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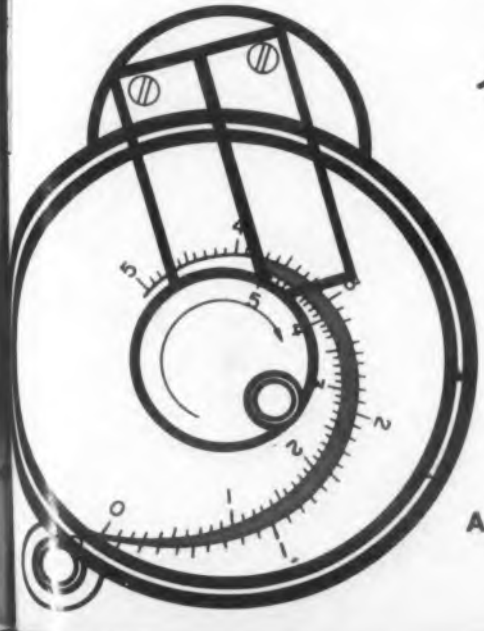

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SIGN

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- ☐ Plug-In Counter Decades
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- ☐ Translators and Printers

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- ☐ Militarized Counters and Timers
- ☐ High-Speed Printing Chronographs
- ☐ Other Data-Processing Systems

You can buy Potter with complete assurance of reliability. As specialists in digital data-handling equipment, Potter engineers welcome an opportunity to study your requirements and to make recommendations for solving your data-handling problems.

Write for detailed technical literature on the above products and other digital equipment available from Potter. Your inquiry will receive prompt attention.

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

That's A Good Idea

Before we're going to get the utmost reliability, an optimized design, or even a preferred circuit, we have to explore all ideas on these subjects. Passing along ideas which you can use now, practical tested ones, has been ELECTRONIC DESIGN's business since Vol. 1, No. 1 five years ago. We have tried hard not to hide these ideas "under a bushel" of trivia.

Of the wealth of material produced by a prolific industry, we have tried to select that which will do the most good for the most design engineers. Your acceptance and response to our efforts has steadily increased our advertising income. We're plowing back dividends to give you still more ideas—in an efficient, readable way. Last year we expanded our Russian translations, expanded our survey of research and development reports, instituted translations of good design ideas from Germany, and started a department covering production equipment which affects the way a product is designed. These are all departments which give us thorough coverage. Our features naturally expanded to cover more, more often. This year and this issue see three new expanded services to readers. First of these is "Ideas for Design" to appear on a regular basis.

We want your contributions to Ideas for Design. We know you have them. The trouble is, engineers too frequently sit on them, keeping them "under the bushel." What is needed is more interchange of ideas. Since one idea frequently parlays into several others, everyone gains. We're opening ELECTRONIC DESIGN's pages to become an inverted bushel—a basket overflowing with Ideas for Design. And to give you incentive to do it now, not to delay till you've got a little free time, we will pay $10 for each item we accept for publication. So think about one right now—It can be brief, several hundred words or less. Simply state the problem and then present your solution. You might write about: Simple circuit tricks, new circuits, clever use of new material or component, good packaging, or time-saving and cost-saving short cuts.

Include with your entry, photos, or drawings preferably inked diagrams made with mechanical aids; name; and company affiliation.

Other innovations beginning in this issue include "Services for Designers," which announces new facilities such as plating, computing, testing, that are available to designers, and Meeting Programs. To help readers evaluate all the meetings that are going on, we plan to publish details on papers that are of special interest to design engineers.—JAL

Engineering Review

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

Television Cancer Studies

Immediate comparative data of chemical activity within normal and cancer cells is provided by an ultraviolet closed circuit system. Used with a high-power microscope and an electronic oscilloscope the ultraviolet-sensitive system permits direct observations and oscillographic measurements of the metabolism of living cells.

Developed by RCA, Commercial Electronic Products, Camden, N.J., the system is now under test at the National Institute of Health, Bethesda, Md. Dr. George Z. Williams, Chief of the NHI Pathology Department, reports that the ultraviolet TV camera tube sees more than the eye can discern when living cells are illuminated with visible light.

Ultraviolet rays are absorbed in specific and measurable quantities by different chemicals. This characteristic enables the medical researcher to: a) identify the nature and scope of several cellular chemical substances by exposing the cell to ultraviolet light and measuring the absorption ratio; b) introduce foreign chemicals and study their reaction with the cell's normal chemicals and, c) by ultraviolet exposure, to maintain serial studies of disease-suspected cells and tissues and detect and identify chemical changes which may develop.

"Heretofore," Dr. Williams pointed out, "the study and observation of ultraviolet-treated specimens represented a long and laborious process due to the lack of a practical medium for direct observation. The ultraviolet TV camera tube developed by RCA makes practical "seeing" ultraviolet pictures by television."

The ultraviolet absorption image, viewed by the TV camera through a microscope, is converted to an electronic signal by the ultraviolet camera tube. The signal is amplified and then viewed on the screen of the TV monitor, a few feet away. Any one of the 525 horizontal scanning lines can be selected and analyzed by a special oscilloscope, which produces a tracing of the absorption characteristics.

Electric Watch—Miniature Marvel

Wire five times finer than human hair, a power supply the size of a shirt button, permanent magnets smaller in diameter than the metal in an ordinary paper clip, screws barely visible to the human eye—80,000 would weigh one ounce—all combine to make the world's first electric wrist watch a marvel of miniaturization.

No larger than a conventional wrist watch, it offers the highest accuracy and dependability ever achieved (99.995 per cent), according to the Hamilton Watch Company of Lancaster, Pennsylvania. The watch will retail from $89.50 to $150.00. A tiny battery used to power the unit was developed by the National Carbon Company. It will power the watch for at least 12 months and replacements cost less than $2.00.

A sub-miniature d-c motor acts as both a motor and a balance wheel. Thus the balance wheel not only controls the time (the same thing it does in conventional watches) but, in addition, it supplies the power to keep itself in motion and to turn the hands—basically the only thing a watch need do. Each time the coil on the balance wheel moves in one direction past a pair of magnets fixed in the pillar plate, the balance wheel itself closes a little switch to send a pulse of current through the coil. The magnetic field generated by that current reacts with the magnetic field from the permanent magnets to kick the balance wheel along its way. This gives it the energy necessary to keep running and also the extra energy needed to permit it to serve as a motor running the rest of the mechanism.

The motor has an efficiency of 60 per cent—ten times greater than available motors of similar size. This efficiency is particularly good when you consider that it must run continuously for a minimum of twelve months. The drag of the brushes in the motor must be reduced almost to zero, but never quite reach it.

The Electronic Industry is becoming more and more dependent on the miniaturization of all types of devices. Technical know-how obtained by the Hamilton Company in perfecting this watch should be an aid to the entire industry.

Electric watch (right) has energizer top center which replaces mainspring; manual watch (left).

Held by tweezers is the combination balance wheel and DC motor which powers the watch.

Dr. John P. Hagen, Director of Project Vanguard, is shown with a Full-Scale Cutaway Model of the Earth Satellite.

Satellite Computer Center

Dr. Herget, Director of Cincinnati Observatory and Professor of Astronomy at the University of Cincinnati, has been appointed by the Navy Department to head the staff of the VANGUARD Computer Center, Washington, D.C.

The VANGUARD IBM 704 computing facility will be directly connected by Teletype and telephone with the Project VANGUARD Communications Center. Following the launching of the satellite, the Computation Center will go into action on a "round-the-clock" basis. Data from a number of radio tracking stations in various parts of the world will be used to calculate the satellites orbit. Each set of data will consist of two angles defining the direction of the satellite and the times of measurement determined by tracking station observers.

The VANGUARD Communications Center also will process information received from unofficial tracking stations and optical observation points throughout the world and turn this data over to the Computation Center for calculation.

No False Alarms

When fire breaks out in an aircraft engine space, it must be detected and quenched within seconds to avoid serious damage or possible loss of life. Too often in the past, frequent false alarms have undermined the airman's confidence in his fire detector, causing him to hesitate or neglect to take action when an alarm sounded.

To provide design specifications for reliable, fast-acting fire detectors, the National Bureau of Standards, Washington, D.C., has been studying flame characteristics that might be applied to aircraft fire detection systems. Results of this work indicate that reliability could be greately increased by a system

that would not respond unless several intrinsic properties of a flame were all present at the same time. These properties are (1) characteristic rate of increase of radiant flux, (2) sufficient level of radiant flux in the required spectral region, and (3) characteristic frequency of flicker.

World of Numbers

Two dozen newly created, colorful displays to show the vital significance of mathematics in our modern world were recently put on exhibit by the International Business Machines Corporation at the Museum of Science and Industry, Chicago, Illinois.

By dramatizing the fascinating and active part of numbers in our ordinary daily lives as well as in complex business and scientific operations, the displays encourage the study of mathematics.

One of the most exciting features of the exhibit is the cycloramic staging of PROJECT SAGE, the nation's electronic air defense system. The three dimensional display and film shows how information is relayed from early warning radar stations and ground observer corps to Air Defense Command Certers. At these Centers, the SAGE computer, calculates the speed, course, and altitude of the approaching enemy planes in a millionth of a second. Within minutes, jet interceptors, NIKE missiles, and coastal anti-aircraft batteries go into defensive action with exact knowledge of where the enemy is, where he is headed, and when he will reach the point of interception.

Hanging models of an earth satellite and a geodesic sphere are exhibited as examples of scientific developments involving the use of mathematics. The sphere illustrates the theory of geodesic, or self-bracing, curved construction, by which man may some day be able to build a huge "tent" around portions of the earth's surface and control the atmosphere in which he lives.

Geodesic dome

Loudspeaker Bomb

A bomb-like loudspeaker system which is dropped from high-flying airplanes and delivers a three to five minute message to anyone within a half-mile area is one of the newer weapons of the Wright Air Development Center at Dayton. Heart of the system is a lightweight magnetic tape unit and a 500-watt battery-powered amplifier.

Descending on a 66-foot chute, the equipment begins broadcasting its recorded message at 4000 feet while dropping at about 14 feet a second over its "captive" audience.

The system of mercury cell batteries giving a total of 2880 volts, explosive squibs for activating parachutes and the compact electronic packages was assembled by Cook Research Laboraties of Skokie, Ill., under the sponsorship of WADC's communication and navigation laboratory.

Meteor and Auroral Studies

Reflection of VHF and UHF radio signals from meteor and auroral ionization is being studied at the Stanford Research Institute, Palo Alto, California. The experimental radar station is equipped with a giant 61-foot diameter antenna and a 100-megacycle transmitter.

An SRI team has been assigned to install and operate a similar radar unit at College, Alaska. The northern station is part of an associated program being carried on in conjunction with the Geophysical Institute, University of Alaska.

Air to Ground Rocket

The Air Research and Development Command (ARDC) announced that a half-million dollar study contract has been awarded to the Minneapolis-Honeywell Regulator Company, Los Angeles, California. The contract is concerned with the development of a new type of air-to-ground rocket suitable for delivery by fighter aircraft. Additional work on the project will be conducted at ARDC's Air Force Armament Center, Eglin Air Force Base, Florida.

CIRCLE 6 ON READER-SERVICE CARD ➤

THE G-V LINE—(l. to r.) Thermal Relays, a Thermal Relay Assembly, Sealed Thermostats. The complete G-V line, incorporating over 1,000 variations, covers more than 98% of all application requirements.

No. 1 of a series

Research and Engineering

What Makes G-V Control Th

G-V TOPS IN THERMAL RELAY FIELD

In business as a producer of thermal relays and thermostats for less than 6 years, G-V Controls has already achieved the enviable position of undisputed leader in the design, development and manufacture of thermal relays. In the vast, competitive electronic industry, this can be considered an outstanding accomplishment.

G-V OFFERS UNIQUE FACILITIES

G-V Controls' rapid progress has been due in large measure to the highly competent personnel and modern equipment which it has devoted to the field of thermal relays. Its Engineering Staff has produced most of the recent technical advances in this field. Its Manufacturing Department has built a reputation for high quality and dependable deliveries. Its Field and Sales Engineering Organization is known throughout the country for helpful and intelligent cooperation. All of these facilities are freely available to our present and prospective customers. They can help you to make your products better.

We give you on these pages a view of some of our Research and Engineering activities. Later in this series, we will feature Production and Sales and Field Engineering.

APPLICATION ENGINEERING

Every new relay application is studied by the Application Engineering Group. Complete operating data on over 1000 types and variations of thermal relays permits these men to recommend the best type and to predict its behavior.

Key spots open for engineers interested in going places with a young progressive organization.

RESEARCH and DEVELOPMENT—G-V Controls developed the first 7-pin miniature thermal relay, the first adjustable hermetically sealed thermal relay, the first hermetically sealed hot-wire relay. The precision and uniform characteristics of G-V's relays have qualified them for many uses new to relays of this type.

UNUSUAL APPLICATIONS are "bread-boarded" to duplicate conditions in users' equipment.

G-V ENVIRONMENTAL TEST LABORATORY—This modern laboratory, with all the newest testing equipment, assures the user of maximum reliability. Qualification tests to military requirements, followed by periodic quality control testing, guarantees continued reliability under extreme environmental conditions.

Radioactive Environment

Design engineers working on future weapons systems are faced with the problem of developing electronic components which can survive and operate in nuclear radiation fields. Fortunately, it appears that there is some compatibility in achieving materials that will survive both high temperature and nuclear radiation.

Cold Punching Printed Circuits

A new cold punching copper clad laminated plastic Formica XXXP-36 for printed circuits can be punched without heating in thicknesses up to 1/16 in.

Printed circuit designers have instinctively shied away from long circuits because the expense of rejects mounts in direct proportion to the square feet of area involved.

The Komak Corp. of Philadelphia, Pa. has fabricated two circuits 34 in. long for an Allen electronic organ. Using Formica XXXP-36 provides dimensional stability and resultant circuit accuracy that practically eliminates the reject problem.

$4 Million Grant for Education

The National Science Foundation has granted $4,065,000 to 16 colleges and universities for teacher training. Purpose of the grant is to help high-school teachers stay abreast of advances in science, mathematics and engineering.

Interest at this level has been heightened because high-school population is the heaviest it has ever been, and is growing steadily. NSF Director, Alan T. Waterman said that the money is to be used for academic-year institutes.

ASA's Scope of Work

The Standards Council of the American Standards Association, recently adopted the following resolution: "that the ASA should be so organized that it can handle any standard standardization project which deserves national recognition—whether, but not exclusively, in the field of engineering, accounting, business practice or consumer goods."

◀ CIRCLE 6 ON READER-SERVICE CARD

FCC Policies Airwaves

In Pennsylvania a local official complained to the Commission and to his Congressman about interruption of his TV reception by a community antenna TV system. Inquiry pinned a double guilt—on cable radiation by the community TV system and on the complaining official's own defective TV receiver. Both parties promised corrective action.

The Commission received letters of thanks from a Congressman and from a woman because it induced a Pennsylvania farmer to mend a break in his electric fence, which improved broadcast reception for the lady constituent.

New Highway System

A new rail-type highway system with a rail either overhead or on the highway itself will be introduced for greater safety according to William Schmidt, Vice President and Director of Styling of the Studebaker-Packard Corporation.

Over 75 million American cars will be on the road by 1970 and crowding will be an increasing problem in the distant future he said. Power for the system could be supplied by a source other than that of the car's own power plant which would allow cars travelling off the highway to run on a compact storage battery.

Better Radar Presentation

An automatic device which defines radar targets more clearly has been developed by the Government Division of Allen B. Du Mont Laboratories, Inc.

Designed to complement airborne radar equipment, the device is called the Clutter-Operated Anti-Clutter (COAC) Receiver. It uses the impulses returned from a "cluttered" target to adjust the radar set to each element of the target shown on the screen so that these elements are shown as well-defined individual images.

The COAC receiver in airborne radar equipment will provide clearer landmarks for navigation, give more faithful and complete information for avoidance of air collision with other aircraft, and show storm fronts in the

◀ CIRCLE 7 ON READER-SERVICE CARD

path of the aircraft. Du Mont has designed and flight tested the new receiver in standard airborne radar sets. Provisions are made for manual gain control of the radar equipment when it is desirable to focus on one individual image to the exclusion of definition of others within a target area.

The COAC receiver, with minor modifications, could be adapted to radar equipment other than that used in aircraft. It could be useful in meteorological, land, or ship radar sets.

Computer Education For Business

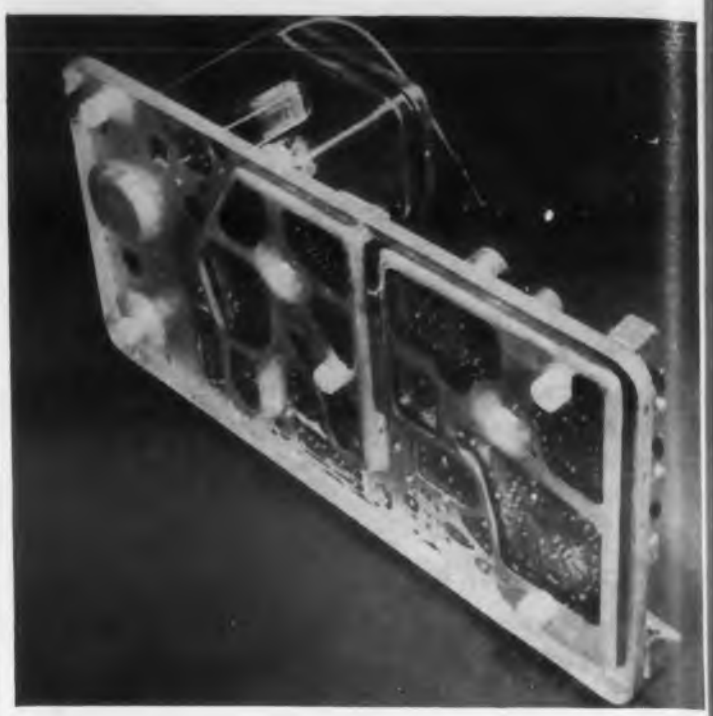
Local business men will be taught what digital computers and similar machines can do for them at the University of Pittsburgh's new Data Processing Center. The new director hired to educate the community, is William B. Kehl, formerly with MIT's Instrumentation Labs. Forty-five business executives, many of them from top Corporation Offices, have enrolled.

High Frequency Lighting

Successful use of high frequency electric current in fluorescent lighting was reported at the Winter General Meeting of the American Institute of Electrical Engineers. Eight hundred and forty cycle frequency was installed in a small industrial office building at lower initial cost, increased efficiency, greater flexibility, and a 20 per cent power consumption reduction over a comparable 60 cps system.

R. D. Burnham, of the Wakefield Company, Vermilion, Ohio, author of the paper said that frequency conversion from 60 to 840 cycles was effected by utilizing a motor generator. A 400 volt, three-phase motor was used to drive an 840 cycle, 400 volt, three-phase generator. Capacitors were used for current limiting. Mr. Burnham further said that "increased frequency for the purpose of operating fluorescent lamps under more advantageous conditions seems to be practical with electrical components available today."

CIRCLE 8 ON READER-SERVICE CARD ➤



Packaged Electronic Circuit for TV

A TV receiver is now in production at Motorola that has as its primary design purpose the use of a plated circuit chassis with packaged electronic circuits. The result is a decrease of chassis area by 20 per cent, the combining of 97 separate parts into 17 group units, and the reduction of conventional wiring by 90 per cent.

By incorporating the new Centralab PEC technique to the fullest possible extent, Motorola has reversed the usual circuit-design procedures. This is the first time that a television receiver has been designed specifically to utilize the advantages offered by a new technique in component parts. The usual practice is for component parts to be fabricated for existing circuitry. This new development is the result of cooperative engineering effort between Motorola Inc. and Centralab.

Reliability

At the 38th Annual meeting of the American Ordnance Association, Daniel E. Noble, Vice-President, Motorola, Inc., pointed out four basic requirements that must be met when supplying the Armed Forces with electronic systems.

- The equipment must be designed in modular and sub-modular construction to permit servicing and maintenance by substitution of sub-modules.
- Testing procedures, which must be coordinated with the sub-module construction plan, must be devised to permit determination of modular failure through the following of routine procedures printed in an instruction manual.
- Printed Circuitry, automatic assembly, and sealed modular construction must be used to improve the uniformity and produceability at the manufacturing level and to protect the equipment from the overzealous serviceman in the field.

• Transistors should replace vacuum tubes whenever the substitution is practical. The use of transistors makes possible the first truly acceptable design for sealed modular construction of military equipment.

He further pointed out that we are not ready for technological warfare until we equip our military forces with apparatus which can function without the attention of career maintenance men or corps of equipment nursemaid scientists.

Measuring Interatomic Forces

Highly pure and perfect metal crystals known as "whiskers" are being used to gain new insight into the enormous forces which bind atoms together. Dr. R. L. Eisner, research physicist, Westinghouse Research Laboratories, Pittsburgh, Pa., described a new technique for evaluating these forces at the Seventh New York Meeting of the American Association for the Advancement of Science. By measuring the tensile strength of whiskers of iron, Dr. Eisner found that iron had a strength of more than a half a million pounds per square inch.

In "whiskers," a metal exists in perfect condition. In contrast, any ordinary piece of metal contains countless millions of structural imperfections. Under stress, it is these imperfections which govern how and when the metal will break. They mask any attempt to measure the much larger forces which hold the metal atoms themselves together.

The strength of the tiny whiskers is measured by reflecting a beam of light from flat optical mirrors attached to the clamps at each end of the whisker, to form an "interference pattern." As the whisker stretches, the mirrors move and cause changes in the pattern similar to the changing "rainbow" colors seen in soap bubbles or thin films of oil. These changes are electronically amplified and analyzed to disclose the amount of stretch. The technique accurately measures changes in whisker length down to less than one millionth of an inch.

Interatomic forces in an iron crystal "whisker" are measured by stretching the tiny strand of metal.

Washington Report

Herbert H. Rosen

Automation Progress Aired

A distinguished assembly of scientists and engineers appeared recently before a subcommittee of the Joint Economic Committee, headed by Rep. Wright Patman (D-Tex.). They presented their version of the progress automation has made in the past few years. Most of the witnesses before the committee were Instrument Society of America members.

The theme for the hearings was set by R. T. Sheen, President of ISA. He thought that there were certain conditions tending to strangle the growth of automation. To counteract these, he cited certain needs: the current labor force should be further trained; new blood and technical personnel should be brought into the industry; worker efficiency should be increased through current instrumentation services, and worker effectiveness should be enhanced through broader communications systems on techniques and equipment.

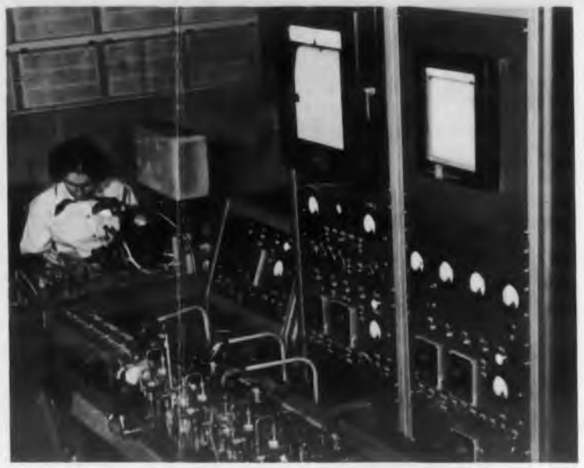
Sheen's recommendations to meet these needs are: (1) better trained high school teachers and more basic scientific courses, (2) vocational training for "instrument mechanics" and technicians, (3) engineering extension services, (4) better use of military training periods, (5) creation of instrument-automation information centers, (6) better liaison between industry and the military, and (7) augment the work of the National Science Foundation and ISA's Foundation for Instrumentation Education and Research.

Most of the other witnesses echoed Mr. Sheen's statements during the four-day hearing. The Labor Department announced that it had conducted a survey of five companies that had turned to automation. The report showed that only a small percentage of worker dislocation occurred. Where the worker could not grasp the operation of the new machines, he was moved horizontally to another position of less complexity with no loss in pay. But increased demand and enlarged production of the automated products invariably resulted in an increased labor force.

Labor unions were concerned with three major areas: migration of industry, training and adjustments in collective bargaining. The migration aspect concerned itself with the movement of industries to other locales, thereby leaving an unemployed work force behind. These would be, in large measure, older workers who could not or would not move with the industry. The training problem, according to the AFL-CIO will have to be solved jointly by management and the union. Pay differentials will also enter this area. Some of that will come up in the collective bargaining aspect in which the unions show concern.

An exclusive machine, designed by Philco engineers. It's a Surface Barrier Transistor Lead Attacher which feeds, cuts, plates, precisely positions and automatically solders the whisker wire to the transistor emitter and collector.

New Philco automatic "Carousel" assembles and processes alloy junction type transistors. It prepares stems by localized plating, solders stems to transistors, solders leads to emitters and collectors, and follows with electrolytic clean-up etching, dip rinsing and ultra sonic rinsing to remove contaminants.



This exclusive Philco Automatic Transfer Machine performs nine operations in the manufacture of surface barrier transistors. Following each step is a rinsing operation, and finally—hot nitrogen drying. Critical operations are automatically monitored and recorded for quality control.

WITH THIS GREAT NEW AUTOMATED PLANT

PHILCO

revolutionizes production methods and sets new quality standards in the transistor field

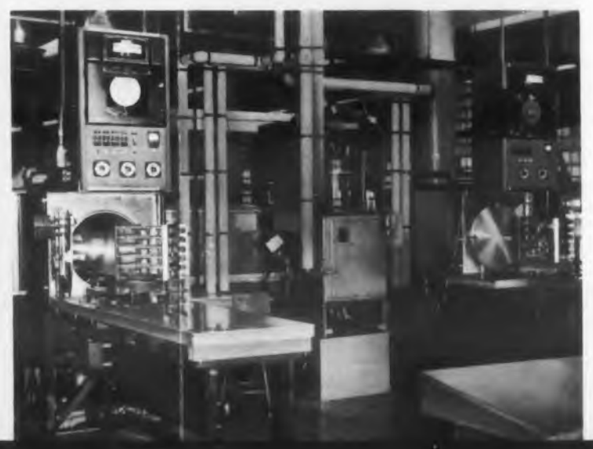
It's the greatest development in transistor history. A complete plant, housing the most advanced transistor manufacturing equipment and utilizing entirely new production methods, is now in mass production at Spring City, Pa. We call it Philco Transistor Center, U.S.A.—and, that's exactly what it is. From this plant come the world's finest transistors—unmatched in quality and reliability.

100,000 square feet of area devoted exclusively to semi conductor production. This plant is equipped with centralized supplies of de-ionized water, vacuum, disassociated ammonia, hydrogen, nitrogen and high purity compressed air, plus complete air conditioning with dust and humidity control.

Shown below is a portion of the Life Test Section where all types of Philco transistors are tested under a variety of storage and operational conditions. Individual test positions are provided for over 10,000 units.

The new Spring City Transistor Plant is unmatched for advanced testing methods. Below is a Philco designed high speed Automatic Test Facility for testing seven parameters of power transistors.

Unsealed power transistors in large batches go into vacuum oven (shown below at left) for baking, while simultaneously caps go into vacuum oven (shown at right). After baking cycle the transistors roll on carriers into dry box for cold weld sealing.



NEW METHODS Extensive research, design and planning by Philco engineers has resulted in completely new and far superior transistor production methods. Mass production is now a reality, and special equipment results in closer devise tolerances.

NEW MACHINES Designed specifically for the new mass production methods at Spring City, Pa., machinery completely new in concept is now in operation, with the finest precision control in the industry. These new machines have been designed with the flexibility to accommodate future advances in the transistor field.

NEW AUTOMATION The result of this new production machinery is automation—more automation than ever before in the transistor field. This automatic equipment eliminates human error, increases production capacity and minimizes contamination.

NEW TEST CONTROLS Automatic test equipment, designed by Philco engineers, tests each transistor at every stage of fabrication. Each vital performance parameter is accurately tested. Environmental and life tests assure utmost reliability.

See Back Page FOR DETAILS ON PHILCO TRANSISTORS

NOW IN MASS PRODUCTION AT SPRING CITY, PA

PHILCO

Transistor Center, U.S.A.

For the first time, the dream of the electronic industry comes true . . . made possible by many years of Philco pioneering, research and production of semi conductors. Philco's great new transistor plant at Spring City, Pa. is designed for and dedicated to the mass production of reliable transistors.

← *Lift the Page and read this important news!*

FOR RELIABLE PERFORMANCE, STABILITY OF OPERATION AND LONG LIFE

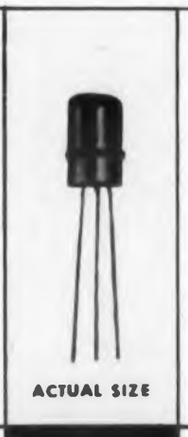
...base your designs on

PHILCO *Transistors*

Proven performance of Philco Hermetically Sealed Transistors has made them the basis for design in commercial and military applications where reliability is the major consideration. Philco transistors range from the world's smallest germanium transistors now in production to silicon transistors with excellent performance at temperatures from —60°C to +150°C. The following are some of the available Philco transistor types:

Low Level Transistors

2N207, 2N207A and 2N207B—Germanium PNP Alloy Junction Transistor ... world's smallest transistor in production. Useful in any low level audio application such as hearing aids where size is an important consideration.



Medium Power Transistors

2N223, 2N224, 2N225, 2N226, 2N227 — Germanium PNP Alloy Junction Transistor for portable radio output stages, medium power switching, servo-amplifiers and other applications where medium power must be handled at low frequencies.

Power Transistors

T1040, T1041—Germanium PNP Alloy Junction Power Transistor with low thermal drop designed for audio output stages, power switching, servo-amplifier output stages and other applications where high power must be handled.

High Frequency Transistors

Surface Barrier Types 2N128 and 2N129 —Surface Barrier Transistors for critical military applications, produced to meet MIL-T-12679A (SigC) military requirements.

High Speed Switching Transistors

2N240 — Germanium Surface Barrier. High Speed switching transistor with response time in the low millimicrosecond range. Made the basis for design of both military and commercial computers where speed and reliability are essential.

Silicon Transistors

T1025, T1159—PNP High Speed Silicon Transistors for computers and amplifiers operating at high ambient temperatures. These transistors feature low saturation voltage.

All Philco transistors are hermetically sealed to insure long life. In addition to the above types, Philco produces a wide range of transistors designed for special applications in accordance with customer requirements. The Philco Micro Alloy Transistor is already in pilot production and tentative specifications and design quantities are available. New and exciting transistor types, such as the Philco Micro-Alloy Diffused Base Transistor, are now in development. In keeping with our policy, specifications will be made available as soon as these units reach pilot production and are available in design quantities.

Make Philco your prime source for complete transistor application information ...
write to Lansdale Tube Company, Dept. I-2, Lansdale, Penna.

Regional offices—Merchandise Mart Plaza, Chicago 54, Ill.—10589 Santa Monica Blvd., Los Angeles 25, Calif.

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

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Automation hearing on Capitol Hill are beginning to show a periodicity. Last year many days were spent on the subject. No bills concerning automation were presented to Congress last session. The Patman Committee, this time, appeared satisfied that the nation's social and economic structure was not being marred by the little automation now being used. Therefore, it was concluded that no legislation on automation will come out of this session of Congress.

FCC TV Interference Ban

Manufacturers of TV receivers and some fm receivers have an additional six months before they must begin to make provisions for interference limiting. The Federal Communications Commission has announced that Section 16.58 (c) of the rules is amended by this notice. This section of the rules governs "Incidental and Restricted Radiation Devices." It also covers the power line interference limit in frequencies between 3 and 25 mc applicable to TV and fm broadcast receivers.

The Notice gives manufacturers of TV receiver chassis until June 30, 1957 to design their circuits for interference-free operation. Manufacturers of television broadcast receivers have until December 31, 1957 to comply.

Delay in the implementation of the rule stems from the fact that the FCC has only partially developed a testing and monitoring technique for interference in this frequency range. Actually, the ruling is part of a larger scheme for interference limiting in the frequency range from 3 to 890 mc. The first act in this area occurred several years ago when a ban was placed on interference from diathermy machines used by doctors and hospitals. As a result of the ruling at that time, new machines had to be purchased that were more carefully radiation shielded, or if the old diathermy machines were used, the rooms had to be shielded.

The manufacturer of TV receivers, like the diathermy machine producers, will have to make certain that oscillations will not interfere, either through the power line or by radiation. Once the compliance has been met, the manufacturer will have to certify in writing or place some kind of seal on the set that it is radiation-free. The FCC will attempt to test pre-production receivers in its own laboratories. If circumstances preclude this prior testing, the reputation of the manufacturer will have to stand by his certification. However, the FCC has some 500 local community TV committees whose job is to listen to complaints. These may be either from people who are getting interference from a TV set or are having their receiver interfered with. This, then becomes a good check on the manufacturer's certification at the all-important customer-user level.

CIRCLE 299 ON READER-SERVICE CARD

Meetings

1957 Transistor and Solid State Circuits Conference

February 14-15, 1957
University of Pennsylvania
Philadelphia, Pennsylvania

Thursday, February 14, AM
Session I Switching Circuits

A Decade Ring Counter Using Avalanche-Operated Junction Transistors. *J. E. Lindsay, Radio Corp. of America*

Transistor Circuits for Magnetic Drum Recording. *Gordon Kuster, Ferranti Electric Limited*

Large Scale Testing of Switching Speeds of Junction Transistors. *Irwin Dorros, Bell Telephone Laboratories*

Effects of Low Temperatures on Transistor Characteristics. *A. B. Credle, IBM*

Thursday, February 14, PM
Session II Computer Switching

Millimicrosecond Transistor Current Switching Circuits. *Hannon S. Yourke, IBM Laboratory*

DCTL Complementing Flip-Flop Circuit. *E. Gary Clark, Burroughs Research Center*

A New Bistable Transistor Element Suitable For Digital Computer. *N. F. Moody, Defence Research Board, Ottawa*

An Analysis of the Complementary Pair Trigger Circuit. *C. D. Florida, Defence Research Board, Ottawa*

A Complementary Symmetry Momostable Multivibrator. *F. F. Chang and A. I. Aronson, Radio Corp. of America*

The Design of Dual-Range Transistor Circuits for Minimum Standby-Current Systems. *Howard E. Tompkins*

Thursday, February 14, PM
Session III Linear Amplifiers

Transistor Low Noise Preamplifier with High Input Impedance. *Andrew E. Bachmann, General Electric Co.*

Wide Band Feedback Amplifiers. *F. D. Waldhauer, Bell Telephone Laboratories*

A Transistorized High Voltage Push-Pull Switching Generator Using High Impedance Technique. *P. Abzalone, Radio Corp. of America*

RIES TUNED METHODS IN TRANSISTOR RADIO CIR-NTRY. *W. F. Chow and Donald A. Paynter, Gen-al Electric Co.*

NEW APPROACH TO TRANSISTOR RECEIVER DESIGN. *Proudfit, K. M. St. John, C. R. Wilhelmsen, and J. Farber, Hazeltine Research Corp.*

Friday, February 15, AM
Session IV Power Circuits

ME SOLUTIONS TO PROBLEMS OF OPERATING GER-NIUM TRANSISTOR SERVO AMPLIFIERS AT HIGH BIENT TEMPERATURES. *P. M. Thompson and Mitchell, Defence Research Board, Ottawa.*

ASE CONTROLLED TRANSISTOR POWER SUPPLY GULATION. *D. E. Deuitch, Radio Corp. of America*

ANSISTOR D. C. AMPLIFIER UTILIZING "FIRING-GLE" CONTROL. *H. R. Lowry, General Electric Co.*

IMPROVED SQUARE-WAVE OSCILLATOR CIRCUIT. *nes Lee Jensen, Minneapolis-Honeywell*

REE-PHASE STATIC INVERTER. *Thomas M. Corry d Ruby P. Putkovich, Westinghouse Electric rp.*

NEW TRAMAG OSCILLATOR. *Albert J. Meyerhoff d Robert M. Tillman, Burroughs Research Center*

Friday, February 15, PM
Session V Special Device Circuits

MPERATURE COMPENSATION OF TRANSFLUXORS. rold W. *Abbott and J. J. Suran, General Elec-Co.*

UNTING CIRCUITS USING FERROELECTRIC DEVICES. *M. Wolfe, Bell Telephone Laboratories*

ITCHING CHARACTERISTICS OF MAGNETIC CORES CIRCUITS ELEMENTS. *R. D. Torrey, A. Krell, Meyer, Sperry Rand Univac*

ANSIENT AND FREQUENCY RESPONSE CHARACTER-ICS OF FIELD EFFECT UNIJUNCTION TRANSISTORS. *. Suran and B. K. Eriksen, General Electric Co.*

Tutorial sessions will be held Thursday morning d Friday morning. Tutorial sessions are aimed at veying recent advances in the subject and will vide the practicing engineer in solid-state cir-try a broader picture of the state of the art.

The 1957 Transistor and Solid State Circuits Con-ence is sponsored jointly by the Philadelphia tion of the IRE, the Science and Electronics chnical Division of the AIEE, the IRE Profes-nal Group on Circuit Theory, and the University Pennsylvania. The Conference will be held on Campus of the University of Pennsylvania, in Irvine Auditorium and the University Museum. Registration and hotel reservation forms may be ained from Mr. F. W. Anderson, General Elec-Company, Missile and Ordnance Systems De-tment, 3198 Chestnut Street, Philadelphia 4, nsylvania. Advance Registration Fee is $3. At Conference $4.

Feb. 4-9: Audio Engineering Society West Coast Convention and High Fidelity Show

Ambassador Hotel, Los Angeles, Calif. Technical sessions will be held Feb. 7-8, Institute of Hi Fi Mfgrs. Show afternoon and evenings Feb. 7-9. Various awards and honors will be presented at the Audio Engineering Society banquet Feb. 4. For further information, write Audio Engineering Society, Box 12, Old Chelsea Station, New York 11, N.Y.

Feb. 5-7: Twelfth Reinforced Plastics Division Conference

Edgewater Beach Hotel, Chicago, Ill. Latest developments in both technical and practical aspects of reinforced plastics. Subject matter will range from reports on research and testing, product design, production methods, to marketing techniques. A complete program, listing papers and speakers, registration forms for the three day conference and hotel reservation blanks are now available. Those interested should write to The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N.Y.

Feb. 7: Operations Research Symposium

University Museum Lecture Hall, University of Pennsylvania. Sponsored jointly by the Professional Group on Engineering Management of the Philadelphia Section of IRE and the Society of Industrial and Applied Mathematics. Major theme will be Mathematical Models in Management Decision Making. Contact Haydn Ringer, 1303 Highland Ave., Palmyra, N. J.

Feb. 7: Annual Symposium of the New York Section of the ISA

Garden City Hotel, Garden City, N. Y. Short papers on "Practical Accuracy of Measurement" will be presented followed by a discussion. Afternoon session will be on "Data Handling." For further information contact G. Newberg, Publicity Chairman, Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, L. I., N. Y.

Feb. 7-8: Special Conference on Nucleonics In Industry

Hotel Statler, New York, N. Y. Principal subjects for discussion will be the present and prospective profitability of atomic investment. Sessions will cover industrial applications as the use of nuclear energy for processing purposes, development of auxiliary power, and the uses of isotopes. Conducted by the American Management Association, 1515 Broadway, New York, N. Y.

Feb. 15-16: Cleveland Electronics Conference

Masonic Auditorium, Euclid Ave. and E. 36th St., Cleveland 14, Ohio. For information, write Robert A. Dambach, Cleveland Electronics Conference, 18511 Euclid Ave., Cleveland, Ohio.

February 14-15: Transistor and Solid State Circuits Conference

University of Pennsylvania, Philadelphia, Pa. Sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and the University of Pennsylvania. For further information contact G. H. Kunstadt, Radio Corp. of America, Defense Electronic Products, Camden 2, N. J.

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

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

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

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

Feb. 26-28: Western Joint Computer Conference

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

March 11-15: 1957 Nuclear Congress

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

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

Hotel Biltmore, Los Angeles, Calif., sponsored b the Society of the Plastics Industry, Inc. Sessio will cover plastics in the fields of electronics, ai craft and defense, building, and processing. Exp sition will be held at the Shrine Exposition Ha Further information may be obtained from the S ciety of the Plastics Industry, Inc., 250 Park Ave New York, N. Y.

March 18-21: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum New York, N. Y. Twenty-three technical subjec such as Telemetry, Antennas and Propagation, Ci cuit Theory, Electron Devices and Receivers, Co puters, Information Theory, Automatic Contr Microwave and Instrumentation, Manufacturi Electronics, Audio and Broadcast, Aeronautic Communication and Military Electronics, Ultr sonics, Medical and Nuclear Electronics will presented at the convention. For further inform tion on exhibits, contact Mr. William C. Copp, IR Advertising Dept., 1475 Broadway, New York, N. Contact the IRE, 1 East 79th St., New York, N.Y. f other information.

March 25-27: Special Conference on Research a Development

Palmer House, Chicago, Ill. Sponsored by t American Management Association. Subject will "Product Development in Medium and Small Co panies." For information, write American Mana ment Association, 1515 Broadway, New York, N

April 4-5: Special Conference on Research a Development

Hotel Statler, New York, N.Y. Sponsored by t American Management Association. The confere will be an Engineering Forum. For informati write to American Management Association, 15 Broadway, New York, N.Y.

April 8-11: Fourth National Electrical Industries Show

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

April 11-13: Southwestern IRE Conference and Electronics Show

Houston, Texas. Sponsored by the Houston Sect of the IRE. This conference will be augmented the National Simulation Conference which will sponsored by the IRE Professional Group on El tronic Computers. For information, write to Ni Southwestern IRE Conference and Electro Show, P. O. Box 1234, Houston 1, Texas.

pril 15-17: Symposium on Systems for formation Retrieval

Western Reserve University, Cleveland, Ohio. Sponored by the School of Library Science of Western eserve University in conjunction with its center r Documentation and Communication Research. his will be a comprehensive demonstration of sysms presently in use for the organization, storage d retrieval of recorded information, together with symposium on information-handling problems d techniques. Further information may be obined from Jesse H. Shera, Dean, School of Library cience, Western Reserve University, Cleveland 6, hio.

pril 16-18: Symposium on Nondestructive Tests veloped in the Field of Nuclear Energy

arrison Hotel, Chicago, Ill. Sponsored by Ameri- Institute of Chemical Engineers, American Nuar Society, American Society for Testing Mateals, and Society for Nondestructive Testing. Inmation resulting from 15 years research and deopment in testing applications in the nuclear ld will be presented. Papers will be in three cateries: reactor materials, completed fuel assemblies, d miscellaneous. For information, write to Ameri- Society for Testing Materials, 1916 Race St., iladelphia 3, Pa.

pril 23-25: International Symposium the Role of Solid State Phenomena Electrical Circuits

ditorium of the Engineering Societies Building, ew York, N. Y. Symposium will cover recent deopments in application to electrical circuits on stems of unusual physical effects in solids. For formation write to the Polytechnic Institute of ooklyn, Microwave Research Institute, 55 Johnson , Brooklyn 1, N.Y.

pril 24-26: Seventh Region IRE Conference

n Diego, Calif. Theme of the meeting is "Elecnics in Space." Sessions will be held on elecnic aids to air navigation, audio, management, es of computers, antennas and propagation, nuar activiation and damage of electronic equipent, electronic devices, electron tubes, microwave, trumentation, telemetering, data handling and tomation, magnetic components, and radio asnomy. For information, write to IRE Seventh Reon Conference, U. S. Grant Hotel, San Diego, lif.

ril 25-26: Annual Technical Meeting of the titute of Environmental Engineers

Salle Hotel, Chicago, Ill. For information contact President of EEI, Henry F. Sander, Vapor aring Corp., 6420 W. Howard St., Chicago, Ill.

A big problem for designers is that of knowing what has been patented in a given field. Sources of such information often seem elusive. This compilation by John T. Milek is the most comprehensive we've seen and is published for purposes of reference. In an attempt to increase the designers general knowledge of patents and their value, two other articles have been published recently in ELECTRONIC DESIGN. They are: "What Good are Patents"—May 15, 1956 and "Patents are Valuable"—Sept. 15, 1956.

Searching Electroni

John T. Mile

A PATENT search often reveals a wealth of electronics information. Large corporations such as General Electric Co., Westinghouse, Bell Telephone Co., and Radio Corp. of America maintain patent staffs which specialize in the art of searching and preparing patents. A thorough patent search can only be made in the Search Room at the Patent Office in Washington, D. C. Row after row of search desks, provided with racks for convenient "flipping and scanning" of patent subclasses, extend across the room. An excellent description of the United States Patent Office facilities is provided by Fleischer ("Exploring United States Chemical Patent Literature," Searching the Chemical Literature, Washington, D. C., American Chemical Society, 1951, pp 61-69).

Patent Indexes

The Electronics Engineering Master Index, published by the Electronics Research Publishing Co., Inc., covered many electronics patents in their four volumes: 1925-1945, 1946, 1947-1948, 1949. For example: In the 1947-1948 volume, 5500 patents were listed; in 1949, 4000 were covered. In 1946, a companion volume, Electronics Engineering Patent Index, covering approximately 2000 patents, was published by the same company.

The United States Patent Office has prepared a Classification Bulletin of the United States Patent Office, Number 400, Revision I, January 1954. The bulletin is a consolidated index to Classification Bulletins 103-416, containing the defined classes arranged numerically with their titles and for each a list of all classification bulletins containing a reference thereto. This index is available gratis from the Commission of Patents, Washington 25, D. C. Approximately thirty-five classes are listed which pertain or relate to electronics and electrical engineering.

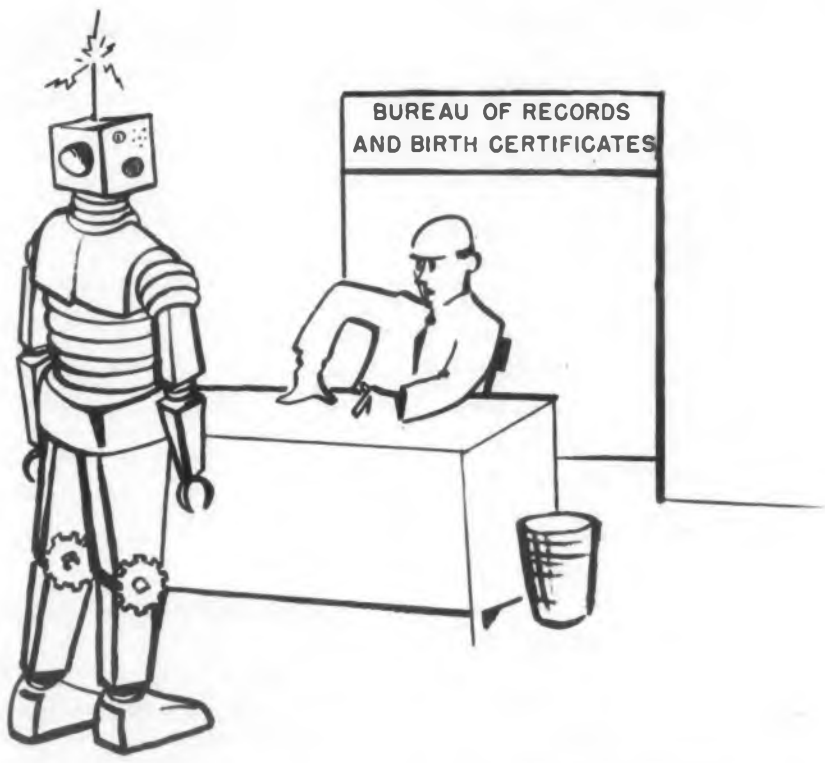
The United States National Bureau of Standards published a "List of the More Important United States Patents Covering the Materials and Methods of Manufacture of Insulating Materials," Letter Circular LC-51 (1922), 29 pp. It intended to include all United States patents issued prior to September 1, 1920 on the manufacture and use of electrical insulating materials. The publication includes a numerical list of 450 patents dating from 1888 to 1920 and other details such as patent number, date, inventor, assignee, title and reissues.

In 1936 the United States Bureau of Mines published an information circular (No. 6883) titled "Patents on Geophysical Prospecting Issued in the United States, England, Canada, Australia, Germany, France, and Russia." It was subsequently continued in the United States Geodetic Survey Bulletin Numbers 887 and 895b. The publication includes many electrical methods of prospecting as well as electronic devi and apparatus.

The United States Government Patents Board 1953 began a series of volumes containing Gove ment-owned inventions available for license. Th volumes of this series are detailed under 9, 10 and of the bibliography.

Abstracts

The United States Patent Office issues a weekly ficial Gazette, recording and abstracting all current leased patents in numerical sequence. Complete nearly complete sets of the Official Gazette can found in the libraries of the major cities of the Un States. For information on electrical patents prio



"How do I go about looking up my Birth Certificate?"

atents

7, a useful source of information is the United
tes Patent Office publication titled "Index of Pat-
s Relating to Electricity, embracing patents issued
the United States Patent Office from July 1, 1881-
7." This index will save numerous hours of search-
for electrical patents of that period since it is ar-
ged by patent class and numerically within the
s. An alphabetical, numerical and chronological
ex of all patents is included also. A more recent
ent indexing literature tool is the Index of Patents
ed from the United States Patent Office, 1920—. It
udes an alphabetical list of patentees, and prior to
4 an alphabetical list of inventions. The publi-
on, Index of Trade-marks Issued from the United
es Patent Office, 1928—affords the searcher trade
k information of patented products and processes.
Chemical Abstracts includes many patents relating
electronics, such as plastics insulation, ceramic in-
tion, dielectric materials, and semiconductors. An-
l and decennial indexes facilitate finding such pat-
data.

Another source of electronics patent information is
RETMA Radio-Electronics Patent Service issued
kly by the Radio-Electronics-Television Manufac-
rs' Association, Suite 800, Wyatt Bldg., 777-14th
et, N.W., Washington 5, D. C. This service (which
ee to members) reproduces in brief all patent list-
from the United States Official Gazette in the
tronic field.

During World War II the Custodian of the United
es Office of Alien Property prepared and pub-
d a compendium, Abstracts of Mechanical and
trical Vested Patents, in five volumes. Several
sand electrical patents are listed by classes.

Many periodicals and trade journals include elec-
ics patents as regular features. These usually can
ct ted through the periodical's index, Engineering
ex, or Industrial Arts Index. Norman Chalfin has

7 Heading Avenue
Angeles 45, Calif.

reviewed electronics patents in a series of articles titled "Pertinent Patents" in 1955 in *Electronics*, McGraw-Hill, New York. A comprehensive bibliography, "Transistor Circuits and Devices" by John T. Milek was published in the January, 1955 issue of *Electronics Digest*. Over 200 patents are included on the subjects of semiconductor devices, germanium and silicon diodes, and germanium and silicon transistors.

A new patent service called "Picturesort" was inaugurated recently offering copies of all United States patents issued. The company (Picturesort Co., New Haven, Conn.) will supply copies of electronics patent abstracts and microfilm on a punched card which can be coded and filed for easy reference.

Patent Suits

In 1926 the Radio Manufacturers' Association, Inc. published a volume titled Information on U.S. Radio Patents and Suits (New York, The Association, 1926, 175 pp.). Supplements numbering 1-21 have been published dating from December 31, 1926 to December 1931. The first half of the original volume is a collection, classification and tabulation of all United States patents relating to radio receiving circuits and systems exclusive of circuits employable peculiarly or only for radio transmitting, and to radio parts or instruments usable in such receiving circuits. The report on each subject is preceded by a discussion of the scope of the report and the methods of treatment and contents, with an analysis of the classification followed. The patents are listed numerically under each subject. Information on each patent includes patent number, date, inventor and title. The second half of the original volume on suits appeared separately (371 pp.). The first half of each supplement continues the patent compilation, the last one going through December 1931. Subject indexes to the original volume and supplements are also included.

Foreign Patents

Information on foreign electronics patents is scarce. Belkhap Severance, chief cataloger of the Scientific Library of the United States Patent Office, has prepared a valuable guide to foreign patent source material in his Manual of Foreign Patents, Washington, D. C., Patent Office Society, 1935, 161 pp. In its introduction, it incorporates "Searching Foreign Patents" by Arthur Worischek, Patent Attorney for General Motors. Worischek describes the problems and difficulties besetting a patent searcher in locating patent information in the various countries. The contents include patent source information of fifty-six countries arranged alphabetically by country. Such information is included as name and address of patent office, patent journals and periodicals, with complete detailed information on each; indexes, classifications, abridgments, specifications, patent laws, legislation and statistics.

White and Ravenscroft give details of patent laws of over 200 countries, islands, territories and colonies in Patents Throughout The World, New York, Trade Activities, Inc., 1944, 416 pp plus Supplements.

Langner has prepared a compendium of useful information relating to foreign patents and trade marks with complete tables and charts specially prepared for the use of attorneys: Langner's Foreign Patent and Trade Mark Digest, New York, Langner, Card, & Langner, 1928-, loose-leaf.

Obtaining Patents

Electric and electronics patents are discussed by Toulmin (Handbook of Patents by H. A. Toulmin, Jr., New York, Van Nostrand, 1949, Chapter VII: Special Types of Patents). He discusses such basic patents as radio, Morse telegraph patent, De Forest radio Tube, Bell telephone patent, incandescent lamp patent, Marconi patents, television, electrical fields, and electrical methods. The reader is referred to this work for a discussion of patent-ability, court decisions, and patent applications of electrical and electronics patents.

A few other books on electrical patents providing sources of information are:

- Beginnings of Telephony by F. L. Rhodes. New York, Harper, 1929, 261 pp. Pages 234-238 includes a numerical list of patents from 1875-July 1918, giving date, patentee, feature covered, and page reference to text.
- Electrical Technology and the Public Interest by Frank J. Kottke. Washington, D. C., 1944, 199 pp.
- The Law of Electrical Invention by Frank G. Kirtz. New York, Boardman, 1954, 742 pp.
- Radio and Television Rights. (A standard reference book on the law of copyright, trade-marks, and unfair competition and the broadcasting industry) Albany, New York, Matthew Bender & Co., 1953, one volume.

Bibliography on Electronics Engineering Patents

1. CHROMY, BENJAMIN (Compiler)
   Radio Patent Service. Washington, D.C., National Press Bldg., 1930-, weekly.
2. ELECTRONICS RESEARCH PUBLISHING CO.
   Electronic Engineering Patent Index, 1946. New York, Electronics Research Publishing Co.
3. ELECTRONICS RESEARCH PUBLISHING CO.
   Electronis Engineering Master Index, 1925-1945, 1946, 1947-1948, 1949. New York, Electronics Research Publishing Co.
4. KIRTZ, FRANK G.
   The Law of Electrical Invention. New York, Boardman, 1954, 742 pp.
5. KOTTKE, FRANK J.
   Electrical Technology and the Public Interest (A study of our national policy toward the development and application of inventions). Washington, D.C., American Council on Public Affairs, 1944, 199 pp.
6. RADIO-ELECTRONICS-TELEVISION MANUFACTURERS ASSOCIATION Radio-Electronics Patent Service, Washington, D.C., The Association, 1945-, weekly.

7. RADIO MANUFACTURERS' ASSOCIATION, INC.
Information on U.S. Radio Patents and Suits. New York, The Association, 1926, 175 pp. Supplements Nos. 1-21 (December 31, 1926-December, 1931).

8. TOULMIN, HARRY A., JR.
Handbook of Patents. New York, Van Nostrand, 1949.

9. U.S. DEPARTMENT OF COMMERCE, GOVERNMENT PATENTS BOARD
Government Owned Inventions Available for License. Washington, D.C., 1953, 168 pp.
(A list of 3658 patents arranged by industrial use. Supersedes 1951 publication, "Government-owned inventions for free use covering 2339 patents active as of January 1, 1951. Information included in the list comprise U.S. patent number, title of invention, name of inventor, and the abbreviated name of the government agency administering the patent. The following major group: Electrical Machinery, Equipment and Supplies and its subgroups are included:

36-11 Wiring devices and supplies.
36-12 Carbon and graphite products for use in the electrical industry.
36-13 Instruments for indicating, measuring, and recording electrical quantities and characteristics.
36-14 Motors, generators, and motor-generator sets.
36-15 Power and distribution transformers.
36-16 Switchgear, switchboard apparatus, and industrial controls.
36-17 Electrical welding apparatus.
36-19 Electrical equipment for industrial use, not elsewhere classified.
36-21 Electrical appliances.
36-31 Insulated wire and cable.
36-41 Electrical equipment for motor vehicles, aircraft, and railway locomotives and cars.
36-51 Electric lamps.
36-61 Radios, radio and television equipment, and phonographs.
36-62 Radio tubes.
36-64 Telephone and telegraph equipment.
36-69 Communication equipment.
36-91 Storage batteries.
36-92 Primary batteries.
36-93 X-ray and therapeutic apparatus and non-radio electronic tubes.

10. U.S. DEPARTMENT OF COMMERCE. GOVERNMENT PATENTS BOARD
4300 Government-owned Inventions Available for License. Patent Abstract Series No. 1: Instrumentation. Washington 25, D.C., U.S. Dept. of Commerce, Small Business Administration, P.B. 11464. (Lists 775 Government-owned inventions available for license applicable to the instrumentation industry, covered by patents active as of December 31, 1953. Inventions are divided into eight groups:

1) Laboratory, scientific, and engineering instrument.
2) Instruments for indicating, measuring, and recording electrical quantities and characteristics.
3) Mechanical measuring and controlling instruments.

4) Optical instruments and lenses.
5) Surgical and medical instruments.
6) X-ray and therapeutic apparatus.
7) Surgical and orthopedic appliances and supplies.
8) Photographic equipment and supplies.

11. U.S. DEPARTMENT OF COMMERCE. GOVERNMENT PATENTS BOARD
4300 Government-owned Inventions Available for License. Patent Abstract Series No. 5; Electrical and Electronic Apparatus. Washington 25, D.C. U.S. Dept. of Commerce, Small Business Administration, P.B. 11468. (Includes 1915 abstracts of govt-owned patented inventions in the electrical and electronic field and a list of govt. agencies which administer the patents. The inventions are classified as to industrial use in the following groups: Wiring devices and supplies; measuring instruments; particle accelerators; motors and generators; controls and switches; heating and welding apparatus; electric lamps; radio and related object locating and navigation apparatus; tubes; computing apparatus; telephone and telegraph equipment; batteries; X-ray apparatus; and miscellaneous electrical equipment.

12. U. S. NATIONAL BUREAU OF STANDARDS
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Germaniu

GERMANIUM power rectifiers, at a cost com petitive with dry rectifiers commonly used i TV receivers, offer a practical means of improvin reliability of TV power supplies. The low cost o these rectifiers also makes them desirable for othe power supply circuits.

Specially developed and designed for televisio receiver use by General Electric, Semiconducto Products, Syracuse, N.Y., the rectifier should outla the TV set. At the present time, approximately 2 per cent of all television problems result from rect fier failure. Unlike selenium rectifiers, no deratin is necessary because of aging effects. Germaniu allows full rated performance over the entire life o the rectifier. The very low forward voltage dro provides a higher d-c output than any other typ of rectifier. Output from a 1N575 germanium rec fier is compared with that from a typical seleniu rectifier in the accompanying graph.

In keeping with automatic assembly trends, th rectifier, with its heat sink, has a mechanical "sna in" type construction. Maximum ambient temper ture is 55 C.

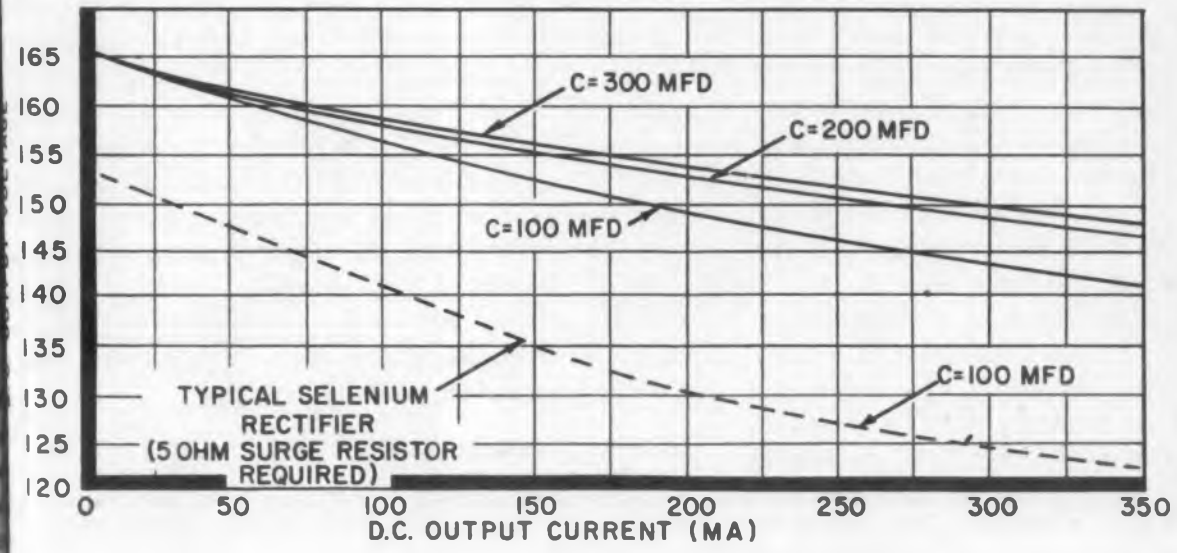
The three rectifiers now available are RETM type designated 1N573, 1N575 and 1N581. Th 1N573 is a half wave rectifier capable of 250 ma d output. The 1N575 is also a half wave rectifier b is designed for 350 ma d-c output. Type 1N581 co sists of two germanium rectifiers connected in voltage doubler configuration and has a d-c outp rating of 250 ma.

Rectifier for TV

Germanium rectifier mounted on "snap-in" heat sink assembly. Photo is approximately twice actual size.

Full load voltage drop for the 1N573 [illegible] v maximum; for the 1N575, 0.30 v, and for the 1N581 0.15 v each section. Maximum peak inverse voltage rating for the three rectifier types is 380 [illegible] Recommended load capacitor for all three types is 100 to 300 μfd.

For further information on this germanium rectifier, fill out the Reader's Service Card and circle **20.**



TYPICAL VOLTAGE REGULATION CURVES
IN575 GERMANIUM RECTIFIER
HALF WAVE — CAPACITIVE LOAD

Vibration Tube Testing

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THE study and treatment of microphonic noise in subminiature receiving tubes requires quite specialized testing techniques, both in simulating expected mechanical vibration environment and in observing the resulting effects on electronic behavior of the tube. As in all phases of electronic development, the amount of engineering time and cost involved depends very much on the effectiveness of the test methods and equipment. This article describes the methods that were used in a specialized program of microphonics study in which it was particularly necessary to develop vibration test methods which were accurate and fast.

Four Steps in Microphonic Tests

There are generally four basic steps in reducing tube microphonics in vibration testing:

1. Create the mechanical vibration. Apply external vibration forces which represent possible external excitation in the critical audio range from 100 to 10,000 cps.

2. Observe microphonics during vibration. Determine accurately the magnitude of tube noise voltage and the corresponding exciting frequencies for all mechanical resonances occurring in the tube.

3. Locate each source of tube resonance. Filament, anode, grid side rods, and other components may be producing one or more resonant peaks.

4. Reduce the effects of resonance. Mechanical changes in the tube design can either raise the resonant frequency of a component above the audio range or damp the resonant magnitude.

Usual practices for locating and reducing tube resonances in Steps 3 and 4 will be briefly summarized later in the article. The same techniques are used no matter how vibration is created or how the noise is observed in Steps 1 and 2.

Creating the Mechanical Vibration

In the series of tests described herein, mechanical vibrations were created with an electrodynamic vibration exciter, in which the frequency and acceleration of specimen motion were controlled at the power source by varying the input current to an exciter driver coil. Three power sources were used; (1) a manually-controlled single-frequency source; (2) a random-noise source; and (3) an analyzer-controlled swept-frequency source. The test equipment (Fig. 1) includes all the elements required to create vibration and observe tube noise in using each of the three sources.

Tube specimens were mounted in a rapid-loading tube carriage device on the table of the exciter (closeup in Fig. 2). The Model C7 electrodynamic vibration exciter used was made by the MB Manufacturing Company, New Haven, Conn., and developed by MB in cooperation with Raytheon and the Diamond Ordnance Fuze Laboratories, Washington, D. C. The manufacturer rates the exciter for a continuous-duty force output of 1.20 lbs, a total displacement of 0.025 in., and less than 5% distortion of table acceleration waveform in the test frequency range from 100 to 10,000 cps.

In Fig. 3, an operator has placed a tube specimen in the test fixture and is sliding it into position on the exciter in preparation for a vibration test.

With the manually-controlled single-frequency source, the driver coil of the vibration exciter was energized with the sinusoidal output of an audio signal generator (Fig. 1). The random-noise source was a gas-tube generator, with a bandwidth maintained between 100 and 10,000 cps. A high-gain amplifier on the output of the random-noise generator provided sufficient current in the driver coil to develop an average table acceleration of 10 g. With the analyzer-controlled swept-frequency source, an audio spectrum analyzer (left in Fig. 2) provided a sinusoidal swept-frequency output synchronized with the response frequency of the trace on the analyzer's oscillograph. As the analyzer swept the test frequency range from 40 to 10,000 cps, the specimen tube under test was vibrated at any instant by only one frequency of sinusoidal vibration rather than by a random band as with the random-noise source.

Observing the Electrical Noise

The occurrence of microphonics during the test was usually observed on the oscillograph of the audio spectrum analyzer. The vertical position of the trace represented the instantaneous magnitude of plate noise. As shown in Fig. 4, the face of the oscillograph

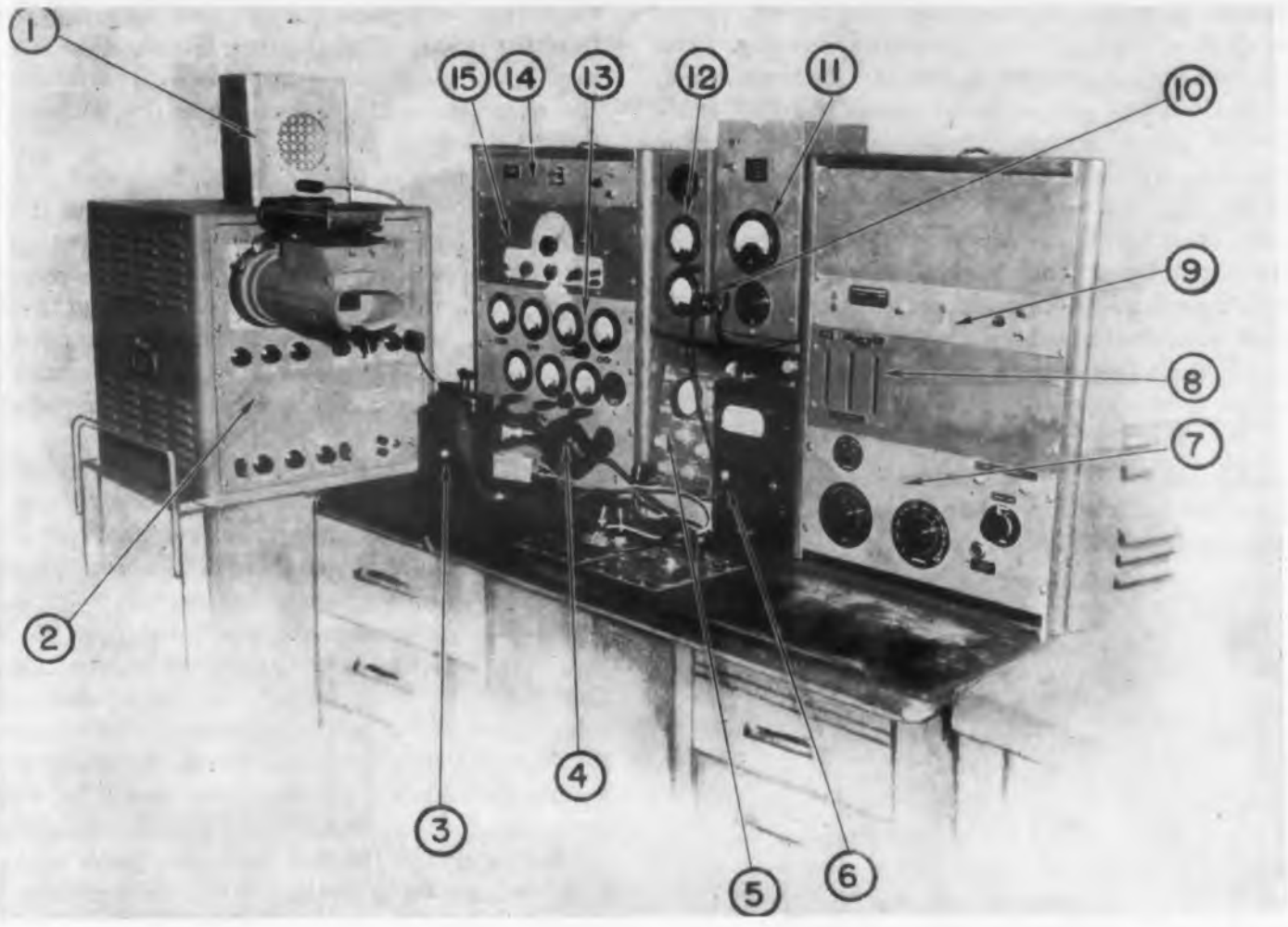


Fig. 1. Tube vibration testing facilities at Raytheon. Keyed items are: (1) speaker for listening to tube noises; (2) audio spectrum analyzer with camera; (3) vibrator; (4) tube under test, circuit, and special noise-free socket; (5) oscilloscope for observing tube instantaneous noise; (6) general-purpose a-c vtvm; (7) control panel, including built-in calibration signals; (8) impulse counters to record occurrence of noise peaks above preset levels; (9) high-gain amplifier for noise signal; (10) vibrator voice-coil current; (11) rms thermal meter for measuring tube noise level; (12) vibrator field supply and control; (13) power supplies for tube under test; (14) random noise source; (15) audio signal generator for driving vibrator with sine wave.

Fig. 2. Closeup of the vibration exciter shows the tube envelope secured in a block on the exciter table.

Fig. 3. An operator is sliding a subminiature tube into the exciter block in preparation for a vibration test. Tube leads are held in a clamping device which connects the tube to its operating circuit during test.

was calibrated linearly on the ordinate in millivolts rms and logarithmically on the abscissa in cycles from 40 to 20,000 cps. The Panoramic spectrum analyzer (Fig. 1) can sweep the frequency range in one second. With a long-persistence oscillograph screen, a plot of tube noise as a function of sweep frequency provided a graphic record of the microphonics behavior of the tube under test.

The test facility shown in Fig. 1 also included other means for finding resonances. A speaker was provided (upper left) to permit the test engineer to listen for tube rattles in the low-frequency range. A standard oscilloscope indicated the instantaneous noise output of the specimen, an rms thermal meter measured tube noise level, and impulse counters were available to record noise peaks above pre-set levels.

Manually-Controlled Single-Frequency Source

The manually-controlled single-frequency source is the slowest and most laborious of the three methods described, but it is most useful in sweeping very narrow frequency ranges and in studying vibration responses very near known resonant peaks. Manual control of the signal generator is common practice in studying microphonics of receiving tubes and any other mechanical and electronic devices in which neither the frequency range nor the number of specimens tested are as large as in the studies performed here.

The plate noise output of a tube specimen is most frequently detected in manual operation as an instantaneous trace on the standard oscilloscope or, if the shape of a resonant peak must be studied, on the calibrated oscillograph of a spectrum analyzer.

Random-Noise Source

While all existing mechanical resonances in a tube are excited simultaneously with a random-noise source, each is easily distinguished on the oscillograph of a spectrum analyzer. A random-noise source permits a much faster test than the manually-controlled single-frequency source and is therefore preferred wherever possible.

It is possible that an oscillograph trace may be too fuzzy for proper interpretation. Because the energy input from the random-noise source is not constant at any given frequency in the sweep range, the traces produced in successive sweeps are not identical. The amplitude of a particular resonant peak will be different on successive sweeps (as the energy input in the vicinity of frequency changes). In such cases, it is necessary to average out the observed peak magnitudes in order to determine noise level. As shown in Fig. 4, the random-noise source used in the tests described here resulted in a good deal of low-magnitude fuzz in the vicinity of resonances and particularly in the "rattle" region below 100 cps. For this reason, manually-controlled single-frequency testing was frequently used for closer investigation of resonances detected in random-noise tests.

Analyzer-Controlled Swept-Frequency Source

Because it retains the advantages and avoids the disadvantages of a random-noise source, the analyzer-controlled swept-frequency source was extensively used in this program. In such a test, tube resonances occur sequentially rather than simultaneously, as both the table motion of the vibration exciter and the analyzer trace sweep in synchronization from 40 to 10,000 cps. Since the pattern of energy input to the tube specimen is identical throughout each one-second sweep of the analyzer, the traces overlap each other with the analyzer-controlled swept-frequency source. A sharp and steady picture is then produced, with each resonance represented by only one trace peak.

There are commercial spectrum analyzers available which are capable of sweep times as high as three minutes. However, it was found that the one-second sweep time obtained with the analyzer in Fig. 1 was sufficient for the program described. Of course, it may be possible that a one-second sweep duration is too short to permit complete build-up of resonances at lower frequencies in certain cases. A sweep that is too fast may be observed as a cluster of several resonant peaks of reduced amplitude at various frequencies above and below the actual resonant peak. These peaks represent partial build-ups to resonance of different degrees. In such rare cases, the manually-controlled single-frequency source may be used.

Locating the Sources of Tube Microphonics

It is often possible to determine the sources of tube resonances simply by interpreting an oscillograph trace on a spectrum analyzer in terms of relative magnitude, sharpness (or Q), and frequency of the resonant peaks. When further investigation is necessary, a damping probe may be used with an open specimen to isolate resonating tube elements, as further described below.

In filament-type tubes (Fig. 5) the major and most obvious resonance is usually in the filament. It is distinguished by a comparatively large amplitude and a very sharp resonant peak (high Q). The distinctive high Q of filament resonance may also be detected by tapping the tube lightly with a mallet and listening for a high ring. In a cathode-type subminiature tube (Fig. 6), there is no such outstanding source of resonance as the filament.

Other than in the filament, mechanical resonances are most frequently found in grid side rods and in the anode or anode supports. The resonant frequencies of the grid winding wires are well above the range of interest in microphonics studies.

Non-filament resonances usually can only be definitely pinpointed by removing the tube envelope and applying a damping probe. The open subminiature tube is operated as a condenser microphone in such a test, with a voltage placed between two electrodes at a time through a very high resistance. The voltage across the load resistance is then proportional to the relative motion of the two electrodes under study.

In the Raytheon tests, the damping probe was pressed against a particular tube component and the trace observed to determine whether the resonant peak had been lost, reduced, or shifted to another frequency. If so, it was evident that the component being damped was the cause of, or was contributing to, the resonant condition. In investigating anode resonance, it may become necessary to apply the damping probe at a number of points on the surface in order to detect local modes of vibration.

Resonance occurring in the grid side rods is not usually due to flexing of the rods, but rather motion of the entire rod, in the support holes of the two mica spacers. The nature of this type of resonance is often that of a rattle, having a low Q and low frequency (usually from 100 to 3000 cps).

It is possible to calculate roughly the approximate resonant frequency of some modes of grid side rod vibration, knowing the material and dimensions. However, because of the complex nature of resonance in the plate, it has been found that the damping probe technique is the only practicable approach.

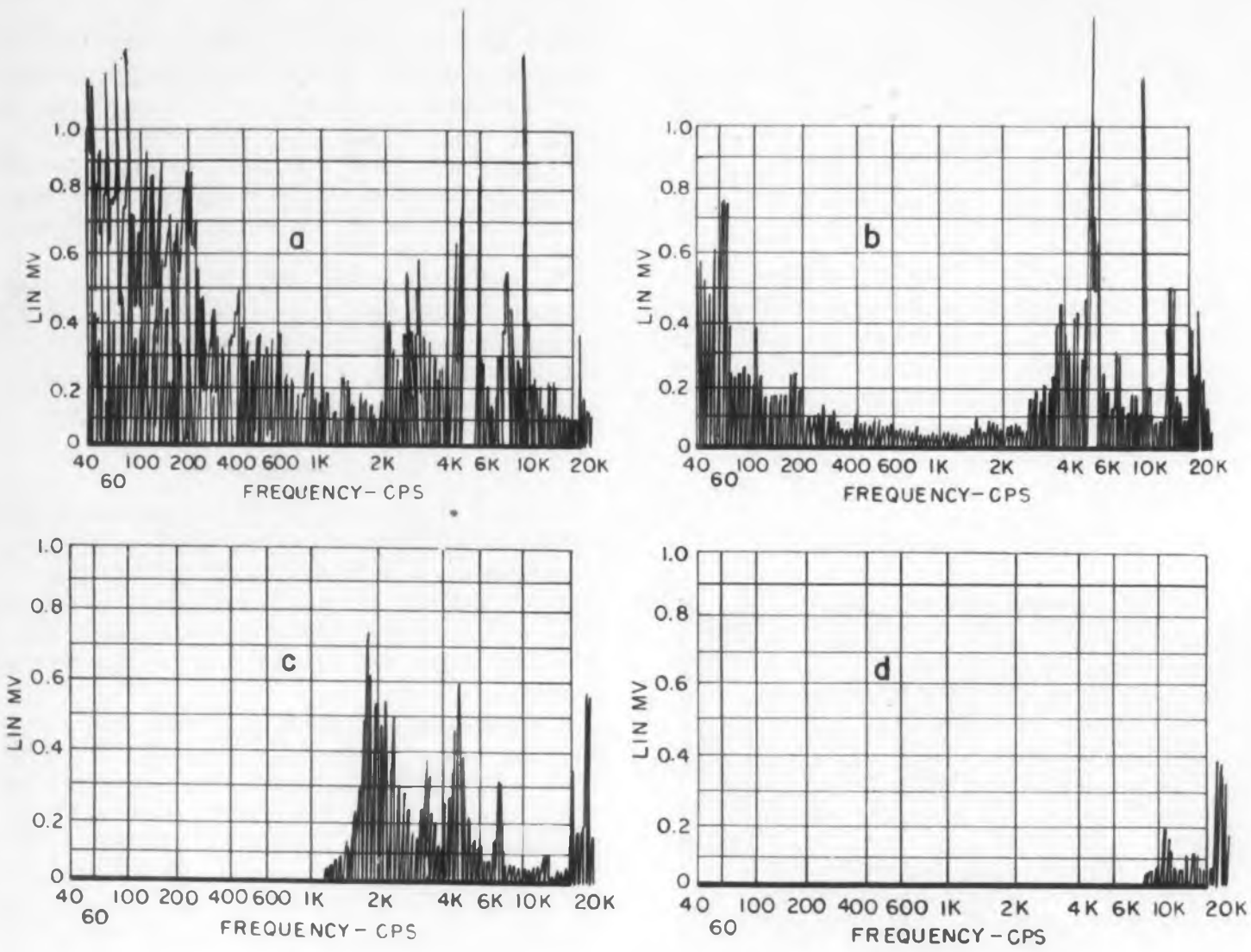


Fig. 4. Tube noise spectrum curves obtained with the test setup in Fig. 1. Tests on two samples of a filament-type tube are shown at (a) and (b). Note the improvement at (c) for a cathode-type tube where normal attention was given to microphonics. The still improved noise factor at (d) is for the specially developed low-microphonic Raytheon tube, Type CK6533. The ordinate is calibrated linearly at 5 mv full scale in each test. A random-noise source was used to produce a constant acceleration level of 10 g in a frequency band from 100 to 10,000 cps. The resonance peaks which rise above the calibrated area have gone off the oscillograph screen and are actually much higher.

Typical Traces in Vibration Studies

In Fig. 4a and Fig. 4b, two specimens of a filament type tube each show extreme microphonics at about 5000 cps. These noise peaks were caused by resonance of filament strands. Apart from that one response, it is evident from the graphs that one specimen was much more microphonic than the other.

The traces in Fig. 4c and Fig. 4d represent tests made on two cathode-type triodes. The tube in Fig. 4c was designed with only normal emphasis on lo

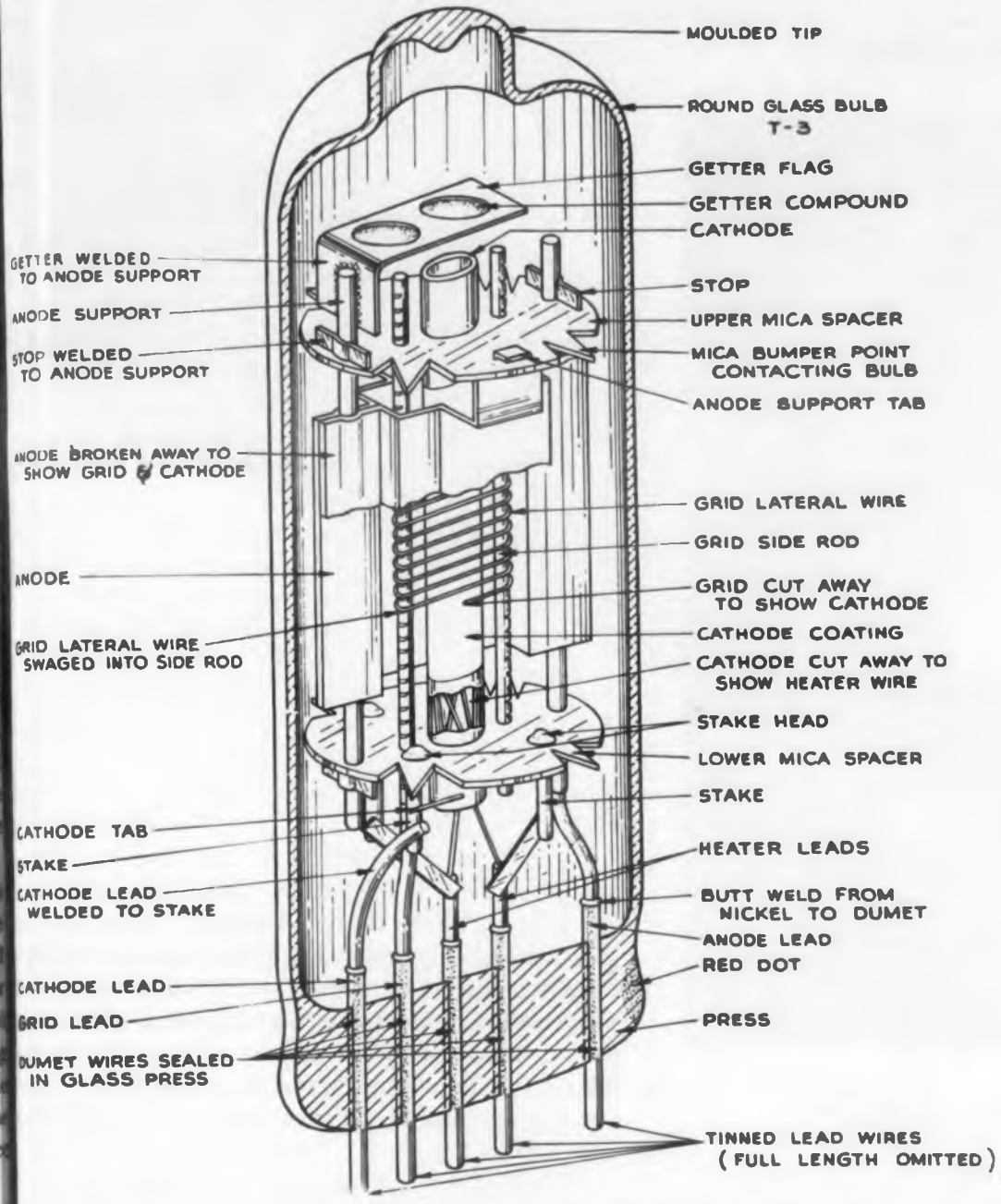


Fig. 5. Cross-section of Raytheon's filament-type CK5672 flat hearing aid tube. The major source of microphonics is resonance of the filament strand between the upper and lower mica spacers. Motion of the grid side rods and resonances in the plate structure may also produce plate noise.

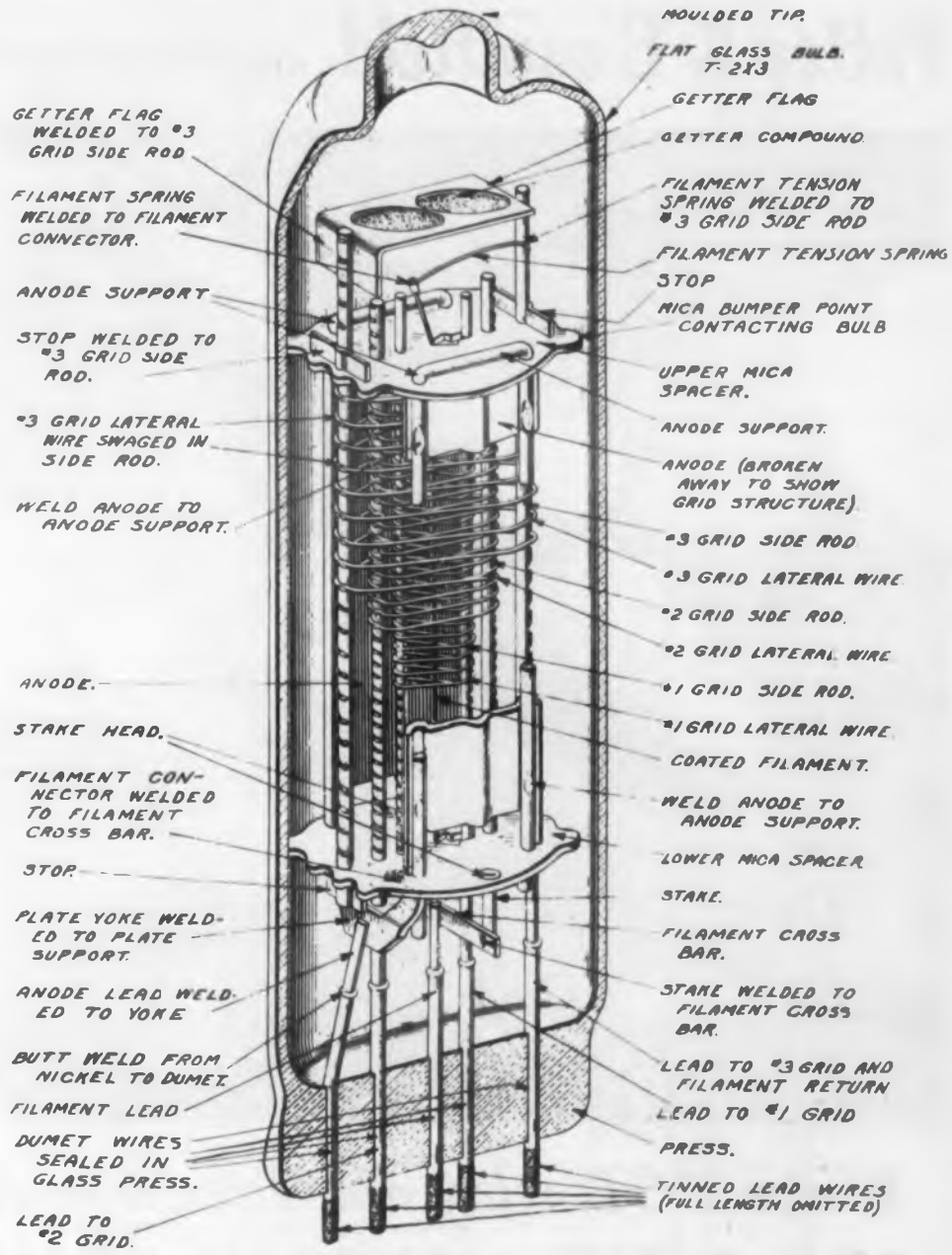


Fig. 6. Cross-section of Raytheon's cathode-type CK5703 subminiature triode. Resonances may occur in the grid side rods or plate structure. Cathode-type tubes inherently exhibit lower microphonics than the filament-type (see Fig. 4) because filament resonance is not present.

icrophonics. Note the successive resonant peaks at bout 2000, 3000, 5000 and 7500 cps exciting fre-uencies. The *CK6533* tube in Fig. 4d, on the other nd, has been developed by Raytheon for exception-lly low microphonics. With the vertical scale cali-ated linearly at 5.0 millivolts full scale throughout e tests recorded in Fig. 4, the relative superiority the *CK6533* is evident.

Eliminating Excessive Tube Resonances

There are two possible approaches for eliminating desirable resonances. The natural frequency of tube component may be raised above the audio nge or the peak amplitude may be reduced by wering the Q.

Since it is not practical in most applications to at-mpt to damp the filament strand in a filament-type ce ving tube, the natural frequency of the filament is always designed to be as high as possible, consistent with burnout life. In Fig. 5, the filament is stretched tightly between the filament cross bar under the lower mica spacer and the filament tension spring above the upper mica spacer. The natural frequency of the filament strand between these two points is raised by tightening the strand.

The filament is tightened by using a stronger filament tension spring, which may be a cantilever type (as in Fig. 5) or a helical coil type. In the last 10 years, receiving-tube manufacturers have changed from oxide-coated nickel filaments to oxide-coated tungsten filaments on most tubes because tungsten wire can be stretched more tightly without breaking. Because the filaments may therefore be more taut, tungsten-filament tubes generally have much lower microphonics. However, certain low-cost miniature tubes still include nickel filaments because they are more efficient emitters, and yet adequate in microphonics.

Grid noise is usually due to vibratory motion of the entire grid side rod rather than resonance; therefore, microphonic output that is traced to the grid side rods may be reduced by anchoring the grid side rod to the upper and lower mica spacers more firmly. This may be accomplished by special straps, welded to the grid and firmly anchored in the spacer by suitable design. In designing anode structure to reduce plate microphonics, the requirement again is to keep the natural frequencies of the anode high enough to avoid the signal frequency range used in the application. To raise its natural frequency, an anode can be made stiffer either by reducing its length or by changing its shape in some manner. The amplitude of resonant peaks in an anode are most effectively damped by proper design of the anode supports and mica spacers.

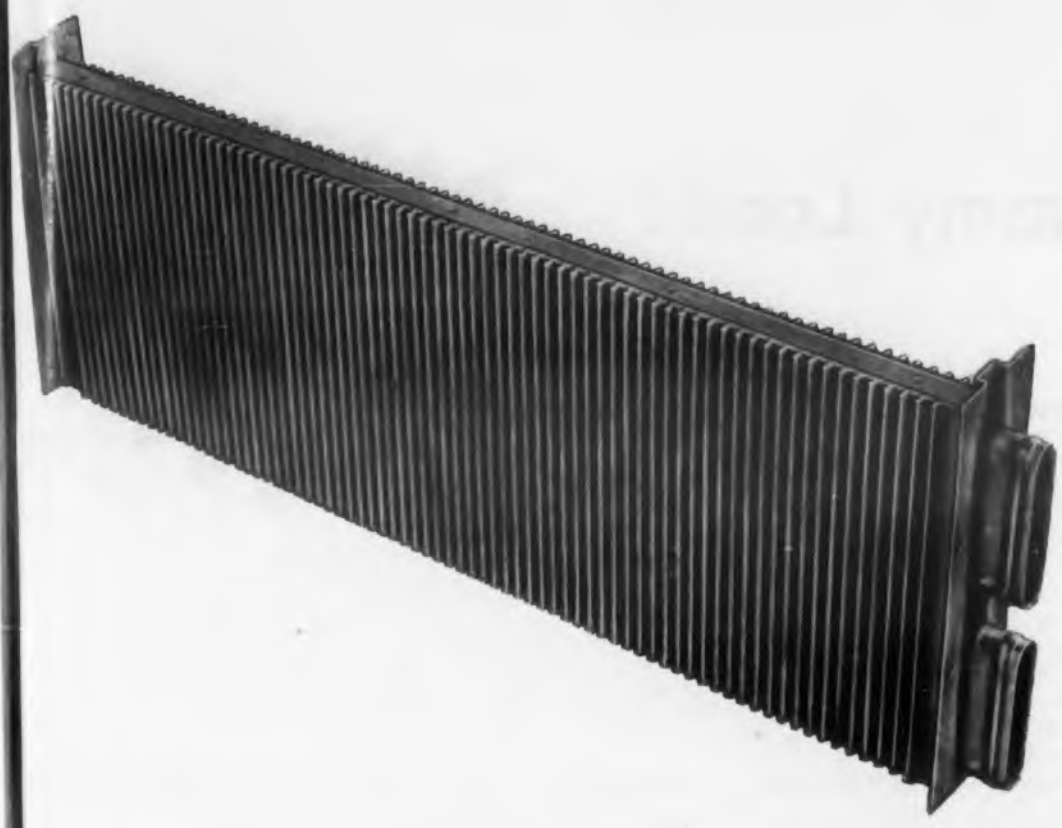
Printed Circuit Heat Exchanger

THIS specially designed air-flow heat transfer unit provides an efficient means for cooling a number of printed wiring boards mounted in close proximity. The heat exchanger, built into the case shown, has accurately machined grooves to correspond with similar grooves in the case. Thus accurate alignment of the printed wiring assemblies is assured.

Although this air-flow heat exchanger was developed specifically for an application at North American Aviation, Inc., it is being made available commercially by United Aircraft Products, Inc., 1116 Bolander Avenue, Dayton 1, Ohio. It can be furnished, not only in the size standardized by NAA but in accordance with a designer's specific requirements.

Termed a "cold-plate heat exchanger," the unit shown has a dry weight of 2-1/2 lbs and is built into a case approx. 18 x 9 x 6 in. It meets requirements of MIL-E-5400 and MIL-E-5272. The grooves, which receive the printed wiring boards, are machined spaced 0.062 in. +0.005 −0.000 in. tolerance. Air flow required is 2 lb per min at a pressure of 1 lb per sq ft. Maximum airside mean temperature difference is 7 F; minimum heat removal capacity at 150 w is 8-1/2 btu per min. It will perform at an ambient temperature up to 160 F at altitudes to 50,000 ft and above.

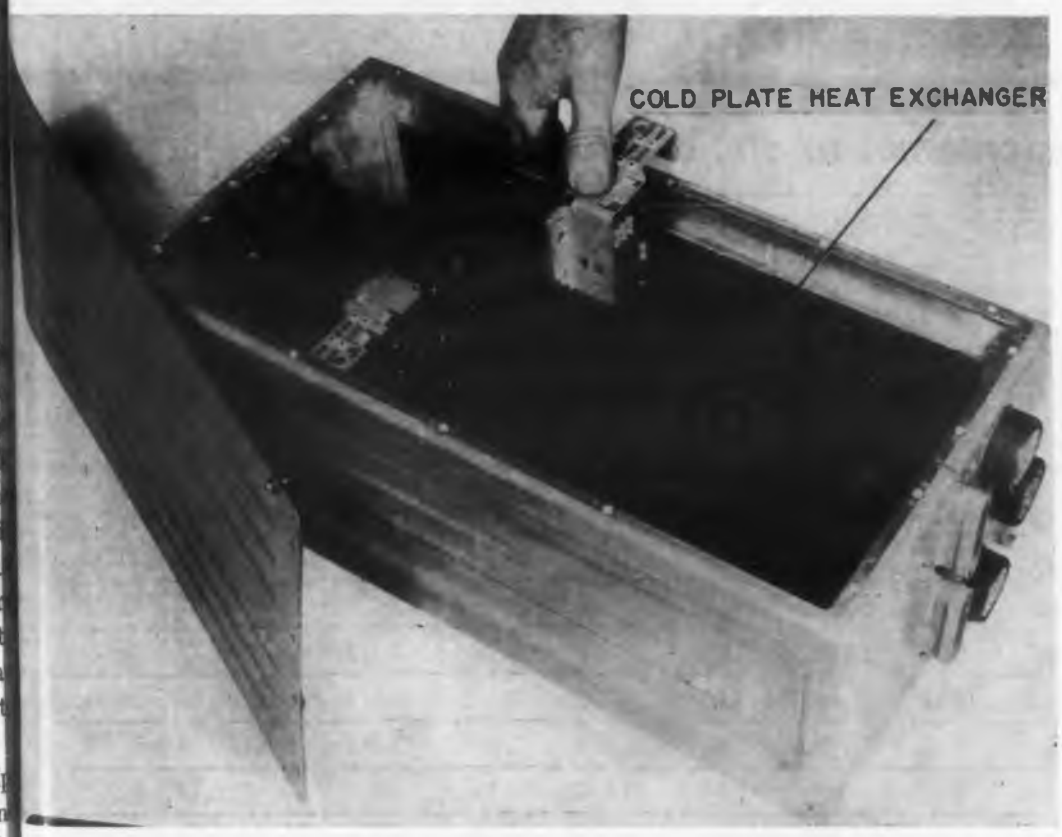
The cold-plate assembly is of aluminum, dip brazed; then black anodized after assembly and machining. The printed circuit shells may be installed in solid banks along either or both sides of the cold plate exchanger with minimum clear-



nce between shells, or they may be inserted at ndom within the case.

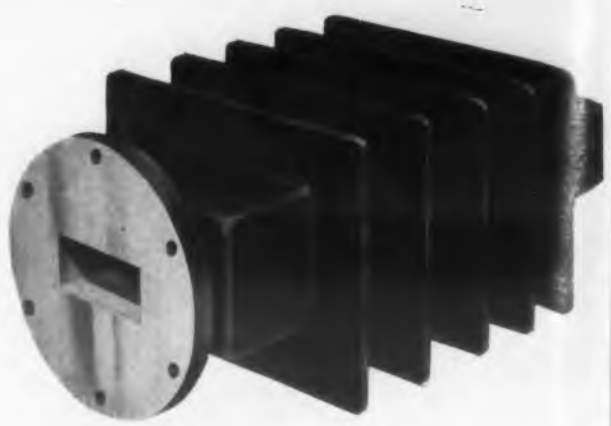
In addition to providing a compact printed circuit ssembly, efficiently cooled, this arrangement fa- ilitates maintenance of the printed circuit boards.

For additional information about this product, ll out the Reader's Service Card and circle No. 23.



Printed wiring housing designed for efficient cooling using UAP cold-plate heat exchanger. Design is one developed by Autonetics Div. of North American Aviation, Inc.

Military Standardization of Dummy Loads



Leon Field and Arthur C. Metzger
Frankford Arsenal

INCREASING power output of radar systems and the need for lighter, more rugged components for military applications, have obsoleted the old lossy wall-high type dummy loads. Dummy loads made of, for example, Portland cement and graphite as the lossy material have too many thermal, electrical, and mechanical disadvantages. Each load has a limited microwave frequency range over which it provides a satisfactory match to the waveguide. In the past, each time a requirement for dummy loads came up, a special design was worked up. No standardization, coupled with the fact that the loads were not very suitable, made the need for improvement obvious. This article is a report on the process of establishing a military standard.

Problems

Thermal—The basic thermal problem in dummy load design is to adequately transfer the generated heat in the lossy material to the surrounding air. This heat transfer is principally due to convection and conduction. The heat is carried from the lossy material to the metal housing by conduction and to the surrounding air from the housing by convection at temperatures up to approximately 200 C. At higher temperatures, both convection and radiation effect this transfer. The conversion from electrical energy to heat energy is made entirely in the lossy material; therefore, the most efficient transfer of heat would take place if a large temperature differential and a low thermal impedance existed between the lossy material and the ambient air. The lossy material in the older Portland cement type loads have very poor inherent conductivity; this molded material tends to shrink with age and will pull away from the inner surface of the housing, thus introducing air gaps and

As a result of a new standardization and simplification program for high-powered dummy loads, the number of government-approved units has been reduced from 54 to 9. The table in the article shows the nine standardized units. A typical unit is illustrated. Despite the desirability of standardization, problems to overcome are many and often apparently insurmountable. We hope this factual success story will give encouragement to others concerned with establishing standards.

MILITARY CHARACTERISTICS OF STANDARDIZED DUMMY LOADS

AN NOMENCLATURE	ORD. DRG. NR.	FREQ. RANGE (KMC/S)	MAX. PEAK POWER (MEGAWATTS)	MINIMUM AV. POWER (WATTS)	MAXIMUM VSWR	LENGTH (IN.)	WIDTH (IN.)	HEIGHT (IN.)	APPROX. WEIGHT (LBS.)	WAVEGUIDE AN TYPE	BAND
DA-147/U	C8212205	1.12- 1.70	17.2	8000	1.10	32-71/8	8-7/8	11-1/2	90	RG-103/U	L
DA-145/U	C8212204	2.60- 3.95	3.2	4500	1.10	14	4-7/8	6-3/8	9-1/2	RG-75/U	S
DA-149/U	C8212208	3.95- 5.85	2.0	2000	1.10	9-3/4	3-5/8	4-1/8	5	RG-95/U	H
DA-144/U	C8212207	5.85- 8.20	0.71	1000	1.10	8	3-1/8	3-7/8	3-1/4	RG-106/U	C
DA-148/U	C8212206	7.05-10	0.46	600	1.10	6-3/8	2-1/2	3-1/8	1-3/4	RG-68/U	B
DA-146/U	C8242917	8.2 -12.4	0.29	500	1.10	5-3/4	2-3/4	2-3/4	1-1/2	RG-67/U	X
DA-159/U	C8227529	12.4 -18.0	0.16	250	1.15	4-1/4	2-1/2	2-1/2	1/2	RG-107/U	Ku
DA-160/U	C8227532	18.0 -26.5	0.125	150	1.15	4-1/4	2-1/4	2-1/4	3/8	RG-121/U	K
DA-158/U	C8227526	26.5 -40.0	0.075	75	1.15	4-3/16	2-3/16	2-3/16	3/8	RG-96/U	Ka

Typical very high power dummy load. The lossy material is a ceramic substance rather than one composed of the more conventional plaster of Paris or graphite in sand. The ceramic approach offers the decided advantages of no moisture absorption and no deleterious effects due to high temperature. There is no binder to disintegrate and temperatures of 3000 F will not destroy the lossy material of the load.

decreasing heat transfer.

Electrical—The older type loads also have a tendency to create voltage breakdown across the waveguide as a result of either chemical changes in the lossy material or by the inherent nature of the material. The compounds themselves will normally have exceedingly high temperature stability; but secondary reactions, such as loss of water of crystallization or loss of absorbed moisture, cause high humidity conditions within the waveguide, influencing voltage breakdown. If extremely high temperatures are placed on certain loading materials, bonding agents will be destroyed and resistive qualities will disappear.

Mechanical—Another problem encountered is the appearance of surface imperfections in the lossy material as a result of forming. These imperfections in the dissipative material may cause field concentrations and eventual breakdown.

Facing the Problem

The military had long been aware of these deficiencies in existing loads. Several programs had been initiated for the development of a high-power dummy load which was compact, lightweight, resistant to moisture absorption, and which would last for the life of the associated transmitting equipment.

During the period from January 1954 to January 1955, the Bureau of Ships surveyed the dummy load field and issued a report whose purpose was:

- To consolidate all the information available concerning waveguide and coaxial dummy loads which have been designed for and used by the three Services. This information was to be put into a form which could be made available to all interested personnel for use as a guide in the procurement of dummy loads for new equipment and for replacement purposes.
- To establish a list of dummy loads which, depending upon electrical and mechanical characteristics,

would represent the preferred items. These loads were to be the best available and have general application.

From the approximately one hundred loads tabulated, twenty were selected as preferred types. It was estimated that an equal number of loads had not been tabulated for two reasons. Many loads were designed for a specific purpose or as an integral part of a system and as a result had never been submitted for nomenclature and designation. Also, the nomenclature prefixes for dummy loads had changed over the years and, therefore, prefix letters other than "TS" and "DA" had not been checked in the survey.

This list was presented to the Miscellaneous Test Equipment Working Group of the Joint Test Equipment Subpanel (J/TE) of the Standardization Panel of the Joint Communications Electronics Committee (JCEC) for consideration. In view of the work that was currently being done in this field by the Frankford Arsenal, Ordnance Corps, the J/TE assigned the standardization of dummy loads to this group in January 1956.

History of Frankford's Action

In an attempt to obtain a suitable high-power dummy load during the latter part of 1949 for a particular radar application, Frankford Arsenal was advised by both the Signal Corps and the Air Force that none was available; in fact, one dummy load type tentatively selected as a possible choice was found to be optimistically rated and had to be derated far below the required application. Consequently, Frankford Arsenal contacted various commercial suppliers in order to find a suitable load but met with little success. A development contract (DA-36-038-ORD-15179) was placed with the Bogart Manufacturing Co., Brooklyn, N. Y., for the design of a high power load for a specific fire-control radar application. The specifications for the load included the following:

1. ***Weight***—The load should be lighter than existing loads at specified maximum average power and ambient temperature ratings.
2. ***Size***—The load should be small enough to comfortably fit in a system allowing sufficient room for radiation of heat. (Compactness is necessary for aircraft application or ordnance fire control systems where it is now being considered for use in association with switching devices.)
3. ***Operating temperature***—The load should not exceed 300 C ambient temperature for use with ground systems.
4. ***Power rating***—The maximum average power requirements for classified systems or radar systems presently being conceived are not specifically known. The load should absorb more average power than other loads and still fulfill all other requirements.
5. ***Pressurization***—The load should be capable of being pressurized.
6. ***Voltage Standing Wave Ratio***—The load should maintain a VSWR less than 1.10 over the complete specified frequency range.

7. *Cooling*—The maximum average power ratings are those which produce the specified maximum operating temperature without external cooling (forced air or water).

8. *Flange*—The load shall be terminated in a plain type flange and attached to the system by different adaptors or wave-guide couplers.

This contract was terminated in July 1954 with the satisfactory testing of the sample load at the Bell Telephone Laboratories, Whippany, N.J. The tests proved beyond doubt that this dummy load was capable of absorbing all of the energy that could be emitted from the radar. In fact, the load was successfully tested to a power 30 percent greater than the anticipated output of the system then being produced.

The Bogart Manufacturing Co. developed a new ceramic-type lossy material resulting in a load which is smaller, cheaper and lighter in weight than any heretofore available. Subsequent testing of this dummy load at a Philco Corp. plant and at the Johnsville Naval Air Development Center conclusively proved that the load could easily accommodate the power of existing systems with indication that even higher power systems will be accommodated when they became available.

Frankford Arsenal submitted nine Military Characteristics for a new family of loads based on the Bogart development. This basic group of dummy loads can, with suitable adapters, readily replace many loads, both high and low power, now existing with their unique electrical requirements and mechanical configurations. Under the old concept of dummy load applications, both a high and low power type dummy load were established. It was assumed that weight, size and price differentiation between the two classes of loads would be great. However, the development of this new family of "high power" loads compares favorably in weight, size and cost of the "low power" loads and Frankford Arsenal has recommended that these become Standard for both applications.

Status

Listed are the nine Military Characteristics for the new family of loads submitted to J/TE by Frankford Arsenal. Based on this technical and standardization accomplishment, the Ordnance Corps has requested a subassignment under Federal Supply Classification 5985 for the Dummy Load area. A new specification has been promulgated which incorporates more stringent requirements than presently specified in MIL-D-5954, Dummies, Load, Electrical, Wave-guide. Military standards and associated implementing documents are also being prepared.

The Navy and the Air Force have indicated a keen interest in these basic loads and a program will be instituted to develop adapters to accommodate various flange terminations. It is anticipated that the bulk of the multitudinous load applications presently in use will be obsoleted by this single family of loads effecting a decrease in cost due to central procurement and simplifying the stocking problem.

Fig. 1. Automatic Interpolation dial in use on PRD Type 504 Heterodyne Frequency Meter.

Automatic Interpolation with Spiral-Scale Dials

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MEASURING instruments having non-linear characteristics, such as heterodyne frequency meters, have in the past been provided with linear dial scales which require that measurements be determined by making an interpolating computation. The dial described here[1] permits such interpolated measurements to be read directly without computation; the required interpolation being effected automatically by manipulation of the dial. The principle of operation, a discussion of the factors that affect applicability, and design equations are given in this article.

The Problem

The interpolation of readings on non-linear instruments becomes necessary when a single non-linear dial scale which would cover the entire range of the instrument becomes too long to be physically practicable, and a shorter scale must do service for several different portions of the instrument's range. For example, on the TS-186/U Frequency Meter (which is provided with a single turn scale and a turns counter) readings of an unknown frequency are taken by first noting the dial readings at two bracketing crystal-controlled frequencies, a and c, which are 5 mc apart, then noting the dial reading, b, at the unknown frequency and determining the known frequency by making the linear interpolation

$$fx - fa = \frac{fb - fa}{fc - fa} \times 5\ mc,$$

and adding this value to the known frequency measured at a. In this way, the same single-turn linear dial scale is made to serve over a hundred different frequency intervals on the instrument, each of which requires a scale of unique length. However, the advantage of being able to use a single short scale in this manner has the disadvantage of requiring the operator of the instrument to make an interpolation by calculation (or by looking-up recorded results of such interpolation in a book).

Scale Expansion and Compression

It is apparent that this disadvantage can only be overcome if a dial which was effectively extensible or compressible were available, for then the dial could be made to correspond to each different portion of the instrument's range. The dial mechanism incorporated in the PRD Type 504 Heterodyne Frequency Meter (Fig. 1) makes such expansion or contraction of scale length possible. The essential feature of this dial mechanism is a scale of spiral form operating relative to a moveable, rather than fixed index line. When the position of the index line is changed, the dial must be turned by a different amount in order to get the same readings. This, effectively is extension or compression of the dial scale.

In Fig. 2 and 3 is shown how changing the position of the index line effects such a scale expansion. In Fig. 2, the index line is in a radial position; that is, it lies in the same plane as the axis of rotation of the dial, and the dial must be turned through an angle of 260 deg to go from the "0" on the scale (as shown in solid line) to the "5" on the scale (as shown in the dashed line).

In Fig. 3, the index, which is mounted so that it can pivot, has been turned through a small angle, and no longer lies in a radial plane. The result is that the dial must now be turned through an angle of 287 deg to go from "0" to "5". Tilting the index has thus made the dial scale 27 deg or approximately 10 per cent longer. Tilting the index in the opposite direction makes the dial scale shorter. The greater the tilt angle o index, the greater the increase or decrease in length.

The reason that tilting the index line, lengthe shortens the dial scale is due to the fact that point on the scale is at a different distance from center of the dial. If the index is tilted too fa course, it will no longer intersect the spiral scale. T the angle of tilt allowable, and consequently, amount of expansion or contraction available is ited.

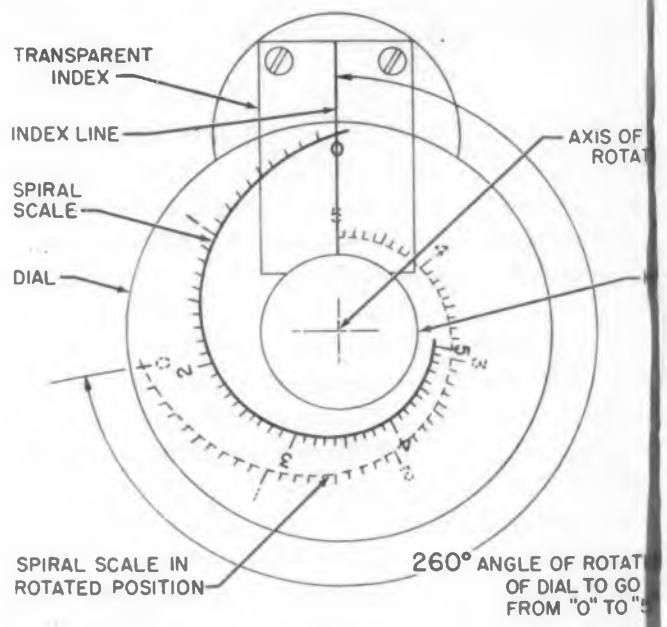


Fig. 2. Angular rotation of dial required to go from 0 to 5, when index line is in radial position.

*Now with The Hoover Company, North Canton, Ohio.
[1]Patent pending.

How The Dial Operates

When the non-linearity of an instrument is so great that one spiral scale cannot be expanded or contracted enough to fit all portions of the instrument's range, two or more spirals of different actual length can be used. It is for this reason that the PRD Type 504 Heterodyne Frequency Meter has two spiral scales. The outer spiral is generally used at the low frequencies and the inner spiral at the higher frequencies. The dial mechanism on this meter is operated in the manner shown in Fig. 4 in measuring an unknown frequency. The disk on which the dial scales appear is not fixedly attached to the control shaft but is coupled to it by a friction clutch. This permits the dial to be turned around, for zero-setting purposes, without holding the control shaft.

To provide a convenient means for holding the control shaft, a lock is provided which engages the larger disk in back of the dial. The disk is attached fixedly to the shaft, so that by clamping it, the shaft is held. The coarse indication of frequency appears in the rectangular window at the left of the dial. It should be noted that the pivot axis of the index is at the same distance from the dial center of rotation as is the "0" graduation on the spiral scale. This makes it possible to tilt the index to any position without affecting the zero setting of the dial.

Up to this point, the tacit implication has been made that points or graduations on the spiral scale which are equal angular distances apart relative to a radial position of the index will be equal angular distances apart relative to the index in a tilted position. To put it another way, any mark or graduation on the spiral, such as the "1" or "2" in Fig. 2, which is 1/5 or

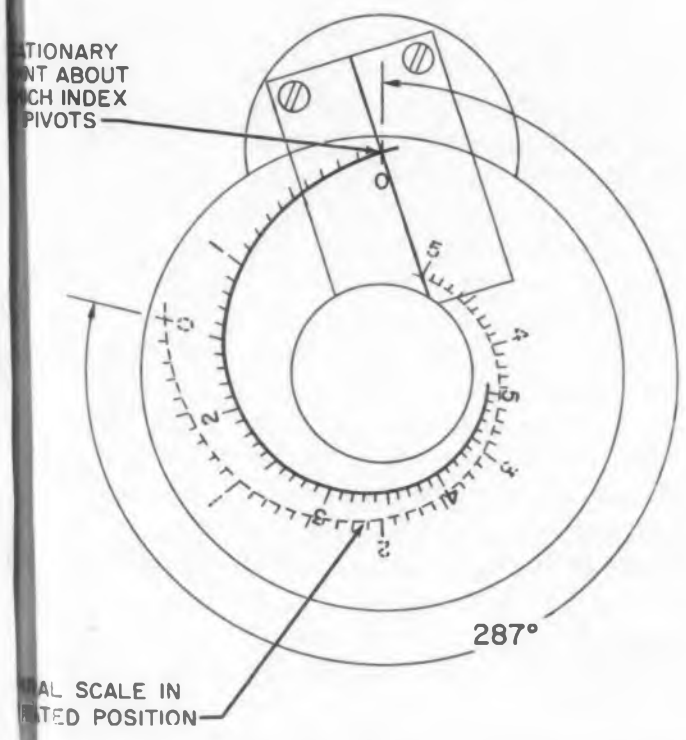


Fig. 3. Angular rotation of dial required to go from 0 to 5, when index line is in a tilted position.

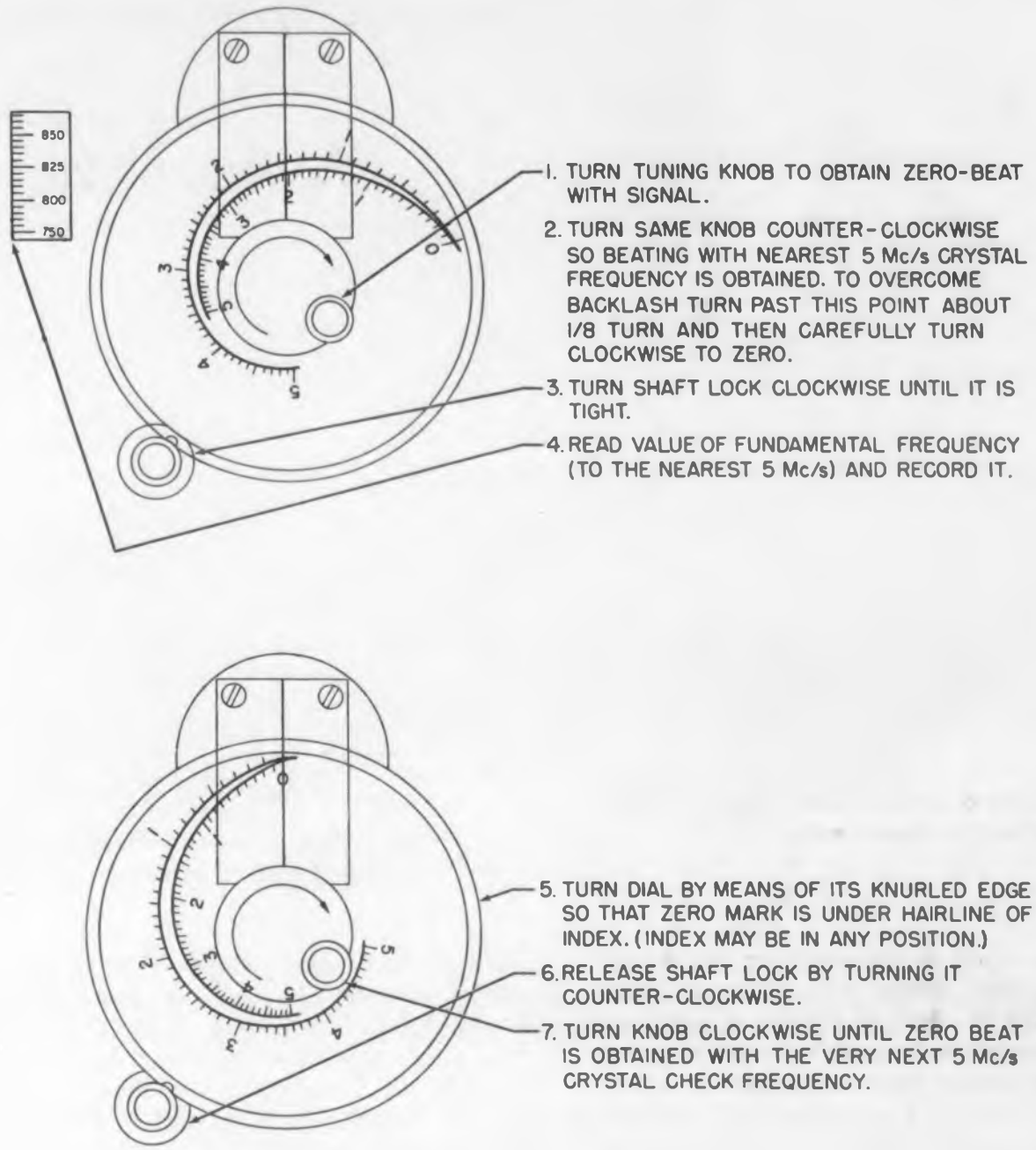


Fig. 4. Instructions for operating spiral-scale interpolating dial on PRD Type 504 frequency meter, to determine frequency of a signal.

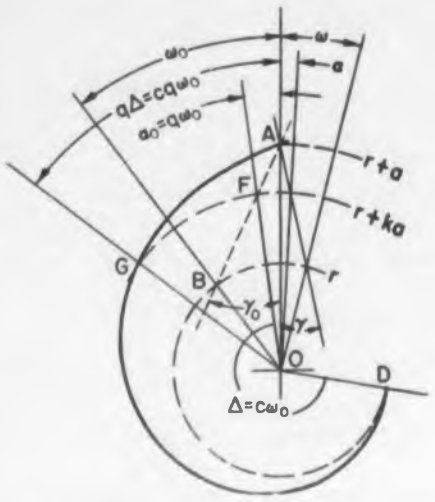


Fig. 5. Spiral of Archimedes dial scale.

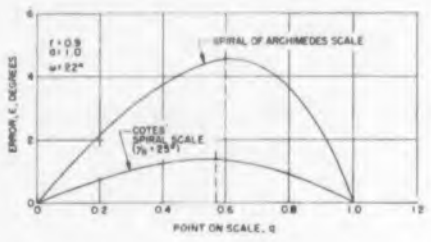


Fig. 6. Error of spiral scales as a function of location of point on scale, q.

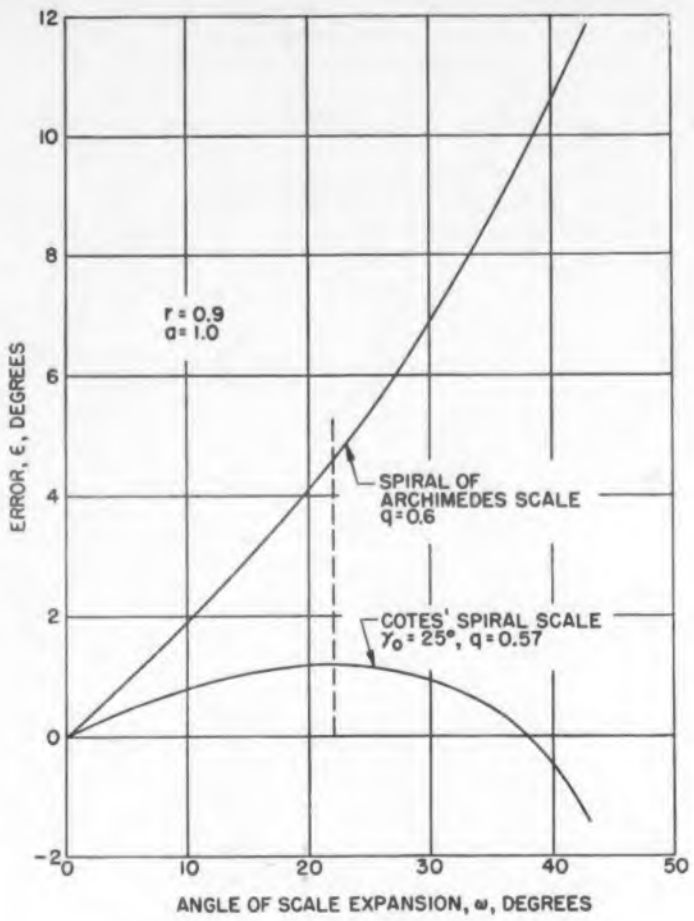


Fig. 7. Error of spiral scales as a function of angle of expansion, w.

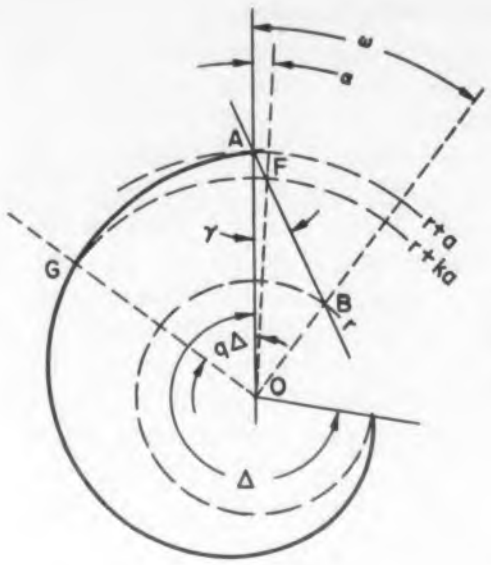


Fig. 8. Cotes' spiral dial scale.

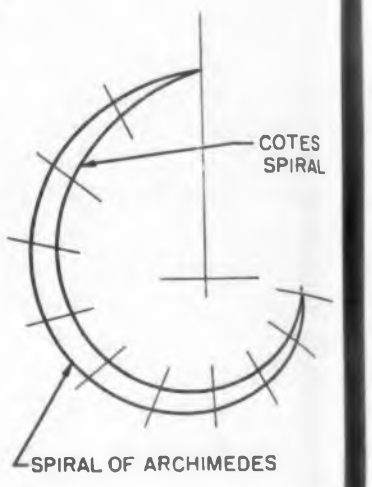


Fig. 9. Comparison of spirals.

2/5 of 260 deg around on the spiral should intersect the index in the tilted position of Fig. 3, when the dial is turned through 1/5 or 2/5 of 287 deg, respectively. Such a condition obviously is necessary in order that the linear interpolation described above is valid.[2] However, this condition is never precisely satisfied; intermediate points on the scale are always slightly out of place, or in error, when the index is tilted (except for the singular case to be described). The suitability of this dial mechanism for any particular instrument is governed by the magnitude of this structural error. The remainder of this article is therefore devoted to a discussion of the factors that affect its inaccuracy.

Accuracy

The inaccuracy or structural error at any position is best defined as the difference in angle between the position of the dial as shown by the intersection of the scale with the index and the actual position of the dial when the dial is operated in the manner shown in Fig. 4. By definition, the error at both ends of the dial is zero. The magnitude of the structural error for any particular point on the scale depends on the angle of tilt of the index line and on the shape of the spiral scale. It is entirely independent of the angular length of the scale, even when the spiral has more than one convolution.

The spiral scale shown in Fig. 5 has an arbitrary angular length, Δ, and the radii of the outer and inner ends are, respectively, r+a, and r. The index line pivots about the fixed point, A, which is also at a distance r+a from O. When the index is in a tilted position, the effective expansion of the entire scale is the angle, ω, and the expansion (or contraction) for an intermediate point, G, at an angle qΔ from the outer end, is the engle, α. In order for the structural error, as defined above, to be zero:

$$\frac{\alpha}{\omega} = \frac{q\Delta}{\Delta}$$

or

$$\alpha = q\omega$$

The structural error, therefore, may be defined as:

$$\epsilon = q\,\omega - \alpha$$

By an application of the Law of Sines it can easily be shown that:

$$\omega = Arc\ Sin\left[\left(\frac{r+a}{r}\right) Sin\ \gamma\right] - \gamma$$

and

$$\alpha = Arc\ Sin\left[\left(\frac{r+a}{r+ka}\right) Sin\ \gamma\right] - \gamma.$$

To determine the error from these equations, it is necessary to know the relationship between q and k, and this depends on the shape of the spiral. For the simplest spiral–the Spiral of Archimedes–q = 1-k, so that ε can be easily evaluated. Curves of the error obtained with a Spiral of Archimedes, for which r = 0.9 and a = 1.0, are shown in Fig. 6 and 7. (This is the spiral actually shown in Fig. 5.)

In Fig. 6, the error is shown as a function of q; that is, for different positions of the point G on the scale. The curve shown is for the particular angle of index tilt which provides an angle of expansion of 22 deg. This curve indicates that the maximum error at this setting occurs at q = 0.6. In Fig. 7, the error is shown as a function of the angle of expansion; that is, for varying angles of tilt of the index. The curve shown is for the particular point, G, for which q = 0.6.

These curves plainly show that, for the purpose of an expandable dial scale, the Spiral of Archimedes is unsuitable; except perhaps where a very small range of expansion is required. The underlying reason for this unsuitability of the Archimedes' Spiral is the fact that equal angular segments at different radii sweep through different angles in passing a tilted index line. At larger radii, smaller angles are swept through. It was reasoned, therefore, that to reduce the error, a spiral with a more rapidly increasing radius vector is needed. Furthermore, the author conceived that there was a way of constructing a special spiral curve which would have no error whatever for at least one particu-

[2]Non-linear or curvilinear interpolation with this dial mechanism is also possible. All that is required to obtain such interpolation is that the spiral scale be graduated, i.e. angularly divided, in a non-linear manner. For example, the scale can be divided logarithmically by making the angle between each succeeding pair of graduations equal to a constant fraction of the angle between the preceding pair.

lar angle of tilt of the index, as well as no error for the radial position of the index.

The spiral, as shown in Fig. 8, is constructed by first drawing the line AB at an arbitrary angle, γ_0, and then transforming this line into the spiral by distorting the angular coordinate of each point on the line by a constant multiplier, while preserving the radius vector coordinate unchanged. Thus, point D at angle $\Delta = C\omega_0$ and radius r corresponds to point B at angle ω_0 and radius r; and point G at angle $q\Delta = cq\ \omega_0$ and radius r+ka corresponds to point F at angle $q\omega_0$ and radius r+ka. It can be shown that this special spiral has an equation of the form:

$$\rho\ Cos\left(\frac{\theta}{C}\right) = \text{constant},$$

which is known as Cotes' Spiral. Both Cotes' Spiral and the Spiral of Archimedes are shown in Fig. 9 for comparison and clearly illustrates how much more rapidly the former increases in radius with increase in angle.

The spiral, shown in Fig. 8 and 9, has c = 7; but for our purposes, c can have any value. Its error properties are not a function of c. By virtue of its construction this spiral can have no error when the index is tilted at angle γ_0. This is because the effective angle of expansion (or contraction) of the whole scale is ω_0, while that for point G is $\alpha = q\omega_0$. Thus, the ratio of these angles is q, which is the requirement for zero error. However, there is an error at all angles of $\gamma \neq \gamma_0$ and $\gamma \neq 0$. This can readily be determined from the previous equations, after q is evaluated from:

$$q = \frac{\alpha_o}{\omega_o} = \frac{Arc\ Sin\left[\left(\frac{r+a}{r+ka}\right) Sin\ \gamma_o\right] - \gamma_o}{Arc\ Sin\left[\left(\frac{r+a}{r}\right) Sin\ \gamma_o\right] - \gamma_o}.$$

Curves of the error obtained with a Cotes' Spiral having an angle $\gamma_0 = 25$ deg and the same values of r and a as for the Archimede's Spiral previously discussed, are shown for the same angle of ω in Fig. 6, and for q = 0.57 in Fig. 7. They are plotted with reversed sign (which is of no consequence), to aid comparison. Perhaps the most noteworthy observation to be made from these curves is that for the same allowable error of 1.2 deg, Cotes' Spiral permits expanding or contracting the scale by 42.5 deg while the Spiral of Archimedes would only permit 6.5 deg. The spiral scales used on the PRD Type 504 Heterodyne Frequency Meter dial are Cotes' Spirals having these proportions (the outer scale being identical to that in Fig. 8, and the inner scale differing only in that c = 5 instead of 7. The maximum percentage error caused by the use of these scales occurs at the lowest fundamental frequency, which is 500 mc, at which point the outer 260 deg scale is stretched to about 300 deg. As this 300 deg of dial rotation represents 5 mc or 1.0 per cent of the frequency, the 1.2 deg error that can occur amounts to only 0.004 per cent of the frequency.

Ceramic Film Resistor

BEST features of both the film and wire-wound resistors are worked into the Vamistor*. High physical strength and toughness, as opposed to the fragility of most deposited metal films is one of the desirable properties of these precision resistors. The film is thin enough to give low skin effect phenomena at high radio frequencies. Additional styles of this metal film, ceramic-type precision resistor have been developed recently which extend its usefulness to many new applications.

In the Vamistor, developed by Weston Electrical Instrument Corp., Newark, N.J., the resistance element is actually a ribbon of metal which is thermally fused to the inside wall of a ceramic tube having silver terminals fired to each end. Plated brass terminal caps with tinned copper wire leads are attached to the silver ends of the tube, and the entire unit is molded in epoxy resin for protection.

The internal surface of the tube is prepared with a high-temperature fired glaze coating, and the resistive material deposited on this surface between the two conducting silver bands. The resistive film is a highly refined and carefully controlled alloy of the nickel chromium family. After it is deposited on the internal surface, a second firing treatment is given to disperse the deposited film evenly throughout the body of the glaze. The desired resistance is obtained by cutting a helical groove of a predetermined pitch in the hardened film. Encapsulation of the resistor in epoxy resin is for insulation primarily, but it also makes the unit impervious to weather, humidity and salt spray. The insulating cover, while thin enough to allow full wattage dissipation without excessive rise in internal temperature, is sufficiently thick to provide satisfactory flow under severe thermal shock conditions.

Specifications and Performance

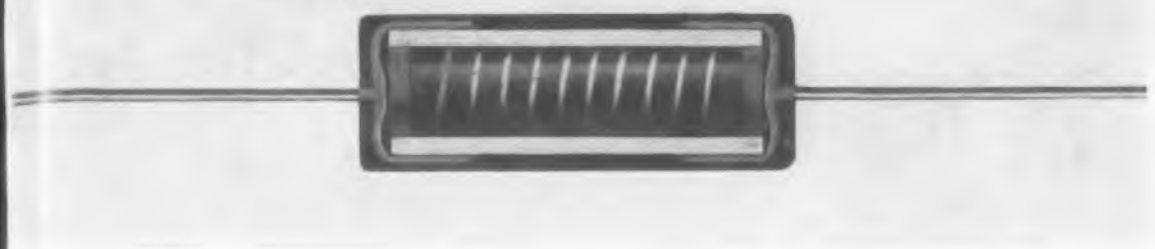
The Vamistor not only meets all known military and civilian specifications pertaining to film type resistors, but also is the first non wire-wound resistor to meet, or surpass, requirements of MIL-R-93A covering precision wire-wound resistors. Vamistors are smaller and operate at higher ambient temperatures than this specification requires, and also exceed several of the stability requirements. They meet the upgraded MIL-R-19074A (ships) specification, MIL-R-10509B, or the proposed MIL-R-10509C (film) specifications. They will operate wherever wire-wound or film resistors are specified, providing greater stability under most conditions than either type.

Some of the design specifications are: resistance range, 1000 to 100,000 ohms; power rating 1/2 w at 85 C derating to zero watts at 150 C; accuracy 1/2, 1, or 5 per cent; temperature coefficient, +50 ppm/degrees C (± 25 on selected units). Low temperature rating is —65 C. Size is 3/4 in. long, 5/16 in. diameter. For r-f work the over-all capacitance from end to end is only 0.9 μμf. The temperature coefficient is the sum of an inherent positive magnitude for

Fig. 1. Per cent change in resistance with temperature for various specifications. Resistors of comparable size were selected. For an 80 C variation, a composition resistor will change 12 per cent compared with 0.25 per cent for a Vamistor.

Fig. 2. Total per cent resistance change due to effect of adding tolerances for major specification requirements. Lowest temperature coefficient and adjustment tolerance for each spec was used.

*Registered trade mark



Enlarged sectional view of the ceramic-film resistor.

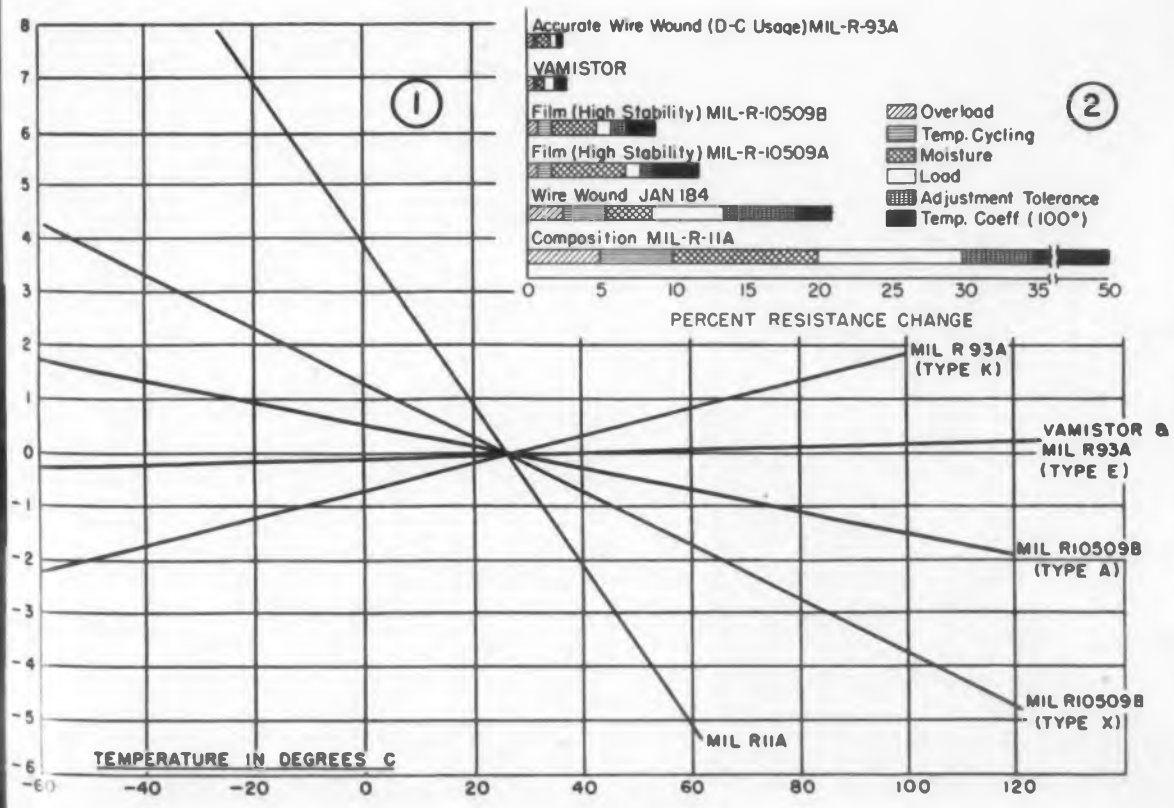
e metal alloy and negative coefficient to ess change.

Although present specifications list the ighest ambient temperatures for full load ssipation as 85 C, other ratings are possi- e. By special treatment, units are now ailable that dissipate one watt at 70 C or ernatively 1/2 w at 125 C ambient.

In an attempt to compare the Vamistor ualities with military requirements for her type resistors, Figs. 1 and 2 show how sistance changes. Fig. 1, for example, ows what happens to the over-all value the resistor with changes in ambient temperature for various specifications.

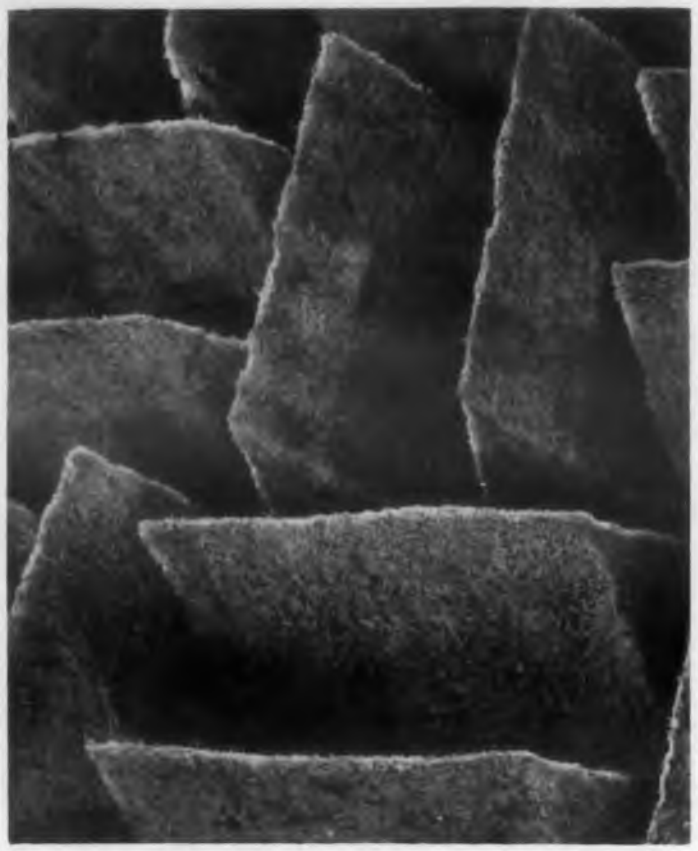
Departures from the rated resistance value can be caused by such things as overload, temperature cycling, moisture, load and adjustment tolerance. It is unlikely that all of these factors would be strictly additive in any one installation, but considerable information can be obtained by adding these changes to show the relative overall merits of the different resistor types, Fig. 2. On this basis, Vamistor specs compare favorably with military requirements.

For more data on these products fill out the Reader's Service Card and circle No. 30.



Radiation Absorbers -

Their Selection And Us



This treated-fiber wedge-shape absorber material (Eccosorb CHW) is useful at VHF, UHF and microwave frequencies. The wedges are mounted on a plywood panel and are used mainly in darkrooms. Because of its wide frequency coverage, it is useful in making simultaneous tests on several antennas. For example, a complete aircraft could be placed in such a darkroom and all electronic equipment tested to simulate in-flight performance.

ELECTROMAGNETIC energy absorbers to simulate free-space are currently produced to cover the VHF, UHF and microwave frequency ranges. Described here are characteristics of available absorbing materials, methods of selecting, and application.

Where Used

The largest use for free space absorber is in antenna measurement darkrooms, sometimes termed "anechoic chambers" because of the audio analogy. Antenna measurements can be made indoors with the same accuracy of outdoor test range measurements, but with none of the weather uncertainty. The darkroom can be shielded with metal screening on the outside surface or may be unshielded depending upon whether external electrical disturbances are presen The absorbing material is applied to walls, ceiling, a floor of the room. Attachment is done by impaling t absorber on nails, cementing, or tying with twine.

Free-space absorber is used in enclosures to pr vent unwanted reflections. Housings which conta antennas are frequently lined with absorber at ce tain critical areas. This prevents reflected energ from detuning the transmitter; it also eliminates u wanted echoes on the radar presentation. Many rad antenna nacelles aboard aircraft are so lined. Are in which magnetrons or other transmitting tubes a located can be lined in order to absorb radiation.

For most free-space applications it is imperati that the absorber be broad-banded. Thus, if the fr

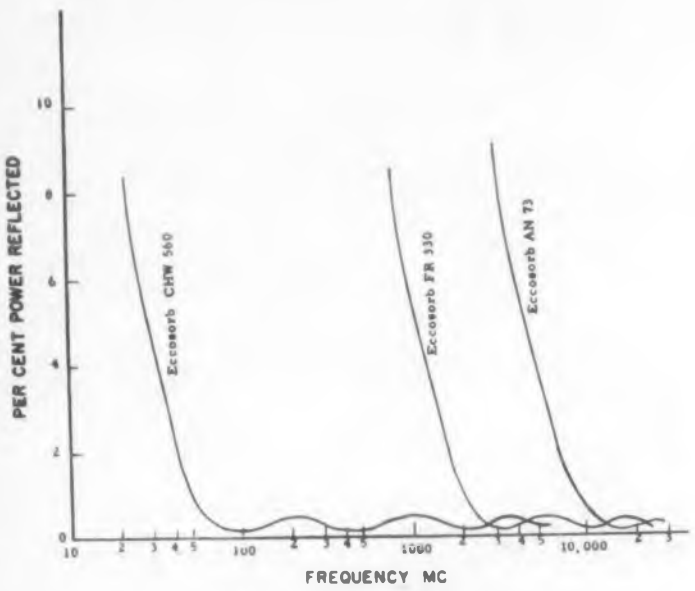


Fig. 1. Reflection from selected absorbers.

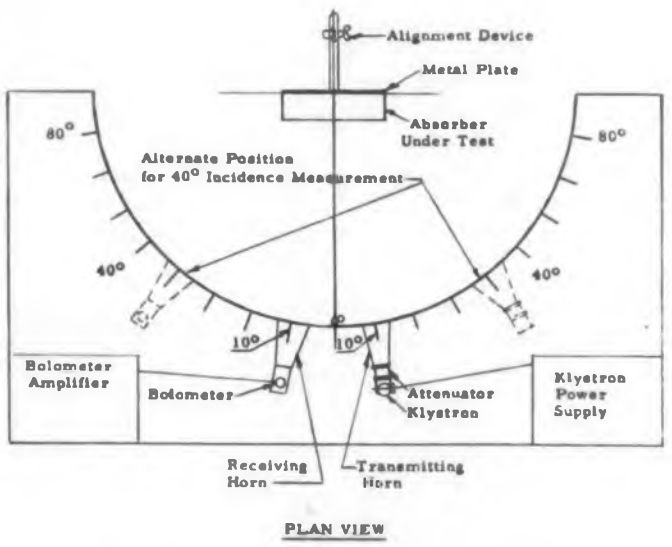


Fig. 2. Absorber test equipment for single-frequency reflection measurements.

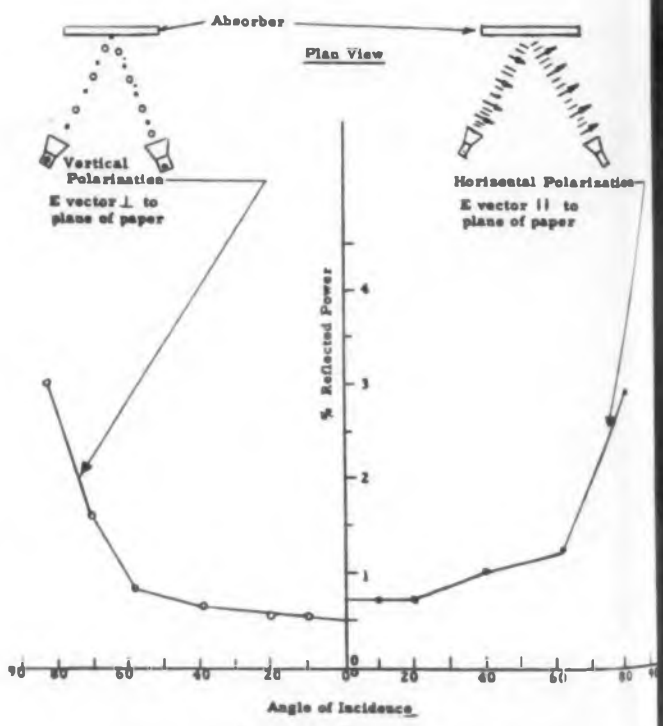


Fig. 3. Typical incident-angle reflection data for Eccosorb FR 330 at 3.2 cm.

Donald J. Newman
Emerson & Cuming, Inc.
Canton, Mass.

ency of the incident energy changes, the absorber ffectiveness is undiminished. At the present stage of velopment, broad-band absorbers have a thickness hich is dependent upon the longest wavelength to used. An absorber which is effective at S band 0 cm wavelength) can also be used at X band 2 cm) and K band (1.0 cm) with at least equal ffectiveness.

In addition to the free space absorbers, other mate- ls are produced for use in waveguides and coaxial nsmission lines. Supplied in rod or sheet form, ese materials are machined for use as terminations, mmy loads, and attenuators. There are two general sses of absorbers for these uses—those which have gh dielectric dissipation factor and those with a gh magnetic dissipation factor. The former materials e bulk conductive.

Absorption Theory

A broad-band electromagnetic energy absorber is so nstructed that dissipative material is increased with pth. Incident energy is confronted with a material hich does not differ greatly from free space; i.e., a od match is made. As the energy proceeds into the sorber, it is confronted with more dissipative mate- l and it eventually becomes greatly attenuated.

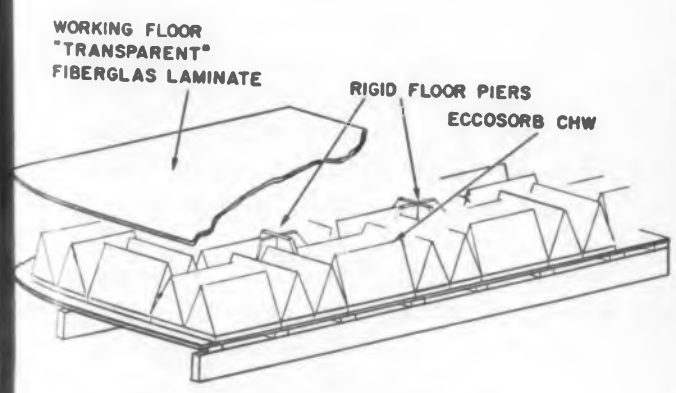


Fig. 4. Floor construction for darkroom using wedge-type absorber. For details, see text.

Standard Manufactured Absorbers

Description	Temperature Range	Wavelength Range	Frequency Range	Bands Covered	Size	Thickness Nominal	Weight Per Sq Ft	Eccosorb Type
Rigid foam block for microwave darkroom	—94 to +180 F	13 cm and all shorter	2300 Mc and up	S,C,A,B, X,G,K	12″x36″	2″	10 oz	FR 330
		32 cm and all shorter	940 Mc and up	L and S,C,A,B, X,G,K	12″x36″	4″	1 lb 4 oz	FR 340
		66 cm and all shorter	455 Mc and up	UHF and L,S,C,A,B, X,G,K	12″x36″	8″	2 lb 8 oz	FR 350
Modification of rigid foam block for flooring applications	Data on the various types of Eccosorb FR applies. Absorber has thin laminate facing to distribute load.							
Flexible foam sheet for antenna enclosures and airborne uses	—94 to +300 F	1.5 cm and all shorter	20 kMc and up	K	24″x24″	1/8″	0.6 oz	AN 72
		4.0 cm and all shorter	7.5 Mc and up	X,G,K	24″x24″	3/8″	2.0 oz	AN 73
		8.6 cm and all shorter	3.5 kMc and up	C,A,B, X,G,K	24″x24″	5/8″	4.0 oz	AN 74
		12.5 cm and all shorter	2.4 kMc and up	S,C,A,B, X,G,K	24″x24″	1″	5.0 oz	AN 75
Rigid foam block for extreme temperature use	—94 to +1200 F	4.0 cm and all shorter	7.5 kMc and up	X,G,K	24″x24″	1/2″	6 oz	HT 620
		12.5 cm and all shorter	2.4 kMc and up	S,C,A,B, X,G,K	12″x12″	1″	12 oz	HT 630
Enmeshed fiber Sheet for darkrooms	—94 to +200 F	13 cm and all shorter	2300 Mc and up	S,C,A,B, X,G,K	24″x24″	2″	1 lb	CH 460
		32 cm and all shorter	940 Mc and up	L and S,C,A,B, X,G,K	24″x24″	4″	1 lb 12 oz	CH 475
		66 cm and all shorter	455 Mc and up	UHF and L,S,C,A,B, X,G,K	24″x24″	8″	2 lb 6 oz	CH 490
Two wedges mounted on plywood panel for extremely wide band darkrooms	—94 to +200 F	600 cm and all shorter	50 Mc and up	VHF, UHF and all Micro-wave bands	24″x24″	Wedge Height 54″	Unit Weight 27 lb	CHW 560
		300 cm and all shorter	100 Mc and up	"	24″x24″	28″	17 ib	CHW 570
		150 cm and all shorter	200 Mc and up	"	12″x12″	15″	13 lb	CHW 580

The exact nature of the change in electrical properties of the absorber with depth is the key to manufacture of a high efficiency material.

In designating a broad-band absorber, the lowest frequency of usefulness is given. The absorber is then useful at all higher frequencies. This is illustrated in Fig. 1 for a few selected materials. There are several members of each absorber type; each with a designated lower frequency limit.

Broad-band absorber functions equally well whether backed by a reflective surface or not. Energy is attenuated to such a degree in passing through the absorptive material that an insignificant amount is present at the back surface. A metal or screen room is, therefore, not required so far as the absorber is concerned. The screen room merely prevents external electrical disturbances affecting the test area.

Absorber Rating

Absorbers are usually rated with respect to returned power at normal incidence. Most absorbers are rated at a maximum of 2 per cent reflection of incident energy. This means that reflected power is down 17 db with respect to transmitted power. Certain absorbers will operate over the temperature range from —94 F (—70 C) to +1200 F (+648 C), are unaffected by humidity, are non-flammable and are light in weight.

Reflection Measurements

A typical set-up for reflection measurement is diagrammed in Fig. 2. The transmitting and receiving horns are at essentially the same location with their axes normal to the plane of the sample. Power reflection from the sample when backed with a metal plate is compared with power reflection from the metal plate alone. The metal plate is aligned to return the maximum signal.

Reflectivity is expressed as a per cent or as db down. For some applications, reflected power at angles other than normal are important. The horns are merely adjusted appropriately in azimuth. The power reflected from the sample is calculated as a per cent of the power reflected from the plate at these new locations.

A typical curve for a good quality absorber at various angles of incidence is shown in Fig. 3. Certain absorbers are sensitive to polarization. It is, therefore, good practice to measure samples at mutually perpendicular polarizations. At high incidence angles reflected power increases significantly. This usually is not disadvantageous, due to the fact that energy at high incidence angles is not reflected back directly to the source but strikes other absorbing material. Multiple reflection, of course, attenuates the energy enormously.

Darkroom Considerations

Construction of a darkroom is relatively simple. Wooden 2 x 4's are usually adequate. Only a fram

to which the absorber is attached is needed. The cost of absorber for S, X and K band measurements in the room (3 walls, floor and ceiling) would be about $2000. Attachment of the absorber is done by impaling on nails, cementing or tying with twine. For the walls, it is convenient to drive nails into the wood and impale the absorber on them. Reflection from the nails embedded in the absorber is negligible. Wedge-type absorber (see photo) is available mounted on plywood panels. Screw inserts in the panels permit mounting by bolts through the 2 x 4's.

Ceiling mounting is usually done by the use of a quick setting cement, or by tying. Nails or hooks have also been used. One method consists of attaching the absorber to large plywood panels which they rest on the ground and then inverting and lifting them to the ceiling. Several possibilities exist with respect to the darkroom floor. Loose pieces of absorber can be placed on the floor only where needed and may be shifted as required. The rigid foam sheet absorber is available in a form suitable for flooring. A very thin fiberglass laminate facing is applied to the foam to permit walking on it and for the bearing of moderate loads. Complete absorber room floors can be put down using this material.

When using the wedge type absorber on floors, a working floor can be laid of fibreglass laminate as shown in Fig. 4. Reflections from this "transparent" fiberglass floor are small except in the microwave range. Pieces of rigid foam absorber could, of course, be placed on top of the "transparent" floor when microwave measurements are to be made.

For highly critical applications, baffles made of absorber are used in the microwave darkroom. These consist of movable wooden frames to which absorber is attached. Baffles are so located that undesirable radiation undergoes multiple reflection. Selection of absorbing material and judicious use of baffles can result in rooms which are 50 db down when measured with transmitter and receiver located at essentially the same point.

Most measurement work requires only a rectangular room with absorber attached to all surfaces. It is often convenient to leave one side of the room completely open for easy access of equipment. Such a room, using absorber rated at a maximum of 2% reflection (17 db down) for normal incidence at the operating frequency, would actually measure considerably better—at least 30 db down. This is due to most of the absorber being better than the 2% figure and the possibility of multiple reflections.

Available Absorbers

Absorbers generally have a white surface so that good lighting conditions can be maintained, and they are made from fire retardent materials. Various available standard types of free-space absorber are listed. Contoured pieces and a few special types are made on a custom basis.

RF and IF Amplifier Design with Conductance Curves

Keats A. Pullen, Jr.
Ballistic Research Laboratories
Aberdeen Proving Ground, Maryland

VACUUM tube conductance curves[1] can be employed directly as a tool in the design of rf and if amplifiers. The rf or if amplifier is slightly more complicated than a rc voltage amplifier because of the regenerative feedback problem and the range of amplification which needs to be available without manual adjustment. Control of amplification is usually obtained by automatic biasing of the amplifiers for amplitude type of modulation, or automatic biasing and limiting for frequency or phase type of modulation. Discussed here, with the aid of tube conductance curves, are recommended tube operating conditions, and their associated circuit parameters. A few helpful suggestions for chassis layout, socket orientation, and electrical grounding are made.

The Basic Tuned Amplifier

In a tuned amplifier having not more than two amplifying stages at a given frequency, the regeneration problem is primarily one of reducing magnetic and capacitive couplings to well below the level which may provide unity voltage feedback. In multistage tuned amplifiers, electromagnetic field propagation must be considered in addition to direct magnetic and capacitive coupling.

The distribution of coupling currents and chassis currents needs careful attention in all tuned amplifiers. The selection of an input grounding point and an output grounding point for each amplifying stage is the first step in the actual construction of an rf or an if amplifier stage. The grid pin on the tube socket should be oriented toward the input circuit and the socket hole actually located as close as possible to the input circuit. Then, the output circuit should be located as close as possible to the plate pin of the socket. The output bypass point is located near the plate pin of the tube.

Where a separate suppressor connection is provided for a tube, the screen bypass should be returned to the input ground. The suppressor then is returned to the output ground. The plate decoupling circuit by pass also is returned to the output ground. If a single tuned circuit is used interstage, the output ground for the first stage and the input ground for the succeeding stage may be a common point. The bypass circuits connected to the various common ground points should be arranged to provide sufficiently small impedance to the rf voltages applied to the tube compared to the input, output, shunt, and cathode impedances, so that good isolation is provided. Some of the interrelations affecting the isolation are considered in connection with the experimental designs.

The design of the tuned amplifier is accomplished in the same manner as for the resistance coupled amplifier. The equation for amplification of the tuned amplifier is

$$VA = - G_M Z_L \qquad (1)$$

where Z_L is the resonant impedance of the tuned circuit. A combination of a static and a dynamic load line is required.

The Limitation of Amplification

Tuned amplifiers normally have to be designed to provide amplification of a limited magnitude. If the voltage amplification provided becomes unduly large, the tube plate to grid feedback may become excessive, causing oscillation. To show the feedback effect, assume that an if amplifier for a center frequency of 5 mc is to be built, using *6CB6* tubes. Single tuned circuits are to be used as interstage coupling circuits for this design. The screen characteristics curves of the *6CB6* tube of Fig. 1 show that for small signal levels, operation with a plate current of about 5.2 ma and a transconductance of about 6000 μmhos may be obtained with a screen voltage of about 60 v and a bias of −1/2 v. For a stage amplification of approximately 20, the load impedance Z_L, should have a maximum value of 3300 ohms. The reactance of the grid to plate capacitance should be of the order of 250,000 ohms at 5 mc for a stable amplifier design. This reactance corresponds to a grid to plate capacitance of 0.13 μμf. Since the grid to plate capacitance of the *6CB6* amplifier, including stray capacitance could probably be held to 0.13 μμf, an amplification of 20 per stage should prove satisfactory at 5 mc.

The choice of the screen series resistor, if used and the cathode series resistor is entirely conventional. Frequently, the screen and plate supply voltages are taken equal, to reduce the number of parts in practical amplifier designs. Since this reduction of number of parts may result in an increase of mutual coupling between the input and the output of the tube, caution should be used in the choice of the simplified circuit for practical problems.

Choice of bypass capacitors, particularly for the screen, may require special consideration. Variation of screen voltage, because of the resultant cross coupling in an rf or an if amplifier, should be kept not more than 1/20 of the incoming grid signal. The lower the magnitude of the signal voltage developed in the screen circuit, the more effective is the isolation, and the more stable the resulting amplifier. A convenient equation for the tolerable amplification in the screen circuit is:

$$G_M X_{C_2} Z_{C_2} < 0.05 \qquad (2)$$

where Z_{C_2} is the effective impedance from screen to ground, and X_{C_2} the screen factor. Fixed tuned amplifier circuits may profitably use resonant bypass capacitors to reduce the screen signal voltage to the smallest possible value.

Nominal size of the bypass capacitor for either screen or cathode may be a poor measure of its bypassing effectiveness. For effective isolation, the actual screen structure within the tube must be held at ground potential. Either short, stubby, low inductive reactance leads to both sides of the bypass capacitor itself must be provided, or the structure must be resonated. Resonating of the screen circuit to ground may be accomplished by removal of plate and screen voltages from the tube whose screen is being resonated, and adjustment of the screen capacitor lead lengths to provide minimum signal feed-through in the tube.

Cathode degeneration should be used sparingly in amplifiers tuned to frequencies above 10 mc. The reactances of stray capacitances and inductances normally present in tube circuits can introduce serious difficulties, due to sneak regeneration paths when signal frequencies are high.

As the operating frequency of an rf or an if amplifier is increased, the stage amplification which can be obtained without instability becomes less and less. Possibly fortunately, the effect of transit time loading becomes serious as the effect of low grid to plate reactance becomes serious. The combination of both these factors is to reduce the available amplification.

Bandwidth, Q, and Impedance

The relation between tuned circuit Q and bandwidth may become rather involved in the high frequency tuned amplifier. Where natural circuit loading is small, and the required bandwidth is small, the tuned circuit should, if possible, be designed to provide the required load impedance without swamping resistance. This results, when properly compensated for temperature effects and similar phenomena, in a high C type of circuit having a high inherent stability and good selectivity. For the 5 mc if amplifier mentioned earlier, for example, use of a tuned circuit having a Q of 100 would require coil and capacitor reactance levels of 33 ohms. Approximately 1000 μμf capacitance is required for this circuit. Where additional bandwidth is required to be obtained by resistive swamping, the tuned impedance required should be divided by the required loaded Q to give the design reactance levels. Then, sufficient loading resistance is added to provide the required load impedance.

In amplifiers using double tuned circuits, the same basic principles apply. Limitation of amplification to minimize oscillation requires that the load impedance be determined by Eq. 1, and also by a feedback calculation to make certain that with the grid circuit impedance selected, the signal voltage fed back is small compared to the input voltage. A designer would at first think that one could limit the amplification in the plate circuit and obtain additional amplification by an impedance transformation between the coupled coils. He finds, however, that the increase in grid circuit impedance which results, reduces the amount of amplification which can be obtained to a point that no advantage is obtained. Since the grid circuit impedance rises as the square of the voltage step-up ratio, the intrastage amplification permitted is an inverse function of the square of the voltage ratio. The overall plate to plate amplification then depends on the inverse one-half power of the grid circuit inductance. The significance of this condition in optimizing the signal-to-noise ratio of input stages appears worthy of study.

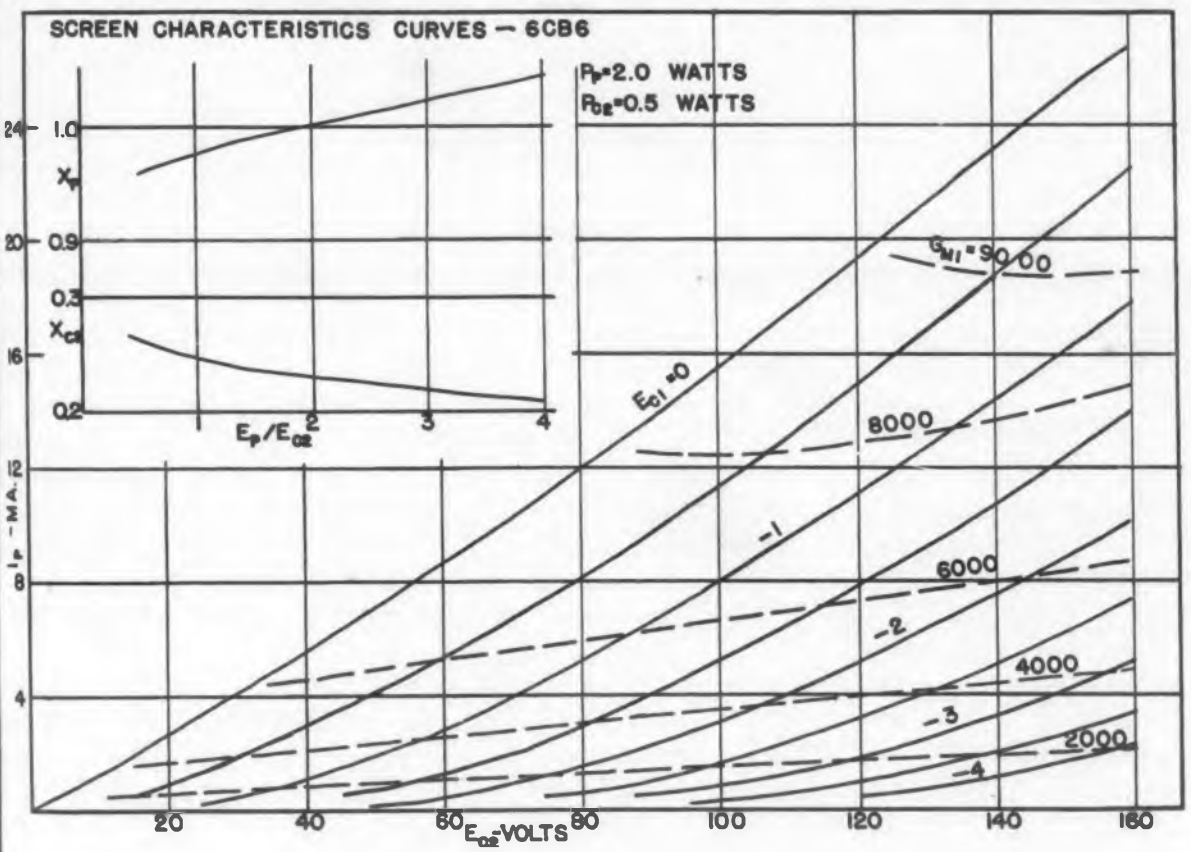


Fig. 1. Characteristics Curves—6CB6

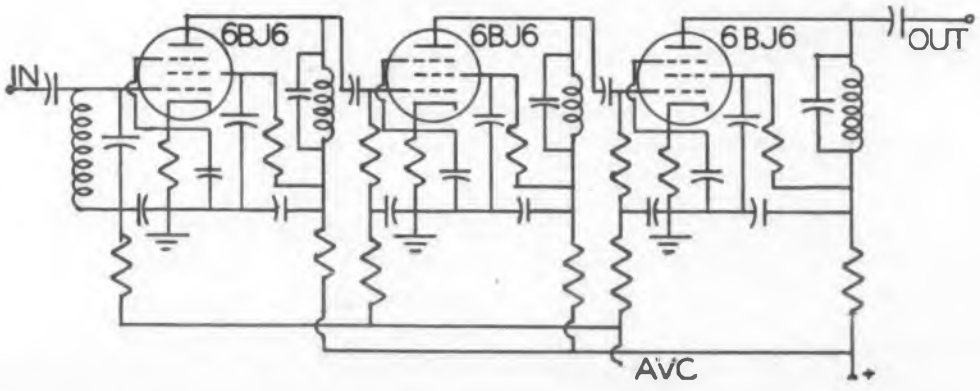


Fig. 2. Three Stage IF Amplifier

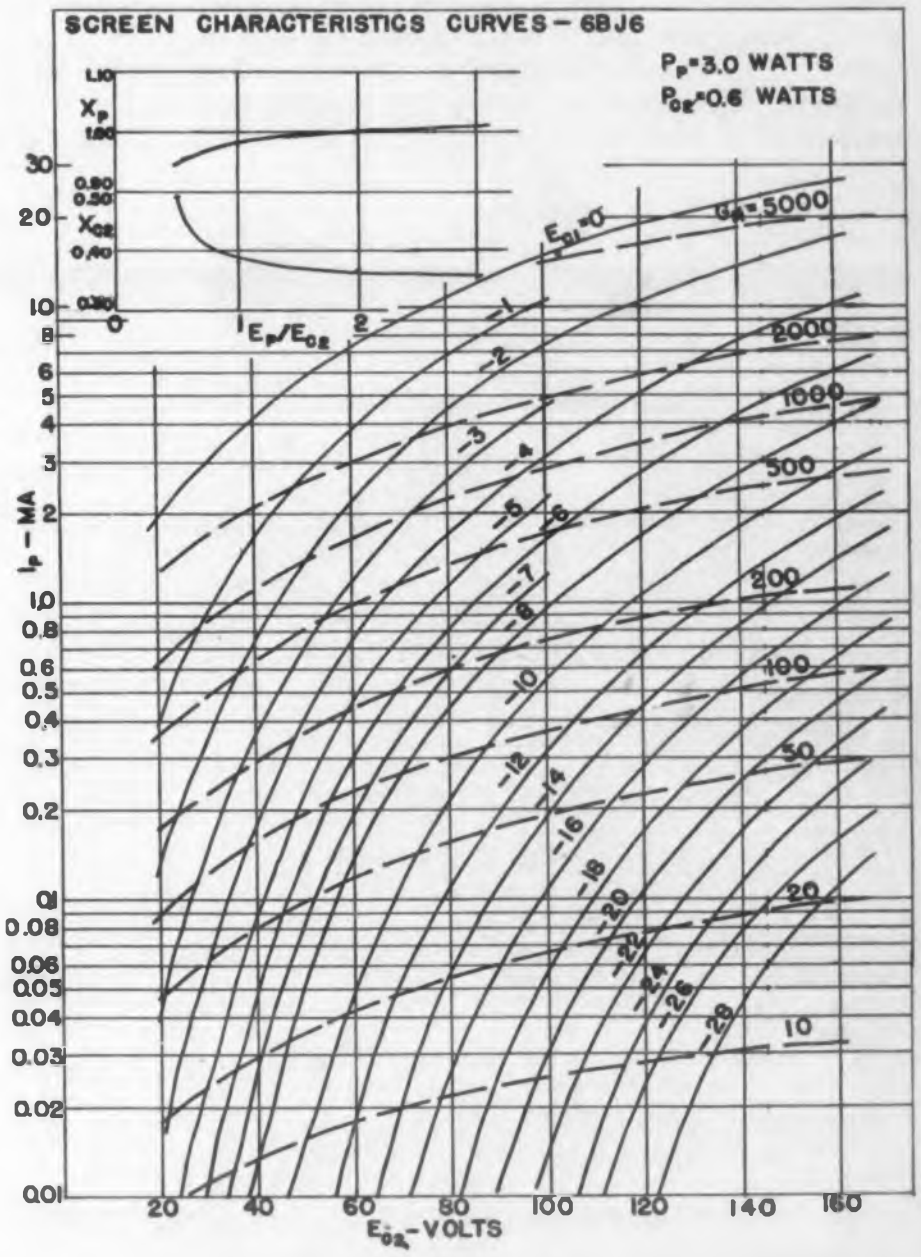


Fig. 3. Logarithmic Characteristics Curves—6BJ6

The bandpass built into any receiver should be kept as small as the physical limitations of the design problem permit. Attenuation of strong interfering signals prior to cross-modulation with the desired signal is the most effective means of controlling interference yet found. The use of broad-band, or over-coupled, input transformers, although satisfactory with small signals, should consequently be avoided wherever possible. Design of stability into an amplifier stage does not necessarily require broad-banding, if adequate attention is given to proper choice of impedance levels and proper components in the interstage circuits. The design of low inductance coils having adequate Q and the selection of the proper size capacitors are the main problems faced in the design of the required low impedance circuits.

The Design of Variable Gain Amplifiers

Variable gain amplifiers are frequently used to compensate for variations of signal strength of one or more received signals. The usual method of varying the gain of an amplifier is the use of some form of bias control of tube transconductance. The form of curves normally provided for pentodes, does not provide the design information needed where variable gain is required. Data on tube transconductance from values as low as 10 to as high as 5000 to 10,000 μmhos may be required to meet the range of amplification needed in some practical problems.

Assume that a three stage 465 kc if amplifier, shown in Fig. 2, is required, which will develop a bias for any incoming signal having more than 3 v peak amplitude at the detector. The amplifier shall provide a maximum amplification of 15,000, and shall function properly with a 0.1 v peak input. The minimum peak input signal which will activate the AVC bias then is 200 μv.

Establishment of a design to provide proper operation with minimum signal input requires techniques of the sort already discussed in detail. Setting the design to handle adequately the entire range of signals is new examined. The *6BJ6* tube is used in this design and the conductance curves for this tube are shown by Fig. 3. The nominal load impedance of each plate load circuit is set by the required maximum amplification per stage of 25. Assuming a maximum effective transconductance of 3000 for each stage, the load impedance required is about 9000 ohms for unity interstage transformer amplification. The screen supply voltage is arbitrarily chosen as 100 v.

Uniform distribution of the amplification among the three stages would require a minimum stage gain of between 4 and 5. Assuming a stage amplification of 5 for an input of 0.1, gives an output of 12.5 v. The available bias then is 9.5 v. A quick check of the feedback loop shows that the output will not be quite 12.5 v, since 9.5 v AVC bias would limit the stage amplification to 1.53.

An iterative calculation yields the correct bias and stage amplification. With a 100 v screen potential and six v bias, each stage would have an amplification of 4. The overall amplification of 64 would provide a bias of 3.4 v. For a 5.7 v bias, the stage amplification of about 4.4 develops about 5.5 v bias. Consequently, a 0.1 v incoming signal produces an output of about 8.5 v and a bias of about 5.6 v.

Linearity is the next question. The 1.9 v final amplifier stage peak excursion either side of the mean bias point will produce non-linearity and distortion. The distortion is nearly 15 percent. This high a percentage of distortion in general is not tolerable. The designer might either raise the screen voltage or decrease the AVC voltage on the last tube in the amplifier. In either of these ways, or by use of both together, one may reduce the distortion appreciably.

One of the reasons the large distortion is developed with strong signals in this amplifier is the large signal voltage which must be developed to provide the bias for the gain control action. The use of an AVC amplifier, since it could reduce the amount of excess signal voltage required to provide control, would provide both a more constant amplification and a lower amplifier distortion. For example, a triode or a pentode amplifier, which used a negative supply and

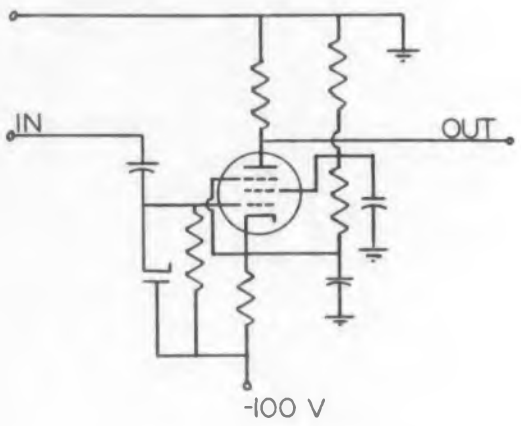


Fig. 4. AVC Amplifier

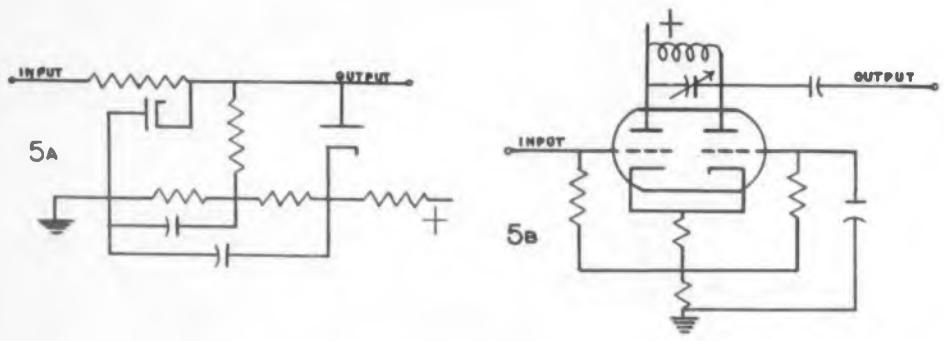


Fig. 5. Balanced Limiter Circuits

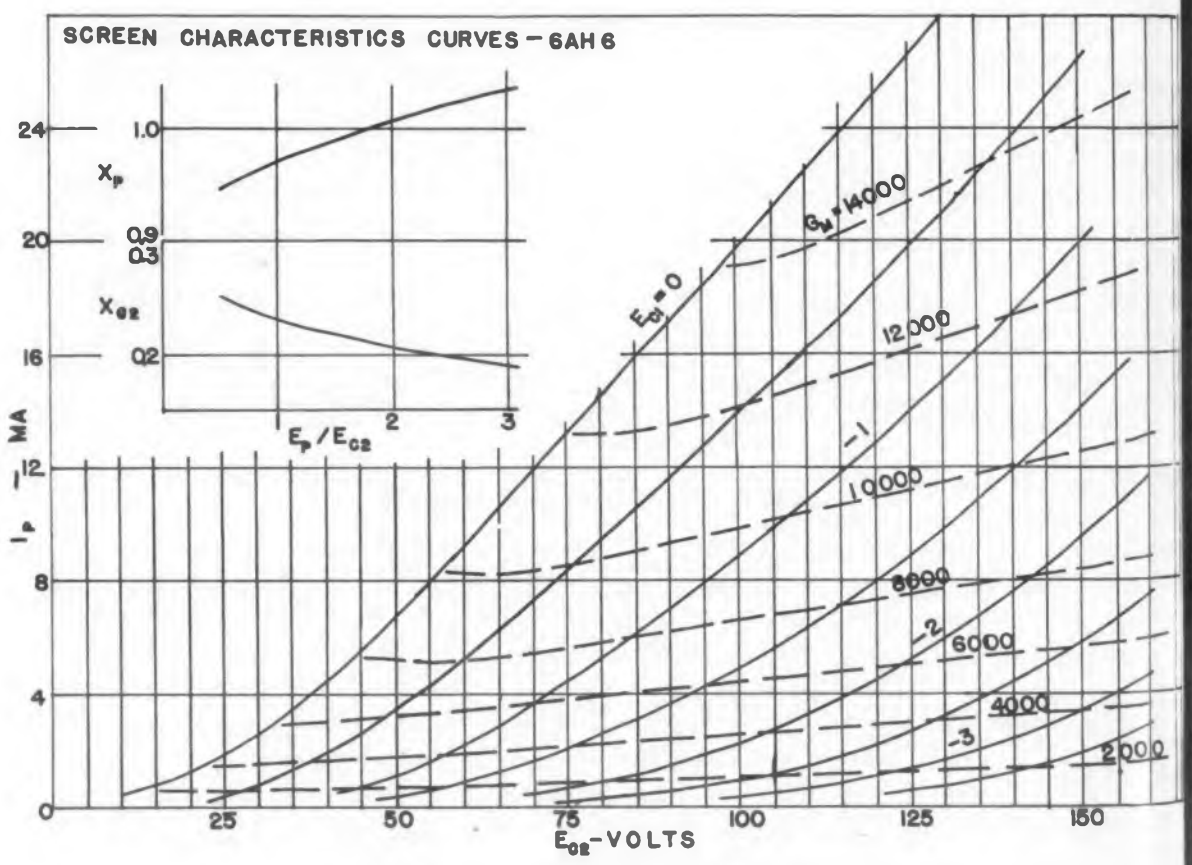


Fig. 6. Characteristics Curves—6AH6

had its control grid biased about 3 v below cutoff, would provide both the delayed action desired and also the required constancy of output level. Maximum efficiency in this amplifier would be obtained by the use of a crystal rectifier and filter rather than using the tube as a bias rectifier. Since only a fraction of a volt over 3 v signal now would produce as much as 8 or 10 v AVC, the amplifier distortion would be markedly reduced. Proper distribution of the volume control action among the various stages of the amplifier and the use of the AVC voltage amplifier in most cases can provide an amplifier having both low distortion and excellent constancy of amplification.

The fixed minimum bias applied under no-signal conditions has been ignored in the above discussion. A zero signal bias of −1.5 v is required to provide the net zero signal gain of the amplifier. Since this bias is normally provided by the flow of the cathode current through a bypassed cathode resistor, the effect of the cathode bias with large amounts of AVC becomes small enough to be neglected.

As an example of the design of an amplifier for amplified AVC operation, assume that a *6BH6* pentode were to be used as a delayed AVC amplifier, shown in Fig. 4. A crystal rectifier is to be used to rectify the rf being applied to the AVC rectifier. The amplifier is biased 3 v below approximate cutoff. Taking the *6HB6* screen to cathode potential to be 75 v, a net bias of approximately −6 v is required. Using a plate load resistance of 20,000 ohms and a plate supply voltage of 100 v, 0.5 ma of plate current in the amplifier will produce an AVC of 10 v. Since a net bias of −2.2 v produces the 0.5 ma plate current change, a peak signal of 3.8 v amplitude can limit the amplification by the application of 10 v AVC. The overall if amplification per amplifier stage will be approximately unity for 10 v bias. Consequently, an input signal range from 200 μv to about 4 v would be provided with an input change of only one third.

Checking the effect of distortion shows that the amplification of the final amplifier stage of the amplifier cannot be reduced as much as the amplifications of the earlier stages. If the maximum incoming signal in the above amplifier were 0.1 v peak, then, the final amplifier stage should have an amplification of 10 with maximum input signal. With a screen voltage of 100 v on the 6BJ6 tubes, and a final stage amplification of 10, a bias of −8.8 v is required on the first two stages. The peak output of the amplifier then corresponds to about 3.5 v for a 0.1 v input, as against 3 v for 200 μv input.

Limiter Amplifiers

In fm receivers, removal of incidental amplitude modulation is obtained by the use of limiting amplifiers. Basically, there are two types of limiters, the symmetrical, and the non-symmetrical. The symmetrical limiter usually uses either a pair of biased diodes or a cathode coupled clipper, shown in Fig. 5. The non-symmetrical clipper uses a grid rectification and cut-off to accomplish its action. The non-symmetrical limiter is the more commonly used form.

The symmetrical limiter appears to introduce a smaller magnitude of carrier phase shift as a function of signal amplitude than the non-symmetrical limiter. This is a result of two considerations. The first consideration is that with the symmetrical limiter, the limiting is localized in one or two stages exclusively. The second consideration is that the symmetry causes the tuned circuit in the output of the limiter, which is shock excited by the limiter output current pulses, to be excited in relatively unchanged form regardless of the applied signal voltage. Consequently, where phase stability is important, use of symmetrical limiting is indicated. Conventional if amplifier design techniques apply to the amplifier used with biased diode limiting.

Non-symmetrical limiter stages frequently are used in pairs. In the average limiting amplifier, the number of tubes actively limiting an incoming signal may increase as the input signal voltage is increased. Where carrier phase stability need not be considered, the limiting action obtained is entirely adequate.

Normally, the non-symmetrical limiter circuit uses a rectification biased (zero bias static) pentode having a screen voltage low enough so that limiting is obtained with comparatively small changes in grid voltage. For a *6AH6* tube whose conductance curves are shown in Fig. 6, with a 20 v screen voltage for example, limiting occurs on input signals exceeding 0.5 v peak to peak.[2] Since the limiter clips the negative peaks only, two limiters in cascade are required to minimize the effects of noise on both negative and positive peaks.

Non-symmetrical limiters should be designed to use sharp cut-off pentodes, operating at a very low fixed value of screen voltage. Only then can the desired limiter characteristics be obtained.

One caution should be mentioned with regard to limiter and discriminator circuits. Arguimbau and Granlund[2] have shown that wide band tuned circuits are essential in all circuits following a nonlinearity in an fm receiver. If adequately wide band tuned circuits are used, the desired signal does not lose control of the limiters and the discriminator. Consequently, loss of readability of a signal occurs at an appreciably lower signal-to-noise ratio.

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   Designing Cascode Amplifiers With g-Curves, K. A. Pullen, Jr., *Electronic Design*, May 1, 1956, pp 26-27;
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   Design Techniques Using Conductance Curves, Pentode Degenerative Amplifier and Cathode Follower, K. A. Pullen, Jr., *Electronic Design*, Oct. 1, 1956, pp 32-35.
2. Sky-Wave F-M Receiver, L. B. Arguimbau and J. Granlund, *Electronics*, Dec. 1949, p 101.

New Products

Combined Push-Pull Switch
And Gain Control

A complete line of P. R. Mallory controls for printed circuit applications, embodying a new type of push-pull switch, is now available. The radio or television volume control setting is not altered when the push-pull switch is used to turn the set off or on. The switch closes circuit when its central shaft is pulled out; opens circuit when the shaft is pushed in. The control is not rotated in switching, and switching does not produce wear on the resistance element.

Contact is made by free floating rings of Mallory alloy. These rotate slightly with each operation, distributing wear. Since only the rinfs carry current, overloads cannot cause loss of spring action.

P. R. Mallory Co., Inc., Dept. ED, 2039 E. Washington St., Indianapolis 6, Ind.

CIRCLE 35 ON READER-SERVICE CARD FOR MORE INFORMATION

Easily Assembled Dish
32-Foot Model

This 32-foot dish is built in 13 sections, each of which weighs only 150 lb, and can be assembled on the ground and hoisted into place. It is built entirely of aluminum alloy 6061-T6, except for the bolts used to fasten the sections together. They are stainless steel. The assembled dish, and its tower mounting, are extremely rigid. Heavy I-beam sections act as the actual mounting surfaces.

Designated as model D-322, the dish is designed to be driven in the frequency range 100 to 2400 mc.

Technical Appliance Corp., Dept. ED, Sherburne, N.Y.

CIRCLE 36 ON READER-SERVICE CARD FOR MORE INFORMATION

Improved Selenium Rectifier
No Center Mounting Shaft

A new selenium rectifier of standard 65-mil rating but of improved construction that offers major advantages is pictured here. There is no center mounting shaft; the individual cells are placed flat against each other like pages in a book and there is no air space between cells. This new construction is more rugged, gives greater protection against moisture, and gives each cell a larger effective area. The metal "wrap-around" protects the rectifier against physical damage and provides thermal coupling to the chassis.

Federal Telephone and Radio Co., Dept. ED. Components Div., 100 Kingsland Road, Clifton, N.J.

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

Humidity Sensing Element
Uses Semiconductor Principles

A new type of electric humidity sensing element has been designed using thin films which have charge patterns on the molecules. Energy bands are set up in the films which are controlled by water molecules in the air close to the film.

The elements will operate over a temperature range to 200 F. An all glass unit will operate up to 600 F. The unit has good stability and reproducibility.

Photo-Crystals Inc., Dept. ED, 15 South First St., Geneva, Ill.

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Generator
Square Wave Output

This miniaturized, transistorized square wave generator covers the frequency range from 5 cps to 30 kc; and delivers a peak-to-peak voltage output that may be varied from 1 v to 1 mv. Output wave has a rise time of 0.25 μsecs and is flat at top and bottom. Operating temperature is 0 F to 140 F.

Required power source consists of nine standard "C" size flashlight cells. In this application the cells have an approximate service life of 1500 hours, continuous operation.

Burr-Brown Research Corp., Dept. ED, Route 4. Box 139, Tucson, Arizona.

CIRCLE 39 ON READER-SERVICE CAR DFOR MORE INFORMATION

Tuneable RF Probe
900 to 18,000 Mc

The rf probe Model 229 has a fine wire, which is adjustable in depth over a wide range by means of a fine-pitch threaded knob, and which in effect is an extension of the center conductor of a coaxial line. This line is provided with shunt and series tuning elements for tuning the probe pick-up over the range of 900 to 18,000 mc. The probe has two outputs. Its detector output takes a BNC series connector and has provision for either a Series IN21 or IN23 standard microwave crystal, or for a Narda N-610B bolometer. The rf output is for use with microwave receivers or other internal detectors. In most slotted lines probe insertion loss is 25 db or less.

Narda Corp., Dept. ED, Mineola, L. I., N.Y.

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

Closed Circuit TV Monitor

Coax to Camera Unit

Requiring only one coaxial cable between itself and the camera control unit this 14-in.-screen TV monitor provides remote viewing of information in industrial or broadcast television cameras, and remote control of camera pan, tilt, iris, focus and 3-lens turret. The remote controls, however, are not part of this unit; the rack mount model is designed to accept any three remote control units. The monitor itself consists of a 14-in. tube suitably mounted, and an installed video amplifier providing a bandwidth of more than 8 mc and a horizontal resolution better than 600 lines, available either in a cabinet or on a 19-in. rack-mounting chassis. Sync is obtained from the blanking pulses in the video waveform, and only one coaxial cable is needed between monitor and camera. Line amplifiers are not needed for distances up to 1000 feet; but operation at greater distances can be obtained by adding line amplifiers.

Kay Lab, Dept. ED, 5725 Kearny Villa Road, San Diego, Calif.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

Synchro Performance Meter

Accuracy ±0.2 Per Cent

This meter, designated Model 100, reads the performance of synchros and synchro systems with a high degree of rapidity and accuracy. The reading is given in the form of percentage deviation of the actual synchro transformation ratio from ideal ratio. The instrument consists of a high-accuracy, expanded scale voltmeter, a precision voltage divider, and input switching. Full scale covers ±3 per cent, smallest division is 0.1 per cent, and accuracy ±0.2 per cent. Nominal input voltages are 57.3, 78, 90, 105, 115; frequency range 50-1000 cps, and impedance 10,000 ohm/v.

Beckman Instruments, Inc., Dept. ED, Shasta Div., P. O. Box 296, Station A, Richmond, Calif.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

Smooth-Surface Cleanser

Cancels Static Fields

GTC-59 cleaning compound cancels static fields o nglass, plastic or ceramic surfaces, cleans and degreases them, and coats them with a tough, dust repellant and water repellant protective coating It contains no caustics or abrasives, and has been approved by the Air Force for use on such delicate equipment as electron-optical systems. It is available in 16 oz, 32 oz., gallon and drum containers; and is recommended by its maker not only for cleaning glass, plastic or ceramics, but also for stainless steel, porcelain, enamel, chrome and marble.

Beaver Laboratories, Inc., Dept. ED, 86-51 Palo Alto St., Hollis 23, N. Y.

CIRCLE 46 ON READER-SERVICE CARD

Elastomer-to-Metal Adhesives

Bond Many Materials

Natural rubber, Neoprene, GRS, Buna N or butyl may be bonded to carbon steel, alloy steel, stainless steel, aluminum alloys, magnesium alloys, die casting alloys, copper, brass, plated metals and rigid plastics by synthetic polymers and reagents designated Chemlok 201 and 220. When Chemlok 201 is used as a primer for Chemlok 220 the resulting bond resists wide temperature variations, hot and cold water, salt spray, solvents and corrosive atmospheres. In suitable circumstances, Chemlok 220 may be used without a primer. Metal parts may be coated with Chemlok at room temperature by any of a number of methods, such as brushing, spraying, dipping or rolling; the resultant surface is non-tacky and non-smearing. Coated metal parts may be stoerd for up to four weeks before the rubber, etc., is bonded to them.

Lord Mfg. Co., Dept. ED, 1635 W. 12 St., Erie, Pa.

CIRCLE 47 ON READER-SERVICE CARD

Correction

The precision potentiometer, Helipot Series 5300, announced on page 74 of the November 1 issue was erroneously stated to have a diameter of 1-1/2 in. The correct diameter is 1-1/4 in.

CIRCLE 48 ON READER-SERVICE CARD ➤

Automatic Electric Typewriter

120 Words Per Minute

Designed for use as an input and output device for the data processing field, a new electric typewriter has been developed.

Automatically typing at a rate of 120 words a minute or approximately twice as fast as the average typist, it can be used in conjunction with computers as well as with measuring and recording instruments, scales, and meters in such applications as engine testing, liquid flow through pipelines, production control, wind tunnel research and others, to provide a visual record.

The input-output typewriter is operated by a series of electro-magnets and solenoids mounted beneath the keyboard. The magnets and solenoids act as receivers of signals transmitted from the controlling device, or computer, and automatically actuate keyboard functions of the typewriter, including carriage return, spacing, tabulation, ribbon color control and others.

International Business Machines Corp., Dept. ED, 590 Madison Ave., New York 22, N.Y.

CIRCLE 49 ON READER-SERVICE CARD

Rubber Products That Cling

In Rolls, Shapes and Forms

Available either in continuous length rolls of many sizes, or die cut to specifications, or fabricated in specified shapes and forms, polyurethane foam rubber products are now supplied with "non-stretch" pressure sensitive adhesive coatings. These pressure sensitive coatings attach the product to practically any surface—all that is necessary is to remove the protective paper backing and press the product firmly against the surface. These products, relatively new to the American market, have the ability to resist oils, solvents and aging. They are of high compression strength, provide excellent sound insulation, and are available in a wide range of colors.

Durable Rubber Products, Dept. ED, 609 W. Lake St., Chicago, Ill.

CIRCLE 50 ON READER-SERVICE CARD

◀ CIRCLE 48 ON READER-SERVICE CARD

Copper Clad Sheets

Photo Sensitive

With these photo-sensitized copper clad sheets any etched circuit panel may be produced in any quantity on the user's premises. Processing chemicals and supplies are also available. The sheets are available in any rectangular size desired up to 18 in. x 21 in.

This method of processing produces circuit boards to satisfy critical applications. Extremely fine circuit detail and exact circuit reproducibility is obtainable.

Requirements on the part of the user necessitates exposing, developing and etching to a finished panel. Large sheet sizes allow the preparation of more than one circuit panel simultaneously.

Sample quantities for experimental and prototype use may be obtained in kit form which supplies the presensitized sheet, all processing chemicals and handling equipment.

Keil Eng. Products, Dept. ED, 4358 Duncan Ave., St. Louis 10, Mo.

CIRCLE 52 ON READER-SERVICE CARD

Feed-Through Terminal

For High Horsepower

A higher horsepower hermetically sealed electrical feed through terminal has a range to 7-1/2 horsepower at 220 v. Specifically designed for high horsepower applications, it is made in both singles and three pin multiples. The new terminals feature special glass extensions on the pins both top and bottom to provide over the surface spacing necessary to meet Underwriter Laboratories specifications. Increasing the current carrying characteristic is the copper core stainless steel pin. This core runs the entire length of each pin.

Connections to the electrical source and the hermetic motor are made through a mechanical spade type connector. Male spade or tab is resistance welded to the terminal electrodes. Female portion of the connector is attached to lead wires.

Fusite Corp., Dept. ED, 6000 Fernview Ave., Cincinnati 13, Ohio.

CIRCLE 53 ON READER-SERVICE CARD

◀ CIRCLE 54 ON READER-SERVICE CARD

Lettering-Slot-Guide Template

Simple to use

Announced is a new convenient lettering-slot-guide template made of 0.060 in. thick acrylic material which is durable, shatterproof and transparent. The template is cut in five guide slots in the popularly needed sizes of 1/8, 3/16, 1/4, 3/8 and 1/2 in. Five circles in these same sizes have also been incorporated. In addition, the top of the template is a 6 in. ruler in 16ths and the bottom a 6 in. ruler in mm.

Compact and handy (overall size 4-1/8 x 6-3/4 in.), this template is designed to give an unlimited choice of lettering or numbering in slant, broad or narrow characters wherever uniform capitals or lower case letters are required.

Alvin & Co., Dept. ED, Windsor, Conn.

CIRCLE 56 ON READER-SERVICE CARD

Flexibly Sealed Resistors

Precision Wire-Wound

Precision grade wire-wound resistors have been developed that combine the advantages of resin embedment and hermetically sealed metal cans. These units can be supplied oil-filled, wax-filled, etc., where special conditions so require. In any case the seal forms a vulcanized bond, with flexibility sufficient to compensate for differences in expansion coefficients of the components. No void is needed to compensate for pressure increases resulting from expansion of the filler, while the non-metallic nature of the enclosure results in better frequency stability. The resistors are produced in two classes, A and H; A having a temperature range from —30 C to +250 F; while the temperature range of Class H is from —130 C to +250 C. Both classes exceed the requirements of MIL-R-93A with respect to voltage overload, salt water immersion, salt spray, 100 per cent humidity, temperature cycling and stability resistance.

Dmeter Mfg. Co., Dept. ED, 22-24 Larkin Plaza, Yonkers, N. Y.

CIRCLE 57 ON READER-SERVICE CARD

CIRCLE 58 ON READER-SERVICE CARD ➤

Audio Spectrum Analyzer

Speeds Design, Production

To speed up laboratory and production processes, simplify testing and trouble-tracing, and improve product performance is the object of sonic analyzer LP-1a, used for spectrum analysis of sounds, vibrations and waveforms. With this analyzer, any audio-frequency parameter, having first been converted to an electrical waveform by a sensing device such as a microphone, is presented as a visual waveform picture. Relative strength of various components, individual distortion components, changes in energy, and the like can be seen, measured and recorded. Frequency and amplitude data can be compared and analyzed. The LP-1a is versatile, substituting for many different types of machines and testing methods, and eliminating complicated point by point measurements.

The LP-1a sonic analyzer (an improved version of the same manufacturer's earlier model, the LP-1) provides a logarithmic sweep range of 40 to 20,000 cps. It identifies mechanical and electrical defects and variations. It is used to make fine adjustments, to improve the design of such products as jet and reciprocating engines, electric motors, and other types of rotating or oscillating machinery.

A companion, optional feature is a recorder, which may be added to make a permanent record of waveform content over extended periods. Tuning controls allow the selection of narrow bands within the frequency range for recording and subsequent analysis.

Panoramic Radio Products, Inc., Dept. ED, 10 S. Second Ave., Mount Vernon, N. Y.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

Small 120 Kv Capacitors

Have Corona Shields

Among the very smallest high voltage capacitors commercially available, these units function in 10 kv to 120 kv range, and feature corona shields of spun aluminum to permit closer operation. They are designated as the type OT.

Plastic Capacitors, Inc., Dept. ED, 2620 N. Clybourn Ave., Chicago, Ill.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Mu Triode

Sharp-Cutoff Pentode

The 6AW8-A is a general-purpose high-mu triode, sharp-cutoff pentode of the 9-pin miniature type intended for application in television receivers. The pentode unit is especially useful as a video amplifier tube, video intermediate-frequency amplifier tube, or as an automatic-gain controlled amplifier tube. The triode unit may be used in sync-amplifier, sync-separator, sync-clipper, and phase-inverter circuits.

The 6AW8-A is like the popular 6AW8 but features a pentode unit having a plate-current characteristic with a controlled knee to provide good linearity at relatively low plate voltage and a high value of transconductance (9000 μmhos). In addition, this tube is designed with a 600-ma heater having a controlled warm-up time to insure dependable performance in television receivers employing series heater-string arrangement. The 6AW8-A has two cathodes with individual base-pin terminals.

Tube Div., Dept. ED, Radio Corp. of America, Harrison, N.J.

CIRCLE 64 ON READER-SERVICE CARD

Tape Resistive Strip

Versatile For Wide Applications

Stripline and waveguide dissipative cards made by the Tape Resistor Process have a thickness of only 0.008 in. This allows operation at much higher frequencies in waveguide. A further advantage with stripline is that cards may be sandwiched between stripline boards with much less interference than with thicker boards which are usually about 1/32 in. thick. Scissors may be used to cut the strip into triangular and other shapes as required to give matching. HF-1 Resistive Strip has standard dimensions of 1 x 3 in. and values of 50, 100, and 200 ohms per square. Other sizes and values are available.

Hansen Electronics Co., Dept. ED, 7117 Santa Monica Blvd., Los Angeles 46, Calif.

CIRCLE 65 ON READER-SERVICE CARD

CIRCLE 66 ON READER-SERVICE CARD ➤

Chromatograph Scanner

Charts Radioactivity

Accurate graphical presentation of the activity distribution along a paper chromatogram which has been tagged with low-energy beta-emitting isotopes is provided by this automatic radioactive chromatograph scanner. The scanner has important advantages over a rectilinear chart. Any of ten different scanning speeds can be selected by setting a lever. Chart and chromatogram speeds are always identical, facilitating reading the result by simple alinement. Chromatograms up to 3 in. width and 5 ft length can be accomodated.

The radioactive chromatograph scanner can be operated without a window to increase its sensitivity to C-14, S-35, H-3, etc. If used with a window, contaminated windows can be exchanged in a few seconds for a cost of less than one cent. All parts of the instrument are designed for easy de-contamination; the scanning head has been made readily removable for that purpose.

Scanning is interrupted automatically when the end of the chromatogram is reached, and in addition an audible signal is given to alert the operator. The instrument is portable, weighing only 32 pounds, and is provided with a convenient carrying handle.

Forro Scientific Co., Dept. ED, 833 Lincoln St., Evanston, Ill.

CIRCLE 69 ON READER-SERVICE CARD FOR MORE INFORMATION

100 Kc Quartz Crystals

For Secondary Standards

This quartz crystal unit is sealed in glass and intended for use in secondary frequency. standards. It is a DT-cut, 100-kc element with a tolerance of ±5 ppm at 70 C, and a temperature coefficient of less than 0.7 ppm per degree C between ±65 C and ±75 C. The unit, designated BG9D-S, measures 3-1/16 in. overall, and is mounted in T-9 bulb with a standard octal base.

Bliley Electric Co., Dept. ED, Union Station Building, Erie, Pa.

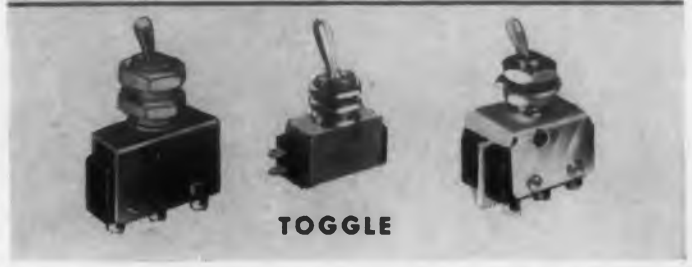
CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

Switching problems resulting from new size, weight, rating, environment, circuit simplification, or cost requirements can be time consuming and expensive to solve if tackled alone. But Electro-Snap engineering can save you time, money and performance—and usually with "standard" switches—if you bring your switching problems to us. The switches and actuators on these pages may solve some of your problems immediately, but they are only a fraction of the thousands of switch configurations available "off-the-shelf" at Electro-Snap. Remember that *all* Electro-Snap switches have self-wiping contacts and quick, positive snap action . . . and are built to the toughest aircraft and industrial specifications. Complete data are available for every switch so you always deal with known quantities—no wasted time in finding out for yourself. Ask for this data. Use the coupon below, write us your problem directly.

HERMETICALLY-SEALED	DIE-CAST	
		
H1-43	ES4-KM	
DPDT	SPDT NO	SPDT 2 Ckt.
10A—200,000	10A—MIN 100,000	
10A—200,000		
—100° TO +250° F.*	—67° TO +160° F.	
8 oz.	4-1/2 oz.	
1-1/4 X 3-3/4 X 1-7/32	1-3/4 X 2 X 1-1/32	
Hermetically sealed case; adjustable actuator arm. New "Landing Gear Switch".	Impulse one way, opens circuit during over-travel and return.	

HERMETICALLY-SEALED	DIE-CAST
	
H10-7	ES4-D
DPDT 4 Ckt.	DPDT 4 Ckt.
10—50,000	15A—500,000
15—50,000	10A—500,000
—100° TO +250° F.	—67° TO +160° F.
6 oz. APPROX.	7 oz.
1-7/64 X 2-1/8 X 1-7/16	2-1/2 X 2 X 1-3/4
Rotary actuator with seal bonded to shaft AND case; 120° travel.	Environment free; good for machine tool applications; wet areas.

TYPICAL ACTUATORS



MAIL COUPON FOR CATALOG DETAILS

ELECTRO-SNAP SWITCH & MFG. CO.
4216-30 W. Lake St., Chicago 24, Illinois

Please send complete information on the Electro-Snap Switches checked below:

- ☐ Miniature Switches
- ☐ Basic Switches
- ☐ Multi-Pole Switches
- ☐ Hermetically-Sealed Limit Switches
- ☐ Die-Cast Limit Switches

Name_____
Company_____
Street_____
City_____ Zone_____ State_____

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Colored Toggle Switches

Eye Appeal and Coding

A new toggle switch with toggles of colored plastic in many colors improves the eye appeal of commercial appliances, and facilitates color coding of multi-circuit panel boards. These switches are available in sp, dp and center-off types; with screw, solder, or quick dismount spade terminals, or with wire leads. They are rated for up to 20 amps, and 1 hp, and carry the Underwriters' label of approval.

Carling Electric, Inc., Dept. ED, West Hartford, Conn.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor-Gearhead-Clutch

Bu Ord Size 10

Designed to operate directly from either a 115v or 26v 400 cps line, this motor-gearhead - clutch measures only 0.938 in. in diameter and 1.75 in. long. It conforms to the requirements for Bu Ord size 10 specifications, and to MIL-E-5400.

Input power per phase at stall is 3.0 watts, motor stall torque 0.26 oz.-in. no load speed 7000 rpm, rotor inertia 0.46 gm-cm^2, backlash at gearhead 30 min max, continuous torque rating of gearhead 25 oz-in., available slip clutch settings 2 to 25 oz-in, gearhead efficiency 90 per cent min. and weight 2.1 oz.

Available standard gear ratios are 4.8, 6.4, 8.1, 11, 14, 18, 24, 30, 39, 53, 67, 90, 115, 150 and 200. Gear ratios up to 10,000 are available to order (with increase in the length of the unit). Special voltage and power ratings, and extra high internal damping, also are available on request. The internal slip clutch, which protects both gearing and loads when operating under high stall torque conditions, can be omitted if desired.

The unit is installed and completely encased in an aluminum housing. The pinion shaft is 0.1250 in. in diameter and protrudes 7/16 in.

Servomechanisms, Inc., Mechatrol Div., Dept. ED, 625 Main St., Westbury, N. Y.

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Controllers

Thermistor-Actuated

Two dual-range models thermistor-actuated temperature controllers can be used for sub-zero applications. The operating ranges of Model 56006 are 200 to 600 F and 100 to 300 F, providing a total coverage of 100 to 600 F. Model 56007 will cover —100 to +50 F and 0 to 150 F, providing a total spread of —100 to +150. The ranges can be switched instantly without recalibration or other adjustment.

These controllers deliver exceptionally accurate control (0.25 per cent over their entire control range). Connecting leads can be up to 200 ft long, using ordinary electrical wiring without diminishing sensitivity and control accuracy. The instrument is ruggedly-built, is not position sensitive, and can be moved without affecting accuracy or calibration. Because of the high stability and excellent aging characteristics of the thermistor sensing element, the controller can be operated for periods of several months or more without recalibration. Recalibration is done simply with screwdriver adjustments without external reference standards.

The controllers contain an integral spdt power relay rated at 10 amps, 115 v ac. Separate circuits for indication and control make these two functions independent.

The thermistor sensing element can be supplied encased in a stainless steel probe 3/16 or 1/8 in. in diameter and 2 to 5 in. long, with a choice of three types of mounting heads.

Fenwal, Inc., Dept. ED, Ashland, Mass.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

Chopper in All Frequencies

Small-Size Series

Now available in all operating frequencies and models, a new series of choppers features reduced size, better dust seal and improved shielding. Measurements of this smaller unit are 2-5/8 in. high overall, and are 1-1/2 in. in diameter.

James Vibrapowr Co., Dept. ED, 4050 N. Rockwell St., Chicago 18, Ill.

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermal Time Delay Relay

Sub-Miniature Size

With a timing range from 3 to 120 seconds (±10 per cent) this relay has a non-inductive contact rating of 3 amps either at 115 v ac or 28 v dc. It operates on 2.5 v to 115 v ac or dc; and can be supplied to order for voltages up to 220 ac or dc, as well as for 400 cps 115 v ac. Heater power is 8.75 w.

Overall size of the relay, exclusive of base pins, is 1-13/16 in. long by 0.750 diameter. Port is provided so adjustments can be made without removing the metal dust cover. The unit is supplied with solder lugs, 7-pin miniature, glass to metal pins.

Belltron Mfg. Co., Dept. ED, 463 Hoover Ave., Bloomfield, N. J.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Electro-Hydraulic Control

And Transistor Amplifier

A transistorized servo amplifier and electro-hydraulic servo valve for electro - hydraulic control of industrial machinery is made in two new "building block" components. They combine features of electronic signal sensing with hydraulic control of variable delivery pumps, hydraulic motors, cylinders, and similar equipment. The XRJ301A amplifier and the electro-hydraulic servo valve, XVJ300A, make it practical to apply hydraulic power to many applications previously limited to electric drives.

The fully-transistorized amplifier is designed to receive signal inputs from any standard 60-cy a-c signal source. The user can provide manually variable controls, can make the control source a function of position, velocity or other command variable, or can utilize input signals from tracers or computers. The amplifier is designed for parallel summation, ratio comparison, or series summation of input signals. Output is designed to power a balanced single load, or split loads, of as high as 5 w.

The amplifier supplies the driving power for the new electro-hydraulic, 3-way servo valve which, in turn, controls the flow of oil to hydraulic linear or rotary motion drives. The single stage servo valve is driven by a high performance torque motor and is available in ratings up to 10 gpm, and 3000 psi.

Minneapolis-Honeywell Regulator Co., Dept. ED, 2753 Fourth Ave. S., Minneapolis, Minn.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

Pressure Transducer

For Fuels or Gases

A new, small, low-cost pressure transducer for both airborne and ground applications is designed for reliable and accurate service with jet and piston engine fuels, lubricating and hydraulic oils, and air, carbon dioxide and oxygen. Output signals may be either linear or to any desired curve, as required for actuating the appropriate control or measuring system.

The transducer will be available in pressure ranges of from 0 to 2 psi to 0 to 250 psi, although other ranges can be supplied as required. It is offered with potentiometer cards in resistance ranges of from 0 to 2000 ohms to 0 to 20,000 ohms. Current rating of a typical potentiometer is 10 ma at 5200 ohms, although other requirements can be handled. Models with resolution of better than 0.1 per cent are available.

Fitted with standard 3-pin connector plug terminals, and 1/8 in. ANPT or 7/16 in. 20NF3 pressure fittings, the units are hermetically sealed; all materials have been selected for galvanic similarity. Over-all length is 2-7/16 in., diameter is 2-7/8 in., weight is 6 oz.

The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Demodulator Unit

30 Cps To 100 Kc

Suitable for portable and airborne applications because of its high degree of tolerance for severe vibration and shock, the Model ED-551 and ED-551L electronic demodulator compares an ac input with a fixed reference and furnishes a dc output that is a direct measure of the amplitude and phase comparision. Input range is 0-15 v rms, 30 cps to 100 kc, reference input is 0-25 v rms; output 0-10 v dc. Dimensions are 1-1/2 in. x 3 in. The units are hermetically sealed. Model ED-551 plugs into a standard octal socket; Model ED-551L is mounted on a miniature 7-pin solder lug header.

Atlas Electro-Mechanical Labs., Inc., Dept. ED, 14734 Arminta St., Panorama City, Calif.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Sensing Relays

Built to Requirements

Sensing relays for aircraft and other applications, built to requirements, are announced by Cook Electric Company. They are intended for accurate voltage sensing by means of a controlled differential between operate and release voltages. These relays are used, for example, in a miniaturized inverter failure warning device which meets the requirements of MIL-R-7611, Cook Electric Company part number 645-40. Another typical application is in the same company's 645-14 relay. This unit, working on 400 cps ac, has an operating voltage of 93 to 10 v, release voltage of 82 to 92 volts, and is normally adjusted for a differential of 5 v. The unit can be tailored to sense either ac or dc, and to meet a wide range of temperature, shock and vibration ratings.

Cook Electric Co., Dept. ED, Diaphlex Div., 2700 Southport Ave., Chicago 14, Ill.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

Rugged Missile Gyros

Resist Severe Shock

Designated Series RG03-0100, this gyro, designed specifically for missile applications, and built for severe shock and vibration requirements, more than conforms to MIL-E-527A. Advance design features include replacement of pivots and bearings by wheel and gimbal system, use of standard miniature motors, high natural frequency, potentiometer pickoff, pressure-sealed cases and floating piston dry air dampers. Conventional spin axis orientation permits easy interchangeability with other gyros.

The motor is 115 v, 400 cps, one or three phase. Standard potentiometer pickoff is 5000 ohms, power dissipation 1 watt, maximum. Available ranges are ±10 deg/sec to ±800 deg/sec. Resolution is 0.35 per cent, linearity ±1.0 per cent, hysteresis ±0.5 per cent, and angular momentum 250,000 cgs units. Weight is 14 oz. The case measures 2.47 in. high and 2.13 in. diam.

Humphrey, Inc., Dept. ED, 2805 Canon St., San Diego 4, Calif.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Beacon Antenna

For 75 Mc Marker Beacon

Intended to be installed by flush mounting on the bottom of an airplane fuselage, the Model AT-134, 75 mc marker beacon antenna has a shunt-fed, bent-channel receiving element top loaded by a small variable capacitor in parallel with a 25 mmf temperature-compensated fixed capacitor. It measures 11-3/4 in. long by 7-3/4 in. wide and 3-1/4 in. high. Its flanged, deep-drawn aluminum-alloy case forms the antenna cavity. This case is open at the bottom, or airplane, side; the enclosure of the cavity is completed when the case is mounted on the airplane. The slotted shaft of the variable capacitor extends through the closed top of the case to permit screwdriver adjustment and tuning. Lead-in receptacle is provided, and an 18-mm threaded hole which may either be closed with a plug or used for dehydration.

Telectro Industries Corp., Dept. ED, 36-16 37th Street, Long Island City 1, N. Y.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Indicator

Counts to 60 Kc

Developed specifically for industrial applications, the Model 7340B frequency indicator and counter features a 50 mv input sensitivity, counting rate to 60 kc, and the use of printed wiring for compactness and reliability. The instrument provides economical measurement of frequency or speed, counts events per unit item, or operates as a totalizer.

Gate times of 1 or 10 seconds are available, with automatic recycling or single sample operation, and manual gate control is provided for longer sampling times or totalizer operation. Indication to 10,000 events per second, with automatic decimal point location, is easily read directly from glow transfer counting tubes.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

◀ CIRCLE 93 ON READER-SERVICE CARD FOR MORE INFORMATION

3-Inch Oscillograph Tubes

Varied Phosphor Persistence

A line of three 3-inch cathode ray tubes, with short-, medium- and long-persistence phosphors, has been made available. They are coded 3WP1, 3WP2 and 3WP11. The last has a short-persistence phosphor suited to photographic recording of the indicated phenomena. The 3WP2 utilizes a long-persistence phosphor especially useful in applications where only a temporary record of the phenomena is desired. 3WP1 has a medium-persistence phosphor for general oscillographic use.

Each tube has a flat face, a minimum useful screen diameter of 2-3/4 in. and a maximum overall length of 11-5/8 in.

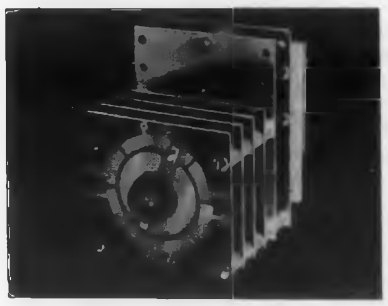
Design features permit the spot to be sharply focussed and to remain in sharp focus both at the edges and at the center, when beam current is varied over a wide range.

Radio Corporation of America, Tube Division, Dept. ED, Harrison, N. J.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION

Versatile Sequence Timer

Controls 32 Circuits



A miniaturized, small size, light weight sequence timer, originally developed for balloon instrumentation, has now been made available for general use in any field. Its power requirements are 8 ma at 6 v dc. It can be supplied with from 1 to 4 decks, with from 2 to 8 contacts on each deck, thus controlling a maximum of 32 circuits. Within these limits any timing sequence is supplied to the user's requirements by means of printed circuit manufacturing techniques. Speed regulation of the timer is ±1 per cent over a wide voltage range; weight is 3-1/2 to 4-1/2 oz. and dimensions (depending on the number of decks) are 1-3/4 in. to 2-5/8 in. deep, 2-1/4 in. high and 2-5/8 in. deep. Designation is Model AGC Sequence Timer.

Brailsford & Co., Inc., Dept. ED, 670 Milton Rd., Rye, N. Y.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN ADDS ANOTHER SERVICE FOR READERS

NEW "HOME REPLY FORM" BECOMES PART OF READER SERVICE CARD

Inquiries relating to employment can now be routed directly to your home. ELECTRONIC DESIGN'S new Reader Service Card carries a special "Home Reply Form" with space for your home or non-business address. If you wish to reply to any of the employment opportunities listed in ELECTRONIC DESIGN'S "CAREERS SECTION", simply circle the appropriate number in the gray area of the card . . . then fill in your home address in the space provided at the bottom of the card. The privacy of your inquiry is protected, while still offering you the speed and efficiency of ELECTRONIC DESIGN'S reader service card system.

ELECTRONIC DESIGN

Name and Title (Print or type all information)

Company

Company Address City Zone State

For Change of Address: Old Company Name

Old Company Address City Zone State

	10	20	30	40	50	60	70	80	90	300	310	320	330	340	350	360	370	380	390
1	11	21	31	41	51	61	71	81	91	301	311	321	331	341	351	361	371	381	391
2	12	22	32	42	52	62	72	82	92	302	312	322	332	342	352	362	372	382	392
3	13	23	33	43	53	63	73	83	93	303	313	323	333	343	353	363	373	383	393
4	14	24	34	44	54	64	74	84	94	304	314	324	334	344	354	364	374	384	394
5	15	25	35	45	55	65	75	85	95	305	315	325	335	345	355	365	375	385	395
6	16	26	36	46	56	66	76	86	96	306	316	326	336	346	356	366	376	386	396
7	17	27	37	47	57	67	77	87	97	307	317	327	337	347	357	367	377	387	397
8	18	28	38	48	58	68	78	88	98	308	318	328	338	348	358	368	378	388	398
9	19	29	39	49	59	69	79	89	99	309	319	329	339	349	359	369	379	389	399
100	110	120	130	140	150	160	170	180	190	400	410	420	430	440	450	460	470	480	490
101	111	121	131	141	151	161	171	181	191	401	411	421	431	441	451	461	471	481	491
102	112	122	132	142	152	162	172	182	192	402	412	422	432	442	452	462	472	482	492
103	113	123	133	143	153	163	173	183	193	403	413	423	433	443	453	463	473	483	493
104	114	124	134	144	154	164	174	184	194	404	414	424	434	444	454	464	474	484	494
105	115	125	135	145	155	165	175	185	195	405	415	425	435	445	455	465	475	485	495
106	116	126	136	146	156	166	176	186	196	406	416	426	436	446	456	466	476	486	496
107	117	127	137	147	157	167	177	187	197	407	417	427	437	447	457	467	477	487	497
108	118	128	138	148	158	168	178	188	198	408	418	428	438	448	458	468	478	488	498
109	119	129	139	149	159	169	179	189	199	409	419	429	439	449	459	469	479	489	499
200	210	220	230	240	250	260	270	280	290	500	510	520	530	540	550	560	570	580	590
201	211	221	231	241	251	261	271	281	291	501	511	521	531	541	551	561	571	581	591
202	212	222	232	242	252	262	272	282	292	502	512	522	532	542	552	562	572	582	592
203	213	223	233	243	253	263	273	283	293	503	513	523	533	543	553	563	573	583	593
204	214	224	234	244	254	264	274	284	294	504	514	524	534	544	554	564	574	584	594
205	215	225	235	245	255	265	275	285	295	505	515	525	535	545	555	565	575	585	595
206	216	226	236	246	256	266	276	286	296	506	516	526	536	546	556	566	576	586	596
207	217	227	237	247	257	267	277	287	297	507	517	527	537	547	557	567	577	587	597
208	218	228	238	248	258	268	278	288	298	508	518	528	538	548	558	568	578	588	598
209	219	229	239	249	259	269	279	289	299	509	519	529	539	549	559	569	579	589	599

For Personnel Ads Only (Nos. 550-599)

HOME ADDRESS City Zone State

LOOK FOR THE JOB OPPORTUNITIES LISTED IN ELECTRONIC DESIGN'S "CAREERS SECTION"

Begins on page 115 this issue

Hayden Publishing Company, Inc.

Tube Tester

Gives Triple Test

The Model 107 tube tester is a portable tester which provides three important vacuum tube checks. All tubes may be given the grid-circuit test to reveal intermittent leaks or shorts, gas content or reverse grid current, commonly called grid emission. A pre-wired panel permits a dynamic mutual conductance test to be run on all popular high transconductance or amplifier type tubes. All tubes may also be tested for cathode emission. Free point selection sets up every tube that fits six popular sockets and will not be obsoleted.

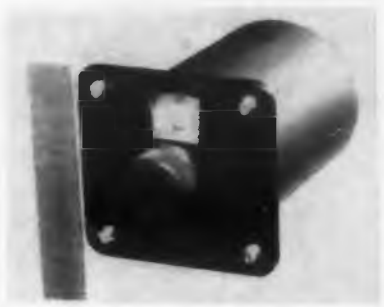
A handy "flip-chart" lists complete tube setup data for all current tubes. Completely self-contained, mounted in a handsome vinyl-plastic covered light green carry case. This tube tester weighs just 11-1/2 lbs.

Seco Mfg. Co., Dept. ED, Minneapolis, Minn.

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

Vernier Pot-Rheostat

Miniaturized



Available with either wire wound, carbon or carbon film resistors, a rheostat - potentiometer just announced has a rated accuracy of 0.1 per cent of full scale, resolution rated at 0.1 per cent or better, and rated linearity within plus or minus 0.1 per cent. Resistance range is 0 to 10,000 ohms for the wire wound model; other ranges and other accuracies are offered in the carbon element units. Single knob control of two decades is among the features of this unit; two turns of the knob cover the full range and provide resolution equal to that of a conventional ten turn potentiometer. Basic construction of the unit is that of a four terminal voltage divider. Panel space required is only 2 x 2 in., with 2-1/2 in. projecting behind the panel; wattage rating is 4 w when used as a potentiometer, 25 ma when used as a rheostat.

Research Instrument Co., Dept. ED, P.O. Box 9168, Portland 16, Ore.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 106 ON READER-SERVICE CARD ➤

Now – threaded ceramics that permanently hold precision tolerances!

Centralab Engineered Ceramics . . .

— can be extruded or molded

— can be worked before firing the same as metal

— ground, drilled, threaded, or tapped

— can be metallized

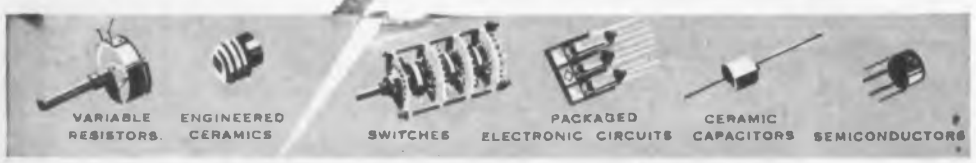
Another reason to insist on Centralab

- Threads ground into the ceramic itself — after firing. There's no shrinkage to cause variations in width and depth.
- Other fired-ceramic precision-grinding operations include centerless, cylindrical, disc, surface, and lap grinding — to precision tolerances previously unavailable.
- Ask Centralab to quote on your requirements.

Write for Centralab's Ceramic Buyer's Guide, Bulletin 42-221. Or refer to it in Sweet's Product Design File.

Centralab

A DIVISION OF GLOBE-UNION INC.
960B East Keefe Avenue • Milwaukee 1, Wisconsin
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

Wide Band Sweep Generator

VHF-UHF Range

A wide band sweep generator contains all the essential features of a standard cw and am signal source and covers the range from 15 to 400 mc. The model SG-132 is intended for use with vhf-uhf receivers and with similar equipment. It is helpful in measuring receiver sensitivity, selectivity, image rejection and gain, and for calibration, etc., of if amplifiers, broadband amplifiers, television equipment, and the like. Its output is entirely fundamental, not derived from beat-frequencies. Sweep width is 40 per cent of the center frequency of 15 to 400 mc, dial accuracy 0.01 per cent, output constancy with ±0.2 db over the entire frequency range, calibration from 0.1 to 150,000 μv throughout the frequency range. There is an integral de-coupled oscilloscope, and the panel also incorporates modulation, dbm and microvolt meters.

Transitron, Inc., Dept. ED, 186 Granite Street, Manchester, N. H.

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

80 To 10 Meter Tank Assembly

Continuous Tuning

Here shown is an improved version of a continuous - tuning amateur band transmitter tank assembly spanning the range from 80 to 10 meters. It is designated MB-40DL and is intended for use in grid circuits with approximately 20 watts input or in final plate circuits with not more than 40 watts input power, loaded. The tuning range is from 3.2 to 9.0 mc and from 12.0 to 34.0 mc and to tune to any of these frequencies it is only necessary to turn the dial to the proper setting. A vernier dial with 180 degrees rotation is recommended.

The Model MB-40DL can be used with push-pull or single-ended circuits. Output power can be coupled to an antenna or to a link; preferably to a 300-ohm load. Tetrodes such as the 6V6 or 6L6, etc., are recommended; but pentodes also can be used.

National Co., Inc., Dept. ED, 61 Sherman St., Malden 48, Mass.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

STROMBERG-CARLSON

"BB" Series Relays

For your automation ...computing...control circuit applications... "Telephone Quality" at an ordinary price

To meet your needs for precision and durability in automation, computing and control circuitry, this relay provides *telephone quality* at an ordinary price.

The "BB" Series Relay accommodates up to 100 Form A spring combinations. It incorporates such important advantages as twin contacts, knife-edge pivot and special frame-armature construction. Like all Stromberg-Carlson relays, it is built to operate under extreme ranges of temperature and humidity. *Prompt delivery is available on all orders.*

This catalogue will give you complete technical details and specifications. We will gladly send you a free copy on request. Please ask for Catalogue T-5000R.

S-C STROMBERG-CARLSON

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION
TELECOMMUNICATION INDUSTRIAL SALES
116 CARLSON ROAD, ROCHESTER 3, N. Y.

CIRCLE 111 ON READER-SERVICE CARD

Enclosed Limit Switch

For Industrial Control

An enclosed precision limit switch, Type 30, has three choices of actuators and three housings, to form sixteen types of switches. Die-cast aluminum housings provide a rugged enclosure, adequate wiring space and a 1/2-14 internal tap conduit hub. Actuators include a plunger, roller arm and roller plunger types.

The roller arm actuator has a micrometer screw adjustment which moves the arm through a wide arc in setting the trip point. When the switch trips, a slight additional turn is given to allow for overtravel, then the locknut is tightened. This way of setting the trip prevents borderline operation and offers an unlimited number of trip positions. The roller plunger type actuator is adjustable through 360 degrees to take actuation from any direction. The plunger actuator type switch has a 0.002 movement differential and a 1/2-in. overtravel.

The Type 30 Sealed Enclosed Limit Switch is oil, dust and water tight, by use of improved methods. Switch actuation is sensitive. The switches give more than 10,000,000 actuations under severe operating conditions. The serpentine switch mechanism largely eliminates the problem of switch fatigue and assures positive equipment actuation.

Licon (R) Switch and Control Div., Dept. ED, Illinois Tool Works, 2501 N. Keeler Ave., Chicago 39, Ill.

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

Fiber Glass Switch Box

Corrosion-Resistant

Produced entirely of fiber glass reinforced polyester to make it strong, flame and corrosion resistant, a new insulated switch box is now on the market. Its corrosion resistance makes it ideal for application in barns and all farm buildings, industrial plants, or in all buildings where contaminated or highly humid air is present. The new switch box in itself is completely insulating and on many circuits eliminates the necessity of grounding. Its strength brought about by the inherent characteristics of fiber glass reinforced plastic is great enough to withstand any abnormally rough treatment in shipment or installation.

Porcelain Products, Inc., Dept. ED, Findlay, Ohio.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

22.5 V DC Power Supply
Is Line Transient-Free

A new line transient-free, short circuit-proof airborne power supply unit provides 22.5 v dc for various telemetering and instrumentation applications.

While the MRP 22.1 may be used for various purposes requiring 22.5 v dc, it was designed specifically to power MRC's new MMO-522 low-level magnetic dc signal amplifiers, which eliminate gain variations by operating directly from a dc source. The power supply itself operates from a standard 400 cy aircraft main, feeding dc input to the MMO-522 signal amplifiers, each of which incorporates a transistor oscillator. Since they are dc-powered, the amplifiers are free from the variations normally encountered when excitation is provided by a 400 cy line supply which is subject to a ± 10 per cent tolerance. The MRP-22.1 power supply drives from 10 to 12 of the MMO-522 amplifiers. The amplifiers themselves are used principally in the amplification of the thermocouple and strain gauge output in industrial, military and medical installatons. They serve equally well as very stable dc v amplifiers for radio telemeter systems or as high-gain dc power amplifiers for relay-type temperature and servo control systems.

Magnetic Research Corp., Dept. ED, El Segundo, Calif.

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Resistor Networks
For Strain Gauge Amplifiers

Especially designed to fit the front panel of strain gauge amplifiers, these resistor networks are available on anodized aluminum front panels to facilitate ease in selecting the proper resistor block. Each resistor is wound on glass-reinforced plastic forms with glass-insulated wire, and is capable of dissipating 10 watts overload for short periods of time. Any number of these precision resistors can be supplied in one encapsulated package, and a variety of configurations and schematics can be arranged.

Eastern Precision Resistor Corp., Dept. ED, 675 Barbey St., Brooklyn, N. Y.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW **2** INEXPENSIVE

MICRO-MICROAMMETERS

1 MODEL 411 *for maximum stability*

Meets or exceeds the zero stability of the most costly equipment; recommended for long-term control, alarm, and monitoring work, as in thickness gaging and reactor control. No transients created by switching from range to range.

★ **RANGES:** two per decade, from 10^{-3} to 10^{-11} ampere full scale.

★ **ZERO DRIFT:** less than 2% per week, with source voltages above 10 volts.

★ **TIME CONSTANT:** less than 4 seconds on the 10^{-11} range with 5000 mmf across input.

2 MODEL 410 *for maximum sensitivity*

The general purpose instrument for measurement and control of microcurrents. Typical uses: currents in ion gages, ion chambers, photocells, vacuum tube grids, back currents of silicon transistors.

★ **RANGES:** two per decade, from 10^{-3} to 3×10^{-13} ampere full scale.

★ **ZERO DRIFT:** less than 2% per day, with source voltages above 300 millivolts.

★ **TIME CONSTANT:** less than one second on the 10^{-11} range with 5000 mmf across input.

BOTH MODELS include a 250-volt tap for polarizing ion chambers, an output that drives 50-millivolt and 5-milliampere recorders, input and output connections at both front and back. Suited to both bench and rack mounting, and available with a contact meter in place of standard meter.

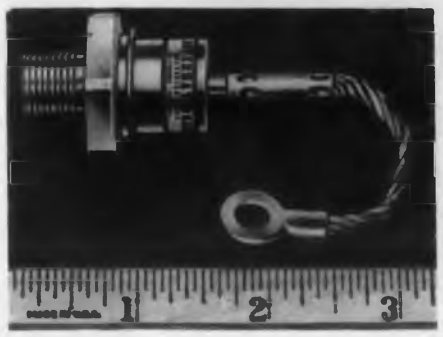
DESCRIPTIVE LITERATURE is now available. A request on your company letterhead will bring your copy promptly.

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

CIRCLE 123 ON READER-SERVICE CARD

Silicon Power Diodes

14 to 70 HW Amps



A series of silicon diodes in the 14 to 70 (half wave) amp rating have been made available for such industrial uses as motor loads welders and battery chargers, and for dc power supplies in aircraft and missiles, and on ships. Six of these diodes assembled on heat sinks and connected in a three-phase bridge can supply 13 kw at 175 v dc with natural cooling or 33 kw at 175 v dc with forced draft cooling. The diodes are available for peak inverse voltages from 50 to 300 v. They are miniaturized, and hermetically sealed.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

Data Recording Cameras

Have Synchronized Control

These all-purpose precision data recording cameras provide automatic, matched-frame analysis. They have been used for data reduction by aircraft manufacturers in fire control evaluation, flight testing, missile tracking and bomb spotting.

The cameras can be used for time and motion studies, the analysis of machine operation techniques, testing new products, and expediting the study of various manufacturing processes.

The cameras photograph motions or events taking place simultaneously at separated locations. The shutter and film drives are synchronized to an accuracy of one and one-half milliseconds from camera to camera, providing automatic frame-for-frame comparisons of films taken by any number of cameras in a parallel-operated gang. Three individual coding lights in each camera permit the coding of film sequences and indicate time intervals on film.

Small and lightweight, the cameras are available in 16 mm and 35 mm models. The MOD III 16 mm camera accepts the standard Eastman 50 ft. magazine; the MOD IV-C 35 mm camera has an internal film capacity of 100 ft on daylight loading spools.

Flight Research, Inc., Dept. ED, Richmond, Va.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Here's your guide... to better wiring with one-third the work

This new bulletin gives you the facts . . . and complete how-to-do-it instructions for wiring your product with PANEL CHANEL® raceways. All steps are fully illustrated. PANEL CHANEL does the wiring job with one-third the work . . . and even greater reductions in cost. PANEL CHANEL is relatively new . . . but it is already the standard wiring method used by hundreds of leading electrical and electronic equipment manufacturers for their products. *You Should Have the Facts.* Send for your copy of Bulletin S-301, today.

Panel Chanel®

STAHLIN BROTHERS, INC. • 103 MAPLE STREET
Belding, Michigan

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Designers might find it profitable to redesign their present products, or to conceive of better products, to take advantage of the capabilities of these new production equipments.

Ultrasonic Cleaner

For Small Parts

A new ultrasonic cleaning apparatus has been developed. The AP-10-B is a small, compact instrument, designed specifically for bench-top operation in the washing of delicate, intricate parts that must be "surgically" clean.

The new instrument comprises a 36-40 kc/sec. power generator, and a cylindrical cleaning tank with transducers hermetically sealed into the base. RF power output of the generator is 50 w avg, 200 w peak on pulses. Tanks are of 1 pint, 1 quart, or 1/2 gallon capacity, giving a maximum effective cleaning area of 18 sq. in. Two of the smaller tanks may be operated simultaneously, and two of the larger tanks alternately, depending on tank size specified.

Branson Ultrasonic Corp., Dept. ED, 37 Brown House Rd., Stamford, Conn.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

Tool Room Miller

Multipurpose Uses

A new Model 422 precision tool room model bench milling machine has been designed. This small precision mill has the machine tool accuracies of mills costing two to three times its price. This mill can also be quickly converted into a precision surface grinder and for special lathe operations. A new low cost 4 x 8 in. magnetic chuck is offered as one of the many accessories.

Lloyd Tool Corp., Dept. ED, P.O. Box 647, Burbank, Calif.

CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Rotary Hearth Oven

Permits Production Runs

This oven has been designed and built to permit loading and unloading from the same position by a single operator, and at the same time permits a continuous movement of work in and out of the heating zone.

A large volume of work space is obtained with this rotary design. Standard speed range from 2 to 10 in. per min or approximately one to five revolutions per hour makes this type of oven practicable for processing many types of products. No doors are used. An alloy steel chain curtain is used to conserve heat and provide convenient access to work chamber.

These ovens are built to individual requirements. Oven illustrated has inside working space 14 x 9 x 50 in. long on an OD of 54 in., ID 26 in. Maximum working temperature 1000 F.

Grieve-Hendry Co., Inc., Dept. ED, 1401 W. Carroll Ave., Chicago 7, Ill.

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

Two-Sided Spray Etching Machine

For Printed Circuits

Expressly designed for the production of printed circuits, a new and advanced spray etching machine has been built. Among some of the salient features of the new etching machine are simultaneous two-sided etching of a circuit board, temperature and baume control, rapid etching time as well as certain very interesting automation features.

Robertson Photo-mechanix, Inc., Dept. ED, 7440 Lawrence Ave., Chicago 31, Ill.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Bench Type Welders
5 and 10 Kva

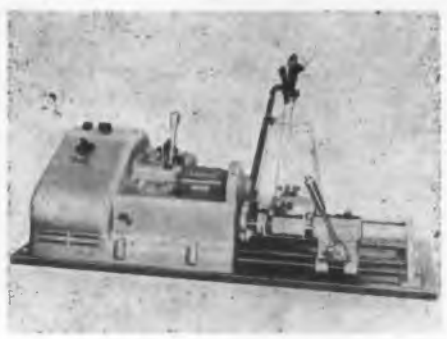
Two new bench type air-operated 5 and 10 kva spot or projection welders specially designed for light and nonferrous metals are available. Features include valve and speed controls mounted at the cylinder for easy access and greater speed, and a ram bearing surface of 15 sq in. at full stroke. When horns are used, the greater bearing surface gives more rigidity and reduces tip skidding. Air controls are mounted above the welder for better cylinder lubrication. Spring follow-up heads are available.

The welders are water-cooled and the transformers have four heats. No. 1 Morse taper electrodes are used and the lower bracket has a 4 in. vertical adjustment. Cylinders are 2-1/2 or 3 in. with a 2 in. stroke. Similar floor type and foot-operated welders are offered for use where air is not available. The company has a complete line from 1 to 50 kva.

Weldex, Inc., Dept. ED, Detroit, Mich.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

Gearless Bobbin Winder
High Speed Direct Drive



Need to make gear changes on this coil winder is eliminated entirely by a unique time-saving pitch selector which cuts job change-over time in half. The high speed, direct drive, adjustable winding length bobbin winder has an emergency safety stop button which halts the machine instantly.

Winding speed is up to 8000 rpm with a range of 60 to 700 turns per inch. Features include wire sizes from 27 to 46, 2 in. max coil OD, 3-1/2 in. maximum transverse for any single continuous winding, 8-1/2 in. max loading area for multiple winding, and winding traverse infinitely adjustable from 1/8 to 3-1/2 in.

Geo. Stevens Mfg. Co., Dept. ED, Pulaski Rd. at Peterson, Chicago 30, Ill.

CIRCLE 139 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

High Speed Machine Brands

Variety of Vacuum Tubes

Tube manufacturers can now imprint trademark, company name, tube type designation and other detail on vacuum tubes at rates as high as 7000 per hour, with a cylindrical object marking machine.

The Model 20A machine handles tubes ranging from miniature glass types to "bulgy" or pear-shape types, by means of five different interchangeable chutes. Chutes are marked according to the tube types they accept, together with calibrated adjustment scales. Precision molded rubber printing elements, and specially formulated marking compounds for glass, metal, etc., assure clear, attractive imprints. Chute feed and automatic ejection provide production speeds from 3000 to 7000 tubes per hour.

Specifications of the 20A machine include dimensions of 26 x 13 x 18 in.; bench mounting; 1/4 HP motor drive; max imprint size 2-7/8 x 6 in.

Marken Machine Co., Dept. ED, Keene 59, N.H.

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Toroidal Coiler

Electronically Actuated

A completely new approach to the problem of high speed production of the diminutive toroidal components used in shift register, computer memory and similar magnetic devices, is used in this miniature machine. Specifications: core size, maximum outside diameter 3/4 in. height to 1/2 in.; residual hole, minimum, using smallest ring, 0.055 in.; wire size, 34 to 45 AWG; winding rings, 3 in. diameter, 1/8 to 3/64 in. cross-section; wire capacity, exceptionally large, typical value for 1/16 in. winding ring is 235 circular mill feet; turns counter, thyratron actuated high speed impulse counter provides positive counting to a maximum of 1200 counts per minute; speed, variable to limits of counter capabilities; footage counter, automatic registration of loading footage; feed, manual, 180 or 360 degree, as desired; power, 115 v, 60 cy for motor and electronic counting equipment.

Donald C. Harder Co., Dept. ED, 3710 Midway Drive, San Diego 10, Calif.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Miniature Toroid Winder

1/16 Inch Core Diameter

Employing a new winding technique, a unique toroidal winder has been developed which uses a magnetically controlled needle. The needle, of the ordinary sewing variety, is threaded with a length of wire and, by means of a rotary permanent magnet, is made to pass successively through the toroidal core in a simple sewing action. In this manner, turns of wire are placed on the core. The ID of the toroid is limited essentially by the size of the needle.

Toroids with initial hole diameters of 1/16 in. or smaller are readily accommodated by the machine. This technique is in contrast to the conventional winder which employs a split, circular bobbin. A simple needle passes through a smaller hole than can a more complex bobbin.

In addition to accommodating smaller cores, the new machine has simplified the winding action in that wire is wound directly onto the core. No involved intermediate actions are required, such as the insertion, winding and removal of bobbin.

Hughes Aircraft Co., Dept. ED, WSDL, Culver City, Calif.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

Commutator Turning Machine

Finishes Up to 700 Per Hour

Model CTM 2000, a fully automatic commutator turning machine has been introduced. By employing diamond cutting tools, the new design of this machine allows a single semi-skilled operator to turn automatically from 500 to 700 finished commutators per hour. Rough and finish turning can be performed simultaneously by simply using two diamond tools.

Completely flexible, the machine can be quickly adjusted to turn commutators of up to 2 in. diameters and 2 in. lengths, with a tolerance of 0.0003 in. or better, and with a 15 micro-inch surface finish if so desired. A complete armature change can be made in approximately fifteen mins.

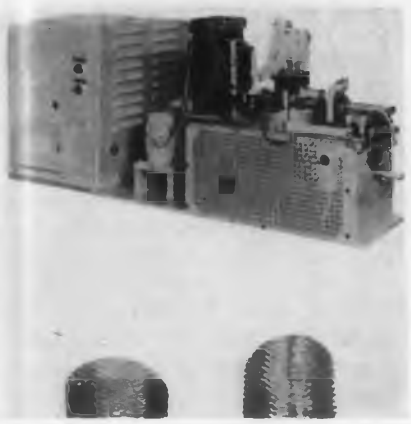
Motor-Mation, Inc., Dept. ED, 116 W. 9th St., No. Canton, Ohio.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Wire Cloth Welding Machine

Completely Automatic



A new, completely automatic machine for forming and welding cylindrical screens of wire cloth has been introduced. The new welding machine is expected to find wide use in the electronics industry for forming and welding vacuum tube and microwave parts. The wire cloth is fed to the machine from a reel, cut to exact size, wrapped on an arbor, welded, then ejected. This complete process is automatic, and nominal production rate is 3000 parts per hour.

For fuel filters, the automotive industry is using 120 x 108 mesh of monel metal wire cloth, 0.687 in. wide, formed on a 0.192 in. arbor. However, with appropriate tooling, the machine will form other cylindrical parts in a wide range of diameters and in lengths to 0.750 in. The automatic wire cloth welding machine is supplied complete with all power supply components and controls, ready for installation and operation.

Federal Tool and Engineering Co., Dept. ED, 1384 Pompton Ave., Cedar Grove 1, N.J.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

Thread Cutting Fastener

For Thin Sheet Metals

Specially designed to hold die-cut or cold-forged name plates, emblems and trim against sheet metal surfaces, this thread cutting fastener cuts clean, deep threads on unthreaded studs, and can also be used in other applications which require a spring take-up fastener.

When used with its pre-assembled plastic sealer, the new TCF makes a watertight seal. (The sealer precedes the fastener onto the stud so that it is not damaged by the thread cutting process.)

The TCF is low cost, re-usable, self-locking, vibration proof and has a spring take-up which guarantees flush mounting on flat or contoured surfaces.

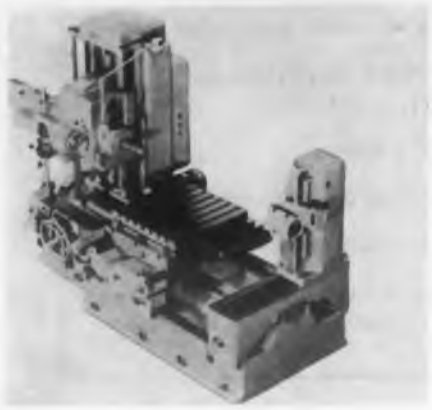
United-Carr Fastener Corp., Monadnock Mills Div., Dept. ED, San Leandro, Calif.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Tool-Room Boring Mill

Optical Coordinate Settings



A new system of optical coordinate setting has been incorporated in the "Optimetric" tool-room boring mill.

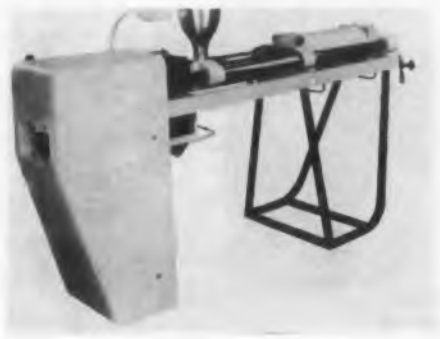
Projection screens are fitted to the vertical adjustment of the spindle slide and boring stay, and the transverse movement of the table. This patented system of optical measuring permits utilization of the full degree of accuracy available in a machine of this capacity. Settings within an error of no more than 0.00025 in. are easily obtained. The wide bed support enables the table to be brought out at either extreme end without deflection. Three sizes are available in the series: Model OA, 2-1/2 in., Model OB, 2-3/4 in., and Model OC, 3 in.

British Industries Corp., Dept. ED, 80 Shore Rd., Port Washington, N.Y.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

Transfer Molding Press

Completely Automatic



For thermosetting plastics, Model 99-A Automatic Transfer Molding Press uses general purpose powder which does not require preheating. Standard mold blocks are held in place by a standard mold retainer set. The unit is particularly well suited for low quantity runs.

Tolerances to ±0.0005 in. are possible. Flash is minimized and finishing holes are possible, since core pins can be piloted through to the other half of the mold. Maximum parts dimensions (2 cavity mold) are 1-1/8 x 1-1/8 x 7/8 in. Per cycle feeder capacity is 0.9 cu in.

After mold is put into operation, the press is completely automatic, other than the refilling of the hopper and emptying the container of finished parts.

Hull Standard Corp., Dept. ED, Abington, Pa.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

Production Products

Strip Cutter

Produces Precision Grids

A series of new grid strip cutter (chopper) machines is now being marketed. Typical of these new strip cutters is machine No. 2823 which accurately cuts wound strips into individual radio tube grids of all sizes. These sizes are controlled by a unique "stop strip" holder which assures accuracy, and by special steel cutting blades. To facilitate sharpening these cutting blades are easily removed.

Designed for safety, these grid strip cutters have full, protective guards that help prevent possible accidents. An air operated mechanism is used in this equipment to assure positive, dependable operation with minimum maintenance. Standard machines handle a variety of materials and material sizes, "customized" units for every production requirement can be supplied with a selection of features including full automatic programming.

Kahle Engineering Co., Dept. ED, 1400 Seventh St., No. Bergen, N.J.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Koil Kradle

Simplifies Materials Handling

For supplying coil stock to presses and other equipment, an improved koil kradle is announced. The new koil kradle is equipped with casters enabling it to be moved easily from machine to machine, as needed, and also facilitating alignment of Koil Kradle to the machine. It is available in capacities from 1200 to 16,000 lbs, handling 60 in. diam coils up to 48 in. wide.

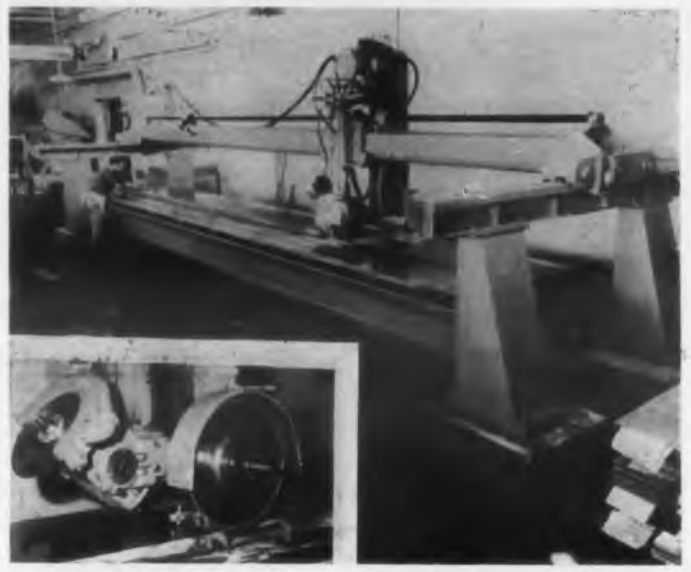
Front wheels of the portable model swivel for steering. As tongue is lowered, bed is lifted by a cam, clearing the floor 1/4 in. With tongue in vertical position, front of bed is lowered to set solidly on the floor.

Benchmaster Mfg. Co., Dept. ED, 1835 W. Rosecrans, Gardena, Calif.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

Services for Designers

Extra Long Laminates Cut by Special Saw



A special long-length saw enables the Synthane Corp., of Oaks, Pa. to saw laminated plastic sheets up to 38 in. wide and lengths up to 25 ft, although sheets of almost any length can be sawed by hitching. By the use of hitch-curing or multiple pressing techniques, Grades C and L can be furnished in extra long lengths from the Company's 96 in. x 24 in. press. The maximum length for sheets of 2 in. thickness is 276 in., but lesser thicknesses can be furnished in lengths up to 29 ft.

The new saw may be equipped with diamond or abrasive cut-off wheels, tungsten-carbide tipped wheels, or high carbon steel saws, depending upon the grade of laminated plastic to be cut.

Display Boards Of Short Run Stampings

Display boards showing different types of short run stampings have been developed to provide factual information to companies using or considering short run stampings in their manufacturing process. It gives tooling costs and running costs in addition to showing actual samples of typical short run applications.

Included on the display are short run samples of stamping, forming, and drawing. Metals included are copper, brass, aluminum and steel. There are also samples of plastic and phenolic stampings.

The Display Boards can be loaned from the Federal Tool and Manufacturing Company, 3640 Alabama Ave., Minneapolis 16, Minn.

Services for Designers

Printed Circuit Design
And Packaging Service

A printed circuit and modern packaging service, complete from design to manufacturer, is now being offered to the electronic industry for commercial and governmental use.

The service, available through the Federal Telephone and Radio Co. Printed Circuit Laboratory, offers the latest techniques for solving complex problems in such fields as guided missiles, electronic controls, telephone controls, flush circuits, sub-assembly modules, Microstrip, aircraft communication equipment and electronic calculators.

Among the facilities are equipment for rapid etching of copper laminates, a variety of plating equipment ranging from solder-coating to gold, equipment for processing printed-circuit resist patterns by several techniques including photography, special facilities for automatic potting and encapsulation, and protection of printed circuits by many types of protective coatings. Development of special dielectrics and laminates for particular requirements is also a part of the service.

Complete details may be obtained from Electronic Systems Sales Department, Federal Telephone & Radio Company, 100 Kingsland Road, Clifton, N. J.

Miniature Coil
Production and Design

A nationwide design and production service is available for users of miniature magnetic coils. Tur-Bo Jet Products Co., Inc., of San Gabriel, Calif., specializes in the engineering and rapid production of tiny coils, a job which many users find difficult. The firm has methods of winding miniature coils with such high-temperature insulations as epoxy, silicone, Teflon and Ceroc-windings which conform to NEMA and military specifications. The company has a national service for manufacturers of relays, valves, clutches, gyros, synchronous motors and solenoids.

The company uses controlled-tension winding machines, and has large stock of small wire, down to #52 AWG copper in size.

Prototypes are built in a very short time; only a few days at most. The company maintains two plants, each equipped for short runs or mass production under quality control. Literature will be sent on request to Tur-Bo Jet Products Co., Inc., 424 So. San Gabriel Blvd., San Gabriel, Calif.

New Literature

Engineer—Author's Guide 181

Title of this guide is "It's Easy to Write Articles for ELECTRONIC DESIGN." What to write about, and how to write the article is covered. Subject ideas covered are circuits, design techniques, design aids, measurement techniques, design data charts, application stories, and design survey stories. The guide is concise and easy to read. ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N.Y.

Germanium Plating Rectifier 182

Bulletin GED 2934 describes an air-cooled germanium plating rectifier. Among the design features explained are the hermetically sealed cell, the cooling system, the remote control installation, and the automatic voltage control. Illustrations show both individual parts and the entire assembly. The folder also contains a list of available models. General Electric Co., Schenectady 5, N.Y.

Impedance Meters 183

Two models of coaxial impedance meters operating in the frequency range of 1500 t 12,400 mc, and six models of waveguide im pedance meters, operating in the frequenc range of 2600 to 18,000 mc, are described i data sheet just published.

Photographs, features and specification are included in the data sheet. The Nard Corp., 160 Herricks Rd., Minneola, L.I.

Electronic Design Article Index 185

A reprint of the Index of Articles appear ing in the Dec. 15 issue of ELECTRONIC DE SIGN is offered to readers. The index cover the period of July 1 through Dec. 15. A précis of each article is included. Cros reference aid breaks the coverage into var ous subjects under the categories of Com ponents, Design articles, Materials, an Test Equipment. ELECTRONIC DESIGN, 19 E 62nd St., New York 21, N.Y.

Filtered DC Power Supply 192

Literature explaining the construction and operating principles of the Model NFA, a specially filtered dc power supply, has been announced. With less than a 3/4 per cent ripple at top load the NFA is used for design testing and servicing radios and electronic equipment in aircraft, autos, tanks, and marine craft; transistor circuits; relays and solenoids; telephone circuits; laboratory and research instruments; plating operation; and low voltage devices. The illustrated catalog sheets give specifications and design features. Electro Products Labs., 4500 N. Ravenswood Ave., Chicago 40, Ill.

Batching and Counting 193

Printed in booklet form is a 7-page article entitled "Batching and Counting Using Gas-Filled Decade Tubes" by W. Grimmond and W. H. P. Leslie. The article describes a range of units in the form of "building blocks" which can be quickly assembled to form a variety of frequency meters, chronometers, frequency dividers, batching counters. International Standard Trading Corp., 22 Thames St., New York 6, N.Y.

Teflon 196

The first of a series to be devoted to Teflon, Bulletin T-50 considers this plastic resin as a material. In 4-pages it details chemical, mechanical, thermal, electrical and other properties. A number of Teflon products — thin-and-heavy-walled tubing and rod, steel pipe lining, insulated wire, machine parts, and sheet—are illustrated and described. Haveg Industries, Inc., Halocarbon Div., 900 Greenbank Rd., Wilmington 8, Del.

Electrohydraulic Servo Valves 197

Volume 3, No. 1 of the Cook Technical Review, an issue of 28 pages, deals with electrohydraulic servo valves. Part I presents basic information relative to the types and characteristics of high response servo control valves. A second part describes the various types of valves which are commercially available and discusses the selection of electrohydraulic servo valves and their system application. The issue is $1.00 per copy in the U.S. and Canada and $1.25 in other countries. Cook Electric Co., 2700 N. Southport Ave., Chicago 14, Ill.

Cathodes for Electron Tubes 206

Up-to-date information on cathodes and other tubular electronic parts is given in the revised catalog No. 51 just released.

Using a smaller ceramic than standard, the narrow neck disc cathode permits manufacturers to produce cathode ray tubes with glass neck, thereby increasing the deflection angle of the tube to allow a shorter tube design. In order to provide cathode alloys with improved performance characteristics, a new series of alloys has been developed. These are covered.

The dimension and tolerance tables of round and shaped seamless and Lockseam form cathodes has been expanded, and additional information on standard and miniature disc cathodes is included. Chemical analysis, mechanical and physical properties of electronic materials is included for 11 cathode nickel alloys, glass sealing alloys, and alloys for fabricated tubular parts.

Other items described in the catalog are anodes and grid cylinders, tubing and tubular parts for transmitter and special purpose tubes and semi-conductor devices and fabricated tubular parts. Superior Tube Co., 1848 Germantown Ave., Norristown, Pa.

Fluorescent Lamp Ballasts 207

Listings of a complete line of fluorescent lamp ballasts are tabulated in Bulletin GEC-983J. The booklet's 12-pages contain electrical specifications and prices of ballasts for germicide, circline, rapid-start, and slimline and 40 w instant starting lamps; and of weatherproof, trigger-start, and general line fluorescent ballasts. Also covered are ballasts for dc operation and for dimming and flashing. Wiring diagrams and cross section drawings illustrate the booklet, and a cross-referenced table shows ballast lead lengths. Installation and operation instructions are included. General Electric Co., Schenectady 5, N.Y.

Pressure Gages 208

Four-page bulletin No. 403A describing pressure gages with new concept in transmitting linear motion is now available. Deflection of the pressure cell is transmitted to the indicating pointer of the gage without gears.

Among the advantages are elimination of back lash, and positive response to movement of the pressure element; accurate calibration over the full dial arc; and elimination of hairspring.

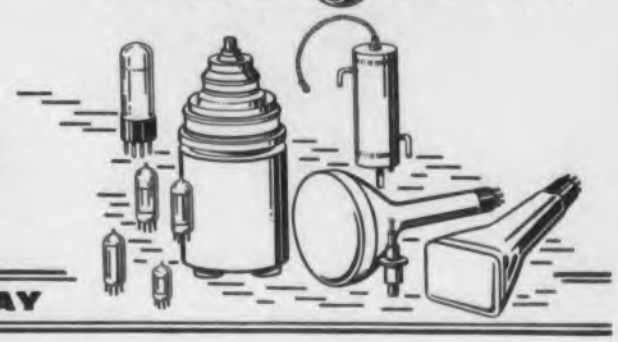
The bulletin is illustrated and gives the specifications and the standard ranges—from 0-60 psi to 0-20000 psi. Norden-Ketay Corp., Instruments & Systems Div., Commerce Rd., Stamford, Conn.

CIRCLE 300 ON READER-SERVICE CARD

TUBE DESIGN NEWS

GENERAL ELECTRIC

RECEIVING • POWER • CATHODE RAY



Using Low-Noise GL-6299's, Applied Research Analyzer Monitors Republic Fighter Planes for Radio Interference

ABOVE: narrow white band across bottom of the scope portrays low noise level of the GL-6299 triode (less than 5 db) in 225-to-400-mc service. Actual (or simulated) signal impulses of microvolt and up show as sharp spikes, easy to detect. RIGHT: monitoring the electrical components of a Republic plane for absence of radio interference or interaction.

Applied Research Inc., Flushing, N. Y. employs 11 GL-6299 tubes in the SPA-224 visual noise-interference analyzer, developed jointly by Applied Research and Republic Aviation Corporation to detect any radio interference from airborne electrical equipment.

Super-sensitive, the SPA-224 analyzer continuously presents 225 mc to 400 mc, making possible identification of any spurious signal in this range from one microvolt up.

While an extremely low noise figure and high tube gain were primary reasons for specifying Type GL-6299 in the SPA-224 analyzer, other features were its small size (1 inch long by ½ inch diameter), planar design, and metal-ceramic construction. The GL-6299 is suited to many advanced instrument and other applications which call for precise, dependable performance and space-saving compactness.

Wide frequency range—from v-h-f to 3,000 mc—plus tube efficiency throughout this range, make for versatility. Extensive tests show life to 2,500 hours.

GL-6299's are in full-scale production, for immediate delivery. Characteristics, ratings, and price available from any General Electric office on the next page.

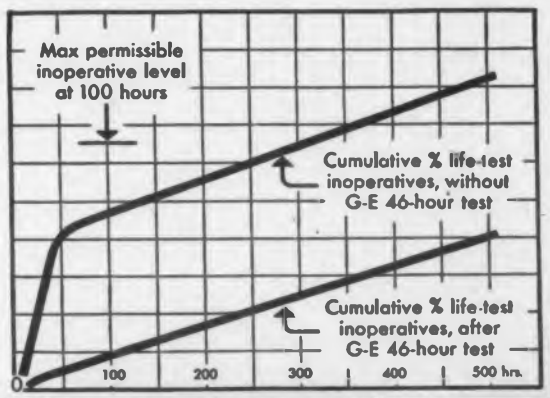
46-Hour Inoperative Control Test of All G-E Five-Star Tubes Cuts Failure Rate Sharply

By operating all 5-Star Tubes for 46 hours as an additional process before life tests begin, General Electric weeds out early-life tube failures.

Consequently, as the chart at right shows, the inoperatives in any 5-Star lot on life test are only half as many, at 500 hours, as they would be without G-E inoperative control. Furthermore, at 500 hours, the percentage of G-E 5-Star inoperatives is still far below the permissible figure established for 100 hours.

Employed only by General Electric, this 100% inoperative control process helps assure that 5-Star Tubes installed in critical military and industrial sockets will perform dependably across the board.

(Continued on Page 2, Column 1)



RIGHT: General Electric 5-Star Tubes on 46-hour inoperative control test. Only G.E. conducts this 100% pre-life test process on high-reliability tubes, to weed out early-life failures. ABOVE, the result: curve of General Electric 5-Star inoperatives is far lower throughout regular life test—1 to 2 at 500 hours' operation.

CLOSE G-E TUBE-MICA SPECIFICATIONS MEAN STEADIER TV. With tapered-pin micro-gages like that shown above, the diameter of grid side-rod apertures in G-E vertical sweep-tube micas is checked to an allowable half-mil tolerance, providing tight grid fit and minimum microphonics. By micro-measuring G-E tube micas and holding the grids to precision tolerances, image "jitter" on TV screens is virtually eliminated.

46-Hour Inoperative Control Test

(*Continued from Page 1*)

All 5-Star tests, as well as all product inspection—all manufacture of parts and assembly of tubes—are carried out in a special 5-Star factory set apart for the purpose, which is air-conditioned and pressurized to keep out dust and dirt. Lint-free Nylon and Dacron garments are worn throughout.

The industry's most extensive testing, plus manufacture under "Snow White" conditions, continues the quality theme that was established in the 5-Star Tube design stage, where ruggedness, reliability, and long life were the aims. For a convenient listing of these high-reliability types, ask any General Electric tube office for the 5-Star Selection Chart (ETD-1276-A) described on this page.

NEW PRODUCT BRIEFS

Receiving Tubes:

5DH8. New G-E triode-pentode for TV, especially suited to 600-ma series-string use.

6BW8. New G-E duplex-diode pentode for TV, useful as a horizontal phase detector and sound i-f amplifier, limiter, and AGC keyer.

6CX8, 8CX8. New G-E triode-pentodes for TV. Identical except for heater ratings. Also, 8CX8 is suited to 600-ma series-string circuits.

6919. New G-E twin diode for computer gating and clamping circuits. Has separate cathodes, low heater power, high perveance.

Cathode-Ray Tubes:

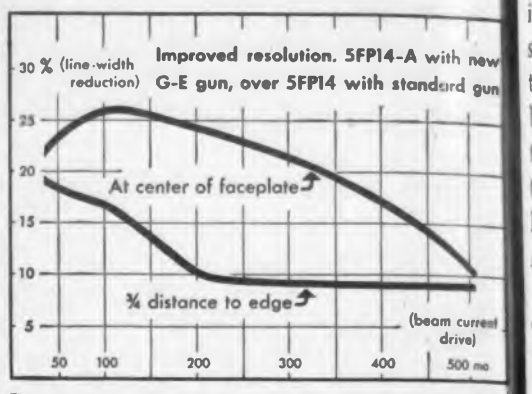
New radar types with high-resolution gun. 5FP7-B, 5FP14-A, 7BP7-B, 10KP7-A, 12DP7-C, 12SP7-D. Fully interchangeable with their prototypes.

ASK FOR COMPLETE INFORMATION!

Higher Resolution up to 35% from New G-E Precision C-R Gun

A new General Electric gun for military and industrial cathode-ray tubes makes possible improved image resolution, which with some types reaches the high figure of 35% at center of face-plate.

Three construction features are responsible for the new gun's efficiency: smaller grid apertures . . . less space between Grids 1 and 2 . . . closer tolerances on parts.



Improvement in image resolution in Type 5FP14-A with the new gun is shown by these curves of increased line-width reduction over the 5FP14 at successive beam drives. Better resolution for this tube ranges 8.5 to 26.1%.

G.E.'s high-resolution gun has wide application—can be used in any magnetic focus and deflection tube, with any phosphor.

Six radar tubes with the new gun already are available, ranging from 5 to 12 inches. Their presentations show details that with former types were cloudy or obscure. These types are listed under NEW PRODUCT BRIEFS at left.

REVISED!

General Electric 5-Star Tube Selection Chart

Up-to-the-minute . . . all types are included, with key ratings. Useful to designers of military and industrial equipment. Ask for ETD-1276-A!

EASTERN REGION
General Electric Company, Tube Sales
200 Main Avenue, Clifton, N. J.
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) Wisconsin 7-4065, 6, 7, 8

CENTRAL REGION
General Electric Company, Tube Sales
3800 North Milwaukee Avenue
Chicago 41, Ill.
Phone: SPring 7-1600

WESTERN REGION
General Electric Company, Tube Sales
11840 West Olympic Boulevard
Los Angeles 64, Cal.
Phones: GRanite 9-7765; BRadshaw 2-8566

Progress Is Our Most Important Product

GENERAL ELECTRIC

162-1C2

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

Electronic Computing System Guide 214

Recently published is a 9-page operational guide to the 1103A electronic computing system. The letter-size booklet includes a 3-page section on the terminology of the system, with definitions of word length, instruction word, address allocations, arithmetic registers, control registers, input-output registers, magnetic tape and magnetic drum storage, program sequence control, and automatic program interruption. Also featured is a complete list of the system's instruction repertoire, along with the execution time, in μsecs, for each instruction. A keyed block diagram of the system, and descriptions of the computer's characteristics and mode of operation are also included. Remington Rand Univac Div. of Sperry Rand Corp., 1902 W. Minnehaha Ave., St. Paul, Minn.

Thermopiles 215

A 12-page illustrated brochure features air and vacuum-sealed thermopiles which convert infra-red energy into electrical energy suitable for amplification and measurement. Recently introduced in the United States, the thermopiles are designed for use in infra-red spectrophotometry, astronomical infra-red measurement, emission pyrometry, and as components of temperature control devices. The booklet, CH313, cites principal characteristics, specifications, and available window materials for a variety of models and points out suitable applications for each. An amplifying galvanometer system is also illustrated and described. Jarrell-Ash Co., 26 Farwell St., Newtonville 60, Mass.

Precision Cameras 216

Eight-page illustrated brochure describing the multiple-purpose precision data recording cameras has been released.

It was designed and developed specifically to meet the increasing demand for multi-purpose photographic data recording instruments. Being small and light-weight, the cameras permit automatic, synchronized motion picture or single frame operation.

The brochure shows how the cameras have eliminated hundreds of hours in data reduction time for our armed forces and aircraft manufacturers in such diverse applications as fire control evaluation, flight testing, missile tracking and bomb spotting. Among the features of the cameras are the radar scope recording, neon lights code film for timing and event marking; frame-for-frame synchronization within 1.5 millisec., and withstanding ambient temperature extremes from −65 to +135 degrees F.

Full operating specifications and details of construction are given for both models. Flight Research, Inc., Post Office Box 1-F, Richmond 1, Va.

CIRCLE 300 ON READER-SERVICE CARD

High Frequency Resistors 226

Bulletin F-1A describing high frequency and miniature high frequency resistors designed to meet specifications MIL-R-10683A, has been released.

Eight-pages of comprehensive data on construction, characteristics, specifications, applications, types, resistance values, tolerances, terminals and installations are given.

The bulletin is well illustrated and includes detailed charts and graphs. International Resistance Co., 401 No. Broad St., Philadelphia, Pa.

Screw Machine Products 227

A brochure on screw machine products is now available. Printed in three colors, it depicts typical screw machine work in a variety of tough alloys including stainless steels, Inconel, nickel, and titanium. Fabrication operations and techniques required for each of the eight illustrated items are described. Dimensions and tolerances for both cold-headed and screw machine products are included. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, N.Y.

Cylinders and Hydrometer Jars 228

Product data sheet No. 4 on flasks and sheet No. 5 covering cylinders and hydrometer jars which are a part of a continuing series of data sheets are now available.

Sheet No. 4 describes the multi-purpose flasks which are able to withstand temperatures of 20 C and have a capacity of from 10 to 2000 ml.

No. 5 describes cylinders and hydrometer jars with diameter from 25 to 115 mm. Doerr Glass Co., No. East Boulevard, Vineland, N.J.

Phenolic Products 229

Catalog CDC-322 describes a full product line of phenolic molding materials and resins. The 12-page booklet cites special properties and product features of phenolic molding powders, rubber phenolic molding powders, phenolic laminating varnishes and industrial and foundry resins. Detailed technical data are presented in table form and illustrations show many typical applications for the compounds. General Electric Co,. Chemical Materials Dept., 1 Plastic Ave., Pittsfield, Mass.

Hydraulic Plate Shear 234

Illustrations and a detailed description of a hydraulic plate shear are provided in Catalog 305. The 8 pages contain complete data on controls, construction, and dimensions. Pacific Industrial Mfg. Co., 848 49th Ave., Oakland 1, Calif.

Steel Tube Fittings 235

Complete engineering specifications for a line of steel tube fittings are listed in a 48-page catalog. Hydraulic and hydraulic flareless types are included. The booklet contains a section on assembly instructions, materials, finishes and operating pressures. The Weatherhead Co., 128 W. Washington Blvd., Fort Wayne, Ind.

Tubular Capacitors 236

An 8-page publication, GET-2671, covers molded tubular capacitors for computers, missiles, telephone equipment, and other high grade military and commercial electronic equipment. The illustrated booklet contains descriptive information and lists ratings and dimensions. General Electric Co., Schenectady 5, N.Y.

Two-Way Radio 237

Bulletin ECR-380-A is devoted to the Progress Line two-way radio. It gives details on printed circuitry, interchangeable components, cabinets and mounting. General Electric Co., Communication Equipment, Electronics Park, Syracuse, N.Y.

Servo Components 238

Bulletin 410 is a single illustrated page which lists a number of high temperature servomechanism components such as servomotors, tachometers, etc., along with the degree of heat under which each can operate. The sheet also lists important features of the units. Norden-Ketay Corp., Commerce Rd., Stamford, Conn.

Solderless Wiring Devices 239

In Bulletin 856 a line of solderless terminals and connectors are catalogued and described. The 8 illustrated pages list ring, spade, and hook tongue devices; snap plugs; flag types; and parallel, butt, and 3- and 4-way connectors in a variety of sizes and wire ranges. Electric Terminals Corp., 2019 Center St., Cleveland 13, Ohio.

No-Mistake D

WHERE fast, accurate readings must be taken, a direct-reading digital dial can eliminate many reading errors. It is generally more esthetically pleasing as well. The dial shown is Beckman/Helipot Corp.'s answer to the problem. They have designed a 10-turn, direct reading "Digidial."

This dial has three windows across its face. The left-hand window indicates full turns; the middle, tenths; and the right-hand window, hundredths. Reading accuracy is 0.05 per cent. White-filled numerals on a black background allow readings to be taken up to six feet away. The design of the Plexiglas snap-on cover allows the numbers to be seen at wide angles from head-on.

A positive friction brake can be engaged to hold a given setting and prevent the dial from being turned. The use of precision steel pinions and a brass spur drive reduces backlash to one one-thousandth of a turn. There are no mechanical stops. After ten full turns have been completed, the reading returns to zero and counting begins again.

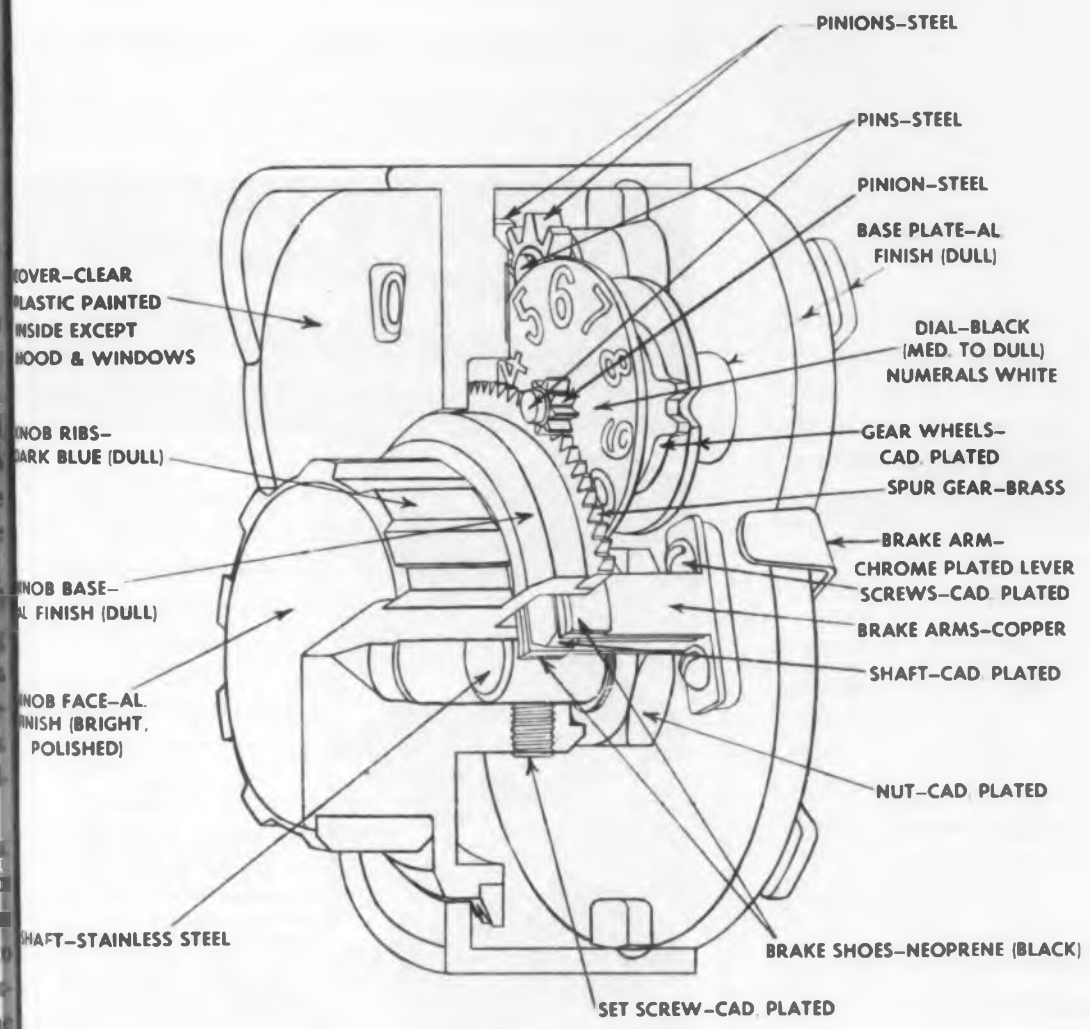
The "Digidial" is 1-15/16 x 2-1/16 x 1-1/8 in. overall. It accommodates standard 1/4 in. shafts and 3/8-32 NEF-2A bushing mountings. It weighs only 2-1/4 oz. and can be installed on panels up to 1/4 in. thick. A snap-on cover allows for easy indexing of the dial to the device being metered. The finish consists of a clear Plexiglas cover, blue-coated on its inside surface, and a buffed aluminum knob fitted with a blue vinyl grip.

The cutaway view shows in detail how the dial is designed, including materials employed.

A new regular feature covering clever circuit and mechanical design ideas—individual contributors will be paid $10 for items published.

e Dial

"Digidial" direct-reading digital dial for quarter-inch shafts and standard panel mounting.



Cutaway view of "Digidial" showing details of design and materials.

Ideas for Designers

Transistor Circuits

Recently released by P. R. Mallory & Co. Inc. of Indianapolis, Ind. are two transistor circuits of general interest, primarily conceived for aircraft applications.

In Fig. 1 two transistors and a reversing switch are used to actuate the lamps, as in "wing and tail" flashers. Most important advantage of this circuit is the tremendous reduction in radio interference (28 v at 75 ma motor current and 0.5 v at 100 ma base drive) thereby reducing the filter size from approximately 12 cu in. and 1 pound to 1 cu in. and 1 oz for a 5 amp flasher. Peak interference is in the hundreds of microvolts at low power instead of 0.1 to 0.2 v at 1.5 kw inrush. At the same time, the overall flasher volume is cut in half and the contact life of the switch is extended indefinitely. Relaxation oscillators might also be used.

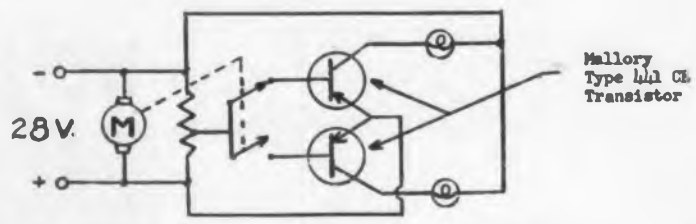


Fig. 1. Low Radio-Interference Flasher Circuit.

In Fig. 2 is a possible use of transistors for relay action, thus eliminating all moving parts and contact points. The motor employed is a blower motor from Globe Industries Inc., and is a 28 v at 6 amp unit. It is possible, at the present time, to control a 5 amp load using approximately 200 ma drive.

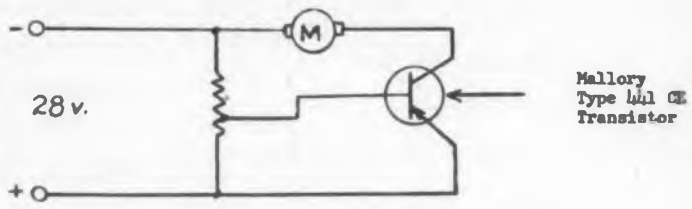


Fig. 2. Relay Action Without Relays.

Simplified Testing of Printed Circuit Laminates

Use of a standard, direct-reading force indicator greatly simplifies bond-strength testing of foil coatings on printed circuit laminates at the Synthane Corporation, Oaks, Pa., manufacturers and fabri-

Ideas for Designers

cators of laminated plastics. The device replaces the more conventional but inconvenient and unwieldy test set-up requiring a dead weight, a cord-and-pulley system, and a framework to support them.

The photograph illustrates the simplified test

Simplified testing procedure

procedure. A special knife, with edges spaced exactly 1 in. apart, cuts a test strip of copper foil. A knurled clamp, with chain attached, is then fastened to a free end of the strip, which has been peeled from the laminated phenolic to receive the clamp.

A model L-20 Force Indicator, manufactured by the Hunter Spring Company, Lansdale, Pa., is then hooked to the chain at a convenient height for the operator to apply tension and read the dial. The operator then lifts the indicator, pulling the chain and attached test strip until the copper test strip peels from the base material as shown. The maximum indicator dial reading gives the bond strength —in pounds and fifths of pounds—between the strip and the laminated phenolic. Once the foil has begun to peel, the dial reading will fall off slightly.

Report Briefs

Automatic Data Reduction

This catalog lists five categories of devices useful in automatic data recording and reduction systems which are available commercially or under development. The scope of the catalog is limited to devices essentially digital in nature. Categories: Analog Voltage to Digital Converters, Shaft Position to Digital Converters, Digital Plotters and Digital to Analog Converters, Miscellaneous Digital Devices, and Special Tape Recorders. An appendix lists the manufacturers. *PB 111928 Automatic Data Reduction, Part II, R. S. Hollitch and A. K. Hawkes, OTS, US Dept. of Commerce, Washington 25, DC, Nov. 1954, 80 pp. $2.00.*

Fast Video Pulses

Preliminary work is described toward the attainment of pulse repetition rates of 1000 pps and greater, and pulse duration below 0.1 μsec. Methods were studied for generating fast voltage step functions at the desired rates, and for shaping very narrow pulses. Experimental circuits are described and analyzed. *PB 121404, Generation of Fast Video Pulses, S. Krasnick, Signal Corps, OTS, U.S. Dept. of Commerce, Washington 25, D.C., Dec. 1955, 2 pp, $.75.*

Reliable HF Communications

Investigations for improving antennas, open-wire transmission lines and associated lumped-constant circuits for reliable high-frequency communications. A major emphasis in the study is to be placed on consideration of high-power levels, from 50 to 500 kw. *PB 120378 Reliable High-Frequency Communications, Second Report, Apr.-July 1955, D. F. Bowman, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., 47 pp, Microfilm $3.30, Photocopy $7.80.*

Radar Simulation Study

During the period of Sept. to Oct. 1955, work continued on the simulation program which includes development of a digital multi-target radar simulator of high realism and precision, and the further improvement and extension of the existing single-target radar simulator in connection with its application to beam splitting and automatic track-while-scan problems. *PB 122375 Simulation Study For The Period 1 Sep-31 Oct 1955, Columbia Univer., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Nov. 1955, 49 pp, Microfilm $3.30, Photocopy $7.8*

Radio Astronomy Antennas

This report discusses the progress of antenna designs for measurements of ionospheric absorption and refraction of discrete radio noise sources at low frequencies in the range of 15 to 80 mc. The requirements of the antenna are: *a* Sufficiently broad-band characteristics to permit operation without essential change in pattern (but not necessarily impedance) over the range from 16 to 20 mc, *b* Forward gain 10 db over a dipole, *c* Compactness, so as to allow alt-azimuth mounting. *PB 123219 Antenna Studies For Radio Astronomy, Scientific Report #1, 15 June to 15 Sept. 1955, Contract AF19(604)-1503, J. W. Warwick and P. W. Carlin, Colorado University, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Jan. 1956, 18 pp, Microfilm $2.40, Photocopy, $3.30.*

Electron Beam Interaction

A field theory of a spaced-harmonic traveling wave tube is developed using a stationary field matching procedure. The circuit is the circularity symmetric disc loaded waveguide. Two cases are studied: a solid low current electron beam which completely fills the openings between sections, and a hollow beam of arbitrary radius. *PB 120413 Interaction of an Electron Beam With a Periodic Circuit, R. W. Gould, California Inst. of Technology, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Mar. 1955, 23 pp, Microfilm $2.70, Photocopy $4.80.*

Mag-Amp Two-Speed Servo

Described is a half-wave magnetic amplifier which utilizes a full-wave slave output stage to replace a vacuum tube amplifier in a two-speed servo system. Complete system performance is given, and a comparison between vacuum tube and magnetic amplifier systems is made. *PB 120818 Magnetic-Amplifier Two-Speed Servo System, J. J. Suozzi, NAVORD 3973, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Aug. 1955, 25 pp, Microfilm $2.70, Photocopy $4.80.*

Radar Modification To Improve Stability

Investigation of improving the stability and accuracy of the AN/CPN-18 indicator for PPI presentation required in a traffic control system. Stability and accuracy are much improved with the recommended modifications and PPI presentation is considerably enhanced. *PB 120415 Modification of Indicator Group OA-184/CPN-18, J. J. Bogart, US Air R&D Command, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Mar. 1955, 23 pp, Microfilm $2.70, $4.80.*

Ionospheric Antennas Survey

The material presented covers first a study and survey of propagational effects associated with ionospheric forward scatter transmission, then an examination of various antenna types having possible use, and finally a comparison of the advantages and disadvantages of the various antennas. *PB 122372 Survey Study On Antennas For Forward Ionospheric Scatter Transmission, Pickard & Burns, Inc., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Feb. 1956, 59 pp, Microfilm, $3.60, Photocopy $9.30.*

Traffic Control Radar Simulator

The radar simulator described is capable of simulating 30 moving aircraft targets on a PPI indicator. Control of target heading, velocity, position, and turn rate are available at each aircraft target operating station. Additionally available are: simulation of wind drift effect, distinctive coding symbol on each target, automatic variation of aircraft speed as a function of altitude, continuous targets display on CRT. *PB 123088 Radar Simulator For Use In Air Traffic Control Studies, Hixson, Harter and Warren, Ohio State University, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Jan. 1954, 28 pp, Microfilm $2.70, Photocopy $4.80.*

Cathode Studies Demountable Diode

Described is a demountable planar diode with a movable anode. The tube has been used to confirm an experimental method for determining the motional transconductance of a diode. It has also been used to compare two distinctly different methods for measuring the conductivity of oxide coated cathodes. Modifications are suggested for improving the tube. *PB 119937 Demountable Diode For Cathode Studies, A. Eichenbaum and H. Farber, Brooklyn Polytechnic Inst., Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Mar. 1955, 23 pp, Microfilm $2.70, Photocopy $4.80.*

Spontaneous Magnetization Curves

Curves of spontaneous magnetization vs. temperature have been computed for simple ferromagnetic materials containing only one kind of magnetic ion. The results for various values of the parameters lambda, alpha, beta are tabulated and graphed. *PB 122057 Computed Spontaneous Magnetization Curves For Ferromagnetic Materials, Warfield, Smart and Wangness, NAVORD 3815, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D.C., Dec. 1954, 50 pp, Microfilm $3.30, Photocopy $7.80.*

VLF Recording and Analyzing

An FM system of magnetic tape recording for signals from dc to 15 cps has been developed along with playback apparatus permitting wide band frequency analysis from 0.016 to 4.2 cps. The recorder operates for 24 hours unattended. The recordings can be played back either 30 or 60 times faster than when recorded, producing frequencies great enough to be separated by special octave band pass filters which were developed. *PB 120991 Very Low Frequency Recording and Analyzing Instrument, W. E. Austin, NAVORD 3615, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25, D. C., Jan. 1954, 25 pp, Microfilm $2.70, Photocopy $4.80.*

Transponder Approval Tests

Final report on the type approval tests for TN-103/APX "Black Maria" transponder. Horizontal and vertical directivity patterns were taken of the antenna and horizontal patterns for the S-band portion over the frequency band required. SWVR of the antenna for both S- and G-bands were measured at several points. *PB 120718 Type Approval Tests For TN-103/APX "Black Maria" Transponder (For IFF Mark III), D. P. Heritage, NRL Report 2740, Order from Library of Congress, Photoduplication Service, Publications Board Project Washington 25, D.C., Jan. 1946, 21 pp, Microfilm $2.70, Photocopy $4.80.*

Ordnance Resistance Measurement

The problem of measuring resistance of a sensitive initiator, such as a primer or detonator, has resulted in the development of a number of special meters. Presented is a brief description of several special purpose meters and analysis of some common general purpose meters, with low current characteristics usually. *PB 122077 Discussion of Some Meters and Test Sets For the Resistance Measurement of Electric Primers and Detonators, A. M. Corbin, NAVORD 2288, Order from Library of Congress, Photoduplication Service, Publications Board Project, Washington 25 D.C., Jan. 1952, 22 pp, Microfilm $2.70, Photocopy $4.80.*

Data Reduction and Storage

This report is on superimposed coding as recorded in two are more codes in the same field to facilitate information searching on machine-sorted index cards. Multiple and single field types are discussed and tables on dropping fractions for multiple and single field coding used for searching any machine or catalog are included. *PB 121345 Superimposed Coding For Data Storage, M. Taube, OTS, US Dept. of Commerce, Washington 25, DC, Sept. 1956, 27 pp. $0.75.*

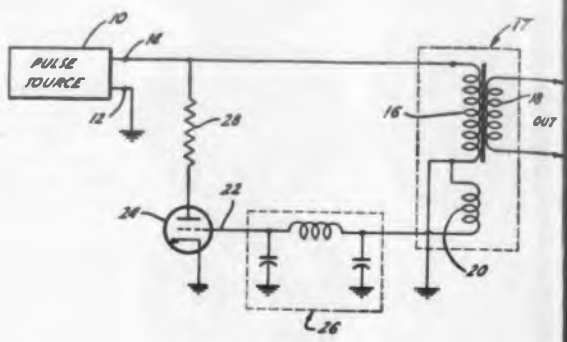
Patents

Post-Pulse Clipping Circuit For Pulse Modulators

Patent No. 2,744,195. P. Winokur, Jr. (Assigned to Philco Corporation.)

In radar systems, a magnetron is usually used in the oscillator and it is triggered by a negative pulse of short duration and relatively high amplitude. This negative pulse is applied to the cathode of the magnetron through a coupling transformer. Because of the inductance and distributed capacitance in the coupling transformer and the non linearity of the magnetron, there is a "backswing" positive voltage generated which can detrimentally affect the magnetron, such as setting up spurious oscillations. Damping of this backswing voltage has been sought by using a diode as a unidirectional switch shunting the primary winding of the transformer. Diodes, however, have limited current capacity with the result that a relatively high resistance must be used in series therewith, with the result that in high power systems the clipping of the backswing voltage is not wholly effective. Backswing voltages can also damage the magnetron.

Thyratrons also have been used in such damping circuits because they have high current capacity and, therefore, require considerably less load resistance. A difficulty is encountered with thyratrons because of the high interelectrode capacitance which acquire a negative charge on the grid cathode capacitance during the negative triggering pulse. As a result, there is a delay in firing the thyratron. This delay causes a sharp spike of backswing potential before the thyratron becomes conducting to damp the backswing voltage. This spike of positive potential sets up oscillations which generate undesired signals in the magnetron. In order to avoid this effect, it has been the practice to generate a thyratron triggering pulse which is applied to the control grid of the thyratron to render the tube conducting without delay. This additional circuit means makes the circuit more complex.



The circuit illustrated provides effective damping in a very simple manner, using a thyratron tube. The pulse source *10* is coupled to the cathode circuit of the magnetron through a coupling transformer, *16*, *18*. The backswing potential is dissipated through the resistor *28* and the thyratron *24*. In order to avoid the negative charge developed between the cathode and grid of the thyratron by the negative triggering pulse, a winding *20* is coupled to the primary winding *16* of the transformer so that a positive pulse is generated by the negative triggering pulse in the primary winding *16*. This positive pulse is applied to the control grid of the thyratron through a delay circuit *26*. As a consequence, a positive pulse is applied to the electrodes of the thyratron during the negative pulse which counteracts the negative interelectrode charge and maintains the thyratron in a conductive state when the backswing voltage is generated. The backswing potential is dissipated through the thyratron without any positive spike as heretofore encountered in a circuit using a thyratron in the damping connection.

Transistor Trigger Circuits

Patent No. 2,744,198. G. Raisbeck. (Assigned to Bell Telephone Laboratories, Inc.

Trigger or multivibrator circuits using two vacuum tubes are well known. With

the tubes alternately becoming conductive, symmetrical wave forms are derived from such circuits because of the phase inversion characteristic of the vacuum tubes. Similar circuits have been attempted using a pair of transistors. Since phase inversion is not a characteristic of a transistor such circuits have not been entirely successful.

If each of a pair of like transistors have their respective collector electrode connected with the emitter electrode of the other, a circuit is derived in which both transistors change from a current conducting state to a non-conducting state at the same time and not alternately as in the usual multivibrator circuit. A multivibrator circuit using a pair of transistors has been devised in which the collector of each transistor is coupled to the base electrode of the other transistor. In such a circuit the transistors become conductive alternately and a symmetrical output wave is secured. The difficulty in this circuit is that no electrode can be connected to ground, and as a consequence stability is lost and it is not suitable for some applications.

The patentee has devised a multivibrator circuit using transistors as shown in Fig. 1. This is accomplished by using a P-type of transistor as one of the amplifying elements and an N-type transistor for the other. These two transistors have current voltage characteristics of opposite sign which is made use of to generate a symmetrical wave form. In this circuit the emitter of an N-type transistor *1* is coupled to the collector of the other transistor 2 which is a P-type and the collector of the latter is coupled to the emitter of the former. For the N-type transistor operating current is provided for the emitter by the circuit *R2*, battery 3, and inductance *L*. The P-type emitter circuit has operating current supplied by battery *4* through resistors *R'2* and inductance *L*. In this circuit the base electrodes are and can be grounded to provide stability.

The frequency of oscillation of the transistor multivibrator circuit can be adjusted as desired by selection of proper values for the resistors and inductors. The circuit may also be used as a frequency divider. The patent illustrates many variations of the circuit. Fig. 2, included here, is a schematic circuit diagram of a "one-shot" or monostable trigger circuit. Fig. 3 is a bistable or so-called "flip-flop" trigger circuit.

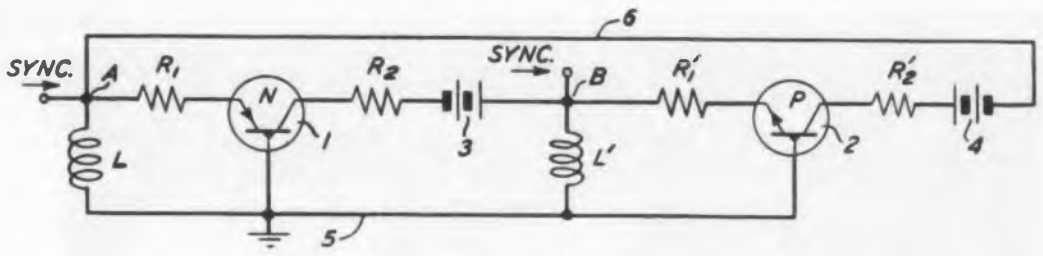


FIG. 1

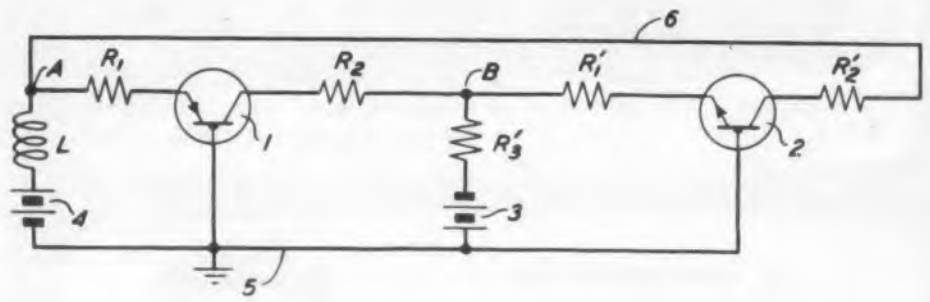


FIG. 2

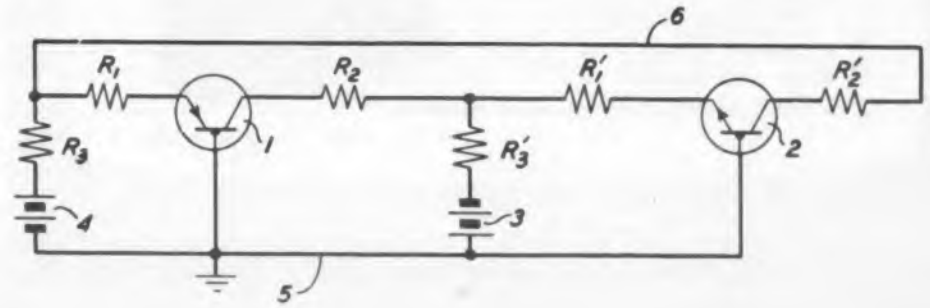


FIG. 3

Books

Mechanical Design for Electronics Production

John M. Carroll, McGraw Hill Book Co., Inc., 330 W. 42nd Street, New York 36, N.Y., 348 pages. Price: $6.50.

This book is directed primarily at the mechanical engineer who wishes to acquire knowledge of problems peculiar to the design of electronic equipment or for the beginning electronics engineer who needs to know more about the mechanics of packaging circuitry. It contains the following chapters: The Importance of Mechanical Design, Space Planning in Equipment Design, Chassis Design and Layout, Fabricating the Chassis, Manufacturing Small Parts, Shielding Components and Equipment, Potting, Embedding and Encapsulating, Moving Parts, Electric Motors and Rotating Components, Wiring and Soldering, Assembly Methods, Cabinet Construction, and Environmental Factors in Equipment Design.

Basics of Phototubes and Photocells

David Mark. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N.Y., 136 pages, $2.90.

Suitable for servicemen or newcomers to the field, this book provides an elementary explanation of the principles and practices surrounding phototubes and photocells. To make the subject more readily understandable, picture presentation is used wherever possible. The book contains a number of typical circuits and a good bibliography which designers may find helpful.

lected ASTMA Engineering aterials Standards

merican Society for Testing Materials, 16 Race St., Philadelphia 3, Pa., 358 ges. $4.00.

Although prepared for engineering dents and teaching staffs, this book is a luable reference for designers who must cify materials of construction, including metals and nonmetals in common use.

An unusually worthwhile chapter is inded on "Writing A Technical Paper or port." It lists standard abbreviations and tes the rules governing their use.

equency Modulation Engineering, 2nd vised Edition

ristopher E. Tibbs and G. G. Johnstone. hn Wiley & Sons, Inc., 440 4th Ave., New rk 16, N.Y. 435 pages. Price: $8.50.

Intended for both students and engineers his readily digestible survey of the whole ld of frequency modulation engineering. apters are devoted to the frequency dulation of a carrier wave, interference d noise structure, interference suppresn, frequency modulation propagation, and aerials. The remainder of the book describes the technique and circuits employed for frequency modulation and reception. Wherever possible, circuits of actual commercial equipments have been described and component values indicated. The work includes treatment of the theory of discriminator circuits and working designs together with measured response curves. This second edition has been substantially altered and enlarged.

Training Manual On Antennas, Vol. I

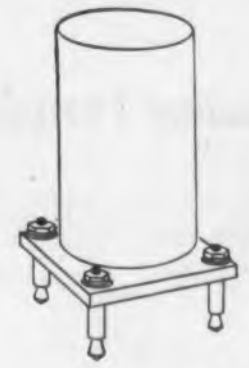
Philco Corp., TechRep Div., 22nd St. and Lehigh Ave., Philadelphia 32, Pa., 221 pages, $1.93.

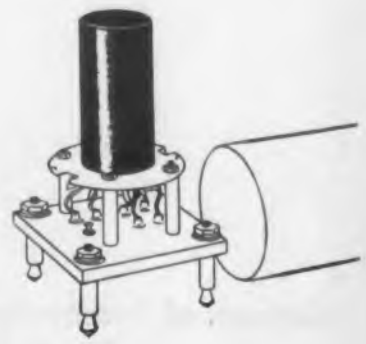
This manual, intended primarily for training technicians, is an excellent elementary text on antennas and propagation. The electronic designer may find the manual useful as a reference, or for familiarization with a specific-type antenna system or construction. The main topics treated are propagation of radio waves, antenna fundamentals, transmission-line theory, methods of feed at the antenna, coupling circuits, and types of antennas. Construction and measurement information and a glossary of antenna terms are provided.

Deliquescent Domains

Western Electric has announced that their relays will no longer be available for sale to manufacturers. The problem—obviously—will be to find satisfactory equivalents.

The Sigma Type 72AOZ—160TS can replace the WE 255A polar telegraph relay. It is functionally interchangeable by design and mechanically interchangeable by means of an adapter. The "72" has been exposed to such varied field service that comparative experience for most applications can be cited.





COMPARISON—WE 255A AND SIGMA 72AOZ-160TS

	255A	72AOZ-160TS
RESISTANCE PER COIL, OHMS	136 ±10%	160 ±10%
TURNS PER COIL	3200	2400
INDUCTANCE PER COIL, HENRY	0.9 *	1.0
CONTACT GAP, NORMAL MINIMUM, INCHES	.004	.004
CURRENT SENSITIVITY, ONE COIL, MA.	0.56-1.8	0.6-1.4
NORMAL RANGE OF SIGNAL LEVEL, MA.	10-60	10-60
MAXIMUM INTELLIGIBLE SPEED, PULSES/SEC. (70% CONTACT EFFICIENCY)	—	800
WORDS/MIN. EQUIV.	—	1350
BIAS DISTORTION ALLOWED, 5 MA. SIGNAL 60 CPS	—	2%
PERCENT BREAK, 100 WORDS/MIN., 20 MA. SIGNAL	—	4%
TOTAL COIL DISSIPATION FOR 40° C. RISE, WATTS	2.2 *	1.3

* AS MEASURED IN SIGMA LABORATORY

As for the WE 280, there is no exact Sigma replacement. We do have five different polar relays which, depending on your application, may be equivalent even though not interchangeable.

Thus, if you do not need an exact duplicate of a Western Electric polar relay, there is undoubtedly a suitable Sigma polar relay available immediately. If you do, your comments may be all the incentive we need for providing a new design.

What The Russians Are Writing

J. George Adashko

Contents of Avtomatika i Telemekhanika No. 8, 1956

DC Amplifiers with Photo Compensation, B. A. Seliber, S. G. Rabinovich, (18 pp, 13 figs).

When bolometers or similar devices are used to measure photocell currents, low temperatures, radioactivity, etc., it is necessary to employ dc measuring instruments with sensitivities much higher than those of conventional moving-coil or d'Arsonval galvanometer elements. This paper deals with galvanometric instruments with photocell feedback amplifiers, so-called photo-compensation amplifiers. A diagram of such an amplifier (designated F-16) is given in Fig. 1. The authors discuss the principal parameters of some amplifiers, the inherent errors, and actual methods of error compensation. The operation of photocells and photoresistances is analyzed, and some recommendations are made concerning the best selection of photocells.

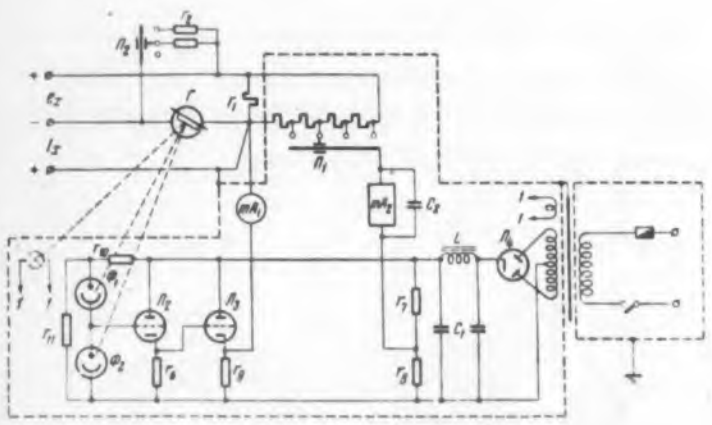


Fig. 1

Narrowing the Signal Spectrum in Telemetering Radioactivity Measurements, V. N. Mikhailovski, A. N. Svenson, (6 pp, 5 figs).

The output signal of radioactivity indicator consists of pulses of various amplitudes, the spectrum of which is sometimes too wide for the transmission channel. It is therefore of interest to find ways of narrowing the spectrum, principally by converting the random distribution of the pulses obtained at the output of the indicator into an equivalent discrete distribution, with the pulses spaced by time intervals that are either equal or multiples of a fixed value. Essentially this involves storing the random signals in a memory device and cyclic pickoff at a constant frequency. The memories used may be capacitors, ferromagnetic coils, or cathode-ray storage tubes. A memory device using capacitors is shown in Fig. 2. The various stages of pulse shaping are illustrated in Fig. 3.

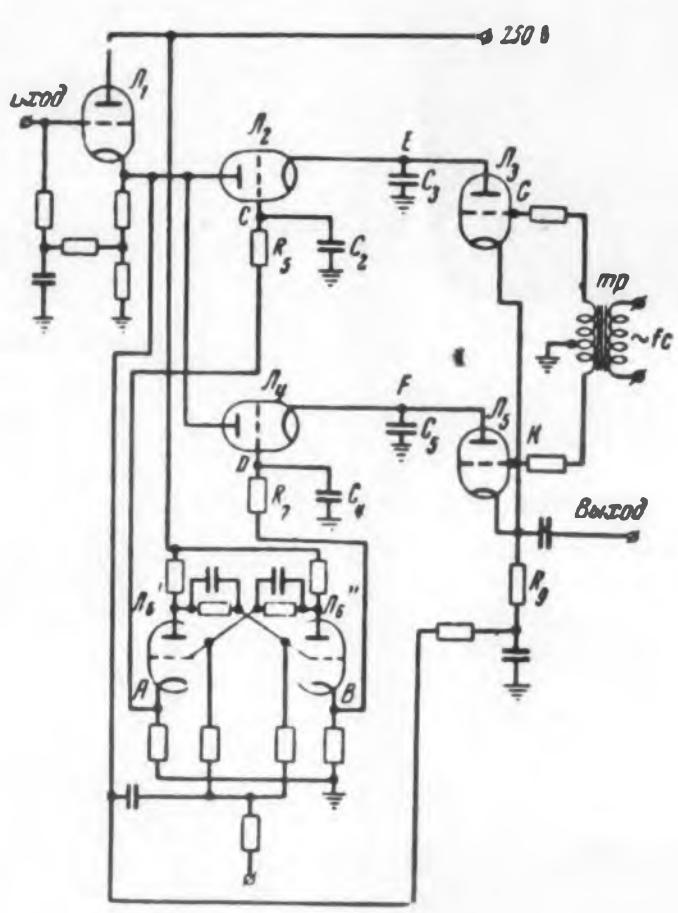


Fig. 2

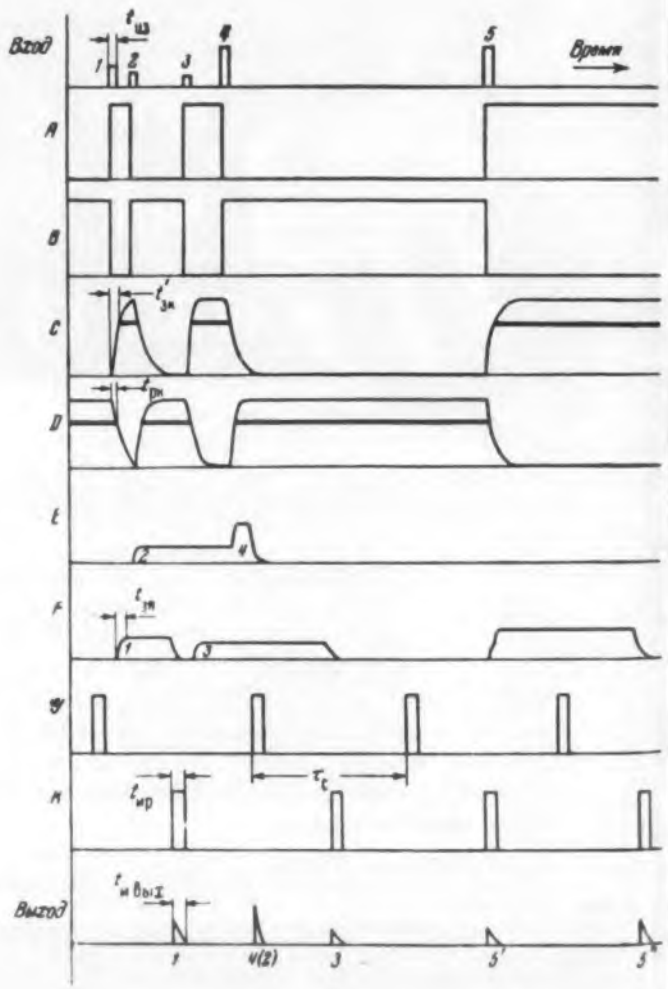


Fig. 3

Magnetic-Amplifier Control of Two-Phase Induction Motor, O. I. Aven, S. M. Domanitski, A. Ia. Lerner, (5 pp, 7 figs).

The use of two ordinary saturated reactors instead of a push-pull magnetic amplifier for reversing control of two-phase induction motors is shown to be more efficient. The control of a servomotor, Fig. 4, is used as an illustrative example. The discussion includes simple mathematical analysis, curves, and experimental test results.

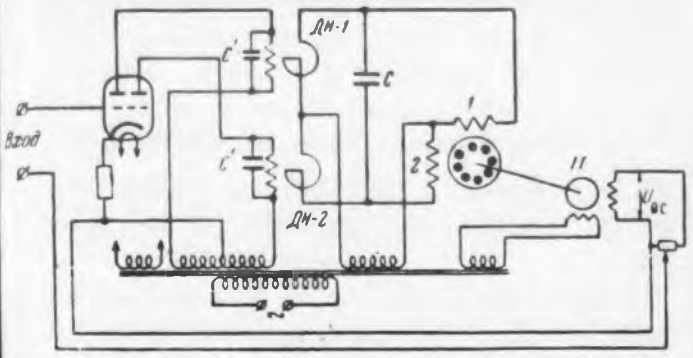


Fig. 4

Automatic Control Systems Containing Digital Computers, Ia. Z. Tsypkin, (15 pp, 13 figs).

The digital computer is treated in this article as an element of the control loop, and the usual operational analysis is performed. A classification is given for various automatic control systems containing digital computers. Some of the more advanced control-theory methods, including the theory of intermittent-control systems, are used to determine the dynamic behavior of the system.

Comparison Analysis of some Improved Methods of On-Off Control, A. A. Kampe-Nemm, (19 pp, 22 figs).

On-Off control of temperature or other parameters is still among the most widely used regulation methods. Its main shortcoming is that it is sometimes accompanied by a continuous, frequently considerable fluctuation of the regulated quantity. In many cases this limits the accuracy and applicability of the control. The article discusses several methods of improving the accuracy of On-Off control. Among the methods considered are the addition of first-derivative supplementary pulses, the use of thermocouple correcting devices, and other schemes. Experimental and graphical analysis of the various schemes presented is given.

Approximate Theory of Magnetic-Modulated Transducers, M. D. Ageev, (13 pp, 15 figs).

Theoretical analysis of magnetic-modulated transducers without initial magnetization. Also discussed are the considerations dictating the choice of optimum operating conditions and choice of optimum settings of the transducer. Experimental results are given.

The particular transducer discussed in this article comprises an open ferromagnetic core with ac excita-

Use of Semiconductor Diodes in Non-Linear Analog Computer Elements, G. M. Petrov, (10 pp, 16 figs).

In several previously abstracted articles it was shown that the non-linear elements most extensively used in Soviet computers for such operations as multiplication of two quantities or for function generation employ essentially piecewise-linear approximation with diode circuits. Some of the characteristics of such diode circuits are discussed in this article, and new diodes for use in non-linear computers are proposed. Included among such diodes are silicon point-contact and junction elements as well as germanium junction diodes.

New Russian Books on Electronics

The publication of the following book is scheduled for the last quarter of 1956 and the first quarter of 1957:

"Pulsed Thyratrons," by T. A. Vornchev. Devoted to the results of theoretical and experimental investigations of pulsed thyratrons. Discussion of the development and design of the hydrogen-filled thyratron and of the physical processes that take place during its operation. The book also contains an analysis of the operation of a linear modulator, as well as technological and construction information.

"Transistors in Automatic-Control Installation," by I. Konev. Covers application of junction transistors in medium-current amplifiers and in phase-sensitive amplifying circuits. Gives procedure for the design of several circuits.

"Theory of Random Processes and its Application to Radio Engineering," B. R. Levin. In addition to providing the minimum theory needed by the radio engineer for handling the subject, the book contains copious radio-engineering examples, illustrating the potentialities of probability-theory methods in the solution of many practical problems.

"Elements of the Theory of Bessel Function with Applications to Radio Engineering," T. A. Rozet.

Other books scheduled for publication are a new edition of Andronov and Khaikin's "Theory of Oscillation," a book on Radio Meteorology by D. I. Nasilov, a book on Theormocouple Cooling by A. Ioffe (Soviet expert on semiconductors) and other two books, one by S. A. Lebedev "Electronic Computers," and the other by A. I. Kitov, and "Automat (i. e., Machine) Translation" by D. Iu. Panov.

Announced titles that are somewhat off the beat track are: "Theory of Potential Noise Stability" by V. A. Kotel'nikov, "Mathematical Analysis of Beats" by A. N. Popov, "Non-Linear Ceramic Capacitors" by D. M. Kazarnovski.

It may interest our readers to know that among the many American books to be translated soon into Russian are "Television" by Zvorykin and Morton, "Magnetic Amplifiers" by Storm, "Ferromagnetism" by Bozorth, "Information Theory" by Goldman, and "Principles of Color Television" by Kyver.

Russian Hams

We notice with interest that Russian amateurs are no different from hams all over the world and like to let their fellow hams in on all sorts of makeshift gear and various hookup hints. Two such tips are given in the December 1955 *Radio, a popular* amateur magazine.

Whether this is indicative of the relative availability of transformers and tubes in Russia your editor does not dare to guess, but the circuit of Fig. 1 will enable a ham to double his rectifier power by using two transformers to feed a single tube. The dotted lines show an optical 220 v circuit (rather than 450).

The circuit of Fig. 2 is somewhat more novel—a rectifier with a continuously varying output, capable of delivering 40-250 v to 1.5 kilohm or 60-380 v to 5 kilohm, with a maximum current output of 180 ma. The value of grid-control potentiometer R_1 is 0.5 megohm.

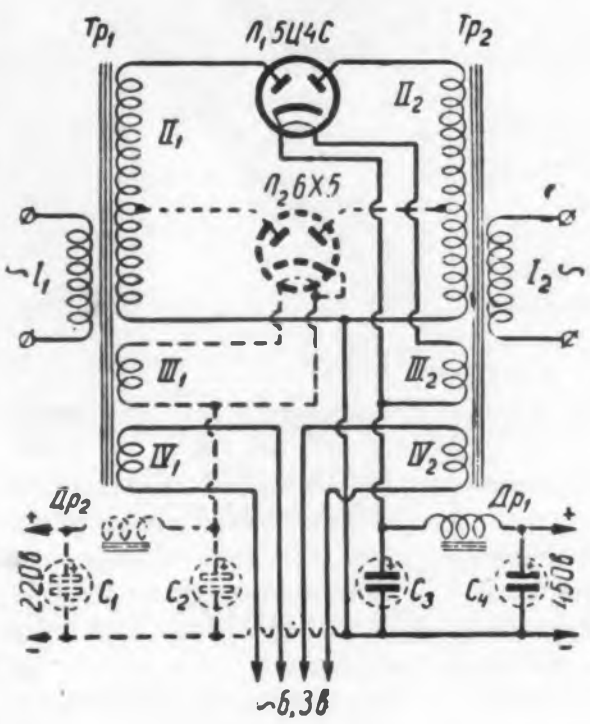


Fig. 1

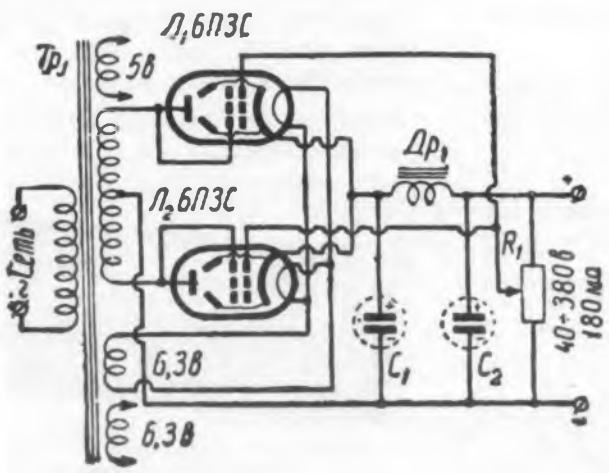


Fig. 2

Russian Wire and Cable

Those who attempt to read Russian wiring diagrams sooner or later come up against the types and sizes of wire used in radio communication and allied fields. The following rather extensive table is taken from "Spravochnik Radioliubitelia" (Radio-Amateur's Handbook), a 250-page booklet published by Gosenergoizdat (State Power Publishing House) in 1955. Wire sizes are always given in mm (unless otherwise described).

Winding Wire

Russian Letters	Transliteration	Description
ЛЭШО	LEShO	Lietz (h-f) wire with enamelled, single silk cover
ЛЭШД	LEShD	Lietz wire with enamelled strands, double-silk cover
ПБО	PBO	Copper wire, single cotton cover
ПБОО	PBOO	Copper wire, cotton cover and braid
ПБД	PBD	Copper wire, double cotton cover
ПШО	PShO	Copper wire, single silk cover
ПШД	PShD	Copper wire, double silk cover
ПШКО	PShKO	Copper wire, single-layer silk-capron cover
ПЭВ	PEV	Copper wire, coated with "viny-flex" enamel
ПЭЛ	PEL	Copper wire, enamelled lacquer-proof
ПЭЛБО	PELBO	Copper wire, enamelled lacquer-proof in cotton single-layer cover
ПЭЛБД	PELBD	Copper wire, enamelled lacquer-proof in cotton double-layer cover
ПЭЛШО	PELShO	Copper wire, enamelled lacquer-proof in silk single-layer cover
ПЭЛШД	PELShD	Copper wire, enamelled lacquer-proof in silk double-layer cover
ПЭЛШКО	PELShKO	Copper wire, enamelled lacquer-proof in silk-capron single-layer cover
ПЭЛШКД	PELShKD	Copper wire, enamelled lacquer-proof in silk-capron double-layer cover

The marking of constantan or manganin wire is the same as that of copper, except that the letter K or M follows the marking, e.g.: ПШОК PShOK Constantan wire, single-layer silk cover.

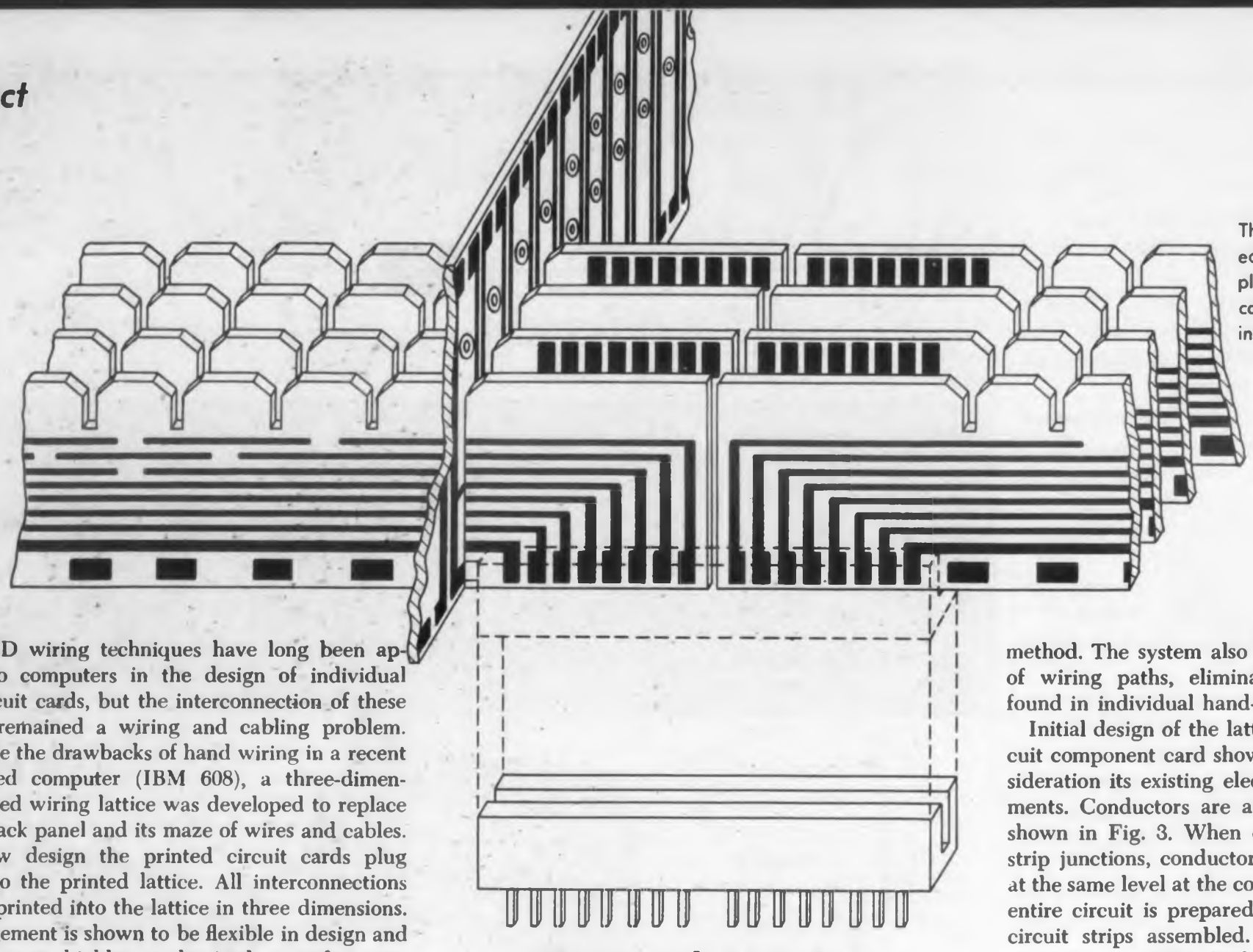
Hookup Wire

МГШ	MGSh	Hookup wire, flexible, silk braid
МГШД	MGShD	Hookup wire, flexible, silk single-layer cover

МГБЛ	MGBL	Hookup wire, flexible, cotton lacquered braid
МГБОО	MGBOO	Hookup wire, flexible, cotton cover and braid
МГБООЛ	MGBOOL	Hookup wire, flexible, cotton cover and lacquered braid
МГВ	MGV	Hookup wire, flexible, vinylite insulation
МГВЛ	MGVL	Hookup wire, flexible, vinylite insulation, lacquered cotton braid
МР	MR	Hookup wire, single-conductor, rubber insulated
МРГ	MRG	Hookup wire, rubber-insulated, flexible
МРГЛ	MRGL	Hookup wire, rubber-insulated, flexible in lacquered cotton braid
ПМВ	PMV	Hookup wire, single-conductor, vinylite insulation
ПМОВ	PMOV	Hookup wire, single-conductor, vinylite insulation, braided
ПМВГ	PMVG	Hookup wire, vinylite insulation, flexible
ПВР	PVR	Hookup wire, vinylite insulation, for wired-radio installations
РМШ	RMSh	Speaker cord with tinsel-wire conductors in cotton braid
РПШ	RPSh	Cord with rubber installation for radio-installation wiring in rubber sheath
РПШЭ	RPShE	Cord with rubber insulation for radio-installation wiring, in rubber sheath, shielded
РШ	RSh	Speaker cord in colored or glazed cotton braid
ШЭП	ShEP	Cord for electric record players

The identity of a wire not listed above can be guessed at by noting that the code is based on the following abbreviations (those underlined are the most probable).

Russian Letter	Transliteration	Designation
	B	cotton
	V	vinyl, vinylite, vinyflex
	G	flexible
	D	double
	K	capron, constantan (end of symbol only)
	L	Lietz wire, *lacquered*, lacquerproof
	M	*hookup wire*, manganin (end of symbol)
	O	*single, braid*, single-layer, cover
	P	*wire*, supply, player
	R	*rubber*, radio, speaker
	Sh	*silk*, cord, sheath
	E	*enamelled*, shielded, electric



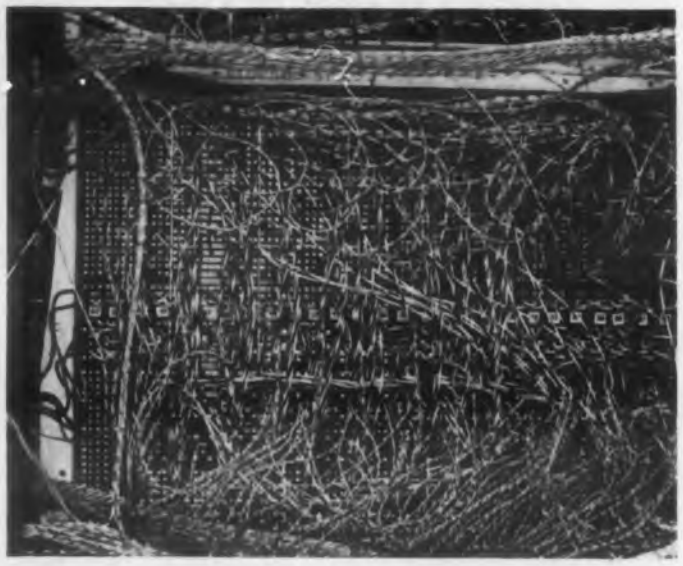
Three dimensional printed circuit replaces complicated interconnect ng cables. Single terminating tab shown.

Printed Wiring in Three Dimensions

Abstract

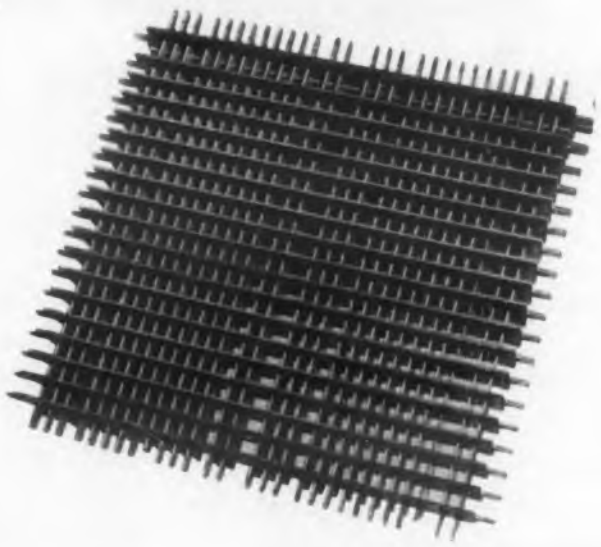
PRINTED wiring techniques have long been applied to computers in the design of individual printed circuit cards, but the interconnection of these cards has remained a wiring and cabling problem. To eliminate the drawbacks of hand wiring in a recent transistorized computer (IBM 608), a three-dimensional printed wiring lattice was developed to replace the usual back panel and its maze of wires and cables. In this new design the printed circuit cards plug directly into the printed lattice. All interconnections have been printed into the lattice in three dimensions. This arrangement is shown to be flexible in design and adaptable to a highly mechanized manufacturing method. The system also guarantees the repeatability of wiring paths, eliminating stray coupling errors found in individual hand-wired computers.

Initial design of the lattice centered around the circuit component card shown in Fig. 4, taking into consideration its existing electrical and physical requirements. Conductors are arranged in narrow strips as shown in Fig. 3. When conductors must connect at strip junctions, conductor paths are brought together at the same level at the corner, as shown in Fig. 3. The entire circuit is prepared in this manner and all the circuit strips assembled. The assembly is then immersed in a solder bath. The solder wets the con-



Problem

Fig. 1—Back panel of computer storage register. The wires and cables are connections between printed circuit component cards plugged into the panel.



Solution

Fig. 2—Three dimensional printed circuit lattice is equivalent to all interconnecting cables on back panel of computer.

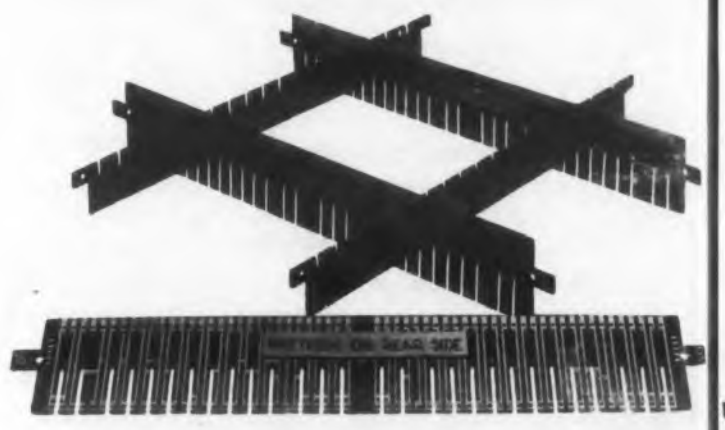


Fig. 3—Modular elements for three dimensional printed wiring.

ductors and fillets in the corner where two conductors meet, completing the electrical circuit.

An assembly of the elemental strips nested together prior to the soldering operation is shown in Fig. 2, and the same assembly after immersion into the solder and affixing of hardware is illustrated in Fig. 4. The spring contacts shown on the top of the assembly are the connecting device between the back panel section and the tabs of the circuit cards. Two of the 36 circuit cards are plugged into the assembly in Fig. 4. A molded connector for cable information for service voltages and communication to and from the rest of the computer is provided. This assembly physically and electrically replaces the sockets and wiring shown in Fig. 1. The array replaces approximately 650 wires and the sockets. It should be noted that the cable entry and exit hubs have been centralized and systematized in one location.

Engineering changes can be handled by several methods. In Fig. 3, in the rear view of the larger element, the contact pads on top all have conductors leading to pads on the bottom of the strip. In the array, the bottom pads are at the back of the panel and are easily accessible. Part of a conductor is easily removed by scratching or cutting with a sharp tool. After all of the undesired circuits have been removed, the customer engineer can either clip or solder conventional insulated wires to the small pads in the rear and thereby create a new wiring hook-up. Preliminary indications are that it might be possible to remove a vertical card from a soldered assembly and install a new vertical card. On an extensive change, the relatively low cost of a back panel module would indicate it might be economical to send a new, completely

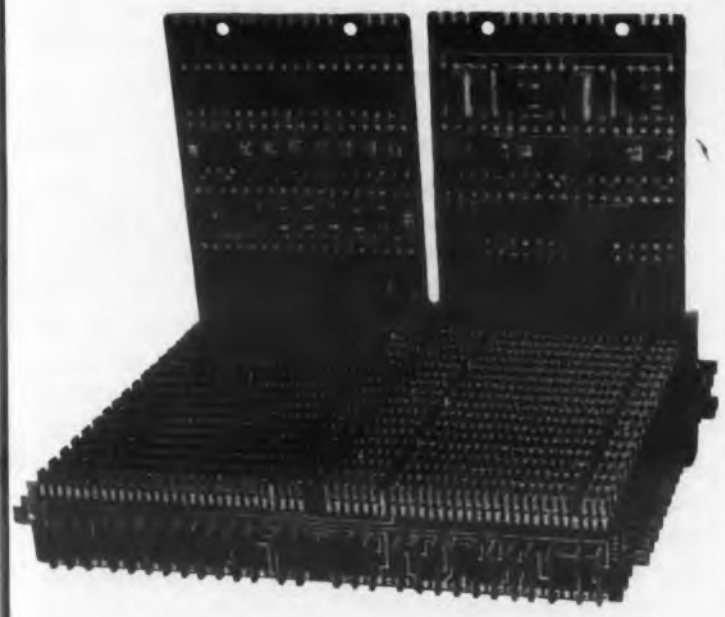


Fig. 4—Modular printed back panel with component cards clipped in.

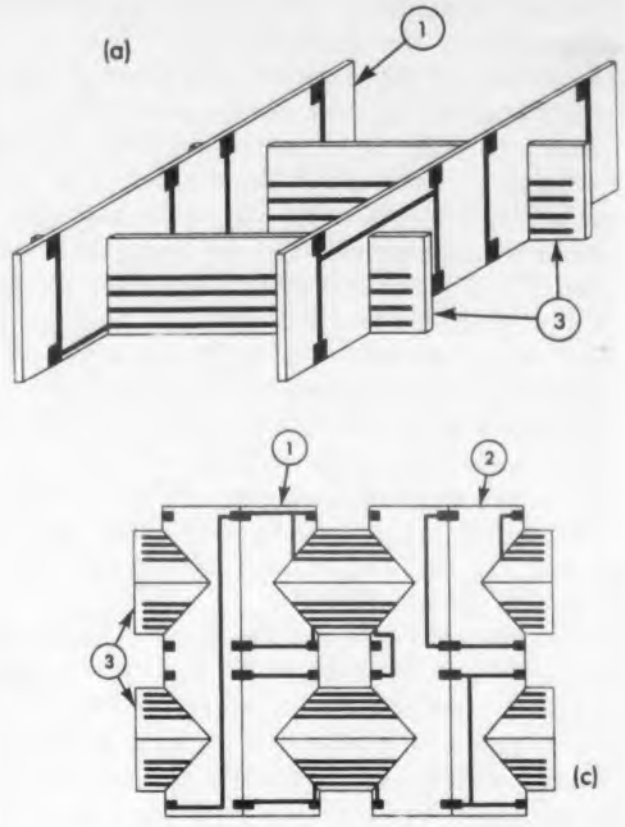


Fig. 5—Three views of an assembly section, showing layout of circuits. Cards have been drawn split at the

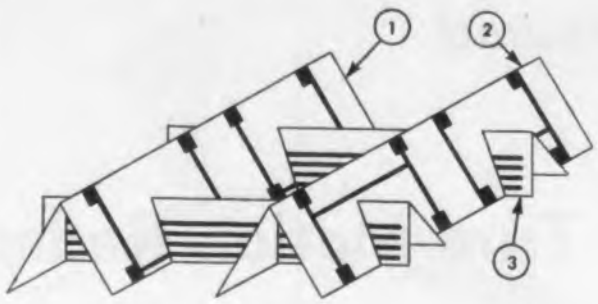
tested assembly to the field to replace an obsolete section. The old section would either be destroyed or returned to the factory for updating.

Changes can be accomplished quite easily at the manufacturing level. Because of the relatively large number of conducting paths available, it is comparatively easy to effect a change in artwork to add new circuits to the required vertical elements.

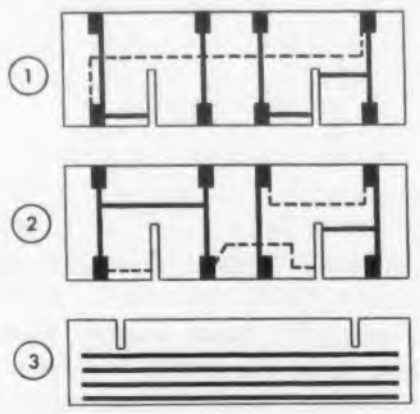
Each point in the circuitry is available for probing by virtue of the pads at the bottom of the strip. In Fig. 3 it can be seen that these pads also serve a mechanical purpose. After the circuit strips are soldered, a strong fillet is formed at the intersection of the horizontal and vertical elements, adding much to the inherent strength of the assembly.

The physical spacing is identical to that of the sockets used in the IBM 608, thus allowing the same circuit-to-volume ratio. This system provides a large number of conductor paths. By increasing the width of the strips and thereby allowing more conductors the designer can allow for his circuit requirements.

Engineering prototypes can be easily and quickly bench-built. Utilizing vertical elements that contain all the unvarying patterns of printed conductors, the technician can construct new circuit elements with conventional wires laid along the eventual path of the printed wires. The conventional wires are soldered to the printed pads. When these elements are joined to the standard horizontal strips and the solder fillets made, the circuit is complete. Thus, circuits can be evaluated in a matter of a few hours after they have been designed, with electrical characteristics identical



(b)



bottom to show connections on both sides. A work sheet similar to (c) is used in laying out printed wiring paths.

to those of the manufactured product. This aid may prove quite valuable.

The mechanical design of the circuits for vertical cards turns out to be a fast and relatively simple task. The design of the printed wiring for the circuits shown in Fig. 1 has been done by an uninitiated technician in less than three hours. This includes the routing and assignment of the 170 cable conductors associated with this section. A section of an assembly is shown, in perspective, in Fig. 5a, and Fig. 5b shows the same section with the elements split and opened at the bottom. A view looking directly down at the opened-element section is shown in Fig. 5c. A work sheet similar to Fig. 5c is used to draw in the conductors connecting the desired contact points. From this work sheet the artwork for the vertical elements is drawn. The horizontal members are identical, a standardized conductor pattern on each element. The section of back panel wiring shown in Fig. 4 has been in actual use on an IBM 608 Computer for several months. During this period it functioned without any trouble or disturbance. Compared to the conventionally wired circuits, the printed back panel shows approximately 15 per cent more capacitance to ground. The same section shows approximately 33 per cent less interlead capacitance than the conventional wires. This improvement is probably due to the greater uniformity of conductor spacing possible with printed wiring than with flexible wires. On the basis of limited experience, it is reported that the solder fillets performed satisfactorily on the low-power transistor circuits. *Abstracted from an article by E. R. Wyma,* IBM Journal, *Jan. 1957.*

Abstract

True Motion Radar

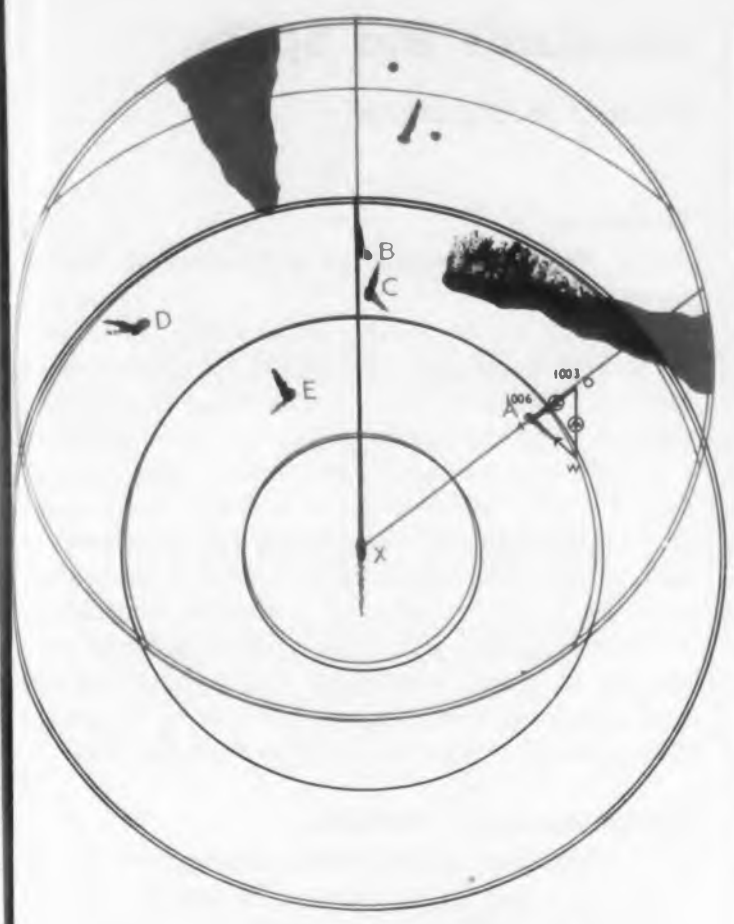
TRUE movement rather than the conventional relative movement can now be shown directly on a ship-borne PPI radar display. Introduced by Decca Radar Ltd., the system indicates the "own" ship's true heading pictorially and offers the viewer a more dynamic presentation of marine traffic within the range of the radar.

A distinct advantage of this Decca True Motion Radar TM46 is illustrated in the comparison between PPI patterns. All objects seem to be in movement in "black" with the apparently "fixed" conventional radar transmitter at location X. With the new system, color clearly explains that ship X is in motion, shows its path of travel (as well as the absolute path of travel of all other *moving* targets) and, additionally, indicates all *stationary* targets which could not be so identified earlier.

True motion display is obtained in the new system by feeding compass and speed information into a small resolver. Speed and direction of the "own" ship are converted into E-W and N-S movements which control currents in the offcentering coils of the CRT. This, in turn, affects the center source position about which the PPI trace rotates.

Range rings and a variable range marker appear as concentric circles around "own" ship and an electronic bearing marker enables bearing of other vessels to be measured regardless of "own" ship's position. Since "own" ship moves over the PPI continually in the vector of the ship's course, the range of warning ahead is steadily reduced. Periodically, then, it is necessary to reset the "own" ship position and this can be done anywhere over the CRT face. After resetting, the true, absolute picture is developed almost instantaneously. The PPI tube persistency acts to create the true course directions very rapidly, affording reliable and accurate information for the pilot-navigator.

Abstracted from "True Motion" Radar, British Communications and Electronics, Heywood & Co., Ltd., Drury House, Russell St., Drury Lane, London, W.C.2, Dec. 1956, p. 659.



Conventional relative motion PPI display is shown in black. New true motion PPI display is shown in color. "Own" ship at location X shows clearly its travel vector. Buoy B and other fixed targets are so indicated by no movement on true motion PPI. Land outline is distinct and clear.

Indicator of new true motion radar for shipboard use.

Standards and Specs

Sherman H. Hubelbank

Grounding

AIEE No. 953, GROUNDING OF INDUSTRIAL POWER SYSTEMS

Although not an AIEE standard, this report presents a well-rounded analysis of the problems of grounds. The discussions are of value to all interested in systems grounds, equipment grounds, static and lightning protection grounding, and connections to earth. Included in the material are the pros and cons of grounded systems, the problems of making equipment grounds, how static is generated, and what should be done to prevent its generation, and the problems of making a low resistance connection to earth. Copies of this publication are available from the American Institute of Electrical Engineers, 33 West 39th St., New York 18, N.Y.

RETMA Standards—Revisions

The following RETMA standards proposals are being circulated for comment. Although the official comment period may have expired, you are encouraged to contact the RETMA Engineering Department, 11 West 42nd St., New York 36, New York.

S.P. 517, RIGID COAXIAL TRANSMISSION LINES AND CONNECTORS—50 OHMS

Gas-filled rigid coaxial transmission lines and their connectors containing electrically transparent supporting structure are covered in this proposed standard. This standard does not apply to any semi-flexible transmission lines or connectors. It is the intent of this standard to provide complete mechanical interchangeability for all lines and connectors. It is not the intent of this standard to restrict electrical design parameters.

S.P. 518, TERMINATING AND SIGNALING EQUIPMENT FOR MICROWAVE COMMUNICATIONS SYSTEMS—PART I: TELEPHONE EQUIPMENT

Covered in this proposal are standards for talking circuits and standards for signaling circuits. Included within each section are definitions of terms and methods of measurements. A section of supplementary definitions is also included. A cross listing of ASA definitions of telephone terms is included.

S.P. 519, DIMENSIONAL CHARACTERISTICS—45RPM PHONOGRAPH RECORDS FOR HOME USE

This proposed standard is dimensional in character, and serves to permit interchangeability and facilitate equipment design. It is not intended to indicate or imply quality or performance levels.

SP. 520, DIMENSIONAL CHARACTERISTICS—33-1/3RPM PHONOGRAPH RECORDS FOR HOME USE

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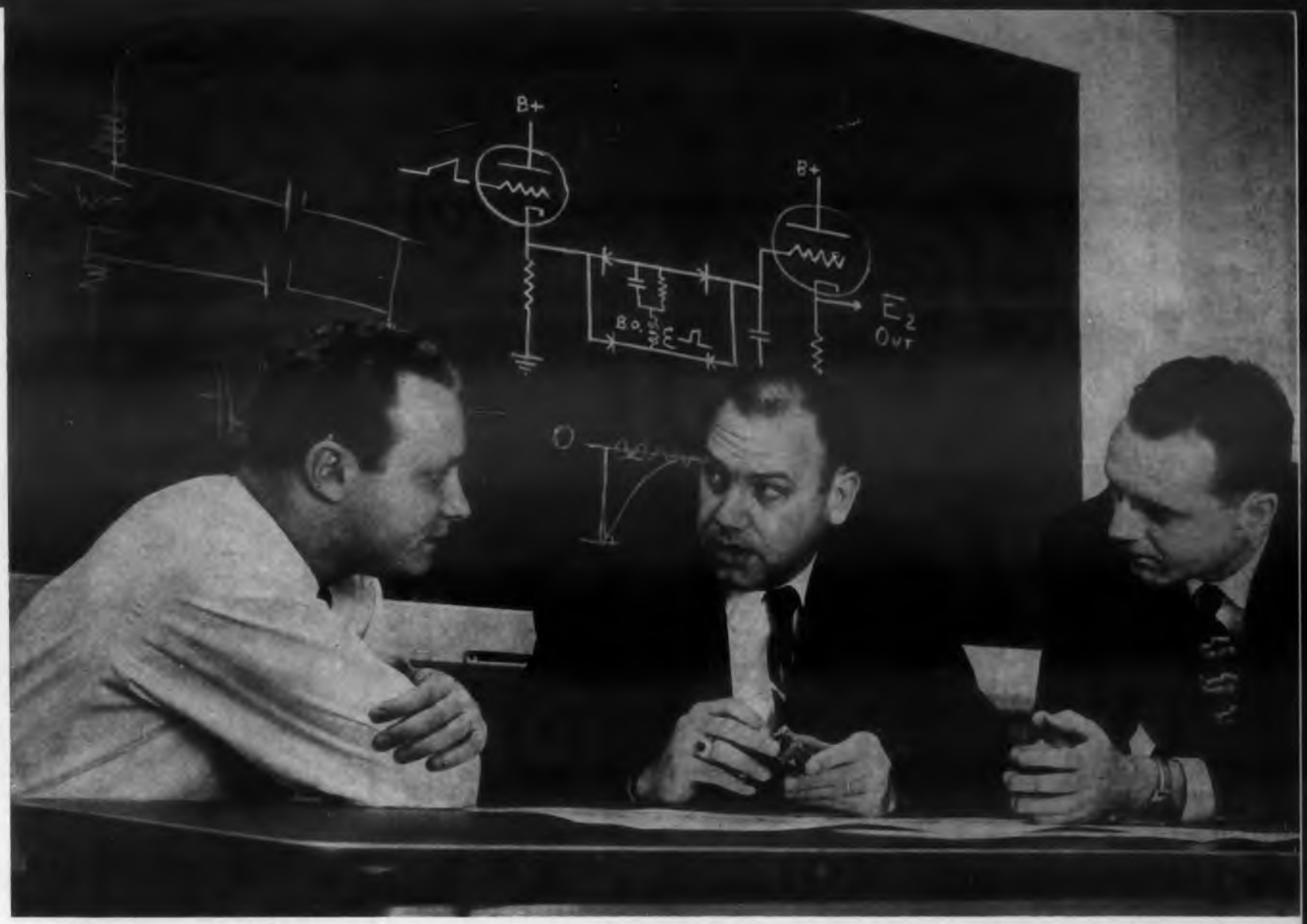

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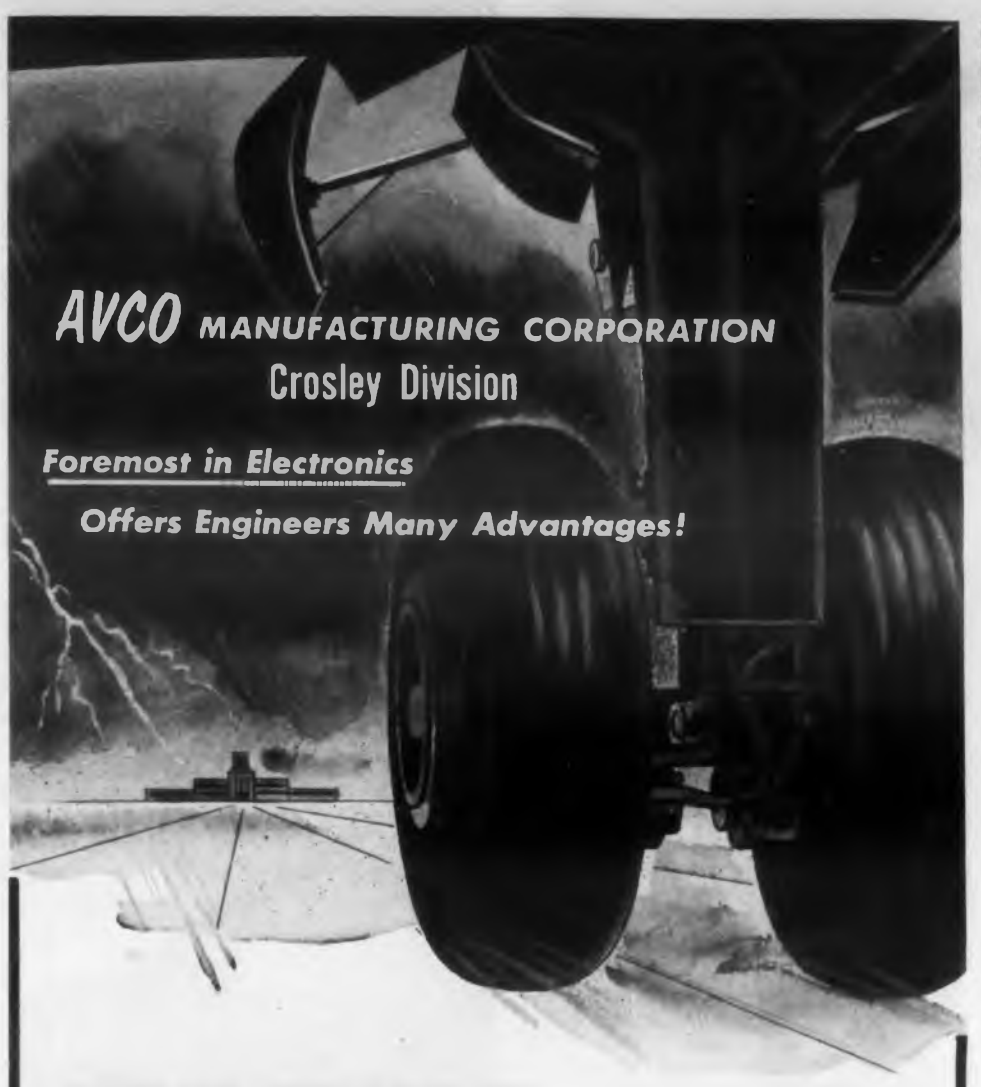

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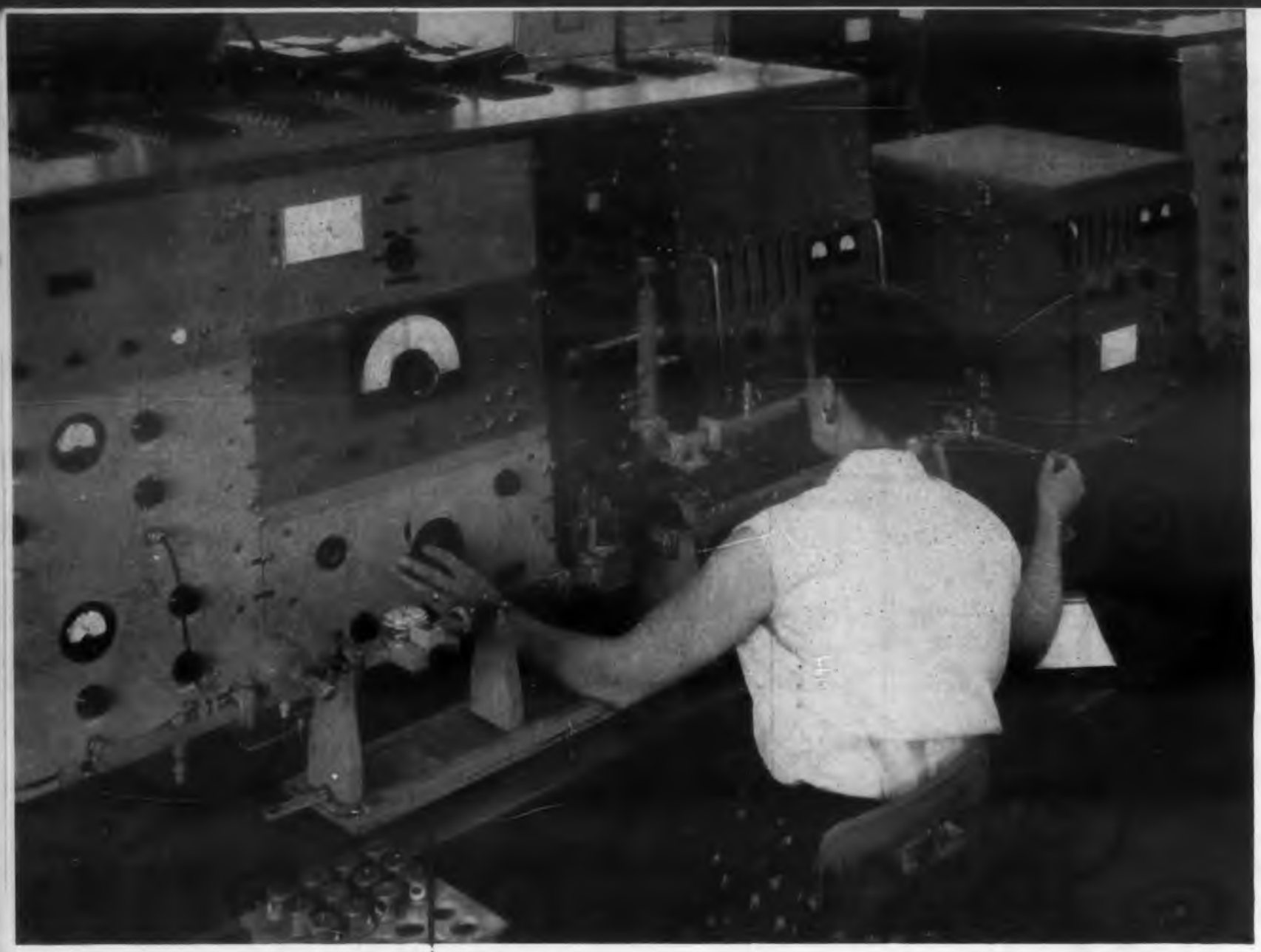

ADVERTISING INDEX
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