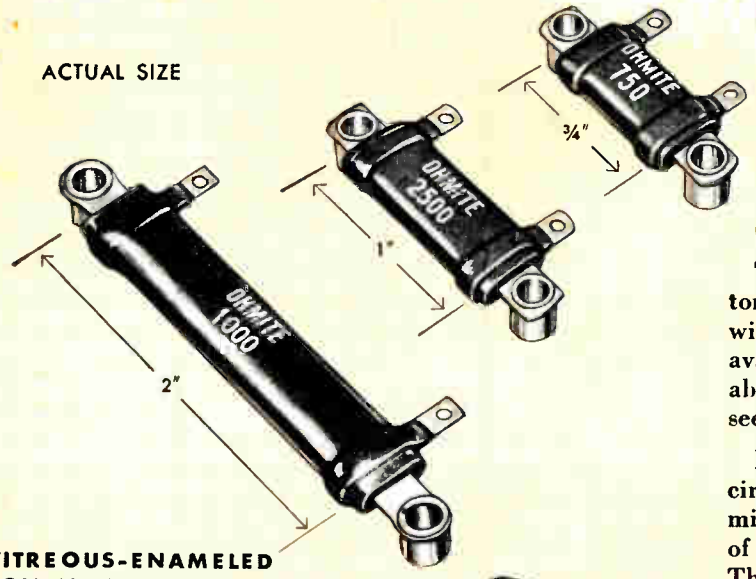
You hear comments like these everywhere informed people in the electronics industry get together to "talk shop." It's a fact . . . there is nothing quite like Kester Solder. And that's why it's so universally popular.

KESTER SOLDER

Company 4210 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

...pack higher wattage into less space with NEW MINIATURE OHMITE® THIN-TYPE power resistors

ACTUAL SIZE

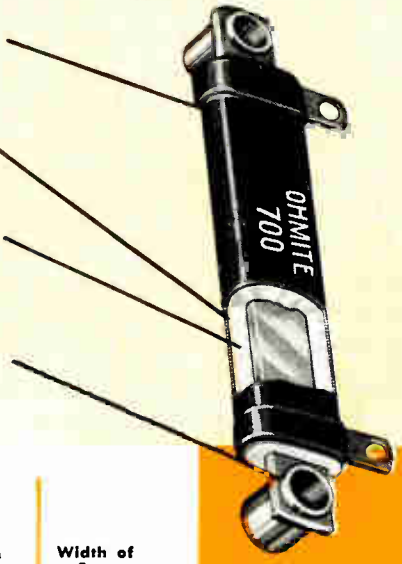


VITREOUS-ENAMELED COVERING holds winding rigidly in place . . . protects winding from damage.

UNIFORM WINDING prevents "hot spots" and resultant failures.

STRONG, CERAMIC CORE provides a solid base for winding. Core unaffected by cold, heat, or high humidity.

INTEGRAL MOUNTING BRACKETS distribute heat more evenly throughout resistor and conduct heat away.



The new Ohmite *miniature* thin-type power resistors are now available in three wattage sizes in a wide range of resistance values; two wattage sizes are available from stock; also three wattage sizes available from stock in the standard thin-type resistor . . . see (*) table below.

Designed especially for use in modern electronic circuitry where space is at a premium, these new miniature units have all the timeproven superiority of standard Ohmite vitreous-enameled resistors. They are only 1/8" thick and 3/8" wide, and range in length from 3/4" to 2".

Because of their compact design, the new Ohmite *miniature* thin-type resistors pack higher wattage into less space. The stacking bracket allows mounting close to the surface and a hollow stud provides for convenient stacking of two or more units. The miniature thin-type rises only 11/32" above the mounting surface; stack mounted, four units are less than 1 1/8" in height. Shown in photograph are: 1 Standard Thin-Type Resistors with Unit Brackets; 2 Standard Thin-Type Resistor with Stacking Brackets; 3 Miniature Thin-Type Resistors.

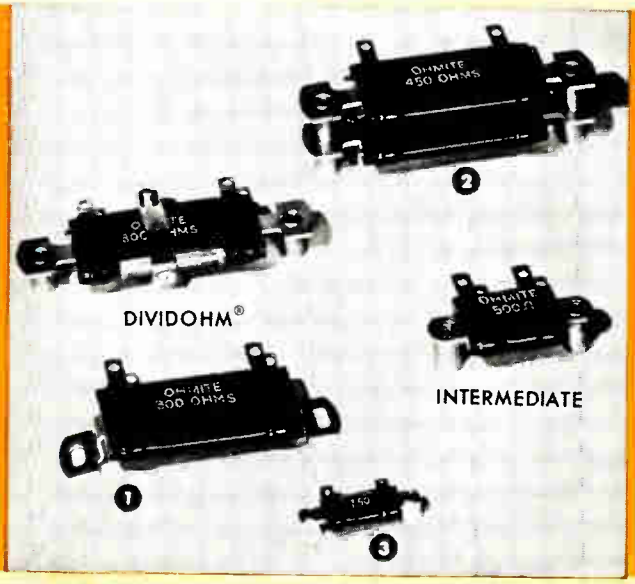
Write on company letterhead for Bulletin 138-B.

Watt Rating	Length of Core	Width of Core
MINIATURE THIN-TYPE RESISTORS		
* 10	3/4"	3/8"
15	1"	3/8"
* 20	2"	3/8"
INTERMEDIATE THIN-TYPE RESISTORS		
20	1"	13/16"
30	1 1/2"	13/16"
STANDARD THIN-TYPE RESISTORS		
* 30	1 1/4"	1"
* 40	2"	1"
* 55	3 1/2"	1"
65	4 3/4"	1"
75	6"	1"

Now available from stock . . .

2 miniature sizes: 10 and 20 watts

3 standard sizes: 30, 40, and 55 watts

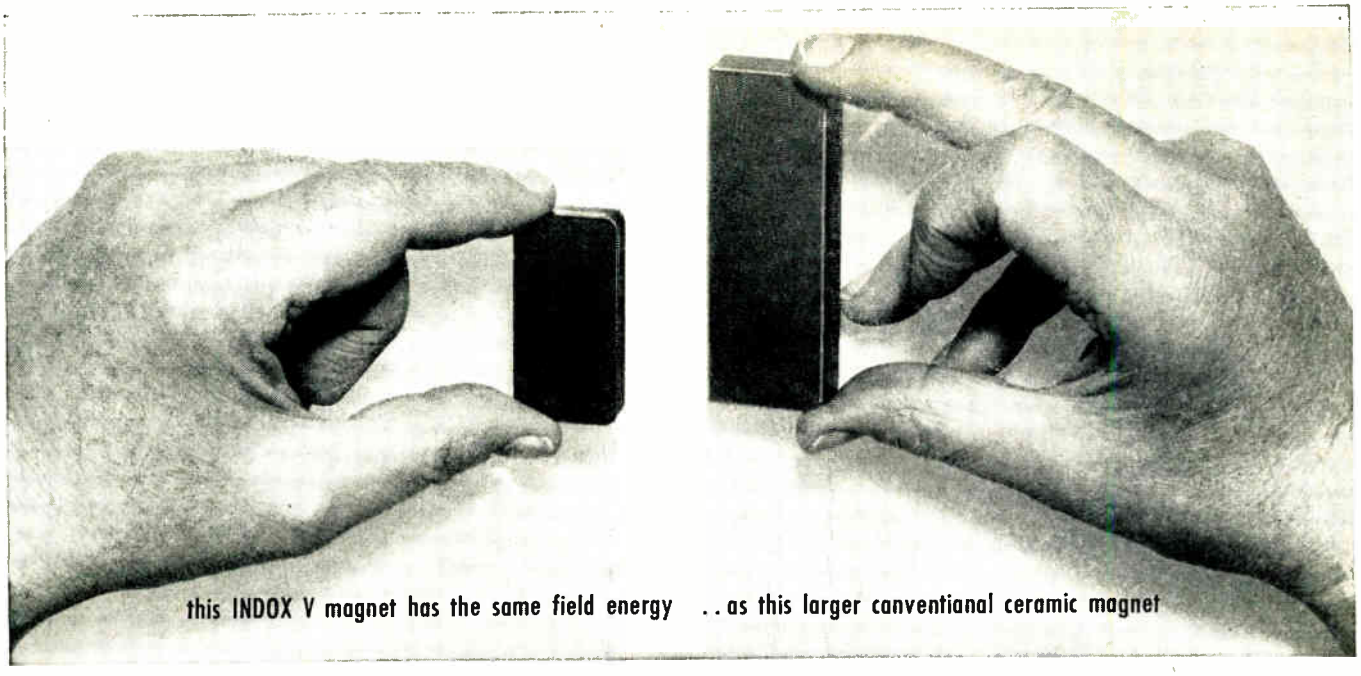


WATTAGE RATINGS ARE BASED ON THE RESISTOR MOUNTED ON A HORIZONTAL STEEL PANEL .040" THICK BY 10" SQUARE. RATINGS SHOULD BE REDUCED APPROXIMATELY 15% FOR NONMETALLIC MOUNTING SURFACE.

BE RIGHT WITH OHMITE®

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES • TANTALUM CAPACITORS

OHMITE MANUFACTURING COMPANY • 3662 Howard Street, Skokie, Illinois



NEW, high energy Indox V ceramic permanent magnets

..they're 3½ times stronger than conventional ceramic magnets

Indox V — another first from the research and development laboratories of The Indiana Steel Products Company — is available to magnet users *immediately*. This unique, new, magnetic material offers these important advantages . .

Indox V requires no critical materials. It is a highly oriented barium ferrite . . using inexpensive, noncritical, raw materials that are constantly available. Shortages in times of emergency cannot occur.

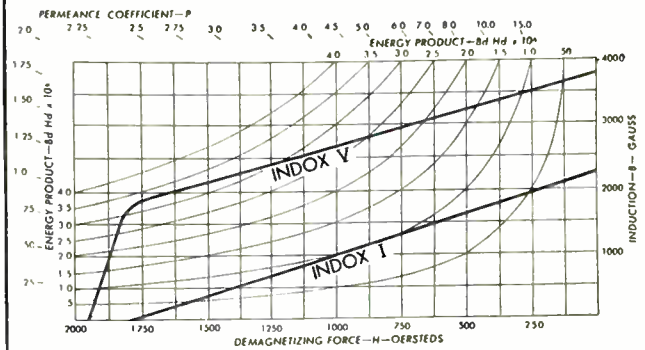
Indox V requires less space, weight to do same job. Volume and weight comparisons show that the energy of Indox V far exceeds Indox I . . and is comparable to Alnico V, the strongest permanent magnet material commercially available.

Indox V offers high resistance to demagnetization. Indox V magnets can be designed for applications where extremely high demagnetizing forces exist . . without irreversible losses occuring. This means it can be used where other types of magnets have been impractical . . for example, in stators of medium-size electric motors where electromagnets are now being used.

JUST PUBLISHED! *This two-page data sheet gives detailed information on new high energy Indox V. Use this coupon to request your copy. Ask for Bulletin 16-N5.*

..ideal for:

- D-C motors
- Synchronous drives
- Traveling wave tubes
- High-fidelity loud-speakers
- Eddy current drives
- Tractive devices where size is important



Comparison of demagnetization and energy product curve for conventional Indox I ceramic magnets and the new, high energy Indox V magnets.

THE INDIANA STEEL PRODUCTS COMPANY • VALPARAISO, INDIANA

. . the world's largest manufacturer of permanent magnets

Name_____

Company_____

Address_____

City_____ Zone____ State_____ 16-N5

INDIANA PERMANENT MAGNETS

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

New Tech Data for Engineers

Magnetizers

A 2-page bulletin on magnetizers has just been released. The Indiana Steel Products Co., Valparaiso, Ind., offers 2 principal types of magnetizers that meet the requirements of most applications and offer many advantages. Includes data and charts.

Circle 84 on Inquiry Card, page 101

Automation

A new booklet, "High-Speed Analog Computers, Key to Rapid Systems Development," answers questions from engineers, executives, and educators who are concerned with automation and the development of control systems for industrial and military applications. GPS Instrument Co., 811 Boylston St., Boston 16.

Circle 85 on Inquiry Card, page 101

Guided Missiles

Entitled Guided Missiles: Modern Weapons for the Modern Army, this 16-page booklet explains the Army's past and present missile activities, suggests future activities, discusses manpower and facility requirements, and depicts unclassified missiles. Also included is a 45 r.p.m. record which portrays an actual missile launching. The brochure is available at no charge from General Electric Co., 3198 Chestnut St., Philadelphia, Pa.

Circle 86 on Inquiry Card, page 101

Bearing Differentials

PIC Design Corp., East Rockaway, L. I., N. Y., is offering a catalog that describes fully their complete new line of precision oil-less bearing differentials. Catalogue is complete with photographs, specifications and drawings.

Circle 87 on Inquiry Card, page 101

Selenium Rectifiers

A 52-page replacement guide, with detailed information on selenium rectifier replacement for servicing literally hundreds of different TV and radio receiver chassis and a variety of other electronic products, has been compiled by the Components Div. of Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J., a div. of International Telephone and Telegraph Corp.

Circle 88 on Inquiry Card, page 101

Test Equipment

Waveline, Inc., Caldwell, N. J. has issued a series of brochures covering their complete line of microwave test equipment. Brochures are complete with specifications, photographs, and prices.

Circle 89 on Inquiry Card, page 101

Aircraft Connectors

A 20-page catalog just released by the Deutsch Co., 7000 Avalon Blvd., Los Angeles, Calif., describes a revolutionary new line of miniature, quick disconnect, aircraft connectors. Booklet is complete with pictures and specifications.

Circle 90 on Inquiry Card, page 101

Antenna Equipment

Collins Radio Co., Cedar Rapids, Iowa, has issued an 8-page brochure describing their complete line of directional antenna equipment. Complete with pictures, the booklet describes antenna power distribution equipment and phasers.

Circle 91 on Inquiry Card, page 101

Pressure Sensing

A 4-page, 2-color booklet has been issued by Clark Electronic Laboratories, Palm Springs, Calif. Brochure describes pressure sensing devices in all shapes and forms along with specifications and prices.

Circle 92 on Inquiry Card, page 101

Magnets

A new 12-page catalog covering both cast and sintered permanent magnets is being issued by General Electric's Magnetic Materials Section, Edmore, Mich. It includes information on magnetic and mechanical properties, approximate tolerance, magnet assemblies and how-to-order. Illustrations and engineering data in the catalog provide the user with required information for various shapes.

Circle 93 on Inquiry Card, page 101

Resin Tape

Technical data on a thermoplastic polyester resin tape, known as GT tape, has been issued by G. T. Schjeldahl Co., Northfield, Minn.

Circle 94 on Inquiry Card, page 101

Precision Resistors

Bulletin B-3 contains comprehensive data on construction, applications, characteristics, identification, tolerance, dimensions, and detailed performance charts and graphs for metal film precision resistors. International Resistance Co., Phila. 8, Pa.

Circle 95 on Inquiry Card, page 101

Cases & Containers

An 8-page, 2-color booklet describes a complete line of reusable cases and containers for the aviation and electronic industries. Craig Transit Cases Systems, Inc., Danvers, Mass.

Circle 96 on Inquiry Card, page 101

Solderless Terminals

"Molto Allegro," a 48 page brochure, profusely illustrated and printed in full color, presents the story of solderless terminals as applied to this age of automation as well as presenting the business philosophy of AMP Incorporated, (formerly Aircraft Marine Products), Harrisburg, Pa.

Circle 97 on Inquiry Card, page 101

Electronic Instruments

Complete specifications and photographs of various types of signal generators, voltmeters, power meters, multimeters and impedance bridges are contained in a 6-page, 2-color brochure from Commercial Electronic Products Div., RCA, Camden, N. J.

Circle 98 on Inquiry Card, page 101

Rate Gyro

Norden-Ketay Corp., Commerce Rd., Stamford, Conn., has issued a 4-page, 2-color brochure containing complete specifications and pictures of their new floated rate gyro.

Circle 99 on Inquiry Card, page 101

Silicon Rectifiers

A 40-page, 3-color catalog, No. 669, issued by Sarkes Tarzian, Inc., Bloomington, Ind., contains many graphs, circuits, tables, and complete specifications for their lines of silicon rectifiers. Engineering data and applications are included.

Circle 100 on Inquiry Card, page 101

Capacitors

Complete technical information describing a complete new line of high reliability capacitors is provided in engineering bulletin 2900 and specification PV-100, copies of which are available from Sprague Electric Co., North Adams, Mass.

Circle 101 on Inquiry Card, page 101

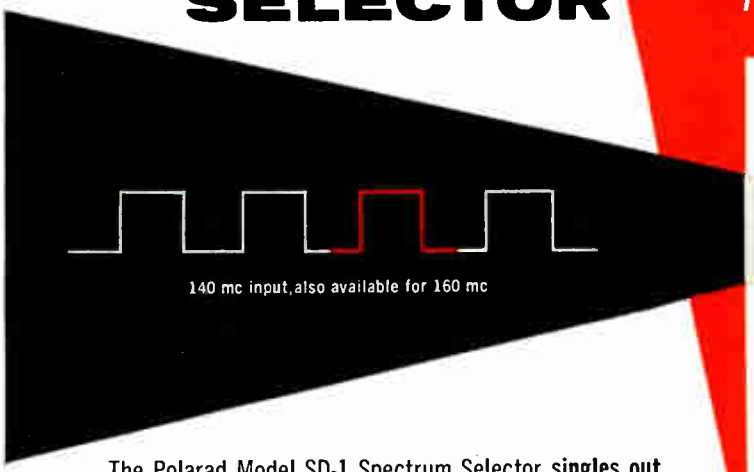
Components

The newest line of electronic components manufactured by the Freed Transformer Co., Inc., Brooklyn, N. Y., is featured in a 48-page catalog. Transformers, filters and discriminators, toroids, magnetic amplifiers and ultrasonic components are all pictured and described in detail, including 128 graphs showing the performance of many of these units. Complete data on transformers for military and commercial applications is also included.

Circle 102 on Inquiry Card, page 101

MULTI-PULSE SPECTRUM SELECTOR

Permits spectrum analysis of individual microwave pulses in a pulse group in the fields of IFF, beacons, interference coding, radio telemetering and radar.



Model SD-1

The Polarad Model SD-1 Spectrum Selector **singles out** a particular microwave pulse from a coded pulse chain so that it can be examined individually on a Spectrum Analyzer or Microwave Receiver.

Operation is simple. A pulse group is displayed on the CRT of the Selector. The pulse to be analyzed is intensified on the scope, and at the same time an automatic electronic gate allows only this pulse to pass through to the Spectrum Analyzer.

The Model SD-1 has been designed for use with Polarad Models TSA and LSA Spectrum Analyzers

Its operation does not affect the performance or restrict the frequency of the Spectrum Analyzer to which it is connected.

Write to Polarad or your nearest representative for complete information.

FEATURES:

- Makes possible the spectrum analysis of individual pulses in a pulse group.
- CRT display of a pulse group.
- Sweep expansion provided for inspection of closely grouped pulses.
- Pulse intensification to facilitate pulse selection.
- Automatic gating of spectrum analyzer, during the interval of pulse analysis.
- Continuously variable sweep width.
- Continuously variable gate width and gate position for pulse selection.
- Triggered sweep on first pulse in any pulse train.
- Provision for external sync and gate.
- Completely self-contained portable unit.

SPECIFICATIONS:

Gate Width
Continuously variable from 0.4 to to 10 μsec.

Gate Delay
For the Model SD-1
Continuously variable from 0.3 to 180 μsec.
For the Model SD-1X
Continuously variable from 1 μsec to 350 μsec.

Maximum Pulse Train Time
For the Model SD-1 ..... 180 μsec.
For the Model SD-1X ..... 350 μsec.

Minimum Pulse Rise Time ..... 0.05 μsec.

Minimum Pulse Separation
0.5 microsecond between first and second pulses; 0.2 microsecond between any two following pulses.

Pulse Repetition Rate .... 10 to 10,000 pps.

Minimum Pulse Width ..... 0.1 μ sec.

R-f Input Frequency
160 mc input also available for 140 mc input

For private demonstration without obligation ask for the

to stop at your plant

Reliable maintenance service throughout the country is an important part of the Polarad instrument.

POLARAD
PROVEN RELIABILITY

ELECTRONICS CORPORATION
43-20 34th Street, Long Island City 1, N. Y.

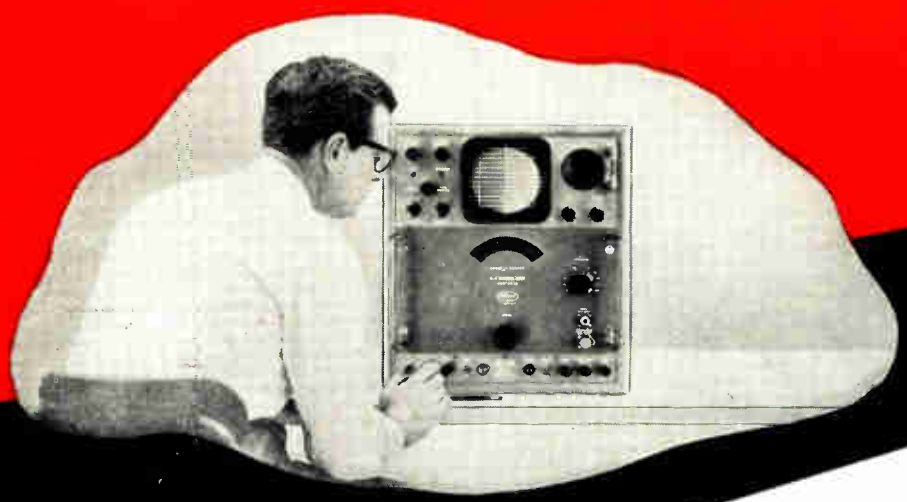
REPRESENTATIVES:
Albany, Albuquerque, Atlanta, Baltimore, Boston, Chicago, Cleveland, Dayton, Denver, Englewood, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, Rochester, St. Louis, San Francisco, Schenectady, Stamford, Syracuse, Washington, D. C., Winston-Salem, Canada: Arnprior, Ontario.
Resident Representatives in Principal Foreign Cities

Direct Reading Spectrum Analyzer

for

- Visual frequency calibration — high resolution
- Leakage and interference measurements
- Standing wave measurements
- Pulse modulation analysis
- Sensitive receiver

The BASIC SCOPE for VISUAL MICROWAVE



SPECIFICATIONS

Model No.	Equipment
Model Du.....	Spectrum Display and Power Unit
Model STU-1...	RF Tuning Unit 10-1,000 mc.
Model STU-2A.	RF Tuning Unit 910-4, 560 mc.
Model STU-3A.	RF Tuning Unit 4,370-22,000 mc.
Model STU-4...	RF Tuning Unit 21,000-33,000 mc.
Model STU-5...	RF Tuning Unit 33,000-44,000 mc.

Frequency Range: 10 mc to 44,000 mc.
Frequency Accuracy: ±1%
Resolution: 25 kc.
Frequency Dispersion: Electronically controlled, continually adjustable from 400 kc to 25 mc per one screen diameter (horizontal expansion to 20 kc per inch)

Input Impedance: 50 ohms—nominal
Overall Gain: 120 db
Input Power: 400 Watts
Sensitivity: (minimum discernible signal)

STU-1:	10-400 mcs	—85 to —95 dbm
	350-1,000 mcs	—80 to —90 dbm
STU-2A:	910-2,200 mcs	—85 to —95 dbm
	1,980-4,560 mcs	—75 to —87 dbm
STU-3A:	4,370-11,000 mcs	—77 to —90 dbm
	8,900-22,000 mcs	—65 to —85 dbm
STU-4:	21,000-33,000 mcs	—57 to —75 dbm
STU-5:	33,000-44,000 mcs	—50 to —65 dbm

RF internal 100 db continuously variable (STU-1, STU-2A, STU-3A)
IF 60 db continuously variable

Frequency differences as small as 40 kc measurable by means of variable frequency marker with adjustable amplitude. Portable and completely self-contained.

Broadband 10-44,000 mc

Now, the Polarad Model TSA Spectrum Analyzer provides the same visual advantages for microwave testing as the standard oscilloscope accomplishes for low frequency signals. This is a "must" instrument for microwave work! It displays with high sensitivity on a bright easily defined CRT, pulse modulation components, frequency differences, attenuation and band width characteristics, leakage detection, radiation and interference signals, and VSWR information.

This is visual instrumentation—it provides immediate and complete information because of the high resolution obtainable.

Frequencies are read directly on the linear dial with 1% accuracy as the set is tuned. Maximum reliability and long life are assured through use of non-contacting oscillator plungers. A variable frequency marker with both frequency and amplitude adjustable is provided.

ANALYSIS

Write today—directly to Polarad, or your nearest Polarad representative—to find out how the Model TSA Spectrum Analyzer can speed your research and solve your microwave measurement and testing problems.

Write for your copy of the Polarad "Handbook of Spectrum Analyzer Techniques". 50c per copy. Includes discussion of Spectrum Analyzer operation, applications and formulae for analysis techniques.

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

For private demonstration without obligation ask for the

to stop at your plant

POLARAD
PROVEN RELIABILITY

ELECTRONICS CORPORATION
43-20 34th Street, Long Island City 1, N. Y.

REPRESENTATIVES: Albany, Albuquerque, Atlanta, Baltimore, Boston, Chicago, Cleveland, Dayton, Denver, Englewood, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, Rochester, St. Louis, San Francisco, Schenectady, Stamford, Syracuse, Washington, D. C., Winston-Salem, Canada: Arnprior, Ontario.
Resident Representatives in Principal Foreign Cities

IRE Avionic Show (*Continued from page 71*)

house Electric, Dr. Clarence Zener, Westinghouse Research Laboratories
Organization of Research Projects, Dr. W. O. Bowie, Sylvania Electric Research Laboratories
Achieving Teamwork in Research Projects, Mr. R. Kompfner, Bell Telephone Laboratories
Measurement of Research Results, Dr. L. R. Fink, General Electric Company
The Climate of University Research, Dr. Carl W. Gartlein, Cornell University

Tuesday Morning—May 14

ENVIRONMENT I

Organized & Presented by the Institute of Aeronautical Sciences
Moderator: Mr. Walter Robinson, Consulting Engineer
Main Ballroom—Dayton Biltmore Hotel
Integration of Crew and Equipment Cooling in Supersonic Bomber Design, A. E. Hitsman, Boeing Airplane Company
Cooling Airflow Control Systems for Airborne Electronic Equipment Designed for Efficient Use of Refrigerated Air, L. H. Schreiber and H. R. Wesson, Convoir
Factors Influencing the Selection of Liquid Rather than Air for Cooling and Airborne Electronic Component, K. J. Fawcett, Melpar, Inc.
High-Reliability Thermal Design for Commercial Avionics, H. M. Possman, Collins Radio Company, Cedor Rapids, Iowa
Crossflow Cooling of Sealed Electronic Modules, C. D. Jones, Ohio Stote University

Tuesday Afternoon—May 14

FORUM PANEL

Engineers Club—Auditorium
Moderator: Dr. George L. Haller, General Manager, Defense Electronics Division, General Electric Company
Forum Subject: Wanted—New Ideas in Airborne Electronics, Professor John E. Arnold, MIT
Lt. General T. S. Power, Commander, Air Research and Development Command, USAF
Dr. Bertrom D. Thomas, Director, Battelle Memorial Institute, Columbus, Ohio
Rear Admiral Rawson E. Bennett, Chief, Office of Naval Research
H. Leslie Hoffman, President, Hoffman Radio Corporation
A representative of a University Research Organization—as yet unconfirmed

Wednesday Morning—May 15

AIR SAFETY

Moderator: Mr. Lester Glantz, Bulova Research and Development Laboratories, Inc.
Engineers Club—Auditorium
The Challenge of Air Safety, Jerome Lederer, Flight Safety Foundation, Inc.
Safety Provided by the Future Air Traffic Control System, Gordon C. Dewey, G. C. Dewey & Co., Inc.
Words of Caution Regarding Any Air Safety Program, Dr. K. C. Black, Raytheon Mfg. Company
Air Force Considerations in Collision Avoidance, Albert Segen, C & N Laboratory, WADC
Operational Requirements for Data Link (Tentative Title), Briaadier General Milton W. Arnold, Air Transport Assoc. of America
Problems in Airborne Communications (Tentative Title), Capt. J. D. Smith, Airline Pilots Association

Wednesday Morning—May 15

COMPONENT PARTS — MISC.

Moderator: Mr. H. V. Noble, WADC
English Room—Dayton Biltmore Hotel
Effects of Nuclear Radiation on Electronic Components and Systems, J. Robert Milliron, Electronic Components Laboratory, WADC
High Temperature (500°) Capacitors, Roger L. Foust, Electronic Components Laboratory, WADC
Some Considerations in the Measurement of Copacitor Insulation Resistonce, Frederick W. Grahame, General Electric Company
High Temperature Film Resistors, E. M. Griest, Corning Glass Works
Foilure Rate Measurements by Means of Accelerated Tests, I. K. Munson, Radio Corp. of America
Pulse Transformer, W. A. Ernst, Westinghouse Electric Corporation

Wednesday Morning—May 15

MANAGEMENT II—DEVELOPMENT

Moderator: Mr. Louis DeRosa, Federal Telecommunicotions Labs.
Main Ballroom—Dayton Biltmore Hotel
Papers in this general area of interest are to be delivered by the following persons:
Mr. Thomas Meloy, Melpar, Inc.
Dr. Jomes E. Boyd, Georgia Institute of Technology
Mr. John F. Byrne, Motorola Research Laboratory
Centralized or Decentralized Program Planning, Dr. Eugene G. Fubini, Airborne Instruments Lab., Inc.
Titles for the papers to be delivered by the above Author-Speakers to be determined later

Wednesday Morning—May 15

ENVIRONMENT II

Orgonized & Presented by the Institute of Aeronautical Sciences
Moderator: Mr. Jomes P. Welsh, Cornell Aeronautical Laboratory
Junior Ballroom—Dayton Biltmore Hotel
Temperature Control Design of the Airborne Bombing and Navigation System AN/ASB-4, Beal Marks, J. J. Student, R. M. Dailey and R. W. Hook, International Business Machines Corp.
Improved Airborne Equipment Design with Forced-Air and Liquid Cooling, Walter Robinson, Consulting
Heat Exchange System Design for Airborne Electronic Equipment, F. P. Benning and J. P. Jacob, United Aircraft Products, Inc.
Design of Liquid-Filled Containers for High-Voltage Equipment, T. P. Jordan, Sylvania Electric Products, Inc.
Effect of Submerged Liquid Cooling on the Electronic Performance of Several Common Types of Electronic Circuits, K. R. Vincent and G. W. Millsap, Convair

Wednesday Afternoon—May 15

MANAGEMENT III—PRODUCTION

Moderator: Mr. Werner Auerbacher, Emerson Radio & Phono. Corp.
Main Ballroom—Dayton Biltmore Hotel
Engineering Management of a Production Project, Jack Giles of General Electric Company
Low Volume Production of a Complex System, Irving Anthony, Emerson Radio & Phonograph Corp.
Reproduction Engineering Starts with Research & Development, Leon Himmel, Federol Telecommunication Labs.
Monagement Problems in Engineering—Production Relations for a Crash Program, H. Kenneth Hudson, Raytheon Mfg. Company

Wednesday Afternoon—May 15

COMPONENT PARTS—SEMI-CONDUCTORS

Moderator: Mr. Robert M. Ryder, Bell Telephone Labs.
Junior Ballroom—Dayton Biltmore Hotel
Medium Power Silicon Transistor, R. W. Aldrich and M. Waldner, General Electric Company
Theoretical Discussion of Radiation Effects on Transistors, J. J. Loferski, RCA Laboratories
A Silicon Unijunction Transistor, Stanley Brown, General Electric Company
High Frequency Germanium Transistors, Norman H. Ditrick, Radio Corp. of America
High Voltage Silicon Rectifiers, J. W. Thornhill and Lt. J. S. LaRue, Texas Instruments, Inc.
A 5 to 10 mc Ten Watt Transistor, Author to be determined, from Bell Telephone Labs.

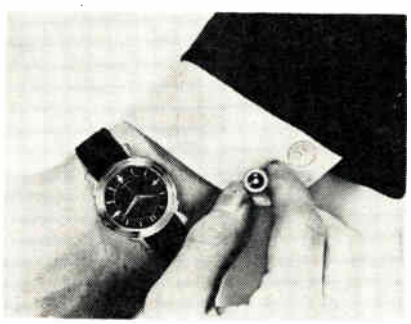
Wednesday Afternoon—May 15

ENVIRONMENT III

Orgonized & Presented by the Institute of Aeronautical Sciences
Moderator: Mr. Frank E. Carroll, United Aircraft Products, Inc.
Engineers Club—Auditorium
Cooling and Its Application to Infrared Detectors, K. W. Harper, General Electric Company
Methods of Determining the Thermal Condition of Electron Tubes, James P. Welsh, Cornell Aeronautical Laboratory
A Method Of Packaging Transistorized Printed Circuit Board Assemblies for Efficient Use of Refrigerated Air, H. Kamei, North American Aviation, Inc. and Arthur R. Tice, G-V Controls, Inc.
Expendable Liquid Cooling of Missile Electronic Equipment, W. W. Hagner, Johns Hopkins University
Forced Air Cooling for Power Transistors, Melvin Mark, Consulting Engineer

ELECTRIC WATCH

The new electric wrist watch developed by Hamilton Watch Company, Allied Products Division, Lancaster, Pennsylvania operates over twelve months from the shirt-button-sized "Energizer" cell produced by National Carbon Company.



Mark of a New and Deadly Guided Missile

"Sidewinder" is the Navy's newest air-to-air guided missile. Flight tests have proved the missile to be as vicious as the desert rattlesnake for which it was named.

In brilliant performances against airborne targets at China Lake, "Sidewinder", Navy's new air-to-air guided missile, has captured the attention of the entire missile industry.

Simple in operation, small and light enough to be carried in quantity by single-seat Interceptors, "Sidewinder" can be fired singly or in salvos. It requires no complex launching system or special pilot training, and it maneuvers deftly at supersonic speeds. The missile displays extremely high single-shot accuracy —and even more important, *it can be launched well beyond reach of the target aircraft's defense.*

"Sidewinder" was developed by the Naval Ordnance Test Station of the Navy Bureau of Ordnance at China Lake, California. Philco assisted NOTS in the research and development program, and performed the subsequent engineering required for manufacture of the missile. "Sidewinder" is *now in full production at the Philco Government and Industrial Division.*

Philco is proud to have made this important contribution to the development of more effective electronic systems for our national defense.

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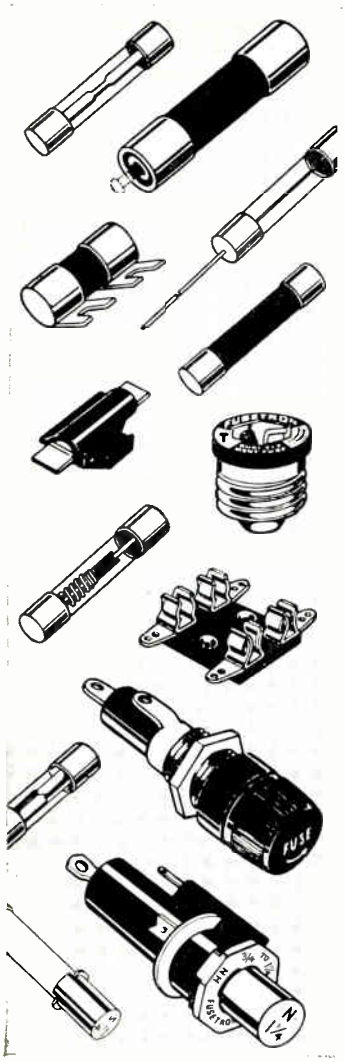
PHILADELPHIA 44, PENNSYLVANIA

Circle 109 on Inquiry Card, page 101



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D. W. ONAN & SONS INC., MINNEAPOLIS, MINNESOTA

"Our automatic line transfer units are used to transfer the electrical load from the normal commercial service to the Onan Standby Generating Set should a power failure occur.

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"You can see why all the components used in our equipment must meet the very highest standards for dependability.

"Fuses are an integral part of the battery charging circuit which is incorporated into our line transfer controls.

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The unfailing dependability of BUSS fuses helps keep equipment operating properly. Whereas, faulty fuses might cause needless burnouts or useless shutdowns,—BUSS fuses can be relied on to operate properly under all service conditions.

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

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

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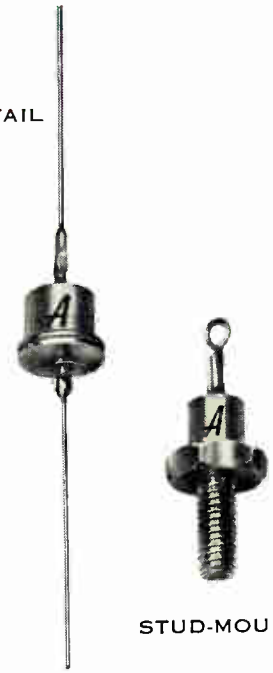
AUTOMATIC SILICON RECTIFIERS



Quantity PRODUCTION MEANS Quantity PRICING — FAST DELIVERY

TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (MA)	Reverse Leakage At Rated P. I. V. (μA)	Mounting
1N440	100	300	0.03	Pigtail Leads
1N441	200	300	0.075	"
1N442	300	300	0.10	"
1N443	400	300	0.15	"
1N444	500	300	0.18	"
1N445	600	300	0.20	"
1N530	100	300	0.30	"
1N531	200	300	0.75	"
1N532	300	300	1.00	"
1N533	400	300	1.50	"
1N534	500	300	1.80	"

TYPICAL VALUES AT 100°C

Type No.	P. I. V. (volts)	Average DC Output Current (MA)	Reverse Leakage At Rated P. I. V. (μA)	Mounting
1N535	600	300	2.00	Pigtail Leads
1N560	800	300	1.50	"
1N561	1,000	300	2.00	"
1N550	100	500	.05	Stud-Mount
1N551	200	500	.10	"
1N552	300	500	.15	"
1N553	400	500	.20	"
1N554	500	500	.25	"
1N555	600	500	.30	"
1N562	800	500	1.50	"
1N563	1,000	500	2.00	"

The development of mass production techniques now enables Automatic Manufacturing to offer most types of their quality Silicon Rectifiers **from stock** and at a price consistent with both project and production work.

Now, for the first time, you can utilize all the superior design characteristics of silicon at a cost comparable to other kinds of rectifying devices . . . characteristics which include:

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These all-welded, hermetically sealed units are designed for dependable operation at ambient temperatures in the range of $-55°C$ to $+150°C$. Their small size and light weight make them ideal for use in all types of miniaturized equipment.

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New Products

PHOTOMULTIPLIER SUPPLY

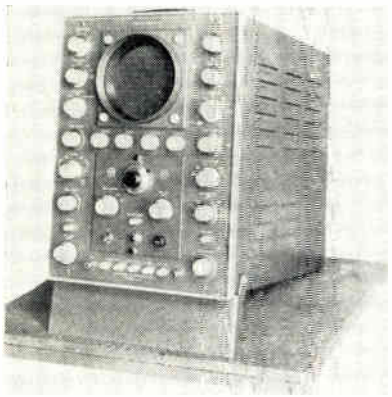
The Model 223 is a compact, self contained, voltage regulated power supply for use wherever a highly stable, high voltage, low current dc source is required. Specifications are:

output voltage, 1500 ±25 vdc; output current, 1.5 ma. max.; input voltage, 105 to 125 v @ 60 cps; line regulation, less than 0.1% for a 10 v line shift; output ripple voltage, less than 75 mv. RMS; load regulation, less than 0.4% for a 1 ma. load shift; physical, assembled in a drawn enameled steel, size 3¾ x 3½ x 6⅞ in. C. J. Applegate & Co., 1840 24th St., Boulder, Colo.

Circle 182 on Inquiry Card, page 101

OSCILLOSCOPE

Improvements in the vertical channel, the high voltage supply and the ventilation system have been made. The Model 411A is a general purpose, precision laboratory type instrument. It has a bandwidth of dc to 10 MC. It incorporates a sweep speed range of 0.1 μsec to 0.1 sec. per centimeter. Six plug-in units provide complete versatility in application. Of particular in-

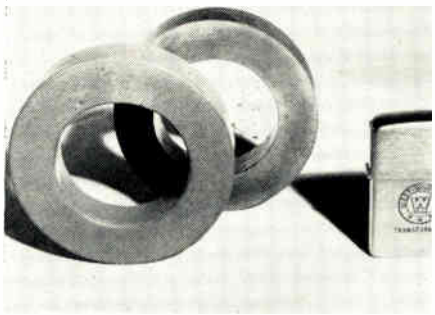


terest in laboratory use are the sweep delay, the gated marker generator and the dual trace plug-in units. Laboratory for Electronics, Inc., 75 Pitts St., Boston, Mass.

Circle 183 on Inquiry Card, page 101

TOROID CORES

A resin-insulated ring-type core made from grain-oriented steel in all gauges from 1 to 12 mils thick is available. It is used for toroidal core designs ranging in size from small

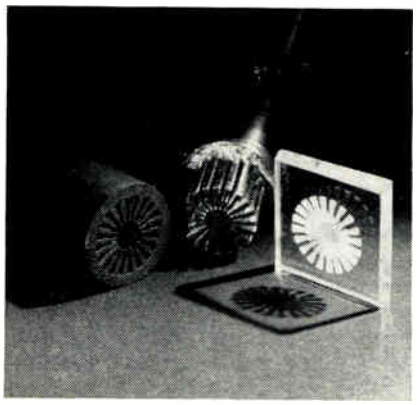


blocking-oscillator pulse transformers through large power units. Windings can be placed directly on the core, eliminating the need to tape or encase it. Corners are rounded to eliminate shorting. The coating does not impair magnetic properties of the core and withstands a voltage to ground of 2500 v. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Circle 184 on Inquiry Card, page 101

ULTRASONIC GRINDER

Intricate shapes drilled in carbon block and glass are typical applications of the new, low-cost, ultrasonic impact grinder. The unit reproduces the shape of the tool in hard and brittle materials such as germanium, glass, ceramics, ferrites to tolerance of 0.0007 in. Uses include drilling, slicing and shaping areas from 0.002 to one inch diameter. Bench mounted,



weight is under 200 lbs. Power source for the unit is 115 vac and water cooling is not required. Raytheon Manufacturing Co., 100 River St., Waltham 54, Mass.

Circle 185 on Inquiry Card, page 101

Hustler System

(Continued from page 76)

memory in a binary pattern suitable as a direct input to an IBM 704 computer. The data outputs from the demodulators are correlated in time to give a true indication of the time relationship of the signal inputs.

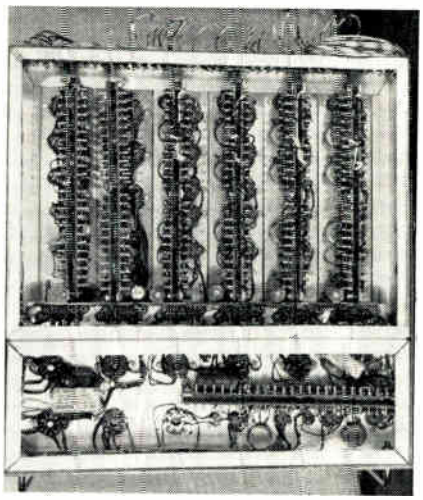
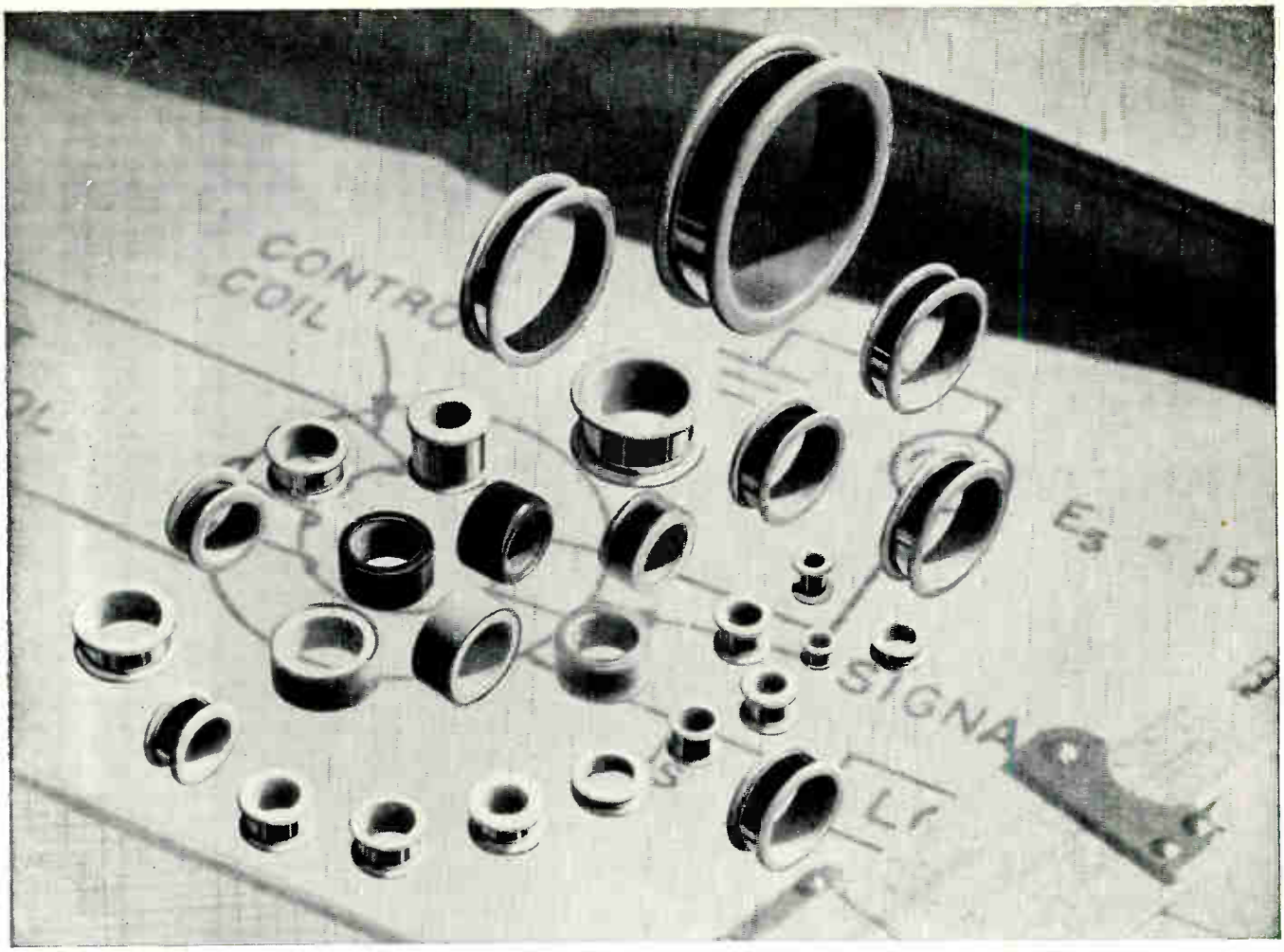


Fig. 3: This bottom view of the Frame Program Unit shows the typical method of construction—terminal boards are provided for component lay-out.

Programming

Real time addresses are on the tape every 10 seconds and the playback of the tape readout can be programmed by using the addresses to start and stop the tape under search or read modes of operation. The tape readout may be started at any second interval. Readout over a particular section of tape may be repeated by selecting a REPEAT operating function.

"No flight volunteers from the engineers on this project. . . . gentlemen, come, come. . . ."



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ADDRESS DEPT. T-75

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Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps depending on the ultimate use of the core. Magnetic materials usually employed are Deltamax, Permalloy and Supermalloy, in standard thicknesses of .001", .0005", and .00025". Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation. • Let Arnold supply your requirements for Bobbin Cores—or other tape-wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry. WSW 6399

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Supply Voltages

(*Continued from page* 65)

Fig. 2a shows the equivalent circuit of the triode amplifier as seen by a plate load impedance, while Fig. 2b is the equivalent circuit for a cathode load impedance.

For the generalized amplifier of Fig. 3, Z_L consists of R_L in parallel with R_g and Z_k consists of R_k in parallel with R_o. In addition, the grid-to-ground signal is separated into a dc or fixed bias component, A, and an ac component. The negative and positive peak amplitudes of the ac component are E_{gn} and E_{gp}, respectively (see Fig. 3a and b).

The negative and positive peak outputs across R_o are, respectively,

$$E_{Ron} = E_{gn}G_k \qquad (7)$$

and

$$E_{Rop} = E_{gp}G_k \qquad (8)$$

Similarly, across R_g,

$$E_{Rgn} = E_{gn}G_p \qquad (9)$$

At cutoff, since the plate current is zero, output voltages E_{Ron} and E_{Rgn} exist only because the coupling condensers are discharging. The discharge also takes place through R_k and R_L. Across these components, the voltages are

$$E_{Rkn} = E_{gn}G_k \frac{R_k}{R_o} \qquad (10)$$

and

$$E_{RLn} = E_{gn}G_p \frac{R_L}{R_g} \qquad (11)$$

The voltage giving rise to E_{Rkn} and E_{Ron} must be

$$E_{ck} = E_{gn}G_k \left(1 + \frac{R_k}{R_o}\right) \qquad (12)$$

This voltage remains constant. At the zero-grid condition, for example, E_{ck} can be added to E_{Rop} to give E_{Rkp}:

$$E_{Rkp} = G_k \left(E_{gpp} + E_{gn}\frac{R_k}{R_o}\right) \qquad (13)$$

The fixed bias voltage is now given by E_{Rkp} minus E_{gp}:

$$A = G_k \left(E_{gpp} + E_{gn}\frac{R_k}{R_o}\right) - E_{gp} \qquad (14)$$

Returning to the conditions at cutoff, the plate-to-cathode voltage is μ times the cathode-to-grid voltage. This yields

$$E_{pkn} = \mu E_{gpp}(1 - G_k). \qquad (15)$$

Finally, the plate supply voltage is given by $E_{RLn} + E_{pkn} + E_{Rkn}$, or

$$B = \mu E_{gpp}(1 - G_k) + E_{gn}\left(G_p\frac{R_L}{R_g} + G_k\frac{R_k}{R_o}\right) \qquad (16)$$

Thus, A and B are given as functions of the tube constants, the resistors, and the peak signal voltages.

(*Continued on page* 128)

Unit Oscillators

250 to 920 Mc
1209-B Unit Oscillator

200 mw over the range . . . G-R butterfly tuning unit avoids sliding contacts and other difficulties inherent in uhf tuning . . . ±1% frequency calibration; 10:1 slow motion drive . . . output through adjustable loop . . . audio modulation from external source; accessory Type 1000-P6 Crystal-Diode Modulator permits video modulation with negligible incidental fm.

★ **High Power Output** ★ **Simplicity of Operation** ★ **Wide Frequency Ranges** ★ **Low Cost**

Unit Oscillators . . . covering the range from 20c to 7425 Mc . . . provide value per dollar difficult to match anywhere.

The fundamental task of signal generation is performed simply and well by instruments devoid of expensive frills. Sound electrical circuitry, incorporating only the essential features, makes them the equal in quality of any made by General Radio. Mechanical design emphasizes small size, light weight and basic miniaturization — the cabinets are about as small for heat developed within them as good engineering practice will allow.

The G-R UNIT INSTRUMENT concept provides flexibility as no other equipment does. One of the high-frequency Unit Oscillators, plus a Unit Power Supply, serves as an unmodulated general-purpose signal source having high-power output and good shielding. Add an audio fixed-frequency Unit Oscillator, and the assembly becomes a modulated power source. Add an attenuator, crystal rectifier, and a meter, and you have a standard-signal generator. Substitute a different high-frequency oscillator, and the system covers a new frequency range. At low frequencies, the addition of a Unit Amplifier gives more power.

Use of new G-R Sweep Drives adapts these manually-operated oscillators to automatic sweep applications. Accessory G-R attenuators, rectifiers, and modulators all may be used to contribute to the measurement at hand. There is no end to the assemblies and combinations possible — systems are easily extended to meet the requirements of new and different measurement problems with precision and economy.

Unit Oscillator	Frequency Range	Maximum Output/ Open Circuit Volts	Nominal Load Impedance	Additional Features
1210-B RC Oscillator, $165	20 cycles — 0.5 Mc (sine or square waves)	80 mw/7v 40 mw/45v 0-30v, p-p	500Ω 12,500Ω 2,500Ω	Multi-purpose lab signal source — 7v output, flat within ±1 db to 200 Kc; distortion less than 1.5%.
1214-A Unit Oscillator, $75	400, 1000 cycles (2 fixed frequencies)	200 mw/60v	8000Ω grounded or ungrounded	Inexpensive fixed-frequency oscillator, has built-in power supply.
1211-B Unit Oscillator, $275	0.5–5 Mc 5–50 Mc	2 w 200 mw	50Ω	Compact, well shielded — frequency increments of 0.2% per division.
1215-B Unit Oscillator, $190	50–250 Mc	80 mw	50Ω	Semi-butterfly tuned circuit with no moving contacts.
1208-B Unit Oscillator, $200	65–500 Mc	100–500mw	50Ω	Very wide range in one band; thorough shielding.
1209-B Unit Oscillator, $235	250–920 Mc	200 mw	50Ω	Butterfly circuit avoids uhf tuning difficulties — excellent stability.
1218-A Unit Oscillator, $465	900–2000 Mc	200 mw	50Ω	Audio, pulse, square-wave or frequency modulation from external source.
1220-A Klystron Oscillator $205 without tube	8 Klystrons available 2700 to 7425 Mc range. $49.65 to $107.15	40 mw	50Ω	Compact, low cost microwave source — internal 1-kc square wave modulation; pulse or frequency modulation from external source.
1217-A Unit Pulser, $235	30 c — 100 kc (12 fixed frequencies)	20 v	200Ω positive pulses, 1500Ω negative pulses	Rise time, 0.05μsec–durations continuously variable 0.2 to 60,000μs.
1213-C Time-Frequency Calibrator, $195	5 Mc crystal provides 10 kc, 100 kc, 1 Mc, 10 Mc fundamentals and harmonics to 1000 Mc	10-30 v, p-p video output	cath. follower approx. 300Ω	Compact secondary frequency standard — accurate timing source for scope calibration, etc. — stability 1 ppm/°C after 1-hr. warmup.

★ Unit Instruments except 1214-A require Unit Power Supplies — 1203-A Unit Power Supply, $40 — 1201-A Unit Regulated Power Supply, $85 — 1202-A Unit Vibrator Power Supply, $125, for operation from 6v or 12v storage battery

Converted to Sweep Oscillators by

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. . . attaches to knobs, shafts or dials of a variety of equipment for automatic sweeping . . . Speed adjustable from 0.5 to 5 cps; Sweep Arc and Center Frequency also continuously variable . . . Type 1263-A Amplitude Regulating Power Supply, also shown, holds oscillator output constant as frequency is swept; Price, **$280**

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. . . for sweeping at slow speeds; ideal for recording of filter characteristics — sweep voltage for oscilloscope or x-y plotter also provided — easily installed; panel knob readily disengages motor for manual operation.

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1000 N. Seward St. **LOS ANGELES 38** — 1182 Los Altos Ave., Los Altos, Calif. **SAN FRANCISCO**

(*Continued from page* 126)

For power calculations, it is important to know the average and peak values of plate current. For the average value of plate current, the substitution of A for E_{in} in Eq. 4 yields

$$i_{po} = \frac{B + \mu A}{r_p + R_L + R_k (1 + \mu)} \quad (17)$$

while the peak value of plate current is given by

$$i_{pp} = i_{po} \frac{E_{gpp}}{E_{gn}} \quad (18)$$

As an example of the application of the above equations, suppose that

$$\mu = 24$$
$$r_p = 10\text{K } \Omega$$
$$R_k = 2\text{K } \Omega$$
$$R_o = 0.5\text{K } \Omega$$
$$R_L = 80\text{K } \Omega$$
$$R_g = 26.67\text{K } \Omega$$
$$E_{gn} = 9 \text{ v.}$$
$$E_{gp} = 5 \text{ v.}$$

For this example, various calculated values and their associated equations are listed in Table 1.

Table 1

Quantity	Equation	Value
Z_L	—	20K Ω
Z_k	—	0.4K Ω
G_p	5	12
G_k	6	0.24
A	14	7 v.
B	16	588 v.
i_{po}	17	5.4 ma
i_{pp}	18	8.4 ma

The generalized circuit of Fig. 3 is employed in only a small minority of practical applications. The usefulness of the derived expressions can therefore be extended by applying them to more commonly used circuits. If Fig. 3 is designated as Circuit 1, Fig. 4 shows 9 additional circuits, for which the expressions appear as follows:

Circuit 2—Dual output, $R_g >> R_L$:

$$G_p = \frac{\mu R_L}{r_p + R_L + Z_k (1 + \mu)}$$

$$G_k = \frac{\mu Z_k}{r_p + R_L + Z_k (1 + \mu)}$$

$$A = G_k \left(E_{gpp} + E_{gn} \frac{R_k}{R_o} \right) - E_{gp}$$

$$B = \mu E_{gpp} (1 - G_k) + E_{gn} G_k \frac{R_k}{R_o}$$

Circuit 3—Dual output, $R_o >> R_k$:

$$G_p = \frac{\mu Z_L}{r_p + Z_L + R_k (1 + \mu)}$$

$$G_k = \frac{\mu R_k}{r_p + Z_L + R_k (1 + \mu)}$$

(*Continued on page* 130)

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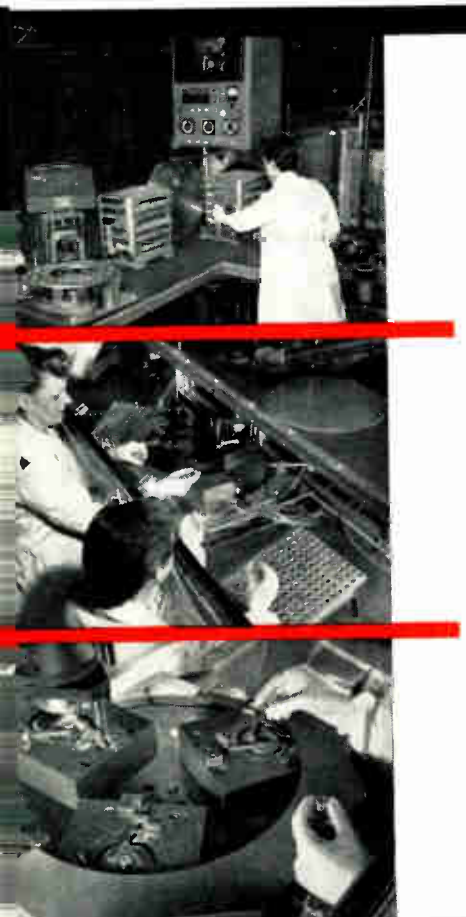
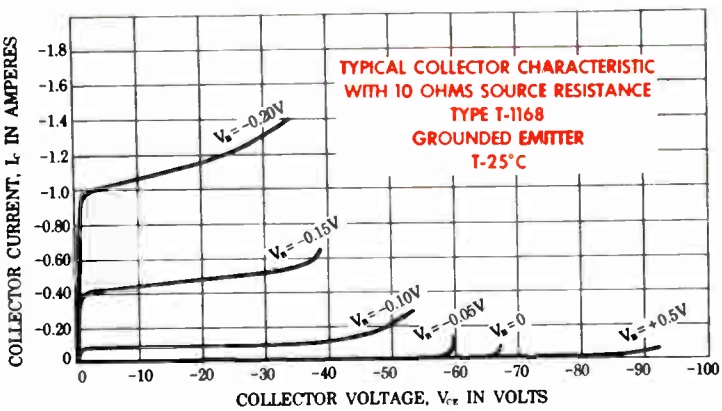


Philco cold-welding process permits hermetic sealing in controlled atmosphere . . . assuring exceptional transistor life and performance!



Philco transistors, after vacuum baking, emerge into a controlled atmosphere . . . where they are welded to insure perfect sealing for life. This process eliminates contamination of the transistor elements by moisture or atmosphere. Uniformity and quality control are strictly maintained throughout.

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(*Continued from page* 128)

$$A = E_{gpp}G_k - E_{gp}$$

$$B = \mu E_{gpp}(1 - G_k) + E_{gn}G_p\frac{R_L}{R_g}$$

Circuit 4—Dual output, $R_g >> R_L$ and $R_o >> R_k$:

$$G_p = \frac{\mu R_L}{r_p + R_L + R_k(1 + \mu)}$$

$$G_k = \frac{\mu R_k}{r_p + R_L + R_k(1 + \mu)}$$

$$A = E_{gpp}G_k - E_{gp}$$

$$B = \mu E_{gpp}(1 - G_k)$$

Circuit 5—Grounded cathode:

$$G_p = \frac{\mu Z_L}{r_p + Z_L}$$

$$G_k = 0$$

$$A = -E_{gp}$$

$$B = \mu E_{gpp} + E_{gn}G_p\frac{R_L}{R_g}$$

Circuit 6—Grounded cathode, $R_g >> R_L$:

$$G_p = \frac{\mu R_L}{r_p + R_L}$$

$$G_k = 0$$

$$A = -E_{gp}$$

$$B = \mu E_{gpp}$$

Circuit 7—Cathode follower:

$$G_p = 0$$

$$G_k = \frac{\mu Z_k}{r_p + Z_k(1 + \mu)}$$

$$A = G_k\left(E_{gpp} + E_{gn}\frac{R_k}{R_o}\right) - E_{gp}$$

$$B = \mu E_{gpp}(1 - G_k) + E_{gn}G_k\frac{R_k}{R_o}$$

Circuit 8—Cathode follower, $R_o >> R_k$:

$$G_p = 0$$

$$G_k = \frac{\mu R_k}{r_p + R_k(1 + \mu)}$$

$$A = G_kE_{gpp} - E_{gp}$$

$$B = \mu E_{gpp}(1 - G_k)$$

Circuit 9—"Grounded" cathode, cathode resistor bias:

$$G_p = \frac{\mu Z_L}{r_p + Z_L}$$

$$G_k = 0$$

$$A = 0$$

$$R_k = \frac{E_{gp}r_p}{E_{gn}(\mu - G_p)}$$

$$B = E_{gp} + \mu E_{gpp} + E_{gn}G_p\frac{R_L}{R_g}$$

Circuit 10—"Grounded" cathode, cathode resistor bias, $R_g >> R_L$:

$$G_p = \frac{\mu R_L}{r_p + R_L}$$

$$G_k = 0$$

$$A = 0$$

$$R_k = \frac{E_{gp}r_p}{E_{gn}(\mu - G_p)}$$

$$B = E_{gp} + \mu E_{gpp}$$

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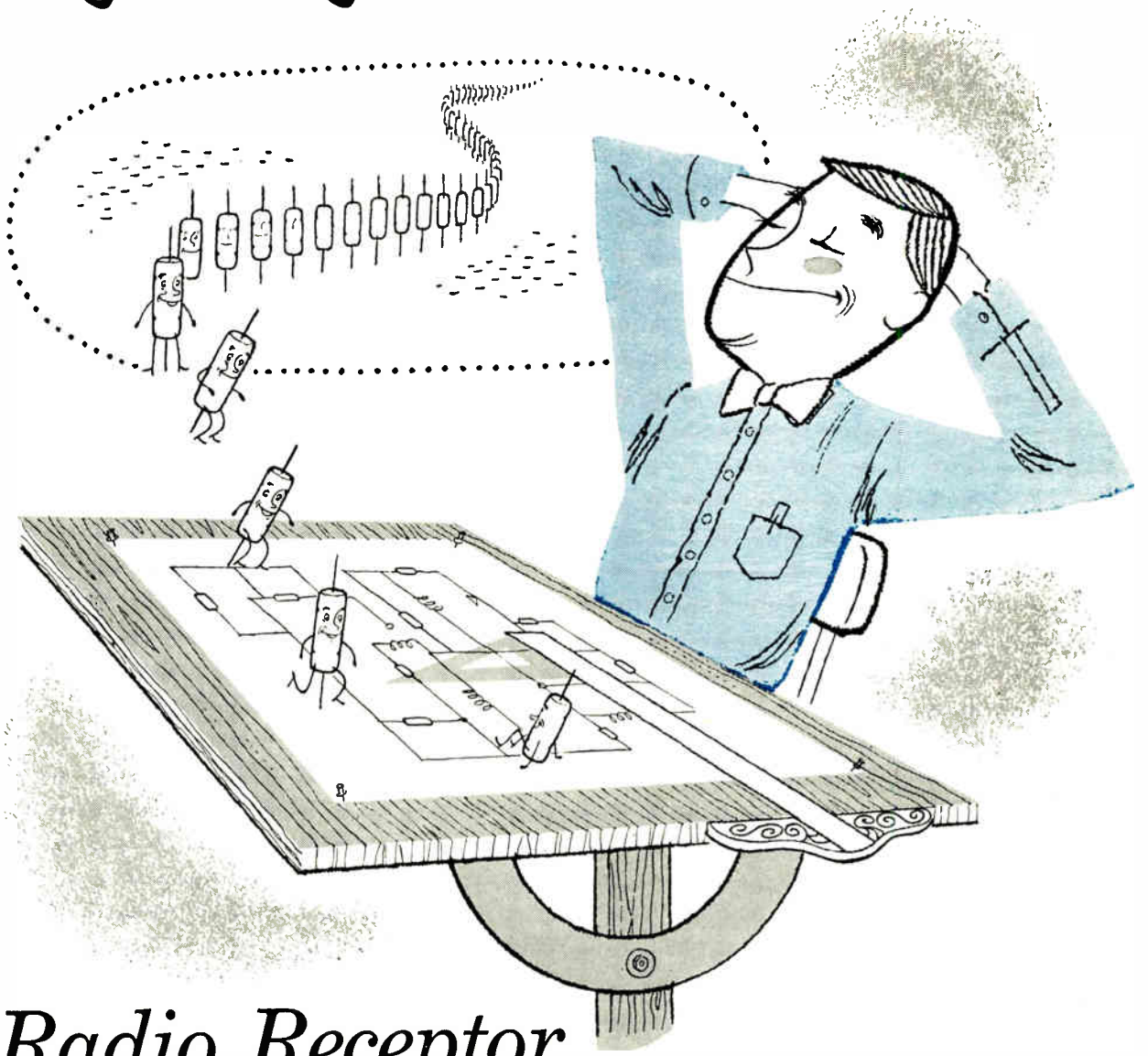

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Shock Design (*Continued from page* 63)

this designation, the system having a damping ratio of 0.1 has a transmissibility at resonance of five and is thus said to have a Q of five. This latter method of defining damping is employed here.

Analysis

The maximum acceleration experienced by the mounted equipment and the maximum deflection of the isolators as a result of the landing shock of the P-80 aircraft was determined for isolators having natural frequencies of 10, 20 and 30 cycles per second, with damping values of $Q = 2.5$, 5 and 10 for each of these natural frequencies. The results of this analysis were recorded by plotting the maximum response acceleration of the mounted equipment and the maximum deflection of the isolators, both as functions of the natural frequency of the isolators. The damping in the isolators is the parameter of the family of curves. The results obtained from the analysis of landing shock records for the P-80 aircraft are shown in Fig. 5, wherein the maximum acceleration of the mounted equipment is indicated by the solid lines and the maximum deflection of the isolators is indicated by the dotted lines. For reference, the maximum acceleration on the lower oscillograms in Fig. 4 is 1.4g.

Significant Trends

Significant trends in the analysis, as deduced from the presentation in Fig. 5, may be summarized as follows:

1. The maximum acceleration experienced by the mounted equipment increases somewhat as the natural frequency of the isolators increases. The increase in maximum acceleration is quite moderate, however, and does not appear to be of important significance when compared with other factors.
2. The maximum deflection of the isolators tends to become relatively great when the natural frequency is less than 20 cycles per second. This maximum deflection appears to be approximately independent of the natural frequency for values of the natural frequency greater than 20 cycles per second.

Damping Analysis

The effect of damping in the isolators is more difficult to evaluate. If the maximum response acceleration or maximum deflection of the isolators as shown in Fig. 5 is the only criterion, the benefits derived from greatly increased damping are quite modest. This approach, however, overlooks the effect of fatigue resulting from repeated applications of load.

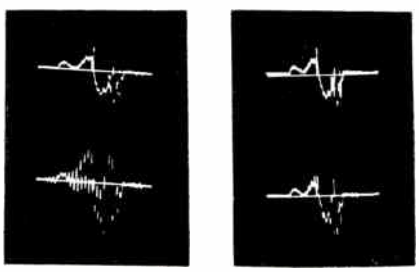

Fig. 4: Landing shock of a P-80 aircraft. Upper trace—response of damped linear single degree of freedom system; Lower trace—acceleration recorded in aircraft.

The oscillograms shown in Fig. 3 include response accelerations for systems having $Q = 2.5$ and 10, each

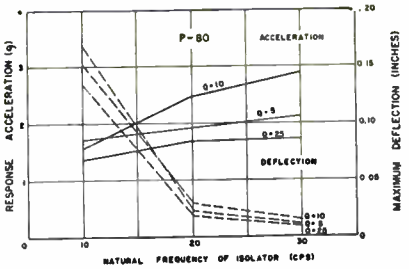

Fig. 5: Analysis of landing shock records of Fig. 4.

for the natural frequency of 20 cps. The pronounced difference between the oscillograms for high and low damping is not the magnitude of the greatest acceleration but rather the number of repetitions before the disturbance is damped out. When the damping is relatively low, the vibration tends to continue and the equipment may be damaged by the repeated loading. This effect is difficult to evaluate tangibly because the conclusion must be a function of the equipment—whether the equipment is vulnerable to many cycles of acceleration whose values are somewhat lower than the maximum acceleration experienced.

Where a time history of acceleration is available to define the environment, the analog computer is available as a tool to determine optimum characteristics for the isolators. The analysis yields not only the acceleration pattern experienced by the mounted equipment, but also the space requirements to accommodate the expected deflection of the isolators. A cut-and-try procedure is used in which the isolator characteristics are varied and the optimum values selected.

Medical Electronics (*Continued from page* 61)

with minute voltages in the form of nerve impulses. And the cardiologists have long been aware that the muscular action of the heart is under the control of minute voltages.

Just recently great progress was reported in the use of tiny electric shocks to find the brain lesions which are the usual cause of epilepsy. Through holes in the skull tiny wires are pushed against the brain. A minute voltage is applied. When the thin wire probe is placed against the brain lesion which causes the trouble, the patient goes into an epileptic seizure. With the lesion localized, treatment is very much simplified.

The average layman, when confronted with the term "medical" usually limits his thoughts to three topics—the brain, the heart, and the blood stream. In all three areas, most exploited are counters and closed circuit television.

Dr. George Z. Williams, himself responsible for one of the latest uses of closed circuit TV in the field of pathology, and a member of N.I.H TV Committee, pointed out a few of the main applications of closed circuit TV.

Closed Circuit TV

Dr. Williams' system uses ultra-violet light and a quartz optical system microscope for the study of living cells. This in itself is not new. Previously, due to the inability of the human eye to see ultra-violet light, only photographs could be made and later studied—

(*Continued on page* 134)

Medical Electronics

(*Continued from page* 133)

odds were against a sharp-focused photo.

This system incorporates an ultra-violet sensitive vidicon, at the microscope eyepiece. The cell may then be studied for about 3 min. on the monitor. The cells are no longer living after an exposure of this duration. The system, though it can be used on any type of cell, is now being used for the observation of living cancer cells. See Fig. 5.

Another application pointed out by Dr. Williams is its use in conjunction with the cobalt bomb treatments, in which the bomb must be aimed, and the patient required to remain still. During the treatment, the patient only is permitted in the room. In the past, the operators were never sure if the patient moved and consequently ruined the aim of the bomb. Closed circuit TV permits view of the bomb and the patient from safety.

Behavior may also be studied by use of an image orthicon and a movie camera. By using infra-red light, a subject may be studied while asleep. The infra-red light eliminates the need for incandescent or fluorescent lights that would possibly keep the patient awake or affect his sleeping behavior.

Fig. 7: Electrical potentials caused by heart action produce a record on this direct writing instrument which permits the doctor's immediate study.

By using electronic controls and recorders on the ultra-centrifuge, a study of the rate of precipitation of very fine fat particles in the blood stream may be made which can be positively correlated to hardening of the arteries and consequently heart disease. The specimen is compared with a reference using a chopped beam technique.

Anticipated in the not-too-distant future is closed-circuit television not only for showing within the immediate area but for inter-city viewing. This will enable the technique of great surgeons to be viewed by a far greater number of students.

In the Washington, D. C., area, such a system was successfully put into operation last month. The system connects Walter Reed Hosp. with the N. I. H. Anticipated is a linkup of Boston, New York, Philadelphia, and Washington.

Counters

Some brain tumors absorb radioactive substances. A Geiger counter can then be used to pin-point the location of the defect. Quite naturally, the entire brain must be scanned, and at present there are two methods. A battery of counters can be swept over the skull in an arc and from their readings the affected area can be isolated. Another method is to use one counter and a mechanical set-up that systematically scans the entire area, sweeping back and forth, forming a hemisphere. Whichever technique is used, the results are equally definitive.

In conjunction with a "radioactive cocktail", the Geiger counter can also be used for the study of thyroids. The day after the patient has had a drink, containing radioactive elements, his thyroid is scanned and the amount of radioactivity is recorded. The rate of accumulation of radio-active isotopes in the thyroid is then determined by periodic, sometimes hourly, scanning with the counter. The rate of degeneration is determined in a similar manner.

The simplified circuitry for a digital counter set-up which is being used for the study of blood cells is shown in Fig. 8. The flow assembly has a constriction that effectively changes the resistance of the circuit from the anode to the cathode when a cell is passing through. This sudden change in the circuit creates a pulse which, after passing through the amplifier, triggers the counter. The circuit is energized for a definite period of

(*Continued on page* 138)

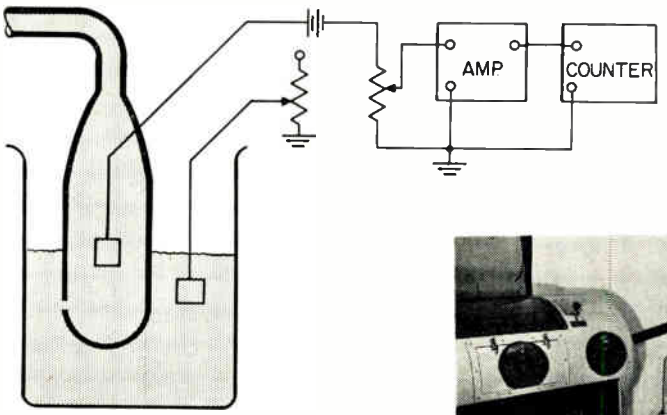

Fig. 8 (above): Blood cell counter. The flow assembly resistance determining constriction measures 100 microns diam. by 300 microns.

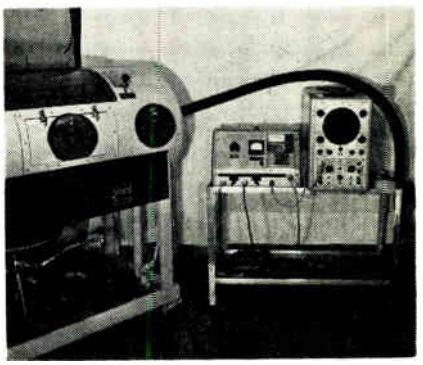

Fig. 9 (right): Selective amplifiers permit patient to control respirator cycle, eliminating the most discomforting feature.

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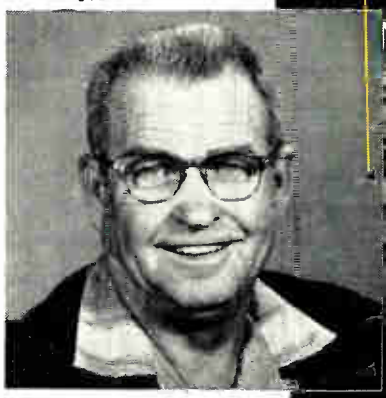

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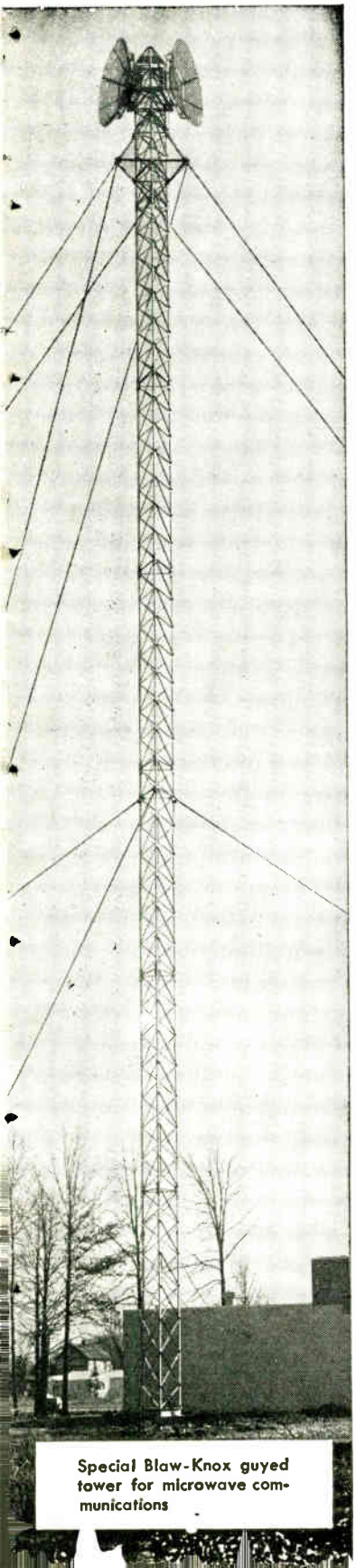

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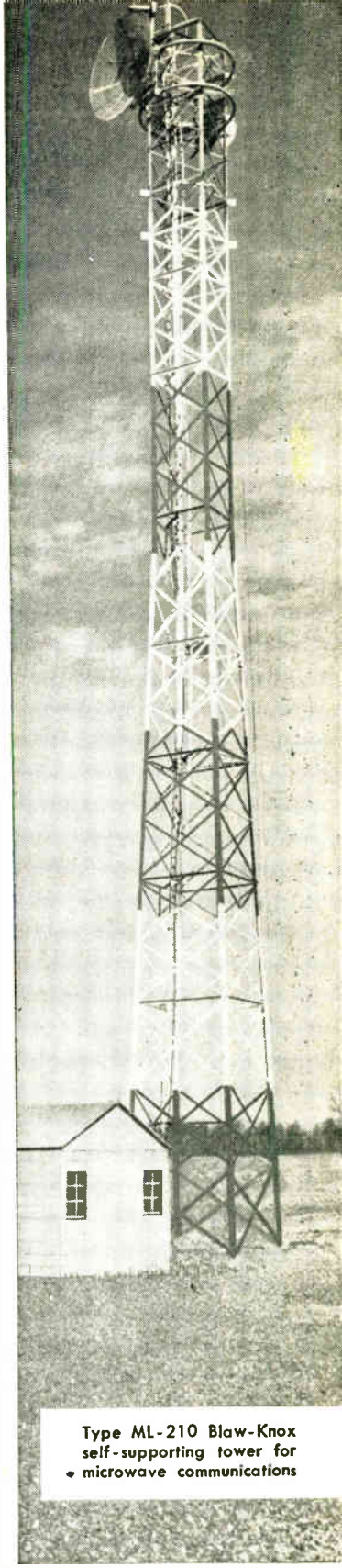

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time so that the total count indicates a rate. This rate can then be compared with that of other specimens.

Automation

It is readily recognized by all, even those without any technical training, that servos and automation can do a much better job than human beings when the operation is repetitive. Such things as day-dreaming and weariness do not affect a machine as they would a technician, no matter how conscientious that person may be.

Elimination of all possibility of human error is the goal of medical electronics in the field of research. Where a person must take numerous readings of a similar nature, then correlate, then extrapolate, and finally record, there is the possibility of four or five human errors. The human error will be eliminated when we have a "little black box" that will go between the original instrument, such as a spectrometer, and the final record sheet, which will perform all of these functions automatically.

Physician's Protection

Another interesting facet is that in which not only the patient benefits but also the physician. This is a development of Dr. Russell H. Morgan of the Johns Hopkins Hospital, Baltimore, Md., and is referred to as an image intensifier.

A good X-ray doctor will make a dynamic study with a fluoroscope—not a static study with a photo. When using a fluoroscope, not only the patient but also the doctor is exposed to the rays. The patient is subjected to the rays only briefly—but the doctor may be exposed as much as 15 times a day.

The image intensifier actually a closed circuit TV permits lowering of the dosage that the patient receives and can practically eliminate the operator's exposure, because the viewer can be located at a remote location. The device permits electronic control of intensity and contrast much like a TV set—the actual X-ray can then be considerably lessened.

Cardiology

To get back to the patient, another development permits acoustic mapping within the heart. A special ceramic element built into a uniquely designed cardiac catheter is introduced into a vein and from there passed into the heart using well established techniques of cardiac catheterization. Double bore catheters have been constructed which allow for measurement of pressures within the heart

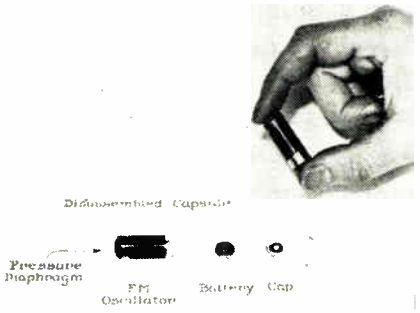

Fig. 10: The "radio pill" transmits an FM signal which is externally detected.

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at the same time that sounds are being recorded. (See Fig. 2.

Cardiologists have discovered that low voltage shocks can also overcome fibrillation, a condition in which various groups of the heart's muscle fibers beat independently and without rhythm. This condition occurs frequently during operations when the patient suffers from heart disease. Electrodes are placed in position around the heart and should fibrillation occur, systematic pulsing can free the seizure of the heart by shocking one set of muscles and then the other.

By using ultrasonic techniques, heart deficiencies can be detected more conclusively than by EKG. The principle is as follows: The distance between the outer skin and the heart is measured and with every breath the difference is registered. Should any defect exist that would cause a flutter, it is immediately apparent by the change in the cyclic process.

As an example of what continuing research can show, Dr. Herman P. Schwan, who holds Associate Professorships in the Medical School and the Moore School of Electrical Engineering, both of the University of Pennsylvania, indicates that a new deep-skin diathermy technique will utilize a frequency much lower than the 2450 MC which has been serving the medical profession since 1947.

Difficulties

Probably the most outstanding difficulty is that of collaboration. Not only must the engineer and the physician work together but they must also be able to understand each other.

There are only a few men with experience in both fields, that is, electronics and biology. Because the demand for people with experience in both fields individually is so pronounced, finding a man with experience in both fields is very difficult.

Special acknowledgment should be given to George Z. Williams, M.D., National Institutes of Health, Bethesda, Md., Herman P. Schwan, Ph.D., and Makeo Murayama, Ph. D., both of the University of Pennsylvania, Philadelphia, Pa., for their cooperation in making this article possible.

Beta Gauge

(*Continued from page* 74)

indicate whether the material is too heavy or too light.

For deviation gauges Eq. 3 will have to be modified

$$I = G(V' - V) \quad (6)$$
$$= GqRN_o(e^{-\mu x'} - e^{-\mu x})$$
$$= GqRN_o e^{-\mu x'}(1 - e^{-\mu(x - x')})$$

where V′ is equivalent voltage of a desired density thickness.

Backscatter Gauge

Electrically a backscatter gauge, Fig. 6, is quite similar to the absorption gauge described above. It is usually used to measure thickness of a material which is applied to another heavier material, e.g., a coating process or tinning of metal. It is sometimes used in hard to get at places where an absorption gauge would not fit.

In a backscatter gauge the radioactive source is on the same side as the ionization chamber. Some of the radiation is absorbed by the material to be measured, some is absorbed by the backing material and the rest is "back scattered" into the ionization chamber.

Since the backing material is of saturation thickness, the amount of radiation backscattered is proportional to the density-thickness of the material to be measured.

Vibrating Capacitor

A very good and accurate method of measuring the minute current for radiation gauge application has been found by using a vibrating capacitor. The vibrating capacitor serves as dc to ac transducer, then a regular ac amplifier can be used and finally with a phase sensitive detector we get dc back which then can be indicated or recorded.

Let us briefly describe the operation of a vibrating capacitor. If a charge Q is placed on a capacitor C then the voltage V across the capacitor is by definition

$$V = Q/C \quad (7)$$

If C is changed by an amount of dC, V will change by dV and Q remains constant, then

$$dV/V = -dC/C \quad (8)$$

If C is varied periodically, a periodic voltage appears across the capacitor.

This ac voltage is a function of Q, C, and dC. In order that such a vibrating capacitor can be used on a reliable measuring system C and dC have to be kept constant, or a system has to be found that will be hardly affected by changes in these parameters.

The easiest way to accomplish this is to use a null balancing system. The output voltage of the system is a measure of the charge Q on the vibrating capacitor and independent of the capacitance C.

Since negative feedback is a null system, it is extensively used in radiation gauges with vibrating capacitors. In addition, of course, negative feedback provides improved and stable operation with variation in tube characteristics or aging of components.

There is one major source of zero drift in the vibrating capacitor due to contact potential. This is a result of the difference in the work functions of the two surfaces of the plates of the vibrating capacitor.

However, by using very closely controlled manufacturing processes, including vacuum plating, it is possible to keep the contact potential

very small. In addition, contact potential is canceled out by inserting a voltage equal and opposite in series with it.

Radiation Gauge

The basic radiation gauge consists of a measuring head (directly built into the process machine) an indicator and nominal value setter, and a console holding the electronic components, the recorder, tolerance indicators, and controls.

The overall block diagram of a radiation gauge is shown in Fig. 7. Radiation is emitted at source S. Part of it is absorbed by the material M and the rest enters the ionization chamber causing ionization of the gas and current through R. The dc voltage V_R developed charges one plate of the vibrating capacitor. The other plate of the capacitor is charged by the adjustable voltage V_P.

Now, one plate of the vibrating capacitor, which is in form of a diaphram, is mechanically vibrated sinusoidally by means of the oscillator. The oscillator frequency is 1000 cps so chosen as to have no interference with 60 cps line harmonics. The dc voltage

$$V_C = V_P - V_R \qquad (9)$$

which is impressed across the vibrating capacitor C is changed to a 1000 cps ac voltage and amplified by the preamplifier and the amplifier. The amplified signal is converted to dc by a phase sensitive detector, indicated and recorded, used for automatic control purposes, and fed back through resistor R_F.

The above mentioned value V_P is set by potentiometer P in the feedback loop of the gauge. The potentiometer is connected to a very precise and stable constant current source. It serves as an adjustable reference standard.

The dial is very carefully calibrated from the absorption curve (See Fig. 3) of the material to be measured and/or controlled. It is then possible to adjust it in such a way that the voltage V_P is equal to voltage that would be developed across R if the weight per unit area (or the thickness) of the material measured is equal to a nominal value.

Hence any deviation of the material to be measured is indicated

(*Continued on page* 142)

(*Continued from page* 141)

with its proper polarity, in accordance with Eq. 9 by the meter, recorded by the recorder or used for automatic control purposes. The voltage V_K (See Fig. 7) serves to counter balance contact potential.

The phase sensitive detector receives its synchronizing signal from the same oscillator that drives the vibrating capacitor diaphragm. As a result, the detector will only detect a narrow band of frequencies around the vibrating frequency and give band pass characteristics necessary for max. signal-to-noise ratio.

Since the vibrating capacitor and the detector are driven from the same source any drift in frequency will not cause change in gain. The phase sensitive detector makes it possible to obtain positive or negative signals from a preset value.

Radiation gauges have a large number of varied applications. Each installation has to be carefully analyzed and a system designed for it. However, the basic electronic plug-in units are always the same, which assures interchangeability, ease of maintenance and a minimum of "down" time.

In many cases, a single point measurement with one measuring head as described above is sufficient. Sometimes during a calender operation the calender is controlled by two screw-down motors, one on each side. Then it is often desirable to have two radiation gauges one for each motor.

Often two or more gauges are used on the same process line. For instance in a coating process (See Fig. 8), where the material is first measured without coating and then with coating and the difference which is the coating applied is recorded and controlled.

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Presented at the 2nd IRE Instrumentation Conf., Atlanta, Ga., Dec. 1956.

DC-8 Avionics

(*Continued from page* 59)

Results of Tests

Upon completion of the tests performed on a given component, the results must be compared with the requirements of the advanced electronic system. Tests 1 through 8 above, performed on the miniature electrical connectors, were completed and the results established their superiority over the AN-E connectors tested. Tests 9 and 10 are still in process. The results to date are listed below:

1. The contact engagement and separation forces of the miniature connectors were approximately ½ those of the AN-E control group.
2. The contact resistance per unit area of the miniature connectors was approximately ¾ that of the AN-E control group.
3. The high potential breakdown values of the miniature connectors were approximately equal to those of the AN-E control group.
4. The insulation resistance of the miniature connectors was approximately 3 times that of the AN-E control group.
5. The durability test resulted in no electrical or mechanical damage to either the miniature connectors or the AN-E control group.
6. The contamination test equally affected the high potential breakdown values of the miniature and AN-E connectors.
7. The altitude, temperature and humidity tests revealed that the seals on both the miniature and AN-E connectors were marginal, i.e., some connectors in each group passed and some failed. This test also disclosed that the AN-E connectors used, could be sealed only upon initial assembly due to designed damage to a gasket in the backshell. All potted connectors failed in the first cycle due to swelling and carbon tracking of the compound under heat and reduced pressure.
8. The vibration test produced no evidence of reduced contact pressure, contact opening or

(*Continued on page* 144)

(*Continued from page* 143)

physical damage in any of the connectors.

9. The corrosion test has been running continuously for 1,000 hours and no operational deficiencies in the coupling mechanism have been detected.
10. The dirt and mud impregnation test had no adverse effect on the operation of the coupling mechanism with the exception of test d. The connectors were difficult to operate with the dried mud in the coupling mechanism, but a subsequent washing restored them to their initial ease of operation.

Changing Wires

It has been generally agreed that since the harness can be assembled, checked, and quickly installed in the airplane, much time is saved. However, during major changes of radio equipment, the question has been raised whether a single wire could be changed as easily with the plug and harness system as with a terminal strip system. This has been given considerable thought. In general, on the 7-pin connectors, design limits the use to only five contacts, the 19 pin connectors are limited to the use of 17 contacts, and the 37 pin connectors are limited to 33 contacts.

The unused contacts could be used for additional circuits or may be considered as spares to be used in the field for bypassing circuits that may be damaged while in service. These temporary repairs could be replaced with permanent fixes at some future date such as major overhaul.

To eliminate transits and interference on board the aircraft, the ships main power circuits were run along one side of the ship. The electronic circuits were run along the opposite side. The wiring harnesses for the various systems are laid into channels which have covers fastened on them. Previously most wiring was pulled through conduit.

Antenna Problems

As the speed of an airplane increases the least desirable from an aerodynamic standpoint are external wires, masts, or blades. Each antenna requirement had to be ex-

amined to determine how best to optimize radiation pattern efficiency, minimize loss in the antenna and the antenna lead-in, minimize aerodynamic drag and the antenna component weight.

Since the antenna must radiate power in useful directions, model studies were made to determine radiation pattern efficiency. Studies are usually made with the antenna in different locations, since the pattern is dependent on the antenna's position on the airplane. The antenna's position on the air frame varies with the frequency and the shape of the air frame. As an example of antenna air frame dependents, the tail HF antenna was examined in great detail, and it was found that various paths along the air frame became resonant as the operation frequency is changed. By electrically insulating the tail cap from the rest of the airplane, a means is provided for exciting or feeding power to the various resonant paths along the air frame. The air frame itself is then the radiating element rather than the tail cap.

Minimizing losses involves the basic antenna element design, including dielectric materials, and the loss in the coaxial cable lead-in. The latter becomes more important as the size of the airplane increases. To reduce the intended loss in very long cable runs, Douglas developed a low-loss coaxial cable. In many respects, this cable is more rugged than RG-8/U, yet it has less than half the loss of RG-8/U for an equivalent length. This cable minimizes system loss, enabling the antenna to be installed in their optimum locations.

Flush or External Antennas

Minimizing aerodynamic drag and weight are inseparable problems. Flush antennas are usually heavier than external antennas, but their weight must be compared to the parasitic aerodynamic drag of the external antennas.

A general overall comparison for the DC-8 shows one square foot of parasitic drag area[1], to be equivalent to 1200 lbs. This figure, once

[1] The parasitic drag area considered, is the drag divided by the free stream dynamic pressure and is roughly equal to the area of a flat plate producing an equival nt drag.

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established, guides the antenna designer in determining the relative merits of flush and external antennas. This weight-drag figure may not be alarmingly higher than that for conventional aircraft; the real difference is that the same external antenna will have a higher parasitic drag as the Mach number is increased and consequently a higher drag equivalent weight.

Figure 6 shows the variation of drag with Mach numbers for an external mass of different thickness ratios. It can be seen the drag is increased by a factor of 20 if a mass with a thickness ratio of 0.40 were to be used on a DC-8. Thus most of our presently available external antennas present a large amount of drag weight at high speeds.

Drag Weight Comparison

To compare this drag weight with the weight of a flush antenna, let's consider for an example, a VHF communication antenna. The installed weight of a flush antenna mounted in the fuselage may be as much as 45 lbs, it may be approximately 45 in. in diameter, and it may protrude through the floor of the baggage compartment. In this particular case, all 3 factors make a flush antenna look like a poor choice. However, an analysis of the standard VHF antenna shows that it has an antenna installation weight of 5 lbs plus a parasitic drag weight of 48 lbs giving a total weight equivalent of 53 lbs.

Since the equivalent weight of both the flush and available external antenna would be high, an external antenna was designed which was much better from a drag standpoint at the DC-8 Mach number. The antenna that Douglas developed has an actual weight of 3 lbs. plus a drag weight of 11 lbs. for a total of 14 lbs. In this particular case, an external antenna imposed the smallest penalty on the airplane. In most of the other cases, it was found that flush antennas were more desirable. Each antenna requirement must be carefully analyzed to determine the best solution. Of the 20 possible antennas on the DC-8, only three will be external and two will be semi-flush. In the later case, an

external fairing is placed around the antennas to reduce the drag.

Douglas considered the proper design of antenna systems for the DC-8 so important that more engineering time was placed into this project than on the antenna systems of all the other Douglas commercial airplanes.

Acknowledgments

Much of the material used in this article was taken from R. H. Jerome's article "Electronic Problems Encountered in High Speed Commercial Jet Aircraft" and "Component Design & Development to Meet Advanced Application Requirements" by T. A. Thompson.

Approach System

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vertical control is required simultaneously, the exact shape of the glide path is not critical insofar as its effect on the landing rate is concerned. Improvement of glide-path control, especially during the flare-out before touchdown, should not be neglected; but, for the problem now at hand, it is valid to assume that a straight glide path has been established before the final-approach gate is reached. By that time, it is also assumed, the approach speed is constant, and is known to within a few per cent.

Three rules are adopted here, in the interest of safety, and are used as limiting conditions for the curved approach courses to be derived. Whenever an aircraft is following an intended course exactly, the following conditions are to be met:

(1) Rates of turn exceeding 180° per minute shall not be required;

(2) The rate of turn shall decrease continuously during the final approach; and

(3) Upon reaching touchdown, the aircraft shall be within 15 ft. of the runway centerline, and flying at a relative track angle of less than 1°.

These limits for rate of turn and displacement from the centerline at

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touchdown were chosen, arbitrarily, as reasonable values on which to base some sample calculations. The effects of using different values will be discussed later. Track angles of less than 1°, at touchdown, are automatically obtained by the methods to be discussed; this will not be shown here, but can easily be checked.

The simplest horizontal course that can satisfy the adopted safety rules is defined by a fixed ratio between displacement and the rate of change of displacement. This is illustrated in Fig. 3, where displacement is measured in terms of an angle, θ, between the runway centerline and the radius vector to the aircraft. A curved path, approaching the runway centerline asymptotically, will result if the rate of change of displacement angle, θ, is varied in proportion to the measured angle:

$$\theta + K\dot{\theta} = 0 \qquad (1)$$

Some additional symbols are identified in Fig. 3: the track angle, α, is the direction of the velocity vector, V, relative to the runway centerline; the backset, D, is the distance behind touchdown from which angular displacement is measured—about equal to the length of the runway; and R is the ground range to the aircraft from the angular origin.

The problem is to apply the assumed limits on rate of turn and on final displacement at touchdown, using various values of the time constant, K, and thereby to determine the maximum displacement at the gate for which this type of course satisfies the rules. Solution of Eq. 1 for θ yields a time exponential:

$$\theta = \theta_0 \epsilon^{-t/K} \qquad (2)$$

where θ_0 is the initial value of θ, and t is elapsed time after the gate is passed. Solution for rate of turn, which is the rate of change of track angle, α, gives:

$$\alpha = -\frac{2\theta + \tan(\alpha - \theta)}{K} \qquad (3)$$

Writing Eq. 2 for the final value of θ, and Eq. 3 for the maximum value of α—which can be shown to occur at the gate—one may obtain simultaneous equations in θ_0 and K:

$$15/D = \theta_0 \epsilon^{-60/K} \qquad (4)$$

$$3°/\text{sec} \cong -\frac{2\theta_o}{K} - \frac{1}{K}\tan \sin^{-1}\frac{(60V - D)\theta_o}{KV} \quad (5)$$

Eq. 5 contains the approximation that the direct ground distance to an aircraft at the gate equals the distance along the curved flight path; for the cases derived here, this is true to within 2%.

Fig. 4 illustrates the ranges of initial displacement conforming to this control function, with rate of turn limited to 180° per minute and final displacement limited to 15 ft. The scale of this drawing is greatly exaggerated, for clarity. As would be expected, the width of the gate varies approximately in proportion to the approach speed. The widest gate, which is for 240-knot aircraft, allows for initial displacements from the centerline of up to 3000 ft. The maximum initial track angle, in all cases, is between 35° and 40°.

It is assumed here that the displacement angle is measured relative to an origin beyond the far end of a 10,000-ft, runway, where equipment can be installed. It is shown that all 1 minute final-approach courses that result from this simple control function, and which do not violate the adopted safety rules, must lie within a sector of just over 10°.

It is possible to use other control functions, which allow even greater initial displacements from the centerline, without exceeding the limits imposed on final displacement and track angle, and on maximum rate of turn. One such control function is

$$\theta + (1 - t/C)K\theta = 0 \quad (6)$$

where t is elapsed time measured from the gate, and both C and K are time constants. The value of C must be greater than the final-approach duration; 100 sec. is a reasonable and convenient choice.

The solutions of Eq. 6, corresponding to those for the simpler case just considered, are:

$$\theta = \theta_o(1 - t/C)^{C/K} \quad (7)$$

$$\alpha = \left[-\frac{2\theta_o}{K} - \frac{(C - K)}{(CK)} \frac{(-R\theta_o)}{KV\cos(\alpha - \theta)}\right](1 - t/C)^{C/K-2} \quad (8)$$

$$15/D = \theta_o(0.4)^{100/K} \quad (9)$$

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$$3''/\text{sec} \cong -\frac{2\theta_o}{K} = \frac{100 - K}{100\,K}\tan\sin^{-1}\frac{(60V - D)\theta_o}{KV} \quad (10)$$

Eq. 10 contains the previous approximation that the slant distance to an aircraft at the gate equals the distance along the curved approach course.

By simultaneous solution of eq. 9 and 10, one can obtain the gate dimensions illustrated in Fig. 5. Here, the initial displacements from which approaches satisfying the safety rules can be made are about 70% greater than before, and the maximum initial track angles have increased about 15°. Notice that the sector containing all one-minute approach courses of this type is nearly 18° wide, when the suggested safety limits are observed.

The particular control equation that leads to these results is not necessarily advocated; but it illustrates the fact that, by fairly simple modifications of the relationship defining on-course conditions, it is possible to take advantage of a wide sector of coverage by the final-approach system.

The question arises: How much wider than this is it worthwhile to make the final-approach system coverage? An answer can be found in the effects of choosing different tolerances for residual displacement from the centerline at touchdown, and for maximum rate of turn. Although Eq. 6 might not be the ultimate in short-turn-on control functions, it is difficult to imagine the safe application of one that allows significantly wider gates. This control equation will therefore be assumed in estimating the maximum usable sector of coverage. Assuming, also, a 10,000-foot backset of the angular origin from touchdown, Fig. 6 shows how the coverage requirement is affected by maximum final displacement and by maximum rate of turn. Extrapolations of the 240-knot curves indicate that a sector width of about 24° would be adequate, for any reasonable limits on turning rate and on displacement at touchdown.

It should be kept in mind that arbitrarily chosen safety criteria will be ignored in an emergency. If

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an aircraft can land successfully, on its last drop of fuel, by turning at 10° per second and ending up 100 ft. from the centerline, it should be allowed to do so in an emergency. Therefore, the sector served by final-approach aids should not deliberately be limited to a size that is adequate for routine approaches; the limit should be set, rather, by the technical difficulties, and the cost, involved in exceeding the routine requirements.

Fuel Gauge

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gage systems in both jet- and piston-engine aircraft. Fuel-gage systems for both types of aircraft are now easily maintained by periodic standardization with this one highly accurate instrument.

Tester

The Tester, pictured in Figure 1, is essentially two accurately calibrated, variable three-terminal capacitors which are set to simulate the capacitance existing across the fuel-gage sensing elements. To adjust an uncompensated system, the Tester is connected in place of the fuel-gage sensing capacitor in the tank, and set so that its capacitance is the same as the known capacitance of the tank unit when the tank is full. The "full adjust" potentiometer in the system (Figure 2) is then adjusted so that control-panel, fuel-gage indication corresponds to that for a full tank. A similar procedure is followed to calibrate the system for an empty tank reading. With a compensated gage, in addition to the above, the compensating capacitor must be replaced by the second variable capacitor and its capacitance properly set.

The equipment described permits accurate and convenient checking of fuel-gage performance. While specifications for this design were established by the Wright Air Development Center of the Air Research and Development Command, General Radio initiated and underwrote the development program under P. K. McElroy in advance of evaluation or armed-service contract. The unit has passed all environmental and other tests required by MIL-T-8579 and is regularly in military use.

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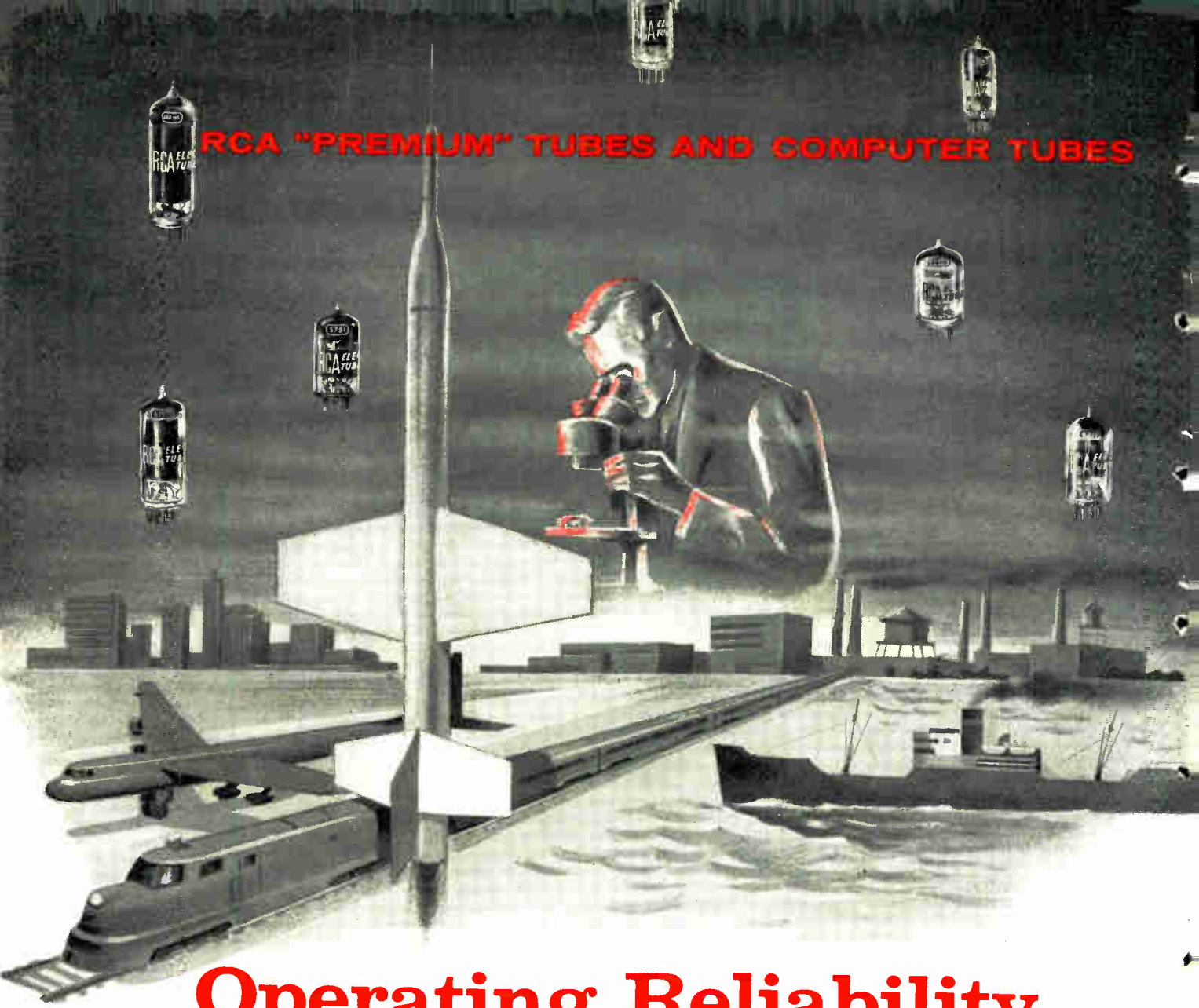

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