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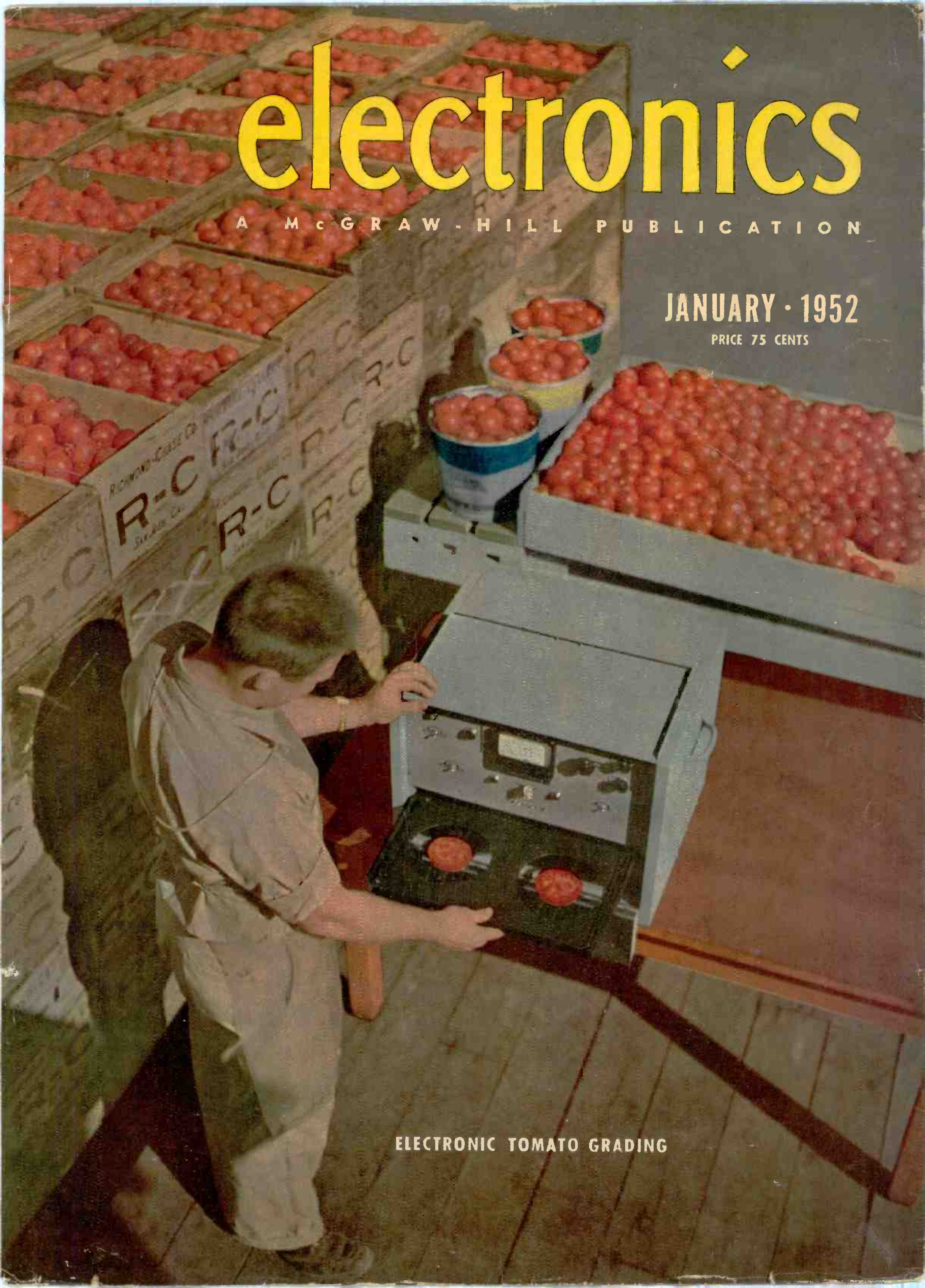

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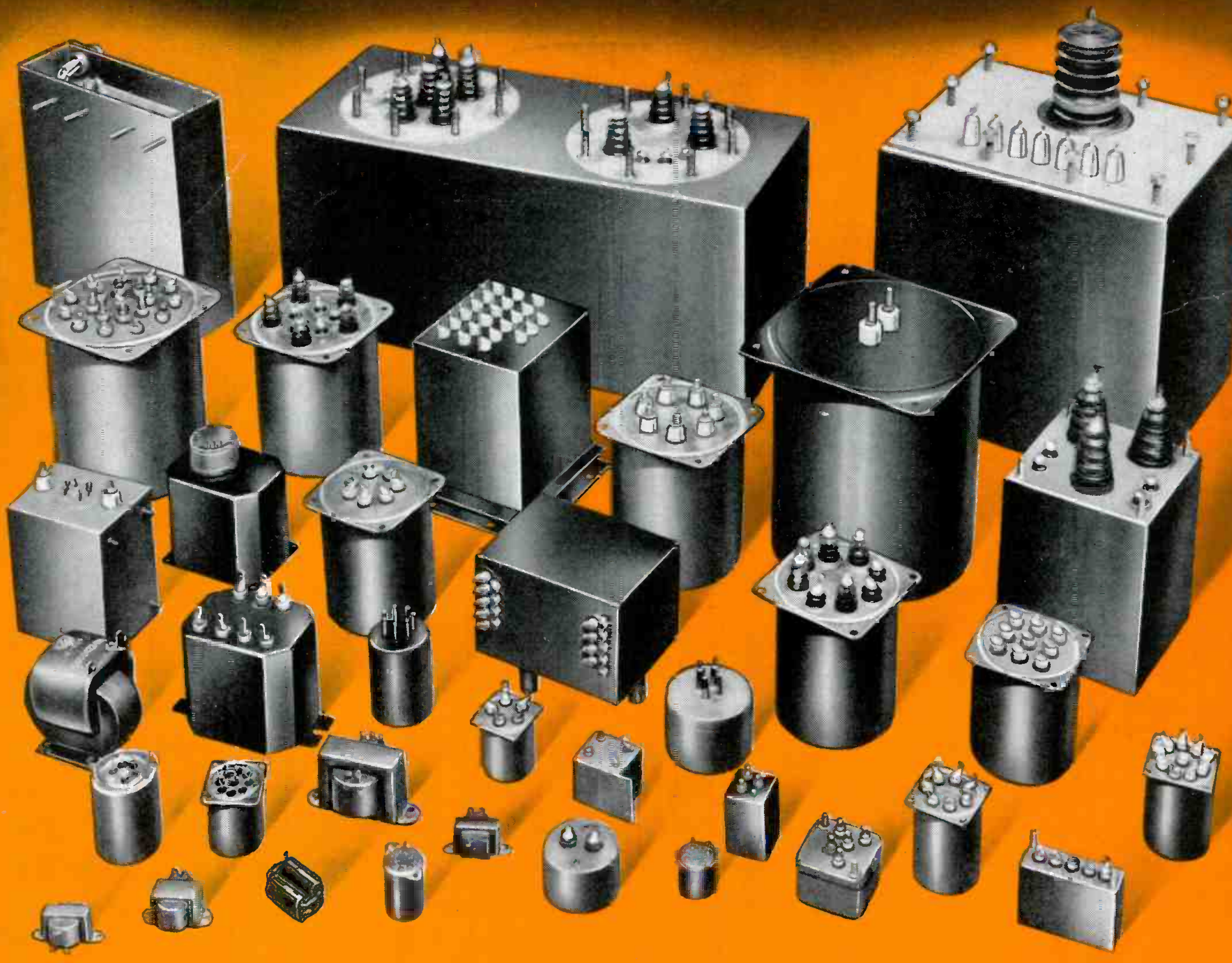

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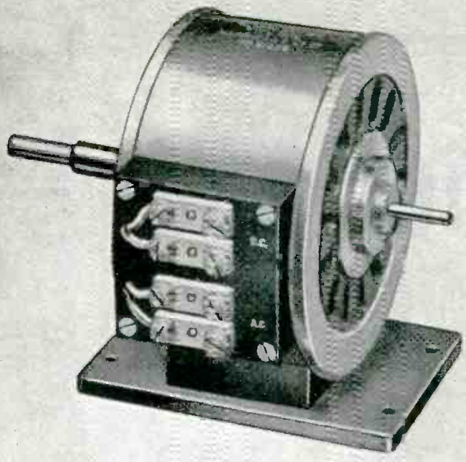
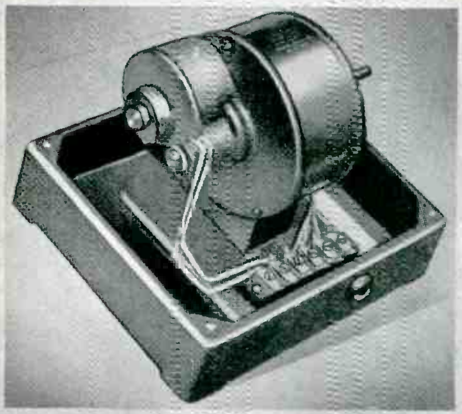
Phonic Motors and Timing Devices

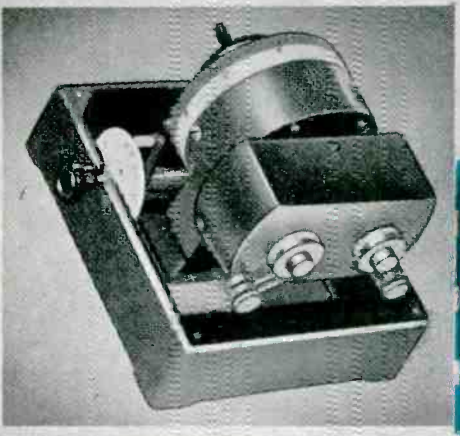


Designed for use at frequencies from 50 c/s - 2000 c/s. Phonic Motors of this type form the nucleus around which are built the timing devices illustrated on this page.



The Timing Device Type D-195-A provides an impulse of 1/10 second duration once every second, when the motor is supplied with power at a frequency of 1000 c/s.

The Timing Device Type D-193-A provides an impulse of 1/10 second duration 60 times per minute and in addition, an impulse of ½ second duration once per minute. A worm and wheel adjustment allows phasing correction.



IN many branches of scientific work the need arises for a motor capable of a very high standard of constancy of speed. The frequency of the mains electricity supply is not normally controlled to better than one or two per cent., so that a mains-operated synchronous motor may be inadequate, and centrifugal governors, as used on gramophone motors, may not provide a sufficiently precise control. In such cases a phonic motor driven by an alternating current supply of high frequency stability may be employed. It is not perhaps generally realized that in their modern form such motors may be used to give quite a large torque, and are able to maintain synchronism despite the sudden imposition of relatively large inertia loads. Under steady-state conditions, "hunting" is almost entirely eliminated, and the constancy of rotational speed is almost entirely dependent on the frequency stability of the alternating current supply.

A precision quartz crystal controlled frequency of 100 kc/s may attain a frequency stability of the order of one part in 10^8. This frequency is then divided electronically to 1,000 c/s by means of regenerative dividers or locked multivibrators. In order to facilitate comparisons with time signals, or to use the frequency standard as a clock, it is necessary to derive a still lower frequency—preferably one cycle per second. Electronic division in the range 1,000 to 1 cycle per second, with high phase stability, is difficult, and the simplest and most reliable method is to drive a phonic motor from the 1,000 c/s source, and to fit mechanical contacts to suitably geared driven shafts. An added advantage is that by employing further gearing, more widely spaced signals may be obtained. Thus signals spaced at intervals of one sidereal second, or any other specified interval, may be obtained from an oscillator with a fundamental frequency of 100 kilocycles per mean time second. By means of a simple mechanical device, controlled changes in phase of the timing of the contacts are also possible.

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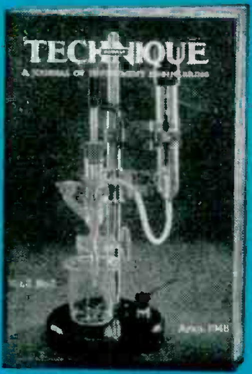

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New (40X) Amplifier and

BROWN INSTRUMENTS ACCELERATE RESEARCH

New (*40X*) amplifier combines high gain and sensitivity with good stability.

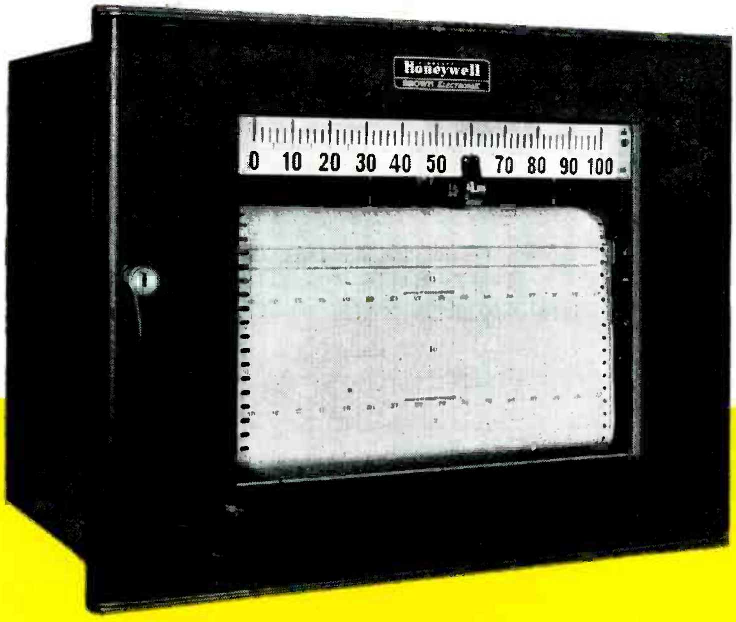
Specially designed to reduce thermal potentials and stray pickup, the new Brown *40X* servo amplifier incorporates an extra stage of amplification to provide increased sensitivity . . . permitting motor drive from signals as low as 0.05 microvolts.

Pictured with the amplifier is the rectifier which provides d-c filament voltage for the first amplifier tubes. It can be used as the basic link in a closed servo loop (where great sensitivity is required) . . . to translate electrical signals into directional motion . . . to provide corrective action in conjunction with minute error signals . . . for null detection . . . or for remote positioning.

Electrical Characteristics

- EQUIPMENT INPUT IMPEDANCE—3000 ohms.
- STABILITY—(after warmup) —within 1.0 μv.
- DEAD ZONE (with 76750-3 motor)—0.1 μv.
- OVERALL VOLTAGE GAIN —40 x 10^6.
- 60 CYCLE OUTPUT CURRENT—0-12 MA.
- 60 CYCLE OUTPUT VOLTAGE—0-154.

Narrow Span Potentiometer



Self-contained *ElectroniK* narrow span potentiometer, incorporating new (*40X*) amplifier, is ideal for measuring low level potentials.

Electrical Characteristics

- **RANGES**—Recorders: 0-100 0-200, 0-500 microvolts, 0-1 millivolts. Indicators: 0-500 microvolts and 0-1.1 millivolts.
- **STABILITY** (after warmup)—1 microvolt or less for all ranges.
- **LIMIT OF ERROR**—⅛% of span.
- **SENSITIVITY**—0.1 microvolt.
- **DEAD ZONE**—0.1 microvolt or 0.006% of span (whichever is greater).
- **PEN SPEEDS**—24 or 12 seconds full travel.
- **CONTROL FORMS**—Any standard pneumatic form, circular chart only.
- **CHART SPEEDS**—Any standard speed.
- **POWER SUPPLY**—115 volts, 60 cycles only.
- **RANGE OF INPUT SIGNALS TO RECORDER**—(approx.) 0.05 µv. to 1 mv.

● ***Important Reference Data***

Send for Data Sheet No. 10.20-4 on the (40X) Amplifier . . . Data Sheet No. 10.0-8 on the *ElectroniK* Narrow Span Potentiometer . . . and Bulletin No. 15-14. "Instruments Accelerate Research"

Now, with the development of a new high gain amplifier and potentiometer circuit, extremely low level potentials can be measured, recorded and controlled in this new self-contained instrument. The sensitivity of this instrument is so high that a change in signal as low as one-tenth of a microvolt can be determined. Spans as narrow as 100 microvolts provide a high degree of resolution. Internal design practically eliminates thermal emf's and stray a-c pickups.

The new *ElectroniK* Narrow Span Potentiometer may be used wherever the accurate measurement of d-c potentials of the order of microvolts is required . . . it is available as a Strip Chart Recorder (illustrated), as a Multi-Point Precision Indicator, and as a Circular Chart Recorder with pneumatic control.

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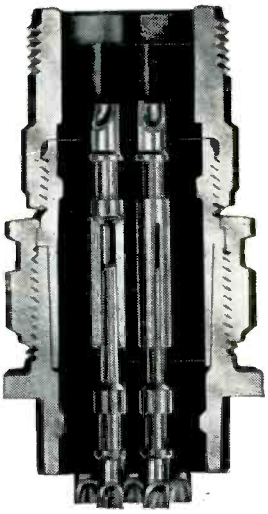
The importance of a completely moisture-proof electrical connector can scarcely be exaggerated. But in addition to this important characteristic, there are a host of other exclusive features that make Bendix Scinflex connectors outstanding for dependable performance. For example, the use of Scinflex dielectric material, an exclusive Bendix development of outstanding stability, increases resistance to flash over and creepage. In temperature extremes, from —67°F. to +275°F. performance is remarkable. Dielectric strength is never less than 300 volts per mil. If you want more for your money in electrical connectors, be sure to specify Bendix Scinflex. Our sales department will be glad to furnish complete information on request.

PLUS



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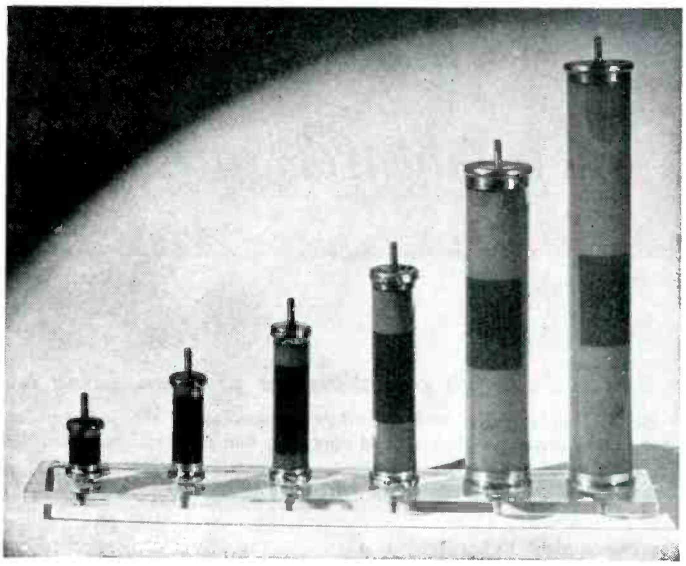
Design and construction of Plasticon Type LSG* feature low-loss silicone-impregnated capacitor elements encased in hermetically-sealed glass tubes.

All current conductors have large surface area and large cross-section to maintain low I^2R losses. Non-ferrous materials are used throughout. Type LSG Capacitors are easy to mount . . . small and rugged. Studs (as shown) are standard. Wire leads are available on request.

The capacitor elements are designed for the lowest possible inductance by using the most advantageous geometric configuration consistent with modern production practices.



Type "L" Glassmikes utilize their superior characteristics in the following applications:

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- De-spiking networks
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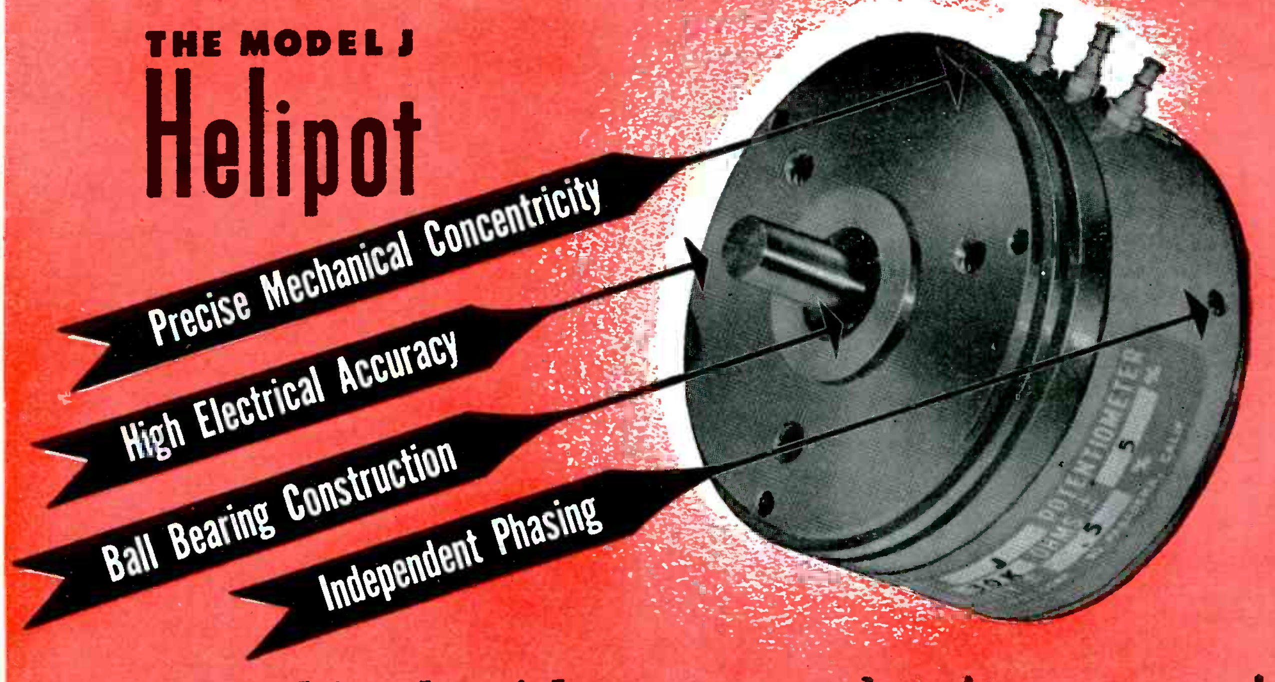

. . . combined with mass-production economies!


TYPICAL 6 GANG MULTIPLE ASSEMBLY

If it's a tough potentiometer problem, bring it to Helipot

—for Helipot has facilities and know-how unequalled in the industry for mass-producing precision potentiometers with advanced operating and electrical features.

This recently-developed 'Model J' Helipot, for example, combines several revolutionary advancements never before available in the potentiometer field . . .

Precise Mechanical Concentricity

Modern servo mechanisms and computer hook-ups require high mechanical precision to insure uniform accuracy when connected to servo motors through close-tolerance gears and couplings.

In the "Model J," close concentricity between mounting surface and shaft is assured by a unique mounting arrangement. The unit can be aligned on either of two wide-base flange registers and secured with three screws from the front of the panel . . . or it can be secured with adjustable clamps from the rear of the panel to permit angular phasing. Or if preferred, it can be equipped with the conventional single-hole bushing type of mounting.

In addition to accurate mounting alignment, exact rotational alignment is assured by the long-life, precision-type ball bearings upon which the shaft rotates. Precise initial alignment coupled with negligible wear mean high *sustained* accuracy.

High Electrical Accuracy

Helipot products have long been noted for their unusually high electrical accuracy and the "Model J" embodies the latest advancements of Helipot engineering in this field.

For example, tap connections are made by a new Helipot welding technique whereby the tap is connected to only ONE turn of the resistance winding. This unique process eliminates "shorted section" problems!

High linearity is also assured by Helipot's advanced production methods. Standard "Model J" linearity accuracies are guaranteed within ±0.5%. On special order, accuracies to ±0.15% (capacities of 5000 ohms and up) have been obtained.

Ball Bearing Construction

The shaft of each "Model J" is carefully mounted on precision-type ball bearings that not only assure sustained rotational accuracy, but also provide the constant low-torque operation so essential for servo and computer applications. Starting torque is only ¾ of an inch-ounce (±.25 in.-oz.)—running torque, of course, is even less.

Independent Phasing

When using the "Model J" in ganged multiple assemblies, each section can be independently phased electrically or mechanically—even after installation on the panel—by means of hidden internal clamps controlled from outside the housing. Phasing is simple, quick, accurate!

Mass-Production Economies

In addition to its many other unique features, Helipot engineers have developed unusual techniques that permit mass-production economies in manufacturing the "Model J". Actual price depends upon the number of taps required, special features, etc. . . . but with all its unique features, you will find the "Model J" very moderate in cost.*

Wide Choice of Designs

The "Model J" Helipot is available in a wide selection of standard resistance ranges—50, 100, 1,000, 5,000, 10,000, 20,000, 30,000 and 50,000 ohms . . . in single- or double-shaft designs . . . with choice of many special features to meet virtually any requirement within its operating field.

***Write for Bulletin 107 which gives complete data and price information on the versatile "Model J" Helipot!**

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Contains complete circuit diagrams, with tube types and component values marked, of nearly every item of equipment employed in the television system, including the sync-signal generator, cameras and camera controls for live pickup and film, microwave relay transmitter and receiver, and three different types of receivers for the home.

11 BIG CHAPTERS

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6. Video Amplification
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TELEVISION ENGINEERING

By Donald G. Fink

Editor, *Electronics*; Vice Chairman, National Television System Committee

721 pages
512 illustrations
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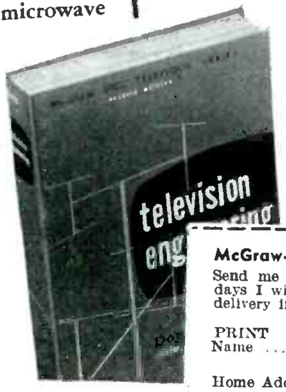
THE thoroughness with which Donald Fink presents the great and rapid advances in television technology makes this second edition more than a revision. It is virtually a new book. Published originally as *Principles of Television Engineering*, it is now fully up to date in its practical coverage of the whole field, including color.

For technical workers who want to add familiarity with television engineering to their knowledge of radio engineering — for readers who want adequate self-training material for engineering jobs in television broadcasting and manufacturing plants—for college and technical institute students in this field—this book meets the need for grounding in the engineering and technical fundamentals of television.



The whole television process, from studio to receiver, is covered—soundly and clearly. Aspects peculiar to television tecchnology, such as scanning and waveform and colorimetry, camera tubes and picture tubes, are treated in detail, starting from first principles.

The principles of operation of television systems, in black-and-white and color, are covered, and the book describes in detail the design, operation, and use of television equipment.

Entirely the work of Donald Fink, this revision offers you *today's* television fundamentals and practice, in the clear and comprehensive form that made the previous edition so widely used.

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A distributor serves not only the factories from which he buys. He also performs an invaluable service to his customers by making quickly available to them the products they require. A machine shop, for example, may need only a few hundred pounds of brass rod; there is a distributor within easy reach who can furnish it almost immediately. Or a contractor may want a few pieces of steel pipe and a thousand feet or so of copper water tube. Again, the distributor has them. A metal products distributor has to carry such items and an infinite number of others. The Revere Distributor who started in business 125 years ago actually has in stock 53,000 different items, cataloged, indexed, and held in warehouses ready for immediate shipment throughout its territory. Each month this stock is drawn upon by 5,000 to 8,000 customers, each order relatively small. There are many Revere Distributors with similar stocks and offering equal service.

To keep this distributor's warehouses filled with a balanced inventory, 18 people are required in his purchasing staff, which includes specialists in various kinds of materials, machines, tools and supplies. And to serve customers with information, quotations and the like, 25 salesmen are on the go constantly, calling on manufacturers, contractors, builders and stores throughout the busy industrial area in which the distributor operates. The large business done by the company is in great contrast to that of 125 years ago, when it was little more than a hardware store. The enterprise has grown in the American tradition of freedom to prosper in accordance with the principles of reliability and efficiency, fair dealing and integrity in performing a desired function.

Revere Distributors are selected for their ability to serve, and also chosen as to location, so that no matter where you are in this big country of ours, there is a Revere Distributor within easy reach. Today metal stocks may be short due to defense demands but manufacturers are doing everything possible to keep distributors supplied.

If you buy from distributors we suggest you remember that they are not only "central stockrooms," but have a great deal of special knowledge about the products they sell and can give you much helpful advice. Not only that, through the Revere Distributors you can be put in touch with the Revere Technical Advisory Service, which will cooperate with you on matters concerning the selection and fabrication of the Revere Metals. Our distributors, and those of every other manufacturer, render many essential services, both to those to whom they sell, and to those from whom they buy. The distributor system as it operates in the United States arose in response to the need for it. Today it fulfills that need more effectively than ever before.

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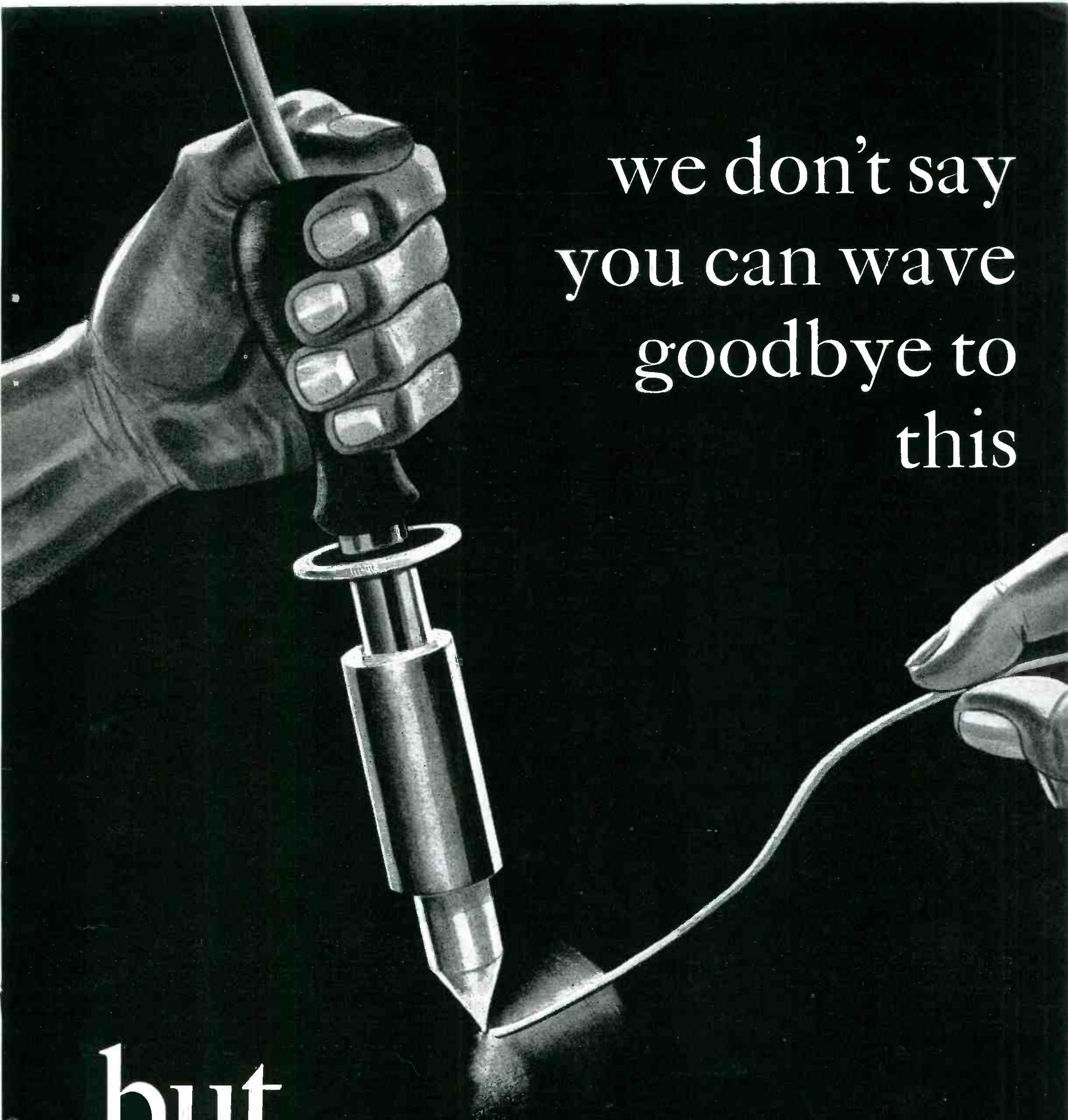


Here's Proof: Printed Electronic

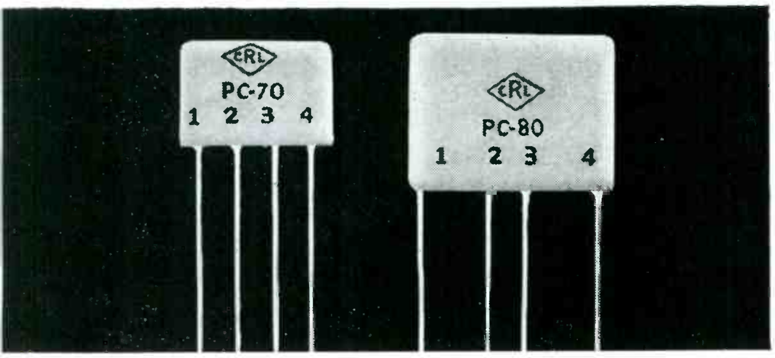
What are Printed Electronic Circuits?

Printed Electronic Circuits are complete or partial circuits (including all integral circuit connections) consisting of pure metallic silver and resistance materials fired to CRL's famous Steatite or Ceramic-X and brought out to convenient, permanently anchored external leads. They provide compact miniature units of widely diversified circuits — from single resistor plates to complete speech amplifiers. No other modern electronic development offers such tremendous time and cost saving advantages in low-power applications. ***Important to note:*** All PEC's illustrated are developed for standard applications. Numerous other circuit complements can be furnished for volume requirements.

How Do They Save Time and Money — Space and Weight?

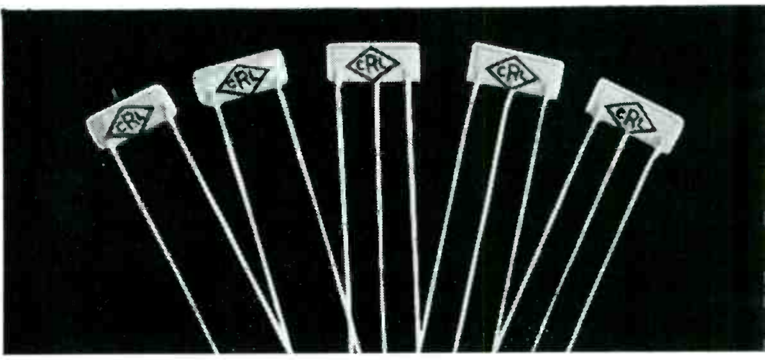
Because Printed Electronic Circuits combine several components on a single plate unit, they eliminate approximately 25% to 80% of formerly required soldered connections within the circuits they replace. This means simplified assembly — savings in material. What's more, because they replace several individual components, they cut down your purchases and inventory. Because they are complete assembled circuits, they do much to eliminate wiring errors. Their small size (note illustrations) means less space needed as well as less weight . . . important factors in today's crowded chasses.

60% Less Soldered Connections with Centralab Triode Couplates



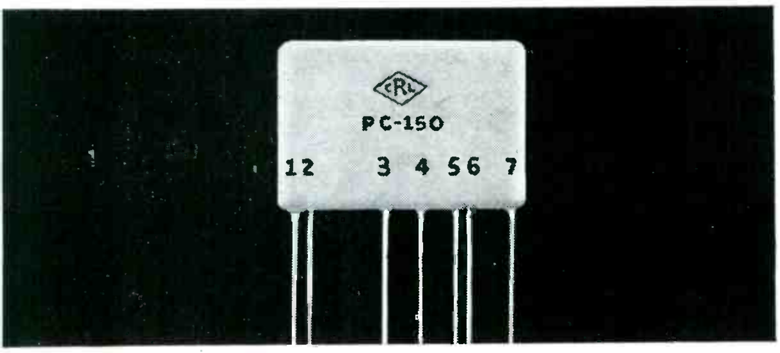
Centralab Triode Couplates replace 5 components normally used in audio circuits. Triode Couplates are complete assemblies of 3 capacitors and 2 resistors bonded to a dielectric ceramic plate. Available in a variety of resistor and capacitor values. Technical Bulletin 42-127.

Plate Capacitor and Resistor-Capacitors Excellent for Miniature Use



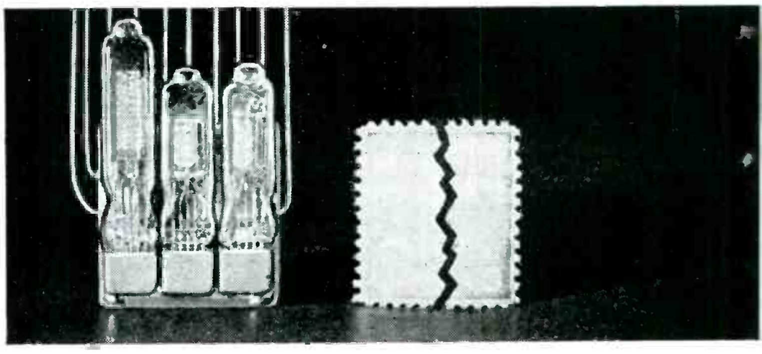
Actual size photograph of plate capacitor, resistor, and resistor-capacitor units. Because of size, they readily fit all types of miniature and portable electronic equipment... overcome crowded conditions in TV, AM, FM and record-player chassis. Technical Bulletin 42-24.

50% Less Soldered Connections with Centralab's AUDET



Audet Printed Electronic Circuits furnish all values of all components generally found in the output stage of AC-DC radio receivers. They provide 4 capacitors and 3 resistors on a small plate with only 7 leads. Technical Bulletin 42-129.

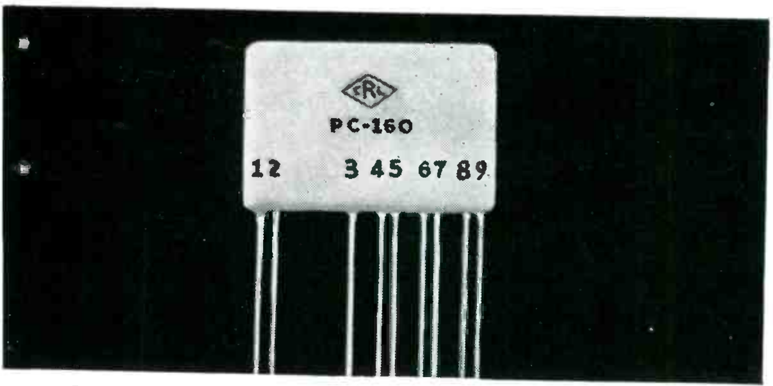
NEW Model 3 AMPEC — A Sub Miniature 3 Stage Speech Amplifier



Here's the latest outgrowth of Centralab's constant research in Printed Electronic Circuit development. The remarkably small dimensions of this new amplifier unit are approximately $1\frac{1}{32}''$ x $\frac{15}{16}''$ x $\frac{11}{32}''$. Check coupon for Technical Bulletin 42-130.

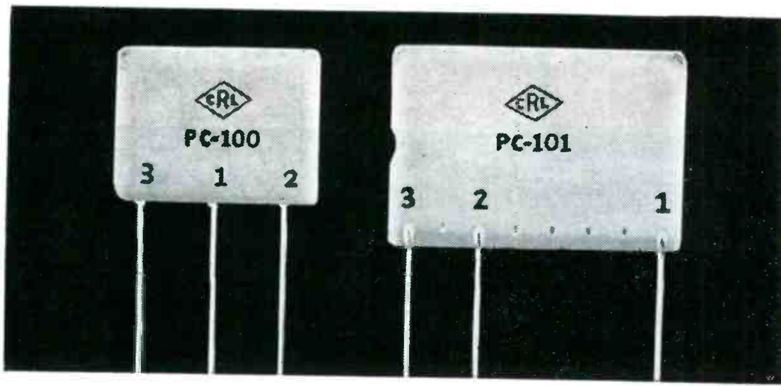
Circuits = BIG SAVINGS

50% Less Soldered Connections With Centralab's NEW PENDET



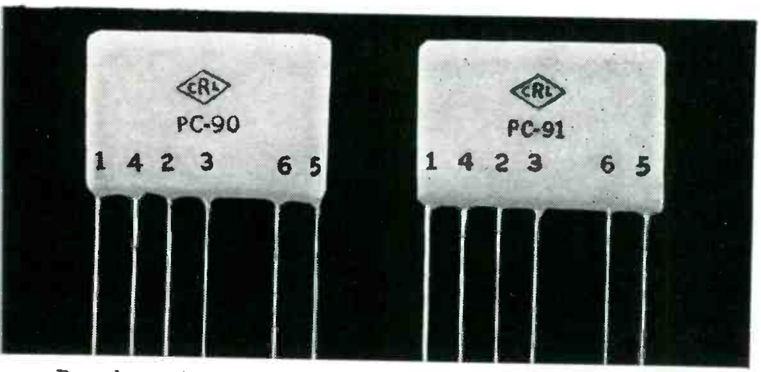
PENDET consists of 5 capacitors and 4 resistors in a single plate with only 9 leads. Similar to the popular AUDET, it is designed to couple the diodetriode and pentode tubes in the output stage of AC-DC sets. Check coupon for Technical Bulletin 42-149.

82% Less Soldered Connections With P.E.C. VERTICAL INTEGRATOR



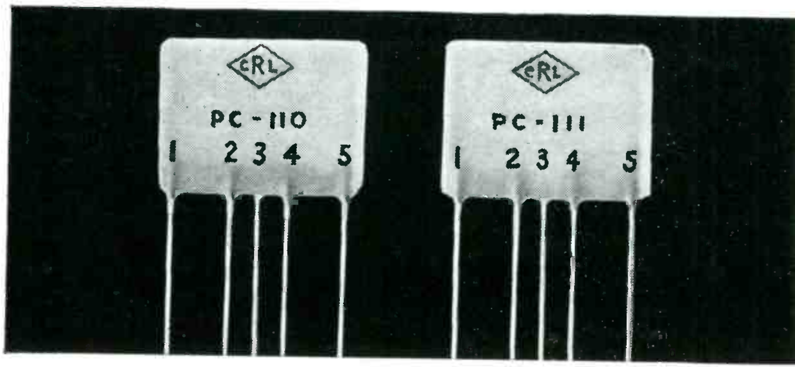
Centralab Vertical Integrators give you big savings in assembly of TV vertical integrator networks. One type consists of 4 resistors and 4 capacitors brought out to 3 leads . . . reduces former 16 soldered connections to 3! Check coupon for Technical Bulletin 42-126.

50% Less Soldered Connections With Centralab's PENTODE COUPLATE



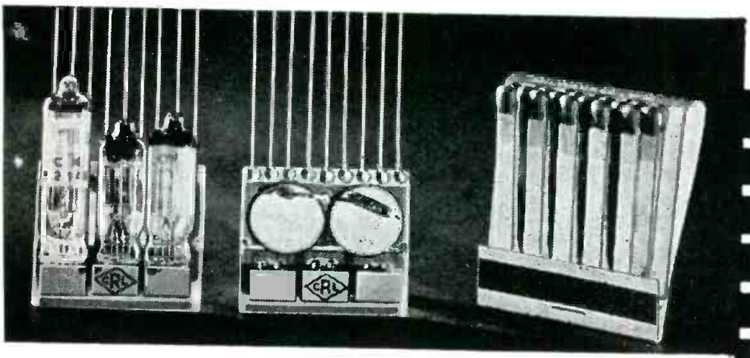
Pentode couplates are complete interstage coupling circuits consisting of 3 capacitors and 3 resistors on a small 6 lead ceramic plate. Compared with old-style audio circuits, they actually reduce soldered connections 50%—wiring errors accordingly. Technical Bulletin 42-128.

28% Less Soldered Connections With NEW FILPLATE



FILPLATES (2 resistors and 2 capacitors) for bypass and filter application in TV, FM and AM, where filter networks of comparable component values and layout are needed. Smaller than special delivery stamp. Save vital low wattage resistor stocks. Technical Bulletin 42-131.

Standard Model 2 AMPEC Miniature 3 Stage Speech Amplifier



AMPEC — A full 3-stage speech amplifier. Provides highly efficient performance. Size 1¼" x 1⅛" x .340" over tube sockets! Used in hearing aids, mike preamps and other applications where small size and outstanding performance counts. Technical Bulletin 42-117.

Centralab

Division of GLOBE-UNION INC. • Milwaukee

Centralab, Div. of Globe-Union Inc.
914 East Keefe Avenue, Milwaukee 1, Wisconsin

Please send me the Technical Bulletins on Printed Electronic Circuits as checked below:

☐ 42-24 ☐ 42-117 ☐ 42-126 ☐ 42-127 ☐ 42-128
☐ 42-129 ☐ 42-130 ☐ 42-131 ☐ 42-149

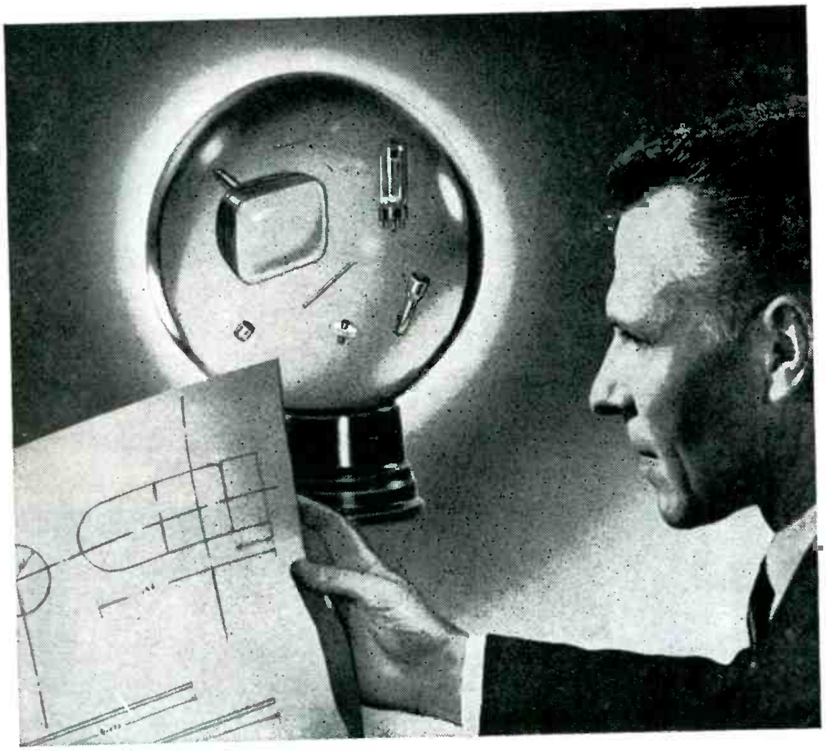
Name..

Address..

Company..

Title..

With our hands full today...we've our eye on tomorrow

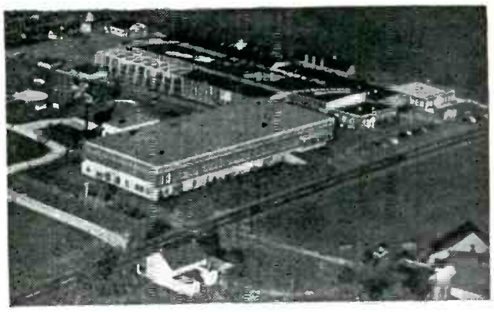


Here at Superior we produce quantities of quality parts for the Electronics Industry. Our research engineers are constantly at work to improve these products and to develop new parts to do the job better. Production-wise we're working just as constantly to produce more and more of these better products for you.

During the year 1950, we doubled our disc cathode capacity, added over 50% to Seamless cathode capacity. Through the same period we almost doubled the number of machines making Lockseam cathodes . . . more than doubled capacity. 1950 production of Lockseam cathodes increased 280% over 1949. Demand kept pace with the increase.

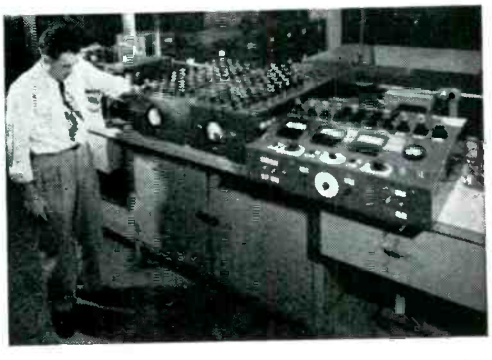
Plans for the future include the installation of new machines and the improvement of already good processes so that the Electronics Industry's coming needs may be as well met as its past demands.

Then as now, we at Superior will deliver truly superior small tubing products to do tough jobs better. Superior Tube Company, 2500 Germantown Ave., Norristown, Pa.



Buildings . . . enclosing more than 4 acres—all devoted to the development, production and testing of fine small tubing.

Men and Machines. . . fabricating, inspecting and finishing parts to meet the most exacting specifications.



Engineering . . . laboratory equipment for all kinds of testing, including emission characteristics of nickel cathode materials.

Which Is The Better For Your Product . . .

SEAMLESS . . .? The finest tubes that can be made. Standard production is .010″ to .121″ O.D. inclusive, with wall thicknesses of .0015″ to .005″. Cathodes with larger diameters and heavier walls will be produced to customer specification.

Or LOCKSEAM*. . .? Produced directly from thin nickel alloy strip stock, .040″ to .100″ O.D. in standard length range of 11.5 mm to 12 mm. Round. rectangular or oval, cut to specified lengths, beaded or plain.

Superior

THE BIG NAME IN SMALL TUBING

All analyses .010″ to ⅝″ O.D.

Certain analyses (.035″ max. wall) Up to 1⅛″ O.D.

*MFD UNDER U. S PATS. SUPERIOR TUBE COMPANY • Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800

LEADING TV MANUFACTURERS REPORT—

G.E.'s ELECTROSTATIC-FOCUS TUBES GIVE THE *Sharpest* FOCUS OF ALL!

17RP4/17HP4
17VP4
20HP4-A
21LP4
21LP4-A

Comparative tests proved General Electric tubes far superior in needle-sharp distinctness!

FOUR large builders of TV receivers ran their own detailed tests of new G-E zero-focus types against other makes of electrostatic tubes. In every case, General Electric tubes gave pictures with *greater sharpness and definition over the entire viewing area!*

- Improved gun design, precision manufacture, share the credit for this G-E contribution to a TV industry that continues to move ahead despite metal shortages and a heavy defense load.

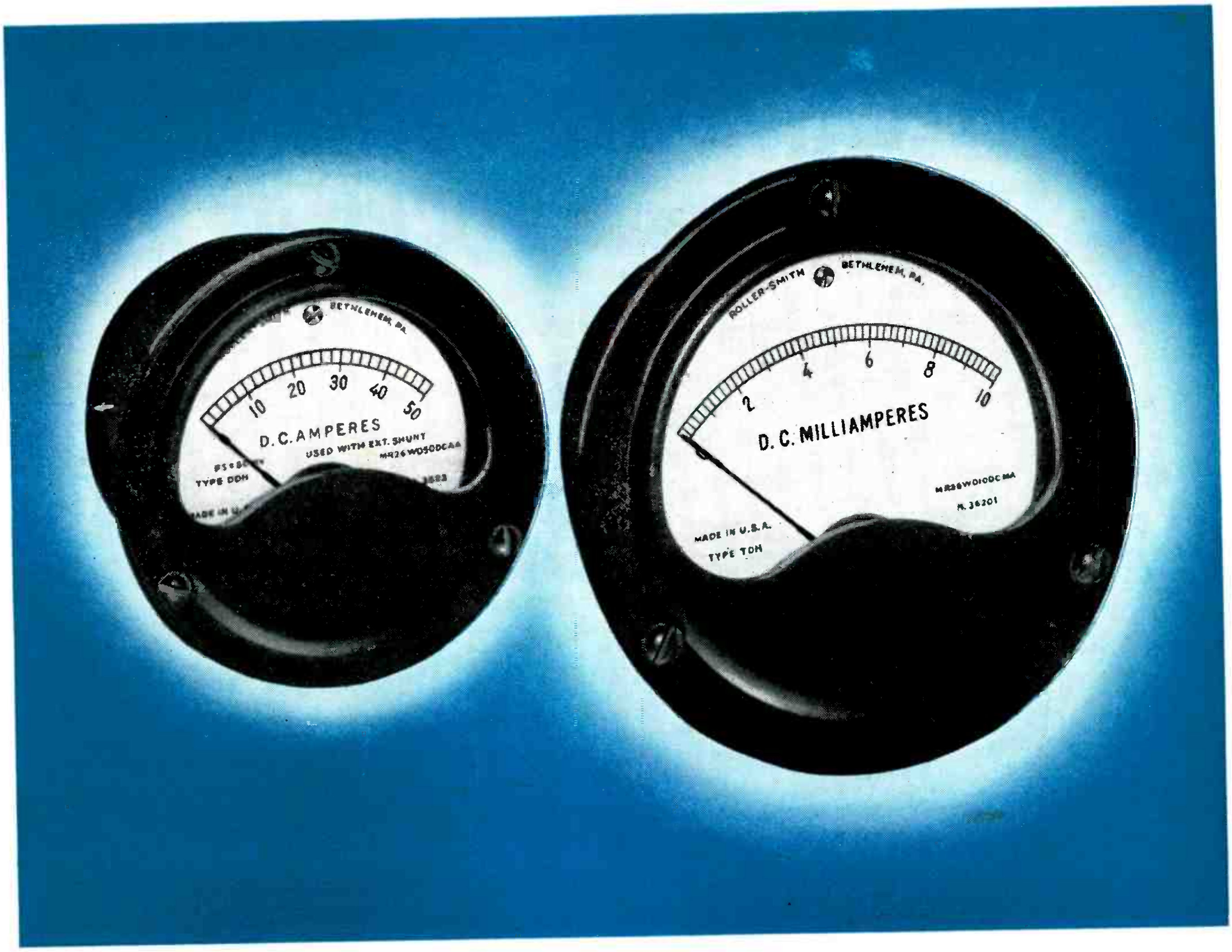
- Saving precious cobalt, nickel, and copper—needing no receiver focus control, which means simpler TV operation—General Electric's new zero-focus tubes have this third big advantage: they produce outstandingly clear, vivid pictures!

- Five types in popular sizes are listed above. Wire or write for complete facts about the tubes in which you are interested as TV designer or manufacturer! *Electronics Division, General Electric Company, Schenectady 5, New York.*

You can put your confidence in—

GENERAL ELECTRIC

162-1A1



Roller-Smith

Ruggedized Instruments

Shock-Proof • Vibration-Proof • Weather-Proof

Roller-Smith announces production of hermetically sealed *Ruggedized* 2½" and 3½" instruments conforming to MIL-M-10304.

In addition to *Ruggedized* instruments, a complete line of hermetically sealed and unsealed types in conformance with Government specifications are available.

ROLLER-SMITH CORPORATION
BETHLEHEM, PENNSYLVANIA

Our Defense Program Faces a Crisis

A major crisis will soon confront our defense program.

It is not a crisis in raw materials. To find enough materials, from steel to cobalt, for defense production is a serious problem. But it is one that is being solved.

It is not a crisis in manpower. Shortages of workers with special skills hamper production, but these shortages are being relieved, slowly.

It is not a crisis in manufacturing capacity. American industry's record-breaking expansion is, with very few exceptions, keeping abreast of defense needs.

The coming crisis will be one of finance. It will rise from our failure to provide the means to PAY FOR the defense program we now have under way.

A $15 Billion Deficit?

Congress has approved a defense program which is scheduled to raise *total* federal spending in the year from June, 1952, to June, 1953, to somewhere between $85 and $90 billion. Additional appropriations for more air power and atomic development, which are now proposed, would add several billion dollars.

But Congress has not approved a tax plan to match such spending. With the new levies enacted in this session, tax collections during the 1952-53 fiscal year are estimated to fall somewhere between $70 and $75 billion. That would be roughly $15 billion short of balancing the budget. If the defense program is expanded, the deficit will be that much greater.

We have not yet felt the impact of the crisis that would accompany a federal deficit of this magnitude. Federal tax collections currently are big enough to balance federal expenditures. But the defense program is scheduled to boost the annual rate of federal expenditures $25 billion in the next year.

To Meet the Crisis

By January the crisis will be clearly in sight.

Then the President will present his budget. After that, Congress must act to close the broad gap between government income and government spending. If it fails to do that, the whole defense program will be menaced by weakness in its financial foundations. That weakness might well take the form of another destructive wave of inflation.

We have three ways to meet this crisis.

The best approach, of course, is to cut unessential expenditures. That can make a real dent in the deficit. The second is to collect more taxes. The third, and by all odds the most dangerous, is to have the federal government meet its deficit by going deeper into debt. Borrowing, which might feed inflation, can easily lead to disaster.

Near Income Tax Limits

It will not be possible to raise taxes to meet the deficit merely by increasing further the rates on corporations and on persons in the upper income brackets. Congress has about scraped the bottom of that barrel.

The Senate Finance Committee said as much in reporting this year's tax bill. The Committee reported that it had "serious doubts as to the feasibility of raising any substantial additional amounts of revenue from income tax sources." The Committee observed that recent tax legislation brings the burdens of most corporate and individual income taxpayers close to the World War II peaks, and actually carries the rates paid by many taxpayers above those peaks.

Our ramshackle federal tax system must be thoroughly overhauled in order to broaden the tax base if it is to produce more revenue—without doing much more harm than good.

The shocking fact is that no one seems ready to act along any line that might enable us to surmount the crisis.

That fact of itself aggravates the coming crisis. And next year's presidential election doesn't make it any easier to move effectively. Both parties will shrink even more than normally from backing any program that might irritate any considerable number of voters.

If we are to meet this crisis on the tax front in an orderly way, the technical work should be in progress right now. To a large extent it is being ignored.

If we are to enforce the vitally essential program of government economy, there is the same urgent need to get under way the spade work that is required.

And if—as a last miserable expedient—we decide to let the federal government drift deeper into debt, it must have a well-developed program of borrowing from individuals and other investors, such as insurance companies, rather than from the commercial banks. Borrowing from commercial banks might speedily translate the deficit into more and more price inflation. No adequate program of borrowing from savings is now in sight.

Now Is the Time

It is possible, of course, that international relations may improve sufficiently to make it safe for us to slow down the rearmament program. If that should happen, the fiscal crisis would not be so critical. But that kind of good fortune has been notably absent in recent years.

Lenin, patron saint of Communism, is quoted to the effect that to destroy a political and social system such as ours "you must debauch its money."

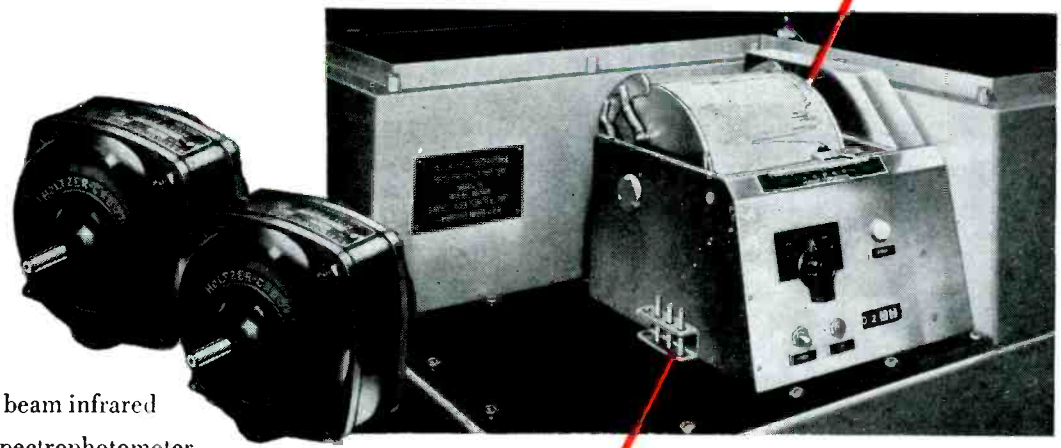
We shall set democracy to digging its own grave if, through our preoccupation with politics during the presidential campaign, we pave the way for further debauchery of our money.

If we really want to avert that disaster, now is the time for us to get going.

Once the crisis is full upon us, it will be too late.

McGraw-Hill Publishing Company, Inc.

Holtzer-Cabot motors help the Spectrophotometer record "signatures" on a beam of light!



The double beam infrared recording Spectrophotometer developed and manufactured by Baird Associates of Cambridge, Mass., is an ingenious instrument which has proven itself invaluable in quickly and surely identifying and defining complex chemical compositions.

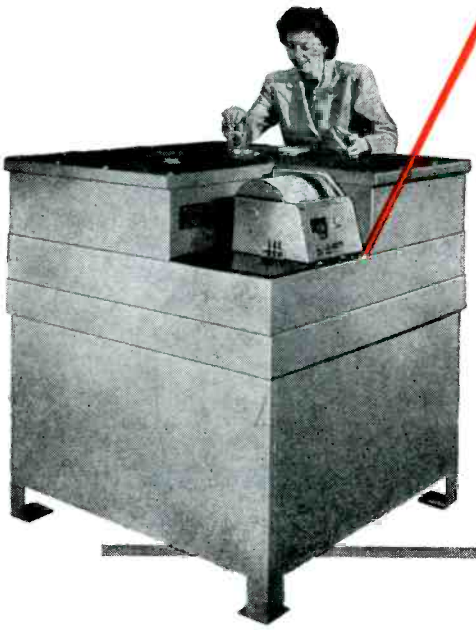
The Spectrophotometer analyzes organic samples by passing an infrared beam through them. The resulting vibration and energy absorption of the sample's molecules form a pattern on the Spectrophotometer's recording drum chart. Comparison of the sample's recorded characteristics with those of known elements reveals the sample's identity and composition.

Rigid specifications were laid down for the motors to operate the variable speed drive used in the Spectrophotometer. Some of the requirements:

- two winding, two speed
- synchronous operation at one speed
- smooth transition between speeds
- all speeds must be reversible
- low vibration and magnetic leakage fields
- small size—low power
- completed design must be applicable to *all* previous models

Holtzer-Cabot engineers, working closely with Baird Associates, developed two different adaptations of the H-C R-25, which met specifications perfectly. These motors are now standard components of the Spectrophotometer and are giving satisfactory, dependable service.

This is but another example of Holtzer-Cabot's ability to meet the most exacting specifications in small-motor applications. Holtzer-Cabot motors range from 1/2000 up through 1½ H.P., from 24,000 RPM to 1 revolution per day!



HOLTZER-CABOT

DIVISION OF NATIONAL PNEUMATIC CO., INC.

BOSTON 19, MASSACHUSETTS

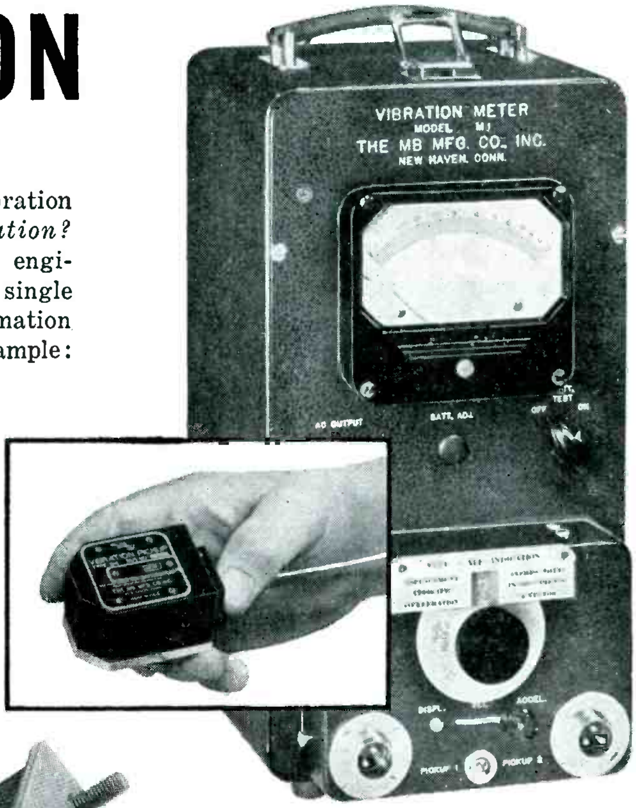
"builders of fine electric motors for three quarters of a century"

Photographs through courtesy of Baird Associates, Cambridge, Mass.

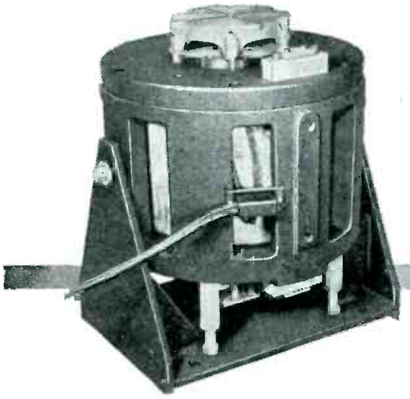
How **MB** can help you

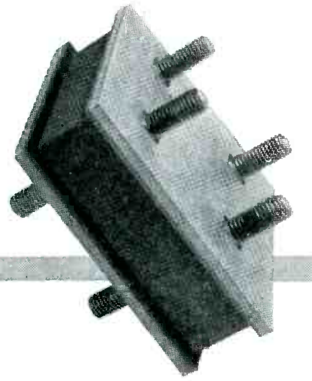
MEET MILITARY SPECIFICATIONS ON VIBRATION

DOES YOUR MILITARY PRODUCTION require vibration *testing?* Shock *absorption*—vibration *isolation?* Representative of MB's specialized vibration engineering, these products show that, from a single source, you can get the equipment and information you need to meet your requirements. For example:



1. **MEASUREMENT** of vibration with MB vibration pickup and meter supplies data for study of disturbing frequencies and for design adjustments. The electrically damped and highly sensitive pickup is convertible for horizontal or vertical operation. Meter gives you accelerations, velocities or displacements of the vibrations directly. Made for each other, the two are the "eyes" for any vibration testing program.





2. **SHAKE TESTING TO MIL-E-5272 and 41065-B** is easily accomplished with MB Vibration Exciters. Model S-3 shown delivers 200-lb force. Others available with 10-lbs to 2500-lbs force ratings—all easily, quickly and accurately controlled for force and frequency.

3. **ISOMODE* SHOCK MOUNTS** have been developed for supporting and protecting aircraft engines from damage while transported in crates or "cans." High load capacity combined with high deflection capacity provides good absorption of shock. **Reg. U.S. Pat. Off.*

4. **MIL-I-5432** (AN-I-16a) can be met with the Type 17 ISOMODE Mount. This unit available for loads from 0.5 to 100 pounds, and controls all modes of vibration with equal efficiency because of equal spring rate in all directions.

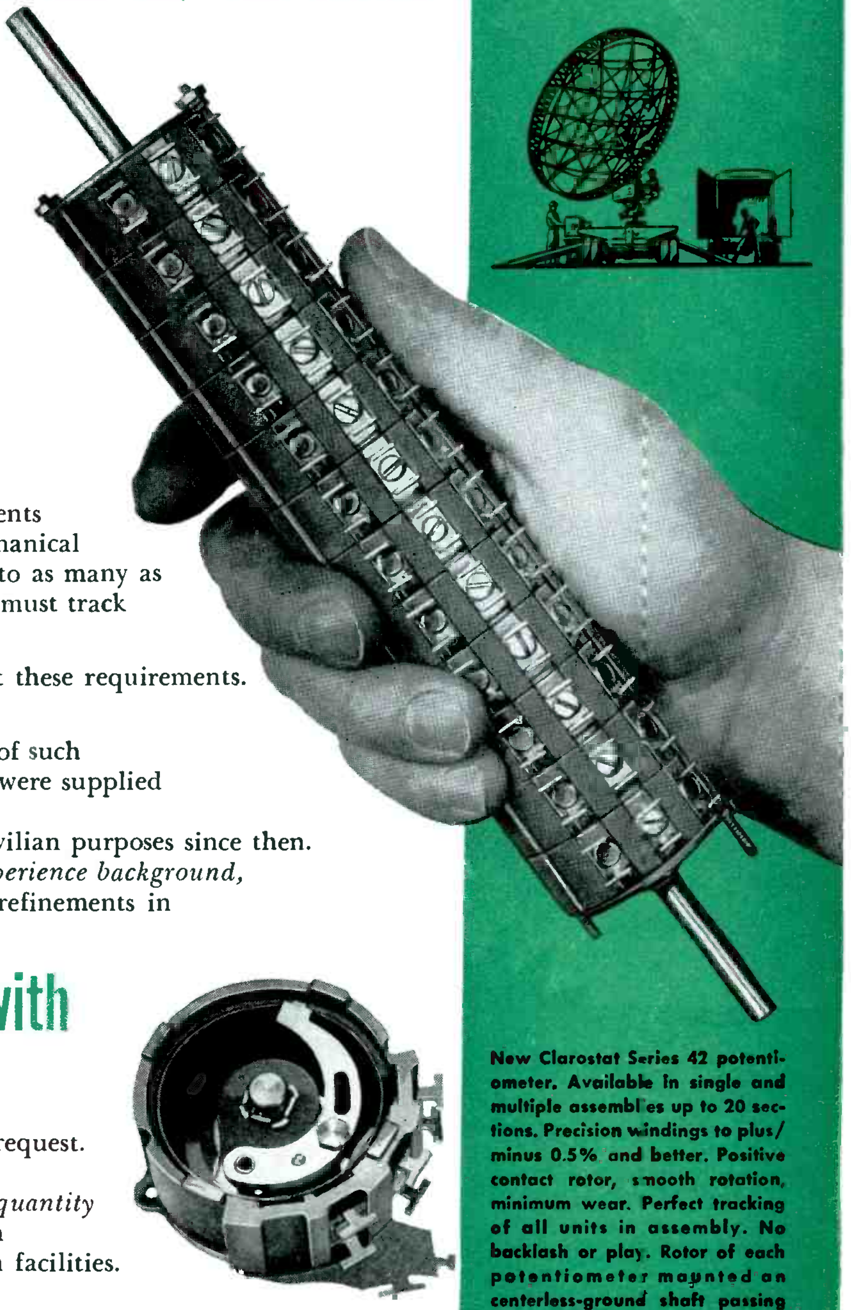
Remember, if you need help with a vibration problem, you can save yourself time and work by contacting MB's vibration specialists. For details on any of the above products, address your inquiry to Dept. N5.

THE MB MANUFACTURING COMPANY, Inc.
1060 State St., New Haven 11, Conn.

PRODUCTS FOR MEASUREMENT . . . REPRODUCTION . . . AND CONTROL OF VIBRATION

PRECISION

Controls



At the *very heart* of highly critical equipment such as electronic computers, electronic gunsights and radar assemblies, the control requirements call for outstanding electrical and mechanical precision. Indeed, from single section to as many as twenty sections, the precision controls must track with mathematical accuracy.

Clarostat Series 42 Controls fully meet these requirements. Thus *the climax in precision controls.*

Clarostat has made the major portion of such precision controls in use today. Many were supplied to the armed forces in World War II. Many more have been supplied for civilian purposes since then. And now, *based on an unparalleled experience background,* Clarostat engineers offer you further refinements in their latest Series 42 design.

New Clarostat Series 42 potentiometer. Available in single and multiple assemblies up to 20 sections. Precision windings to plus/minus 0.5% and better. Positive contact rotor, smooth rotation, minimum wear. Perfect tracking of all units in assembly. No backlash or play. Rotor of each potentiometer mounted on centerless-ground shaft passing through all sections.

You can stand pat with

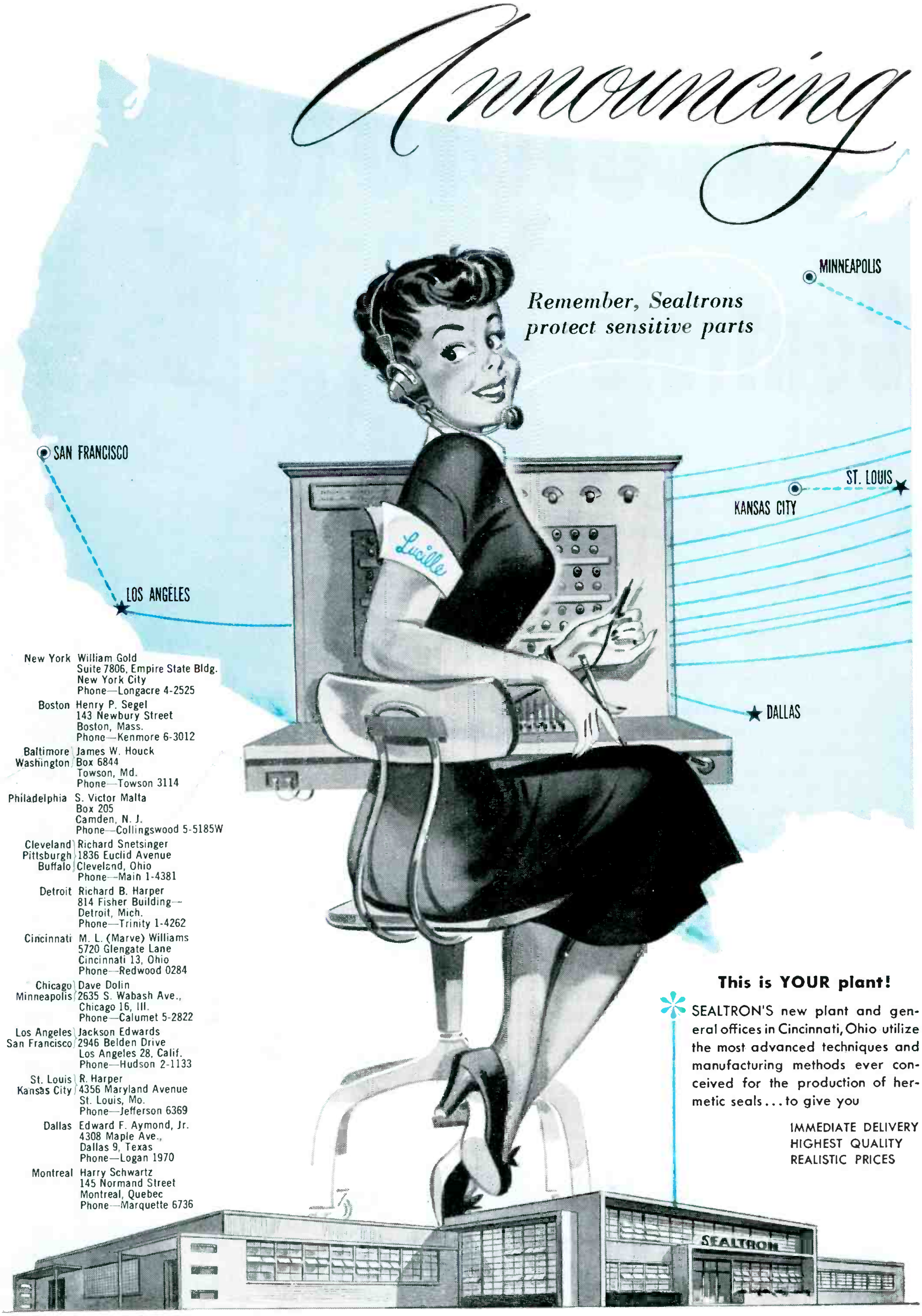
CLAROSTAT

Engineering Bulletin No. 142 sent on request. And remember, when your control or resistor requirements call for *quality, quantity* and *economy,* you can meet them with Clarostat's engineering and production facilities. *Submit that problem!*

Controls and Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

CLAROSTAT



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IMMEDIATE DELIVERY
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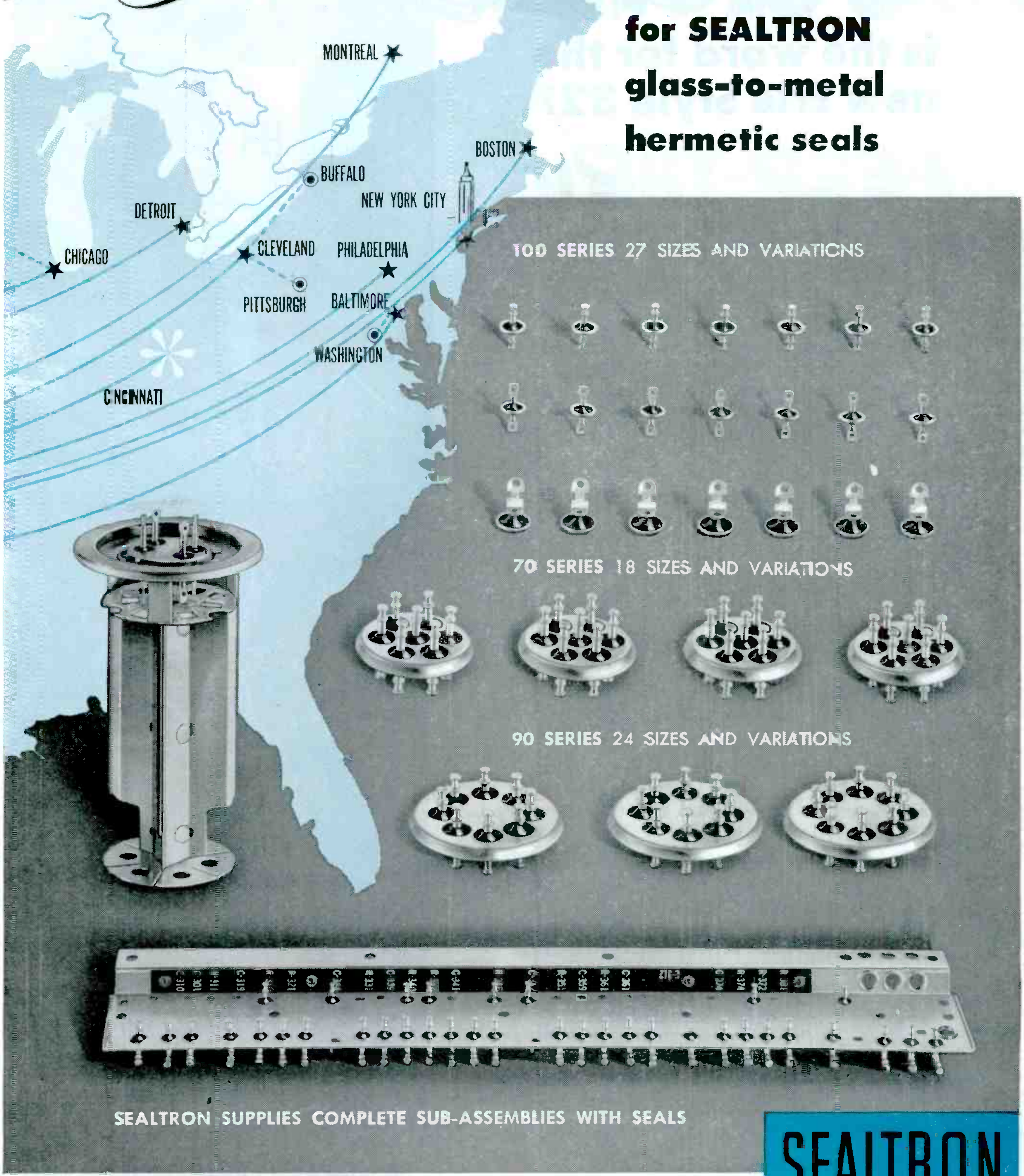
REALISTIC PRICES

25 sales representatives

for SEALTRON glass-to-metal hermetic seals



SEALTRON SUPPLIES COMPLETE SUB-ASSEMBLIES WITH SEALS

SEALTRON

THE SEALTRON COMPANY

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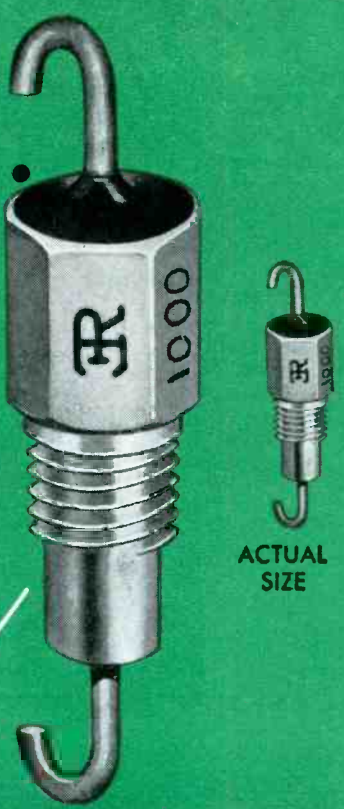
RUGGED...

is the word for the new Erie Style 327

FEED-THRU CERAMICON®



ERIE adds another outstanding capacitor to the most complete line of ceramic by-pass units available. Style 327 Feed-Thru design is a further result of continued Erie development in accomplishing ruggedness in components to meet severe military requirements and to give trouble-free service in other electronic applications. It embodies the following outstanding features:

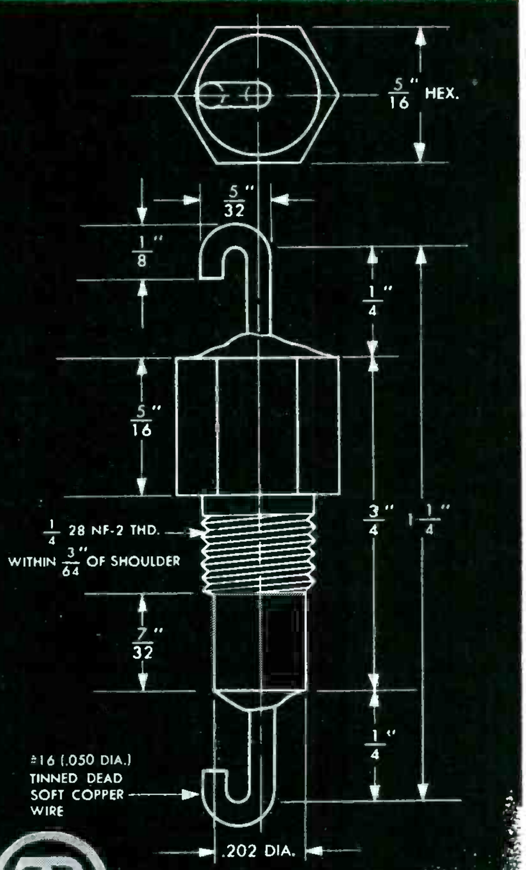
1. Mechanically rugged. Tubular ceramic capacitor is sealed at both ends in thermosetting low loss insulation.
2. Very low and uniform inductance path to ground.
3. Electrical shielding is provided by means of the grounded metal case.
4. All internal connections are soldered; no pressure contacts.
5. Hook type terminals provide sturdy connection tie points; also facilitate precision spacing of leads from other components where required in VHF and UHF circuits.

Specifications:

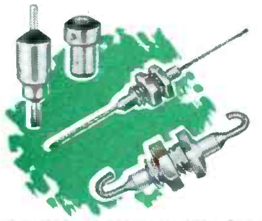
Standard capacitance values, mmf: 10, 33, 47, 68, 82, 100, 470, 680, 1000

Capacitance tolerance: ± 20% or + 80%, —20%

Rated voltage: 500 WVDC (values through 100 mmf also available in 1000 WVDC rating)



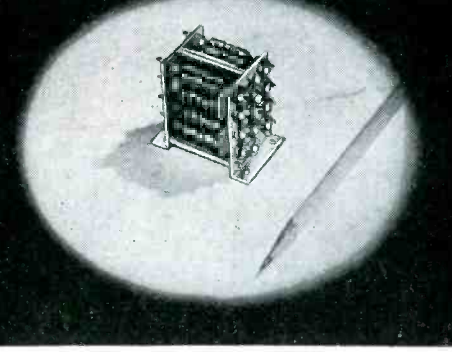
OTHER ERIE FEED-THRU CERAMICONS:



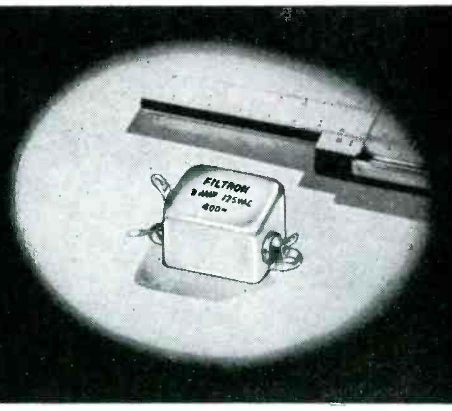
Style 357, rigid hooked wire lead, maximum capacitance 1000 mmf.
Style 362, #20 straight pig-tail wire lead, maximum capacitance 1500 mmf.
Style 2416, rigid wire lead, cadmium plated shell for solder mounting, maximum capacitance 1500 mmf.
Style 2418, no center lead, cadmium plated shell for solder mounting, maximum capacitance 1500 mmf.

Electronics Division
ERIE RESISTOR CORP., ERIE, PA.
LONDON, ENGLAND . . . TORONTO, CANADA

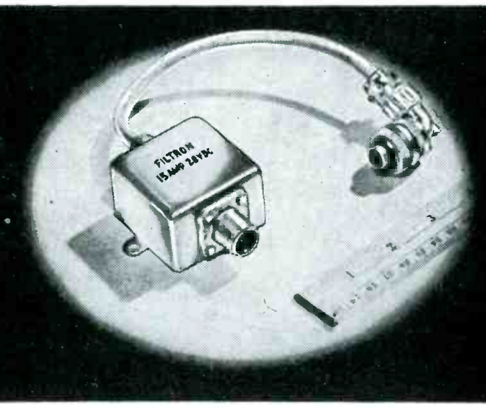
MUST YOUR EQUIPMENT BE RADIO INTERFERENCE FREE?



8 circuit miniaturized filter for wide band RF Interference Suppression.



Miniature 3 amp.–125 VAC–400~ filter–hermetically sealed–size 1⅛" x 1" x 11/16"



15 amp.–28 VDC filter, size 2" x 2" x 1¼", with pressurized AN connectors–high attenuation from 150 KC to 400 MC.

IF YOURS IS A TOUGH RF INTERFERENCE PROBLEM—LET FILTRON SOLVE IT....

FILTRON'S engineering department, cooperating with engineers of leading companies, has solved RF Interference Suppression problems throughout the country.

If your equipment must meet the RF Interference limits set by the military specifications, consult with FILTRON'S engineers in the earliest stages of design. FILTRON can furnish RF Interference Suppression Filters whose size, weight and overall configuration will fit into your equipment.

FILTRON has *custom designed* over 1000 different types of RF Interference Suppression Filters for equipment that meets military RF Interference Suppression limits and specifications.

FILTRON'S completely equipped screen rooms are always available for the RF Interference testing of your units and equipment.

An inquiry on your company letterhead will receive prompt attention.

FILTRON can best solve your RF Interference problems because:

- **FILTRON'S** engineering, research and design divisions are staffed by experienced RF Interference Suppression filter engineers.
- **FILTRON'S** modern shielded laboratories are equipped to measure RF Interference from 14 KC to 1000 MC in accordance with military specifications.
- **FILTRON'S** production facilities, comprising a capacitor manufacturing division, coil winding division, metal fabrication shop, metal stamping and tool and die shops, are exclusively producing the highest quality components for FILTRON'S RF Interference Suppression Filters.
- **FILTRON'S** extensive production facilities permit us to meet your delivery requirements. NOW!

RF INTERFERENCE SUPPRESSION FILTERS FOR:

Motors
Generators
Inverters
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Power Plants
Actuators
Gasoline Engines

And other RF Interference producing equipment

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FLUSHING, LONG ISLAND, NEW YORK
LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS

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SELENIUM RECTIFIERS

May be up your alley, too!

...AS THEY ARE FOR
THE BRUNSWICK-BALKE-
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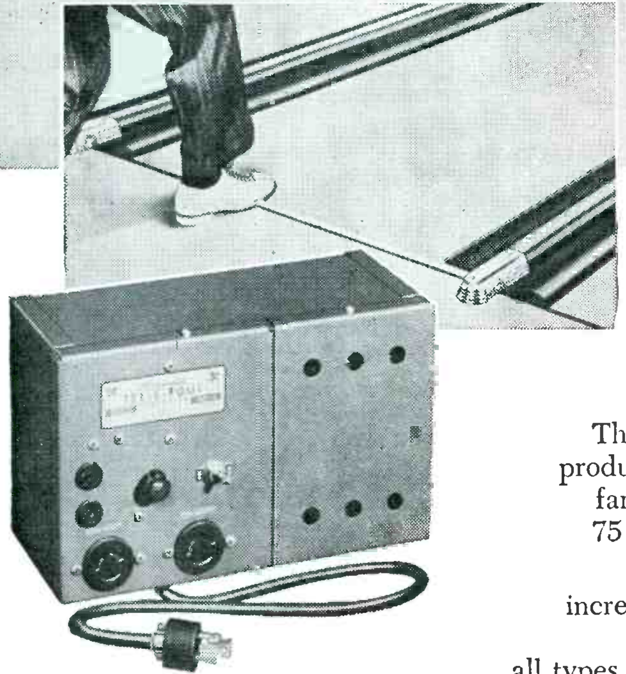
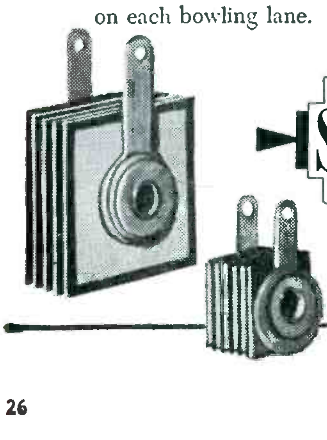


Illustrated above is the "Tel-E-Foul" control box. When the bowler oversteps the foul line the electronic brain conveys an impulse causing a light to flash above the alley. A 75 MA SELETRON miniature is built into the control box on each bowling lane.

The new "Tel-E-Foul," photo-electric Foul Indicator produced by The Brunswick-Balke-Collender Company, famous manufacturer of bowling equipment, includes 75 MA SELETRON miniatures in its electronic circuits.

SELETRON Selenium Rectifiers are the choice of an increasing number of manufacturers in diversified fields because they are so thoroughly dependable under all types of grueling conditions. SELETRON is available in the miniature sizes required for radio, TV and other electronic circuits, all the way up to heavy duty power stacks used in a wide range of industrial applications.

Whenever *you* meet up with a power conversion problem, no doubt SELETRON engineers can be of substantial assistance in recommending the right rectifier for your needs. Write us today!



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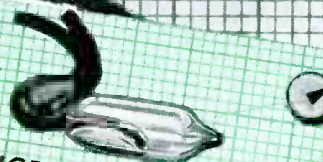

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show you how you can
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Switches as a principle
of good design"

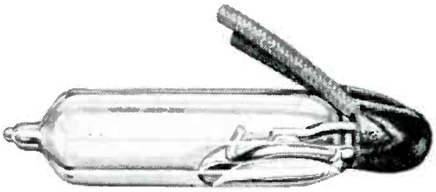
Honeywell Mercury Switches

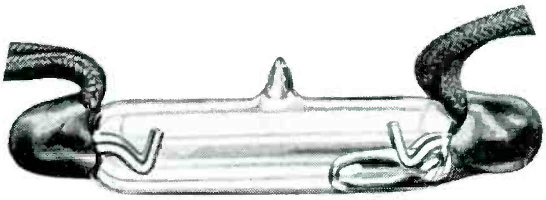
are engineered to solve many complex switching problems

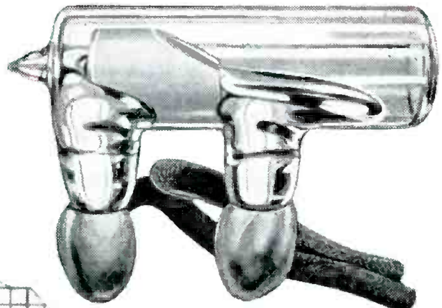
● Honeywell Mercury Switches are ideal for use in applications where tilt motion and low operating force are provided. Because all the switch elements are permanently sealed in glass, they are effective components where dust, fumes, spray and/or splash are present.

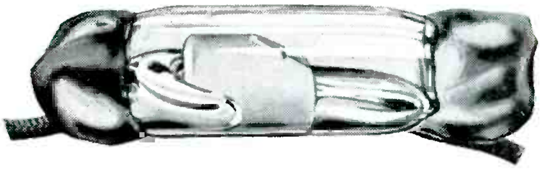
Often the proper tilt motion to permit the use of Honeywell Mercury Switches on a given application can be developed in cooperation with MICRO SWITCH engineering field service. These experienced switching specialists will review your requirements as to mounting, actuating linkages, lead supports, terminal blocks and enclosures. Thus you will not only be sure of the switch best suited to your need but have engineering help in developing complete mercury switch assemblies.

There are over 125 designs of Honeywell Mercury Switches from which to select the exact switch characteristics to meet your specific problem. You are invited to write for catalog and to contact your nearest MICRO SWITCH branch office for more complete information.









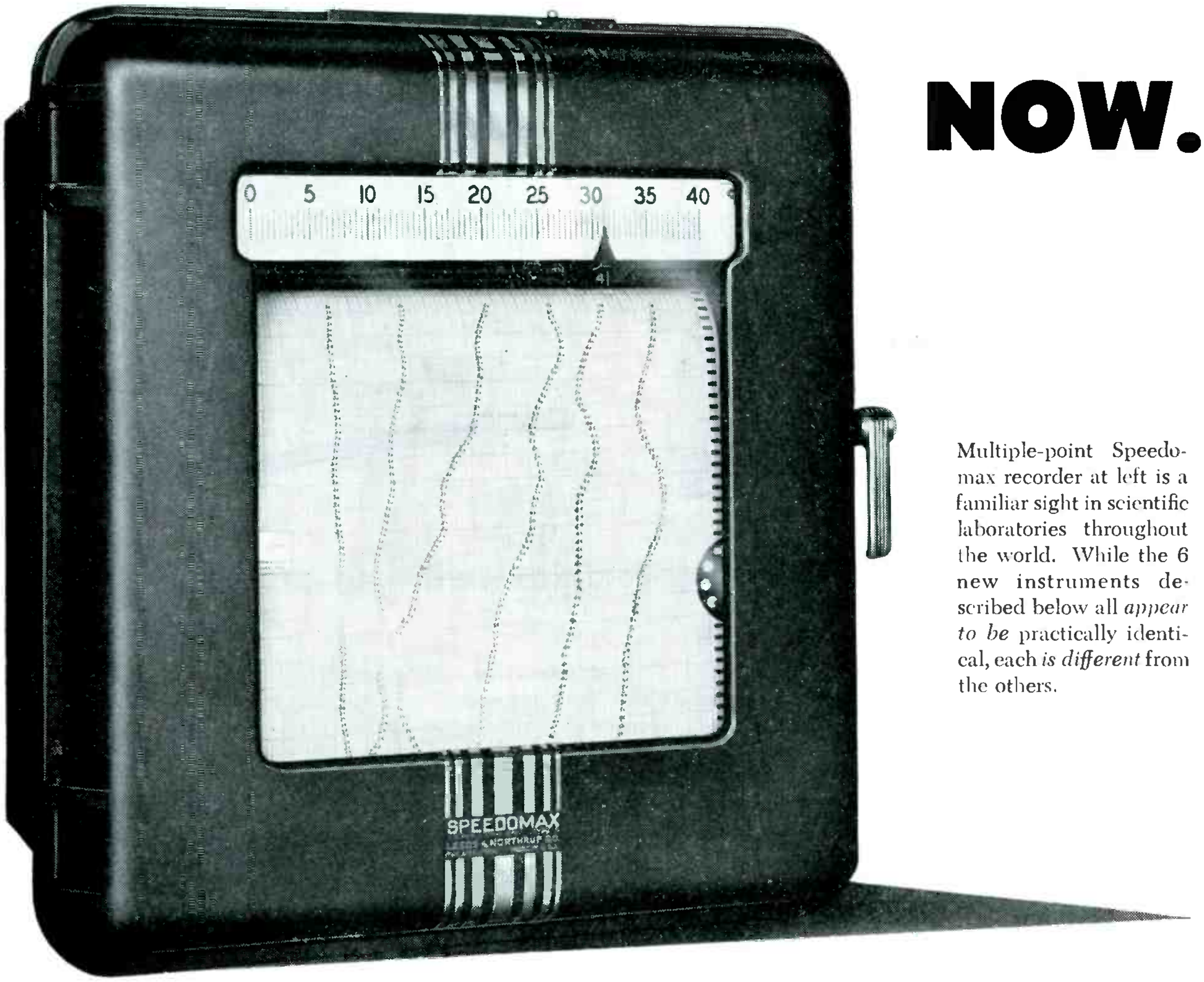
MICRO Snap-Action Switches...

Honeywell Mercury Switches

MICRO MS SWITCH

FREEPORT, ILLINOIS

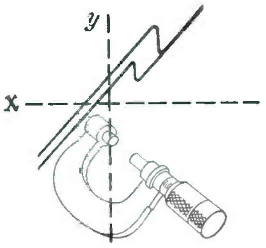
A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY



NOW...

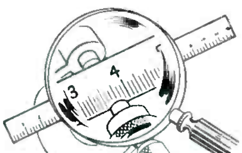
Multiple-point Speedomax recorder at left is a familiar sight in scientific laboratories throughout the world. While the 6 new instruments described below all *appear to be* practically identical, each *is different* from the others.

See how these 6 new Speedomax recorders



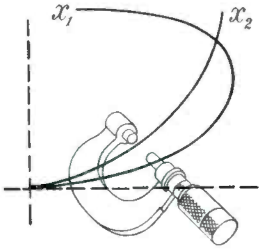
SPEEDOMAX X-Y RECORDER

Automatically plots the relationship between any two variables which can be converted to d.c. signals. Both pen and chart motion are reversible. Instrument records vacuum tube characteristics, hysteresis loops, stress-strain, temperature-elongation, differential thermal analysis curves . . . Applications are as broad as a researcher's imagination. *Write for Folder EM9-420(2).*



SPEEDOMAX ADJUSTABLE RANGE - ZERO RECORDER

Automatically plots voltage representing force, weight, temperature, temperature-difference, speed . . . or any other condition. Suppressing ZERO pushes *non-significant mv* off scale. Adjusting RANGE spreads few significant mv right across chart. Range *continuously* adjustable from —0.1 to +1 mv . . . up to —2 to +20 mv; zero suppression, from —50 to +50 mv. Folder ND46(2).



SPEEDOMAX 2-PEN RECORDER

Automatically plots 2 curves on 1 chart simultaneously . . . overlapping or side-by-side. Follows minute shifts in fast-changing variables with ease. A "2-in-1" recorder, it takes any two standard Speedomax ranges. Circuits work with thermocouples, Thermohms, strain gages, tachometers, thermal converters, pH cells . . . or most other primary elements. *Write for Folder EM9(1).*

For further information and application data on any Speedomax electronic recorders, just write our nearest office or 4907 Stenton Ave., Phila. 44, Pa.

Jrl. Ad. ND46(5)

LEEDS &

SPEEDOMAX *presents*

6 precision electronic servants to speed plotting of test data

AS the tempo and complexity of today's research and engineering activities accelerate, more and more investigators are stepping up efficiency through use of time-saving Speedomax recorders. Tireless automatic assistants, these electronic servants are taking over the chores of routine computation . . . eliminating tedious manual plotting of data.

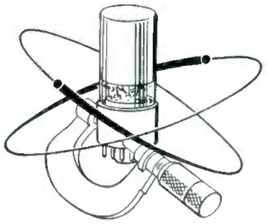
Especially timely are these 6 new Speedomax recorders developed specifically for laboratory use. While each is a *specialist,* it is also designed for a diversity of applications.

Common denominators for all six are traditional Speedomax precision and high-speed response. Recording pens can whip across the 9⅞" chart in as little as *1 second,* if the application demands, though speeds of 2 and 3 seconds full scale are also available. Balancing is velocity-damped to take advantage of this high speed.

Alert to the most minute variation in "X," the sensitive electronic balancing system is the perfect complement for the instrument's accurate null-balance measuring circuit. Thorough filtering, shielding and guarding screen out transients . . . permit use of Speedomax in the presence of severe stray fields.

Net result: the investigator can follow complex, fast-changing variables with ease and confidence . . . knowing that the record on his Speedomax is faithfully following the actual function being measured.

can solve your data-logging problems . . .

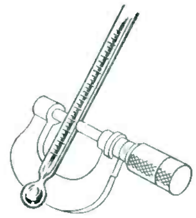


SPEEDOMAX PHOTOMULTIPLIER TUBE RECORDER

Automatically plots accurate record of light intensity or other low level radiation. Can be direct-connected to photo-multiplier tubes . . . eliminating separate preamplifier. Available by switch are four ranges: 0.02, 0.06, 0.2, and 0.6 µs. Dark current or noise of photo-multiplier tube is readily offset by built-in manual compensator. *Write for DS-240-70-EM9(1) to (3).*

SPEEDOMAX POWER LEVEL RECORDER

Automatically plots radiation patterns of antennas and hydrophones . . . frequency characteristics of filters, amplifiers, loudspeakers, etc. Applies accurate "insertion loss" principle of measurement. Recorder can be supplied with full scale reading of 20, 30, 40, 50, or 60 db, referred to a base level of as little as 0.02 microwatt. *Write for Folder ND46-51(1).*



SPEEDOMAX PRECISION THERMOMETER RECORDER

Automatically plots temperature curves for calorimetry, freezing and boiling points . . . reads resistance of platinum thermometer to five significant figures. An "automatic Mueller Bridge," it covers the entire range from —260 to +500 C with precision of ±0.01 C. Automatic range-changing mechanism expands chart width 100 times. *Write for Folder ND46-33-240(1).*

NORTHRUP CO.

40 years of precision recording
20 years of electronic recording

CHASE warehouses from coast to coast offer complete metal cutting services!

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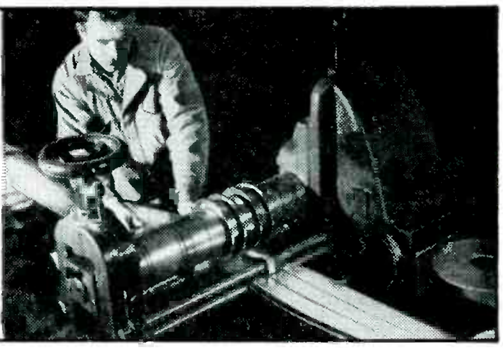

These 7 Chase warehouses do SHEARING

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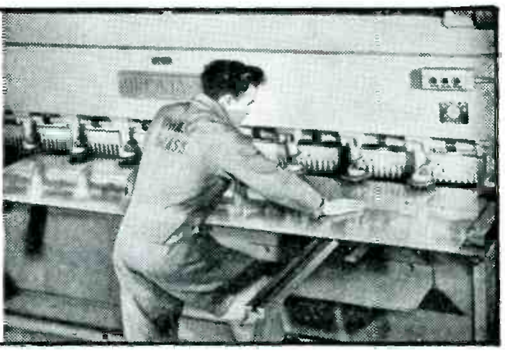
These warehouses also do slitting



These 4 Chase warehouses do SAWING

DETROIT
NEW YORK
NEWARK
CHICAGO

These warehouses also do slitting and shearing

When it comes time for slitting, shearing or sawing, check the Chase Warehouses listed above for the cutting facilities each of them have.

Naturally, this work is done to your specifications on orders for metals we are able to fill. We'll help out, too, on *your* brass, bronze, copper, aluminum, steel, fibreboard or other materials. Just tell us how you want it. The work will be done accurately.

As usual—call Chase!

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An Isotronic* First

±0.01% AC Regulation!

That's the degree of accuracy attained by Sorensen's new Model 1001 AC Line Voltage Regulator!

Heretofore, the closest regulation in commercially available regulators has been ±0.1%, regardless of manufacturer or circuit approach. Now, Sorensen's continuing study and design refinements have produced a super-accurate regulator — the Model 1001 — as a *standard* catalog item.

GENERAL SPECIFICATIONS

Load range	0 — 1000 VA
Input voltage range	95 — 130 VAC, 1ϕ, 55 — 65~
Load P. F. range	0.7 lagging to 0.95 leading
Output voltage	115 VAC, 1ϕ (adjustable from 110-120 volts)
Distortion	3% max.
Time constant	0.1 seconds
Regulation accuracy	±0.01%

The accuracy is *guaranteed* at room temperature, for a resistive load, an input variation of ±10%, and over a two-to-one load change. For *all* other conditions within the specifications, the Model 1001 has a proportionate amount of accommodation.

model 1001

* Isotronics is a trade marked word pertaining to the electronic regulation and control of voltage, current, power, or frequency.

WRITE FOR FULL INFORMATION

Note these extra features

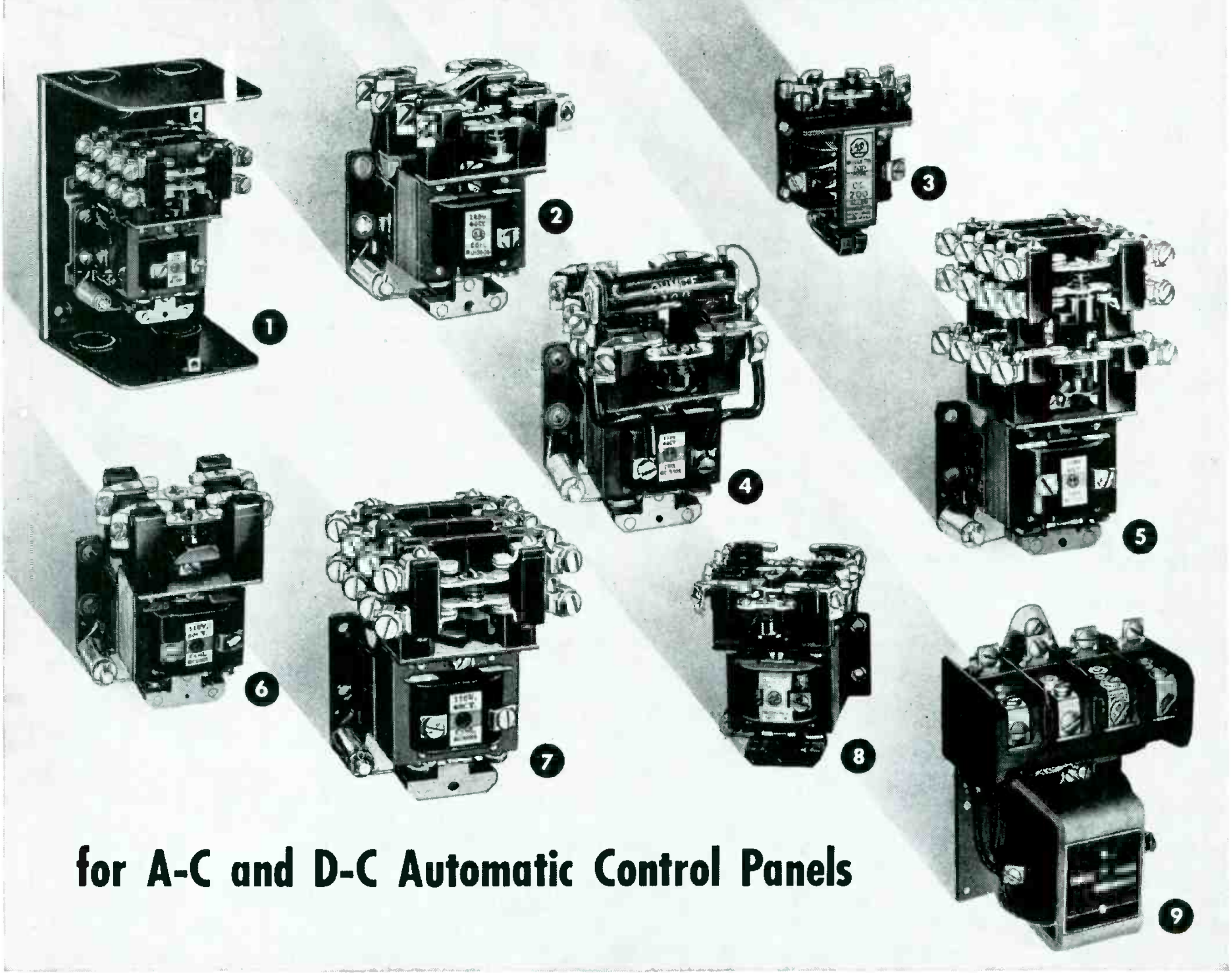
- Combination twist-lock and double-T receptacle, or, output terminals to eliminate contact resistance.
- Three-function output switch for
  1 Normal regulator functioning.
  2 Operation with integral semi-fixed resistance in place of potentiometer.
  3 Direct load connection with the control diode for regulation of voltages other than 115 volts.
- Only FOUR vacuum tubes and NO relays are used.
- All tube filament voltages are regulated for long dependable life.

FOR THE LATEST AND BEST IN ISOTRONICS . . .

Specify **SORENSEN**

SORENSEN AND COMPANY • 375 FAIRFIELD AVE., STAMFORD CONN.

RELAYS and CONTACTORS



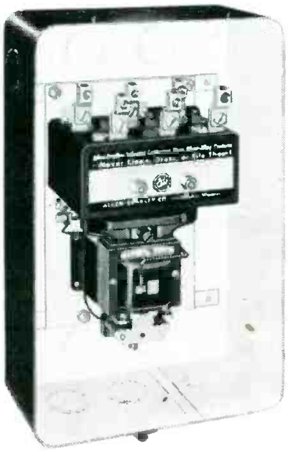
for A-C and D-C Automatic Control Panels

Do you need small relays from one to eight poles . . . or contactors up to 900 amperes? You will find these units, and many more, in the Allen-Bradley line, factory-tested for millions of maintenance-free operations.

Type BX universal relays have interchangeable normally open and normally closed contacts. No assembling to change from normally open to normally closed contacts. A few of the relays in the Allen-Bradley line are illustrated above.

Write for Bulletins 700 and 200.

1. Type BX Universal A-C Relay—in Enclosure
2. Type BM Mechanically Held Relay—No Hum
3. Type CL Low Coil Current Relay
4. Type BA 3-Wire Thermostat Relay—Open
5. Type BX 8-Pole Universal Relay—Open
6. Type B 2-Pole A-C Relay—Open
7. Type BX Universal A-C Relay—Open
8. Type BM Mechanically Held Relay—Open
9. Bulletin 202 2-Pole D-C 25-Ampere Relay



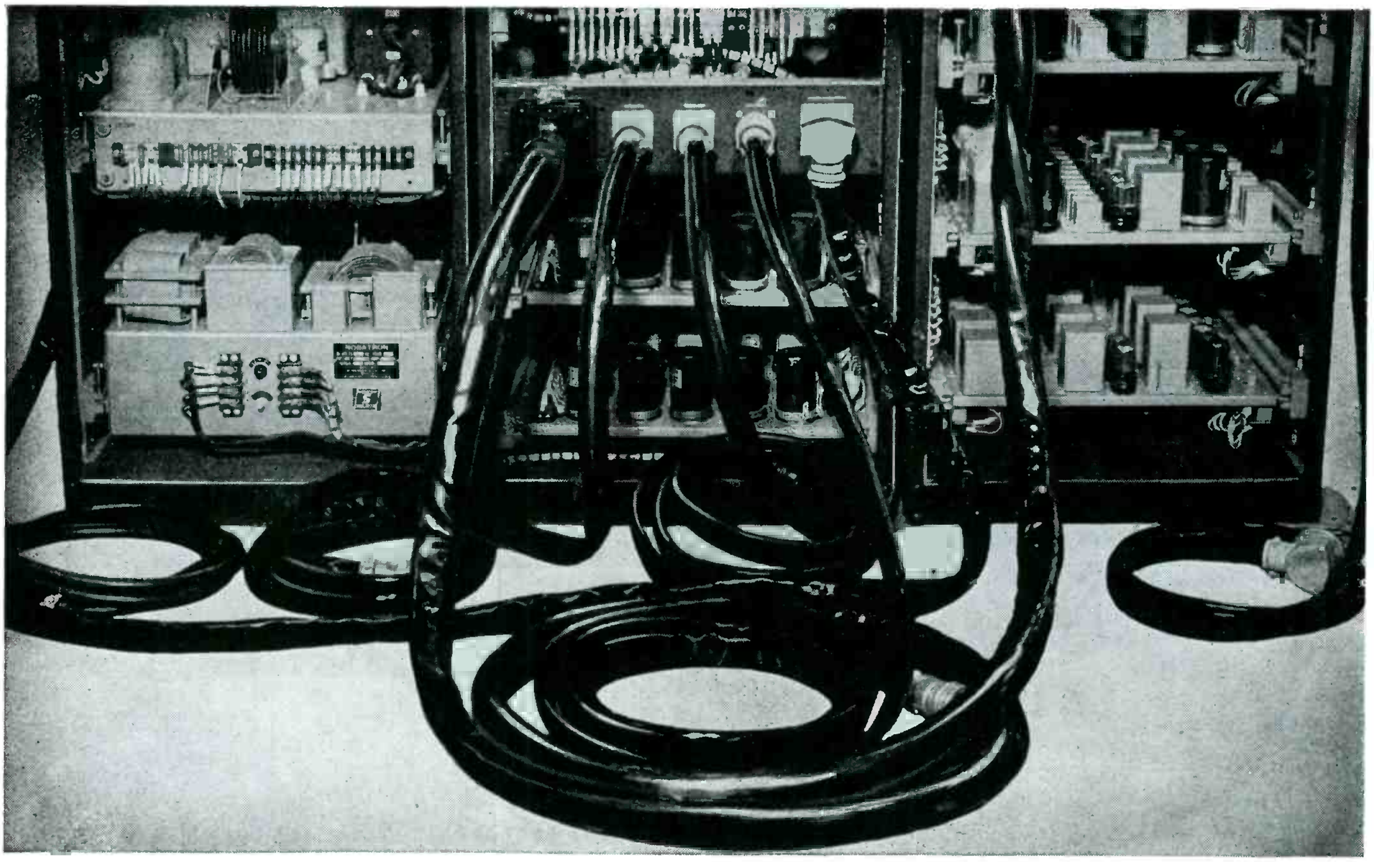
Fifty ampere Contactor in general purpose Type 1 Enclosure.

Allen-Bradley Company, 110 West Greenfield Ave., Milwaukee 4, Wis.

ALLEN-BRADLEY

RELAYS • RESISTORS

QUALITY



Reeves *saves space* in its Electronic Brain...with IRV-O-LITE Tubing

The Reeves Electronic Analog Computer (REAC)* saves plenty of man-hours in performing complex calculations. And in this Electronic Brain's complicated wiring system, shielding and terminal labeling are done exclusively with IRV-O-LITE XTE-30 Plastic Tubing—saving plenty of *space.*

XTE-30's high dielectric strength of 1,000 vpm (dry) frequently permits the use of *thinner-walled* tubing. Where space is at a premium, follow the example of Reeves and hundreds of other manufacturers—use XTE-30!

You get these *other* advantages, too, with XTE-30 Plastic Tubing: high mechanical strength; lasting flexibility; excellent chemical and moisture resistance.

XTE-30 comes in a standard range of sizes from .022" to 2" ID and even larger for special applications. Six contrasting colors simplify identification of leads and speed up complex wiring jobs. See for *yourself* what XTE-30 will do for you—just mail the coupon for free Technical Data Sheet.

Look to
IRVINGTON
for insulation leadership
- INSULATING VARNISHES
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Gentlemen:

Please send me your Technical Data Sheet on IRV-O-LITE XTE-30 tubing.

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Company..
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For Further Information, Consult pages 92-93 in the 1951-1952 Electronics Buyers' Guide

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GAS-FILLED CONDENSERS

More than 15 years service on thousands of Lapp Gas-Filled Condensers proves them to be completely reliable—electrically and mechanically. They offer the advantages of extreme compactness for high voltage and high current ratings... low loss... high safety factors... puncture-proof design... constant capacitance under temperature variation.

In construction, the condenser assembly is supported on a top aluminum ring, the steel tank serving only as a support for this ring and as a leak-proof gas container. The high potential plates are stationary, carried on a rigid aluminum center stud, supported by a ceramic bowl. Rotor plates are grounded, carried on ball-bearings in a race almost the full diameter of the tank. This construction provides a grounded tuning shaft on variable models, makes possible efficient and complete water cooling for high current operation, and results in direct and short current paths to condenser plates.

Write for complete description and specifications. Radio Specialties Division, Lapp Insulator Co., Inc., Le Roy, N. Y.

MODEL 24 IF
Fixed only
Capacitances up to 60,000 mmf.; 1 mc, current ratings: 175, 350, 525 amps.; Safety gap settings: 14, 25, 38 Kv peak.

MODEL 18 R—*Fixed or Variable*
MODEL 18 I—*Variable only*
MODEL 18 IF—*Fixed only*
Capacitances up to 30,000 mmf.; 1 mc. current ratings: 120, 240, 360 amps.; Safety gap settings: 6, 14, 25, 38, 50, 63, 72 Kv peak.

MODEL 12 R—*Fixed or Variable*
MODEL 12 IF—*Fixed only*
Capacitances up to 15,000 mmf.; 1 mc. current ratings: 105, 210, 315 amps.; Safety gap settings: 6, 14, 25, 38, 50, 63 Kv peak.

MODEL 9 R
Fixed or Variable
Capacitances up to 8000 mmf.; 1 mc. current ratings: 85, 170, 255 amps.; Safety gap settings: 6, 14, 25, 38, 50 Kv peak.

MODEL 7 R
Fixed or Variable
Capacitances up to 8000 mmf.; 1 mc. current ratings: 70, 140, 210 amps.; Safety gap settings: 2½, 6, 14, 25, 38 Kv peak.

DISTORTION READINGS

Fast-operating *-hp-* analyzers give you accurate, dependable distortion and wave form measurements at appreciable savings in engineering time. *-hp-* instruments shown here provide complete coverage between 20 cps and 20 kc; they are basic equipment in laboratories, radio and television stations and on production lines everywhere. Each instrument has the traditional *-hp-* family characteristics of simple operation, minimum adjustment, independence of line voltage or tube changes, generous overload protection and sturdy construction from quality components. For complete information, see your *-hp-* field engineer, or write direct.

For TOTAL DISTORTION MEASUREMENTS

-*hp*- 330B DISTORTION ANALYZER (left) is an unusually versatile instrument offering fast, accurate measurement of distortion values as low as 0.1% at any frequency between 20 cps and 20 kc. The equipment also quickly determines voltage level and power output, measures amplifier gain and response, measures audio noise and hum (direct readings), determines unknown audio frequencies and serves as a high-gain, wideband, stabilized amplifier.

This equipment is actually three instruments in one. It includes a high-quality 20 db amplifier with less than 0.1% distortion, a tunable rejection filter offering almost infinite attenuation at any one frequency (see Figure 1), and a wide range, high sensitivity VTVM offering flat response from 10 cps to 100 kc. All of these elements are usable separately, and the amplifier may be cascaded with the VTVM to measure voltages as small as 100 μv.

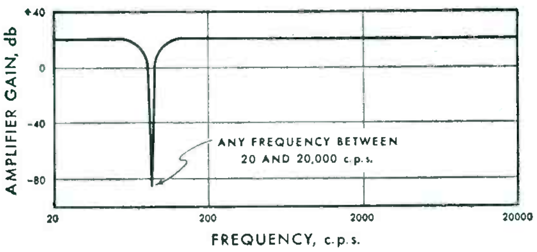

Figure 1. Rejection Characteristics, -hp- 330 series

For BROADCAST MEASUREMENTS

-*hp*- 330C DISTORTION ANALYZER, for FM measurements, is identical with *-hp-* 330B except that indicating meter movement has VU ballistic characteristics meeting F. C. C. requirements for FM broadcasting.

-*hp*- 330D DISTORTION ANALYZER is designed for both AM and FM measurements. It includes an AM detector to rectify AM carrier, plus meter movement having VU ballistic characteristics meeting F. C. C. requirements for FM.

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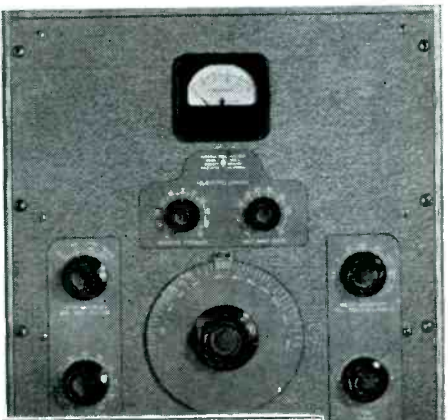
FIELD ENGINEERS IN PRINCIPAL AREAS
Export: Frazar & Hansen, Ltd., San Francisco, New York, Los Angeles

Complete Coverage HEWLETT-PACKARD

. . . . 20 cps to 20 kc

For MEASURING INDIVIDUAL WAVE COMPONENTS



-*hp*- 300A HARMONIC WAVE ANALYZER (right) is a selective voltmeter measuring the value of individual components of complex waves. Its variable selectivity is the key to its speed and versatility of operation. When wave components are close together, a unique selective amplifier can be narrowed to accept only desired components. When components are far apart, selectivity may be broadened to speed measuring without sacrificing accuracy. This feature is also important when measuring waves (such as in sound tracks) where some FM is present. The equipment is also ideal for analysis of noise, broadcast amplifier and network characteristics, recording devices, rotating machinery, hum and for all types of audio distortion measurements.

-*hp*- 300A is direct reading, covers the audio spectrum from 30 cps to 16,000 cps, and makes possible full-scale readings with inputs of 0.001 to 500 volts. Selectivity may be varied between limits shown in Fig. 2.

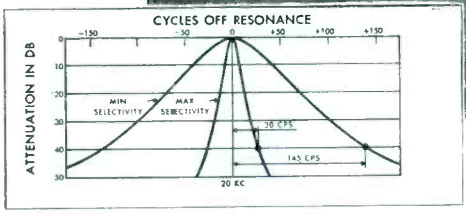


Figure 2. Selectivity, -*hp*- 300A

For TRANSIENT and FREQUENCY RESPONSE

-*hp*- 210A SQUARE WAVE GENERATOR provides a convenient, rapid method of determining transient and frequency response in a single measurement. It is widely used for testing receivers, video amplifiers, networks and transmitters; to measure time constants or provide a time base; to check cathode sweep circuits, indicate phase shift, transient effects or frequency response, to generate harmonics or control electronic switchers.

The 210A is an excellent, easy-to-use source of square waves for production line tests and laboratory use. High-quality square waves are generated over frequencies from 20 cps to 10 kc, and the equipment provides usable square waves up to 100 kc.

LOW COST DISTORTION ANALYZERS

-*hp*- 320A/B DISTORTION ANALYZERS are simple, low-cost devices for determining total harmonic distortion in audio frequency apparatus. They are particularly useful for high-speed production tests. -*hp*- 320A operates at two fixed frequencies: 400 and 5,000 cps. -*hp*- 320B operates at five fixed frequencies: 50, 100, 400, 1,000 and 5,000 cps. Both models require an external detector.

ANALYZER	PRIMARY USES	FREQUENCY RANGE	CHARACTERISTICS	PRICE
-*hp*- 300A	Wave form analysis.	30 cps to 16 kc	Variable selectivity; measuring range 1 mv to 500 v. 5% accuracy.	$625.00†
-*hp*- 320A	Measures total harmonic distortion at 2 fixed frequencies.	400 cps and 5 kc	Requires separate detector.	$75.00*
-*hp*- 320B	Measures total harmonic distortion at 6 fixed frequencies.	50, 100, 400 cps; 1, 5 and 7.5 kc	Same as above.	$150.00*
-*hp*- 330B	Measures total distortion, frequency tunable.	20 cps to 20 kc	Includes input amplifier and VTVM.	$395.00†
-*hp*- 330C	Similar to 330B. For FM broadcast measurements.	20 cps to 20 kc	VTVM has special characteristics to meet F.C.C. requirements.	$425.00†
-*hp*- 330D	Similar to 330B. For AM and FM broadcast measurements.	20 cps to 20 kc	Includes AM detector and special meter to meet F.C.C. requirements.	$440.00†

SQUARE WAVE GENERATOR

-*hp*- 210A	For rapid determination of transient and frequency response.	20 cps to 10 kc	Output 50 v. peak-to-peak. 1,000 ohm impedance.	$150.00*

*Rack mounting available at $5.00 extra cost.
†Rack mounting available at no extra cost.

Data Subject to Change Without Notice. • Prices f.o.b. Palo Alto, California.

INSTRUMENTS **Complete Coverage**

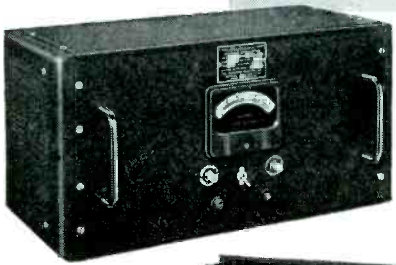
STABILINE *Automatic* VOLTAGE REGULATORS

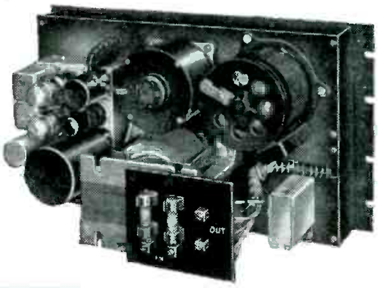
IE

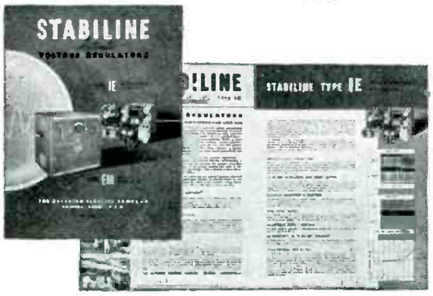

IE51002


IE51002R

EM


EM4102


EM4102R



Two types of STABILINE Automatic Voltage Regulators are offered by The Superior Electric Company to meet the requirements of maintaining constant a-c voltage to electrical equipment.

INSTANTANEOUS ELECTRONIC

Type IE is a completely electronic unit with no moving parts. It provides almost instantaneous correction of line voltage or load changes. Waveform distortion never exceeds 3 per cent. Output voltage is held to within ± 0.1 per cent of nominal for wide line variations; to within ± 0.15 per cent of nominal for any load current change or load power factor change from 0.5 lagging to 0.9 leading. Type IE is versatile in application finding wide use in laboratory work, on test lines and as a component of other equipment where the most exacting voltage regulation is necessary. There are 28 standard models for 115 and 230 volts, 50 or 60 cycles, single phase operation ranging in capacity from ¼ to 5 KVA. Special units are available for higher frequency operation . . . to meet government agency specifications . . . or for unusual applications.

ELECTRO MECHANICAL

Type EM is an electro mechanical unit with a very sensitive detector controlling a motor-driven POWERSTAT variable transformer which feeds a buck-boost auxiliary transformer. Its outstanding advantages are zero waveform distortion and high efficiency. Type EM is most often used in the control of industrial loads. However; the demand of today's electronic equipment for constant voltage with absolutely zero waveform distortion necessitates the incorporation of a type EM as an integral part of the assembly. Type EM is offered in standard models for 115, 230 and 460 volts, 50 and 60 cycles, single and three phase duty in ratings from 2 to 100 KVA. Special units can be designed for higher frequencies, for conformance to government agency requirements and for individual needs.

FOR INFORMATION ON STANDARD STABILINE AUTOMATIC VOLTAGE REGULATORS SEND FOR BULLETIN S351 . . . COMPLETE WITH ENGINEERING DATA, PHOTOGRAPHS, RATINGS, DIMENSIONS AND DIAGRAMS.

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

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MANUFACTURERS OF POWERSTAT VARIABLE TRANSFORMERS, STABILINE AUTOMATIC VOLTAGE REGULATORS, VARICELL D-C POWER SUPPLIES, VOLTBOX A-C POWER SUPPLIES, SUPERIOR 5-WAY BINDING POSTS, POWERSTAT LIGHT DIMMING EQUIPMENT.

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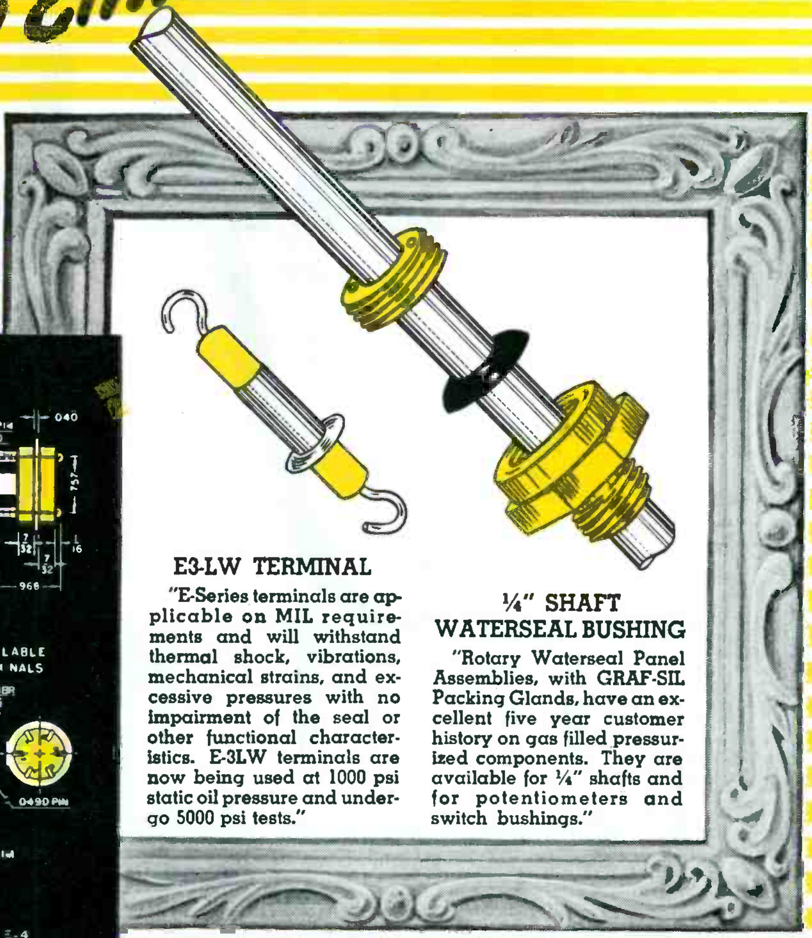
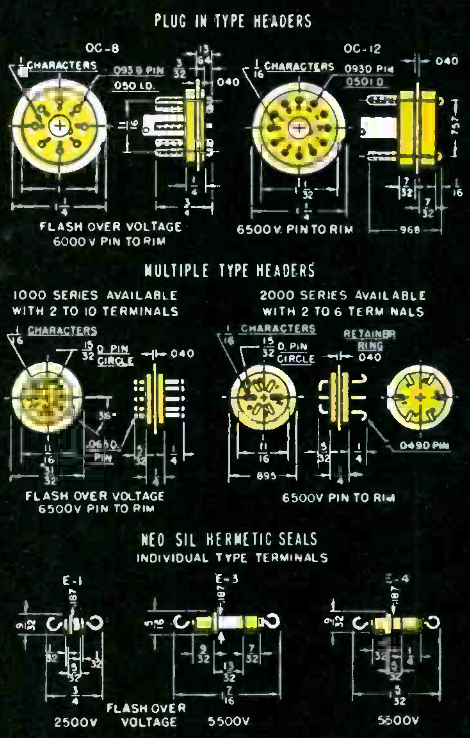


E3-LW TERMINAL

"E-Series terminals are applicable on MIL requirements and will withstand thermal shock, vibrations, mechanical strains, and excessive pressures with no impairment of the seal or other functional characteristics. E-3LW terminals are now being used at 1000 psi static oil pressure and undergo 5000 psi tests."

¼" SHAFT WATERSEAL BUSHING

"Rotary Waterseal Panel Assemblies, with GRAF-SIL Packing Glands, have an excellent five year customer history on gas filled pressurized components. They are available for ¼" shafts and for potentiometers and switch bushings."



TEST DATA

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949, on this material shows the following:

Volume Resistivity at 800 Volts d-c

Room Temperature 25°C	R.H. 30 percent
Megohm-inches	*ohm-centimeters*
1.4 x 10^6	3.5 x 10^{12}

Dielectric Constant and Dissipation Factor

Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 105° to —70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit, and 47% Relative Humidity.

"NEO-SIL's proven Hermetic sealing components will eliminate rejects resulting from breakage, strains, cracks, etc. Each NEO-SIL component is pressure checked at 25 psi — to meet military requirements and as applied to our units, NEO-SIL rubber will resist abusive temperature cycling, salt water, most acids and alkalies, and withstand high pressures and vacuums."

"In addition to the items illustrated above, NEO-SIL offers many other components, such as Hermetically Sealed Fuse Holders,-Octal Type Plug In Headers, Multiple Pin Headers, Hermetically Sealed Cables,-Hermetically Sealed Line Cords With Plugs For European use, Meter Gaskets, Panel Gaskets, Adapters (U.S. to Continental), Coil Forms, Crystal Contacts and other molded bakelite and NEO-SIL rubber units."

"Hermetically Sealed Fuse Holders are available for 3-AG and 4-AG fuses. These units are completely sealed from moisture with or without the cap or fuse inserted and are applicable for use on vacuum or gas filled units."

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CORPORATION

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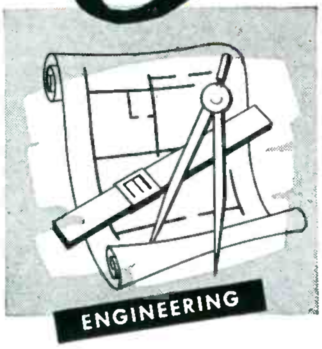

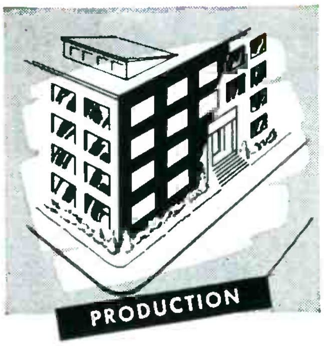

Founded in 1946, Laboratory for Electronics has grown ever since in size, experience and creative ability. As prime contractors for the United States Government on important classified projects, the company pioneered in the development of many new and advanced electronic devices. Soon Electronic Equipment will be ready for commercial distribution . . . research and engineering have been underway for years . . . production has now started. Look for Laboratory for Electronics advertising on your desk and Laboratory for Electronics salesmen at your door. The news they bring to you will be interesting and important.

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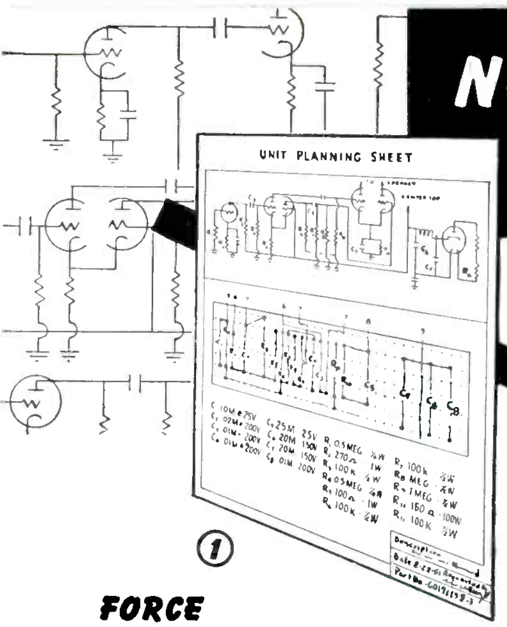
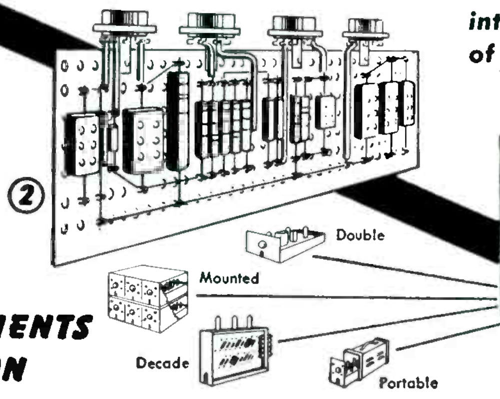
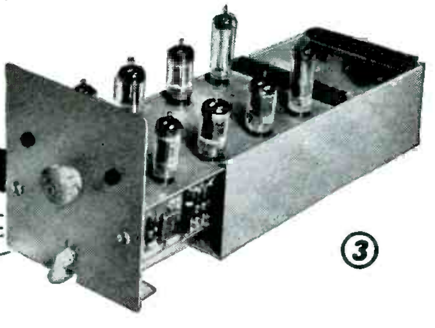


TERMINAL MOUNTING CARDS ORGANIZE CIRCUITS QUICKLY



ALDEN BASIC CHASSIS

Easily fabricated sub-assemblies built into equipment that has utmost ease of service and operation.



FORCE STRAIGHT-LINE THINKING WITH NEW ALDEN COMPONENTS FOR PLUG-IN CONSTRUCTION

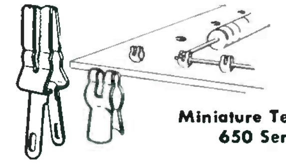
To design Electronic Equipment that must be produced quickly and in quantity, make your model with Alden Basic Chassis and "20" Packages. Save vital engineering and planning time — machine and tool hours — critical material and manhours.

① ORGANIZE CIRCUITS QUICKLY FOR SYSTEMATIC LAYOUT AND CONSTRUCTION

Schematics of most all electronic equipment can be broken down into circuit blocks of logically associated functions. These functional circuit blocks can be mounted readily either in the Alden "20" plug-in packages or Basic Chassis unit. The tube sockets and associated components lay out quickly on full scale Unit Planning Sheets for mounting on terminal cards. These special pre-punched, multi-hole terminal cards have wide flexibility to take an infinite variety of circuit variations. Both sides of card can be used to obtain maximum component density area. Using the Unit Planning Sheets, functional circuit units — components and housings — are all planned in one step.

② GET THE MOST NATURAL, EASY SUB-DIVISION OF LABOR IN MANUFACTURE

Solder terminals and sockets quickly rivet to Alden terminal card according to layout on Unit Planning Sheet. Components snap into the special **Alden Miniature Terminals** which hold them for soldering. — (No twisting or wrapping of leads necessary). — With all tube sockets and their associated components mounted on one card — the wiring and soldering of circuits is an open, easy-to-work sub-assembly operation.



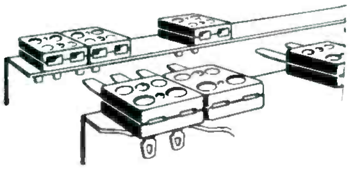
**Miniature Terminals
650 Series**

Terminal cards have been designed to accommodate tremendous number of circuit variations — to make neat tube and component sub-assemblies with a minimum of wiring.

③ INSURE THE LOWEST OPERATING AND SERVICE COSTS IN FINAL EQUIPMENT

The ALDEN BASIC CHASSIS UNIT is rapidly completed by mounting terminal cards into the chassis — soldering unit cables and making connections to **Alden Color Coded Back Connectors** and detachable front panel. Completed unit is easily piloted in and out of rack with the Serve-A-Unit Lock. Open sided construction, aided by the neat direct front and back connections, gives instant accessibility for rapid circuit checks and service.

Alden Terminal Card System means minimum of intercabling — but even this cabling can be laid out easily and proceed as simple sub-assembly. Open sided chassis construction makes cable easy to wire to front panel, terminal cards and back connectors.



Back Connectors — 462 Min Series

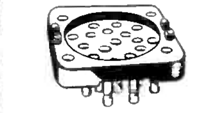
The **Alden Back Connectors** are units that can be discretely positioned on the back of the chassis — isolating lines with incompatible voltages, currents, or frequencies. This design insures accessible solder terminals for soldering — avoids rat nests of congested conventional back connector wiring. — Color coded, the Alden back connectors provide beautiful operational or service check points for all leads to and from chassis.

Hinged front panel design of chassis — allows rheostats, indicator lights, jacks, etc. to be mounted on panel as another easy-to-work sub-assembly. This panel attaches easily to chassis — is wired — swung up and fastened with Alden Target Screws.

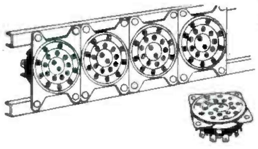
Assembled — Basic Chassis simplifies the operation of your equipment — Slashes service and maintenance time. Smooth, positive insertion and removal of the chassis is provided by the Alden "Serve-A-Unit Lock"

For Smaller Units Alden "20" Plug-in Packages

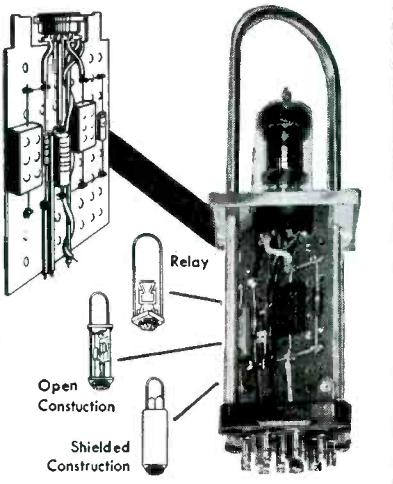
Here is a plug-in package unit using the above method of converting schematic into finished assembly quickly. Simply mount the completed terminal card sub-assembly on the Alden "20" Non-Interchangeable base, dip soldering the leads and adding cover or housing and handle . . . In operation, visual or instrument checks are easily made — if trouble occurs doubtful units are quickly isolated — these units easily unplug and a comprehensive inspection made. Spare units can be plugged in so equipment doesn't have to be inoperable while repairs are in process.



"20" Non-Interchangeable Base



"20" Rack and Chassis Mounting Sockets



TO GET STARTED QUICKLY! **'phone our New Products Director for an appointment to visit our plant — Wire for a sample Basic Chassis at $40.00 or an Open and Closed Alden "20" Plug-in Package at $10.00 — or write Dept. E for Booklet: "Basic Chassis and Components for Plug-in Unit Construction".**

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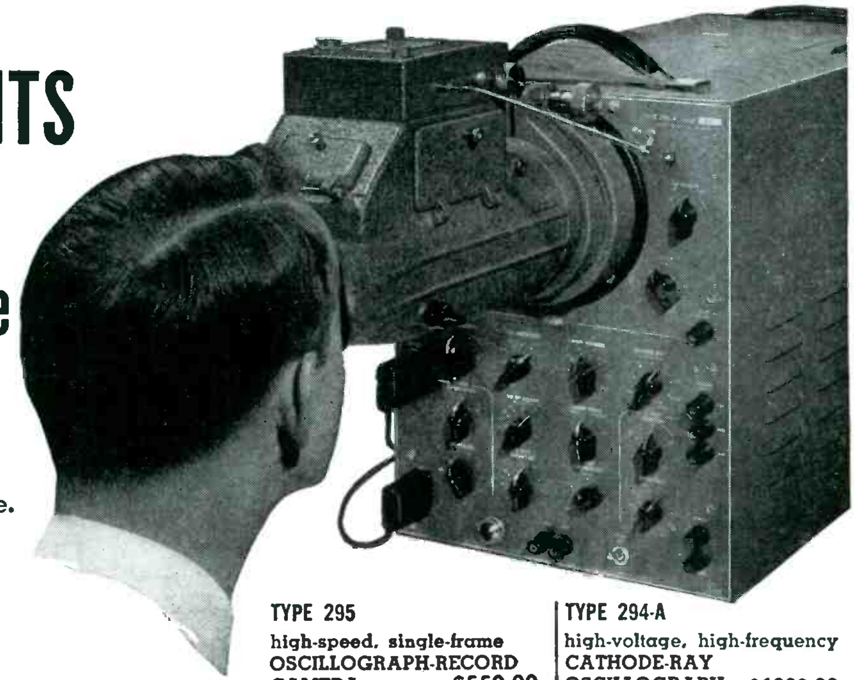


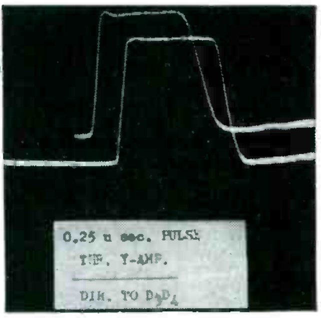
For visual observation of pulses and single transients, the Type 294-A Cathode-ray Oscillograph provides high light-output and wide-band response. For careful study and permanent reference of these signals the Type 295 Oscillograph-record Camera records writing rates as high as 35 inches per microsecond.

TYPE 295
high-speed, single-frame
OSCILLOGRAPH-RECORD CAMERA **$550.00**

TYPE 294-A
high-voltage, high-frequency
CATHODE-RAY OSCILLOGRAPH **$1320.00**

PULSE RESPONSE
FREQUENCY RESPONSE
SENSITIVITY

This oscillogram illustrates the double exposure technique. Binocular viewing in the Type 295 facilitates proper positioning for close comparison.



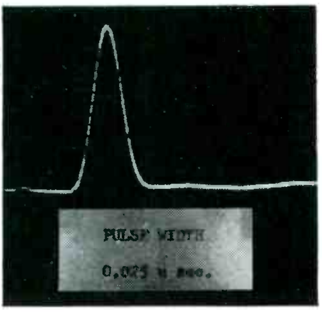
The pulses in the oscillogram at left are identical pulses of 0.25 microsecond width. The first pulse was applied through the Y-axis amplifier of the Type 294-A, and the second, directly to the vertical deflection plates. A comparison of their waveforms illustrates the excellent transient response of the Y-axis of the Type 294-A.

Response of the Y-axis amplifier to a rise time of 0.01 microsecond or less is 0.03 microseconds max. Notice that a minimum of overshoot (less than 2%) is introduced by the amplifier.

For the study of sinusoidal frequencies, the response of the Type 294-A extends from 10 cps. to 12 megacycles (down 30%). Sensitivity of the Y-axis, through the amplifier, is 0.42 peak-to-peak volts per inch.

AVAILABLE DEFLECTION
LIGHT OUTPUT
SIGNAL DELAY

"Time" and "Bulb" exposures may be taken with the Type 295. And provision is made so that equipment may be triggered simultaneously with shutter opening. With appropriate accelerating potentials, the Type 295 is capable of recording single transients in excess of 280 inches per microsecond.

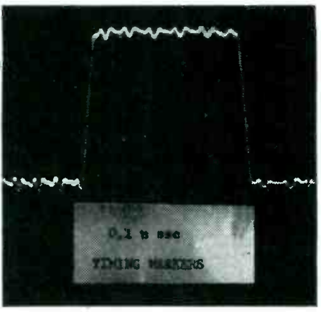


The Type 294-A provides undistorted vertical deflection of 1.3 inches or more for both positive and negative pulses; and 2.75 inches for symmetrical signals. The high light-output of the Type 294-A increases the value of the large, vertical deflection provided by the Y-axis amplifier. This is illustrated by the high visibility of the rise and decay of the pulse shown at left. Here, the Type 5XP– Cathode-ray Tube of the Type 294-A was operated at 12 kv. However, where maximum light output is not required, the accelerating potential may be lowered to 7 kv by means of a switch. At this level of operation, of course, the available undistorted deflection is increased.

To insure the complete display of fast pulses such as those at left, the Y-axis includes a 0.25 microsecond signal-delay line.

SWEEP SPEEDS
TIME CALIBRATION

The built-in illuminated data-card of the Type 295 will prove invaluable when making time measurements. A film take-up cassette is arranged so that exposed frames of film may be separated from unexposed film and taken to the darkroom for immediate developing.



Complementing the Y-axis performance of the Type 294-A, sweep durations are continuously variable from 0.1 second to 3 microseconds. By increasing the length of the sweep, speeds greater than 0.25 microsecond per inch may be obtained, thus providing more detail to facilitate the study of short-duration pulses.

Calibration of the sweeps of the Type 294-A is accomplished with vertical marks occurring at intervals of 100, 10, 1, or 0.1 microseconds. In the oscilloscope at left, the 0.1 microsecond markers appear mixed with the signal on the vertical axis. Time measurements may also be made by double exposure of first, the signal, and second, the timing markers.

Send requests for information to

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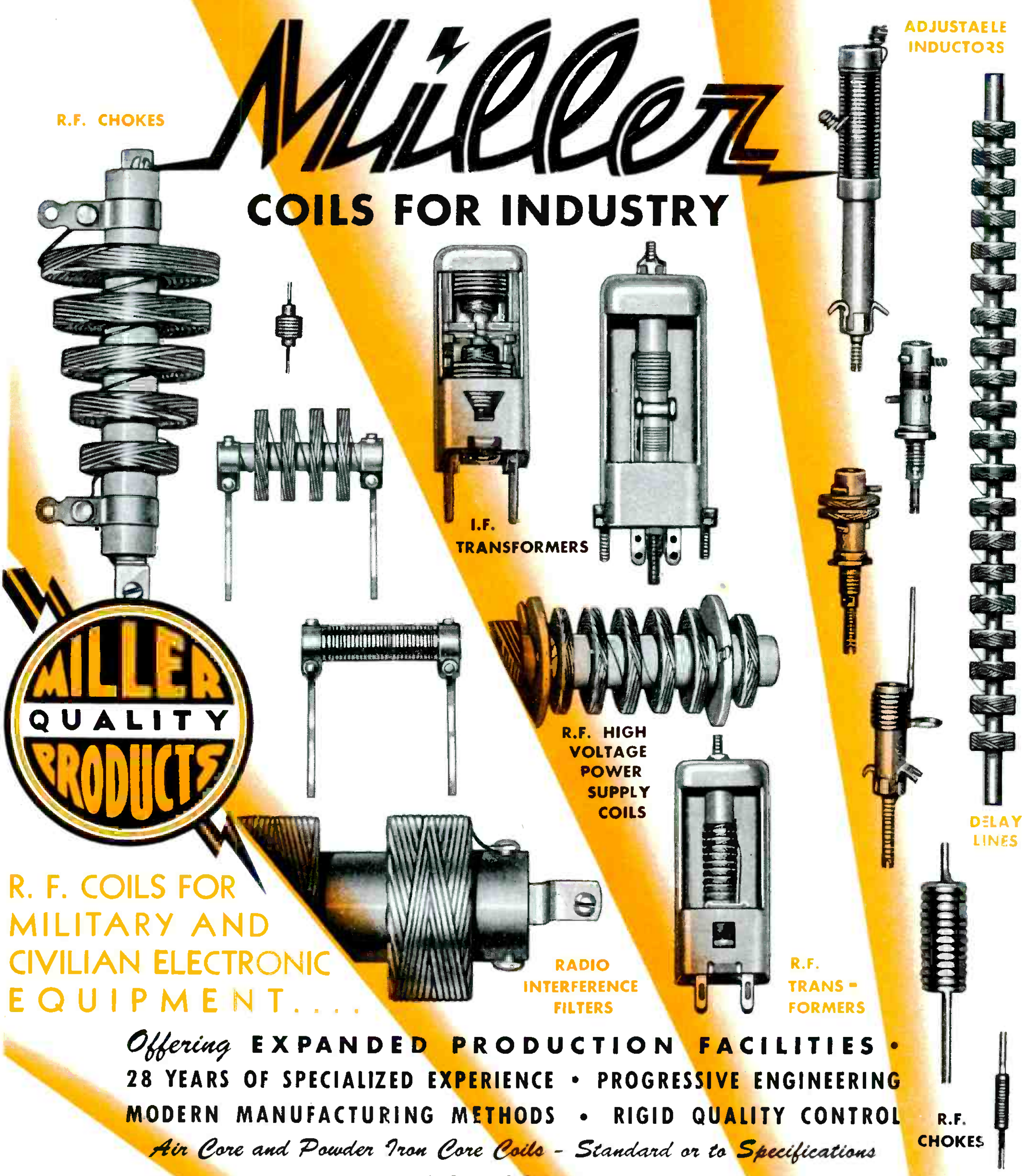

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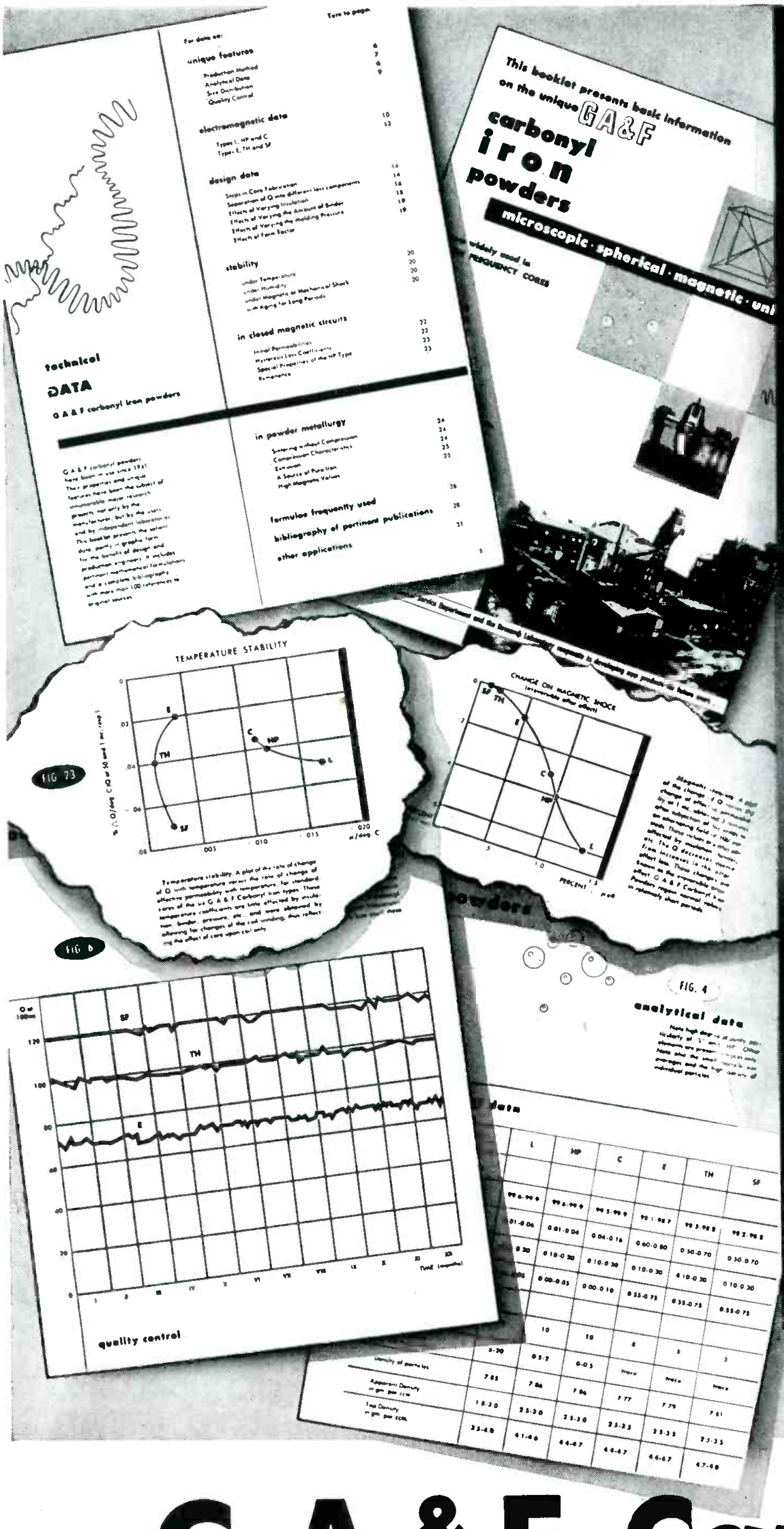

technical

DATA

G A & F carbonyl iron powders

G A & F carbonyl powders have been in use since 1941. Their properties and unique features have been the subject of innumerable major research projects not only by the manufacturer, but by the users and by independent laboratories. This booklet presents the salient data, partly in graphic form for the benefit of design and production engineers. It includes pertinent mathematical formulations and a complete bibliography with more than 100 references to original sources.

For data on: — Turn to page

- unique features
  - Production Method 6
  - Analytical Data 7
  - Size Distribution 8
  - Quality Control 9
- electromagnetic data
  - Types L, HP and C 10
  - Types E, TH and SF 12
- design data
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  - Separation of Q into different loss components 14
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Temperature stability. A plot of the rate of change of Q with temperature versus the rate of change of effective permeability with temperature, for standard cores of the six G A & F Carbonyl Iron types. These temperature coefficients are little affected by insulation, binder, pressure, etc., and were observed by allowing for changes of the coil winding, thus reflecting the effect of core upon coil only.

Magnetic stability. A plot of the change of Q versus the change of effective permeability at 1 mc. observed 3 minutes after subjection of the cores to an alternating field of 1000 gauss. These values are little affected by insulation, binder, etc. The Q decreases due from increases in the after effect loss. These changes are known as the irreversible after effect. G A & F Carbonyl Iron Powders regain normal values in relatively short periods.

analytical data

Note high degree of purity particularly of "L" and "HP". Other elements are present in traces only. Note also, the small particle size averages and the high density of individual particles.

data

	L	HP	C	E	TH	SF
	99.6-99.9	99.6-99.9	99.3-99.9	99.1-99.7	99.3-99.8	99.2-99.8
	01-0.06	0.01-0.04	0.04-0.16	0.60-0.80	0.50-0.70	0.50-0.70
	0.30	0.10-0.30	0.10-0.30	0.10-0.30	0.10-0.30	0.10-0.30
		0.00-0.05	0.00-0.10	0.55-0.75	0.55-0.75	0.55-0.75
		10	10	8	5	3
	3-20	0.5-7	0-0.5	trace	trace	trace
Density of particles	7.83	7.86	7.86	7.77	7.79	7.81
Apparent Density in gm. per ccm	1.0-3.0	2.5-3.0	2.5-3.0	2.5-2.5	2.5-3.5	2.5-3.5
Tap Density in gm. per ccm	2.5-4.0	4.1-4.6	4.4-4.7	4.4-4.7	4.4-4.7	4.7-4.8

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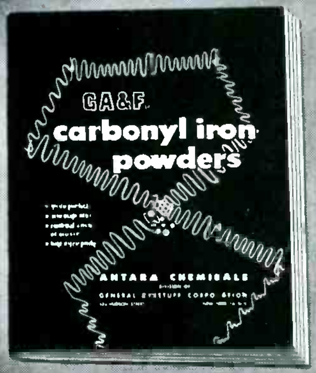
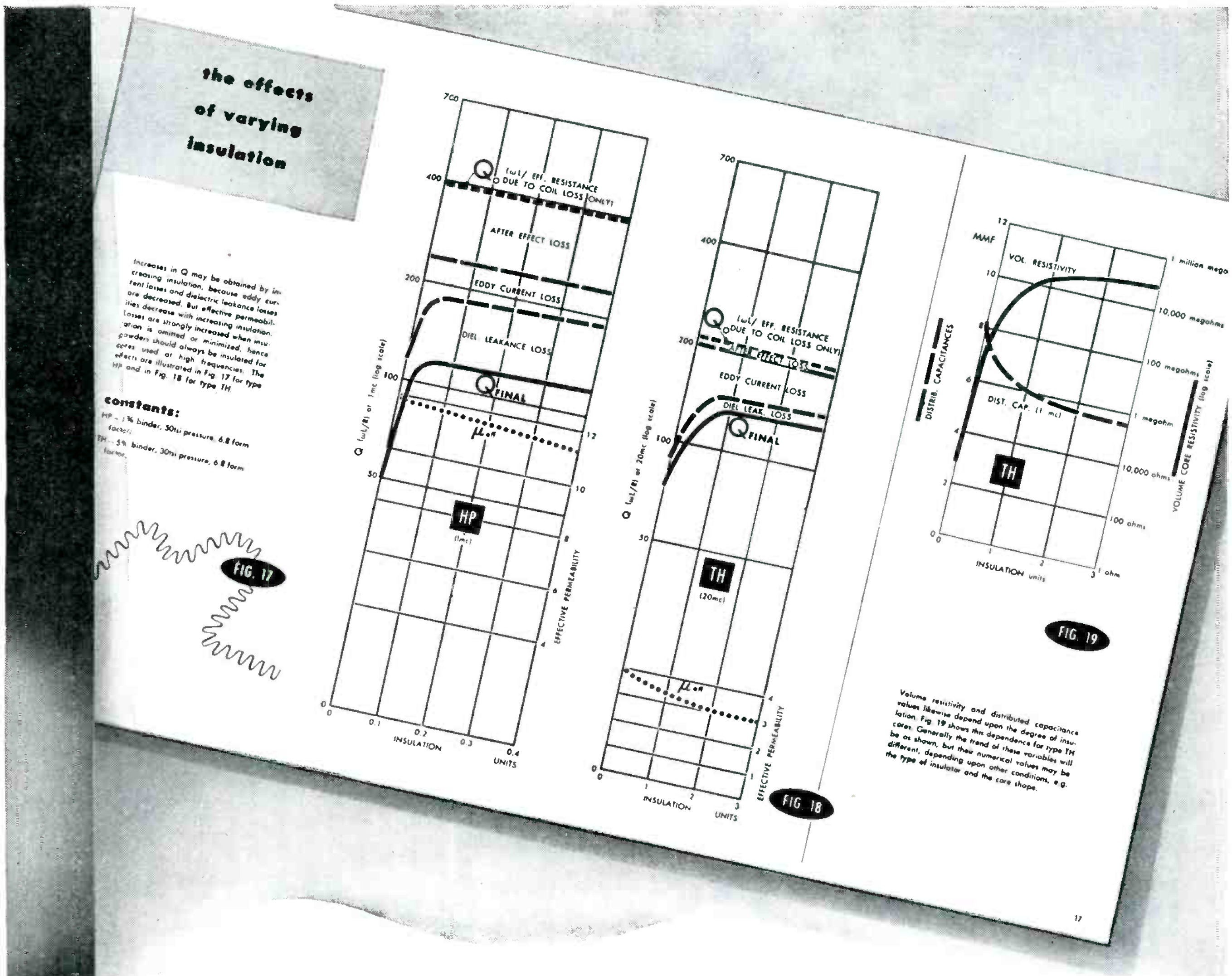


...the
technical portrait
of an
unusual
product

G A & F® Carbonyl



the effects of varying insulation

Increases in Q may be obtained by increasing insulation, because eddy current losses and dielectric leakance losses are decreased. But effective permeabilities decrease with increasing insulation. Losses are strongly increased when insulation is omitted or minimized, hence powders should always be insulated for cores used at high frequencies. The effects are illustrated in Fig. 17 for type HP and in Fig. 18 for type TH.

constants:

HP – 1% binder, 50tsi pressure, 6.8 form factor;

TH – 5% binder, 30tsi pressure, 6.8 form factor.

Volume resistivity and distributed capacitance values likewise depend upon the degree of insulation. Fig. 19 shows this dependence for type TH cores. Generally the trend of these variables will be as shown, but their numerical values may be different, depending upon other conditions, e.g. the type of insulator and the core shape.

G A & F Carbonyl Iron Powders are unique . . . This new book is unique . . . Here is the most comprehensive treatment ever given to the characteristics and applications of Carbonyl Iron Powders. (The 3-page bibliography alone is a valuable addition to your reference library.)

This book was written for the manufacturer or engineer who wants a maximum of facts with a minimum of verbiage. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. Established applications are fully covered; new applications are suggested. Ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can improve the performance and reduce the cost of the equipment you manufacture. Write us — without obligation — for your copy of this new book. Kindly address your inquiry to Dept. 11.

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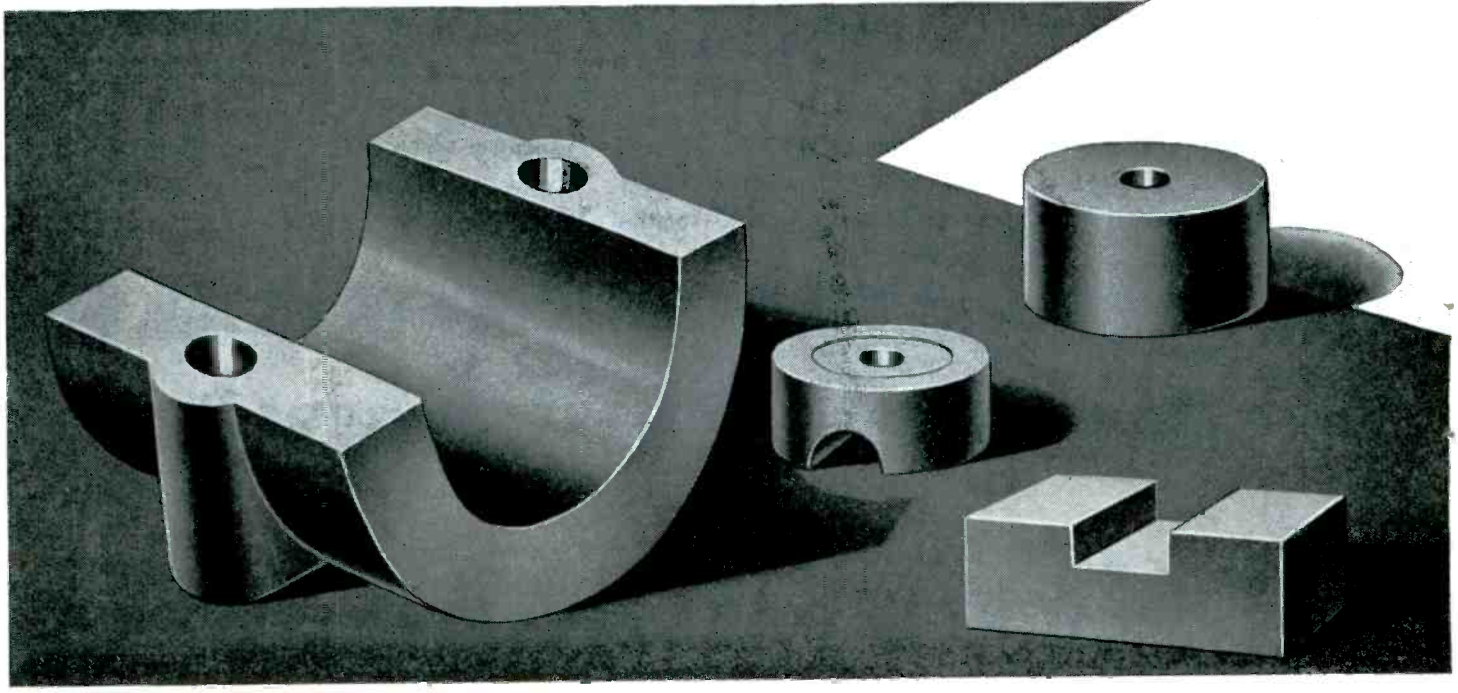

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Then, whether cast or sintered . . . specially designed or from standard stock . . . in blank, assemblies or subassemblies, you'll find that Carboloy Alnico permanent magnets *are right* for you.

For Carboloy magnet engineers, *backed by the very men who first developed permanent magnets*, expertly *design* magnets to your exact specifications . . . or select the proper magnet from among the many thousands already designed and in stock.

Strict Carboloy quality controls and expansive facilities assure you *better-built* magnets, too. Each tops in quality . . . the absolute in uniformity . . . *and each guaranteed to meet or surpass the industry's external energy minimum.* And, once your magnet order has been accepted and scheduled, it is delivered right on the dot, as promised.

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DEPARTMENT OF GENERAL ELECTRIC COMPANY
11139 E. 8 MILE BLVD., DETROIT 32, MICHIGAN

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"Carboloy" is the trade-mark for the products of Carboloy Department of General Electric Company

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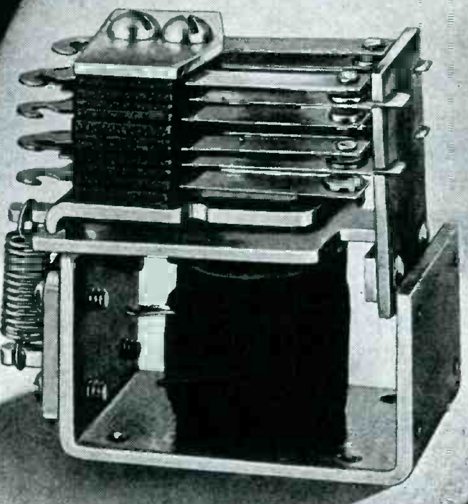
VERSATILITY
QUALITY
PERFORMANCE



TYPE PK RELAY

HERE ARE THE FACTS AND FIGURES:

CONTACTS: 10 amp. standard. 24 volts D.C., 115 volts A.C.
15 amp. contacts available.

SENSITIVITY: D.C.: 4 pole 1.5 watts
2 pole .7 watts
A.C.: 4 pole 5 volt amperes
2 pole 2.5 volt amperes
Can also be furnished in 6 pole AC and DC up to 4000 Ohms.

COIL: To 115 volts D.C., 230 volts A.C.

NOMINAL HEAT RISE: D.C. 30°C above room ambient
A.C. 45°C above room ambient

MAX. INPUT FOR 85° RISE: D.C. 5 watts
A.C. 11 volt amperes

MOUNTING: Base or end mounting

WEIGHT: 4.5 oz. 4 P.D.T.

WEIGHT HERMETICALLY SEALED: 7.7 oz.

DIMENSIONS: Open Relay—2 1/16", 1⅛", 2 1/16"
Sealed Relay—3⅛", 1½", 2 5/16"
Overall Mounting Flange—3⅛"
Center to Center Mounting Holes—2 11/16"

A Quality Relay

The new Allied PK Relay is designed to offer versatility in a power relay where quality and low cost are factors. Besides stability in operation its reliability allows a range in applications from high quality instruments to vending machines. The PKU relay will comply with Underwriters' Laboratories requirements and can also be supplied hermetically sealed.

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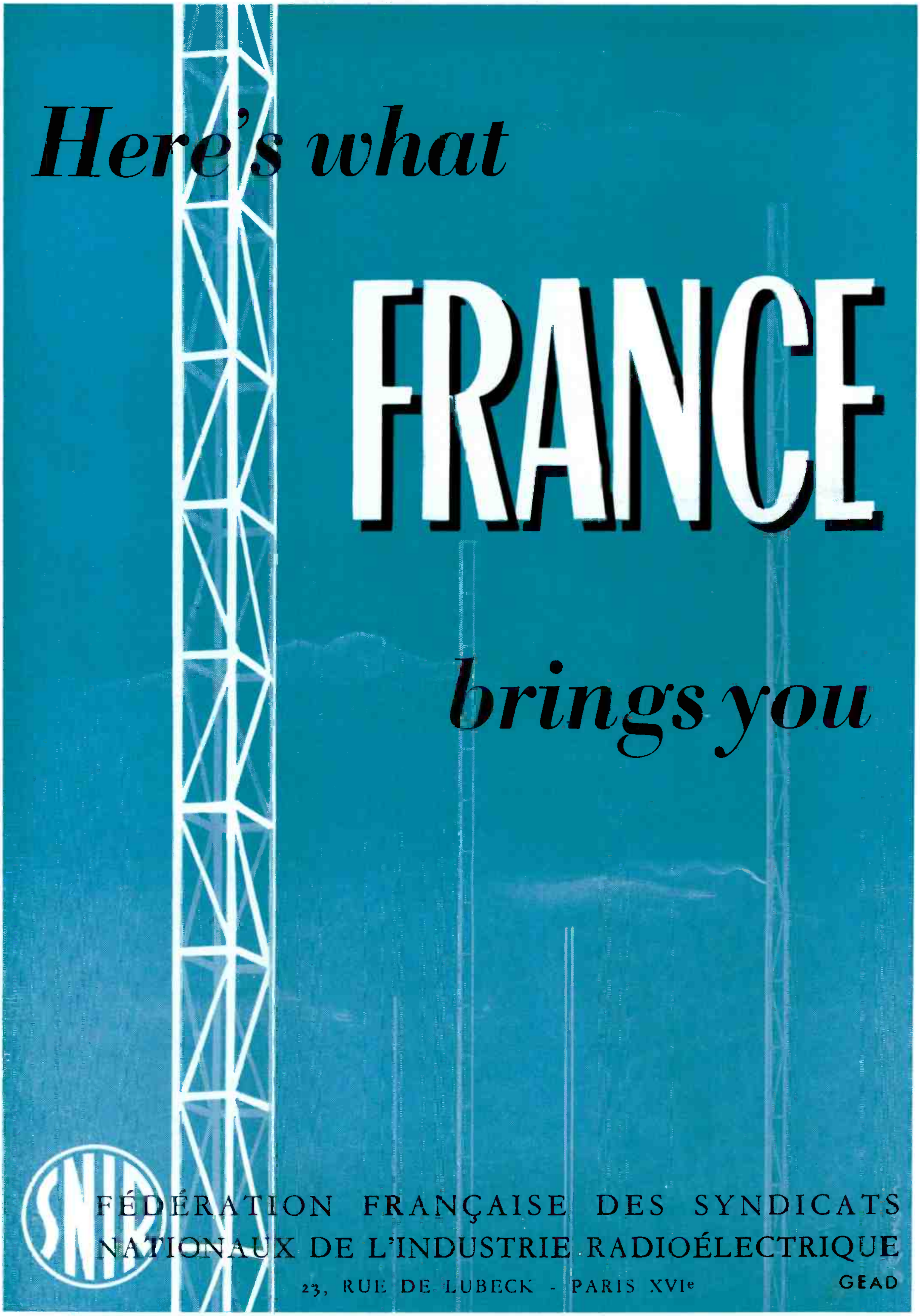
Be sure to send for your copy of Allied's Relay Guide. It gives the engineering data for 27 Allied relays in a concise tabular form for easy reference.

ALLIED CONTROL COMPANY, INC. 2 EAST END AVENUE, NEW YORK 21, N.Y.



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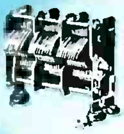

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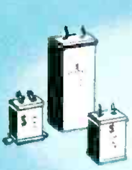

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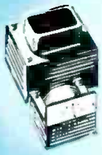

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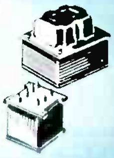

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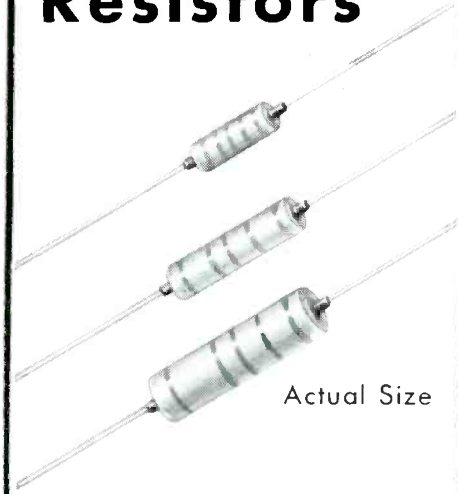

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Long ago, the makers of BUSS fuses realized that you never know when a fuse might have to operate to protect expensive equipment. It might be the day installed . . . or weeks, months . . . even years later, in the hands of someone thousands of miles away.

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ELRC-152

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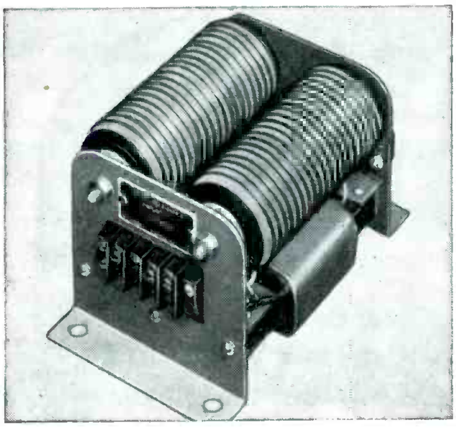
- **DURABILITY—Unaffected by moderate shock or vibration**
- **LONG LIFE—Will operate indefinitely without attention**

1-va amplistat



40-va amplistat

As part of a continuing effort to better serve the electronics industry, General Electric has recently enlarged its line of amplistats (self-saturating magnetic amplifiers). These remarkable units, for amplifying small d-c signals from relatively low-impedance sources, can be profitably applied to many control and instrumentation circuits both in conjunction with, and in place of, electronic equipment.

At present, G-E amplistats are available in three component ratings and one "educational" or laboratory research device. G-E engineers will be glad to aid and advise in developing complete amplification systems around these products.

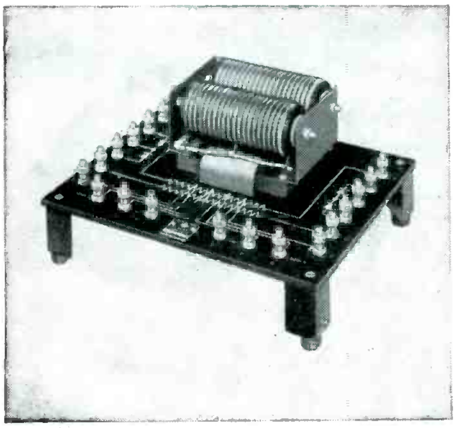
1-VA AMPLISTAT is easy to connect and remove because it's mounted on a standard tube-type base. Maximum power gain is over 2000 watts per watt. Response time is $\frac{1}{3}$ sec or less. Operates directly on 40-volt, 60-cycle a-c. Dimensions, 2 x 2 x $2\frac{5}{8}$ in. high including octal base. Weight, 11 oz. Further details in Bulletin GEC-784.

40-VA MODEL has selenium rectifiers and four separate control windings. Maximum power gain is 15,000 w/w. Response time is 2 sec, corresponding to maximum-gain conditions. No special power supply—operates directly on 115-volt, a-c. Dimensions, 5 x $7\frac{3}{4}$ x $4\frac{5}{8}$ in. Weight 7 lb. See Bulletin GEC-790.

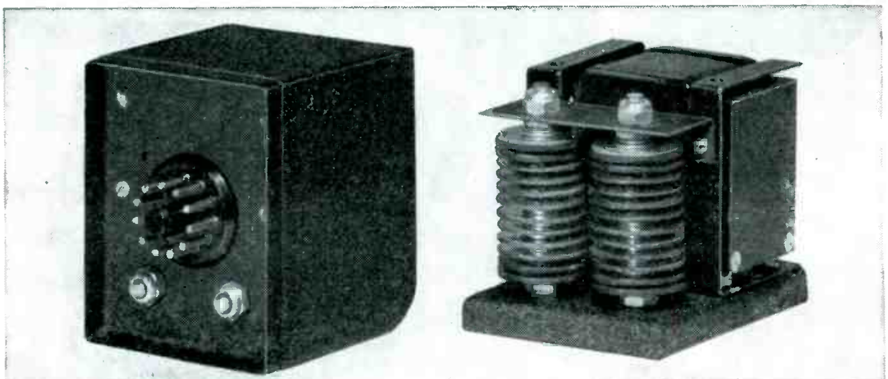
400-CYCLE UNITS are push-pull output, d-c linear amplifiers with three separate d-c input windings. Designed as the first and second stages for thermocouple signal amplifiers meeting aircraft requirements, they're also applicable to many other amplification problems.

Available for power supplies rated 15 or 30 volts, they have a maximum power gain of 2050 w/w. Response time ranges from 0.0036 to 0.0177 sec. Output ratings, 20 to 30 milliamp. Dimensions, $3\frac{3}{32}$ x $2\frac{9}{16}$ x $2\frac{3}{4}$ in. Weight, 14 oz. For further information write to *Special Products Sales, General Electric Company, Schenectady 5, N. Y.*

"EDUCATIONAL" AMPLISTAT is useful in laboratories for experimental work and for studying new circuits. Operates directly from 115-volt, 60-cycle power. Gain is up to 25,000 watts per watt. Output is 1.0 amp continuous. Get more details in Bulletin GEC-599.



Educational amplistat

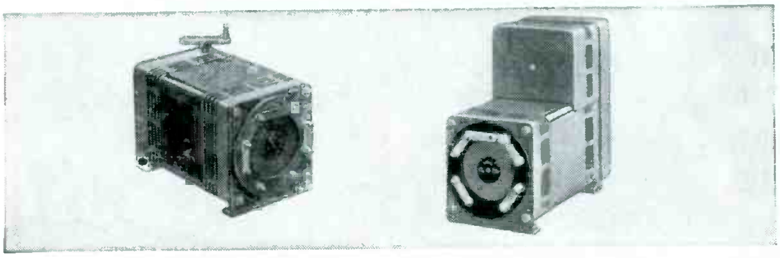


400-cycle amplistat

DIGEST

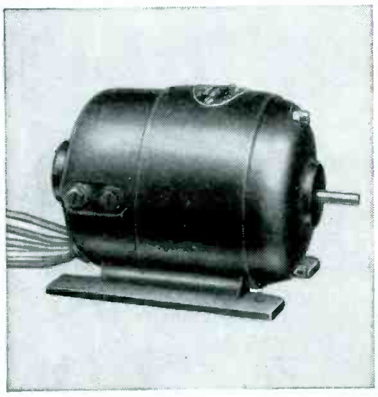
TIMELY HIGHLIGHTS ON G-E COMPONENTS

HOLD VOLTAGE STEADY—OR ADJUST IT PRECISELY—WITH G-E INDUCTROLS



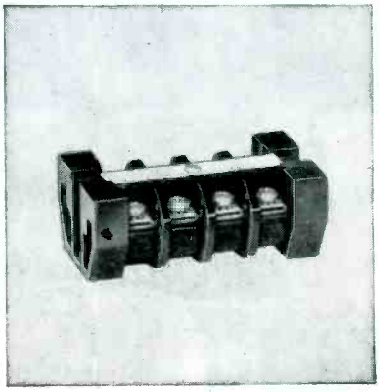
For precise and dependable stepless voltage regulation or variation it's G-E inductrols. These single-phase units are available in ratings from 3 to 240 kva for circuits 600 volts and below. Motor-operated units, used with automatic control, maintain voltage within narrow limits regardless of line-voltage variation. Hand-operated models provide smooth and precise voltage adjustment for instrument calibration, rectifier control, and similar uses. Check Bulletin GEC-795.

G-E SELSYNS INDICATE POSITION—CONTROL MOTION



G-E selsyn transmitters and receivers provide automatically synchronized indication or control at one location with respect to an initial remote reference point. Built for accurate, economical, continuous service, they can be used to indicate angular or linear movement, or to control the motion of a device by controlling its actuating element. Two types are available—general purpose, for accuracy within ±5 deg; and high accuracy, ±1 deg. See Bulletin GEA-2176.

CONTROL WIRING SIMPLIFIED WITH G-E TERMINAL BOARDS



You get positive electrical connections without soldering using G-E Type EB-6 terminal boards fabricated from strong, durable molded Textolite* parts. To facilitate marking, reversible marking strips are white on one side, black on the other. Boards have 4 to 12 poles. Rated 30 amp, 600 volts. Complete details are contained in Bulletin GEA-1497.

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General Electric Company, Section A667-18
Schenectady 5, N. Y.

Please send me the following bulletins:

Indicate: √ for reference only
X for planning an immediate project

( )	**GEA-1497**	**Fabricated Terminal Boards**
( )	**GEA-2176**	**Selsyns**
( )	**GEC-599**	**Educational Amplistat**
( )	**GEC-784**	**One-Volt-Ampere Amplistat**
( )	**GEC-790**	**Forty-Volt-Ampere Amplistat**
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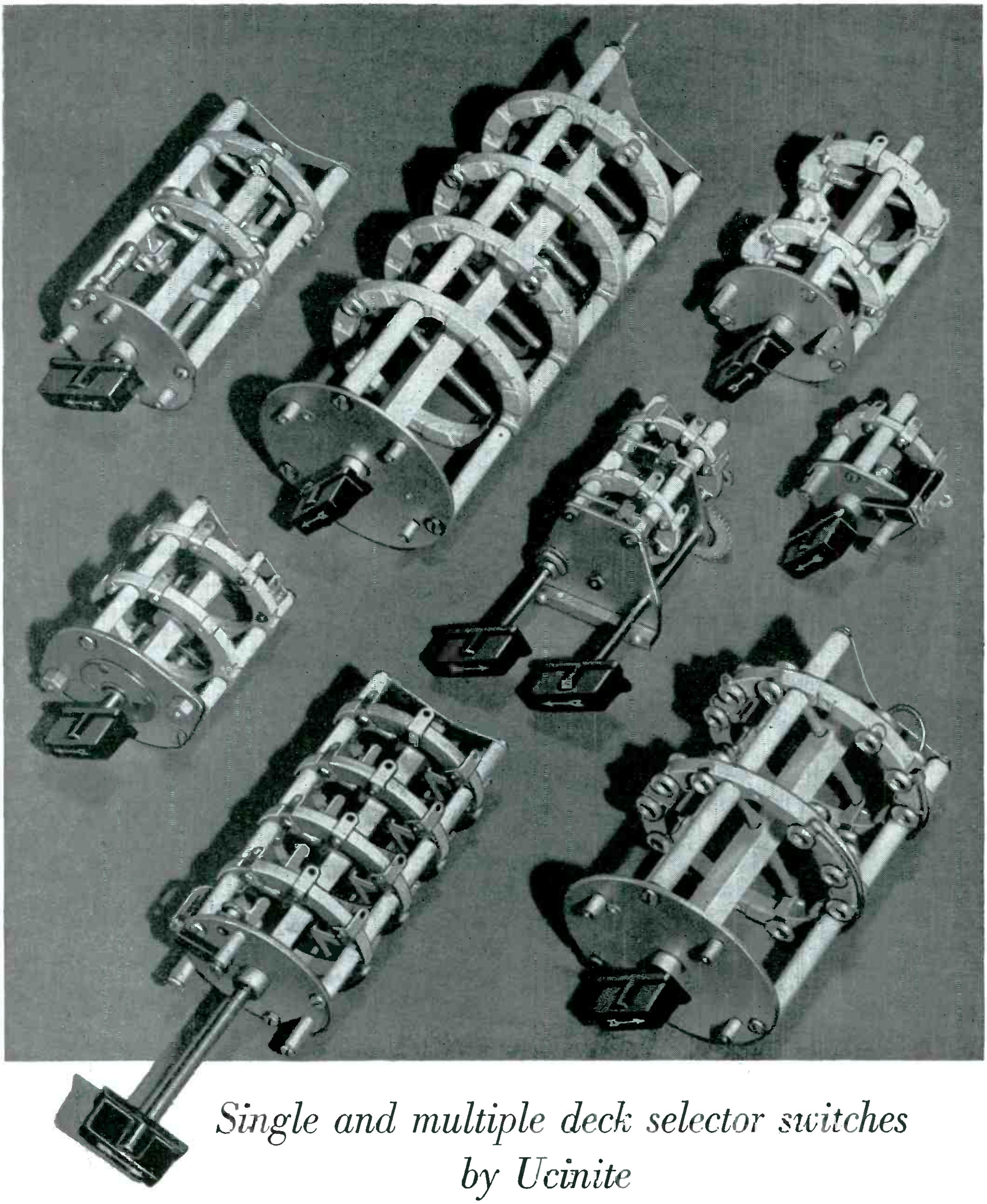
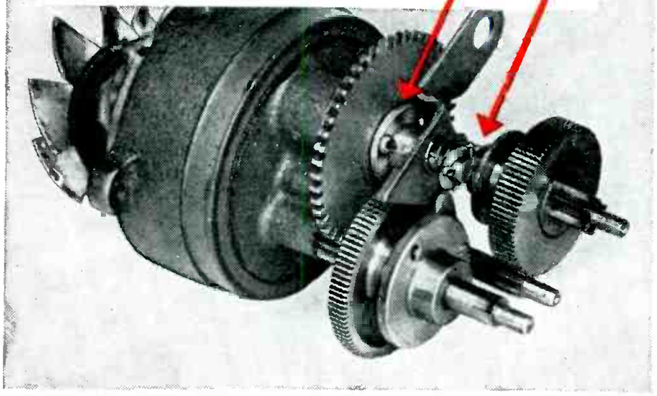


2 WALDES TRUARC RINGS
REPLACE COTTER PINS AND WASHERS...
SAVE $.0219 PER UNIT

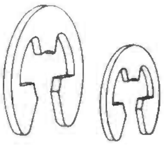
OLD WAY

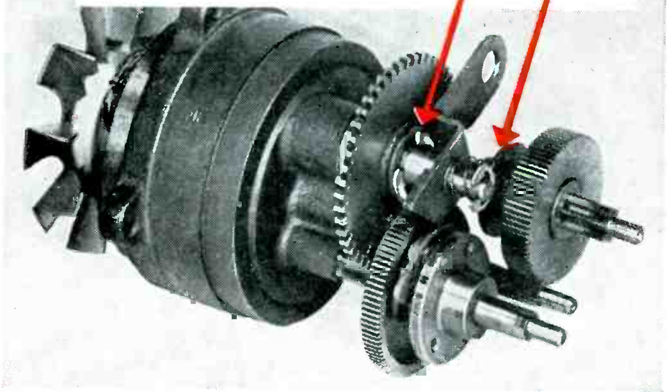
Cam shaft for breathing roll ironer mechanism required: drilling 2 holes; 2 cotter pins; 2 washers. Inaccuracy in locating holes for cotter pins caused frequent rejects.



NEW WAY

2 simple grooves to accommodate 2 Waldes Truarc Rings, are cut in shaft during regular screw machine cycle—at no extra cost. Waldes Truarc Rings are applied quickly, easily.





Using 2 Waldes Truarc "E" Retaining Rings in their Automatic Cabinet Ironer, saved The Horton Manufacturing Co., Fort Wayne, Ind., $.0219 per unit. Truarc Rings saved 50% in assembly time . . . cut down on rejects . . . increased efficiency of the unit . . . eliminated risk of damage to hands and clothing of workers in assembly.

Redesign with Truarc Rings and you, too, will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together.

Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble. Remain circular to give a never-failing grip. They can be used over and over again.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

COMPARATIVE COSTS—

WITH COTTER PINS		WITH TRUARC RINGS	
MATERIAL:		MATERIAL:	
2 washers	.0045		
2 cotter pins	.0017	2 Truarc E Rings	.0283
OPERATIONS:		OPERATIONS:	
drilling 2 holes in shaft	.0223	Cutting 2 grooves	.0000*
ASSEMBLY TIME	.0485	ASSEMBLY TIME	.0268
Total cost	$.0770		$.0551

TOTAL SAVINGS WITH TRUARC RINGS $.0219 PER UNIT

*Grooves are cut in shaft during regular screw machine cycle

For precision internal grooving and undercutting . . . Waldes Grooving Tool.

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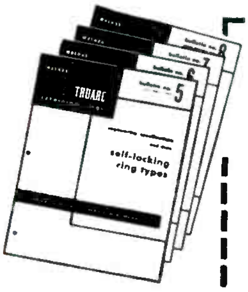

WALDES
TRUARC
REG. U. S. PAT. OFF.
RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947: 2,382,948: 2,416,852: 2,420,921: 2,428,341: 2,439,785: 2,441,846: 2,455,165: 2,483,380: 2,483,383: 2,487,802: 2,487,803: 2,491,306: 2,509,081 AND OTHER PATENTS PENDING

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send engineering specifications and data on Waldes Truarc Retaining Ring types checked below. E-U14

- ☐ Bulletin #5 Self-locking ring types
- ☐ Bulletin #6 Ring types for taking up end-play
- ☐ Bulletin #7 Ring types for radial assembly
- ☐ Bulletin #8 Basic type rings
- ☐ Send me information about the Waldes Grooving Tool.

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- Silastic,* the Dow Corning silicone rubber is used to seal hot air at 600°F., hot oil at 350-400°F., limit switches and bomb bay doors at −100°F.
- Dow Corning Silicone oils and greases make permanent lubrication a practical reality.

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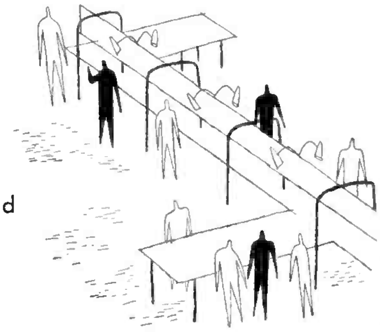

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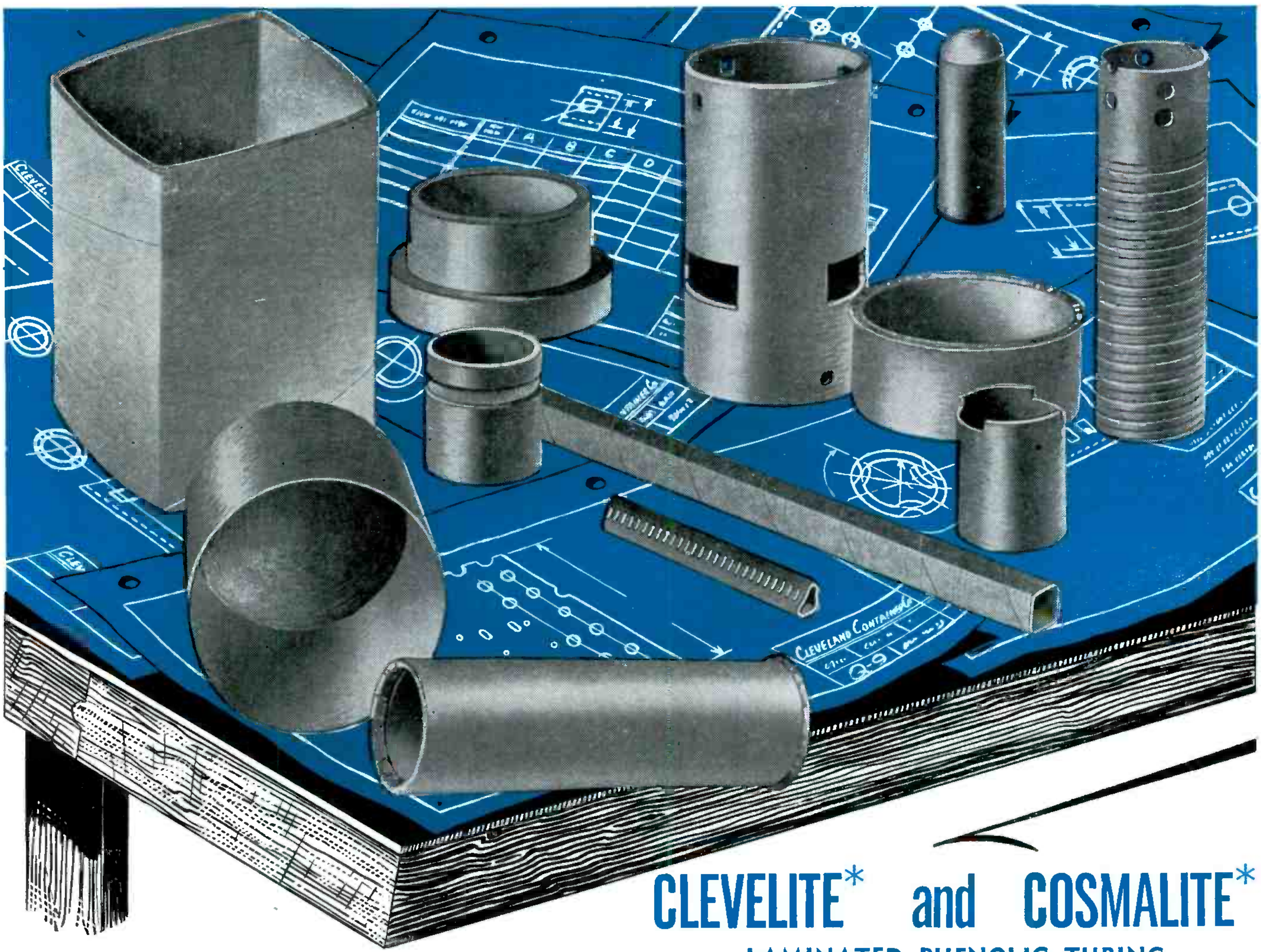

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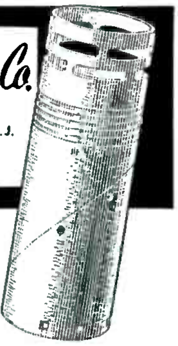

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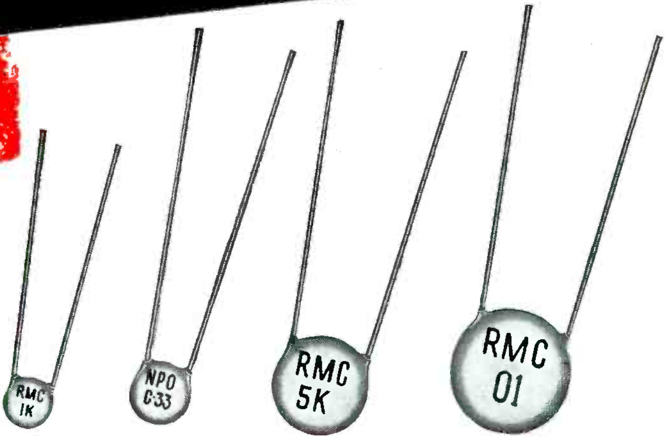
RMC CERAMIC DISCAPS

. . . THE MONEY-SAVING REPLACEMENT FOR MICA AND CERAMIC TUBULAR CONDENSERS

RMC DISCAPS are approved and used by leading manufacturers of TV sets and tuners, radio receivers and high frequency electronic equipment. In addition to their lower cost, they offer the advantages of small size, low self inductance, low power factor, high working voltage, greater mechanical strength and faster production line handling.



TYPE B DISCAPS

GMV By-Pass Series

Type B DISCAPS are the finest high frequency by-pass capacitors available and are engineered to exceed guaranteed minimum capacity at 85° C with 250 applied V.D.C. Capacity change between room temperature and 65° C is only +18%,—0%. Available in all standard capacities from .001 MFD to .02 MFD and in a number of dual capacity types.

SPECIFICATIONS

POWER FACTOR . . . . 1.5% at 1 KC
WORKING VOLTAGE . . . . 600 V.D.C.
TEST VOLTAGE . . . . 1200 V.D.C.
INSULATION . Durez Phenolic—Vacuum Waxed
RESISTANCE . . . . Initial 7500 Megohms
After Humidity 1000 Megohms
LEADS . . . . #22 Tinned Copper (.026 DIA.)
CAPACITY TOLERANCE . . . . GMV

TYPE C DISCAPS

NPO and TC

Type C DISCAPS are ideally suited to coupling and tuned circuit applications. Their capacity will not change under voltage. Available in a wide range of capacities and temperature coefficients conforming to the RMA specifications for Class I ceramic condensers.

SPECIFICATIONS

POWER FACTOR . . .
Less than .1% at 1 Megacycle
WORKING VOLTAGE . . . . 600 V.D.C.
TEST VOLTAGE . . . . 1200 V.D.C.
INSULATION .
Durez Phenolic—Vacuum Waxed
RESISTANCE . . . . Initial 7500 Megohms
After Humidity 1000 Megohms
LEADS #22 Tinned Copper (.026 DIA.)
CAPACITY TOLERANCE . . . .
±5%, ±10%, ±20%

TYPE D DISCAPS

STABLE CAPACITY

Specify Type D DISCAPS when a more stable capacity is required for coupling and by-passing filter networks. Available in a capacity range between 150 MMF and 5000 MMF. They feature a very small capacity change between +25° C and +85° C.

SPECIFICATIONS

POWER FACTOR . . . . 1% at 1 KC
WORKING VOLTAGE . . . . 600 V.D.C.
TEST VOLTAGE . . . . 1200 V.D.C.
INSULATION . . . .
Durez Phenolic—Vacuum Waxed
RESISTANCE . . . . . Initial 7500 Megohms
After Humidity 1000 Megohms
LEADS . . . #22 Tinned Copper (.026 DIA.)
CAPACITY TOLERANCE . . . .
±20% at +25° C

NEW! RMC DEPENDABLE HI-VOLTAGE DISCAPS

ACTUAL SIZE

SPECIFICATIONS

CAPACITY . . . . 500 MMF + 50% — 20%
WORKING VOLTAGE . . . . 20,000 V.D.C.
TEST VOLTAGE . . . . 30,000 V.D.C.
POWER FACTOR . . . . 1% Max. at 1 KC
LEAKAGE RESISTANCE . . . . . Initial 7500 Megohms
After Humidity . . . . 1000 Megohms
INSULATION . . . . Moulded Plaskon

SEND FOR SAMPLES AND TECHNICAL DATA

DISCAP
CERAMIC
CONDENSERS

RMC

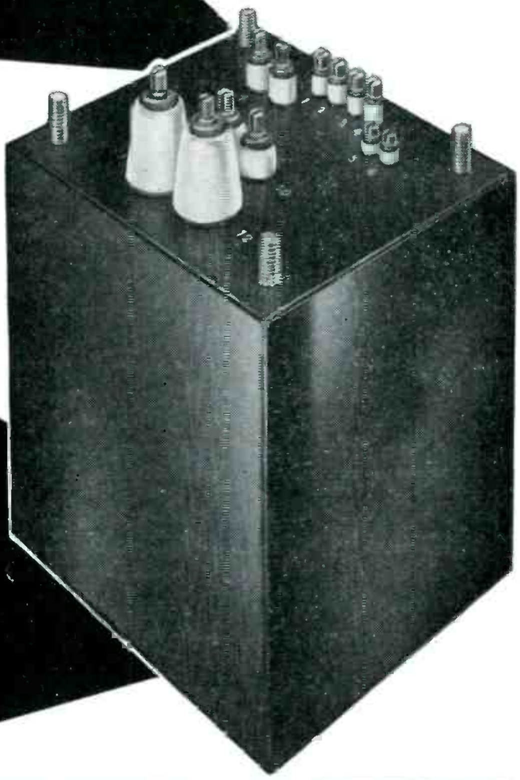
RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 North California Avenue, Chicago 18, Illinois

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Condensers

STANCOR
OP 827 TRANSFORMERS
manufactured with
CANS & TERMINALS
by Heldor



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BUILT TO PASS MIL-T-27 SPECIFICATIONS

Standard Transformer Corporation, one of the nation's leading transformer manufacturers, selected HELDOR CANS and TERMINALS as the ideal components for the design and production of their Stancor OP 827 Transformer . . . built from start-to-finish to pass MIL-T-27 specifications.

If you have any problems with Hermetic Seal Bushings, avail yourself of Heldor's free engineering counsel.

Whether your products must meet government specifications or not, it will pay you to standardize on HELDOR CANS, COMPRESSION-TYPE HERMETIC SEAL BUSHING ASSEMBLIES or COMPLETELY ASSEMBLED UNITS.

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HELDOR MFG. CO.
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Please send me prices and specifications on MIL-T-27 cans and bushings.

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Company . . . .
Address . . . .

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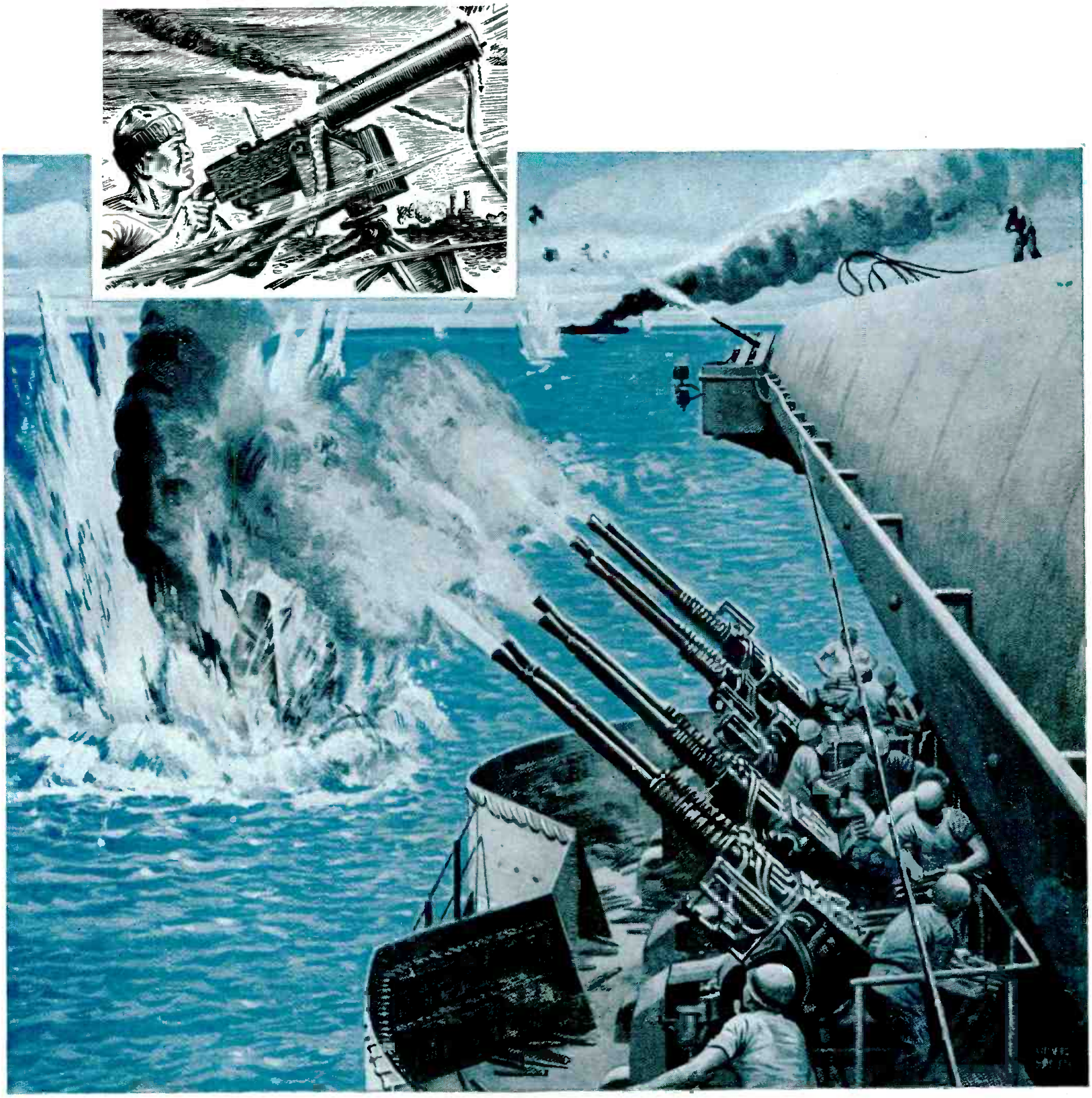
MEPCO
PRECISION
WIRE WOUND
RESISTOR



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RECOMMEND
Simpson Model 480 GENESCOPE
for TV-FM Servicing

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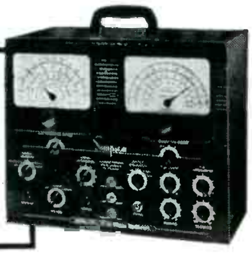
THE SIMPSON MODEL 479 TV-FM SIGNAL GENERATOR

Exactly the same circuits, ranges and functions as the Model 480, with the exception of the oscilloscope.



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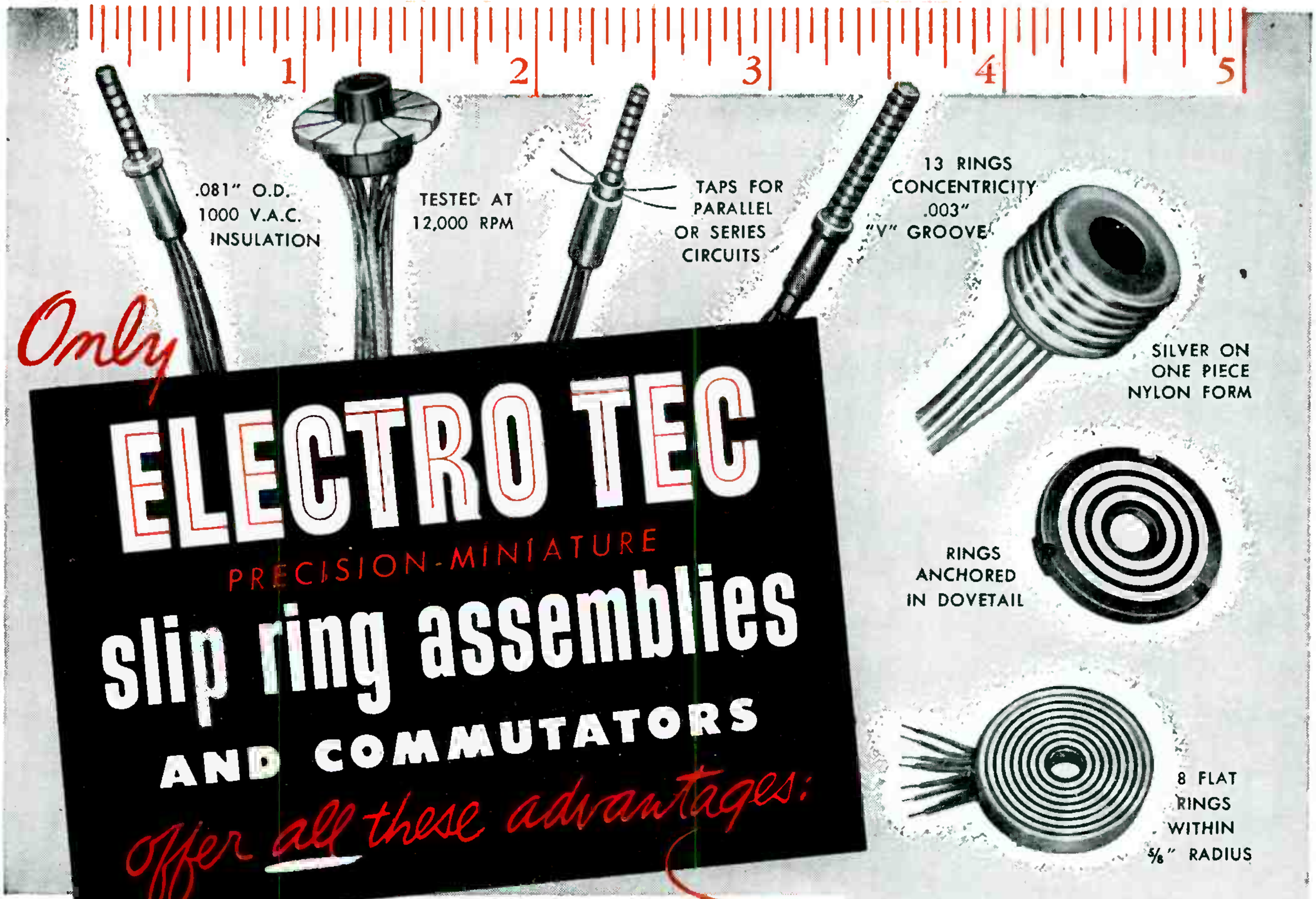

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ELECTRO TEC

PRECISION-MINIATURE

slip ring assemblies

AND COMMUTATORS

offer all these advantages:

- ONE PIECE, UNITIZED CONSTRUCTION
- ABSOLUTE MINIMUM TORQUE FRICTION
- DIAMETERS FROM .045" TO 24.0"
- MINIMUM 1000 V.A.C. HI-POT INTER-CIRCUIT
- UNIFORMLY HARD SILVER RINGS PLATED INTO GROOVES ON PRECISION MACHINED ONE PIECE PLASTIC FORM
- SPECIAL SURFACE DEPOSITS PREVENT TARNISH, MINIMIZE FRICTION, BRUSH NOISE AND PRACTICALLY ELIMINATE WEAR

EXCLUSIVE* ELECTRO TEC TECHNIQUES

insure closer tolerances, absolute uniformity, and the ultimate in miniaturization

Electro Tec units are the product of an exclusive manufacturing technique that results in accuracy unattainable by conventional fabricating methods. In this process a plastic is moulded around the wire leads. Accurate machining reduces this blank to the proper shape, complete with grooves. Hard silver is deposited into the grooves by electroplating to produce the required rings. Final machining insures concentricity and dimensional accuracy. The result is one-piece, unitized construction with conducting rings of 60 to 70 Brinell hardness.

Diameters of these assemblies range from .045″ to 24″ cylindrical or flat. Cross-sections may range from .005″ to .060″ or more. Rings are polished to a jewel-like finish and can be held to 4 micro-inches or better. Even the smallest sizes withstand a 1000 V.A.C. breakdown test. Most types easily withstand rotational speeds up to 12000 rpm.

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6 Insulated Contact Rings
Ring Width .030"
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Ring Diameter .045"
Weight 5.5 Grains (1/80 Ounce)

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Tarnish Resistant, Friction Minimizing Surface Deposits
1000 Volt Hi-Pot Between Rings
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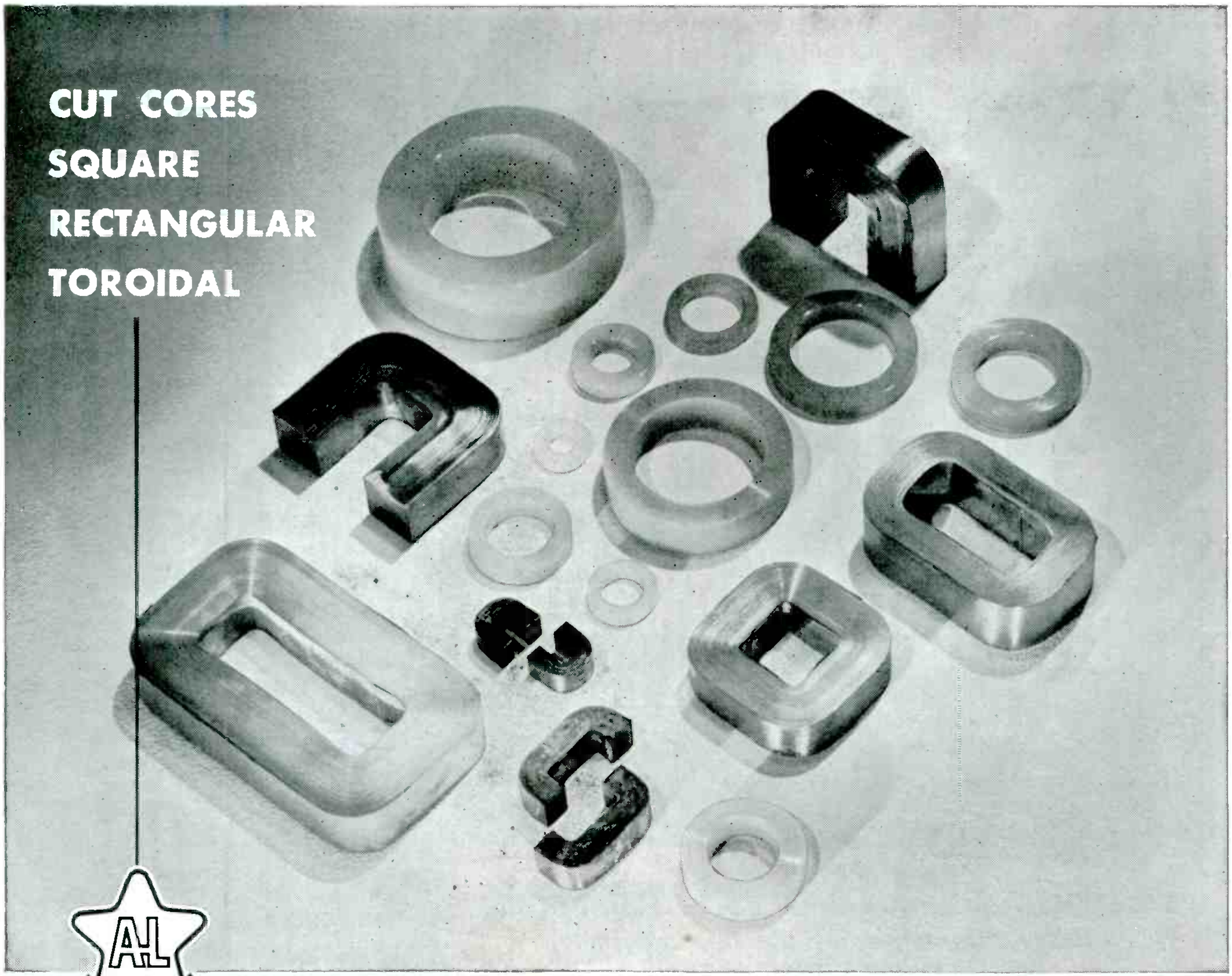

Anything You May Need in
TAPE-WOUND CORES

RANGE OF MATERIALS

Depending upon the specific properties required by the application, Arnold Tape-Wound Cores are available made of DELTAMAX . . . 4-79 MO-PERMALLOY . . . SUPERMALLOY . . . MUMETAL . . . 4750 ELECTRICAL METAL . . . or SELECTRON (grain-oriented silicon steel).

RANGE OF SIZES

Practically any size Tape-Wound Core can be supplied, from a fraction of a gram to several hundred pounds in weight. Toroidal cores are available in fifteen standard sizes with protective nylon cases. Special sizes of toroidal cores—and all cut cores, square or rectangular cores—are manufactured to meet your individual requirements.

RANGE OF TYPES

In each of the magnetic materials named, Arnold Tape-Wound Cores are produced in the following standard tape thicknesses: .012″, .008″, .004″, .002″, .001″, .0005″, or .00025″, as required.

Applications

MAGNETIC AMPLIFIERS
PULSE TRANSFORMERS
CURRENT TRANSFORMERS
WIDE-BAND TRANSFORMERS
NON-LINEAR RETARD COILS
PEAKING STRIPS . . . REACTORS.

W&D 3963

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SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
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If you have a requirement along these lines, give us a call — engineers who are really experts in their chosen fields will be glad to discuss your problems.

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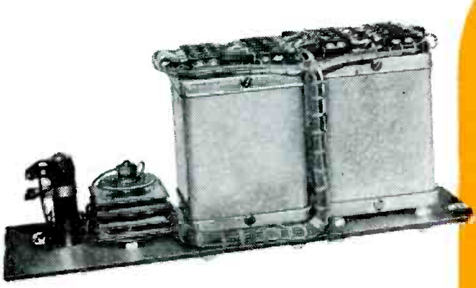

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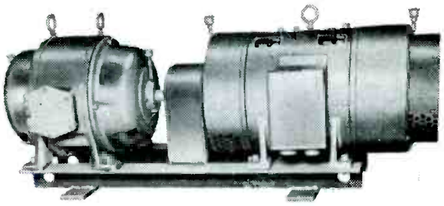

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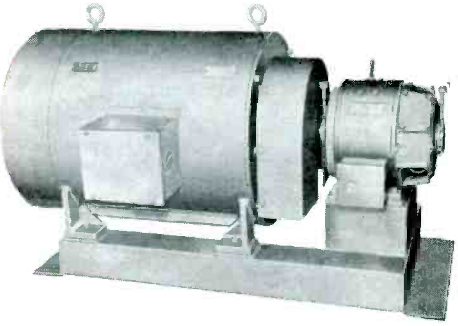

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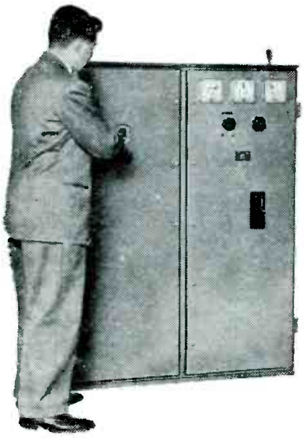

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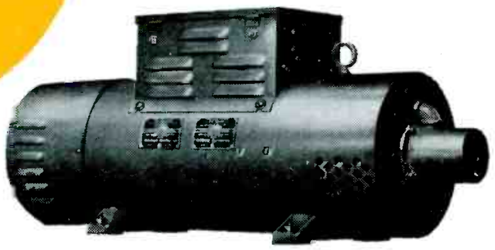
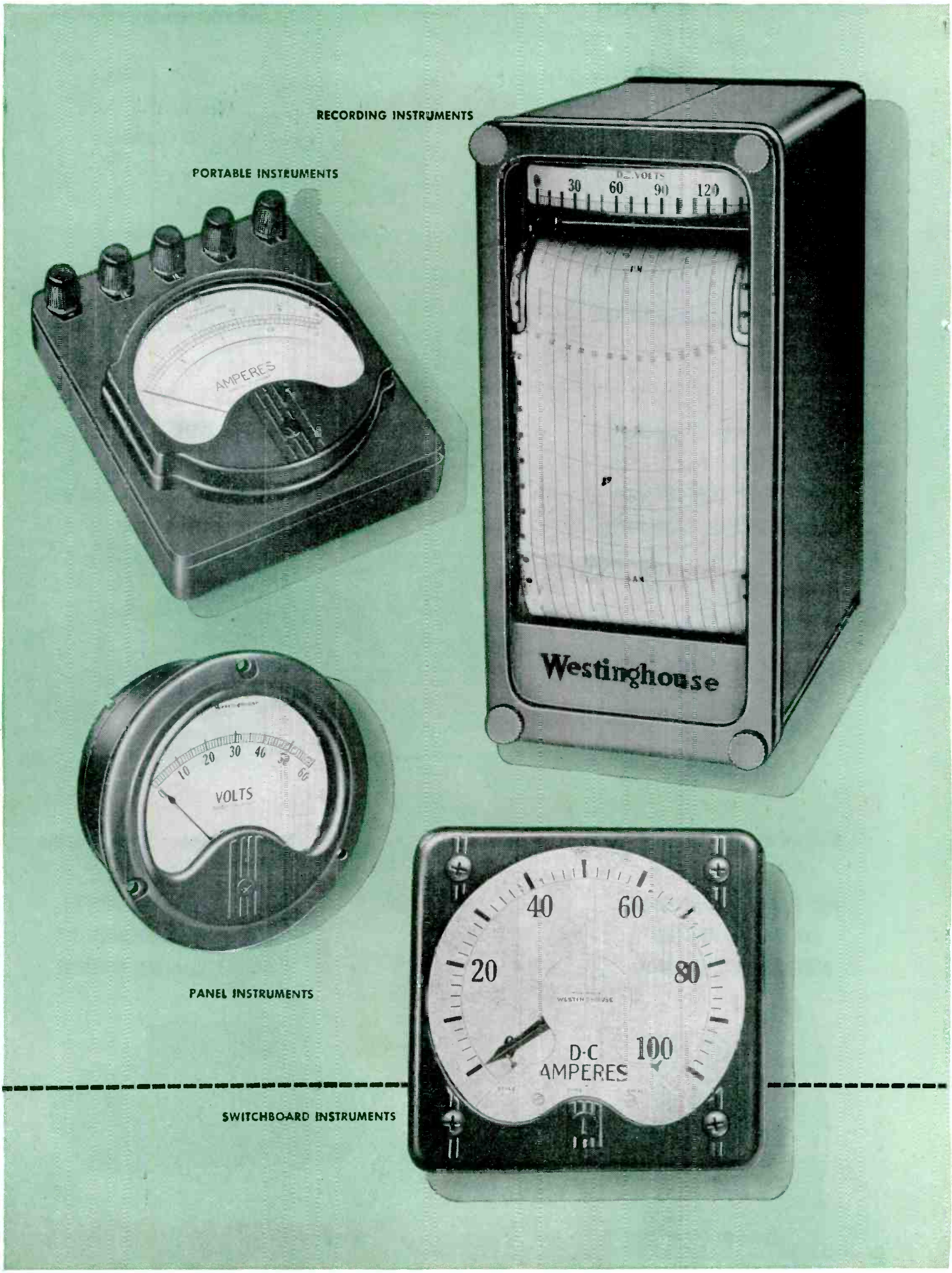


BOGUE PRECISION POWER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J-40407

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INSTRUMENTS

Where would you go for help on springs with low relaxation at

750° F ?

This view shows how the tube is placed on the spider which is held in place by an Inconel "X" spring.

Trutner and Boumans, Inc., Hillside, N. J., came to INCO.

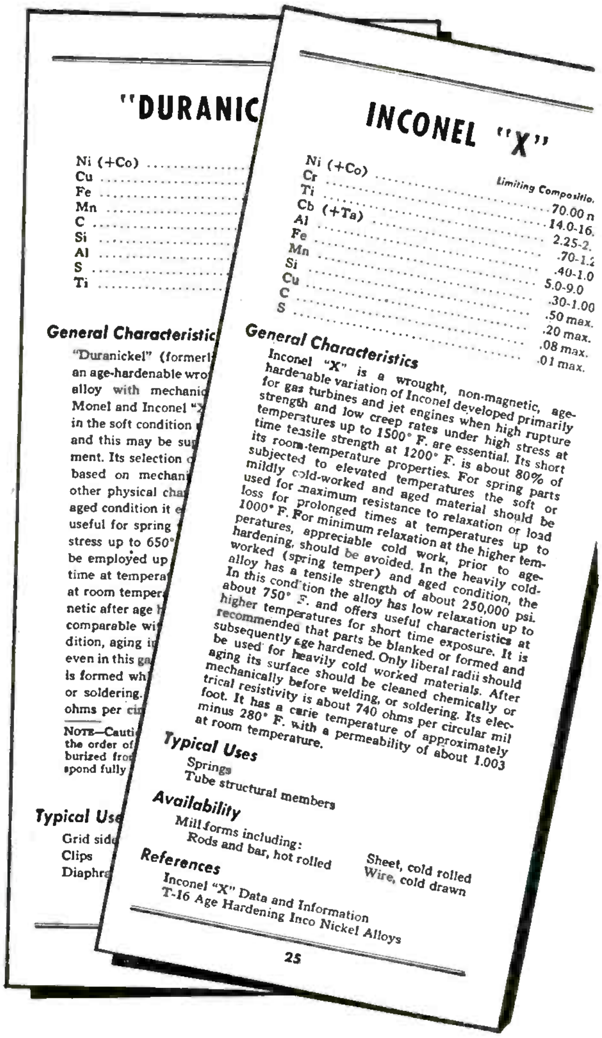
They had designed a new type of television tube screen baker. But they needed a spring material to hold the cathode tubes on a hot air tube — a spring material that would stand up in the 750°F. temperature of the oven.

INCO spring specialists studied the specifications and recommended .042″ Inconel "X"® wire. Ten months passed — in steady, round-the-clock service — and not a single failure was reported.

The same research and knowledge that enabled INCO engineers to solve this metal problem are available to you. And to help you save time in the design stages of your electronic products INCO has recently published a revision of "INCO Nickel Alloys for Electronic Uses."

It discusses in short form the characteristics of various nickel alloys and gives limiting chemical compositions.

With the aid of this valuable booklet, you may be able to find the alloy having the exact electrical, corrosion or heat-resisting characteristics you need. A glance at the pages reproduced here will give you an idea of the wealth of information contained in the 26 pages. And remember, if you don't find the alloy you need, you can always call on INCO's Development and Research Division for help.



"DURANIC

Ni (+Co) ....
Cu ....
Fe ....
Mn ....
C ....
Si ....
Al ....
S ....
Ti ....

General Characteristic

"Duranickel" (formerl
an age-hardenable wro
alloy with mechanic
Monel and Inconel "X
in the soft condition
and this may be su
ment. Its selection c
based on mechani
other physical cha
aged condition it e
useful for spring
stress up to 650°
be employed up
time at tempera
at room temper
netic after age h
comparable wi
dition, aging i
even in this ga
is formed wh
or soldering.
ohms per ci

NOTE—Cauti
the order of
burized fro
spond fully

Typical Use

Grid side
Clips
Diaphr

INCONEL "X"

	Limiting Compositio
Ni (+Co)	70.00 n
Cr	14.0-16.
Ti	2.25-2.
Cb (+Ta)	.70-1.2
Al	.40-1.0
Fe	5.0-9.0
Mn	.30-1.00
Si	.50 max.
Cu	.20 max.
C	.08 max.
S	.01 max.

General Characteristics

Inconel "X" is a wrought, non-magnetic, age-hardenable variation of Inconel developed primarily for gas turbines and jet engines when high rupture strength and low creep rates under high stress at temperatures up to 1500° F. are essential. Its short time tensile strength at 1200° F. is about 80% of its room-temperature properties. For spring parts subjected to elevated temperatures the soft or mildly cold-worked and aged material should be used for maximum resistance to relaxation or load loss for prolonged times at temperatures up to 1000° F. For minimum relaxation at the higher temperatures, appreciable cold work, prior to age-hardening, should be avoided. In the heavily cold-worked (spring temper) and aged condition, the alloy has a tensile strength of about 250,000 psi. In this condition the alloy has low relaxation up to about 750° F. and offers useful characteristics at higher temperatures for short time exposure. It is recommended that parts be blanked or formed and subsequently age hardened. Only liberal radii should be used for heavily cold worked materials. After aging its surface should be cleaned chemically or mechanically before welding, or soldering. Its electrical resistivity is about 740 ohms per circular mil foot. It has a curie temperature of approximately minus 280° F. with a permeability of about 1.003 at room temperature.

Typical Uses

Springs
Tube structural members

Availability

Mill forms including:
Rods and bar, hot rolled
Sheet, cold rolled
Wire, cold drawn

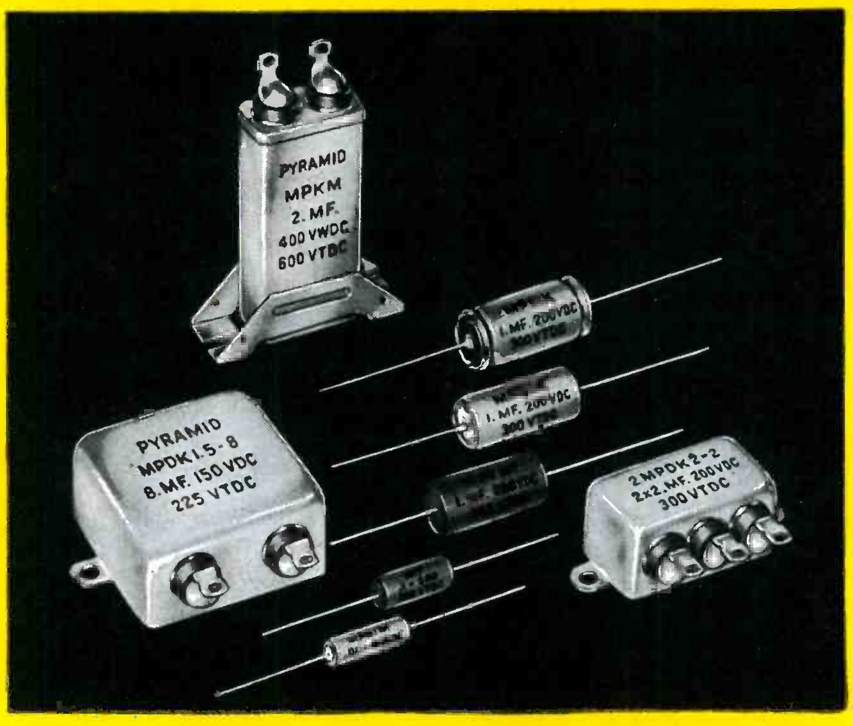
References

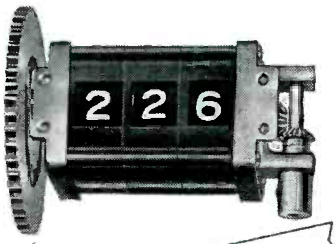
Inconel "X" Data and Information
T-16 Age Hardening Inco Nickel Alloys

25

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM INCO OF SERVICE


PYRAMID
MPKM
2. MF.
400 VWDC
600 VTDC
1. MF. 200VDC
1. MF. 200VDC
300 V
PYRAMID
MPDK 1.5-8
8. MF. 150 VDC
225 VTDC
2 MPDK 2-2
2x2. MF. 200VDC
300 VTDC



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You* can count on
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You* need——

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This REEL CONTROL BOX, complete with its *built-in* counting mechanism, indicates the number of feet of antenna reeled in and out of certain types of military aircraft. Manufactured completely by Veeder-Root, including outside bakelite cover and box, this unit shows another imaginative application of the universal language of direct-reading *Count*rol.

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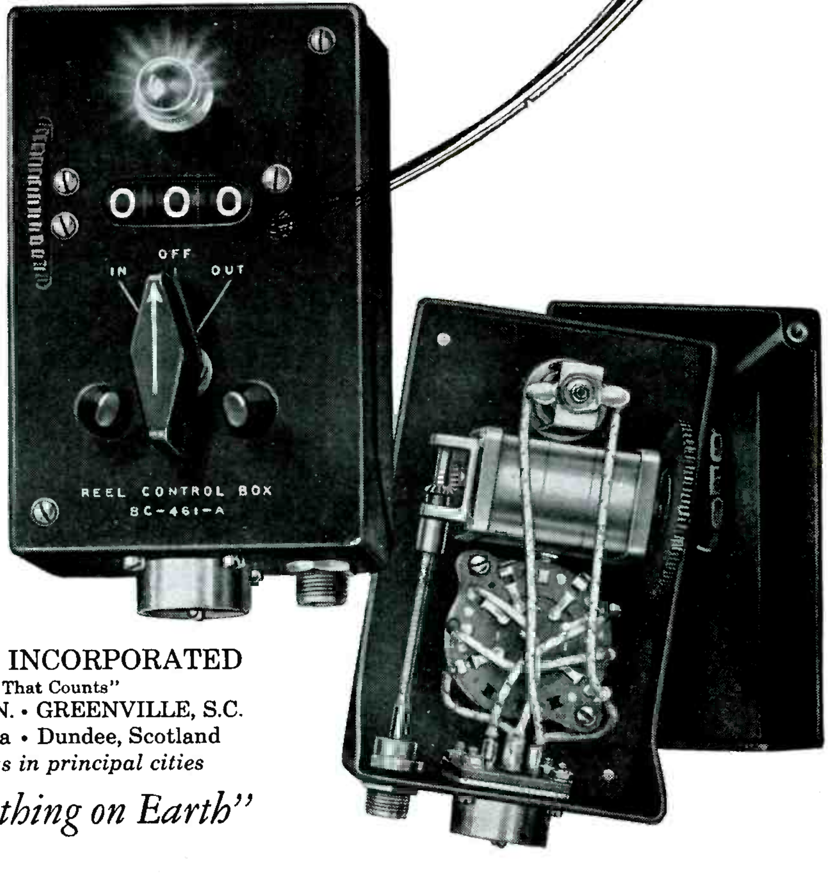

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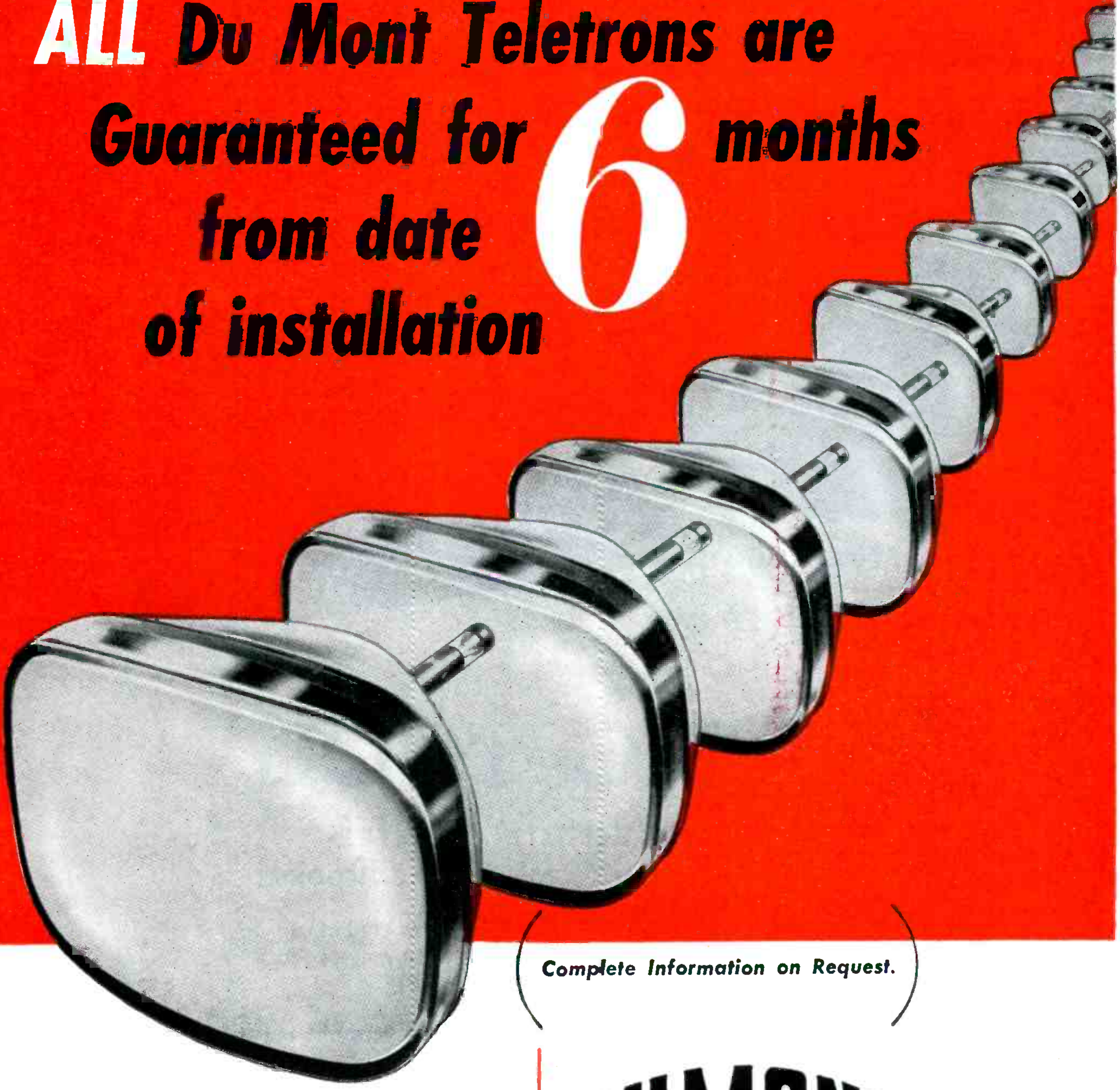
"Counts Everything on Earth"

NOW, *Mr. Manufacturer...*

ALL Du Mont Teletrons are Guaranteed for 6 months from date of installation



Complete Information on Request.

Now Du Mont assures you of six months' protection from the day your receiver is installed in the customer's home, and insures still greater customer-confidence for your brand name. Du Mont offers the best guarantee protection today.

DUMONT

*Teletrons**

CATHODE-RAY TUBE DIVISION ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

*Trade-mark

Model 666-R

NOTE the wide ranges of this compact pocket-size instrument. Note controls—flush with panel. Then study *the inside view. Nowhere will you find, in design and manufacturing quality, the equal of 666-R.*

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POCKET-SIZE: VOLT-OHM-MIL-AMMETER

WITH SELF-CONTAINED RESISTANCE RANGES TO 3 MEGOHMS

1. **Resistance Ranges** from 0-3000 Ohms (.5 Ohm low reading) to 3 Megohms, self-contained. Also A.C.-D.C. Volts to 5000, 10 ranges; and 3 Direct Current ranges.

2. **Enclosed Selector Switch,** molded construction. Keeps dirt out, and retains contact alignment permanently.

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4. **Resistors** are precision film or wire-wound types, each in its own compartment.

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Prices Subject to Change

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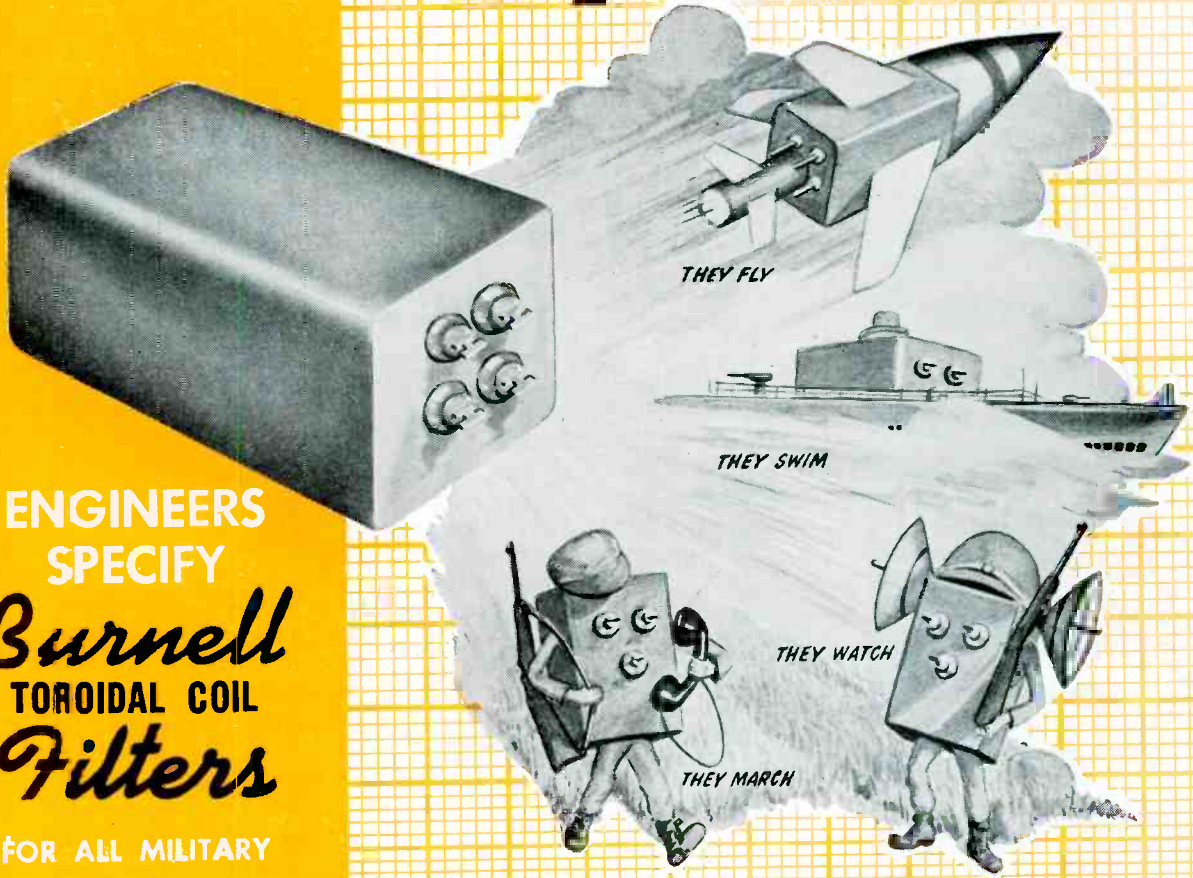
It's No Top Secret



ENGINEERS
SPECIFY
Burnell
TOROIDAL COIL
Filters

FOR ALL MILITARY APPLICATIONS
●
FACSIMILE
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GUIDED MISSILES
●
TELEMETERING
●
AIRCRAFT LANDING SYSTEMS
●
CARRIER TELEGRAPH
●
TELEPHONE
●
CONTROL EQUIPMENT
●
SONAR
●

THE VARIED AND OFTEN UNUSUAL APPLICATIONS THAT HAVE BEEN FOUND FOR TOROIDS AND FILTERS IN MILITARY ELECTRONICS HAVE KEPT OUR ENGINEERING STAFF CONSTANTLY ON ITS TOES. EVERY DAY WE ARE CONFRONTED WITH THE TECHNICAL PROBLEMS OF OUR CUSTOMERS WHO ARE TRYING TO MEET THE DEMAND FOR SMALLER, LIGHTER AND MORE SERVICEABLE EQUIPMENT. FORTUNATELY OUR INGENUITY AND EXPERIENCE HAS SERVED US IN GOOD STEAD IN THE DEVELOPMENT OF FILTERS TO MEET THESE DEMANDS. CONSEQUENTLY IT IS WITH MORE THAN A LITTLE PRIDE THAT WE SEE OUR PRODUCTS SPECIFIED BY MORE AND MORE ENGINEERS WHO CANNOT BUT REALIZE THAT IN THE DESIGN OF QUALITY EQUIPMENT THE "BILL OF MATERIALS" SHOULD INCLUDE BURNELL PRODUCTS.

BURNELL & CO

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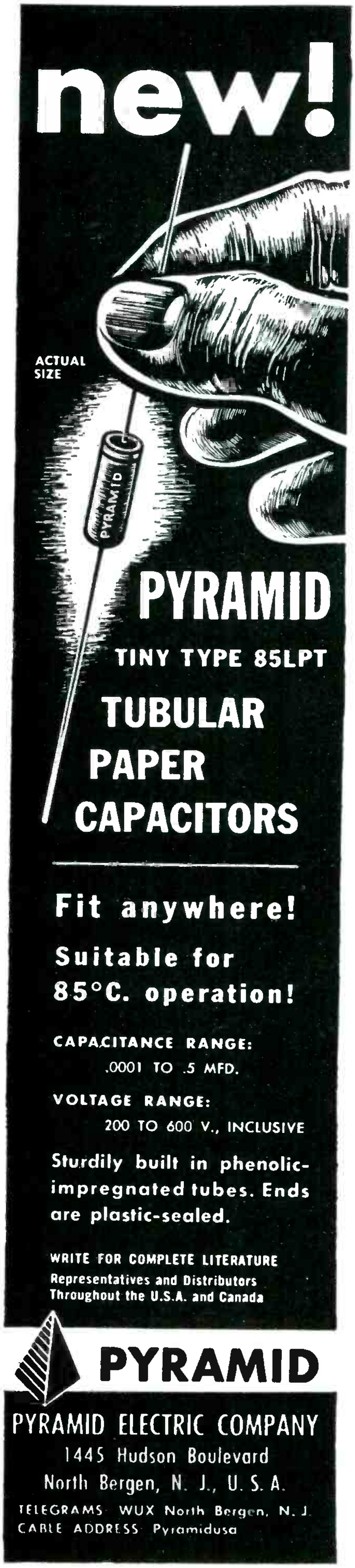
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

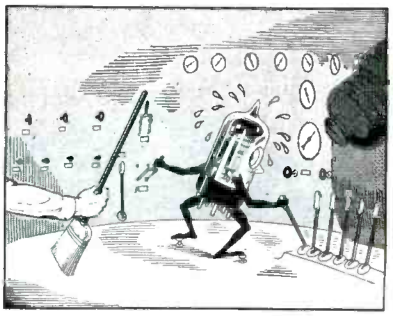
EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS



BUSINESS BRIEFS

By W. W. MacDONALD

SEMICONDUCTORS are being studied by 28 percent of the research personnel in one of the largest laboratories in our field, an indication of probable future importance of the subject. The metallurgical work going on in this laboratory and elsewhere aimed primarily at development of better transistors is, curiously, also proving of value in the development of better tube cathodes.



TUBE RELIABILITY depends to a large extent upon how hard the ambidextrous little bottles are worked, aptly illustrated by this drawing from a Department of Defense booklet

SPEAKING OF TUBES, the subject of reliability, to which we devoted so much space in this column a year or so ago, is once again bubbling to the surface. Cooperation between aviation customers and tube manufacturers at that time has since resulted in substantially better types for this class of service. So has cooperation between the military and tube makers.

Industrial users of tubes are aware of the work going on in many places to increase tube reliability. That's why the subject is found on so many current convention programs, and why requests for more information on more reliable tubes are swelling the mail of tube manufacturers.

IN-LINE READOUT, which might be defined as "digital indication in the simplest possible form," (or, still more simply, as "reading from left to right without ambiguity, like the mileage total on your automobile speedometer) is very much in the minds of many men who design electronic instruments.

Modern instruments such as frequency meters, counters and computers perform a wide variety of functions rapidly and with a high order of accuracy. Making them easier to read, regardless of whether they are used in the laboratory or on the production line, is the next important step.

MINIATURIZATION of military apparatus, and particularly electronic component parts, is making rapid progress. Several readers have asked us what effect this trend will ultimately have on the design of commercial gear.

Some techniques are already being carried over from military to commercial equipment, while others seem too expensive. So we think that commercial apparatus of tomorrow will be smaller than it is today but not as small as its military counterpart.

AIR FREIGHT carries most of the $32,000 mass spectrometers made by Consolidated Engineering despite the fact that the instruments are necessarily both bulky and heavy. Management says it saves money on packaging, that breakage is reduced, and that less time is required for adjustment following installation.

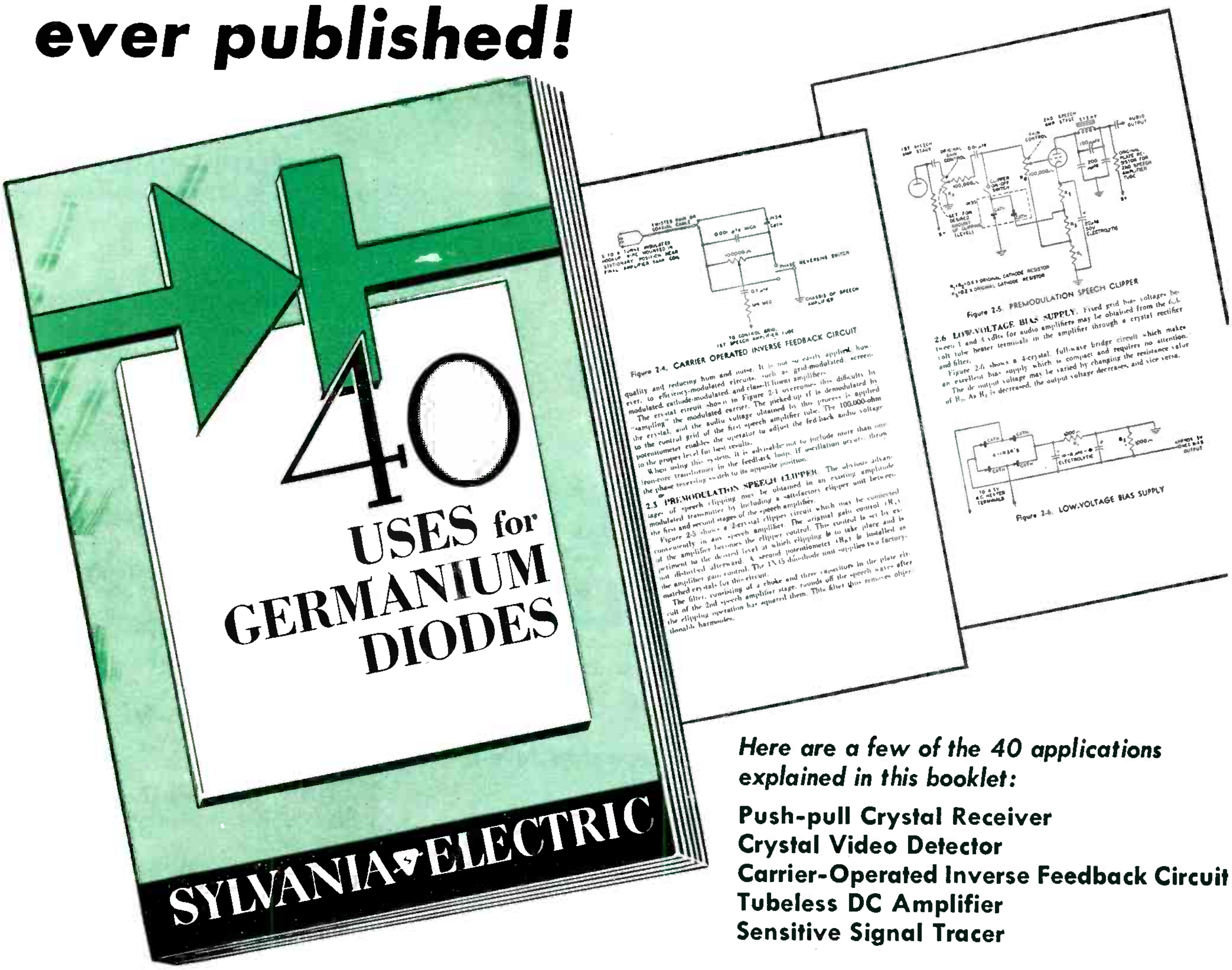
WE UNDERSTAND that RCA's Lancaster plant seals 500-kw tubes at 4 o'clock in the morning to avoid dimming the town's lights. The whole output of the laboratory's largest power supply is hooked to an induction heater for the job.

Fortunately for engineers who like to get home at night, the plant doesn't make one of these big bottles every day.

PUERTO RICO, with its attractive industrial tax exemption plan (p 60, Oct. 1950), has one active electronic equipment plant, the Rico Television Company, a subsidiary of Teletone. The company is assembling 1,200 table-type ra-

ENGINEERS, TECHNICIANS, HOBBYISTS—

Here's the most complete collection of Germanium Diode Applications ever published!



Here are a few of the 40 applications explained in this booklet:

Push-pull Crystal Receiver
Crystal Video Detector
Carrier-Operated Inverse Feedback Circuit
Tubeless DC Amplifier
Sensitive Signal Tracer

Sylvania's handy-sized book, "40 Uses for Germanium Diodes," presents for the first time all the most important applications of germanium diodes. In it, the engineer and technician will find time-saving devices and simplified circuits. Hams, hobbyists and experimenters will find plans for a host of interesting instruments and gadgets, from crystal receivers to voltage and frequency multipliers. Simple, clear explanations, plus more than 40 separate diagrams, describe germanium diode applications in receiver and transmitter circuits, instrument construction and electronic devices.

This book is full of new circuit ideas. It will save you time and money. It costs only 25 cents. Mail the coupon today with your quarter and your copy will be sent you at once.

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City ________ *Zone* ____ *State* ______ dios per day, will soon start trial runs on tv sets. Two other companies are reported ready to open tv plants as soon as station facilities are available. A recent FCC allocations report recommends that tv licenses be issued for the island.

Rico employs 100 workers, mostly native women, whose natural skill with a needle helps them learn the operations they perform in set assembly. The supply of labor is said to be nearly inexhaustible.

AIRCRAFT CARRIERS use more than 13,000 electron tubes, not counting those used in planes carried by the carriers.

SHIPBOARD ELECTRONICS accounted for 700 million dollars of the fiscal year 1951's defense appropriation. During the current fiscal year additional procurement up to 500 million dollars is planned.

AMONG NAVY ORDERS for conversion of various existing ships the following items appear:

12 destroyers to radar picket destroyers
6 submarines to antisubmarine submarines
4 submarines to radar picket submarines
1 submarine to guided missile submarine

In warfare, it looks like electronics is here to stay.

DRY BATTERIES have more than 1,000 military applications.

NICE SET OF SIMILES attributed to Sylvania's E. Finley Carter:

"Both electron tubes and human beings suffer from a small but significant mortality in early life. If they survive the early critical period their chances for a long life are good.

"Tube failure because of defects in other components, because of contamination, and because of old age may be likened to human mortality by accident, by epidemic, and through ultimate old age.

"Tubes, like humans, can be damaged beyond repair by overwork or overloading."

INFLUENCE OF ELECTRONICS: Rohm & Haas describes translucent plastic sheets intended to be inset into corrugated metal factory walls for lighting purposes as having corrugations with the "same frequency and amplitude" as the metal.

ELECTRONIC MOISTURE METERS are being widely used in the agricultural and food fields. Among the things for which Tagliabue (Weston) instruments are calibrated are

Almonds
Barley
Beans
Buckwheat
Corn
Corn Starch
Flaxseed
Hops
Oats
Peanuts
Pecans
Popcorn
Rice
Rye
Seeds
Sorghums
Soybeans
Vetch
Walnuts
Wheat

They are also calibrated for tobacco and for

Ash
Basswood
Birch
Cypress
Elm
Fir
Gum
Hemlock
Hickory
Larch
Magnolia
Mahogany
Maple
Oak
Pine
Poplar
Redwood
Shorea
Spruce
Walnut

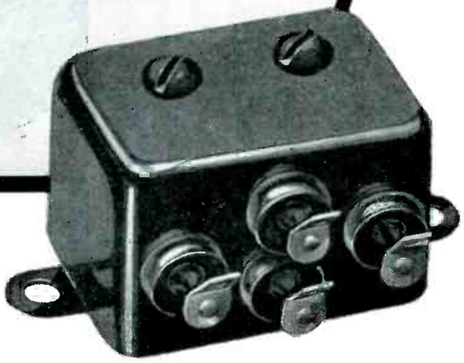
NEARLY 2 MILLION wire and tape machines have been sold since magnetic recorders were first offered commercially, according to Webster-Chicago's W. S. Hartford.

HOW'S THAT AGAIN: The National Labor Relations Board recently held that the Jefferson Standard Broadcasting Company of Charlotte, N. C., operator of WBT and WBT-TV, did not violate the Labor-Management Relations Act by discharging an employee who circulated handbills disparaging the stations' programs as second rate.

A FRIEND reports that he telephoned a company in our field late one evening and asked to be connected with the engineering department. There was a perceptible pause and then a feminine voice at the other end of the wire said: "Oh, you mean the *cone heads.*"
Precisely what the lady implied remains veiled in mystery.

NOW... another "first" from Mallory—

METALLIC RECTIFIERS FOR USE AT AMBIENT TEMPERATURES UP TO 400°F.



The new Mallory IH-R Series Magnesium-Copper Sulfide Rectifiers now make it possible for the first time to get all-around, satisfactory operation of metallic rectifier stacks at ambient temperatures as high as 400° F.

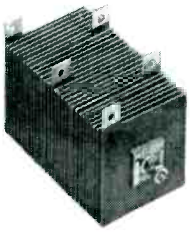
To deliver this long-sought performance, Mallory IH-R rectifiers are hermetically sealed in metal containers—a step that effectively solves the problem of protecting rectifier stacks when ambient temperatures are high. In addition, it is a complete safeguard against the dangers of humidity and atmospheric dirt or dust.

Only inorganic materials, fused seals and silver solder are used in Mallory IH-R rectifiers. Rectification heat is transferred both by radiation through the case and by conduction to the chassis on which the container is mounted.

Ruggedly constructed to withstand the stresses of acceleration and deceleration and other vibration, IH-R rectifiers are compact, suitable for use where space is at a premium.

Models now available will provide from 3 to 12 volts DC at ½ to 2 amperes and will operate over a broad frequency range up to 3000 cycles. For higher output they may be wired in series, parallel or series-parallel.

For complete details and technical data sheets on the new IH-R Series Magnesium-Copper Sulfide Rectifiers, call or write Mallory today.



Outstanding feature of Mallory Mg-CuS rectifiers is the fact that the rectifying junctions are self-healing. A wide range of industry depends on Mallory rectifiers for long, trouble-free service wherever DC power supplies are used . . . in battery chargers . . . electroplating applications . . . laboratory equipment. Mallory rectifiers have no liquids, bulbs or moving parts.

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ELECTRONICS....DONALD G. FINK....Editor...JANUARY, 1952

CROSS TALK

▶ **WRECK** . . . The train wreck in Wyoming last November, in which more than 20 people were killed, inspired the editor of the San Antonio *Light*, one of the Hearst chain, to write "the great challenge to communications science remains today exactly what it was five years ago—the perfection of a system of two-way radio capable of giving instant instructions to train crews when disaster is imminent".

Here we have an accurate statement of a need, but confusion as to modus operandi. This is not a challenge to communications science. The techniques are available, were available long before Mr. Hearst first wrote about the need in 1946. The problem is operational and economic, not technical. Railroad operators must find the economic justification for installation of equipment and training of personnel, suitable for accident prevention as well as more routine uses, and they must develop operational procedures which will prevent equipment or personnel failure when disaster impends.

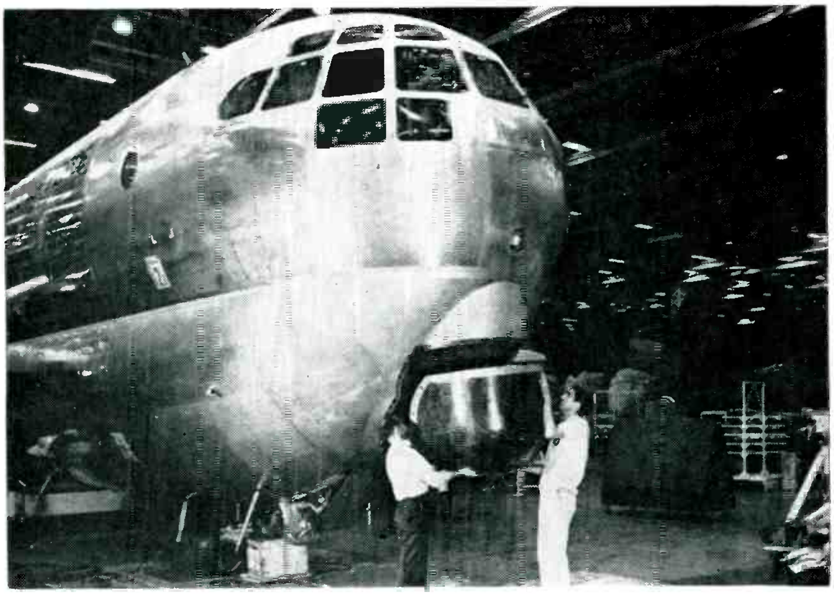
This is a costly business, but technically straightforward. The electronics industry is ready to offer a sound solution to the problem, but it needs a welcoming hand from the railroaders, not "we can't possibly pay for anything like that!" The need for some kind of electronic disaster-prevention control is evident; it has already been accepted and paid for by passenger-carrying ships, and a start has been made in a very much more difficult medium, air travel. Lives of rail passengers will no doubt continue to be lost while economic roadblocks stand in the way of the fruits of existing technology.

▶ **FIGURE** . . . A reliable Defense Department source informs us that the money appropriated and spent for electronic equipment and installations by the Armed Forces has amounted to $6 billion during the period December 1949 to July 1951, an average of about $4 billion a year. It is dangerous to compare this figure with previous allocations and expenditures which may have been arrived at on a different basis. But we are reminded that the peak expenditure in World War II occurred in 1944, and the figure then was $4.6 billion for the year. Moreover during the 1949-51 period mentioned, we had a civilian economy in electronics virtually unaffected by defense demands. We've come a long way, friends, since 1944 and the end is not in sight.

▶ **MINOR MIRACLE** . . . At the Toronto Fall meeting, W. B. Whalley described a new vertical-deflection circuit for tv sets that has greatly improved linearity and, mirabile dictu, costs *less* than conventional circuits. This is a very rare occurrence indeed among circuit designers and one worthy of special mention. For years tv set designers have been unwilling to spend money on stabilization of vertical linearity because the performance of tv broadcasters in this respect is so poor that the set owner would never know the difference. But if it *saves* money, that's different. We can't hope for many minor miracles like this, but we can emphasize the suspicion that at the average tv station the equipment is not as well adjusted, in scanning, as the sets that are tuned to it, and this condition acts as a strong brake on improvements in set design.

▶ **FAITH** . . . In a description of the Canadian atomic pile at the Chalk River (*Physics Today*, November), we find the statement that Friday afternoon is the busiest time around the pile, because the physicists are then setting up their electronic counting and recording apparatus to work for them on a long run over the weekend. Then follows, "This implies faith in the reliability of electronic apparatus which has been won only by much attention in design and maintenance specifically directed towards achieving reliability".

For the faith, we give thanks, even if the faith of a physicist is more readily won than that of the manager of a steel plant. To the prescription of "much attention in design and maintenance" we say, Amen! And if physicists can do it, so can anyone else who goes about it with care and understanding.



PROTUBERANCES Though still permitted on relatively slow planes such as this Boeing-made C-97 Stratofreighter, all protruding antennas and radomes are much deprecated for travel at speeds approaching or exceeding Mach 1

Aircraft Plants

By JOHN MARKUS
Associate Editor
ELECTRONICS

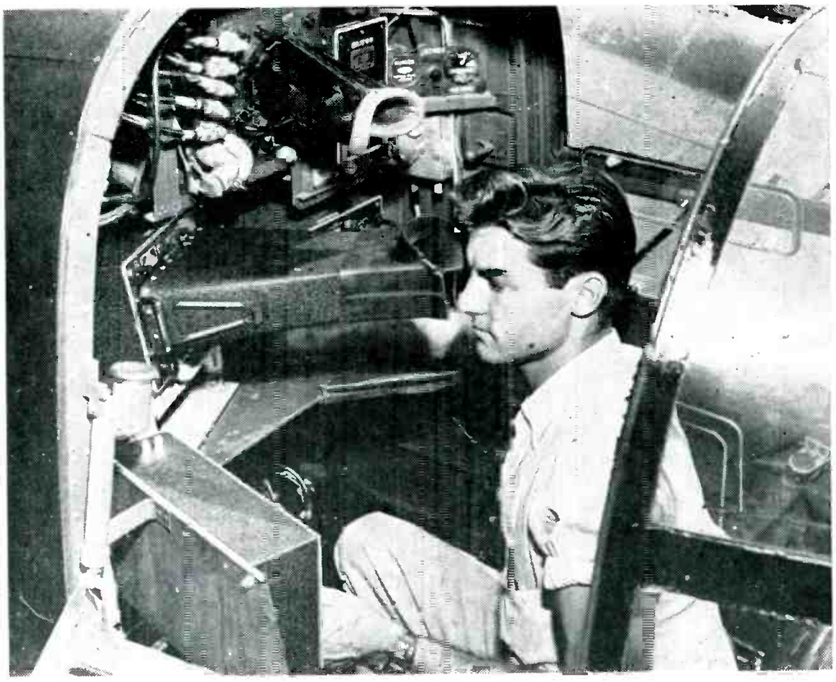
AT SUPERSONIC SPEEDS, things happen so fast in a military airplane that automatic devices become essential for the control of flight and fighting. Target-finding, gun aiming, gun firing, bomb aiming, bomb guidance, identification and navigation are just a few of the functions relegated to electronic equipment in modern planes. These electronic systems are so complex and so integrated with each other that they must be designed into the plane rather than shoved into or stuck onto a finished airframe.

The new electronic systems requirement has caused airplane builders to hire more electronic engineers and establish electronic research and development departments. In most cases these new departments work on an equal basis with older aerodynamic, weight, stress, and power plant groups. This is both fitting and essential, because in many planes currently in production the electronic equipment represents well over a quarter of the total cost. The electronic requirements of aviation, building up gradually from the simple black-box radios of the first world war, today represent a new branch of electronics second to none in importance, size and dollar value.

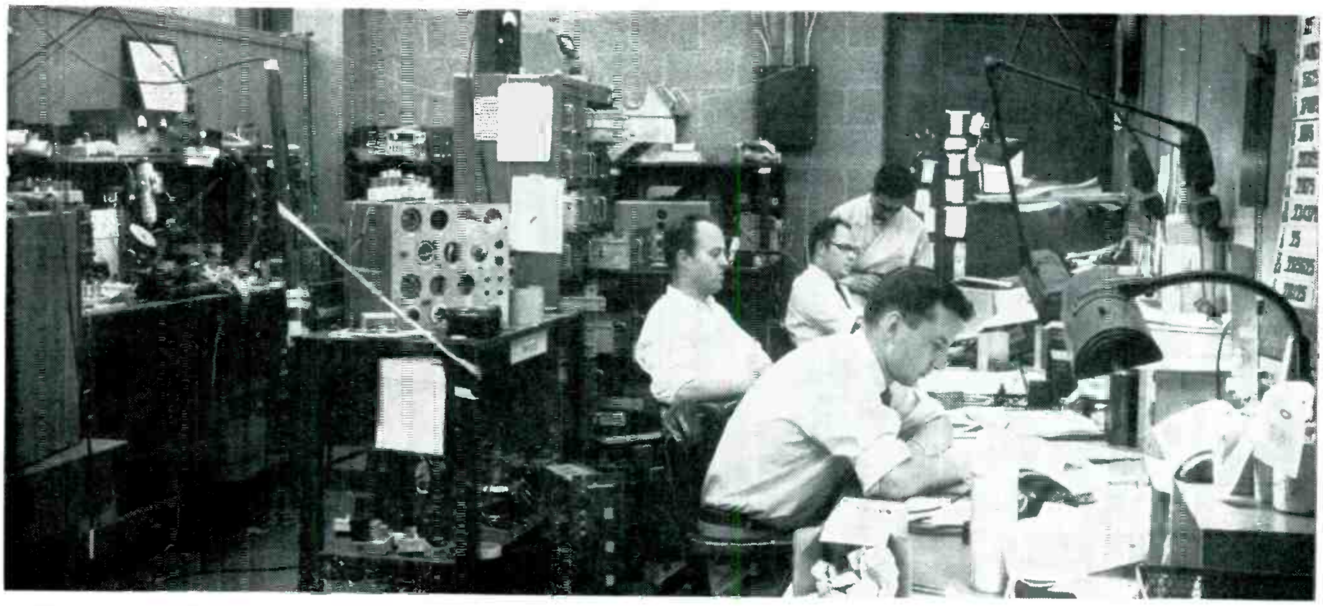
Early Black Boxes

In the days of the Jenny, De Havilland, Spad and Nieuport fighters, the aircraft manufacturer turned out plain and simple airplanes and a pilot flew by the seat of his pants. When weather was bad he stayed on the ground because he couldn't see the enemy anyway.

The advent of two-way aircraft radio along about the end of World War I did not change the plane-building picture. The military airframe manufacturer still turned out pure airplanes and the electronic engineer designed and built the black boxes separately. Installation, done by squadron crews, involved mounting the trailing-wire antenna reel outside the fuselage within reach of the pilot and supporting the transmitter and receiver black boxes inside the fuselage with shock cord and springs, plus elaborate shielding of the engine ignition system. The radio installation belonged to the squad-



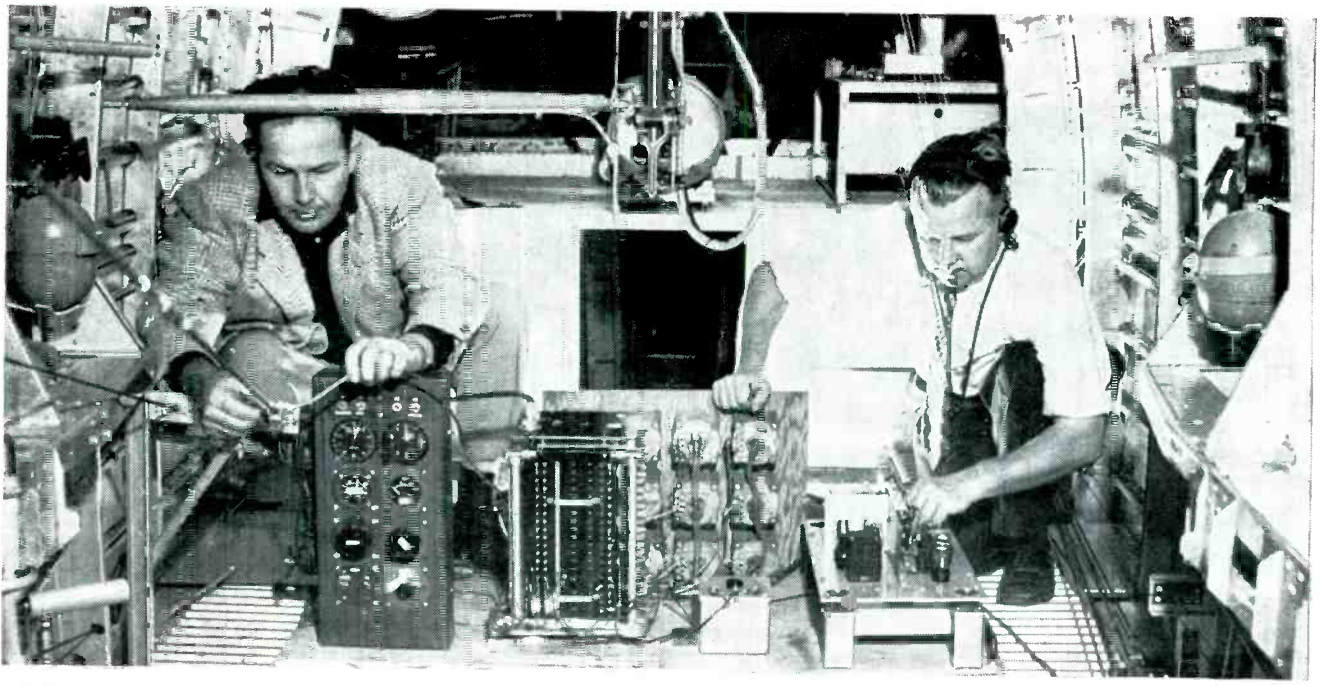
RADAR CHECK Final on-the-ground check of radar equipment in radar observer's station of Northrop Black Widow F-61 night fighter



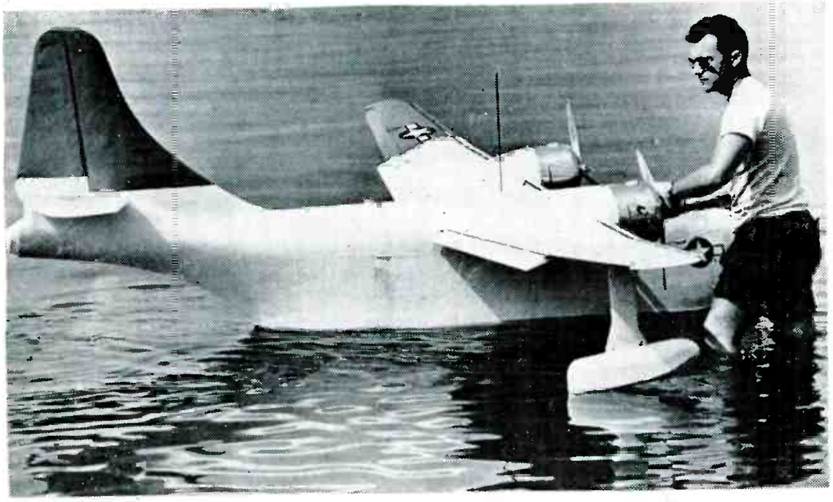
COMPUTER TEAM Electronic engineers make extensive use of analog computers to replace try-and-see or crystal-ball techniques for finding out whether a proposed new idea will work. Here evaluation group for experimental analog computer at Cornell Aeronautical Laboratory converts computer readings into yes-or-no decisions for new airborne electronic control designs

and Electronic Engineers

The Korean invasion accelerated transfer of responsibility to aircraft manufacturers for performance of electronic gear in fighting planes, forcing them to recruit more electronic engineers. Today these transplanted engineers do a variety of jobs



IN-THE-AIR TESTS Convair electronic engineers install a pressure-survey panel and strain recorder in B-24D in preparation for flight tests that involve checking of airframe performance as well as electronic gear



RADIO-CONTROLLED MODEL Free-flight radio-controlled models such as this are used extensively at Consolidated Vultee Aircraft Corporation's San Diego labs to facilitate solution of many Convair hydrodynamic design problems. For many electronic engineers, assignment to the radio control group is play combined with work

ron and stayed with the squadron when the airplane was transferred.

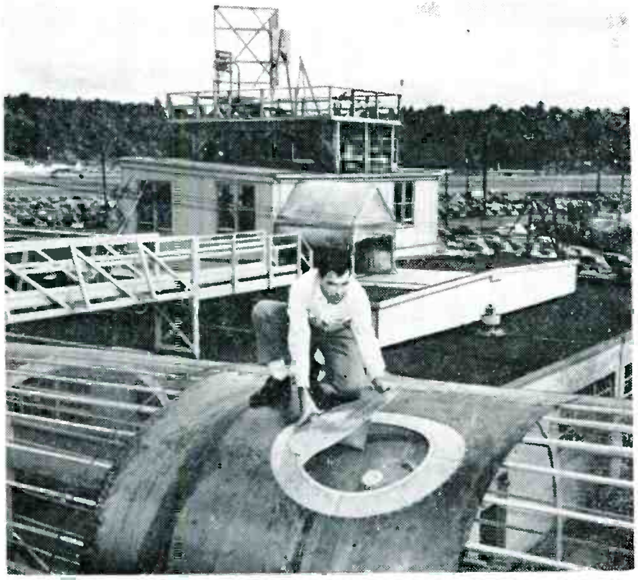
The Radar Era

During World War II, electronic engineers largely stayed in their own factories while aircraft manufacturers produced and delivered standard military airplanes having only the minimum electronic equipment need for flying. This had the advantage of keeping aircraft production rate high because production was independent of the frequent changes in electronic equipment design. The airplanes were fitted with final equipment at one of twelve or more modification centers, most of which were also operated by aircraft manufacturers.

Increasing complexity of airborne electronic gear emphasized the many drawbacks of the modification-center technique. There was a tendency toward laxness because the responsibility for installing, adjusting and flight-testing was held by the military. More important was impairment of airplane performance by addition of radome and antenna protruberances, by addition of weight at locations not considered in original design and by addition of generators that robbed engines of badly needed power. Worse yet, there were many cases where bombing radar had not even been considered in basic design, with the result that a gun turret or other major structure was located at the optimum location for the bombing radar antenna. Finally, there was little or no channeling of essential airframe design changes back to the airframe manufacturer, hence correctable errors went uncorrected. In a nutshell, there was little liaison and cooperation among airframe designers, electronic equipment designers and the engineers who had to squeeze the electronic gear into or onto the plane.

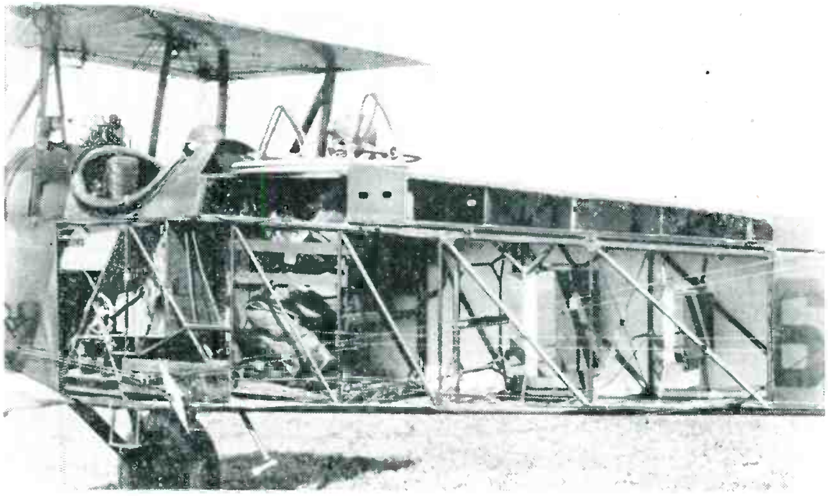
The Turning Point

Modification centers were terminated at the end of the war in 1945, and all their work was given to aircraft manufacturers to help keep staffs going. This was the beginning of the exodus of electronic engineers from their own plants into aircraft factories. But the transition in responsibility for installing and checking out electronic



ANTENNA MOCKUP For testing performance of flush-mounted antennas, wire mesh is as effective as regular aluminum airplane skin. Boeing engineer Michael Schwartz is here fitting such an antenna on a full-size mockup of the Boeing B-47 Stratojet bomber. Structures in background check radiation patterns of scale-model antennas on scale-model planes

PRODUCTION Though most airborne electronic equipment still comes from electronic manufacturers, small runs of a newly designed unit are at times produced right in the aircraft plant. Here chief electronic engineer J. M. Pearce (right) and electronic design engineer H. W. Royce look over some of the equipment turned out in The Glenn L. Martin Co. Baltimore plant equipment was not an overnight affair with every manufacturer. Some companies started by taking over the responsibility for bench tests of military electronic gear, then graduated to in-the-plane tests and finally to flight tests. Radar was the last of the electronic gear to come under the responsibility of the aircraft manufacturer's electronic engineers, even though radar antenna requirements have the most effect on airframe design. The gradual transition, limited pre-Korean production of military aircraft and inherent reluctance of long-established aircraft manufacturers to change their thinking overnight all still served to hold down the migration of electronic engineers.



EARLY BLACK BOXES Experimental installation of Radio Set SCR-134 in De Haviland two-seater fighter about 1926, using coil springs instead of shock cord to support the two boxes in fuselage space behind machine-gunner. Vibration was so great that they went back to shock cord. Weighted trailing-wire antenna was lowered through slanting pipe under gunner's feet—Air Force Photo

Korean Stimulus

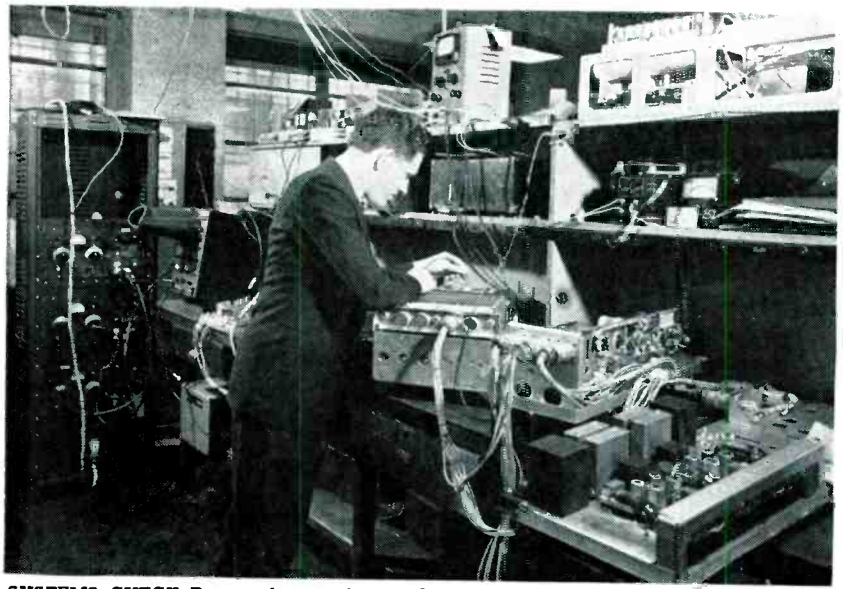
Military aircraft orders built up in volume rapidly after UN troops entered Korea. These orders gave complete responsibility to aircraft manufacturers for installation and performance of all electronic equipment, and some even involved electronic research and development. Thus was created an urgent need for electronic engineers in aircraft plants. Intensive recruiting campaigns brought results, and today these engineers are firmly established in a variety of jobs all contributing to the design and production of better military aircraft. The illustrations in this article show some of these engineers at work.

The Air Force today wants all-weather fighting planes, usable day and night when needed, regardless of fog, snow, rain and other weather conditions that conceal the target and the landing runways of home base, and regardless of atmospheric static that formerly interfered with radio communication.

The primary job of the electronic engineer is to open up the dark and zero-ceiling fog hours to flying and fighting. For each pound of electronic equipment added for this purpose, the gross weight of the plane must be boosted as much as 7.5 pounds to get the same range and pay load, hence counting the ounces has become a new instinctive reaction for the electronic engineer in an aircraft plant.

The electronic industry has gained tremendously by closer contact with the aircraft industry, because no aircraft plants produce all their own electronic equipment. A few may turn out pilot models or even small model-shop runs of a special electronic unit, but large production orders are usually farmed out to the electronic industry either by the aircraft manufacturer or the military purchaser. Guided-missile manufacturers are generally authorized to build their own electronic equipment, but only because standard black-box units for missile control are not yet available.

By finding ways to improve the usefulness of existing electronic black boxes and by helping to develop improved or new units, the transplanted electronic engineer is also helping the military and the aircraft industry to match the production figures of the last war, even though the fighting plane of today is vastly more complex than ever before.



SYSTEMS CHECK Rare today is the single-chassis airborne electronic unit. Many units must be hooked together each time an advanced development is checked, as is being done in this electronics lab at The Glenn L. Martin Company's plant in Baltimore. Interconnection of systems, layout and shielding of wiring, layout of equipment so units cannot bump each other and provision for clearance needed to remove units are just a few new duties of the electronic engineer

Standards Conversion

By V. K. ZWORYKIN and E. G. RAMBERG

RCA Laboratories Division
Radio Corporation of America
David Sarnoff Research Center
Princeton, New Jersey

With different television standards in various areas of the world, converting picture signals from one set of standards to another is a problem requiring an early solution.

It is most urgent in those areas within reach of stations operating on different standards and, in the long term view, to meet the future need for direct exchange of programs between continents. In most contiguous regions, the difference between standards affects only the line frequency, but there are instances where the frame frequency differs as well.[1]

The present discussion deals specifically with problems raised by program interchange between stations operating with 525 lines, 60 fields interlaced and with 625 lines, 50 fields interlaced—the standards prevalent in the western hemisphere and most countries of continental Europe, respectively.

There are, in principle, two different approaches to the problem of conversion; namely, recording of the program and subsequent retransmission and the continuous and immediate translation of the picture signals from one set of standards to the other with the aid of suitable storage devices.

Only the first of these is at present capable of yielding satisfactory reproductions. Furthermore, motion-picture film is the only recording medium which has proved practical so far. With high-speed film development, delay between reception and retransmission need only be a minute.

Photographic Recording

The intermediate film technique is simplest for the transition 525/60 to 625/50. For this purpose it is sufficient to employ standard film-recording equipment[2] which produces 24 frame-per-second positive film by photographing the 60-field-per-second negative image on the face of a suitable picture tube, blanking every sixth half-field for proper pulldown as required.

The time division for this process is shown in Fig. 1. An electronic counter is employed to control the exposure in such fashion that exactly 525 lines are scanned for every exposed frame. This prevents banding at the center of the picture. The sound may be recorded directly on the film with the picture or may be recorded separately.

The film obtained is standard 16-mm film and could be reproduced with any 16-mm film-scanning equipment designed for 50-field-per-second transmissions. The pitch of the sound will be increased in the ratio of 25/24, but this is not regarded as objectionable in practice and applies quite generally for normal transmission of standard 35-mm sound film on 50-field-per-second television systems.

The transition from 625/50 to 525/60 offers somewhat greater difficulties, but here, also, the necessary equipment is available. A Cameflex Eclair camera[3] synchronized with the received 50-field-per-second signal may be employed to produce a $16\frac{2}{3}$-frame-per-second negative film by photography of a kinescope face, every third field period being utilized for pull-down. Figure 2 shows the time division.

This film is then printed so that

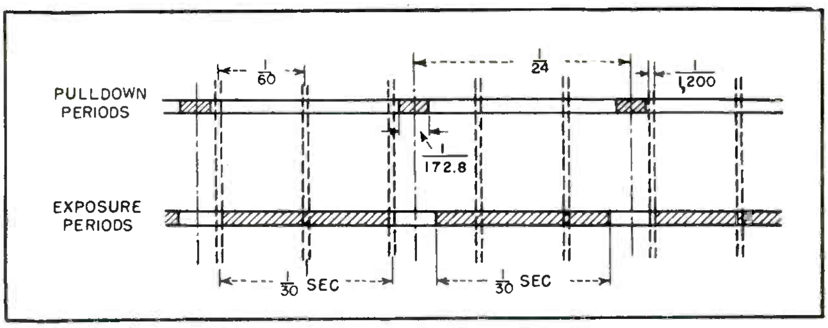


FIG. 1—Time division for recording 60-field-per-second transmissions on film

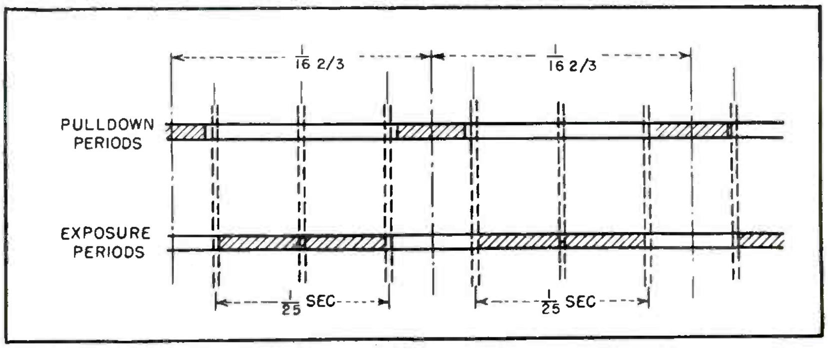


FIG. 2—Time division for recording 50-field-per-second transmissions on film

# of Television Signals

Although there are a number of techniques for converting picture signals from one set of standards to another with a different frame rate, such as from 625/50 to 525/60, they all possess some inherent drawbacks. The intermediate-film process and instantaneous methods are discussed and remedies suggested

every second frame is recorded twice, such printers being available at present for the conversion of 16-frame silent film into 24-frame sound film. Sound must be recorded separately and may also be printed on the resulting 25-frame-per-second positive film. As an alternative, the step-printing can be carried out in the camera itself and the sound be recorded directly on the positive.[4] The resulting film may be employed in standard American television film scanners. The pitch of the sound will be lowered in the ratio 24/25.

Techniques also exist for recording 25 frame-per-second film directly from 50 field-per-second transmissions without loss of interlace. These employ continuously moving film. Thus, in a modified Mechau optical compensation projector[4] the tilting of a mirror on a rotating drum holds the image of the kinescope face stationary on the moving film for the course of a frame time; the next mirror on the drum transfers the image to the next frame on the film.

In another system, the so-called split-field method, the picture is formed, compressed to half-size in the vertical direction, on the screen of a flying-spot tube.[5] Two alternative optical paths, for odd and even interlaced fields respectively, are provided for imaging the picture on the film. A rotating shutter selects one or the other in alternate fields. The reduced vertical deflection on the tube screen and the motion of the film combine to record the picture on the film with the proper ratio of height to width.

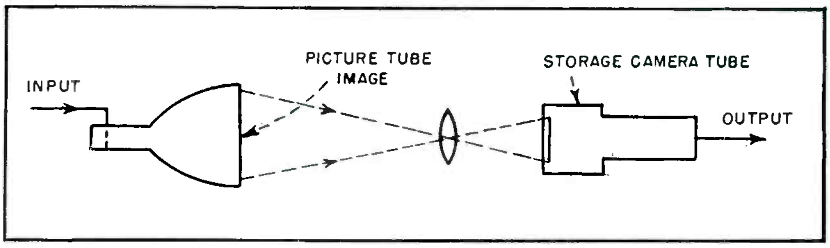


FIG. 3—System for instantaneous conversion of picture signals to different standards

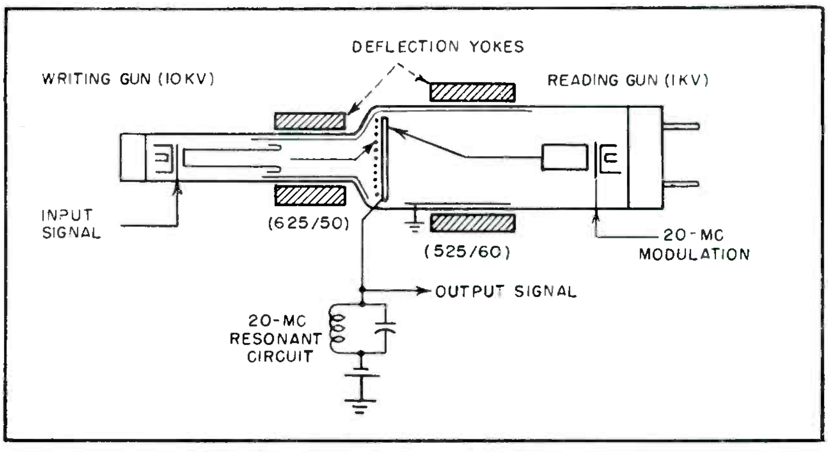


FIG. 4—The Graphechon as standards converter. The writing beam produces bombardment conductivity in the screen-supported insulating target

In all cases it is desirable to take special care that line structure is absent from the recorded images. In the presence of line structure, interference between the two scanning patterns can give rise to a system of horizontal bars in the picture; the frequency of this brightness modulation will be $(625 - 525)/2 = 50$ per field time, so that the bars will be 1/50 picture height or some 10 to 12 scanning lines apart. (In practice, vertical blanking will slightly reduce the number of bars observed and increase their separation in terms of picture height.) This effect may be rendered negligible without appreciable loss of picture resolution by applying a small-amplitude high-frequency vertical spot wobble to the kinescope scanning beam.

Time Difference

In principle, neither transformation can be carried out without time delay, since the rates of transmission of the original program and of the prepared film differ. Thus a continuous hour-long broadcast which is transformed to the 625/50 standard would take only 57.6 minutes to rebroadcast; the initial time delay between broadcast and rebroadcast would hence have to be 2.4 minutes plus the time required for preparing the film. In the opposite direction the delay between broadcast and rebroadcast would

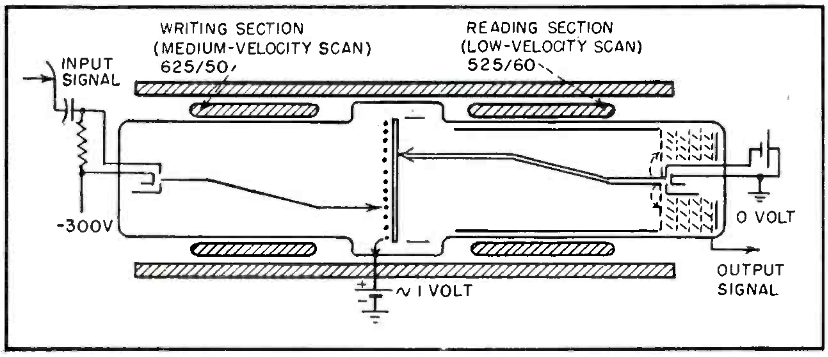


FIG. 5—Standards converter with image-orthicon-type reading section

increase by 2.5 minutes between the beginning and the end of the program.

A more serious objection to the intermediate film process is the great care demanded in the control of development to prevent undue distortion in the transmitted picture signals. Some loss of picture detail is also inherent in the photographic process, and particularly with the type of 16-mm film which is today most widely used for video recordings.

Immediate Conversion

Instantaneous methods of signal transformation necessarily involve storage of the original signals (the written signals) for periods of the order of the rebroadcasting frame time (the reading period). If existing devices are to be employed, the storage may be supplied by a storage-type camera tube; the original picture, reproduced on the face of a kinescope, is imaged on the photosensitive surface of this tube (Fig. 3).

The interposition of a viewing screen between the picture tube and the camera tube may be convenient for checking the adjustment of the kinescope image, but only adds to the deterioration of the final picture. By contrast the use of a storage tube, such as the Graphechon[6], as a standards converter has the advantage of eliminating the optical imaging process. Here a charge image is traced out on a target by a writing beam controlled by the original picture signals and this is, in turn, read off by a reading beam to provide picture signals on the new standards (Fig. 4).

Instantaneous conversion between standards with equal field rates and different line rates has been discussed[7] and some difficulties have been pointed out. These are:

The superposition of the written signal on the read signal.

Interference effects between the two scanning patterns.

Variation in stored signal, depending on the relative instantaneous position of writing spot and reading spot.

Weakening and distortion of the transferred signal by redistribution in the camera tube, such as the iconoscope and image iconoscope, in which storage of the written signal is not saturated.

The last consideration renders tubes of the iconoscope and image iconoscope type unsuitable as storage tubes in conversion systems.

Remedies

Ways in which the other difficulties may be overcome in the conversion between standards with equal field rates have also been indicated. In orthicons, vidicons, and graphechons, in which the output signal is obtained from the signal plate of the target, separation of output and input signals may be effected by high-frequency modulation of the reading beam and the insertion of a corresponding band-pass filter in the output circuit; in the image orthicon or any other storage tube in which the reading signal is separately derived from a collector or electron multiplier (Fig. 5) this is unnecessary.

Interference between scanning patterns may be eliminated by minimizing line structure in the written image, eventually by supplying an appropriate high-frequency vertical wobble to the writing beam.

The variation in the transferred signals with relative position of reading and writing spot can be minimized by establishng a large phase difference (for example, ½ field period) between the vertical deflections of the reading and writing beams.

The remedies, with the exception of the last, apply also if the standards differ in field frequency as well as in line frequency. The difference in the field period now causes a continuous change in the relative phase of the writing and reading spots. This is accompanied by intensity fluctuations in the image whose nature depends on the dimensioning of the writing and reading spots.

These will be examined next, with special reference to a uniformly illuminated object field. In addition, it will be noted under what circumstances the resolution conveyed by interlace is preserved.

It is assumed that writing storage is complete for times of the order of a frame period of the writing beam, that erasure by the reading beam is complete, and that the writing process is instantaneous. This signifies, in the kinescope-camera tube conversion system, that the decay time of the phosphor is small compared to a field period of the reading or writing process, whichever is shorter.

The simplest conditions are realized if both the writing spot and the reading spot are given (eventually by spot wobble) a vertical height just equal to two line widths. This is the only condition for which a flat object field gives rise throughout to individually flat image fields and for which, furthermore, the resolution conveyed by interlacing is preserved for a single frame.

The relationship between the writing and reading spots for signal transformation between 525/60 and 625/50 standards may be represented by Fig. 6. The horizontal scale here represents time, the vertical scale, the vertical position of the writing spot (broken line) and reading spot (full line) on the scanning pattern. The arrows indicate the interval between storage (writing) and erasure (reading) of the picture signals.

The basic period of repetition is ⅕ second, corresponding to the frequency difference between the two frame frequencies. Successive subperiods of 1/10 second are not identical. To consider a single such subperiod, for all but the first reading field the picture signals are provided simply by the preceding writing field; furthermore, odd and even writing fields provide signals for odd and even reading fields, respectively. The first reading field, however, derives its signals from the sum of the two preceding fields for the transformation 525/60 to 625/50 and is entirely free of picture signals for the transformation 625/50 to 525/60.

Every fifth field of a reproduced 50-cycle picture has double brightness, every sixth field of a reproduced 60-cycle picture is black. It must be anticipated that this jump in picture brightness, with a repetition rate of 10 cps, will prove disturbing to the viewer. Since the 50-cycle system and 60-cycle system are not synchronized, the phase of the anomalous field period will tend to drift, rendering correcting measures difficult. It will not coincide exactly with one scanning field as in the figure, but be distributed in some fashion between two successive reading fields.

Interlace Resolution

In the next succeeding subperiod of 1/10 second, odd writing fields produce the picture signals for even reading fields and vice versa. It can readily be demonstrated that this inversion in the relationship of the interlaced fields leads to a loss of the vertical resolution resulting from interlacing.

For example, suppose that the original picture consists of 263 odd black lines and 262 even white lines. Then, in the first subperiod odd lines of the reproduced 625/50 picture will be black, even lines white; however, in the next subperiod the odd lines will be white and the even lines black, so that, averaged over a full ⅕-second period, the picture will appear a uniform gray.

The loss of interlace resolution and the presence of the low-frequency field flicker described above clearly render a system employing double-width reading and writing spots unusable for practical use.

When, instead, a single-line-width writing spot is employed in conjunction with a double-width reading spot, the only change which results is that, now, a bar moiré (with a period of 1/50 picture height) appears in the individual field. For rectangular spots with uniform distribution the fluctuation amplitude for a transition from 625/50 to 525/60 may be shown to ±16 percent for a single field; for a frame it is reduced to half this value and averaged over the entire period of ⅕ second it vanishes. Loss of interlace resolution and 10-cps field flicker occur as in the preceding example.

With a double-width writing spot and a single line width reading spot, interlace resolution is lost even for a single frame; on the other hand, the intensity, for a flat object field, is reduced, for the transition 625/50 to 525/60, to half on two fields in each 1/10-second subperiod, instead of to zero on one of them.

Figure 7 shows a diagram corresponding to Fig. 6 which applies to this example. The charge patterns on the storage tube target are represented in Fig. 8; shaded areas represent the signal taken off in the indicated reading field.

Improved Resolution

Evidently, the preservation of interlace resolution is not consistent with the reproduction of a flat object field by individually flat image fields or image frames when the field frequency is changed, provided that our general assumptions regarding full storage, complete erasure, and instantaneous writing are fulfilled. Consider, then, the intensity variation in the image

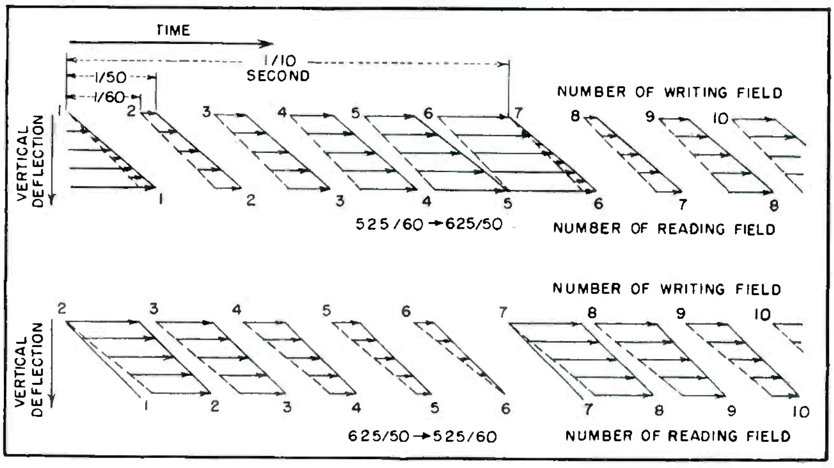


FIG. 6—Relationship between writing and reading process when double-width reading spot is employed

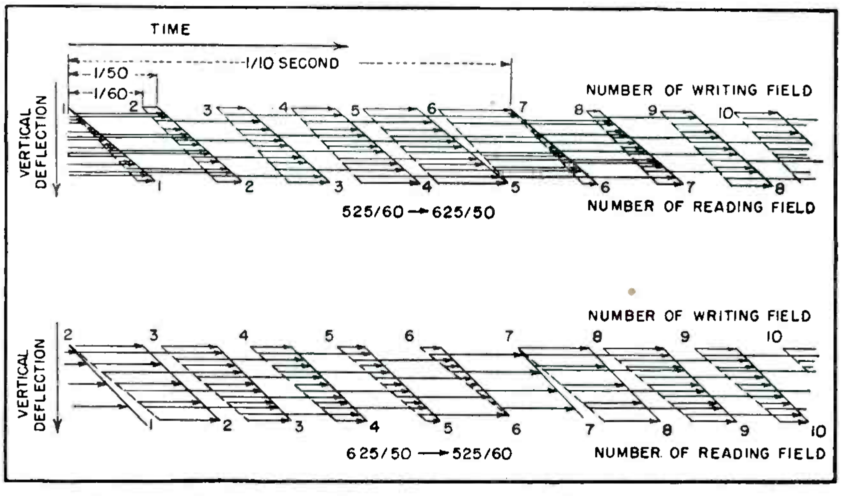


FIG. 7—Relationship between writing and reading process when single-line-width reading spot is employed

which may be expected with rectangular writing and reading spots whose vertical extent is exactly equal to a line width. Interlace resolution is now preserved.

The picture signals obtained for a sequence of 12 reading lines and an equal number of reading fields (constituting one complete ⅕-second period) are shown in Fig. 9. This chart indicates: The average intensity for two fields out of six is reduced to half that of the remaining fields, as for the last example. The four normal fields are flat; in the two anomalous fields the line intensity fluctuates approximately in the ratio of 5:1. Averaged over a full ⅕ second period, the line intensity is constant.

In brief, interlace resolution is purchased at the cost of a fluctuating intensity variation within the image (with a periodicity of 1/50 picture height) added onto the field flicker which is observed in systems with double spot width. This probably represents the best compromise which can be achieved under the assumed conditions.

The effect of incomplete storage, such as might be present with a leaky camera tube target, can most readily be recognized with a diagram like that in Fig. 6. It shows that the picture signal would decrease with increasing length of the arrows shown. Thus, for the transition 525/60 to 625/50, there would be a gradual decrease in intensity in the course of a 1/10-second subperiod, terminated in an abrupt increase; for the transition 625/50 to 525/60, there would be instead a gradual increase in image intensity terminated by an abrupt drop to zero. This should prove more disturbing than the contrast variation with perfect storage. Interlace resolution would be lost as before.

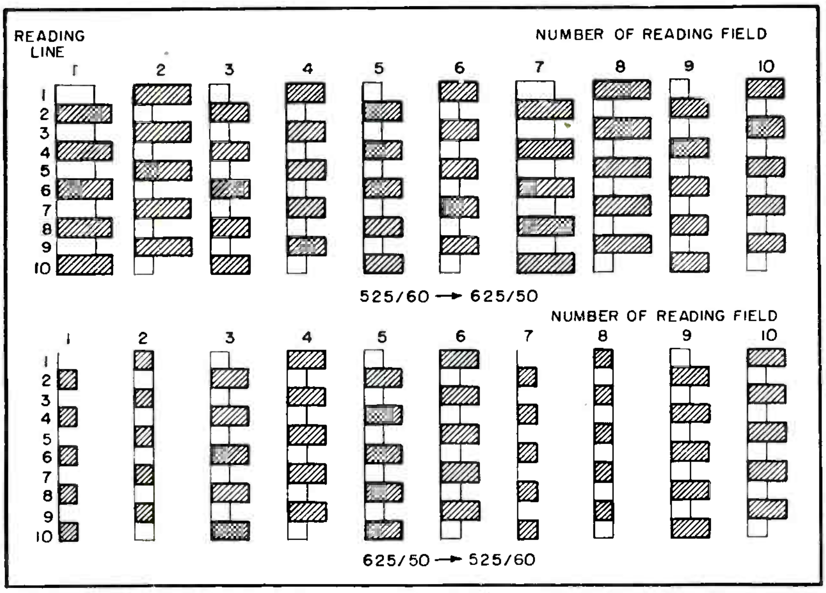


FIG. 8—Picture signal (shaded area) and charge left after reading (clear area) for flat object field when double-width writing beam and single-line width reading beam is employed

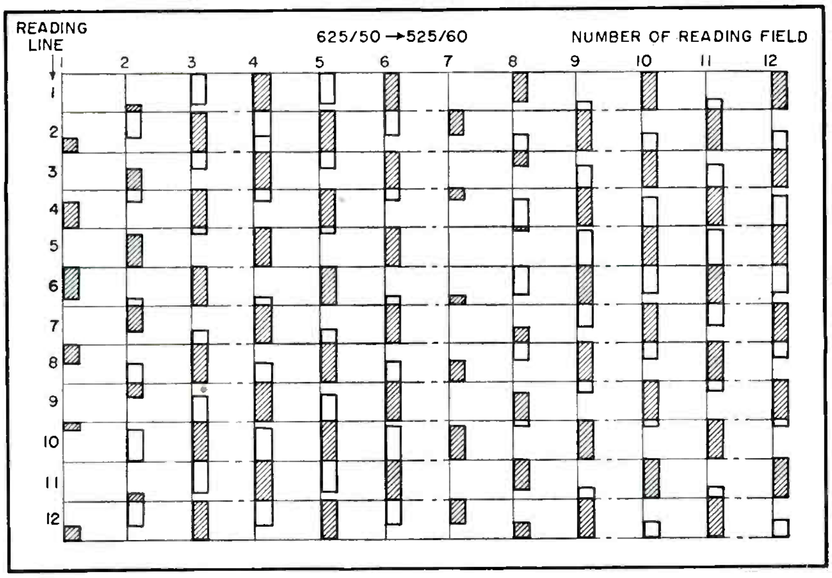


FIG. 9—Picture signal (shaded area) and charge left stored (clear area) for flat object field when single-line-width reading and writing spots are employed

Incomplete erasure by the reading beam would cause trailing for moving objects; at the same time it would reduce somewhat the amplitude of the intensity fluctuations.

If the writing process is not instantaneous, but persists for an appreciable fraction of the writing frame period (as the result of the persistence of the picture-tube phosphor in a kinescope-camera tube converter) the amplitude of the intensity fluctuations also is reduced. Trailing will be observed if the persistence exceeds a frame period. Since phosphor decay is not abrupt, but gradual, some trailing will be noted if the decay is made slow enough to greatly reduce the field and bar flicker which is observed with a rapidly decaying phosphor.

Flicker

All flicker effects could be removed completely if the writing-spot brightness would remain unchanged for an entire writing frame period and would then be corrected to take on its new value. In this case the reading and writing process for a flat object field might be represented, for the transition 625/50 to 525/60, by the diagram in Fig. 10. The broadening of the arrows symbolizes the increase in stored charge in the period intervening between successive erasures by the reading beam. The time relation between the writing process and reading process has here become entirely irrelevant.

The writing portion of such a

conversion system has the basic properties of a storage kinescope, whereas the reading portion may be any pickup system, of a storage or nonstorage type. The usefulness of such a device for standards conversion, as well as the possibility of its realization, have been recognized by Schröter.[8]

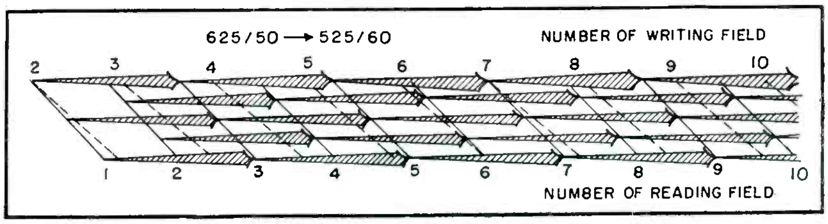


FIG. 10—Relationship between writing and reading process in converter consisting of storage kinescope and storage camera tube (single-line-width reading and writing spots)

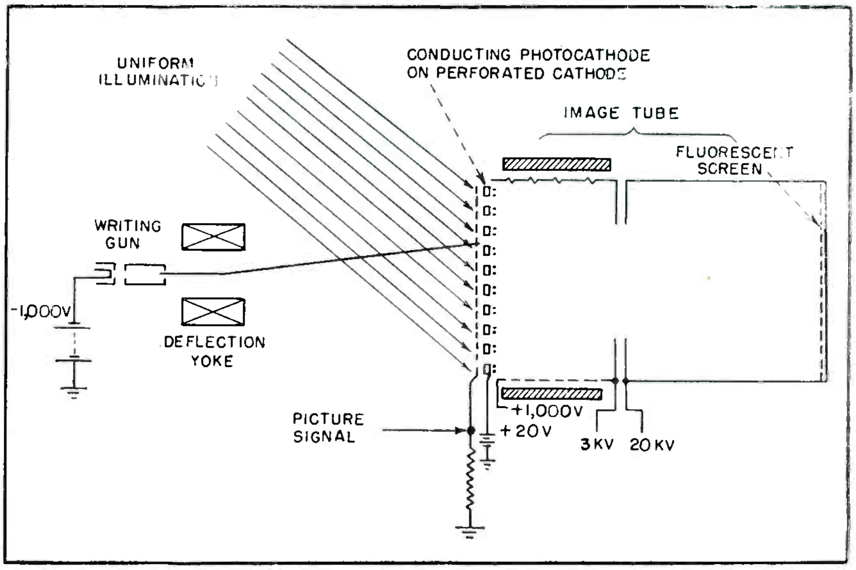


FIG. 11—Principle of storage kinescope (Schroter)

Proposed System

In the arrangement proposed by Schröter (Fig. 11) the electron emission is provided by a uniformly illuminated, extended conducting photocathode which is deposited on a perforated insulating sheet. As the insulator is scanned by a medium-velocity constant-current beam, a closely spaced collector grill (or transparent conducting film) is modulated by the writing picture signals. As a result, the insulator spot scanned at any moment tends to assume (by distribution of its secondary emission) the instantaneous potential of the grill.

In this manner an essentially stationary charge pattern is generated on the insulator, changes occurring only as there are changes in the transmitted scene. This charge pattern controls the emission of the photocathode by coplanar grid action—field leakage through the insulator perforations. The remainder of the storage kinescope is essentially an image tube.

Schröter has suggested the transformation of this system into a standards converter by replacing the fluorescent screen by an aperture and multiplier and providing transverse deflecting coils actuated at reading line and field frequency. The reading portion is here simply an image dissector. The instantaneous potential of the grill would influence the photoemission, resulting in a superposition of the writing signals on the reading signals. This would be most serious with the nonstorage (dissector-type) reading section here contemplated, but spurious intensity fluctuations dependent on picture content would occur also if the reading portion of the converter were an image orthicon, provided that a change in field frequency is involved.

There are other systems involving the storage kinescope principle from which this crosstalk could be eliminated. However, the perfection of these devices meets considerable technical difficulties and none of them have been tried so far even on an experimental basis. However attractive they are in principle, they do not constitute a means of solving the problem of standards conversion at present or in the near future. This approach is not neglected; work on the development of new types of standards converters is in progress.

At the present time there are just two methods of standards conversion between systems with different field frequencies:

The intermediate film method, which is fundamentally capable of yielding good results, but will introduce serious picture deterioration unless great care is exercised in controlling the photographic process and the instantaneous method of signal conversion, utilizing a picture tube and camera tube, which inevitably introduces a certain amount of objectionable low-frequency flicker. Storage-tube converters utilizing tubes of known type are subject to the same drawback. The employment of long-persistence phosphors in the kinescope would reduce the flicker effects to some extent; but their practical elimination by this means would also lead to trailing effects on moving objects.

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Tomato Classification

The Agtron, photoelectric bridge spectrophotometer designed for grading tomatoes by color

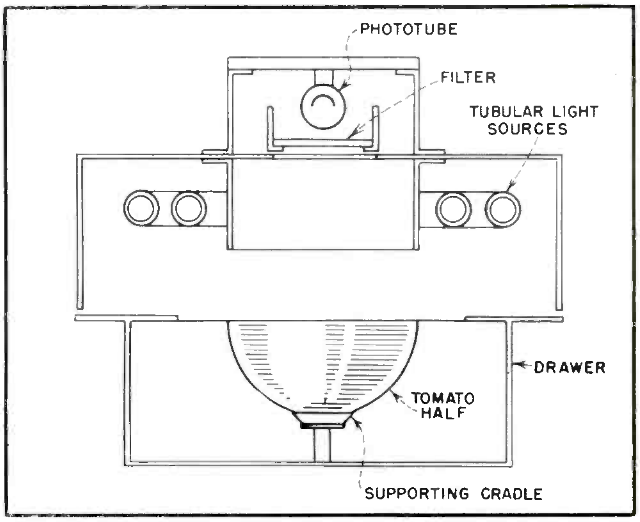

FIG. 1—Cross-section of the light source and phototube assembly for the instrument

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WHEN TOMATOES are delivered by the grower to the canning plant they are usually inspected by a state or state-federal inspector for various factors, including color. The grading is based on a random sampling procedure and the tomatoes are classified as well colored, fairly-well colored or cull in accordance with U. S. Government Standards. Disagreements as to grade nearly always concern tomatoes of borderline color.

Tomatoes are graded for color by comparison with specially-prepared color photographs. The inspectors are carefully trained in color comparison and are closely supervised. Work periods are adjusted to avoid eye fatigue and the inspectors are continuously shifted among the many grading stations to assure uniform statewide grading.

With all these precautions, there persists the feeling that grading suffers from human differences between inspectors. These differences can be eliminated through the use of a color-measuring instrument.

Shown in operation in the photograph, the new instrument, the Agtron, was developed especially for tomato inspection by Magnuson Engineers in consultation with Huggins Laboratories. It has been tested and approved by the state and will now be used by California tomato inspectors for precision color grading. With the instrument, tomato grading is quick, simple and positive. Sample tomatoes are cut in two and inspected visually. When the color grade is not immediately apparent, the instrument is used. The two tomato halves are placed in spring-supported cradles and moved into position. Phototubes view them through red and blue filters while the tomatoes are illuminated by low-pressure neon and mercury-vapor lamps. A sketch of the physical setup is shown in Fig. 1.

To adjust for tomato variations, the red reflectance is set to a full-scale meter reading of 100 and then the band selector switch is pressed to give a blue-reflectance reading. The ratio of red reflectance to blue reflectance has been demonstrated to represent the maturity of the tomato. The meter scale is calibrated in red, yellow and green bands to indicate the three classifications of ripeness. These bands were established by correlating numerical scale readings with the average judgment of a number of experienced inspectors.

Color Considerations

Visual color sensations in the human eye are the combined effect of the spectral reflectance of the surface viewed, the spectral energy distribution of the illuminant, the spectral absorption of the transmitting medium and the spectral sensitivity of the eye. In judging tomatoes by eye, the inspector is attempting to evaluate the first factor while the other three factors are subject to probable variations. In addition, his judgment may be modified by the following secondary considerations: surface gloss of the tomato, its size and shape, its internal cell structure, variations in color over the cut surface, direction of incident light, conditioning the inspector has received from examination of previous tomatoes and the contrast between a given tomato and others within view.

Figure 2 shows the spectral reflectance curves of four tomatoes graded as marked. Curve number one is identified as below minimum, fairly well ripened; curve two is

by Spectrophotometry

To eliminate human element in judgment of color, bridge spectrophotometer measures ratio of reflectance at two critical points. Technique is applicable to grading other agricultural products by use of appropriate points on spectral reflectance curves

approximate minimum, fairly well ripened, curve three is approximately minimum, well ripened and curve four is definitely well ripened.

The presence of chlorophyll in the greener tomatoes is responsible for the dip at 680 millimicrons. Curves for relative eye sensitivity and relative daylight energy have been superimposed. Their effect is to modify the tomato curves to the form of Fig. 3 which represents the relative visual stimulation by which one recognizes color difference.

In development of the instrument, the primary objective was to eliminate the many variables discussed and to produce an instrument which would be direct reading and suitable for use by nontechnical personnel. Additional desirable features were that the instrument would not require destruction of the tomatoes beyond cutting in two, it would be portable, rugged, unaffected by weather conditions in open field stations, simple to calibrate and standardize, not susceptible to inaccuracies from varying supply voltage and moderately priced because of the quantities needed. Since production problems are not involved, it is only necessary to grade one tomato at a time. Further, the equipment is not required to serve any other purpose than evaluating tomato color.

The circuit of the instrument is shown in Fig. 4. Selected blue and red reflectance responses, containing 120-cps modulation from the a-c light sources, feed a 6SJ7 followed by half of a 6SN7. Both tubes are a-c amplifier stages. The other half of the 6SN7 is a detector whose output goes to the bridge vtvm formed by two halves of another 6SN7 with the meter connected across the two cathodes. Various types of d-c amplifiers were investigated but were discarded because of their inherent drift and poor stability.

Operation is as follows: Reference to the spectral reflectance curves of Fig. 2 shows that there are two well-established plateaus, one in the 400 to 520-millimicron region and the other in the 640 to 740-millimicron region. Operation is based upon the fact that the ratio of monochromatic reflectances in these two bands forms a dimensionless function which indicates the ripeness of the tomato. Such a function is independent of variations which would affect the absolute spectral response of the instrument. Previously, general proof of a definite relationship between spectral reflectance curves of agricultural products and their maturity had been published by White[1].

Selection of light sources dictated

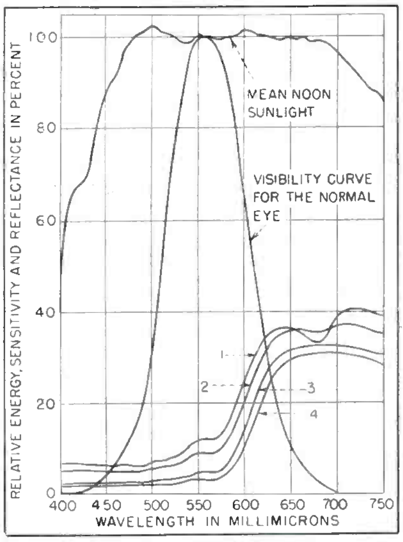


FIG. 2—Spectral reflectance curves for four grades of tomatoes. Normal visibility curve and spectral energy distribution of sunlight have been superimposed

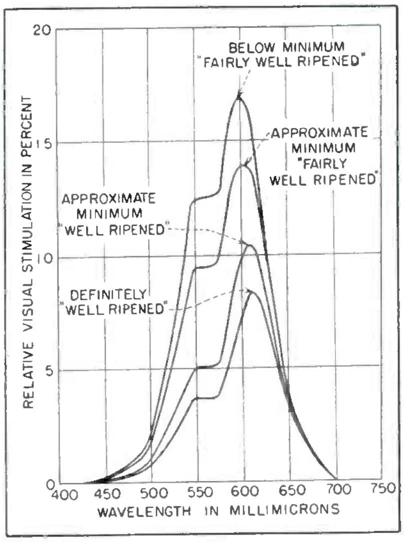


FIG. 3—Curves of Fig. 2 as modified by the normal-visibility and sunlight-illumination curves. The curves indicate the color differences the inspector sees

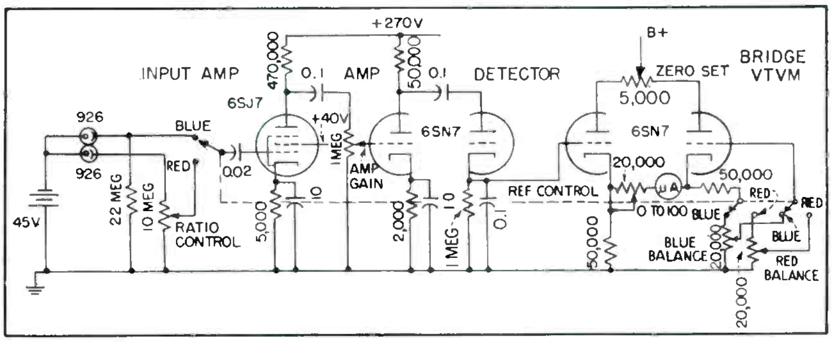


FIG. 4—Circuit of the bridge spectrophotometer includes two stages of amplification and a detector ahead of the measuring bridge

the use of monochromatic elements to eliminate spectral-response differences in phototubes as well as spectral shifts in aging light sources. Use of white light with standard optical filter combinations did not produce sufficient monochromaticity.

The final solution was a low-pressure mercury-vapor arc in conjunction with a Corning number 5113 filter to isolate the 436-millimicron mercury line and a low-pressure neon arc lamp with a Corning number 2412 filter to isolate the 632, 640 and 651-millimicron neon lines. These three dominant neon lines are sufficiently close together to approximate a single line since the tomato curves are flat over this band of wavelengths.

Type-926 phototubes with S-3 spectral response were used because of their good sensitivity in the chosen region.

Grading Procedure

Graphically, the grading procedure may be represented by Fig. 5. First, the unit is set up for use by balancing out the dark current for each color. This is accomplished by using the red-balance and blue-balance controls shown in the accompanying circuit. This operation establishes the baseline along the *X*-axis shown in Fig. 5. The zero-set control in the bridge plate supply is used to adjust for warmup drift. Next, a standard white disk with equal reflectance in the red and blue regions is inserted in the tomato test position and, using the ratio control shown in the output circuit of the red-response phototube, blue sensitivity is set at 10 times red sensitivity. This establishes test points *C* and *D* in Fig. 5 and provides full-scale sensitivity for the various tomato grades. The instrument is now fully calibrated and ready to grade tomatoes.

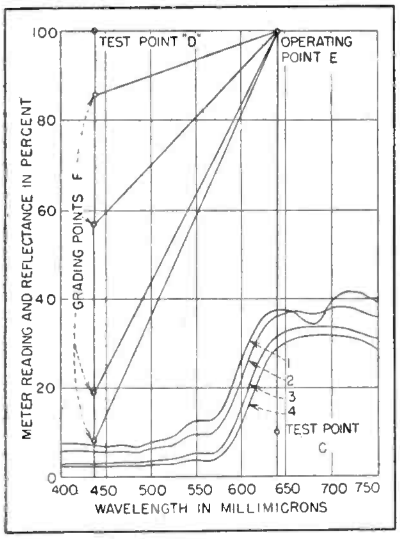
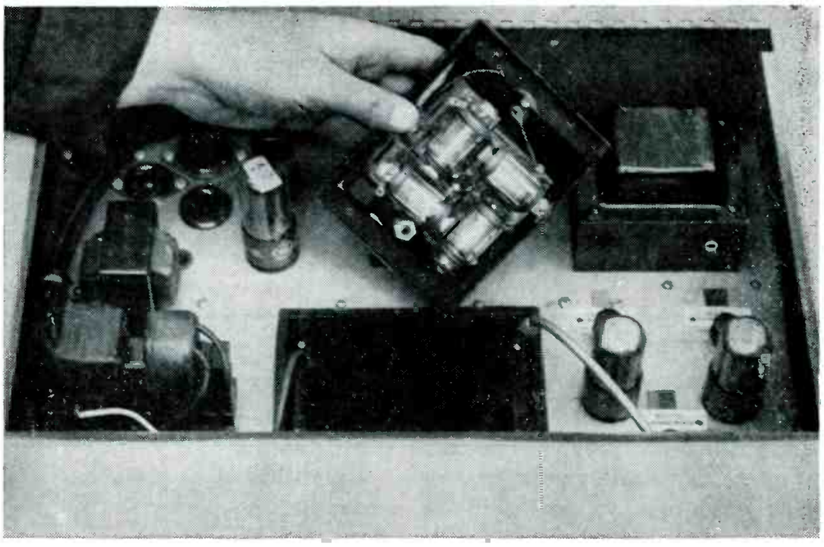


FIG. 5—Graphical representation of tomato grading procedure. Curves 1 to 4 have the same identification as in Fig. 2 and are described in text



Plug-in phototube enclosure projects downward through the chassis above the grading compartment. The inner surfaces of the compartment are finished in black to prevent unwanted spurious reflections. Reference control and band-selection control are on front panel

During grading, the tomato halves are put in position and the red response is adjusted to read 100 on the meter scale, by use of the reference control on the front panel. This establishes operating point *E* (Fig. 5) for that particular tomato. In effect, this procedure causes the spectral reflectance curves of all tomatoes tested to pass through point *E* regardless of their grade, size, shape or other variables. The amplifier-gain control is originally set so that the reference control will have adequate range for the establishment of point *E* for all grades from well-ripened to cull and for all diameters from two to four inches.

Operating the push-button color selector then switches the ganged control to blue response and the grade of the tomato is read directly on the meter. These readings are represented by the points marked F in Fig. 5. This illustrates the scale spread resulting from the ten-to-one ratio previously established. Grading points *F* range from 8 to 86 on the meter dial while the actual ratios from the spectral reflectance curves produce a range of only 0.086 to 0.185.

The instrument is housed in a deep cabinet with a drawer-type grading carriage. Spring-loaded cups press the halved tomatoes against a reference plane established by crossed fine wires. The inner surfaces of this compartment are blackened to prevent spurious reflections. The phototubes are mounted in a plug-in enclosure, illustrated above. The enclosure projects downward through the chassis deck above the grading compartment. Only the reference control and the red-to-blue band-selection control are brought out to the front panel.

The Agtron weighs 65 lb and has carrying handles. It operates from 115-v 60-cps with built-in regulated power supply, drawing 1.0 ampere.

Successful development of this grading device suggests the practicality of grading many agricultural products in a similar way by utilizing the salient points of spectral reflectance curves.

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SINGLE-BAND AUDIO GENERATOR

The complete range from 30 to 15,000 cycles is covered by varying a single resistance. Three-tube device gives choice of two outputs: either 5 volts across 250 ohms or 30 volts across 5,000 ohms. Principles are applicable to equipment for video or l-f

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The device to be described is a simple resistance-tuned sinusoidal oscillator that is capable of covering the audio-frequency range with the variation of a single resistor. This oscillator was developed to meet the need for a circuit providing excellent waveform and constant output voltage without requiring the use of precise, expensive components.

Several types of resistance-capacitance oscillators have been described in the literature. Each consists of an amplifier with either one or two feedback connections. A frequency-selective network is placed in one feedback loop, while an amplitude regulator such as a lamp or thermistor may be placed in the other feedback loop. The condition for steady-state oscillation is met; that is, a net loop gain of unity at zero phase angle is produced.

It is of interest to consider some of the frequency-selective networks employed in these oscillators. Perhaps the first used in such an application is the half-Wien bridge[1] of Fig. 1A. Here a broad maximum, accompanied by zero phase shift, is obtained at the operating frequency. This network, which is placed in the positive-feedback path of the oscillator, requires the variation of two capacitors or two resistors to change the operating frequency for a constant attenuation and constant oscillator output voltage.

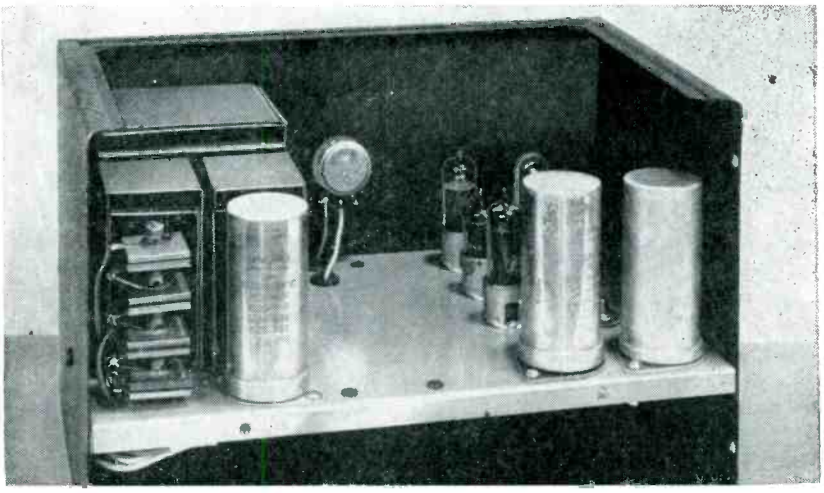
A second network is the twin-T[2], Fig. 1B, which produces a null at the operating frequency. This network, placed in the negative-feedback loop, requires that three circuit elements be varied.

The phase-shift network of Fig. 1C has been employed as an oscillator[3,4,5] in connection with a single-stage amplifier. The oscillator is usually operated at a fixed frequency, since tuning requires a three-gang capacitor or resistor.

Likewise the circuits of Fig. 1D[6,7] and Fig. 1E[8] require ganged capacitors or resistors for tuning. The last network, Fig. 1F, whose application in an oscillator and selective amplifier has been described by Villard[9], consists of two all-pass phase shifters in cascade to provide a total phase shift of 180 degrees at the operating frequency. A single stage of amplification is sufficient to complete the oscillator, and a constant output voltage with variable frequency is obtained by changing both resistors *R* or both capacitors *C*. Accurate tracking of these components is not required.

It has been pointed out[10] that variable-frequency operation may be obtained by changing either one resistor or one capacitor. Since all-pass sections are used, a constant attenuation is provided in spite of the fact that different time constants may be employed in the two phase shifters. However, this scheme suffers from two serious drawbacks. If a 10-to-1 (or larger) frequency ratio is required, a considerably larger variation in the variable time constant must be produced. In a practical oscillator this may impose a heavy load on the phase inverter at one extreme of the frequency range, violating the condition (equal but opposite input voltages) required to produce the all-pass structure. A second limitation is that a very nonlinear frequency scale is produced.

Fig. 2A shows the vector diagram used in analyzing the phase-shift networks of Fig. 1F. As mentioned, two equal voltages of op-



Rear view of the complete oscillator with back and top removed. Resistor R in center. Front panel has calibrated dial, gain control and high-low impedance output switch as well as output terminals, on-off switch and fuse posite phase are applied to the series R-C circuit. A constant-output (all-pass) network is obtained as a consequence of the fact that the voltages across the resistor and the capacitor are 90 degrees out of phase. Thus the locus of the tip of the output-voltage vector is a semicircle as either the frequency or the time constant is varied, providing the load impedance is very high.

In considering the above, the writer was led to question what would happen in such a network if the phase difference between the input voltages were 90 degrees instead of 180 degrees. This is shown in Fig. 2B, where E_A and E_B are the input voltages, E_R and E_C are the voltages across the resistor and capacitor respectively, and E_0 is the output voltage. As before, the locus of the junction of E_C and E_R is a semicircle. However, this semicircle passes through the origin, and hence E_0 experiences a null.

In a practical network the magnitude of E_B, whose phase has been shifted 90 degrees, may vary with frequency. The dashed lines of Fig. 2B show the condition where $E_B >$ E_A. It is apparent from the geometry that the production of a null in E_0 is independent of the magnitude of E_B. This fact suggests the practical network shown in Fig. 2C, in which a phase lag of slightly less than 90 degrees is produced by R_1 and C_1. The resistors R_2 and R_3 function as an attenuator to render E_A and E_B approximately equal at the middle range of frequencies. In drawing the accompanying vector diagram it was assumed that R was much greater than both R_3 and the reactance of C_1.

It will be noted that a true null is not obtained, since the phase shift of E_R is less than 90 degrees. However, five interesting points are observed on the vector diagram. Points 1 and 2 produce 90-degree phase shifts in E_0, accompanied by two different degrees of attenuation. At point 3, E_0 passes through a minimum, accompanied by a phase shift between zero degrees and 90 degrees. Point four produces zero phase shift with some attenuation, while at point five E_0 becomes equal to E_A in magnitude and phase.

Suppose that this network is inserted in the negative-feedback path of an amplifier, and also suppose that controlled positive feedback, independent of frequency, is applied. As the positive feedback is increased to where the negative feedback through the network is cancelled, oscillation will commence.

Since the condition for oscillation requires zero phase shift, the network must be operating at points 4 or 5. However, oscillations will take place at point 4, since greater attenuation (and less negative feedback) is obtained here. If either R or C is varied, variable-frequency operation will be obtained. As the frequency is varied, however, point 4 will move along the X axis, indicating a change in the magnitude of E_0. This requires a readjustment of the positive feedback, producing a variation of the oscillator output voltage. Fortunately the magnitude and phase angle of E_B vary with frequency in such a manner that the variation of E_0 is partially compensated.

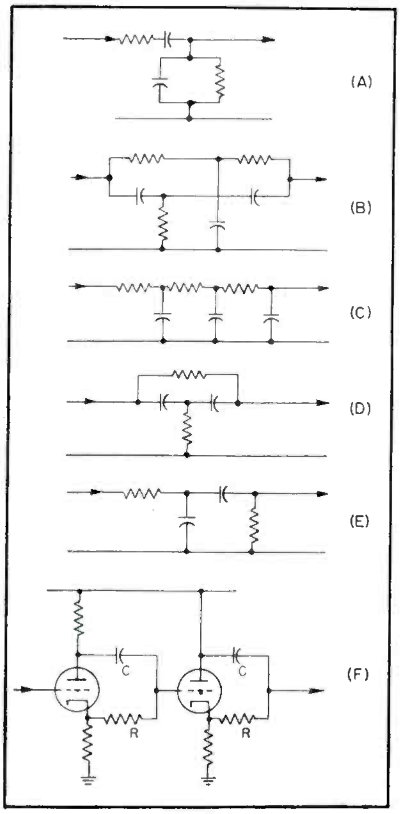


FIG. 1—Frequency-selective networks employed in resistance-capacitance oscillators

As a final step in the development of the circuit, consider the effect of adding a constant voltage E_4 to the output voltage E_0. This is easily accomplished by adding a resistor R_4 in series with the ground terminal of the network, as shown in Fig. 2D. It is seen that the percentage variation in the magnitude of E_0 is greatly decreased.

A typical network shows an attenuation constant within ± 3 percent over the frequency range from 30 to 15,000 cps. It should be noted that the effect of adding such a voltage is to decrease the rate of change of phase of the output voltage with frequency, which would tend to decrease the frequency stability of an oscillator employing the network. This effect has not been found serious.

A simple oscillator employing the network is shown in Fig. 3. Here V_1 is a single-stage pentode amplifier followed by the cathode follower V_2. The frequency-selective circuit is connected in the negative-feedback path from the cathode of V_2 to the control grid of V_1, while positive feedback is applied between the cathodes of the tubes through an attenuator consisting of a variable resistor R_5 and two tungsten-filament lamps.

With the circuit constants shown, a frequency range of 30 to 15,000 cycles was covered with a single rotation of the variable resistor R. The output voltage was constant within ±3 percent, while the waveform appeared good at all frequencies.

The distortion was not measured, but it is presumed to be very low, since the output voltage is stabilized at approximately one-quarter the level at which clipping was observed. Although a maximum output of approximately 20 volts

Bandspreading

The network shown in Fig. 3 covers 30 to 15,000 cycles in one range. Use the values below in microfarads for C and C_1 to cover 20 to 20,000 cycles in three decade ranges.

Frequency range	Capacitor C	Capacitor C_1
20–200 cycles....	0.5	10.0
200–2,000 cycles..	0.05	1.0
2 kc–20 kc.......	0.005	0.1

Resistor R is also changed to a variable 50,000 ohms with fixed 330 ohms.

can be obtained, it is desirable to decrease this to about 5 volts by adjusting R_5.

In covering such a wide frequency range with a single variable resistor, it is observed that the frequency calibration is crowded at the higher frequencies. In some applications, therefore, where precision and resettability are important, an alternate network can be employed. This permits covering the frequency range from 20 to 20,000 cycles in three decade ranges. Suitable circuit values are shown.

Alignment of the oscillator consists principally of obtaining the correct amount of positive feedback. Initially the resistance of R_5 is adjusted to its minimum value, and the plate and heater supplies are connected. The plate voltage of V_1 should be between 110 and 130 volts with the indicated plate-supply voltage. With R adjusted to one-half its maximum value and R_4 adjusted to 500 ohms, R_5 is increased until an output of 5 volts is obtained.

The frequency control R is then adjusted through its entire range, and the output-voltage variation is observed. If the output voltage is not constant, R_4 is changed, and the test is repeated. This may require the readjustment of R_5 to obtain the correct output voltage.

It is felt that the oscillator will fill the need for an economical audio-frequency generator capable of covering a wide frequency range. With a suitable circuit design it should be possible to employ the same scheme at low radio frequencies, and also at video frequencies.

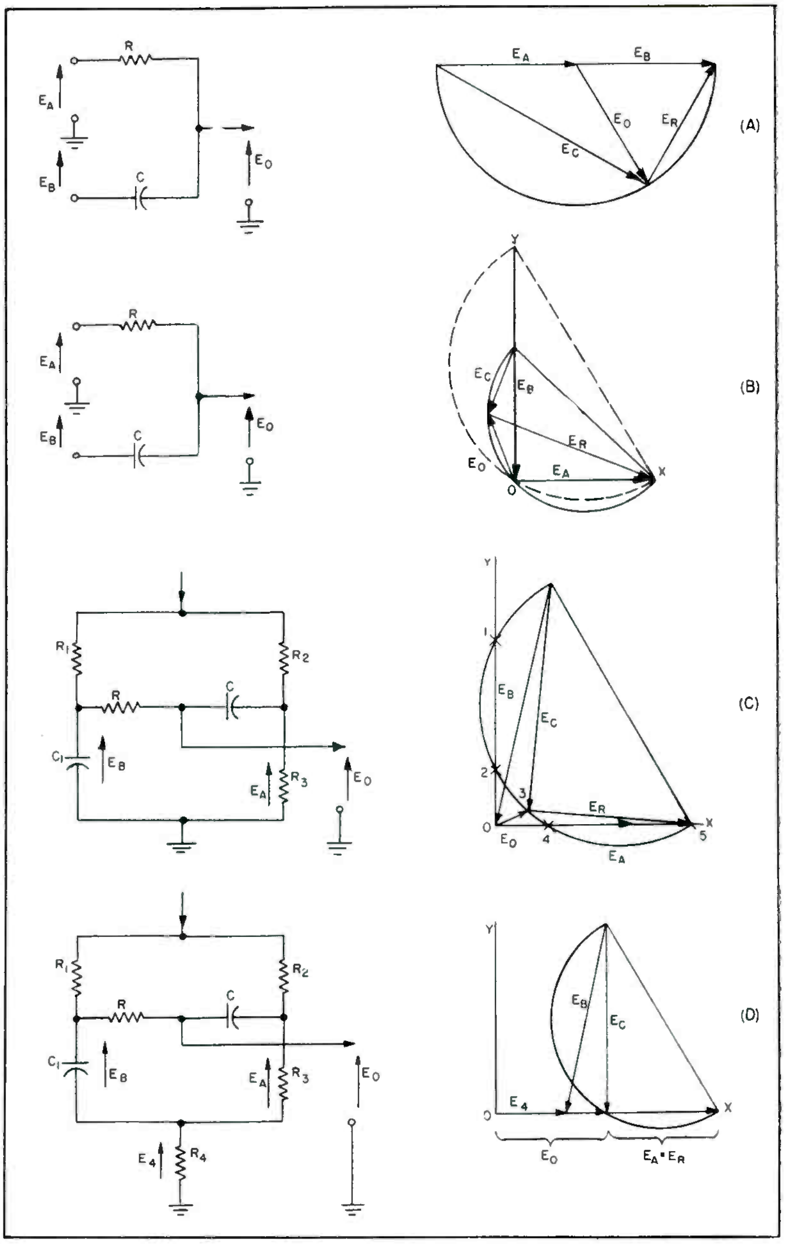


FIG. 2—Steps in deriving the new frequency-selective network described in text

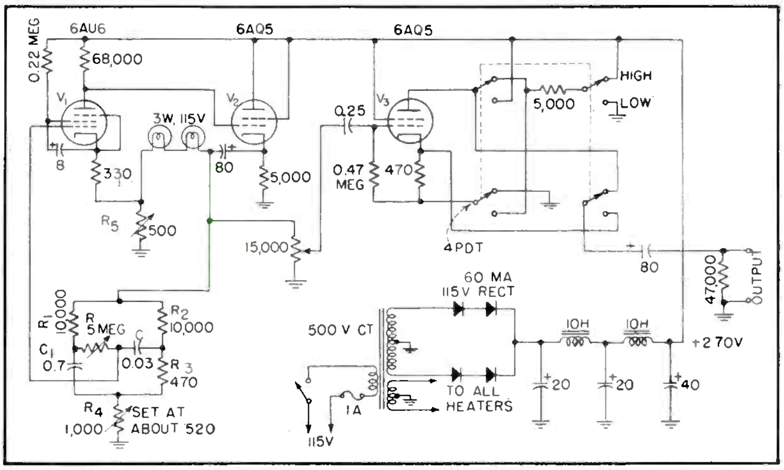


FIG. 3—Complete circuit of the single-resistor (*R*) oscillator. In low position, maximum output is 5 v at 250 ohms; in high position, 30 v is obtained at an impedance of 5,000 ohms

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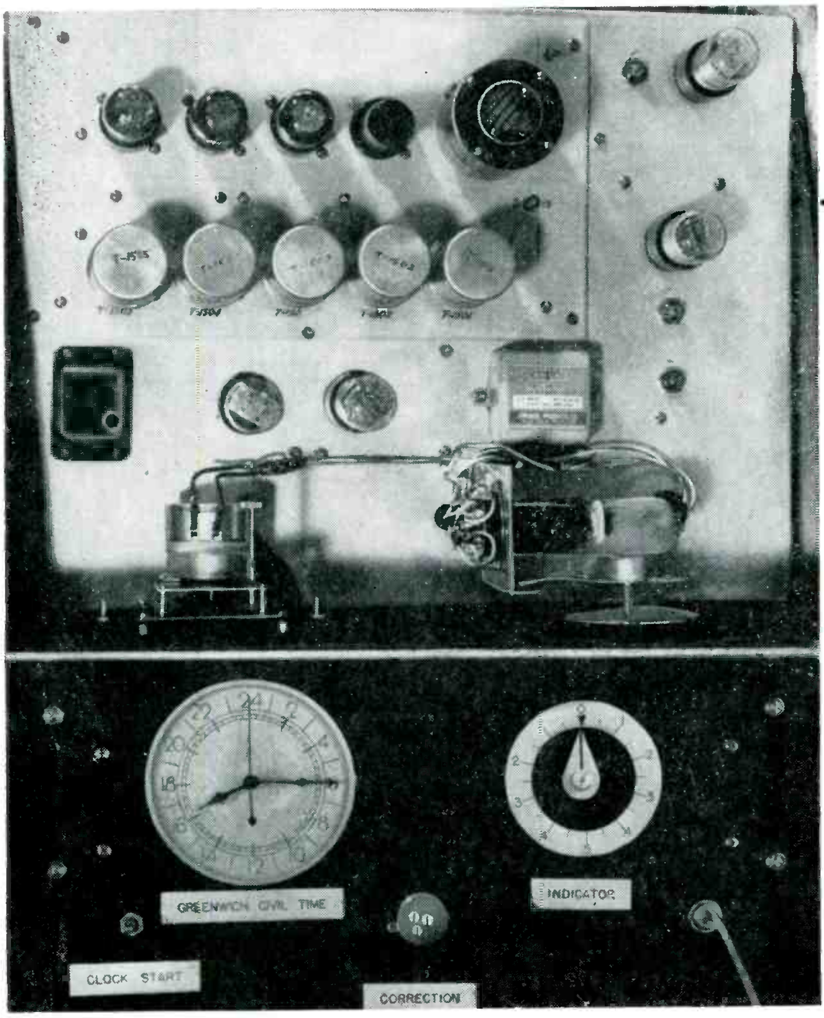
ACCURATE TIME for



Top chassis shows commercial frequency standard built in. Portion of front panel indicates master clock and stroboscopic monitor also shown at top

By FRED E. FOWLER

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ESTABLISHMENT of a correlation between natural phenomena of different types is frequently the objective of a research program. Often such a program requires the comparison of data taken independently at a number of observing stations, and in many cases the value of the data may depend upon the accurate timing of the development of a particular phenomenon.

The timing equipment used at the Sacramento Peak Station of Harvard College Observatory is driven by synchronous motors. The device to be described was designed to make possible the accurate operation of exactly synchronized interval timers, exposure timers, and clocks at a number of different stations on Sacramento Peak.

A block diagram of the timing system is shown in Fig. 1. Essentially it consists of a frequency standard that generates a frequency-stable voltage, a phase-shifter to provide a means for correcting the clocks, a power amplifier to drive the clocks, and a monitoring method for indicating time discrepancies between the system and time as given by radio station WWV.

Frequency Standard

The frequency standard shown in the block diagram is a commercial unit built by the Ernst Norrman Laboratories. This unit consists of a temperature-controlled quartz crystal working at a frequency of 90.72 kc. The crystal oscillator is followed by the frequency dividers necessary to give a 60-cycle output. In terms of time, this unit has a stability of better than ±0.1 second in 24 hours.

Clock Correction

When several clocks or timers are to be driven in the timing system, means must be provided for making corrections simultaneously to all of the clocks and timers on the line.

One method of clock correction is to switch the input to the power amplifier to a frequency several cycles above or below 60 cycles[1]. Thus the operator can increase or decrease the speed of the clocks until the desired time correction is accomplished. This method was tried in a breadboard model of the timing system, but it was not always possible to get identical response from the different rotors driving the clocks as the frequency was switched during correction.

It appears that if the switching takes place at a critical point in the phase relationship between the two frequencies involved, differential errors between clocks may be introduced by small differences in the mechanical and electrical characteristics of the motors. If such an error occurs, the differential rotor displacement usually will be one pair of poles, which results in a time error of one-sixtieth of a second. Therefore, there is the possibility that after a number of corrections have been made, a significant differential error may be accumulated in the system.

To check the magnitude of any differential errors introduced into the system, the gear boxes and cover plates of the synchronous motors used to drive the clocks and timers were removed. Reference marks were placed on the exposed rotors and the operation of the motors was observed in the light of a

Scientific Observations

Exact synchronism of all clocks, interval and exposure timers driven by synchronous motors depends upon a crystal-controlled 60-cps source with stability exceeding ±0.1 second in 24 hours. Phase splitter and selsyn permit resetting to WWV ticks at any moment

Strobotron lamp fired at the frequency of the power applied to the motors.

Before applying power to the motors, the rotors were positioned manually so that all of the reference marks were in the same direction. Rotor displacements that appeared after power was applied indicated the differences in time required for the individual rotors to reach synchronous speed. Differential errors due to the introduction of a correction signal were observed as further rotor displacements.

Three groups of motors were used in the tests. Each group consisted of motors identical in model and manufacture. Two of the groups comprised motors of the hysteresis type while the motors of the third group were of the inductor type. In each case it was found that differential errors could be introduced.

Phase-Shift Method

To overcome the difficulties observed with the correction method just described a phase-shifter is used instead to apply the corrections to the clocks and timers. The operation of the phase-shifter may be understood by referring to the circuit diagram, Fig. 2. The output of the frequency standard is connected to the primary of T_1. The primary of the transformer is resonated to improve the waveform of the voltage from the frequency standard.

The secondary of this transformer drives a resistance-capacitance network that provides three voltages of equal amplitude but separated in phase by 120 degrees. Each of the three voltages is applied to the grid of a cathode-follower. The outputs of these cathode-followers, V_{1A}, V_{1B} and V_{2A} are used to drive the three stator windings of a selsyn. Therefore, if the selsyn rotor is turned through one revolution the voltage at the rotor is progressively shifted in phase through 360 degrees with respect to the voltage at the output of the frequency standard.

Shifting the phase through 360 degrees will add to or subtract from each clock rotor, depending upon the direction of the phase-shift, a displacement corresponding to one pair of poles. Thus, one rotation of the phase-shifter will apply a correction of one-sixtieth of a second to the clocks. To prevent corrections from being applied at a rate that the clock rotors could not follow, a mechanical damper is fastened to the selsyn shaft.

Amplifier

The output of the selsyn is amplified by V_{6A}, V_{7A} and V_{7B}, and used to drive a cathode-loaded power amplifier. The regulation of the power amplifier is such that timers may be connected or disconnected across the output without requiring adjustments at the amplifier. This feature is of convenience to the operator when the timers are used intermittently and when the timers are located beyond reach of the control panel. The amplifier shown in the diagram furnishes power to the frequency monitoring stroboscope disk, a panel clock, and three additional clocks or timers. This output is sufficient for the central observing position at Sacramento Peak.

The cathode-follower V_{6B} provides a low-impedance, low-voltage output so that the standard frequency and corrections may be transmitted to other observing positions. Additional power amplifiers are supplied at the receiving end of the signal line.

Frequency Monitoring

The frequency is monitored by using the once-per-second ticks of WWV to fire a Strobotron lamp placed behind an aperture in a rotating disk. The disk is driven at one revolution per second by a synchronous motor connected across the clock line. Errors in time that result from frequency deviations from the 60-cycle rate are shown by the shifting in position of the aperture with respect

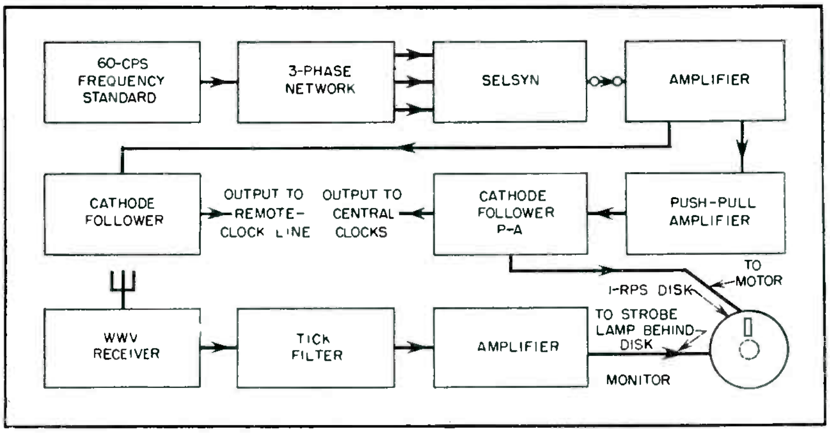

FIG. 1—Elements of the standard time-clock system show dual outputs for local clocks and remote line, stroboscopic monitor to check with WWV and selsyn reset control

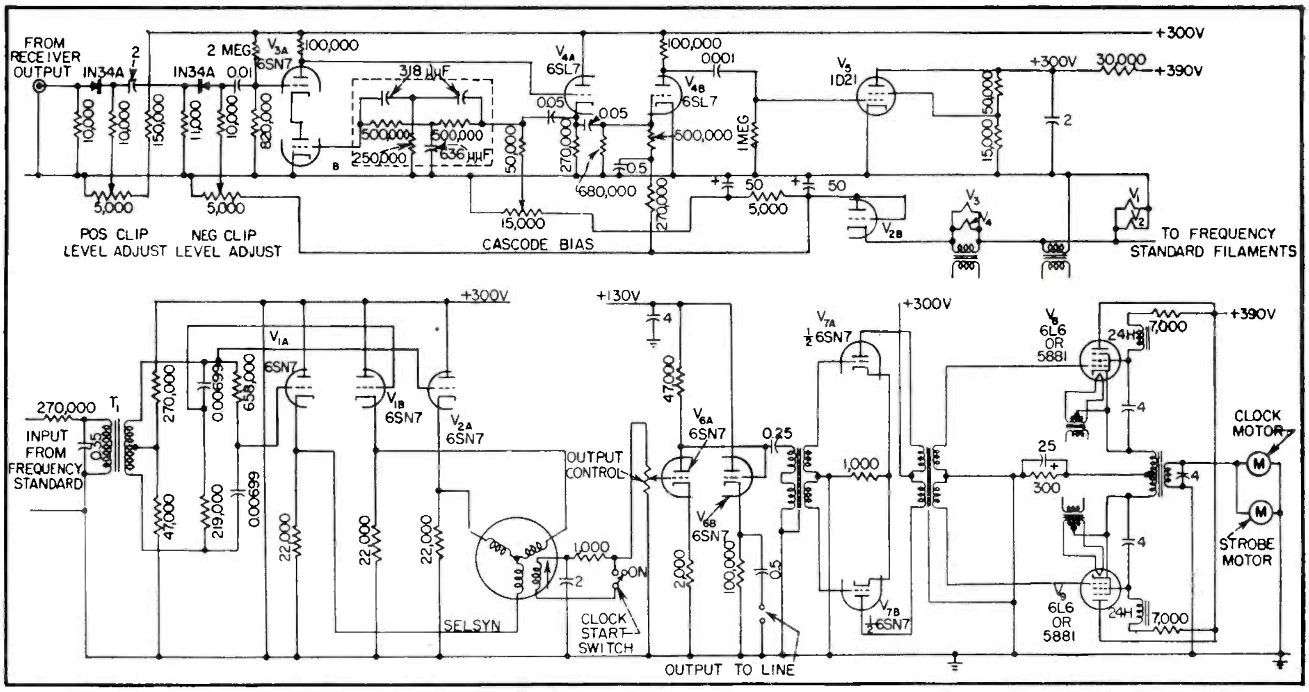

FIG. 2—Features of the timing system include clipping and filtering circuits (upper part of drawing) so that discrete time ticks from WWV allow resetting with great accuracy; and phase splitter for selsyn reset

to the firing time of the lamp.

To remove modulation components other than the 1,000-cycle tick from the audio output of the receiver tuned to WWV, a clipper and a 1,000-cycle filter are used. The clipper consists of two 1N34 diodes that clip both the positive and negative sides of the receiver output to prevent noise pulses from firing the Strobotron lamp.

A parallel-T resistance-capacitance null network in a feedback loop is used for the 1,000-cycle filter. Tubes V_{3A} and V_{3B} are operated in a cascode arrangement. The signal from the clipper is applied to the upper grid while the feedback through the parallel-T is applied to the lower grid. A cathode-follower V_{4A} completes the feedback loop.

The cathode-follower also drives the amplifier V_{4B}. This stage is biased to cutoff so that a large negative pulse is produced with each incoming tick. These negative pulses cause the Strobotron lamp V_5 to fire once each second. Tube V_{2B} is a rectifier that furnishes the negative bias for V_{4B} and the clipper.

To place the equipment in operation, all the clocks are preset for a WWV time signal. The second hands of the clocks and the stroboscope disk are all set to zero. When the time signal is given, the operator throws the clock-starting switch that applies drive to the power amplifier.

The motors used throughout the system reach synchronous speed within two cycles of the applied voltage. This characteristic limits the differential starting time error to less than this value. The error due to the operator's reaction time in throwing the switch may be corrected by rotating the phase-shifter until the stroboscope disk is at the zero position.

Errors that accumulate owing to frequency drifts in the standard oscillator are indicated by a shifting of the position of the aperture of the stroboscope disk with respect to the firing time of the lamp. These errors are also corrected by rotating the phase-shifter. Since the correction system does not introduce differential errors between clocks, the equipment may be left in operation until maintenance is required.

The monitoring disk may be calibrated so that the displacement of the aperture from the zero position may be read directly in terms of error in time. Since the number of rotations of the phase shifter to correct any given error is known, it is a simple matter to reduce the error to zero. It is possible, therefore, to make corrections even when extremely adverse radio reception conditions permit only occasional ticks to come through. Since an error of one-sixtieth of a second results in a shifting of the stroboscope aperture of six degrees, the limit of the indicating system is approximately the same as that of the differential starting error, and this is the available accuracy

The electronic components of the system are housed in a standard two-deck cabinet. The top chassis contains the circuits of the frequency standard, the phase-shifter, and the stroboscope. The amplifier and power supply are mounted on the bottom chassis. These units and a front panel view of the instrument are shown in the accompanying photographs.

The instrument was designed and constructed for Harvard University by the electronics group of the High Altitude Observatory. Members of the group are R. H. Lee, J. C. Palmer, D. S. Johnson, and the writer. The work was sponsored by the Geophysical Research Division of Air Force Cambridge Research Center under Contract W19-122ac-17.

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Magnetic Centering of Electrostatic C-R Tubes

Pictures on the new electrostatically-focused tubes can be centered by one of three different p-m devices—the rotatable magnet, the contrarotatable magnet or the offset ring. Design and adjustment procedures of three basic types are shown

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ELECTROSTATICALLY-FOCUSED picture tubes require some separate centering means since the usual centering methods of moving the entire focus unit in the e-m case and the slide pole piece in the p-m case are not available. The new device used to accomplish centering on the electrostatic tube is called the centering unit and at this time there are three distinct types available. While there are many variations among the three basic types, all being mechanical or material differences, this paper is confined to a typical example in each group.

Early in the development of the electrostatic tube, using the so-called deceleration lens, it was recognized that the quality of focus is sensitive to the maintenance of a high degree of concentricity between the electron beam and the elements of the electron lens. In addition, it was found that the dot is readily distorted into the astigmatic shape or the comma when the beam traverses a magnetic field placed between the ion trap and the deflection yoke if this field is not uniform to a high degree. While it was found that the sensitivity of the beam to these distortions varied with the make of the tube, all tubes suffer to a more or less degree. In addition to the variation between tubes of different manufacture the type of ion trap used was also found to have an effect on the degree of nonlinearity that can be tolerated in the magnetic field.

This information showed that any

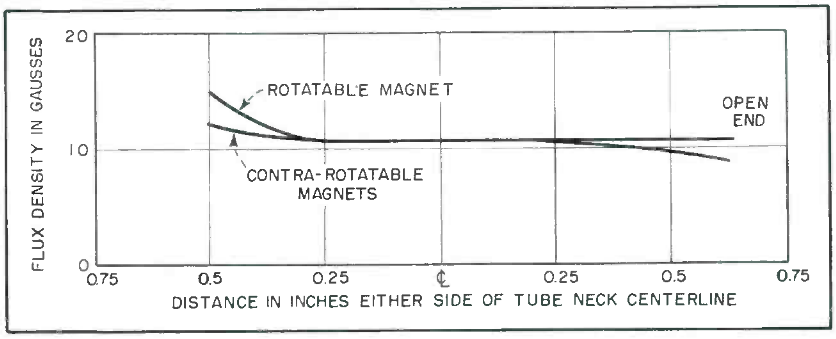

FIG. 1—Curves show linearity of flux distribution across neck of tube

FIG. 2—Plug and flux meter setup used to make field measurements on ion traps and centering units

magnetic device placed between the ion trap and the deflection yoke for centering purposes must have, as a first requisite, a uniform field in the area of interest and should not have a field component parallel to the electron beam since this field will produce some magnetic focusing which is not desired.

The amount of centering motion considered necessary has been decided upon by consultation with tube manufacturers. While most manufacturers feel they will be able to hold the beam within one inch of the center of the face of the tube it is felt that about 2¼ to 2½ inches total displacement should be made available.

Basic Types

The three basic types of centering units may be classified as: The rotatable magnet, contrarotatable magnet, and the offset open ring magnet type.

The rotatable magnet type is based upon the principle that an electron beam will be displaced with minimum distortion as to size and shape when it is passed transverse to a uniform magnetic field. The amount and direction of this displacement is determined by the strength of the field and its direction.

In the rotatable magnet design the control of flux density and field direction is achieved by arranging a magnet that can be rotated between two pole pieces which surround the neck of the tube and between which the electron beam passes in the general manner of the ion trap.

The usual ion trap shape pole pieces can not be used since the flux distribution along the axis of beam displacement is very nonlinear. The measuring technique used in the development of linear flux distribution pole pieces is the same as used in the development of ion trap pole pieces. Figure 1 shows measurements made on two types of centering units along the axis of beam displacement. The ion trap flux distribution is far from the desired linear distribution, as proved by tests on various ion trap types currently being used. Figure 2 shows the plug used for field measurements on both the ion trap and the centering unit as used in conjunction with a General Electric gauss meter.

Rotatable Magnet

The mechanical design of the rotatable magnet unit begins with a small magnet mounted on a shaft with an associated bearing. The magnet is positioned between the pole pieces, which are also used to mount the unit to the neck of the tube as is shown in Fig. 3. The magnet size is such that a field of about 9 gausses is developed at the center of the arcuate section of the pole pieces. As the magnet is rotated from this position the flux goes through zero and then reaches 9 gausses again but with the direction of the field reversed from the original direction. Adjustment of the picture when one of these units is used alone consists of rotating the entire unit around the neck of the tube until the long axis of the device (the one that passes through the magnet) is lined up with the polar axis of displacement of the picture. The magnet is rotated and the picture moves along the polar axis until it is centered.

Some manufacturers prefer to make provision for external control of centering. One in particular has taken advantage of the fact that he has always carried some d-c in the horizontal windings of the deflection yoke. This current is made controllable and is used for horizontal centering. A rotatable magnet type of unit provides the vertical centering and external control is achieved by adding an extension to the magnet shaft which then extends out the back of the set. The other solution, the more general among those requiring external control, has been to arrange two of the rotatable magnet units at right angles to each other and one behind the other. (The one producing the horizontal displacement is closest to the deflection yoke.)

It is possible to combine the two right-angle units into one assembly but the economics are such that nothing is saved by doing so while the magnet problem becomes quite troublesome.

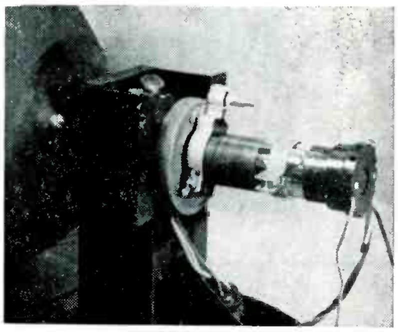

FIG. 3—Rotatable-magnet type centering unit

Of prime importance in all units is the choice of magnet material. The highest coercive material economically available should be used. This is necessary since like the ion trap and the p-m focus unit the device is operating pretty much under open-circuit conditions and thus is subject to self-demagnetizing effects. In addition, in the case of centering devices, due to operating them so close to the deflection yoke, heavy demagnetizing effects by the field from the deflection yoke also exist. In the event an anastigmatic type yoke is used, the demagnetizing can be really serious. As an example, one device tested before installation measured 11 gausses. After exposure to the field from the anastigmatic yoke this dropped to 6 gausses. Because of this, the rotatable magnet type uses a small piece of Alnico V to minimize this problem.

Contrarotatable Magnets

The second basic type of centering control, the contrarotatable magnet design, is shown installed on a tube in Fig. 4. This unit consists of two open ring magnets of either Cunife or piano wire. They fit into two aluminum supports (the pieces with the ears) and the whole assembly is held together by a fiber ring.

The entire unit is held on the neck of the tube by the spring tension afforded by a brass strap that curls inside of the fiber assembly ring.

While this unit looks radically different from the rotatable magnet centering unit, the principles of operation are similar. The two ring magnets, with the diameter larger than the neck of the tube, in addition to being magnets provide the equivalent of the pole pieces of the rotatable magnet unit. Being an-

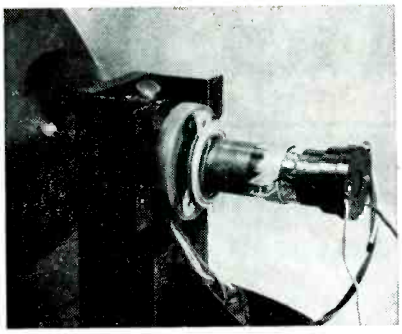

FIG. 4—Contrarotatable unit consists of two open ring magnets

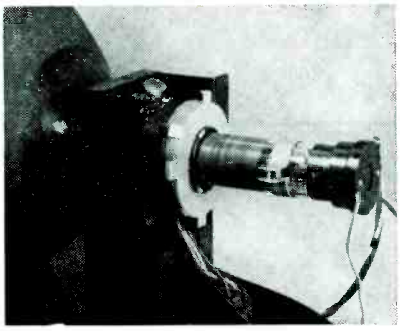

FIG. 5—Offset open ring magnet centering device

nular and of homogenous magnetic construction it is found that the flux distribution along the axis of beam displacement is uniform and as good as the rotatable magnet device. Control of magnetic flux density is achieved by rotating one ring magnet with respect to the other. This is done by using the ears on the aluminum pieces as purchases.

When the openings of the ring magnets are opposite one another and each tip of the same polarity the strongest field is produced. When one magnet is rotated, with the other held still, when the openings are opposite each other again, the magnetic flux is at a minimum. Therefore, by rotating one magnet with respect to the other the flux changes from maximum to minimum, and the beam will displace.

If the openings on the ring magnets are on the wrong side of the tube, it will be found that the beam will displace more in the undesired direction. When this occurs the unit need only be rotated through 180 degrees and the rings again rotated with respect to each other until centering is achieved.

In use, this unit is best handled by orienting the openings of the ring magnets along the axis in the same manner as the magnet of the rotatable type was oriented, and one ring rotated with respect to the other. If this moves the picture in the wrong direction, the entire unit should be rotated through 180 degrees and the rings again displaced.

No convenient method exists to date for providing external control with this type of device which limits it to the serviceman's type of installation. Designs other than the one shown have more positive methods of maintaining the position of the unit on the neck of the tube. One design affords a means for clamping by a screw arrangement similar to the type used on the rotatable magnet unit shown above.

The use of low-coercive magnetic materials, like carbon steels, in an area where strong a-c fields exist, such as in back of the deflection yoke, seems to merit further consideration. One type of contrarotating magnet design uses Alnico V which will undoubtedly be trouble free.

One of the major limitations to this type unit as compared with the rotatable magnet design, is that in spite of relation between magnet position and beam displacement described above, in production and in the field, there are no positive indications between the unit and what a change in the unit will do to the beam.

In the rotatable magnet design, there is a definite and easily-spotted relationship between the position of the unit and what a rotation of the magnet will do to the beam position. This represents a material time savings in final adjustment and inspection in production in addition to helping the worker in the field, whether set owner or serviceman. The amount of centering and the amount of dot distortion produced by most of these units is comparable with the rotatable magnet type.

Offset Open Ring

The third method for centering the picture is the offset open ring magnet. This device consists of one open ring magnet similar to those used in the contrarotatable magnet design except that the ring is larger in diameter. As can be seen in Fig. 5 this ring magnet is mounted on a support in such a manner that it can be rotated about the neck of the tube and also moved transversely with respect to the electron beam axis. Thus by moving in some combination of these two displacements some centering can be achieved.

The method of mounting this device may be seen in Fig. 5. Three ears grasp the cap cover of the deflection yoke sufficiently well for all practical purposes. In addition to the limitations of the contrarotatable magnet device, the only units examined to date are quite limited as to the amount of displacement to the point that their use on electrostatic tubes is debatable.

The contrarotatable types using low-coercive magnet material are not as desirable as these using Alnico V. In either case it is felt that the most desired unit in this group is one with Alnico V magnets and provision for clamping other than spring tension. While spring tension is certainly adequate for ion traps, a clamp is believed necessary in the centering device not only to prevent rotation around the neck of the tube but to insure against twisting of the centering unit. In addition to a good clamping means this requires adequate width of the part that is arcuate with the neck of the tube.

Present Status

At this time, the only rotatable magnet type in use is the one shown in Fig. 3. This unit uses Alnico V (less than ⅛th oz) between properly-shaped pole pieces to insure a high degree of field uniformity. The unit is held in place, once it has been positioned, by a screw and wing nut. The pole piece width is about 0.5 inch preventing any twisting of the unit. Movement of the picture by this unit is directly correlated to movement of the magnet and to the unit as a whole thus eliminating cut and try centering. External control of centering is available if desired.

The rotatable magnet type has the further advantage that it can be used on tubes that require little or no centering correction. The contrarotatable type cannot provide low or zero flux in most cases.

Tunable

By D. A. WILBUR, P. H. PETERS
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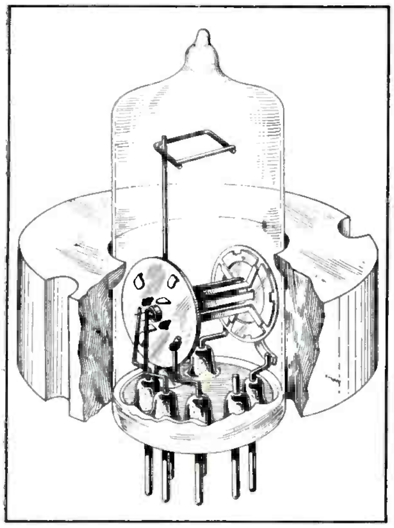


FIG. 1—Cut-away drawing of miniature magnetron shows interdigital construction. A permanent magnet furnishes the required field of 500 to 600 gauss

MAGNETRON OSCILLATORS, well known for their high-power microwave performance, may be constructed on a miniature scale to serve as efficient local oscillators delivering high-frequency c-w energy at levels in the order of one-half watt. Experiments show that such magnetrons are quiet in performance, having carrier-to-rms noise ratios equal to those of an ordinary triode oscillator.

Although conventional triodes are readily available for local oscillator service below 500 mc, their performance above this frequency, in the proposed uhf-tv range of 475 to 890 mc for example, is marginal. In particular, at frequencies much above 500 mc triode dimensional tolerances and element spacings become critical and result in relatively expensive tubes.

On the other hand, a magnetron of the so-called interdigital type is structurally a simple multi-anode diode having relatively large spacings and tolerances between elements. As an oscillator its circuit is inherently simple since no external provision for feedback is required. Efficient operation at the 900-mc end of the spectrum may be attained with comparative ease since the magnetron, operating in the travelling-wave mode, utilizes the effect of electron transit time beneficially in its production of oscillations. It is also possible to generate frequencies as low as a few cycles per second by operating it as a negative-conductance oscillator.

As a result of these considerations a new inexpensive miniature magnetron has been developed to cover a frequency range from 0 to 1,000 mc and to deliver r-f powers in the order of one-half watt or less. Its experimental designation is Z-2061.

Tube Structure

A cut-away drawing of the new magnetron and its associated ring magnet is shown in Fig. 1. Mounted on a standard 7-pin miniature base the anode structure is of the interdigital type and consists simply of eight vanes anchored alternately to two end rings so that four vanes are connected to each end ring. Two mica spacer disks are used to secure the vane assembly and to center an axially-located indirectly-heated oxide cathode.

A permanent magnet with a field strength in the order of 500 to 600 gauss is used to supply the magnetic field. Magnetization is transverse to the cylindrical axis of the magnet. Nonmagnetic material is used for the vanes and supporting rings to assure uniform flux density over the entire anode-cathode interaction space. The T-5½ bulb diameter reduces the magnetic path length in air to a minimum. To minimize hum modulation a reverse coil heater has been used.

D-C Characteristic

To measure the static behavior of the miniature magnetron, both sets of vanes are connected to a common positive d-c potential, and in the absence of oscillations, the static anode current is found to vary as shown in the curves of Fig. 2. Simple theory predicts that for any fixed magnetic field strength a cutoff voltage exists below which no anode current will flow. However, there is always some leakage current below this cutoff voltage in all magnetrons and the relative effect of two different field strengths in minimizing this leakage current is shown in Fig. 2.

The diode leakage current is seen to be as high as 18 ma at 160 volts and 600 gauss. This leakage current below the cutoff voltage has been found especially useful in its

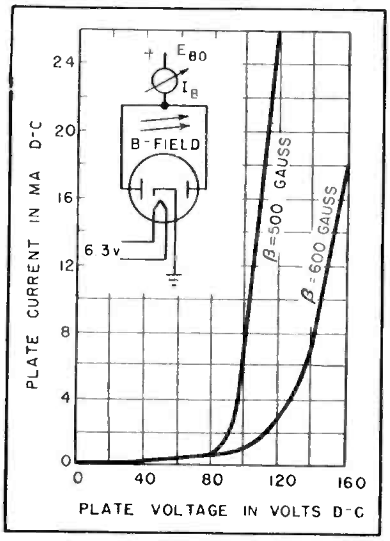


FIG. 2—Typical static plate characteristics of miniature magnetron

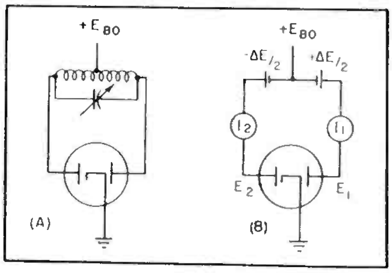


FIG. 3—Circuits for low-frequency oscillator and for measuring negative conductance of miniature magnetron

Miniature Magnetron

Tube designed for use as local oscillator in uhf receivers fits miniature 7-pin socket and provides outputs up to 0.5 watt over a frequency range of zero to 1,000 mc. Stability is good and associated circuitry is extremely simple

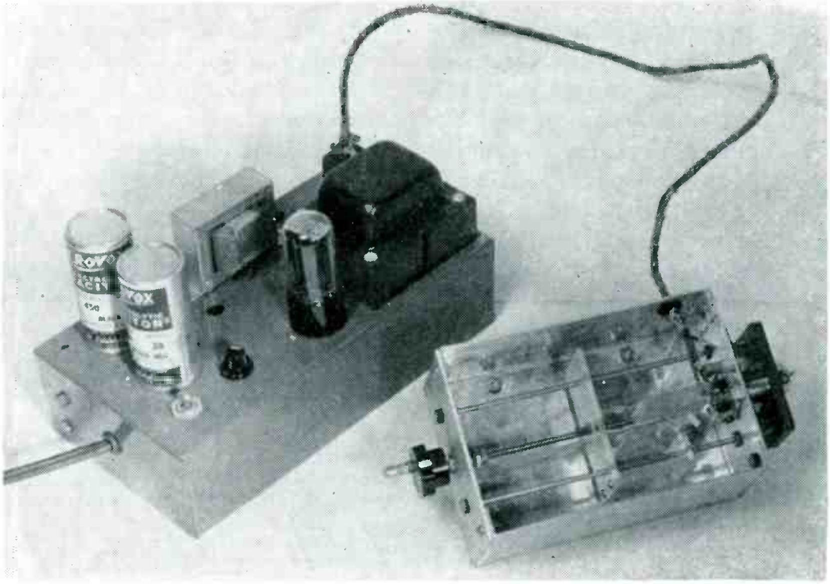
effect on the starting characteristics, as will be described later.

Types of Oscillations

If the terminals of a frequency-determining circuit are connected in push-pull fashion to each anode set, as shown in Fig. 3A, and the voltage raised from zero upward, oscillations at the circuit resonant frequency will occur. Two general types of oscillation can be produced depending on the operating voltage and resonant frequency. One type of oscillation utilizes a static negative conductance existing between adjacent anodes to sustain oscillations. The voltage and field strength need merely be set at a static operating point about which the negative conductance is sufficient to compensate circuit and load loss. Operating voltages for this mode are kept large enough so that the electrons complete their work on the r-f field as they cross under only one gap before being collected by the most negative vane, and they therefore move at velocities greater than required for synchronization with the r-f field alternations.

The highest frequency possible for a given voltage is determined when the duration of one-half r-f cycle becomes comparable to the transit time of electrons in passing from one vane to the next. Although the anode voltage can be increased to raise this frequency limit somewhat, the diode leakage current soon loads the tank circuit so heavily that oscillations are no longer generated. For the voltage, magnetic field, and geometry of the tube, the negative-conductance effect seems best suited for power generation below 100 mc.

Above 100 mc, a second type of oscillation is brought into action. This type, called the travelling-wave mode, is most commonly employed in present day uhf magnetrons and utilizes to advantage the effects of transit time. Instead of attempting to maintain electron velocities much faster than required for synchronization with the anode r-f voltage, the electrons are made to rotate about the cathode in synchronism with the r-f voltage on the tank circuit. The electrons being in step with the r-f field deliver energy to the tank over several r-f cycles, crossing under several vanes before collection takes place.



Magnetron tuner and power supply for continuous tuning from 515 to 930 mc

For a given frequency the operating voltage is much lower than that required for negative-conductance oscillations and energy transfer is more efficient. The voltage must, however, be sufficient to synchronize the electron angular velocity with r-f field. As a consequence there is a minimum starting voltage for each operating frequency in the travelling-wave mode.

It is found that for a given anode voltage, a gradual transition from the negative-conductance type oscillation to the travelling-wave type oscillation takes place as the operating frequency is increased. For voltages near the cutoff voltage, there is evidence that the negative conductance action remains effective well into the uhf range.

Oscillations at UHF

In investigating the operating characteristics of the Z-2061 particular emphasis has been given to operation in the uhf portion of its range as regards power output, noise level, frequency stability and efficiency.

In Fig. 4 are shown the characteristic curves for 600 gauss which result for oscillating frequencies between 400 and 950 megacycles. The tube is acting as a travelling-wave magnetron and, as the voltage is raised from zero, only leakage current is drawn by the anodes until the proper synchronizing voltage is reached, at which point oscillations begin. A further increase in voltage results in a rapid increase in anode current as the r-f energy stored in the tank circuit increases. Depending on the loading of the tank circuit, the rate at which anode current builds up with increasing anode voltage may be more or less rapid and the slope of the dynamic oscillating curves will be altered correspondingly. Light loading results in large r-f voltages and large current collection at the anodes. Heavy loading restricts r-f vane-to-vane voltage and the d-c collection grows less rapidly with applied d-c voltage. The curves of Fig. 4 correspond to particular loading conditions obtained in a turret tuner to be described in a later section, but they are representative of the behavior to be expected with typical uhf circuits.

Referring again to Fig. 4, suppose oscillation is taking place at 700 mc. This corresponds to an operating point of 10 ma at a fixed voltage of 100 volts. If the tank circuit is tuned downward to 500 mc, the anode current will rise rapidly until it reaches about 32 ma which is considerably above normal rated current. Continued lowering of the operating frequency finally causes the electrons to fall out of step with the lower radio frequency being generated. Then the oscillations abruptly stop. Restarting can be accomplished only by lowering the voltage to the 500-mc starting level of about 70 volts or by raising the tank frequency upward again toward 700 mc.

If we retune to our original oscillation at 700 mc and now tune the tube upward in frequency, the anode current drops until at about 750 mc, oscillation ceases and the current consists merely of the diode-leakage component given by the static plate characteristic.

These processes indicate that considerable adjustment of the anode voltage is required to maintain optimum r-f power over a two-to-one frequency band. For operation of the magnetron over a wide frequency range from a fixed voltage supply a series resistor in the anode circuit provides a satisfactory self adjustment of the anode voltage. In Fig. 4 is shown a load line for a 10,000-ohm series resistor and a supply voltage of 300 volts d-c. With this value of resistance the magnetron will run at a reasonably uniform current level near 20 ma between 400 to 950 mc and the anode voltage will be automatically adjusted from 85 to 125 volts over that tuning range.

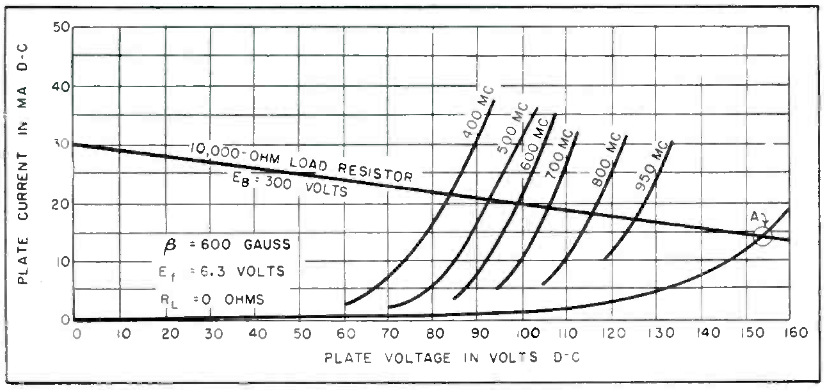


FIG. 4—Stable dynamic plate characteristics for 400 to 900-mc turret tuner

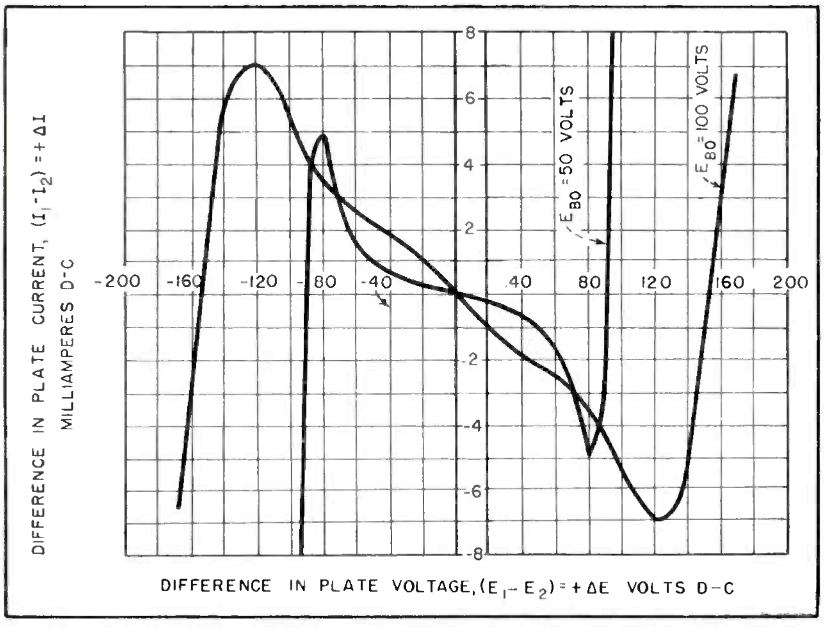


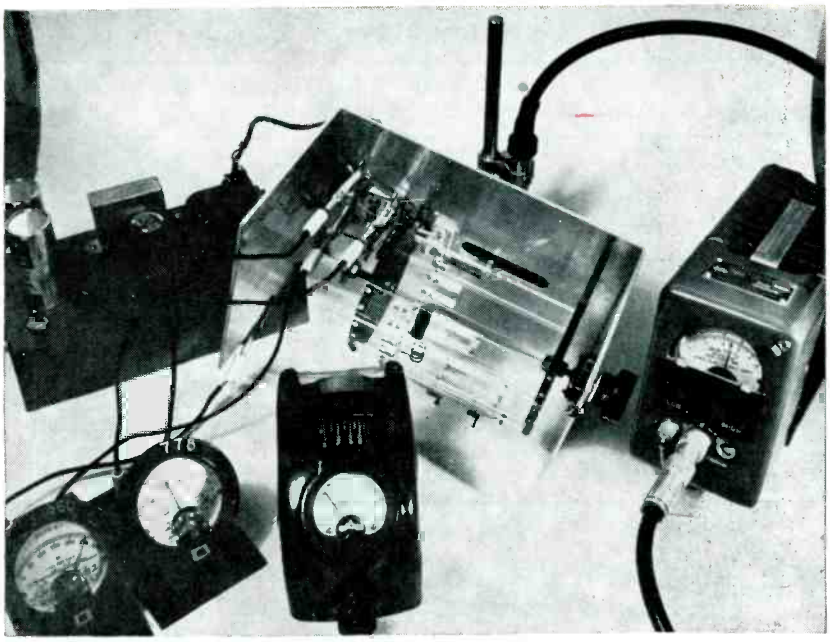
FIG. 5—Negative-conductance characteristic for 600-gauss field

Oscillation Stability

The two ends of each dynamic curve in Fig. 4 define a stable voltage range over which the oscillations at each respective frequency are stable with respect to loading out. While oscillations will continue for currents much higher than defined by the high-current end points in Fig. 4, they will not restart when once loaded out. Within the boundaries of these curves, oscillations will start again upon removal of the load.

For example, suppose at 400 mc the anode voltage is momentarily raised above the top stable point of 95 volts and 37 ma. If the tube is now loaded out of oscillation, it will not restart again until the voltage is reduced so as to be in the 400-mc stable voltage range. On the other hand, if the voltage is made less than 60 volts, of course, oscillations will not commence in the first place.

Addition of the series resistor modifies the loading-out and restarting behavior. When the oscillator is loaded so as to stop oscillations, the anode current and the voltage across the series resistor will drop, as the anode voltage rises to the point where the static characteristic intersects at point *A*. This corresponds to an anode voltage and leakage current of about 154 volts and 14 ma.



Turret tuner uses six tuner strips of the type shown in Fig. 6 and can be adjusted for any six frequencies between 400 and 1,000 mc

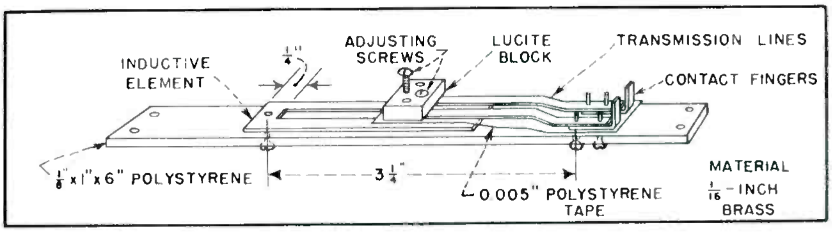


FIG. 6—Drawing of tuner strip for coverage of frequency range from 500 to 600 mc

It would be presumed, therefore, that unless the supply voltage itself were lowered to the stable voltage range corresponding to the tank setting, oscillations could not begin again even after load removal.

However, in practice, the tube will begin to oscillate again even though its anode voltage is far in excess of the proper synchronous voltage. Restarting occurs because of the negative conductance which exists between the anodes at the 154-volt and 14-ma level. This negative conductance is described in detail in the discussion of class-A oscillations. As the oscillation amplitude increases it causes an increase in anode current and a decrease in anode voltage along the series-resistor load line. In turn, the decrease in anode voltage occasions a reduction in the available low-level negative conductance. However, for a given d-c anode voltage, the negative conductance is greater for large r-f signals than it is for small. Consequently, oscillations once started at point *A* quickly become large enough to sustain themselves even though the d-c anode voltage falls well below the 154-volt level. Ultimately this voltage falls low enough for the electrons to synchronize and generate travelling-wave oscillations. The voltage and current then stabilize at an intersection of the load line and one of the curves.

Low-Frequency Oscillations

Although the Z-2061 has been designed principally as a high-frequency oscillator, measurements show that it will generate considerable power in lower frequency bands, including the audio range. Operation from a few cycles to approximately 100 mc is of the negative-conductance type.

This negative conductance is exhibited between the two anode sets and may be measured by applying an incremental positive voltage to one anode and an equal but negative voltage to the other with respect to a quiescent d-c level, as illustrated in Fig. 3B. It is observed that while current to the slightly positive anode will increase slightly, the current to the less positive anode increases far more. Consequently, the difference current through an impedance connected between the anodes will appear to flow toward the anode that is least positive, a condition indicating negative conductance.

If the incremental voltages are applied in opposite sense, the anode which had formerly been most positive will be least positive and will be collecting the most current. In Fig. 5 are shown relationships between incremental difference current and differential anode voltage for two quiescent voltage levels. For example, a +40-volt differential means that +20 volts has been applied to anode 1 and −20 volts to anode 2. The resulting current change is negative indicating a positive current flow away from anode 1.

Class-A Oscillations

As the quiescent level is increased toward the cutoff voltage of 160 volts at 600 gauss, the negative conductance continues to increase. At 150 volts it has been measured as −312 micromhos, whereas at 100 volts it is only −50 micromhos. Of particular interest is the fact that the negative conductance is appreciable for very small incremental voltages about any given quiescent point, when the quiescent voltage is a relatively large fraction of the cutoff voltage. The oscillations generated by this type of operation can start from noise level. Such oscillations are only about five per cent efficient, and may be classified as being developed under class-A operation of the tube.

More familiar is a second type of negative-conductance oscillation which compares with that developed by a class-C triode oscillator. The 50-volt curve of Fig. 5 is suitable for such oscillations. For a typical loaded tank circuit the conductance at the origin is too low to build up oscillations from noise. If a surge across the tank can be established in the order of 50 volts, when the tube is turned on, sufficient power will be delivered to the tank at the

Table I—Typical Oscillator Data for the Miniature Magnetron Operating from 700 cps to 225 mc

Frequency	Anode Voltage	D-C Input (Watts)	R-F Ouput (Watts)	Eff (%)	Mode Type
700 cps	134	3.35	0.252	7.5	Class–A
	(Tank Q too low to start Class–C oscillation)				
2.1 mc	76	0.80	0.053	6.6	Class–C
	123	0.81	0.020	2.5	Class–A
38.5 mc	140	2.24	0.125	5.6	Class–A
	(Tank Q too low to start Class–C oscillation)				
116 mc	59	0.54	0.080	14.8	T–W
	70	1.79	0.210	11.7	Class–C
	140	2.8	0.125	4.5	Class–A
225 mc	67	1.34	0.185	13.8	T–W or Class–C
	140	2.31	0.080	3.5	Class–A

peak of the surge, where the negative conductance is much higher than it is at the origin, to sustain oscillation. Thus maximum current is collected at the most negative anode over a short portion of the r-f cycle, and the circuit is kept oscillating as in a class-C oscillator.

Class-C negative-conductance oscillations begin and drop out abruptly and are about 10 percent efficient. The starting and loading-out behavior are very similar to traveling-wave oscillations and much above 100 mc it is sometimes difficult to distinguish between the two types, since the ranges of operating voltage for each type overlap considerably.

Several tubes were checked at five spot frequencies from 225 megacycles down to 700 cycles per second. Selected data from these tests are listed in Table I. At each frequency the loading was adjusted to give optimum power output. The data particularly show the transitions between the three possible types of oscillation and the relative efficiency of each for increasing values of anode voltage.

Note that the efficiency drops with increasing voltage at each frequency point. The output powers given are not the maximum attainable in any given mode. They lie near the middle of the voltage range for each mode. In operation, the moding action is recognized by an abrupt change in operating current as the voltage is changed uniformly in one direction.

From the data it is seen that much above 100 mc it is evidently most practical to utilize the travelling-wave mode for local-oscillator use. However, even though the class-A mode is least efficient, it does permit 100-percent amplitude modulation of the magnetron with minimum distortion and frequency modulation, a characteristic that may find other practical applications.

Tuned-Circuit Design

The use of printed circuits in vhf and uhf applications of the Z-2061 is entirely feasible and such commercial tuning elements as the vhf Mallory Inductuner work very well.

Two factors inherent in the tube design dictate the design of the external tuning circuits. These include the anode-to-anode capacitance and anode lead inductances. If the tube is mounted in a typical molded socket and the anode pins are shorted as close to the socket as possible the oscillating frequency will be near 600 mc. This upper frequency may be raised to 1,000 mc by first series-resonating the lead inductances with a small capacitor placed in series with each anode lead. This effectively places the anodes electrically much nearer the anode pins. A shorted transmission line may now be connected to these capacitors and used to tune the entire uhf band. The length of this line will be less than one quarter wavelength by the amount of foreshortening due to the inter-anode capacitance. The line may also be operated in a three-quarter wavelength mode above 900 mc.

Alternate Method

An alternative tuning method has been used which results in somewhat stronger oscillations above 600 mc. In this method an open-ended transmission line is connected either directly or through the series capacitors to the anode pins. The operation results in a half-wave distribution on the line with a voltage minimum near the pins and voltage maxima inside the tube at the anodes and at the open end of the line.

To tune the entire 400 to 1,000-megacycle range, a novel type of tuned circuit has been developed using a combination of the tuning and compensating methods just described. Essentially it consists of an open-ended transmission line

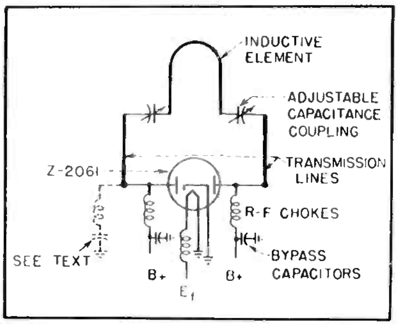


FIG. 7—Equivalent electrical circuit

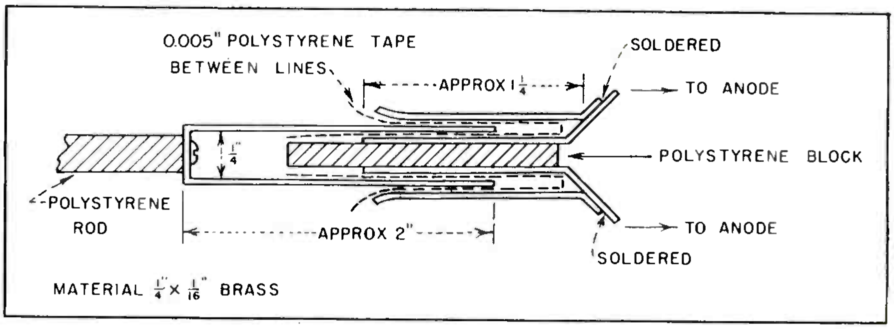


FIG. 8—Tuning element for continuous coverage of frequency range from 515 to 930 mc

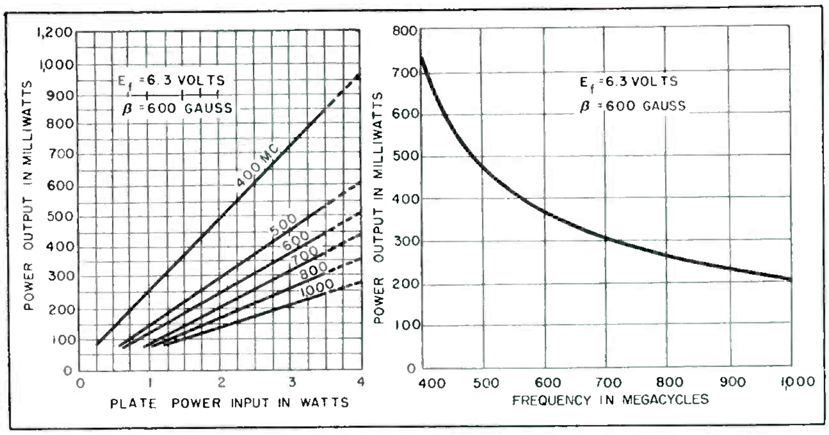


FIG. 9—Curves show power output as function of input (left) and frequency (right)

capacitively coupled to a short-circuited line. With large coupling the two elements combine to act like a short-circuited quarter-wave line. As this capacitance coupling is decreased there is a gradual transition from the quarter-wave line mode to a half-wave line mode. Figure 6 is a drawing of a tuner strip which covers the frequency range from 500 to 600 mc. The frequency increases as the spacing between the open and short-circuited lines is increased.

The photograph shows a turret tuner which uses six tuner strips similar to that shown in Fig. 6. This tuner can be adjusted to resonate at six different frequencies between 400 and 1,000 mc. The tuning ranges of each strip are made to overlap to assure operation at all possible frequencies in the band.

Figure 7 shows the equivalent electrical circuit of the tuner connected to a magnetron. Plate voltage is applied through a pair of r-f chokes consisting of 15 turns of No. 28 wire on a $\frac{1}{8} \times \frac{3}{8}$ in. phenolic coil form. To prevent spurious oscillation at the choke resonant frequency, the chokes may be wound over 200-ohm, one-half watt resistors and connected to their terminal leads.

Another type of tuner using the same tuning method was designed to provide continuous tuning from 515 to 930 megacycles. Figure 8 shows the constructional details of the tuning element.

It has been found that the addition of a small r-f choke and series blocking capacitor connected from one anode to chassis ground, as shown dotted in Fig. 7, greatly improves operation at frequencies over 700 megacycles. In the tuners shown in the photographs, an inductance of approximately 0.25 microhenry and a blocking capacitor of 10 $\mu\mu$f were found to be satisfactory. Design consideration should be given to disconnecting this L-C combination below 500 megacycles since it may affect operation of the tube at the lower frequencies.

Operating Conditions

Power output measurements in the range between 400 and 1,000 mc are shown at left in Fig. 9. With a maximum plate input of 3 watts, the tentative maximum rating of the tube, an average power output of 725 milliwatts has been measured at 400 megacycles and 210 milliwatts at 1,000 megacycles. These curves also show that power output is proportional to power input. The relationship between power output and frequency at 3 watts input is also shown in Fig. 9.

Frequency stability measurements of the turret tuner have been made as a function of line voltage, filament voltage, plate supply voltage, flux density, and time. The results of these measurements show that changes in plate voltage and filament voltage compensate each other. This, of course, is an advantage when the line voltage is changed. The dependence of stability on the magnetic field is not a problem because the magnetic field is quite constant over a long period of time.

The average frequency drift during the first 20 minutes is about 400 kc. In designing a tuner, consideration should be given toward compensating for frequency drift due to temperature change.

With the oscillator circuit tuning fixed near 900 megacycles, the average spread in frequency among 25 sample tubes was approximately 20 megacycles.

Measurements of sixty-cycle hum indicate that the hum and noise level is down more than 60 db below the carrier level. With d-c operated heaters, the noise-to-carrier ratio is better than -75 db. The radio-frequency spectrum, as observed on a spectrum analyzer, shows only a single-frequency signal when observed over a bandwidth up to 60 megacycles.

Several tests made to determine the effect of variations of cathode-anode alignment with respect to the tube pins indicate that once the magnet has been aligned for minimum plate current, further adjustment of its position in replacing tubes is unnecessary. However, the initial alignment of the magnet to within a few degrees may be necessary. Design activity on the magnet structure is under way and future designs may possibly eliminate the alignment procedure.

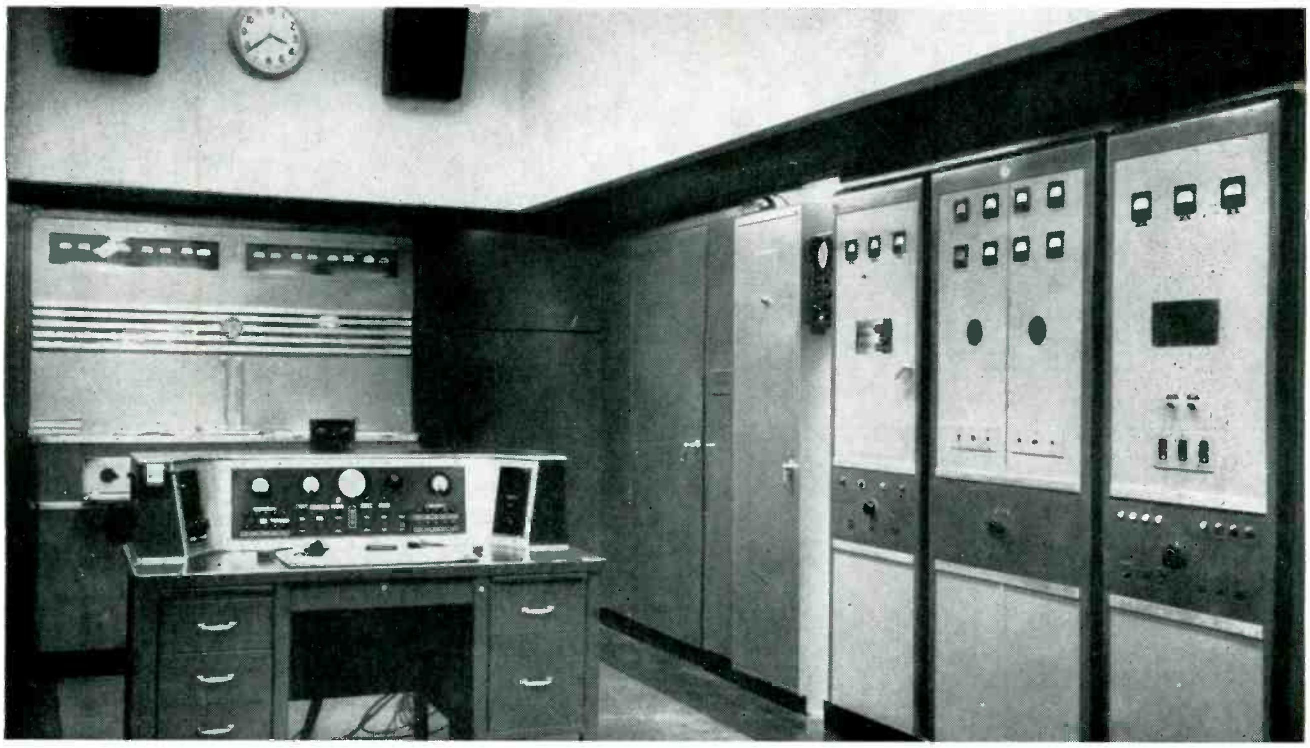
Conclusion

Although the miniature magnetron has been designed primarily for use as a local oscillator its application is not necessarily limited to this service. The extreme frequency range, 0 to 1,000 mc, and relatively large output make it an intriguing tool in such apparatus as signal generators, transmitters operating in the citizen's band, and wherever a low power, compact, and stable source of r-f energy is required.

Availability

The Z-2061 is not currently commercially available. Shortages of cobalt and nickel which are essential in the manufacturing of Alnico V have necessarily curtailed any production plans for the tube.

The authors wish to acknowledge the valuable assistance of C. R. Knight and L. U. Hamvas of the Advanced Development Section of the Tube Divisions in the design and development of this tube.



Complete emergency television transmitter with filaments lighted. In event of main transmitter failure, operator flicks toggle switch and moves chair to emergency console. Coaxial cable run starts behind false wall back of clock and continues around to right. Tall cabinet to left of oscilloscope houses 2,000-mc link that programs Bridgeport uhf experimental transmitter

Reducing Outage

By LESTER A. LOONEY and FREDERICK C. EVERETT

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National Broadcasting Co., Inc.
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With the installation of a new television and frequency-modulation antenna for the National Broadcasting Company, atop the Empire State Building,[1] some innovations were made in the feed arrangements between the tv and f-m transmitters and the antenna.

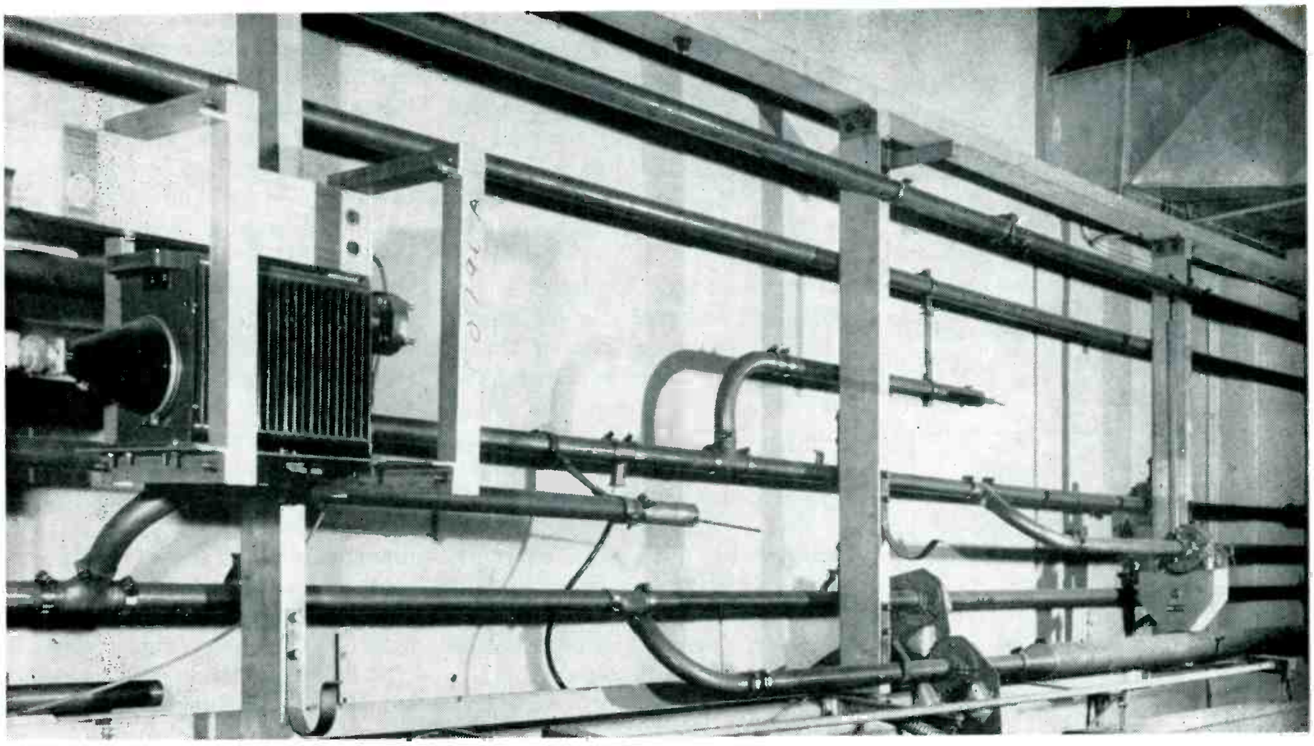
The time charges at WNBT have now reached $4,000 an hour. Added to this figure must be such items as talent costs. It can be seen that with even a short-time outage, serious financial losses can result. At the present state of the art, it is virtually impossible to eliminate transmitter outages completely, tube failures being one important factor.

To provide tv operation with a minimum of outages, a second tv transmitter, picture and sound, has been used for emergencies. This transmitter, in the past, was normally connected to an emergency antenna, which allowed its immediate use when needed, by merely applying plate voltage. Facilities were provided whereby the coaxial lines could be opened up and elbows moved to plug the emergency transmitters into the regular antenna, but this was cumbersome and could result in delay and lost air time.

Because the emergency antenna had lower gain than the regular antenna, in case of transmitter failure the operator was faced with a difficult choice whether to switch transmitters, make repairs, or sacrifice coverage by operating on the emergency antenna. Should he elect to rectify the trouble he might later regret his selection because it might have been quicker to spend a few minutes in changing transmitters.

The new arrangement here described, makes it possible to switch emergency sound or video transmitters to the regular antenna and to do so practically instantaneously.

Referring to Fig. 1, the outputs of two transmitters are joined together and to the antenna feed by means of a tee. Back a quarter wave toward each transmitter is placed a transmission line switch



Top two lines carry f-m. Next line down is emergency sound. It passes through coax switch. To it is attached compensating stub near center of picture. Regular sound line comes in from right through another coax switch and joins extension of emergency sound line. Next lines visible are emergency picture and regular picture lines

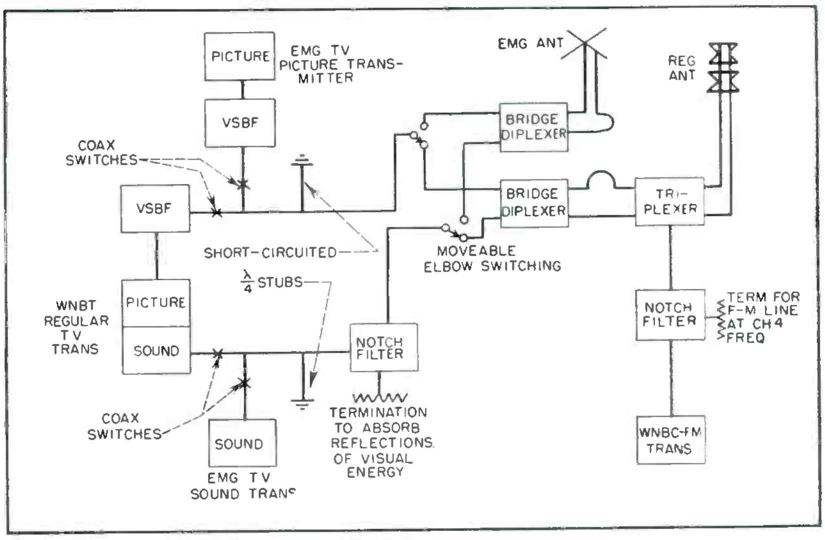
at WNBT and WNBC-FM

With television time charges at $4,000 an hour, transmitter outages can no longer be tolerated. Standard coaxial lines and iris-type shorting switches uniquely arranged allow a quick changeover to the emergency transmitter without interaction with f-m equipment triplexed to same antenna

of the short-circuiting iris type. A short circuit on the unused transmitter line is reflected as an open circuit at the tee connection and allows the signal from the transmitter in use to proceed along the line toward the antenna.

These switches were originally designed for power cut-back systems in f-m transmitters and were not considered sufficiently broad banded for tv use. Furthermore, the presence of the tee fitting and the quarter-wave stub left on the other leg of the tee produces a certain additional amount of discontinuity on the transmission line.

By placing an adjustable, short-circuited, quarter-wave stub a



Complete transmitter and antenna system used at WNBT and WNBC-FM

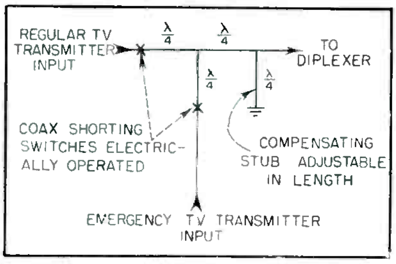


FIG. 1—Elementary arrangement of coaxial shorting switches and compensating stub for emergency transmitter changeover

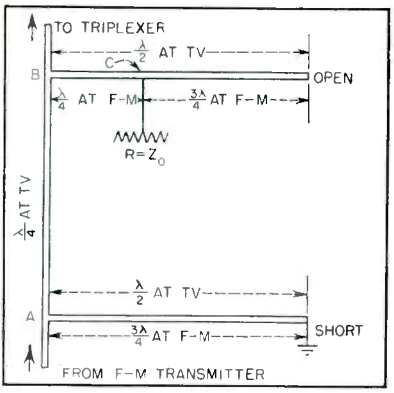


FIG. 2—First approximation of a filter interposed between the WNBC-FM transmitter and common-antenna triplexer

quarter wavelength farther along the line toward the antenna, it was possible to broad-band the switching system. It is a well-known principle that two identical discontinuities a quarter wave apart will cause nearly complete compensation for each other over a relatively wide frequency range.

Before installation the effect of the switching without the compensating stub was checked and while the discontinuity was small, it was easily detectable. With the compensation, the effect is hardly measurable and the stub can be adjusted in advance by the utilization of sweep methods. It was probably not necessary to supply a compensating stub on the sound line, the standing-wave-ratio requirements not being so severe. However, it was simple to build two, so both picture and sound lines were treated similarly.

These transmission line switches are solenoid-operated and are controlled by special five-position switches mounted in the operator's console. To change from one transmitter to the other requires only a flip of the switch. They are suitably interlocked so that the transmitter in use is turned off, the coaxial switch solenoids are pulsed and the other transmitter is turned on in sequence so that the r-f power cannot be applied unless and until the switches are in the proper position.

In practice the switchover is accomplished essentially in the length of time it takes the regular transmitter plate contactors to operate, and the transition is barely recognizable on the air.

Antenna switching between regular and emergency antennas is done by means of double elbows in such a manner that a coaxial patch panel is used. Presumably antenna failures will be few and far between and a few moments longer may be taken to perform this operation.

Triplexer

The tv and f-m signals are all radiated from the same antenna. As the complete tv signal radiated consists of the output of two transmitters, these signals are combined in a diplexer. Similarly, for the f-m signal, a triplexer unit is used. This is a notching type of filter that is now a standard commercial product, originally developed several years ago for the NBC Washington station, WNBW.[2] Similar notch filters are used in such applications as part of the tv vestigial sideband filter.

Due to the physical layout of the station, it would have been almost impossible to install the triplexer close to the f-m transmitter. To do so would have made the tv transmission-line route complex and undesirable. However, since the notching filter in the triplexer consists of tuned circuits (in this case, made of coaxial transmission-line elements) it is vulnerable to impedance presented to its f-m input.

When the triplexer had been installed in a convenient place, the distance back to the f-m transmitter was in the order of 90 feet. The f-m transmitter output circuit presents some variable impedance—which may be variable in value due to tuning. But even if the impedance has a fixed value, as it goes through the length of transmission line connected to it, the values presented along the line go through a complete cycle every half wavelength. This means that at the end of this line containing a large number of half wavelengths, the impedance varies rapidly with frequency. Resonance effects therefore occur with the triplexer circuit elements to cause undesired tv feedthrough into the f-m transmitter with a corresponding mismatch point within the tv frequency band.

Separation Filter

To remove the effect of line length it was desirable to equip the line with a separation filter so designed that the f-m passed through it unimpeded but so made that looking into the f-m line from the triplexer in the direction of the f-m transmitter, the line is terminated in a pure resistance across the tv channel.

A sketch is shown in Fig. 2 of

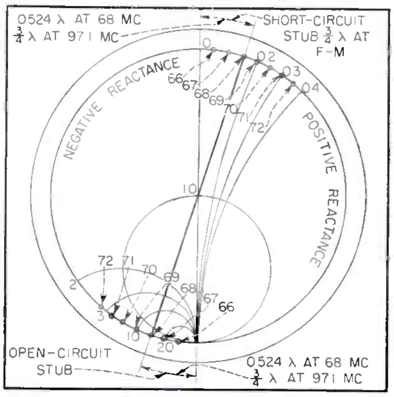


FIG. 3—General method of plotting values of ¾ wavelength f-m lines to find characteristic at television frequencies

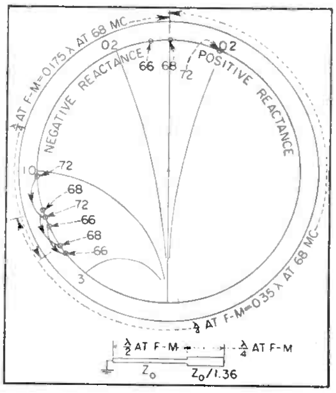


FIG. 4—Fundamental Smith-chart plot shows how short-circuited stub can be modified to have zero impedance at tv midband

the filter, built of coaxial transmission-line elements. The sketch shows the inner conductors only, for simplicity, and indicates that it is installed on the transmission line normally coming out of the f-m transmitter (proceeding in the direction from *A* to *B*).

At point *A* there is a tee that connects a short-circuited stub $\frac{3}{4}$ wavelength long at the f-m frequency. To point *A*, therefore, the stub presents a high or infinite impedance and the f-m signal goes by undisturbed. At point *C* there is an open-circuited stub $\frac{3}{4}$ wavelength at the f-m frequency. This produces a short circuit at the f-m frequency at point *C*. The addition of a resistor at this short circuited point has no effect on the f-m because of this short-circuited condition. Point *C* is joined to the tee at point *B* by an additional quarter wavelength of line that causes a high or infinite impedance to be presented to the f-m at point *B* so the f-m signal goes by undisturbed enroute to the triplexer.

Filter at TV Frequencies

By a fortuitous circumstance, $\frac{3}{4}$ wavelength at the f-m frequency (97.1 mc) is almost exactly a half wavelength at channel 4 (66 to 72 mc). This is not quite true, but for the purposes of discussion it is assumed so. It will be shown later how the discrepancy is handled.

Since the short-circuited line at point *A* is a half wavelength at the picture frequencies now under consideration, it presents a short circuit at this place. The effect of the f-m transmitter is negligible since it is connected to a short-circuited point. The length of line between *A* and *B* is made a quarter wavelength at the picture frequencies so that the short circuit at *A* becomes an open circuit at *B*, in effect disconnecting the f-m transmitter and stubs at that point. Similarly, at *C*, the paralleled stub that is a half wavelength long at tv and open-circuited, produces only an open circuit there, where the resistor is attached.

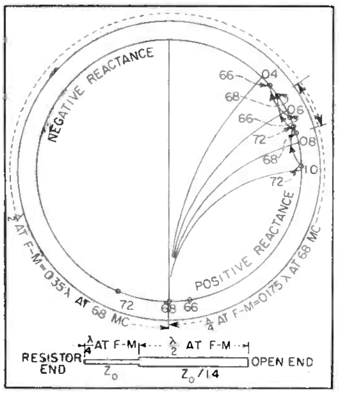


FIG. 5—Open-circuited stub can be formed from two different diameters of inner conductor to represent infinite impedance

Looking into the line from the triplexer in the direction of the filter and f-m transmitter, the line sees the resistor at *C* only at television frequencies. Since this is a termination on the line, the length of the line is no longer significant.

Use of Smith Chart

Figure 3 shows the method of making a Smith chart plot[3] of the open-end short-circuited stubs that are $\frac{3}{4}$ wavelength at f-m frequencies. It can be shown that zero impedance at the start of the stub does not result in a short circuit at the various frequencies in the television band since rotating through $\frac{3}{4}$ wavelength at the f-m frequency is somewhat more than a half wavelength at tv. Similarly, the open-circuit stubs produce various values of impedance which are high, but none of which are infinite in the television band.

However, changing the characteristic impedance of the lines, at the points that are a quarter wavelength or multiples of a quarter wavelength at the f-m frequency can result in correction, if properly done, such that the midband television impedance can be made infinite and zero for the two stubs. This will cause no change in the action of the stubs at f-m frequency.

Figure 4 indicates the method of plotting the short-circuited stub. The first quarter wavelength of the stub is made of a piece of line of lower impedance than the last half wavelength, by changing the diameter of the inner conductor. The impedance of the end of the stub is thus made zero at midband of the television channel.

Similarly, Fig. 5 shows the effect of changing the characteristic impedance of part of the open-circuited stub, causing the television midband impedance to be infinity.

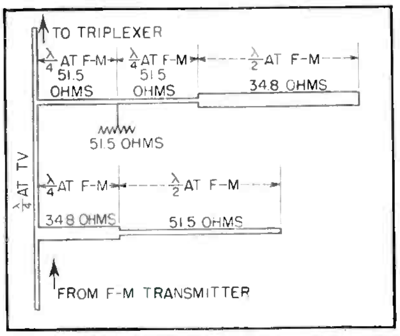


FIG. 6—Completely developed filter differs from that of Fig. 2 by its effectiveness at television frequencies

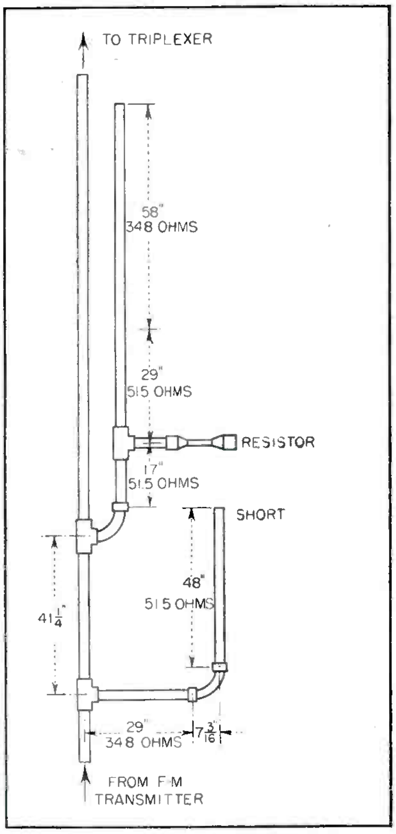


FIG. 7—Physical dimensions of the filter show how it can be constructed from standard fittings

The completely developed filter is shown in Fig. 6, while Fig. 7 gives the physical layout with some folding done to make the unit occupy a reasonable amount of space.

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(1) Frank G. Kear and O. B. Hanson, Television Totem Pole, ELECTRONICS, p 66, Feb. 1951.

(2) L. J. Wolf, Triplex Antenna for Television and F-M, ELECTRONICS, p 88, July 47.

(3) Phillip H. Smith, Improved Transmission Line Calculator, ELECTRONICS, p 130, Jan. 1944.

Nuclear-Resonance

Nuclear-resonance technique makes it possible to regulate a 35-ton magnet with four type 807 tubes to accuracies approaching 0.0025 percent. Servo system control loop is actuated by negative-resistance resonance detector coupled to a proton sample vial of water or mineral oil. Measurements of absolute field obtained with oscilloscope and frequency meter

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RAPID GROWTH of scientific research and development has led to numerous applications requiring the precise measurement or stabilization of magnetic fields. Among the better-known applications that are receiving increased attention in both industrial and basic research are mass spectrometry (gas analysis and mass measurement), magnetron development and cyclotrons.

Previous conventional methods, such as using a search-coil or bismuth spiral for obtaining a correcting or measuring signal directly from a magnetic field are relatively insensitive to small field changes. In addition, absolute measurements with such devices are limited to accuracies of the order of 1 percent. Because of the relative insensitivity of these methods, magnet regulators have usually been designed to regulate the magnet excitation current resulting in stabilization factors of the order of a few thousand.

By the use of nuclear resonance techniques described here it is possible, with relatively simple apparatus, to obtain stabilization factors ranging from 10^5 to 10^6 and to make absolute field measurements with accuracies approaching 0.0025 percent. The techniques involved are largely of a radio-frequency nature and the magnetic field is determined by measuring a frequency.

Protons characterized by a spin I and magnetic moment μ are established in two energy levels when immersed in a magnetic field H_o. These two states differ in energy by an amount

$$\Delta w = \mu H_o/I = h\nu \qquad (1)$$

The division of nuclei between the two states is governed by the Boltzmann factor which gives a slight surplus in the lower state if the proton sample is in thermal equilibrium at ordinary temperatures. Application of a weak radio-frequency field produces transitions between the levels with a net absorption of energy from the r-f field as long as there remains a surplus of protons in the lower state. To fulfill this latter condition, the net energy gained by the protons must be lost to the surrounding lattice.

This process takes place with a characteristic relaxation time T_1. Thus, it can be seen that the absorption of energy from the r-f field tends to upset the normal equilibrium population of the states by equalizing it and the new equilibrium established is a balance between the process of energy absorption by the spin system and transfer of this excess energy to its surroundings.

From Eq. 1 it is seen that the absorption of energy takes place at a single frequency. Actually, if all the active nuclei in the sample see the same field, H_o, the sample shows a small but finite resonance width. In practice, field inhomogeneities spoil this condition and broaden the resonance. The observed line width may be expressed in terms of the frequency width or the magnetic field width at half maximum. A second relaxation time T_2^* is a measure of the inverse line width and is given by $T_2^* = 1/\pi\Delta\nu$ where $\Delta\nu$ is the full line width at half maximum.

Equation 1 can be put in the form

$$\omega_o = \gamma H_o \qquad (2)$$

where $\omega_o = 2\pi\nu$, $\gamma = 2\pi\mu/h$ I and is known as the gyromagnetic ratio of the nucleus. The value of the gyromagnetic ratio of the proton in absolute units has been recently measured[1] with an uncertainty of less than 25 parts per million. This makes it possible to measure magnetic fields with accuracies approaching 25 ppm by means of a relatively simple radio-frequency apparatus for detecting proton

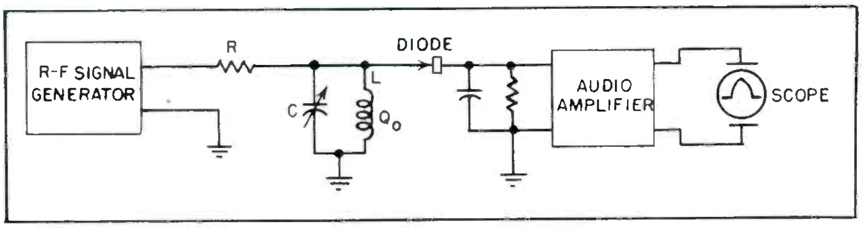

FIG. 1—Basic detector circuit can be modified for control of large magnet

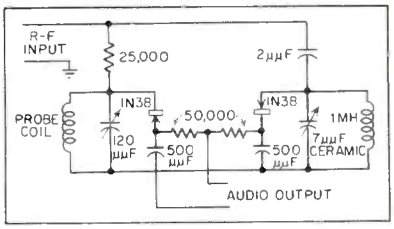

FIG. 2—Amplitude bridge circuit

Magnetic Field Control

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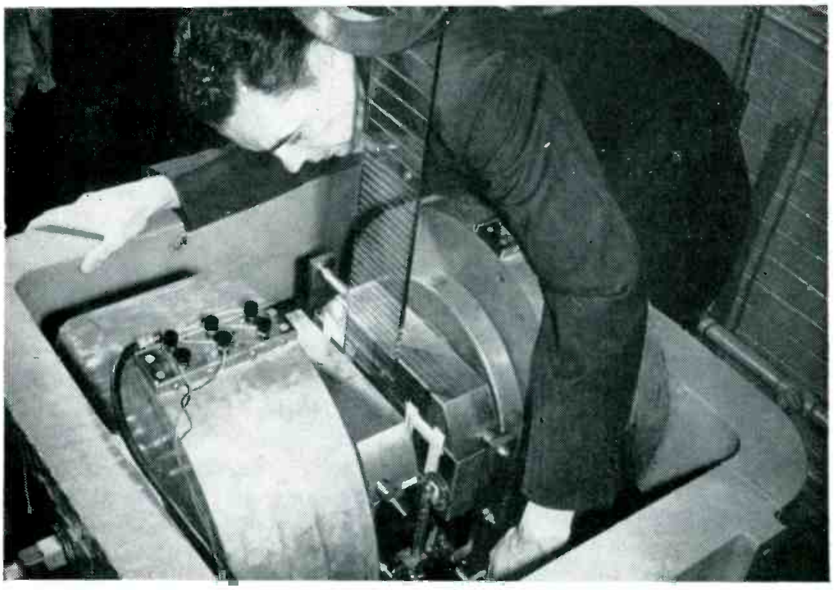


The nuclear resonance probe being used to measure the field distribution of a magnet. The probe, at lower center, is mounted on a crossfeed for accurate positioning in the magnet gap

transitions in a water or oil sample and frequency measuring apparatus that is readily available.

Transition Detector

In the absorption method, the essential apparatus for detecting transitions takes the form of a small r-f coil, approximately 1 cm in diameter for fields of the order of 1,000 to 20,000 gausses, with its axis at right angles to the field H_o. A glass vial containing water or mineral oil may be placed in the r-f coil for the proton sample. The coil is resonated with a capacitor and fed through a high impedance from a signal generator as shown in Fig. 1.

If the field or frequency is adjusted to that value at which the transition takes place, that is, the resonant frequency, power will be absorbed from the coil, the Q will drop, and the r-f voltage across the coil will decrease. It is customary to modulate the field or frequency at an audio rate so that the r-f voltage across the coil will be modulated as the nuclear-resonant condition is passed through. It simply remains, then, to arrange suitable r-f amplifiers, detectors, and audio amplifiers to display the nuclear absorption line on an oscilloscope.

Bloembergen, Purcell, and Pound[2] have shown that the power absorbed per cu cm of sample is given by

$$P\alpha^1 = \frac{\gamma^2 H_1^2 N_o (h\nu)^2 (I+1) I g(\nu)}{6KT} \text{ ergs/sec} \qquad (3)$$

and that where the line width is not the natural line width, T_2, but is broadened by inhomogeneity in the magnetic field, the line shape function, $g(\nu)$, can be conveniently expressed in terms of a relaxation time T_2^* by the relation $T_2^* = g(\nu)/2$. In Eq. 3, K is Boltzmann's constant, T the absolute temperature, N_o the number of active nuclei per cu cm of sample, and H_1 half the magnitude of the r-f magnetic field. The oscillating magnetic field of magnitude $2H_1$ can be considered to be made up of two fields each having a magnitude H_1 and rotating in opposite directions. They have further shown that because of saturation the signal predicted by Eq. 3 is reduced by a factor of two when the optimum r-f field, $2H_1$, is used. This optimum r-f field is given by

$$H_1^2 \gamma^2 T_1 T_2^* = 1 \qquad (4)$$

Substituting these relations into Eq. 3 and introducing the volume of the sample $\upsilon_c\alpha$, where υ_c is the volume of the coil and α is a filling factor for the sample, the total absorption is obtained

$$P\alpha = \frac{v_c\alpha \; N_o (h\nu)^2 I (I+1)}{6KT\,T_1} \text{ ergs/sec} \qquad (5)$$

Power Needed

The power input to the coil required to maintain the optimum value of r-f magnetic field can be easily obtained as follows, if it is remembered that for a simple solenoid approximately all of the energy stored in the magnetic field is contained in the volume of the coil and that H_1 is half the amplitude of the r-f magnetic field. Since energy density is $H^2/8\pi$ the total energy E_o stored in the magnetic field is

$$E_o = H_1^2 v_c / 2\pi \qquad (6)$$

Recalling that $P_o = \omega E_o/Q_o$ and using Eq. 4 and 5 there is obtained the power required to maintain the field H_1

$$P_o = \frac{\omega v_c}{2\pi \gamma^2 T_1 T_2^* Q_o} \qquad (7)$$

where Q_o is the Q of the r-f coil in the absence of an absorption signal.

Now assume that the L-C circuit receives its power, P_o, from a generator having a resistance many times greater than the equivalent shunt resistance, R_o, of the tuned L-C circuit thus making essentially a constant-current circuit in which the loading effect of the generator need not be considered.

Let the voltage across the L-C

circuit in the absence of nuclear absorption be V_o and the change in this voltage due to the peak absorption be ΔV then since $i = (P_o/R_o)^{1/2}$ and $P\alpha = i\Delta V$ we get as a good approximation

$$\Delta V = P_\alpha (R_o/P_o)^{\frac{1}{2}} \qquad (8)$$

Dividing Eq. 5 and 7 by 10^7 to put them into practical units and then substituting them into Eq. 8 we get

$$\Delta V = \frac{I\,(I+1)\,h^2\,\gamma\,N_o\,v_c\alpha}{6\,K\,T\,(10^7)^{\frac{1}{2}}\,v_c^{\frac{1}{2}}} \left(\frac{T_2^*}{T_1} R_0\,Q_o\,\nu^3\right)^{\frac{1}{2}} \text{volts} \qquad (9)$$

The quantity T_2^* is a measure of the inverse line width and is dependent only on the area and maximum value of the line shape curve. If $g(\nu)$, the line-shape function, is that of a simple singly-tuned circuit it may be shown[2] that $\Delta\nu$ the width of the line between half maximum points (on a power basis) is $1/\pi T_2^*$. From this relationship, Eq. 7, and the relation that $\omega_o = \gamma\, H_o$ it may be shown that the power required to maintain the optimum r-f field is

$$P_o = \frac{H_o\,H_2\,v_c}{4\pi\,T_1\,Q_o} \qquad (10)$$

where H_2 is the line width at half maximum in oersteds. The coil voltage required to maintain this field is

$$V_o = (P_o\,R_o)^{\frac{1}{2}} = \left(\frac{H_o\,H_2\,v_c\,R_o}{4\pi\,T_1\,Q_o\,10^7}\right)^{\frac{1}{2}} \text{volts} \qquad (11)$$

For a water sample at room temperature, Eq. 7 reduces to

$$\Delta V = 7.5 \times 10^{-17} \left(\frac{T_2^*\,v_c\,R_o\,Q_o\,\nu^3}{T_1}\right)^{\frac{1}{2}} \alpha \text{ volts} \qquad (12)$$

It will be recalled from an earlier discussion that T_2^* is related to the absorption line width and may be expressed either in terms of frequency $\Delta\nu$ or in terms of gausses H_2 by the relations $T_2^* = 1/\pi\Delta\nu = 2/\gamma H_2$.

For pure water, the natural line width is of the order of a few milligausses but the measured line widths are usually much greater than this because of inhomogeneities in the field H_o. Where this is the case, paramagnetic ions may be added to the water sample without appreciably altering the observed line width. Adding ferric nitrate has the advantage that the interaction between the protons and the lattice (surrounding sample) is increased, decreasing the rate of energy transfer and thus decreasing the value of T_1. For pure water T_1 is of the order of 3 sec but by the addition of a small amount of ferric nitrate may be decreased to an order of 10^{-3} to 10^{-4} thus increasing the available signal by a factor of at least 1,000.

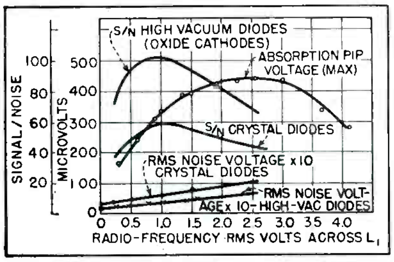


FIG. 3—Signal and noise characteristics of amplitude bridge

In most cases, depending on the field inhomogeneity, it is possible to make T_1 about equal to T_2^*. In practice the optimum condition is obtained by adding the ferric nitrate very slowly while watching the absorption signal grow in magnitude until it is seen that the absorption line starts broadening instead of increasing in magnitude.

Representative Measurement

To illustrate the use of the above equations, the following example of some measurements made with the detector circuit shown in Fig. 2 is given. This circuit is one of the very few that lends itself readily to the absolute measurement of absorption pip magnitudes. With a Q_o of 100, R_o = 4,000 ohms, υ = 1.5 cu cm, $\upsilon_c\,\alpha$ = 0.4 cu cm, ν = 20 mc, and H_o = 4,700 gausses, the line width of an adjusted water sample was 0.5 gauss and the maximum signal occurred at an r-f coil voltage of 2.4 volts. Using Eq. 11 gives a value for T_1 of about 2×10^{-4} sec and substituting this in Eq. 12 indicates that ΔV should be about 1,100 microvolts.

Since the bridge circuit of Fig. 2 reduces the audio output voltage by a factor of 2 and the rectification efficiency of the diodes, ξ, is approximately unity, the output signal should be about 550 μv. This can be compared with the actual observed output voltage of 490 μv. This is closer agreement than would normally be expected. The absorption pip voltage curve of Fig. 3 illustrates the saturation effect mentioned earlier, which gives rise to the optimum r-f coil voltage.

Detection Circuits

Several different types of circuits have been developed for the detection of nuclear resonance signals, only a few of which will be discussed here. The simplest type of circuit is, perhaps, the amplitude bridge[3] circuit shown in Fig. 2 that stems directly from the basic detector of Fig. 1. In that, the coil L containing the water sample is tuned to resonance at the required frequency by C. The resulting resonant circuit having a shunt resonant impedance R_o, is fed from a signal generator through an impedance $R >> R_o$. The change in r-f voltage across the L-C circuit that results when the d-c magnetic field H_o is varied through the value required for nuclear resonance is detected by the diode circuit.

The value of H_o may be varied repetitiously through the critical value by applying a low audio-frequency sweep voltage to small Helmholtz coils mounted on either side of the sample. The resulting audio voltage output of the diode circuit may be amplified and displayed on an oscilloscope.

This circuit is not practical because the noise modulation usually present in the output of the average signal generator will mask the desired signal. In the amplitude bridge of Fig. 2 this noise modulation is cancelled out by having another voltage dividing network and diode detector that detects only the generator noise and then combining the two outputs in phase opposition so that the noise modulation cancels out in the output, whereas the signal does not.

This system does not eliminate noise generated in the diode circuits and, since this is usually much greater than the thermal noise generated in R_o, the circuit has a rather poor noise figure. In spite of this, the circuit will produce quite adequate signal-to-noise ratios as indicated in Fig. 3 and the resonance-line photograph for fields above a few thousand gausses. It displays only the absorption component and is relatively insensitive to microphonics but is not readily tunable. For the latter reason, the circuit is quite satisfactory for use in field-regulator application but not for field measurement.

The photograph shows an amplitude-bridge resonance probe mounted on a crossfeed in a magnet gap for plotting the field distribution. Another probe operating from the same signal generator was used to stabilize the field, while field variations were plotted by noting the bias current through the Helmholtz coils on the movable probe. An inner set of Helmholtz coils is used as magnetic sweep. Relative field measurements of this type can easily be made to 1 part in 10^5.

R-F Bridge Detector

Since the detection of nuclear resonance signals requires detecting a very small change in a relatively large r-f voltage, it would appear that an r-f bridge could be utilized to advantage because the steady component could be reduced to the point where low-noise r-f amplifiers could be used to advantage and also noise modulation of the signal generator could effectively be reduced in the output.

Circuits of this type using a straight r-f bridge[2] and a bridge-T network[4] have been used that show excellent noise figures. These circuits are not particularly applicable to field measurement or regulation, however, because of their complexity, microphony, and critical adjustment required. In addition they are not readily tunable and since they are phase-sensitive as well as amplitude-sensitive they also may indicate the dispersion component of the resonance signal.

It might be noted that resonance absorption, except for the saturation effect, produces a signal much as if a high-Q tuned circuit were coupled into the coil L, thus indicating a reactance term (corresponding to the dispersion component) as well as the resistance term.

As early as 1947, Roberts[5] pointed out that either a superregenerative oscillator or a simple regenerative oscillator could be used as a detector of nuclear-resonance signals and these methods have been used[6,7] to some extent. It appears that the simplest and best circuit for field measurement is a negative-resistance oscillating detector developed by R. D. Huntoon and A. Weiss of the National Bureau of Standards. This is a free-running tunable oscillating detector but a slight modification of the original circuit, replacing a feedback capacitor with a crystal, X, as shown at the bottom of Fig. 4, will stabilize the oscillation frequency at the series-resonant frequency of the crystal and make the same circuit highly suitable for the field stabilization application.

When oscillating at a low level, the magnitude of oscillation of this circuit is extremely sensitive to small changes in impedance of the L-C circuit. While the theory of this circuit as a detector has not been completely worked out nor has the noise figure been measured, comparison of the signal-to-noise ratios obtained between this and other methods of detecting nuclear resonance indicate that it is very good. The required low level of oscillation is obtained by using a reduced plate voltage of only 45 volts and then reducing further by means of the 50,000-ohm variable resistor. In addition, reduced filament voltage can be used if desired.

The audio output signal can be obtained in three different ways. Since a change in r-f level will change the grid bias that will be amplified and will appear in the plate circuit as a superimposed audio voltage, the signal can be taken directly from the plate of one of the tubes through an r-f decoupling network as indicated. The grid bias change can be taken directly off the grid circuit at S. In either of these methods audio noise generated in tube T_1 appears in the output and hence to obtain the best signal-to-noise ratio the diode circuit shown in the lower left-hand corner should be used. The diode circuit is connected across points A and B and the grid-leak capacitor C_1 is changed to 10 μf so that the grid bias cannot change. Audio tube noise is prevented from reaching the diode circuit by the 100-μμf capacitors. This method gives a much better signal-to-noise ratio than either of the other two methods but for most purposes they are good enough.

Field Measurement

From Eq. 2 it can be seen that to measure a magnetic field strength H_o it is only necessary to measure the frequency required for proton resonance in that field. The value[1]

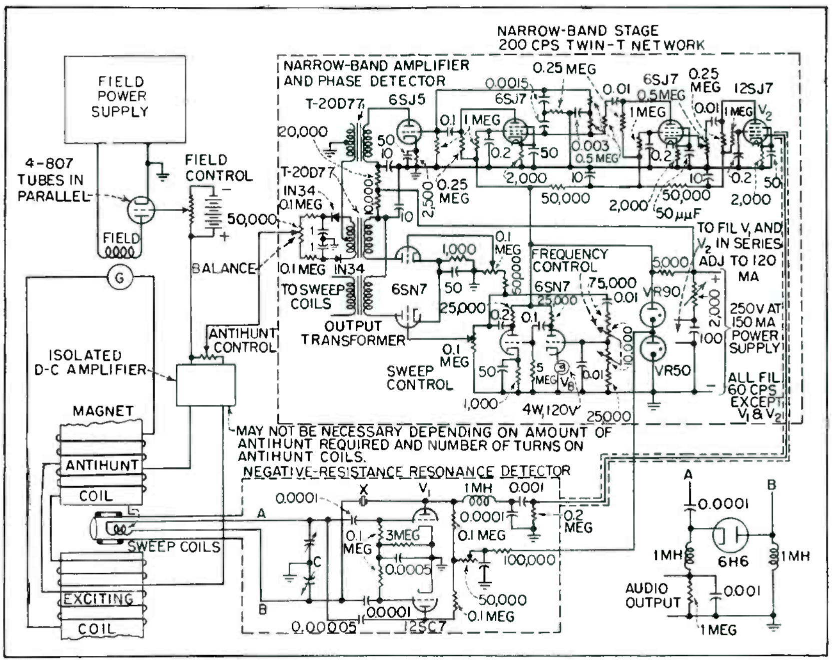


FIG. 4—Circuit of the magnetic regulator applied to control of 35-ton magnet

of γ is $\gamma = (2.67528 \pm 0.00006) \times 10^{-4}$ sec^{-1} gausses^{-1} and since frequency can be easily measured to a few parts per million, the limit of accuracy on field measurements is limited by the uncertainty in γ or the signal-to-noise ratio of the detecting circuit. The signal-to-noise ratio depends on the detector noise figure, the size of the water sample, and the inhomogeneity in the field. The greater the field gradient, the smaller the sample has to be to keep the total line width within a reasonable value.

With the negative-resistance oscillating detector, usable signal-to-noise ratios have been obtained in fields of 4,000 gausses having a gradient of approximately 5 gausses per cm. The sample used in this case was about 2 mm in diameter. With smaller gradients, it can be used in fields as low as a few hundred gausses.

In practice, the circuit shown at the bottom of Fig. 4 is built in the form of a probe with the coil *L* mounted in the end of a brass tube a foot or so long and the rest of the circuit mounted in a small box on the other end. If it is desired to make the complete unit portable, the filament battery (d-c is required to prevent 60-cps modulation), 45-volt plate battery and any additional audio stages can be mounted in a portable carrying case.

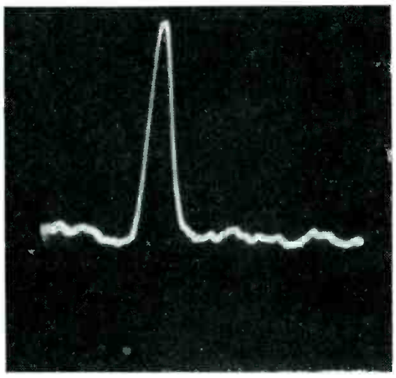
The sweep coils can be excited from 60-cps filament supply if desired. If the sweep voltage is applied to the horizontal input of the scope and the signal output to vertical input, a double trace of the resonance pip will be seen. With a slight phase shift, the pips will be separated slightly and the crossover point makes an excellent indication of the center of resonance. Using a broad sweep, resonance can be approximately located by tuning *C* and then for the final adjustment decreasing the sweep voltage to approximately a line width.

If desired a lock-in amplifier or phase detector similar to that used in the field regulator may be used and the resonance signal indicated on a meter or electron-ray tube instead of an oscilloscope.

The frequency can be measured either by the use of a crystal calibrator unit, wavemeter, or with less accuracy by calibrating the dial on capacitor *C*. Frequency measurement techniques are well known. It should be noted that if the highest precision is to be obtained in field measurement, the shape and type of the sample used must be chosen with care. Water samples with an excessive amount of ferric salts in them sometimes produce a small field shift from the true resonance. Mineral oil samples, though giving a lower signal, have negligible shift[8]. Care must also be used to insure that the sample holder, coil, and shield do not have ferromagnetic impurities.

Magnetic Field Regulation

The nuclear-resonance signal has been used to regulate magnetic fields with good success. It will hold the field to less than 10 percent of a line width and since the error signal is obtained directly from the field, it also corrects for changes in geometry and temperature which the customary current regulator will not do.



Proton resonance line using a water sample adjusted with ferric nitrate

The complete details of a regulator used to regulate a 35-ton magnet[9] have been shown in Fig. 4. In this case the error signal was used to control the field of the main generator and antihunt was obtained by feeding in series with the error signal a rate voltage obtained from an auxiliary magnet winding of small size wire. Because of the high gain of this system, the rate signal had to be amplified by a single-stage floating d-c amplifier. The effect of this rate voltage circuit was to increase the time constant of the magnet from its normal 8 seconds to 17 minutes. The series control tube shown in the field circuit was actually four 807 tubes in parallel, which were quite adequate for controlling the 500-ma, 400-volt field of the 300-ampere generator.

While the method of antihunt and method of introducing the error signal may vary, depending on the magnet design, the rest of the circuit details shown may be used to regulate any magnet. The nuclear-resonance probe used is a crystal-stabilized negative-resistance oscillator described earlier.

The rest of the circuit shows a typical sweep-voltage source (R-C oscillator plus amplifier stage), narrow-band amplifier (twin-T network), and the phase detector circuit. All of these including power supply are mounted on one chassis, and both filament and plate supply for the probe are also obtained from that chassis. The phase detector will not be discussed further as it has already been described[10].

In putting the circuit into operation for the first time it is advisable to use an oscilloscope for locating the resonance line and making the initial adjustments. When locking the magnet in with the nuclear-resonance signal, a fine field adjustment is required since the resonance line is so narrow that it is quite easy to pass through it so fast that the regulator does not have time to pull in. If the feedback phase is wrong, the regulator will try to regulate on either side of the resonance line instead of the center. This may be easily remedied by reversing the sweep-coil leads.

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Job Evaluation Chart

Systematic comparison of advantages and disadvantages offered by various employment opportunities ensures more intelligent decisions. Chart shown below illustrates one engineer's system. It can easily be modified to apply to other individuals and jobs

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CURRENT FLOODS of advertisements pleading for engineers are often bewildering to the average young electronics engineer. Each hiring concern claims certain advantages in living conditions, working conditions, security, and so on. It is usually difficult to evaluate these claims in the true perspective. It is the purpose of this short article to present a flexible system of engineering job evaluation that might be of assistance to engineers considering a change in employment.

The first step is to list all factors that might enter into the selection of a job. In the second step, these factors are weighted in accordance with some arbitrary scale depending on the importance the individual places on each particular factor. The factors and weightings shown in the example of Table I are arbitrary, representing only the views of a particular individual.

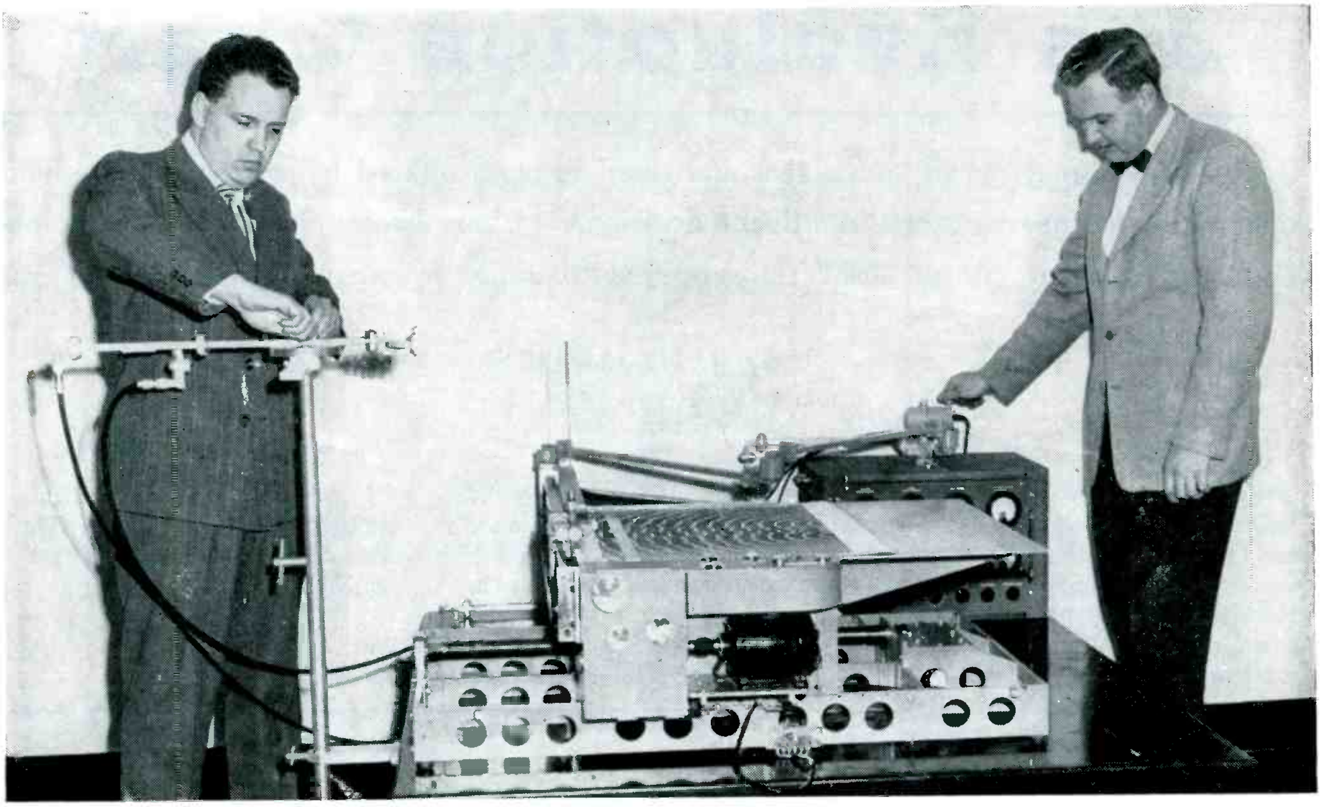
The actual evaluation process consists of considering separately each factor for each job possibility and assigning it an appropriate number with respect to maximum allowable for that particular factor. The results may be tabulated as illustrated in the table. The summation of vertical columns may then be compared with the maximum by any convenient means, the highest sum representing the most desirable situation, and so on.

Particularly close results should be compared separately for more reliable evaluation. The accuracy of the system depends on the amount of thought and effort given to the listing, weighting and evaluating. The latter implies an adequate knowledge of the situation in each case. It is generally desirable, if one has an acquaintance at a particular location, to have him prepare an evaluation as a check.

It is surprising how brown the grass can get on the other side of that fence when this system is applied!

TABLE I—Engineering Job Evaluation Chart

Item	Max. Pts.	Job Possibilities A	B	C	D	E	F
LIVING:							
Weather	20	10	10	5	15	12	20
Housing—cost	15	10	10	5	5	10	15
Housing—availability	15	10	10	10	10	5	15
Housing—location	15	12	11	10	9	7	10
Schools	10	2	10	5	10	10	10
Recreation	10	5	5	7	9	10	5
Traffic	10	5	5	7	8	10	10
Travel to work	10	10	7	6	8	5	5
Moving expense and inconvenience	10	10	10	10	8	6	5
Medical facilities	5	5	5	4	4	4	4
Shopping facilities	5	5	5	4	3	3	5
Neighbors	5	5	5	5	5	5	5
WORKING:							
Supervisor(s)	15	8	7	7	10	15	12
Challenge of job	15	12	14	10	10	10	15
Chance for advancement	20	10	10	15	15	5	20
Prestige of organization	20	15	12	13	18	10	20
Supply and red tape	15	15	12	8	7	15	5
Military relationships	10	10	10	10	7	6	5
Security of future	20	10	5	15	10	5	20
Recognition for work	15	10	10	15	15	10	15
Amount of travel	10	5	5	10	7	8	9
Other opportunities in area	10	10	9	8	6	5	7
Laboratory facilities	15	5	7	10	10	10	15
Policies of organization	20	5	15	12	13	15	15
Salary	30	20	25	30	15	20	20
Value of experience	20	20	10	15	15	15	20
Type of work	20	20	10	15	10	15	20
Totals	**385**	**264**	**254**	**271**	**262**	**251**	**327**
Percent	**100**	**68½**	**66**	**70½**	**68**	**65**	**85**



The authors shown operating the automatic phase-front plotter

Automatic Antenna

Automatic device scans 30 by 36-in. plane in front of microwave antenna and plots full-size map showing either phase or amplitude variations in the plane. Accurate plot eliminates difficult mathematical computing in the near-field region

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IN THE DESIGN of reflectors, horns, lenses and other microwave optical systems, it is necessary to know the shape of the emerging wave front in some detail. The study of such a wave front provides a powerful tool in the analysis and correction of aberrations of the optical device under consideration.

Directional characteristics of antennas are uniquely determined by the near-field phase and amplitude of the radiated signal. Improved methods of determining these parameters have been sorely needed for some time. The machine described herein not only gives accurate information concerning fields but it also presents it in such a way as to be of maximum utility.

Output from the device is in the form of a pair of pictures of the electromagnetic waves as they exist in a plane section through space. One of these pictures is of the phase of the waves and is very much like a photograph of a series of water ripples in a still pond. The other picture, of the wave amplitude, is essentially a contour map of the magnitude of the waves and is read the same as an ordinary geographical contour map.

These graphical representations are not only of inestimable value to the antenna designer in the detailed analysis of antenna aberrations but are also of great value in providing a quick, accurate mental picture of

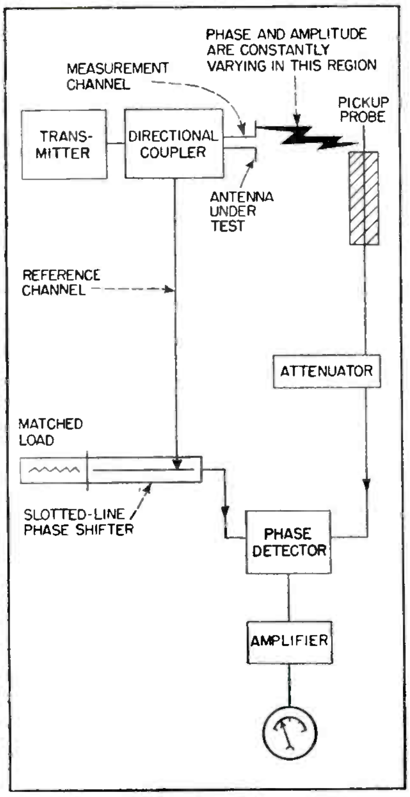


FIG. 1—Manual phase measurement

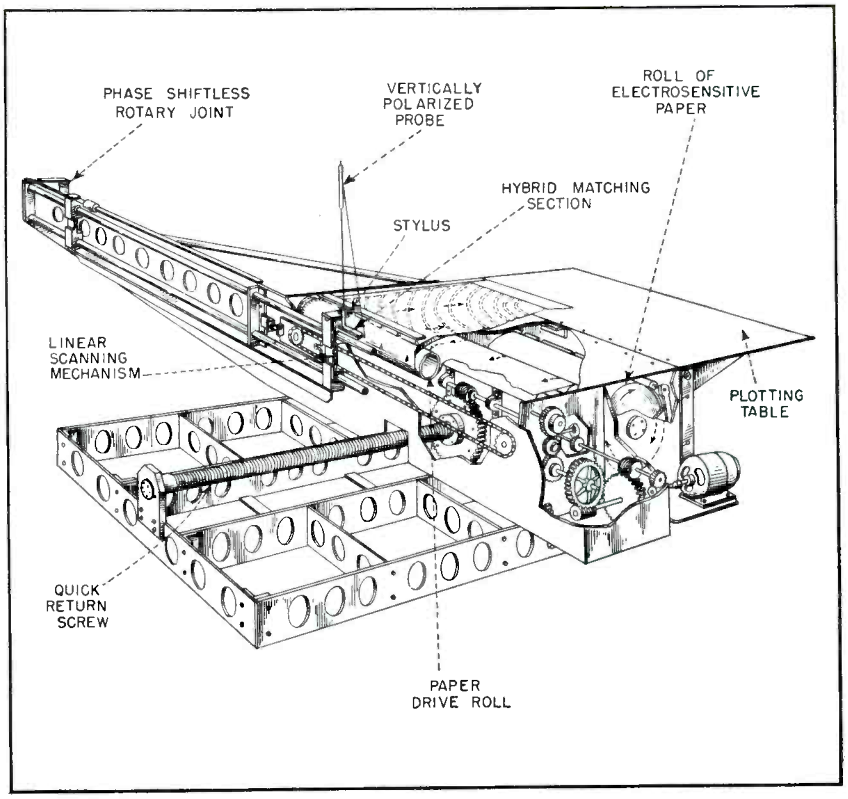


FIG. 2—Cutaway illustration of automatic phase-front plotter

Wave-Front Plotter

the modi operandi of various complex antennas and microwave systems. As an educational tool and an aid to clearer mental concepts of the complexities of electromagnetic propagation, the device has many times proven its worth.

The study of propagation by this technique, where the detailed complexities of refraction, diffraction and reflection can be readily observed, has proven to be particularly fruitful. Even in very complex problems where carefully chosen mathematical approximations and assumed electromagnetic fields are necessary, the available pictures have often saved many laborious hours of computation.

Phase-Front Measurement

The method most commonly employed for phase-front measurements depends upon combining with the pickup probe signal a reference signal of the same frequency and from the same source, whose relative phase and amplitude can be varied independently. These signals are then combined in a phase detector and, keeping the amplitude constant, the phase of the reference signal is varied until the resultant amplitude is minimum. Changes in the phase of the test signal will necessitate equal changes in phase of the reference signal to maintain this minimum.

This method of adjustment of a reference phase for a minimum resultant amplitude is adequately sensitive in practice only if the amplitudes of the test signal and the reference signal are approximately equal. Inasmuch as the amplitude of the test signal will vary over a wide range as the probe is moved through the field, it is necessary to perform continuously a compensating adjustment of the relative amplitude of the test and reference signals. This is a slow and laborious measurement process. Even with provisions for making such an amplitude adjustment, a method of measurement which depends on the adjustment of some variable for a minimum output reading is not entirely satisfactory. This is because small changes in the controlled variable produce only second-order changes in the output when in the neighborhood of a minimum.

In any practical measurement program, it would be necessary to measure the phase and plot several hundred points before a detailed examination of the wave front could be made. As it takes several minutes to make each individual measurement, it can be seen that this method is much too slow and labori-

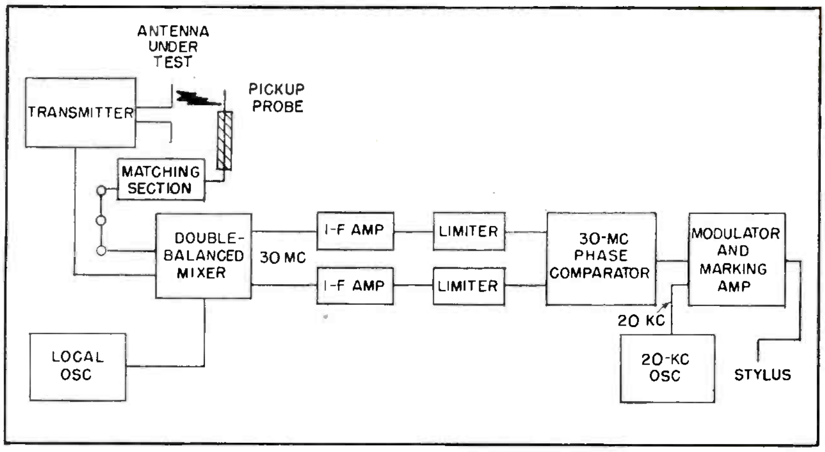


FIG. 3—Block diagram of the plotter system

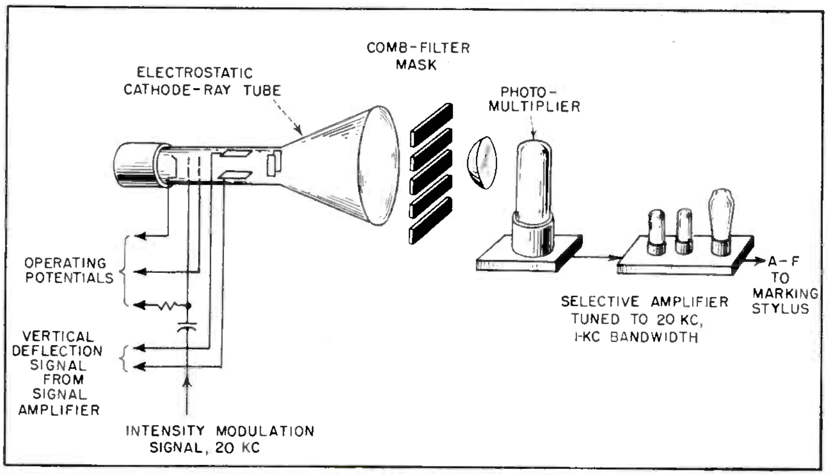


FIG. 4—Operation of comb-type amplitude filter

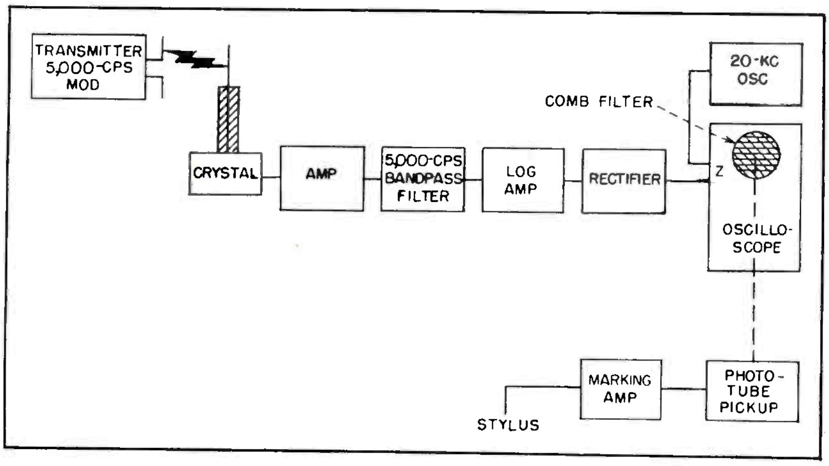


FIG. 5—Block diagram of automatic amplitude-contour-plotter system

ous to be practical in any extensive analysis. There exists a definite need for some form of automatic phase recorder which will automatically perform all necessary balancing and intercomparing functions.

It was the desire of the authors to design and construct equipment that would automatically detect and plot, over a comparatively large area, the phase fronts in a microwave field. It was desired to accomplish these measurements not only in the free-space field but also within solid dielectrics, by scanning close to the surface of the dielectric and utilizing the known relation of the leakage field to the internal field to effectively plot the wave form as it appears within the dielectric.[1]

Automatic Phase Plotting

Phase plotters of the scanning variety were first described by Iams.[2] While his instrument incorporated most of the basic features of an automatic phase-plotting device, it was a rough experimental model and left a lot to be desired in really usable, accurate and automatic phase plotting. The probe scanned the detection space in a circular arc and moved sinusoidally in time, causing a darkening of the chart paper towards the edges of the plot. The basic limitation was, however, the phase comparison mechanism itself. This was sensitive to amplitude fluctuations and would plot phase accurately only over a small range of relative amplitudes.

Since the design and construction of our equipment, another plotter of the scanning variety has been described by Kock.[3] His device used a modulated neon lamp as the stylus and a camera as the recording mechanism. This instrument, however, has the same basic limitation as the Iams plotter in that it is sensitive to amplitude variations.

Referring again to the manual method of measurement, let us examine its essential features as shown in Fig. 1 and consider them in the light of possible adaptation to automatic recording. The r-f source supplies two channels, one passing through the r-f attenuator, the antenna under test and then the pickup probe, while the other passes through the r-f phase changer. These two signals are then combined and detected, with the resultant output indicated on a meter. The r-f phase shifter, which usually consists of a matched slotted line or some other form of line stretcher, can produce known phase changes of the reference signal by motion of the probe along the slot. Thus, any phase change in the test section can be balanced out by means of the phase changer in the reference channel.

Although simple in principle, this type of phase measurement requires a precision matched phase changer and is very sensitive to changes in relative amplitude between the two signals. If the phase changer produces an amplitude variation or if, conversely, the attenuator produces a phase shift when the amplitude is varied, it will be extremely difficult to make an accurate measurement. Some commonly used attenuators have as much as 30-deg phase shift for a 10-db amplitude change.

Phase-Measurement Methods

The methods of phase measurement which are adaptable to automatic recording can roughly be divided into methods which accomplish the phase comparison at the r-f test frequency and methods which use heterodyning to make all phase comparisons at a constant lower frequency. Several variations of the former method were investigated and subsequently eliminated for one reason or another. One such system utilized a waveguide magic tee as a phase detector with probe and reference signal inputs. This resulted in the same disadvantages as the Iams and Kock plotters in that it worked comparatively well over a small range of amplitude but when the probe signal fell below the reference signal level, the stronger reference signal made complete phase cancellation at the magic tee detector output impossible.

In order to overcome this limitation, which is basic to several methods, it would be necessary to maintain constant r-f input to the detector. This presupposes a compensating attenuator without insertion phase shift or else with some means for correcting the varying phase shift introduced as constant amplitude is maintained.

In order to overcome the necessity for amplitude compensation and complexity in circuitry at the r-f test frequency, it was decided to use a heterodyne system where amplitude limiting could be accomplished in both channels.

Circuit Design

Figure 2 shows a cutaway view of the automatic plotter finally evolved. Fig. 3 shows the block diagram of the system. The signal picked up by the probe as it scans back and forth in front of the antenna is introduced into a flat-type hybrid matching section of standard size waveguide. From there it is propagated through three waveguide arms and rotary joints. These are necessary to allow for the scan of the probe without utilizing coaxial cable which produces large phase discrepancies when flexed. The rotary joints were, in fact, completely redesigned to introduce no detectable phase shift due to their rotation. The output of the third rotary joint along with the reference signal from the transmitter are fed into their respective inputs in a flat-type hybrid double-balanced mixer which utilizes a single local oscillator tube to preserve phase coherence.

The two outputs from the mixer, at an i-f value of 30 mc, are fed into two high-gain i-f amplifiers. These amplifiers have a negligible phase shift over a 40-db input variation and are maintained under identical conditions. At the amplifier outputs there are two signals, one constant and the other varying in amplitude. In order to eliminate the phase errors or the necessity for complex balancing systems imposed by variations in amplitude mentioned previously, two stages of limiting were introduced at the output of each i-f strip. The limiter outputs are constant and equal in amplitude over a 40-db input range and vary only in phase as the probe scans. These two signals are then applied to a 30-mc phase comparator which consists of a single diode phase detector. The output of this comparator depends on the phase relation of the two input signals with zero output when the inputs are 180 deg out of phase.

Inasmuch as an a-c high-frequency voltage is necessary for marking the electrosensitive chart paper used, the d-c comparator output is used to modulate the 20-kc oscillator output, which is amplified and applied to the paper by means of a stylus. The pickup probes utilized are three in number: E-field vertical and E-field horizontal polarization and horizontal H-field. The probes consist of a miniature coaxial line (0.033-in. outer-conductor diameter) which is encased in a ⅛-in. diameter rod. At the pickup end there is a series of dielectric loaded decoupling chokes to prevent currents from being set up along the surface of the rod. At the opposite end of the probe, there is a standard type N connector.

After reviewing the characteristics of other types of phase-measuring and phase-plotting devices and after studying the various types of micro-wave fields to be investigated and the type of information required, minimum specifications for a phase-measuring device were evolved. The scan should be linear in time and space. The scanned area should not be less than 30 by 36 in. The device should give a quantitative picture of the entire r-f field in the region of interest. The recorded information should be of such accuracy that it can be used for careful qualitative analysis and design. The device should plot amplitude in the near-field region.

Drive System

With a 30 by 36-in. scan it is possible to plot over a comparatively large area, which is especially advantageous when using this equipment to investigate wide-aperture antenna systems such as lenses, linear arrays and pillboxes. The linear time scan readily eliminates the darkening of chart paper at the edges of the plot. The linear space scan has proven invaluable in scanning close to antennas such as linear arrays and diffraction gratings, rather than approaching only at one point as was the case when the scanning probe moved along a circular path.

To meet the above specifications, a special chain drive with a chain guide pin was designed for the probe and stylus scan. This unique method gives a linear scan over the distance between the vertical centers of the two-chain sprockets which is also the width of the chart paper and when driven with a constant-speed motor produces a scan which is linear in time and space. With each scan of the probe, the chart table and chart are so geared to the probe drive that they roll and move away from the antenna under test approximately one sixty-fourth of an inch. In this way, over a length of chart paper there is a series of closely spaced parallel lines simulating a television-type scan.

As first envisioned, this equipment was only intended for the measurement of r-f phase. However, upon completing the phase-comparison mechanism it was decided to adapt this equipment to plot amplitude contours in the near-field region. In this way, the fields can be probed and the amplitude distribution plotted about the focal regions of lenses and reflectors. To calculate the fields in this near-field region is a complex mathematical problem. Furthermore, little has been done in the past in making precise experimental measurements because of the difficult measurement procedure necessary. Amplitude contour plots supplemented by phase plots made with the equipment described give a fairly complete picture of the near field which can be readily correlated with standard far-field radiation patterns.

As the plotting table and the scanning mechanism were readily adaptable to power contour plotting, this extension of the equipment was primarily a problem in new circuitry.

The major problem in producing amplitude-contour plotting is in obtaining the output necessary for such a device to operate. This is accomplished by feeding the a-m signal through a comb-type amplitude filter which produces an output only when the input signal is at a series of prescribed amplitude levels. Several types of such filters were studied before the cathode-ray type was finally evolved and used. Referring to Fig. 4, this filter operates as follows: The detected signal is applied to the vertical deflection plates of a crt in such a way that the vertical deflection is proportional to the logarithm of the input signal. At the same time, a 20-kc intensity modulation is applied to the electron beam. The face of the crt is covered by an opaque mask containing a series of regularly spaced slit openings. The light output from these openings is detected by a multiplier phototube, amplified and then applied to the marking stylus which burns amplitude contour lines into the paper corresponding to the amplitude levels passed by the slit apertures in the mask. Thus, a continuously varying input is characterized by a series of discontinuous pulses corresponding to prescribed amplitude levels.

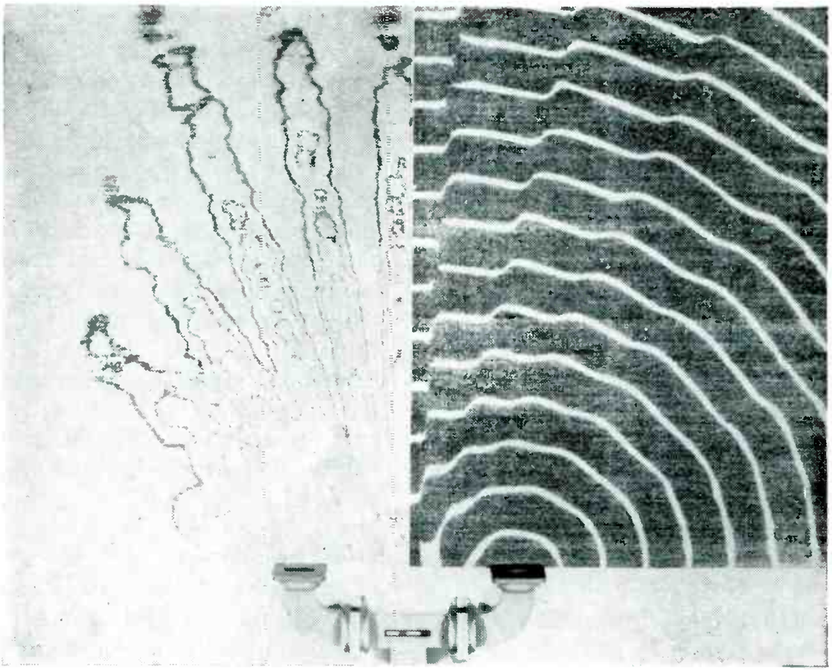


FIG. 6—Amplitude and phase plot of two point sources

Figure 5 shows the block diagram of the amplitude plotting system. The transmitter signal is modulated at 5,000 cycles and detected at the output of the pickup probe. The detected signal is then amplified and introduced into a narrow-band 5,000-cycle filter. After passing through a logarithmic amplifier, it is rectified and applied to the plates of a crt which is intensity-modulated at 20 kc.

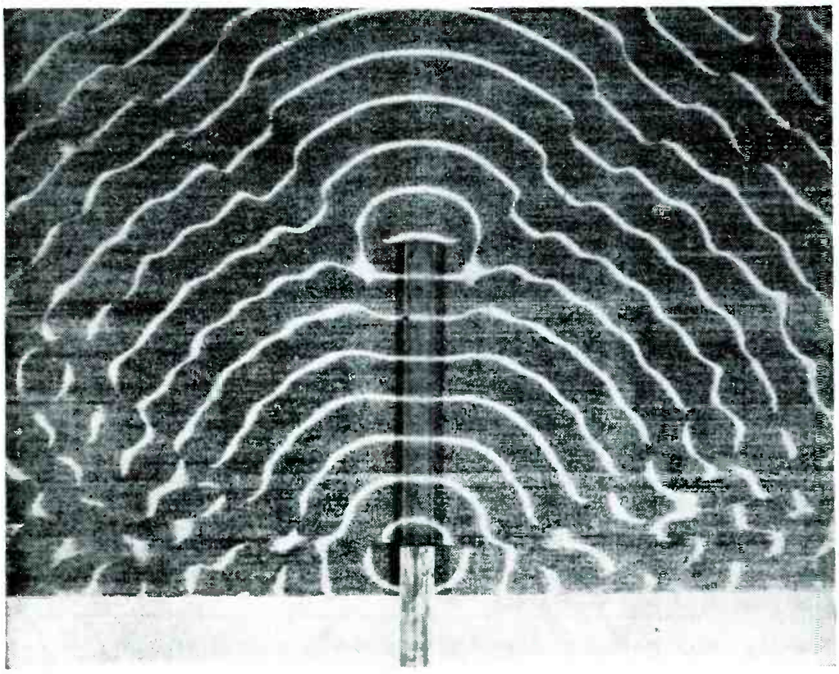
The comb-filter mask is placed over the screen of the crt. In practice, this mask consists of narrow pieces of black photographic tape placed on the face of the tube. As the level of the rectified input to the oscilloscope varies and the spot on the screen passes a slit in the mask, the photomultiplier tube is energized. The output from the phototube is amplified to the potential necessary to mark the paper and is applied to the stylus.

The amplitude plots produced by this method are a series of amplitude contour lines, the number depending on the number of apertures in the filter mask. The levels can be calibrated in order that a contour line will appear for every specified decibel level.

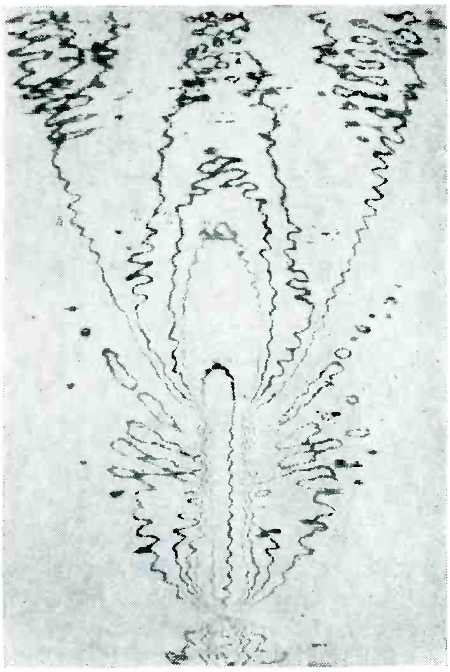
Figure 6 shows a combination of amplitude contours and phase plots of two point sources spaced approximately five wavelengths apart. However, either one plot or the other is actually obtained from the machine at any one time. In the amplitude section, the left half, the lobe structure can be seen and correspondingly whenever a null appears between lobes a phase discontinuity is present in the phase plots of the right half.

Applications

As an example of the use of the machine described above, in the study and analysis of the operation of antenna systems, the plots from a few simple antennas are presented. The plots of the radiation from two point sources, shown in Fig. 6, are typical of the results to be expected from the machine and give a good idea of the average resolution obtained with the equipment in its present form. Modifications now under way are expected to improve the resolution to a marked degree. As can be seen in the amplitude half of the plot, the near-field amplitude pattern of the two point sources is remarkable in that the far-field radiation characteristics with the many lobed patterns are so readily apparent even in the comparatively near-field region. The deep nulls of the amplitude pattern are characterized in the phase half of the plot by sudden 180-deg phase discontinuities.



Phase plot of a polyrod antenna



Amplitude plot of a polyrod antenna

It should also be noted that incomplete nulls are represented in the phase pattern by smaller discontinuities. For shallow nulls a mere ripple appears in the phase front.

The phase pattern of the polyrod antenna shows the characteristic flattening of the wave caused by the phase retardation of energy in and around the polyrod itself with respect to the free-space propagation. The particular polyrod illustrated was so designed that only a comparatively modest amount of energy was radiated from the rod itself, while a large portion of the energy is transmitted to the end of the rod where it is radiated as if from a point source.

The interference of these two radiated signals produces the characteristic hyperbolic interference pattern seen in the figure. This is easily verified from the amplitude plot of this antenna which indicates small radiation along the rod (note rapid lateral amplitude taper) and thus demonstrates the guiding action of the rod. The greater portion of the energy emanates from the end section of the rod and radiates. The phenomenon of isolated amplitude islands is readily apparent.

The phase plot of a typical end fire type metal-clad dielectric antenna is included in Fig. 7. By photographing the phase plot along with a drawing of the antenna, a complete pictorial representation of the phase structure and end-fire characteristics of such an antenna system can readily be seen.

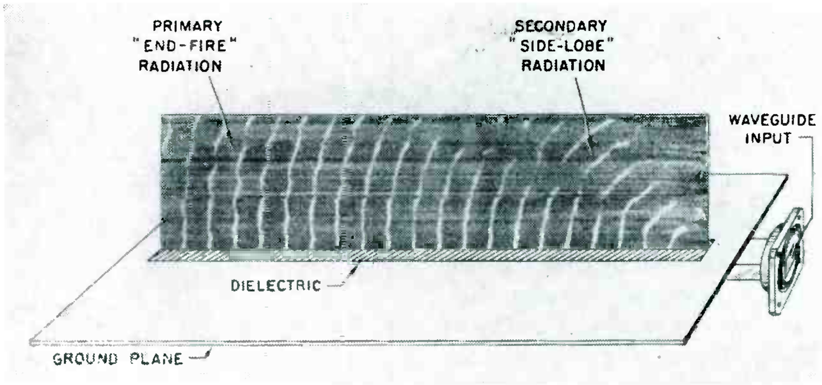


FIG. 7—Phase-front contours of a metal-clad dielectric antenna

The phase-front plotter, as described, is a valuable piece of laboratory equipment for antenna research work. When various types of discontinuities are introduced in solid dielectrics and the probe is scanned close to the surface of the dielectric, the effects of these discontinuities are clearly shown in the plots. In addition, various microwave optical experiments and measurements heretofore impossible or very difficult to conduct are made practical by use of this equipment. Lenses, prisms, multiple-sources and shadow problems are only a few of those which can be completely investigated using the combination phase and amplitude features of the plotter.

The flat-type hybrid used in the equipment design is a development of Dr. Riblet, Microwave Development Laboratories, Waltham, Mass., and the method of amplitude plotting used herein was first suggested and experimentally verified by Walter Rotman.

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Specifications for

THE National Television System Committee released on Nov. 26 the text of 22 technical specifications which describe the compatible color television signal to be field tested over stations in New York, Philadelphia, Washington, Syracuse and Chicago.

The specifications were unanimously approved by the NTSC as the best basis for conducting field tests but have no other significance at this time. Upon the conclusion of the tests, the specifications, modified if necessary in accordance with the results of the tests, are expected to be finally approved by the NTSC and may then be offered to the FCC as proposed standards for compatible color television.

The specifications are divided in two groups. The first consists of nine items summarizing the FCC standards for black-and-white transmission as presently authorized for commercial stations.

The second group consists of 13 specifications related to the transmission of color values.

Reports of participation in the field tests by technical personnel are solicited and should be sent to W. R. G. Baker, NTSC Chairman, care of General Electric Co., Syracuse, New York.

The full text of the test specifications follows:

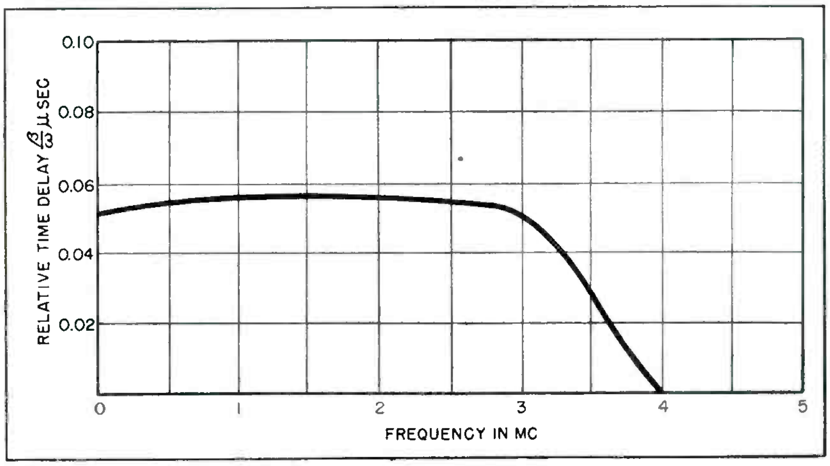


FIG. 1—Delay characteristic of network for compensation of phase distortion associated with cut-off in receiver. Relative time delay versus frequency characteristic of radiated envelope is to be held within + 30 percent and — 0 percent. Ordinate scale may be multiplied by a factor of 1.0 to 1.5

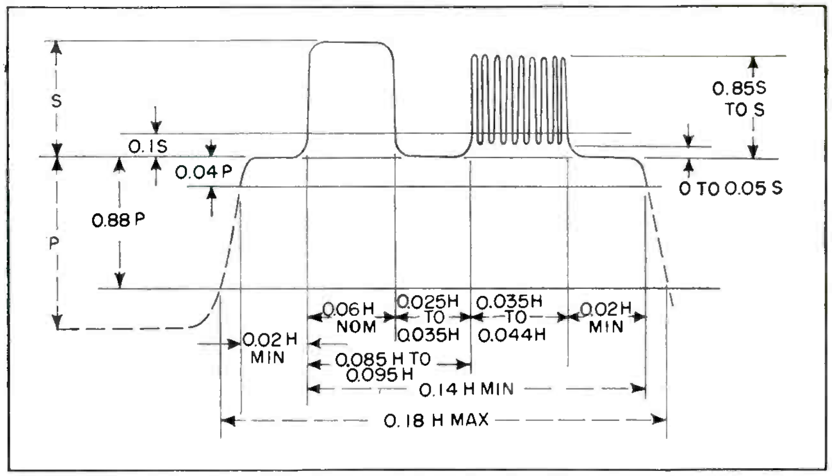


FIG. 2—Color synchronizing signal. This waveform is that which exists at the studio before transmission over limited bandwidth circuits. The burst follows each horizontal pulse. It is omitted following the equalizing pulse and during the broad vertical pulse. Vertical blanking is 0.07 to 0.08 of the vertical scanning period

Group I (Summary of FCC Standards)

1. The image is scanned at uniform velocities from left to right and from top to bottom at 525 lines per frame, 60 fields per second, interlaced 2 to 1.

2. The aspect ratio of the image is 4 units horizontally and 3 units vertically.

3. The black level is fixed at 75 percent (± 2.5 percent) of the peak amplitude of the carrier envelope. The maximum white (brightness) level is not more than 15 percent of the peak carrier amplitude.

4. The horizontal and vertical synchronizing pulses are those specified in Appendix I of the FCC Standards of Good Engineering Practice Concerning Television Broadcasting Stations (for black-and-white transmissions, dated Dec. 19, 1945 as amended Oct. 19, 1950), modified to provide the color synchronizing signal described in specification 21 (Group II).

5. An increase in initial light intensity corresponds to a decrease in the amplitude of the carrier envelope (negative modulation).

6. The television channel occupies a total width of 6 mc. Vestigial-sideband amplitude - modulation transmission is used for the picture signal in accordance with Appendix II of the FCC Standards of Good Engineering Practice.

7. The sound transmission is by frequency modulation, with maximum deviation ± 25 kilocycles, and with preemphasis in accordance with a 75-microsecond time constant.

8. The radiated signals are horizontally polarized.

9. The power of the aural-signal transmitter is not less than 50 percent nor more than 150 percent of

Color TV Field Tests

NTSC releases 22 specifications descriptive of the compatible color signal to be used in forthcoming tests in five cities, urges participation of all interested industry organizations and technical personnel. Signal employs constant-luminance sampling, color phase alternation, and a color subcarrier frequency of 3.898125 mc

---

the peak power of the visual-signal transmitter.

Group II (Supplementary)

10. The color signal has the following composition

$$E_m = E'_y + \frac{1}{1.14}\left[\frac{1}{1.78}(E'_B - E'_y)\sin\omega t + (E'_R - E'_y)\sin(\omega t \pm 90°)\right]$$

where

$$E'_y = 0.59\,E'_G + 0.30\,E'_R + 0.11\,E'_B$$

In this expression the symbols have the following significance:

E_m is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture transmitter.

E'_y is the gamma-corrected voltage of the monochrome (black-and-white) portion of the color signal, corresponding to the given picture element. This signal carries all of the luminance information.

Gamma-corrected voltages E'_G, E'_R, and E'_B correspond to the green, red and blue signals intended for the color picture tube, during the scanning of the given picture element. Value ω is 2 π times the frequency of the color carrier. The phase reference of this frequency is such that the color synchronizing signal (see specification 21 below) corresponds to an amplitude-modulated signal of the form cos ωt, where t is the time.

The plus or minus sign near the end of the expression indicates that the phase of this component is alternately advanced and retarded by 90 degrees on successive scanning fields with respect to the stationary color phase alternation axis, (see specification 20 below).

The portion of the expression between brackets represents the color subcarrier signal which carries the chromatic information.

It is recommended that field-test receivers incorporate a reserve of 10-db gain in the chromatic channel over the gain required by the above expression.

11. The primary colors referred to by E'_R, E'_G, and E'_B have the following chromaticities in the ICI system of specification:

	x	y
Red (R)	0.67	0.33
Green (G)	0.21	0.71
Blue (B)	0.14	0.08

12. The color signal is so proportioned that when the color subcarrier vanishes, the chromaticity reproduced corresponds to illuminant C ($x = 0.310$, $y = 0.316$)

13. Gamma correction is such that the desired pictorial result is obtained on a display device having a transfer gradient (gamma exponent) of 2.75. However, the equipment used is capable of an overall transfer gradient of unity. The voltages E'_y, E'_R, E'_G and E'_B in the expression in specification 10 refer to gamma-corrected signals.

14. The color subcarrier frequency is 3.898125 mc ± 0.001 percent, with a maximum rate of change not to exceed $\frac{1}{3}$ cps per sec.

15. The horizontal scanning frequency is 2/495 times the color subcarrier frequency. This corresponds to 15,750 cps.

16. The bandwidth assigned to the monochrome signal E'_y is in accordance with the FCC standard for black-and-white transmissions.

17. The bandwidth assigned prior to modulation to the chromatic signals (E'_B—E'_y) and (E'_R—E'_y) is not less than 1 mc at 6-db attenuation. A gradual cutoff characteristic is required to be used.

18. The bandwidth assigned to the modulated color subcarrier extends to at least 1 mc at 6-db attenuation below the color subcarrier frequency and to at least 0.4 mc at 6-db attenuation above the color subcarrier frequency.

19. To assure that all the components of the color signal shall coincide in time at the second detector of the receiver, delay compensation is used such that a sinewave, introduced at the transmitter color-signal input terminals, produces a radiated envelope having a relative time delay-vs-frequency characteristic within + 30 percent and − 0 percent of that specified in Fig. 13 of RMA report TS 1.2-3005-A (Figure 1 herewith), except that the ordinate scale may be multiplied by a factor of 1.0 to 1.5.

20. The color phase alternation implied by the (±) sign in specification 10 is such that the color subcarrier phasor representing (E'_R—E'_y) shall lead the phasor representing (E'_B—E'_y) during the scanning field following the vertical sync pulse in diagram (1) of Appendix I of the FCC Standards of Good Engineering Practice Concerning Television Broadcasting Stations, Dec. 19, 1945, and shall lag following the vertical sync pulse shown in diagram (2) of that Appendix. The stationary axis of the color phase alternation corresponds to the (E'_B—E'_y) phasor.

21. The color synchronizing signal is that shown in Fig. 2. This signal corresponds to amplitude modulation of a continuous sinewave of frequency $\omega/2\pi$.

22. Signals outside the assigned channel shall have a level at least 60 db below the peak visual signal amplitude.

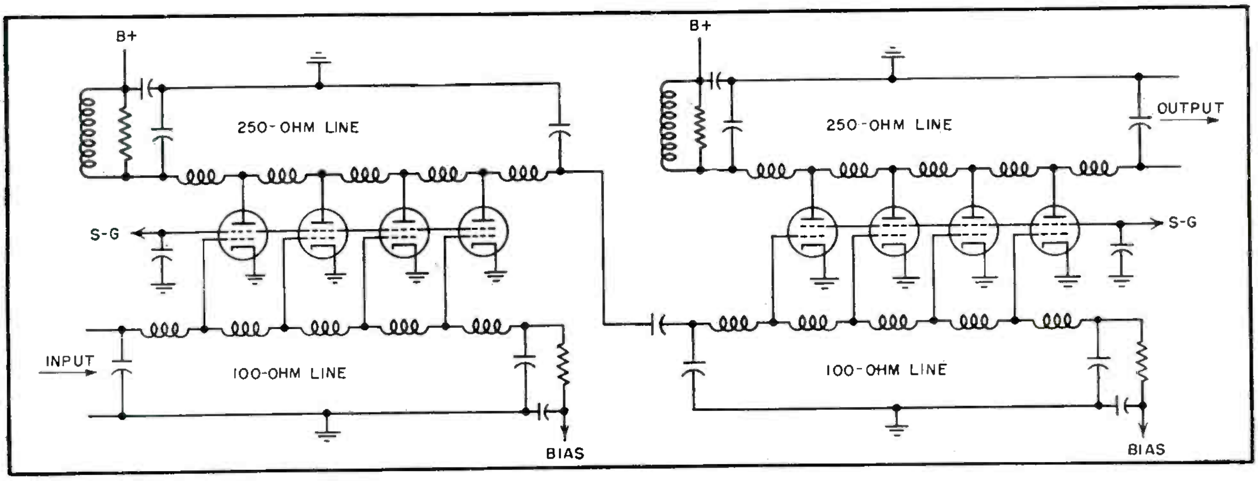


FIG. 1—Circuit diagram showing interconnection of two banks of the distributed-line amplifier. The tubes are all type 4X150A, matched by groups for high and low emission

SHORT-PULSE

Twelve-tube distributed-line amplifier uses three cascaded banks of four 4X150A power tetrodes. Novel circuit layout using standard parts has bandwidth from 1 mc to 100 mc and produces voltage gain of 40 db for oscilloscope presentation of 1-volt pulses

By **GEORGE F. MYERS**

Naval Research Laboratory
Washington, D. C.

THE distributed-line amplification principle can be successfully used for the amplification of short pulses in the order of 10 millimicroseconds using conventional tubes. For pulses considerably shorter than this, conventional tubes no longer satisfy circuit requirements. The amplifier to be described is designed to handle a 15-millimicrosecond pulse, taking it from the one-volt level to one sufficient for oscilloscope presentation. The oscilloscope itself is an experimental model capable of showing pulses in the order of 5 millimicroseconds with negligible jitter.

Design Considerations

The selection of a tube for this circuit is limited to a rather small field since circuit requirements call for a wide frequency response, tetrode or pentode construction, high transconductance, high-current capabilities, low input and output capacitances, and if possible, double-ended construction. The 4X150A power tetrode was selected as having a sufficient number of these qualifications. Its high input capacitance is offset by its good transconductance figure and its high-current capabilities. As a double-ended tube, it is free from oscillation problems.

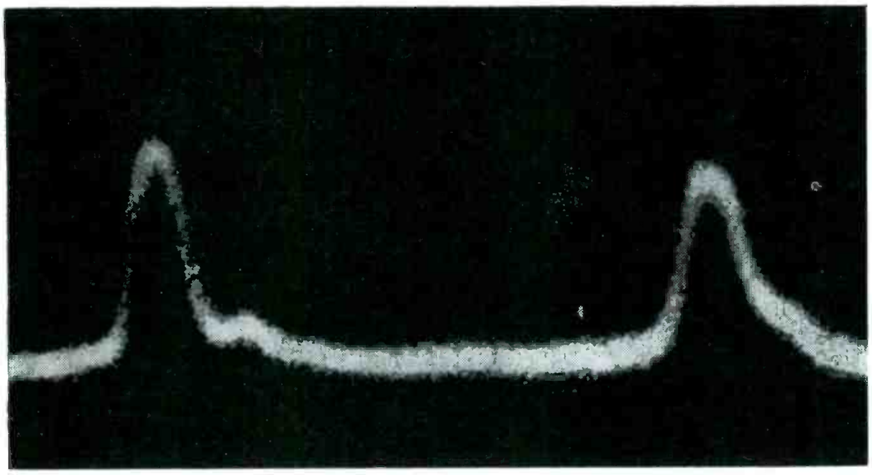
It was decided to use one tube model throughout in this amplifier for the sake of simplicity in power supply requirements and to standardize construction. The selection of this tube then resulted in an arrangement of three banks in cascade, with four tubes per bank.

The schematic form of two of these banks in cascade is shown in Fig. 1. Plate and grid lines are constructed with basic pi-section, constant-*k*, low-pass filter units. A fundamental property of this type of unit is the manner in which its impedance varies with frequency. It is nearly constant over the lower portion of the pass-band (square root of L/C) and rises sharply at the upper end of the pass-band, approaching infinity as the frequency approaches cutoff, for the lossless condition. Thus the gain of the amplifier will rise with the impedance of the filter sections used in the line construction as the cutoff frequency of these lines is approached. This is the origin of the expression "rising gain characteristic" associated with this type of amplifier. Rather than trying to offset this impedance variation and the accompanying phase nonlinearity in the upper region of the pass-band, the line pass-band is arbitrarily chosen as 1.5 times the mum gain per bank. There are three possibilities for cascading when starting out with unequal impedances.

Coupling Systems

The first, transformer action, is ruled out because of the frequency bandwidth, but it can be seen that this ideal method of cascading would result in a voltage loss proportional to the square root of the ratio of the two unequal impedances. The second method would be to reduce the impedance of the plate line to that of the grid line, resulting in a loss in voltage directly proportional to the ratio of the two impedances before reduction. The third and best method in this case is purposely mismatching the two impedances. This results in a voltage less than the ideal transformer method but greater than the equal-impedance method.

No m-derived matching sections or half-sections were employed in the line construction and terminations. The manufacturer's tolerances for this tube are such that little can be gained by the use of such sections unless trimming of these capacitances is employed. Although amplifier performance could be improved by this method it operates successfully without matching. This permits greater

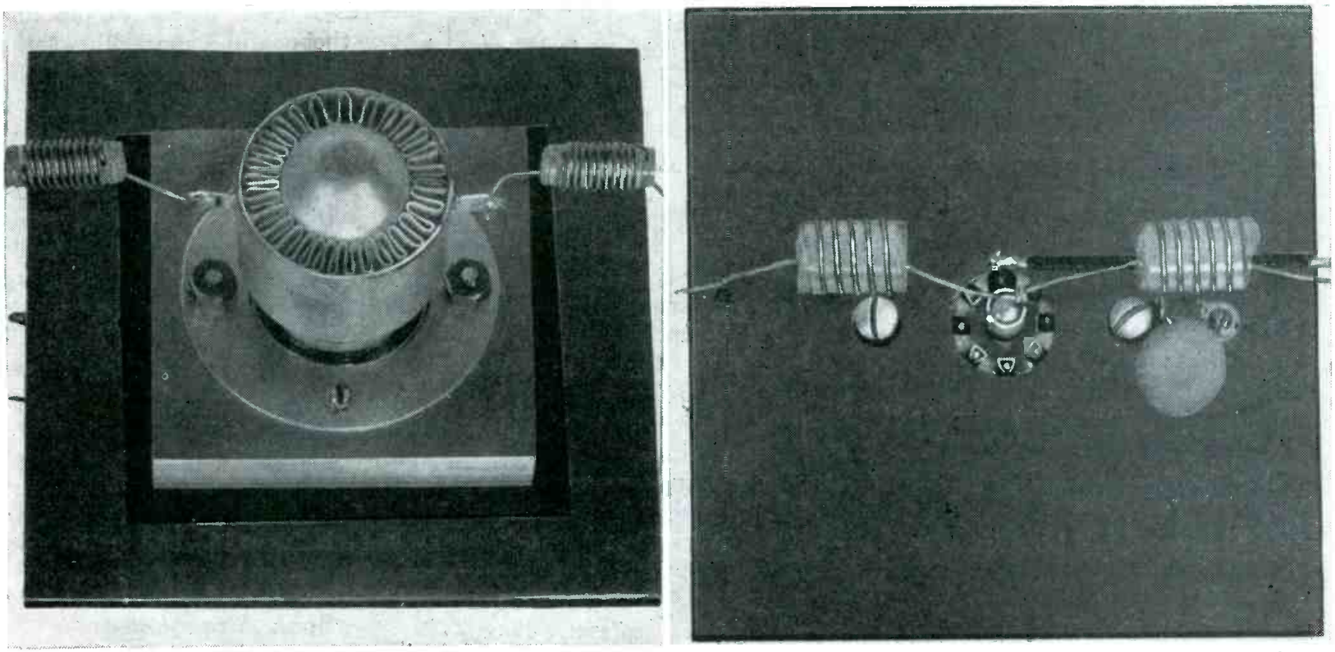


Comparison between 0.015-microsecond pulse directly viewed (left) and delayed and amplified (right), showing how little it is distorted in the amplifier

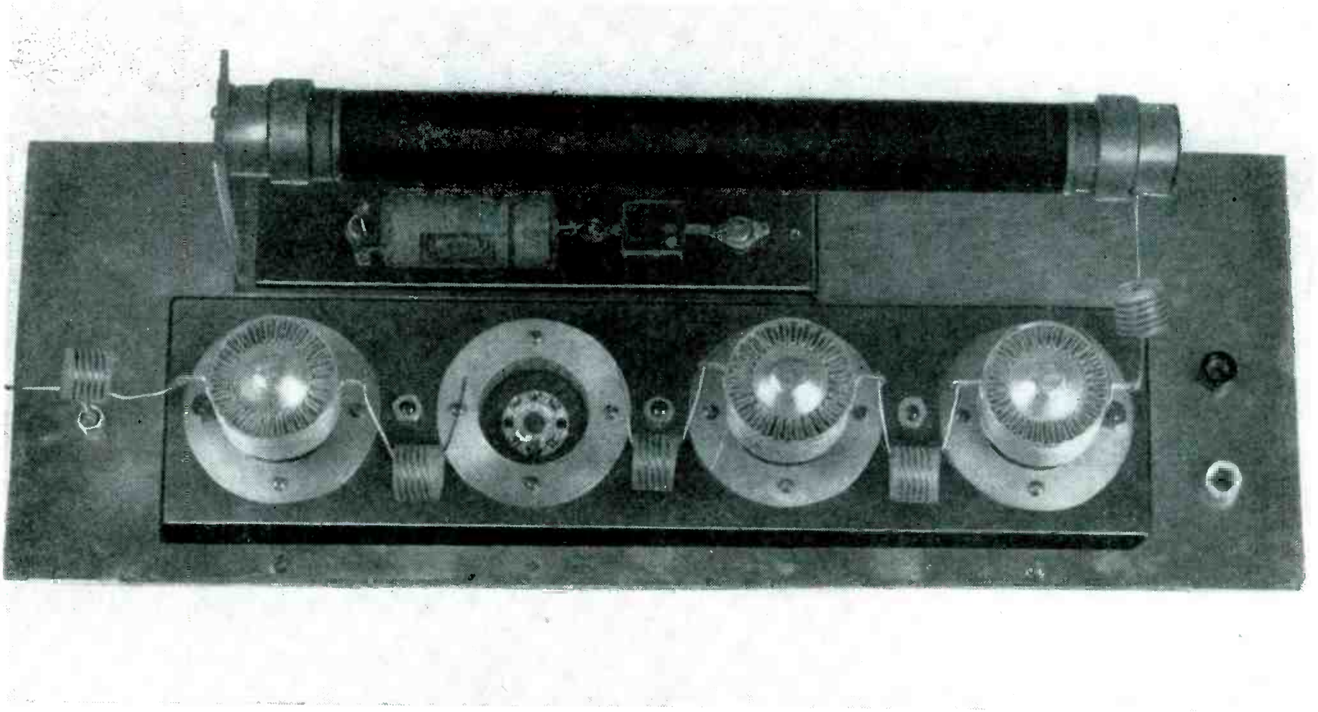
AMPLIFIERS

desired useful bandwidth. The end result is a better impedance match and a more linear phase response over the useful bandwidth.

As is indicated in Fig. 1, grid and plate capacitances are used unpadded as the intermediate shunt arms of the line filters. Filter theory indicates that for a given bandwidth, the magnitude of the line impedance is an inverse function of the shunt-arm capacitance, hence the unpadded plate and grid values of capacitance used will result in maximum impedance possible for the two lines. Since the plate capacitance is smaller, its line impedance will be larger than the grid line. These maximum values of impedance will result in maxi-



Screen-block construction (left) uses insulated chunk of metal above chassis as bypass for screen supply. Underside of block (right) shows positive ground on some tube pins and short projection of grid pin in center



Four-tube bank with one tube removed to show pin connections. Three banks stacked vertically constitute complete amplifier

freedom in standard construction and tube replacement.

The bias-control voltages for all three banks are developed in a common regulated negative supply. Each bank has a separate bleeder circuit that supplies a variable negative bias voltage to each grid line through the terminating resistor. Because groups of four tubes must operate with the same bias voltage, it was found advisable to group all new tubes on initial test into two classes, high-emission and low-emission tubes, using only like-classified tubes in any one bank. This helps to limit the current spread among tubes in a bank.

Equipment Layout

One of the construction features of this amplifier is the screen-block construction illustrated, used to form a low-inductance tube socket. Advantage is taken of the fact that this tube has a ring contact for the screen-grid element between the base and plate end of the tube. A solid block of metal ⅜-inch thick is insulated from the chassis in such a way as to form a good high-frequency bypass capacitance for the screen-supply voltage at which the block is maintained. The tubes are then inserted in spring mounts placed through this block. Contact is made to the plate of the tube by soldering the coils to small projecting lugs on a close-fitting sleeve placed over the plate finning.

The base pins of the tube project into small holes in the ⅛-inch brass chassis. Pins to be grounded fit into small spring clips soldered to the edge of the close-fitting hole, while clearance is given the other pins. Clearance for the ungrounded filament pin is such that contact can be made to this pin by means of a small clip.

Table I—Specifications

Bandwidth	1 mc to 100 mc
Voltage Gain	40 db
Output Voltage	±160 volts
Input Impedance	100 ohms
Output Impedance	250 ohms

The grid pin in the center has sufficient clearance to prevent excessive capacitance coupling to the chassis. This is the only other pin on the base to be contacted and again this is done by means of a small spring clip.

Grid coils are space-wound on ½-inch polystyrene tubing, 8 turns to the inch, while plate coils are space-wound on ¼-inch polystyrene rod, 12 turns to the inch. Plate coils are purposely given a different distributed capacitance figure by geometrical design to help offset the rising gain characteristic of this amplifier.

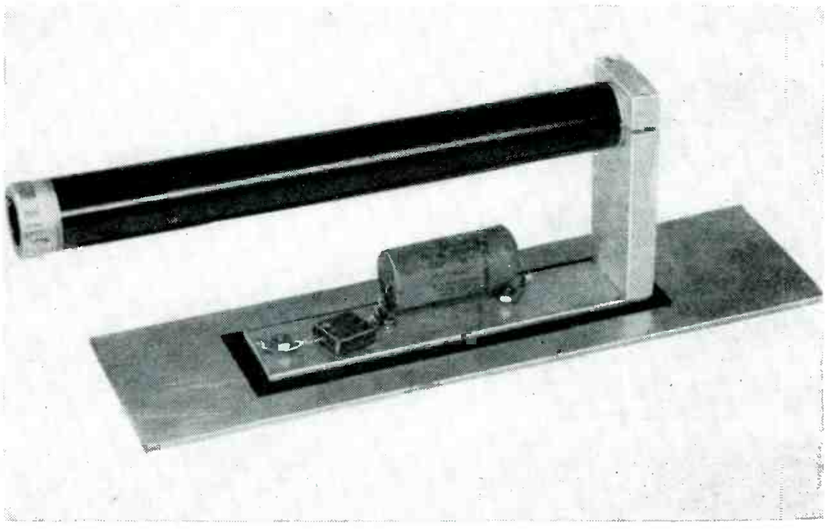
The reverse-termination resistor assembly illustrated makes use of the high-frequency bypass properties of a large plate of metal insulated from the chassis. This plate is maintained at B+ supply potential. To this plate is added capacitance for the purpose of broad-banding its bypass properties and on this plate is mounted the standoff bracket for the reverse-termination carbon-film resistor. This resistor affords a good match to the line over the useful bandwidth of the amplifier and if air-cooled will dissipate 200 watts when conducting the plate current to the tubes. This dissipation is avoided by winding a single-layer helix of No. 27 enameled wire on the outside of this carbon resistor from one end to the other and connecting the winding electrically in parallel with it. This provides a good low-resistance path for the direct current supplied the tubes and does not materially affect the frequency response of the amplifier above 500 kc. The range of pulses considered is amplified as well with this shunt-fed method as with the direct method of supplying d-c to the tubes.

Bank Arrangement

A standard four-tube bank, with one tube removed for display purposes, is shown in the photograph. In operation, the banks are stacked in a vertical plane and a two-inch hole is left in the chassis near the base of the plate resistor standoff to permit feeding the output of one plate line into the input of the next grid line. The signal order is down the first or bottom bank, back in the next bank up, and down the top bank to the output end. Four such banks have been operated successfully in cascade for test purposes, while standard operation of three banks has continued over a period of months. It was found advisable, when cascading, to stagger the line cutoff frequency of any one bank 5 mc above or below the cutoff frequency of the preceding bank, to prevent the rise in gain peak occurring near cutoff from cascading sufficiently to cause oscillation.

Amplifier Performance

The phase response for an amplifier of this type is indicated in Fig. 2. This property is difficult to determine over such a broad band of frequencies so the alternate method of calculating the response is chosen. By taking the deviation per section from linear phase response and multiplying it by the number of sections in the signal path, an overall phase deviation figure is arrived at. This method of phase analysis stresses two points—keep the number of sections in the signal path low and keep the ratio of useful bandwidth to line bandwidth low.



Reverse-termination resistor assembly uses capacitor mounting as one plate of bypass capacitor to chassis

The response of this amplifier to a 15-millimicrosecond pulse is illustrated. By feeding signals to both deflecting plates of the oscilloscope and suitably delaying the signal to one of these plates, both the input and the output pulse of the amplifier under test are shown on one trace. The delayed pulse to the amplifier was attenuated sufficiently to give the amplifier output pulse the proper voltage for comparison with the input shape. With this 15-millimicrosecond pulse, it can be shown that the amplifier distorts the pulse less than does fifty feet of 90-ohm coaxial cable.

The general specifications are listed in Table I. Undistorted output voltages of 160 volts, both positive and negative, are possible with this combination of twelve tubes, with an input signal in the order of two volts. Operation level of 200 milliamperes per tube proved successful, giving a total current of approximately 2.5 amperes at 400 volts for the amplifier. Tube failures were rather frequent until care was taken to insure that filament operation did not exceed 6 volts. After this, only occasional failures were recorded, chiefly during the first hour of the life of the tube. Bias control proved to be an effective means of gain control over a limited range, while variation of the supply voltage for gain control purposes was ruled out owing to the tetrode design of the tube. The main precaution used in the operation of this amplifier, as previously mentioned, was the grouping of tubes into high-current and low-current classes, with the separation of the banks into these classes for the purpose of tube replacements.

Amplifier Limitations

Consideration was given to the maximum bandwidth possibilities of this circuit with the 4X150A tube. Input conductance tests indicate an upper bandwidth limit around 350 mc. In this region the tube input begins to look inductive and can no longer be used as a capacitance shunt-arm without compensating circuits. One breadboard model was tested out to 250 mc with moderate gain, amplifying 5-millimicrosecond pulses. For the best frequency response curve with this circuit and tube combination, there is an optimum cutoff frequency if gain is not the chief consideration. At around 280 mc, the input conductance losses tend to offset the rising gain characteristics of this circuit, and a relatively flat frequency response curve will be achieved with this cutoff.

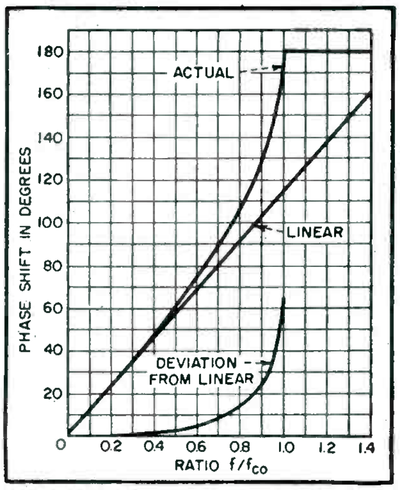


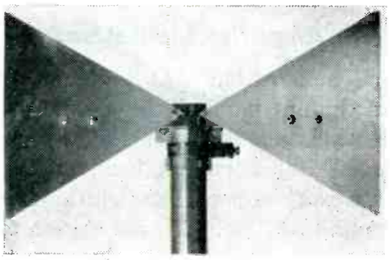
FIG. 2—Phase shift per section of the constant-*k* filter

The writer wishes to express his appreciation to I. W. Fuller, who through diligence and care has eliminated many errors and contradictions from this paper.

REFERENCE

(1) Edward L. Ginzton, William R. Hewlett, John H. Jasberg and Jerre D. Noe, Distributed Amplification, Stanford University Microwave Laboratory Report.

UHF Receiving Antennas

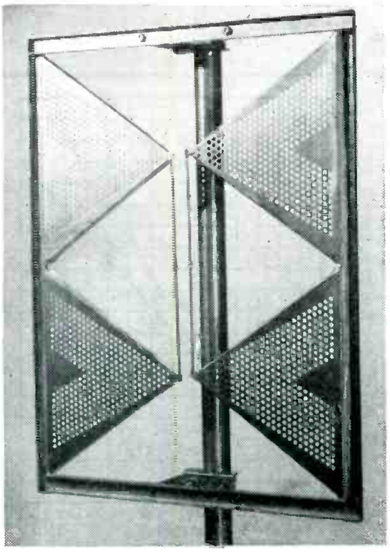


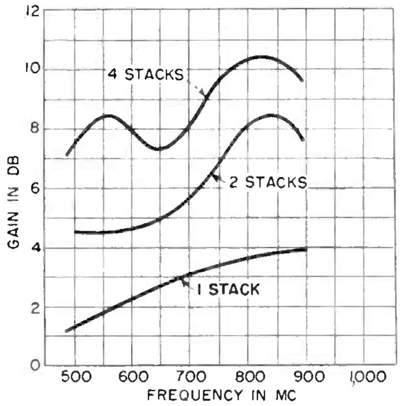
Field tests of wide variety of antennas for 470 to 890-mc uhf television band reveal that the five types shown here are outstanding in performance yet low in cost. All work into 300-ohm line

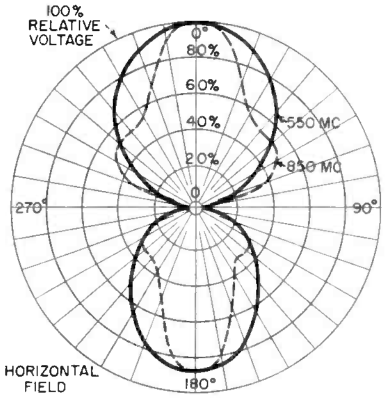
By E. O. JOHNSON and J. D. CALLAGHAN

Advanced Development Section
RCA Victor, Camden, N. J.

RCA Service Company
Gloucester, N. J.



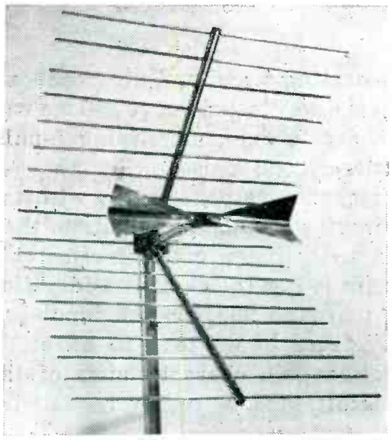


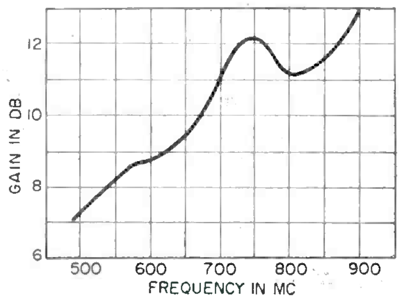


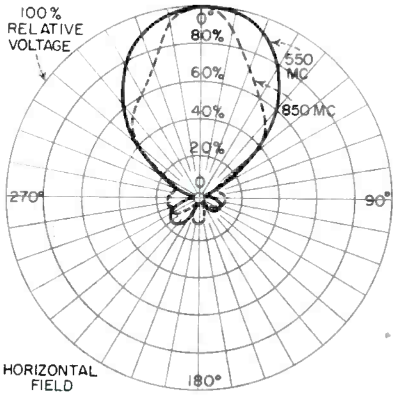
FAN DIPOLE, simplest of all uhf receiving antennas, requires only two triangles of metal supported by an insulating bar. Dipoles are set in metal frame for stacking, which with proper phasing gives greatly increased gain. Bandwidth is excellent. Stacking narrows vertical directivity but does not affect horizontal directivity. Four-stack unit uses two two-stack units connected by twin-lead

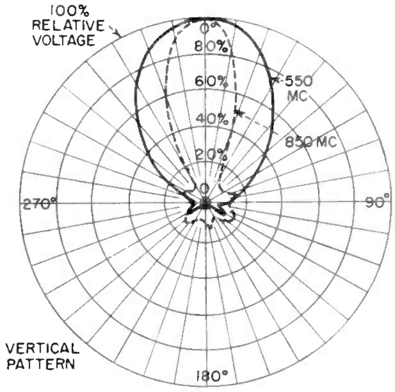
* * *

CORNER REFLECTOR having 90-degree included angle, using fan-dipole element also folded at 90 degrees, gives ultimate in gain for its compact size. It should be one of best fringe-area uhf antennas, being truly unidirectional in both horizontal and vertical planes. Negligibly small unwanted lobes minimize reflection and multipath troubles. On all gain curves here, 0 db reference is gain of thin half-wave dipole adjusted to resonance at each frequency and matched into 300 ohms









Type of Transmission Line	Loss in db per 100 feet					
	100 mc		500 mc		1,000 mc	
	Dry	Wet	Dry	Wet	Dry	Wet
Standard 300-Ohm Flat Line....	1.2	7.3	3.2	20.0	5.0	30.0
Tubular 300-Ohm Line.........	1.1	2.5	3.0	6.8	4.6	10.0
RG 59/U Coaxial Cable........	3.7	...	9.6	....	14.5	....
RG 11/U Coaxial Cable........	1.9	...	5.2	...	7.8	...

(Continued on p 134)

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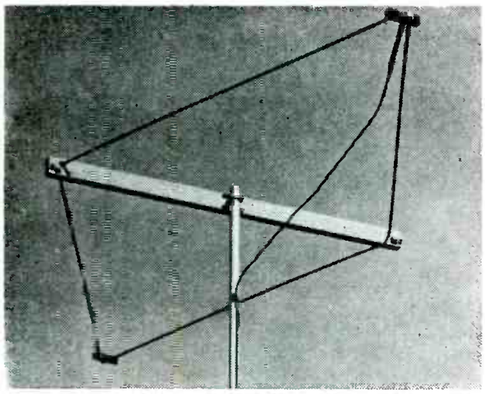
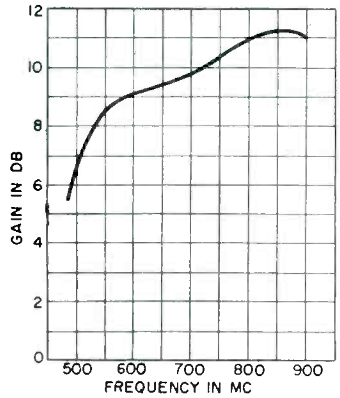
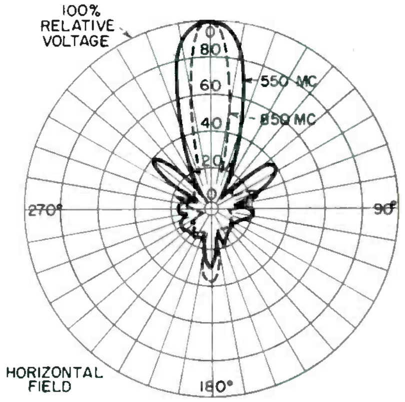
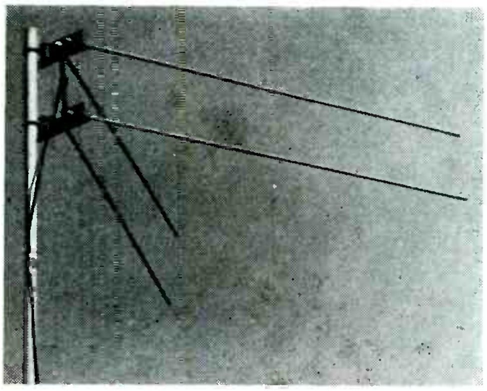
UHF Receiving Antennas (continued from page 132)

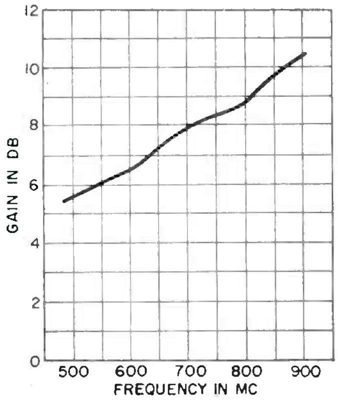


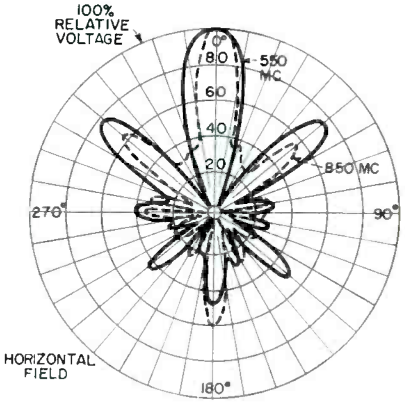




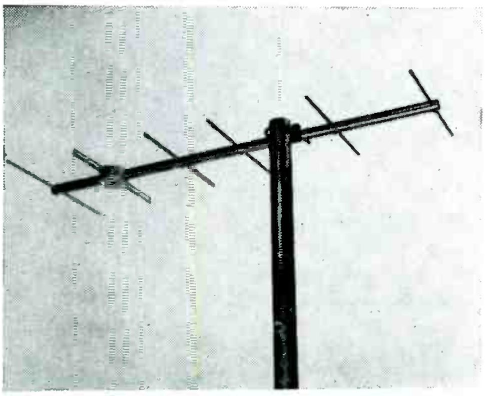
RHOMBICS more than several wavelengths on a leg proved highly successful in uhf field tests when adjusted and terminated for unidirectional operation. Gain is adequately high for fringe areas. Major forward lobe is quite narrow and decreases with frequency as shown. Major vertical lobe, not shown, is about three times as broad as corresponding horizontal lobe. Minor side and back lobes may give trouble in severe cases of reflection or multipath reception. Stacking two of these rhombics 12 inches apart increases gain 2 db across entire band and increases vertical directivity but does not affect horizontal directivity. Rising gain characteristic with frequency is desirable

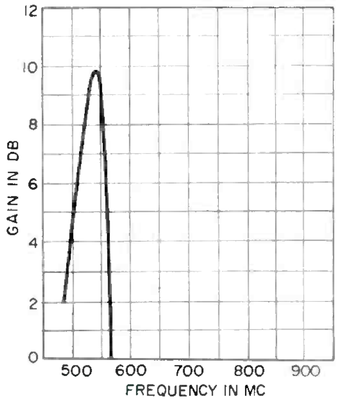


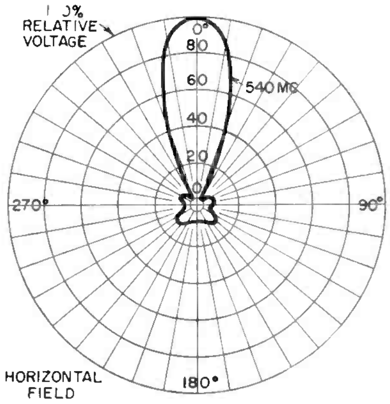




STACKED V antenna uses same rods as standard dipole cut for channel 2 and thus contains about same amount of metal as simple vhf dipole and reflector. Efficiency is good considering simplicity of construction and ease of mounting on existing masts. Gain is high enough for medium and weak signal areas and increases desirably with frequency to overcome propagation and transmission-line losses that increase with frequency. Bandwidth is excellent, but directivity pattern shows lobes that restrict use to areas reasonably free of reflections. Chief trouble with regular vhf antennas on uhf is large number of such secondary lobes and fact that major lobe is usually off the antenna axis







YAGI antennas give more gain for size and weight than any other type of uhf antenna, if close dimensional tolerances are held during construction. Unit shown is 6-element widespaced type with 28-inch overall length. Though gain shown is adequate for most weak-signal areas, stacking gives still higher gains. Peak gain is obtained only on one channel, but total of 7 uhf channels can be covered with sacrifice of only 3-db gain at ends of pass band. Helical and slot-type antennas also adapt readily to uhf use. A balun is used for matching to coax and also gives lightning protection if its shell is adequately grounded. Standard lightning arresters have excessive losses at uhf

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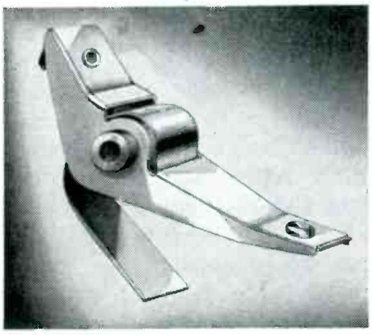

An example of Mallory contact assembly engineering is a tungsten contact assembly for an outboard motor magneto which had to withstand the impact of millions of cycles . . . resist salt water corrosion . . . maintain constant shape and uniform spring action . . . and hold the precise tolerances despite temperature and humidity changes.

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TUBES AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

1,000-Cycle Warning Device

By Philip Whitney

Chief Engineer
Stations WINC and WRFL
Winchester, Va.

This Easily Constructed monitoring device has proven foolproof and positive in action, supplying two types of warning signals, a loud 1,000-cycle tone and a loud bell or brilliant warning light. The latter two are optional but it is recommended that they be included especially in an application where the operator or announcer must concentrate on other duties. The parts for the unit are easily obtainable receiver parts and two surplus tuned audio circuits from the Hammarlund Fleet-Control units.

The input is arranged to bridge a 600-ohm line with no appreciable attenuation. The input coupling transformer is a common, interstage receiver audio transformer with a 2,700-ohm resistor in each leg. The high-mu triodes were used because of the simplicity of the design and conservation of parts by avoiding the necessity of supplying screen voltages.

A 6SF5 was also chosen instead of a gas-type tube for the relay-control tube first because once the gas tube has been ionized, it must be reset; secondly because the high-mu triode is much less critical and more stable with line-voltage fluctuations and last because there are only three types of tubes used in the complete unit, thus cutting down inventories at the station.

It will be necessary to add either a one-μf capacitor or two 0.5-μf capacitors to each capacitor which is contained in the original audio tuned circuit. This was designed to operate at about 6,000 cycles but it will operate very well at 1,000 cycles with the added capacitance. The two stages of tuned audio resonate very sharply at 1,000 cycles and feed two resistance-coupled audio stages which drive a small speaker and also supply the voltage which is rectified by the 1N34 crystal. This voltage is applied to an integrating network. At the levels commonly encountered on network lines, the capacitor will be charged to the required voltage to make the relay control tube pull the relay in after from 6 to 10 seconds.

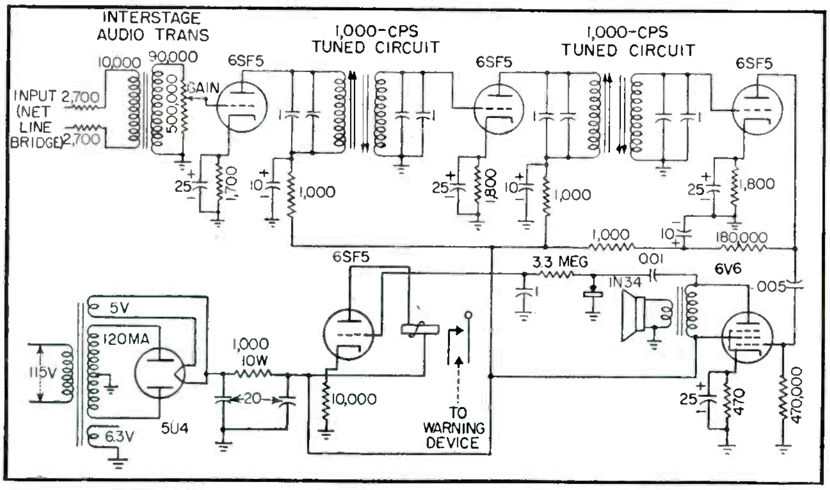


FIG. 1—Schematic of the 1,000-cycle warning device for bridging network program lines

The relay can operate a common doorbell from a separate transformer source or from the heater supply of the warning unit. It can also apply voltage to a brilliant warning light which will attract attention at the operating position. Very little can be heard from the speaker during regular programs, but it will supply plenty of audio when a 1,000-cycle tone is applied. The sensitive relay used in this particular installation is an 8,000-ohm plate relay also salvaged from the Hammarlund Fleet-Control surplus equipment. To avoid trouble, a 120-ma transformer was used, as the equipment is left running night and day and it generally pays to have a power transformer that will not overheat over long periods of time.

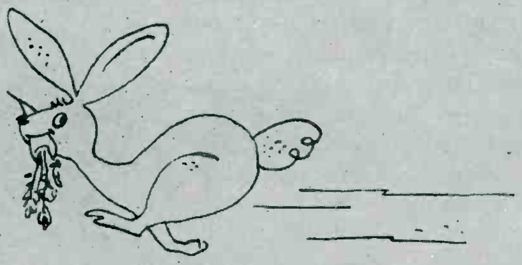
Different values may be chosen for the integrater to give a longer delay time before sounding the warning, if desired, and a wire-wound variable resistor may be used in the cathode of the relay control tube (about 20,000 ohms) to afford a closer control of the time element. After constructing the equipment and adjusting it with an audio oscillator, it was installed and the local telephone company called. They obligingly fed a 1,000-cycle tone at program level while the final touch-up adjustments were made.

Ground-Transmitter Klystron for Air Navigation

By Vincent Learned

Engineering Department Head
Electronic Tubes
Sperry Gyroscope Co.
Great Neck, N. Y.

Development of a klystron tube for the responder-type of ground transmitters for air navigation systems is described. This tube is for the 9,300-mc frequency region with



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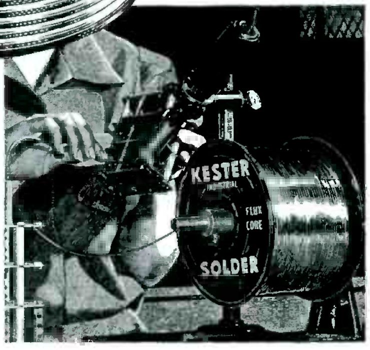

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power output between 5 and 20 kw at high duty cycles.

The unique requirement for the tube is the operation under variable duty-cycle conditions at high maximum power output. This requires satisfactory performance from zero to full maximum-rated-power output with no mechanical tuning readjustment. The tube is an amplifier tube so that master-oscillator techniques can be used to achieve high-frequency stability with a full variation in duty cycle.

SAX-22 Development

At 9,300 mc, the maximum average-power-output capability of gridded klystron tubes is limited to approximately 50 w because of grid heating. By employing a very small diameter beam the use of grids may be avoided, thus removing a major limitation on power output. The SAX-22 was developed for a peak power of 7.5 kw with an average power output of over 200 w in the 9,300-mc frequency range. Other characteristics are given in Table I.

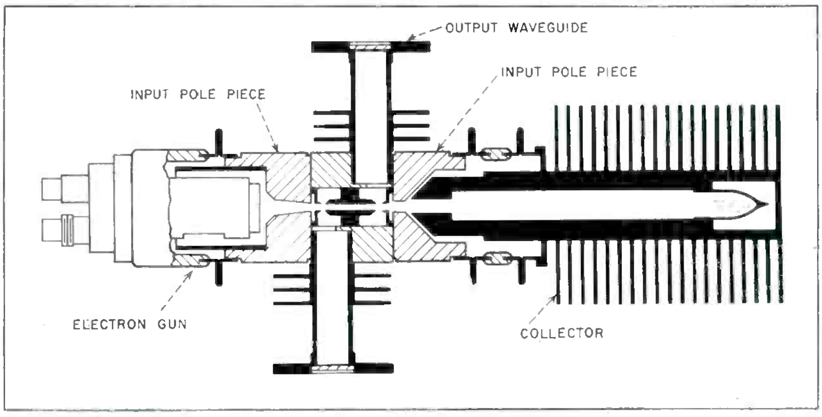
As shown in Fig. 1, the tube is mounted on a permanent magnet which supplies the field necessary for control of the beam. The assembly weighs approximately 6½ pounds with an overall length of 10 in. The tube has waveguide input and output which is designed to operate into a matched ½ by 1-in. waveguide transmission line. Adequate cooling fins are provided for dissipating the large average power. A compensator is provided on the tuning mechanism to hold the cavities on frequency for a wide range of body temperature. Typical characteristics are shown in Table I.

The drawing below shows the cross-section details of the internal construction. The electron gun produces a highly convergent beam which enters an axial magnetic field through a hole in the input pole piece and traverses the input gap, the drift tube and the output gap. The input gap velocity-modulates the beam which becomes density-modulated while moving down the drift tube. The output cavity extracts the fundamental r-f components of current in the beam and delivers part of it to the useful load.

The three separate functions that have to be performed by any microwave tube are performed in this klystron by three separate and distinct parts of the tube. The beam formation is done in the absence of any r-f fields in the cathode region. The r-f interaction takes place in the central region only, where very little beam collection need occur. The third function, the collection of the spent beam, is then performed by the collector at any desired power density. This allows each section to perform its function in an optimum manner.

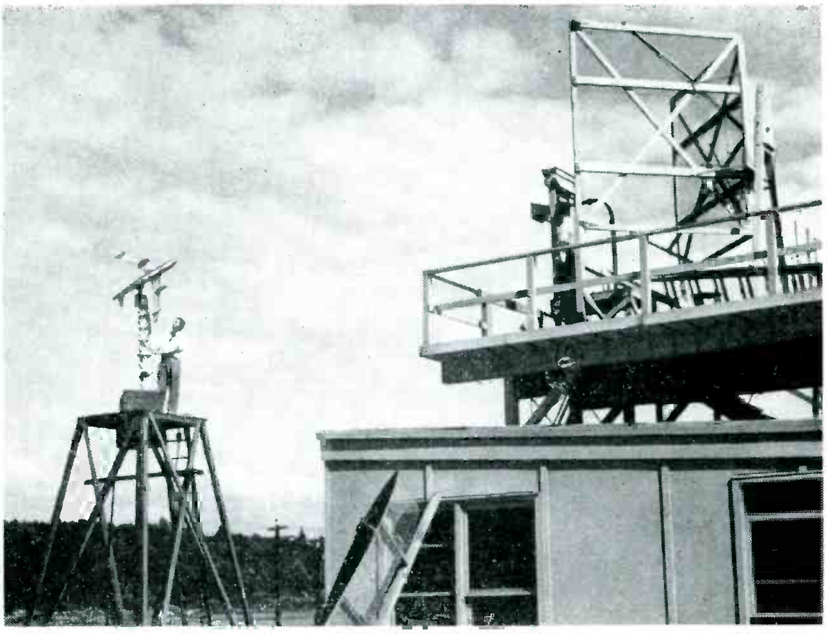
The cavities are coupled to the waveguides through inductive coupling irises. Flexible diaphragms mounted in the sides of the cavities provide a means of tuning. The waveguide coupling connections terminate in a flanged structure which carries a ceramic window sealed to a matching alloy frame. To keep the cavity resonators from mistuning under a variable duty cycle, the dissipation must be kept as small as possible, the internal temperature rise minimized and compensation employed for the wide range of temperatures.

(Continued on page 156)



Cross-sectional view of 9,300-mc klystron

ANTENNA TEST LABORATORY



Antenna laboratory of the Boeing Airplane Company housed at right and tower at left on which model airplane is mounted for tests. Radio waves beamed from horn atop laboratory are received by model antennas inside model airplane. Signals thus received are conveyed back to laboratory by shielded cable for strength measurement as airplane is rotated

... JUST OFF PRESS comes this Sprague Catalog 21 with complete details on paper dielectric capacitors designed to meet Joint Army-Navy Specification JAN-C-25. Comprehensive data on sizes, characteristics, ratings, performance and other factors makes the new catalog invaluable to users of JAN paper capacitor types. Copies are available on letterhead request.

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Over and beyond JAN specifications, Sprague has developed many new ways to reduce size and weight and to improve the high-temperature performance of capacitors and other electronic components. In effect, these are "Super-JAN" components—fully approved via JAN deviations to equipment manufacturers and widely used in critical military applications. At the right are four examples of units that Sprague can supply where equipment engineering progress calls for components that *exceed* JAN requirements.

SPRAGUE SUBMINIATURE PAPER CAPACITORS

Hermetically-sealed, metal-encased and far smaller than equivalent JAN styles. Available in types for 85° C. and 125° C. operation. Sprague Bulletin 213-B gives full technical dota.

COMPARISON—TYPICAL SUPER-JAN VERSUS JAN UNITS

Metal-Cased Tubular Paper Capacitor, Both Leads Insulated from Case

	Sprague Type 196P47492S1	Nearest JAN-C-25 Equivalent' CP25A1EC504K
Capacitance (Mfd., ± 10%)	0.47	0.50
Voltage, DCW	200	200
Insulation Resistance: at 25°C	30,000 M Ω*	6000 M Ω
at 85°C	700*	600 M Ω
at 125°C	20*	**
Capacitance Change (%) From 25°C to −55°C	−4*	−15
Operating Ambient (°C) Max.	+125*	+85
Minimum	−55	−55
Dielectric Test	Twice Rated Volts for 2 Min.	Twice Rated Volts for 1 Min.
Life Test: at 85°C	250 hrs., 1.5 X rated DCWV	250 hrs., 1.5 X rated DCWV
Life Test: at 125°C	250 hrs., 1.4 X rated DCWV*	**
Moisture Resistance	Hermetically Sealed	Hermetically Sealed
Length	1-9/16*	2-1/8
Diameter	9/16*	3/4
Volume (cu. in.)	0.39*	.94

* Ahead of and Beyond JAN

** Above Temperature Limit of JAN-C-25

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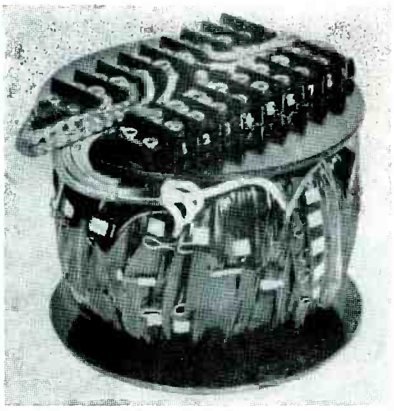
SPRAGUE ELECTRIC COMPANY • NORTH ADAMS, MASSACHUSETTS

THE ELECTRON ART

Edited by JAMES D. FAHNESTOCK



Magnetic amplifier used in voltage regulator circuit

Magnetic Amplifier Voltage Regulator

MANY vacuum-tube voltage regulators have been described in the literature, with varying degrees of regulation and complexity. The following is a description of a tubeless device capable of regulating at 160 to 400 volts within 0.5 percent for load currents from 0 to 500 ma (with line voltage constant), and within 0.5 percent for ± 10-percent change in line voltage and load currents of 0 to 300 ma. This performance is available for ambient temperatures from 0 to 55 C. The regulator is virtually indestructable and its life is almost indefinite.

Figure 1 shows a cross section view of the magnetic amplifier designed specifically for this application. The amplifier was found to have an average power gain of the order of 10^6 with a load resistance of 10 ohms at a power level of 0.5 to 360 watts. Figure 2 shows the transfer characteristic curves for the magnetic amplifier used.

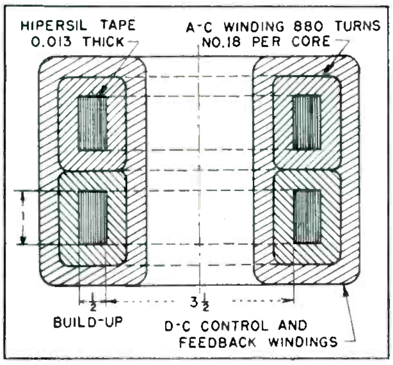


FIG. 1—Construction of magnetic amplifier used in voltage regulator

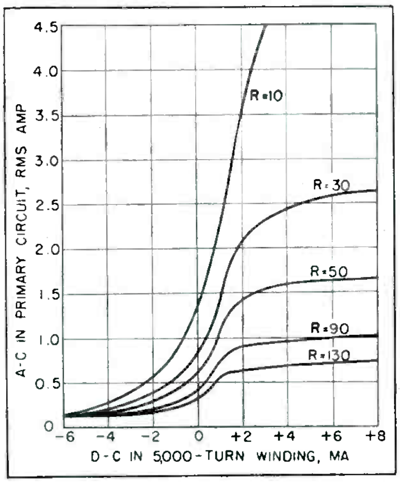


FIG. 2—Transfer characteristic of magnetic amplifier

In Fig. 3 is shown the complete circuit diagram of the regulator, with power transformer and bridge rectifier. The error detector and reference quantity are incorporated in a single parallel circuit (enclosed in dashed lines), containing a linear resistance in series with one d-c control coil (1,000 turns) and a nonlinear resistance composed of six thyrites in parallel, in series with a second oppositely-connected d-c control coil (5,000 turns). At approximately 140 volts across this network, the two control coils are contributing approximately the same ampere turns, but in opposite senses. The resultant is that required for the optimum quiescent operating point. If the output voltage rises, the ampere turns in the control coil with the nonlinear resistance (W_2) rise very fast, while the ampere turns in the linear resistance winding (W_1) rise linearly. The result is a negative increase (decrease) in total d-c ampere turns. Hence the reactance of the a-c winding in the primary circuit of the power transformer increases, the primary voltage is decreased, and the output voltage returns to the desired value. A drop in output voltage will have the opposite effect.

Different values of output voltage may be obtained by adjusting R_1. The value of this control is simply set to make up the difference between the output voltage and the operating point of the nonlinear device which, in this case, is 140 volts.

A third control winding (100 turns) in series with the load is so oriented on the magnetic amplifier that changes in load current cause changes in primary voltage to the transformer for further regulation.

Figure 4 shows the remarkable regulating performance obtained with the magnetic amplifier supply. Regulation data taken on the three units constructed were found to

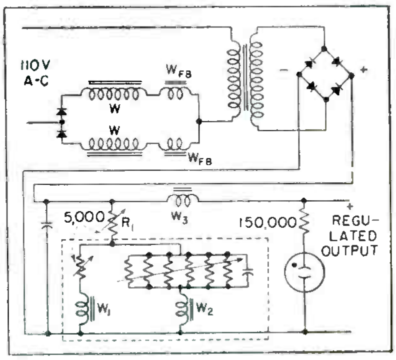
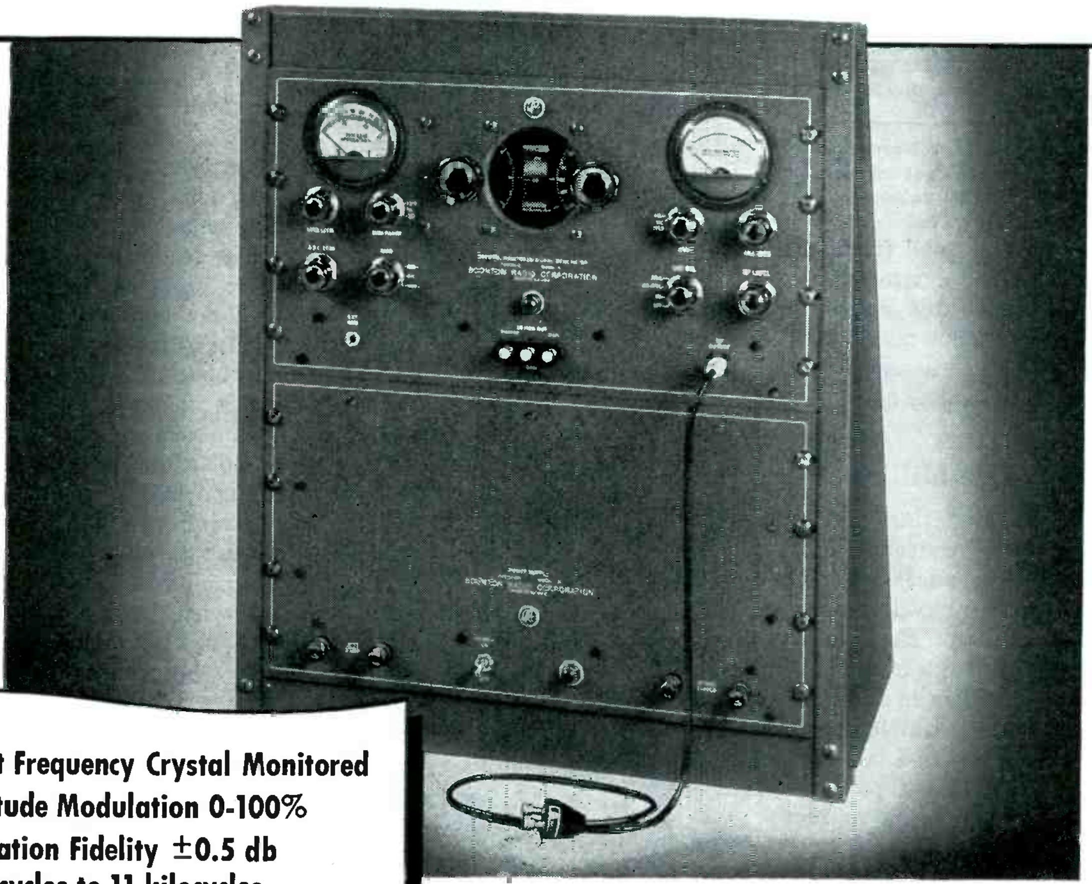


FIG. 3—Circuit diagram of magnetic amplifier voltage regulator

SIGNAL GENERATOR
FOR OMNI-RANGE RECEIVERS

Type 211-A • Frequency Range 88-140 Megacycles



Output Frequency Crystal Monitored
Amplitude Modulation 0-100%
Modulation Fidelity ±0.5 db
30 cycles to 11 kilocycles
Negligible Spurious FM

SPECIFICATIONS

FREQUENCY RANGE: Master Oscillator: 88-140 megacycles in one range. Vernier frequency dial has 100 divisions and is coupled to the main tuning capacitor through a 120:1 gear drive. Each vernier division is equivalent to a 10 kc. change in frequency.

Crystal Controlled Frequencies: Either of two crystals 110.100 mc. and 114.900 mc., accurate to ±0.0035%, may be selected by a switch for use individually or in combination with the master oscillator to standardize its output frequency.

AMPLITUDE MODULATION CHARACTERISTICS: Two amplitude modulation ranges, 0-30% and 0-100%, are provided for use with the internal oscillator or a low distortion external oscillator. Distortion is 5% or less at 95% amplitude modulation.

Internal Audio Oscillator: Two modulating frequencies, 400 and 1000 cycles.

Modulation Amplifier: The internal modulating amplifier has the following characteristics:

Uniform response within ±0.5 db.	30 cycles to 11 kc.
Uniform response within ±0.1 db.	90 cycles to 150 cycles.
Uniform response within ±0.1 db.	9500 cycles ta 10.5 kc.

Phase Distortion: (up to 60% amplitude modulation.)

Less than 0.25 degrees at 30 cycles.
Less than 10 degrees at 11 kc.

AUDIO TEST VOLTAGE: This instrument contains a demodulator or detector which supplies to front panel terminals a portion of the demodulated carrier.

SPURIOUS FM: Less than 1 kc. at 60% AM.

OUTPUT ATTENUATOR: Single ended piston type, adjustable from 0.2 volt to 0.1 microvolt. Output impedance as seen looking in at terminals of output cable is 26.5 ohms.

The Type 211-A Signal Generator is specifically designed for the testing and calibrating of omni-range radio receiving equipment. It is also well suited for laboratory and development work where a precision type amplitude modulated R. F. signal source is required.

Careful consideration has been given to the location of panel controls with respect to function and degree of use. The main frequency dial is located in the center of the panel, with the vernier dial to the left in close proximity, utilizing the same fiducial for simplicity and ease of operation. Symmetrically located to the right of the frequency dial is the output attenuator dial, directly calibrated in microvolts. The center panel enclosure embodies those controls which the operator will have the greatest occasion to use, permitting rapid, accurate settings to be made with maximum convenience.

The calibration accuracy of the frequency dial settings is ±0.25% at any point; however since crystal controlled frequencies are also available within the instrument, zero beats may be obtained from which the output frequency may be standardized to an accuracy of about ±0.025% by slipping the vernier frequency dial with respect to the main frequency dial. This feature permits the identification and checking of channel frequencies differing by as little as 100 kc.

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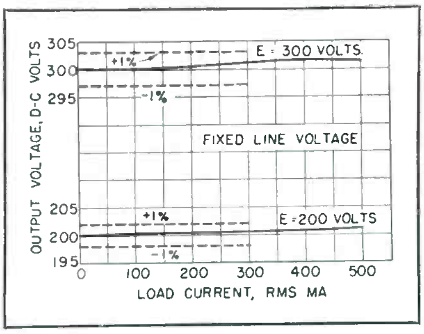
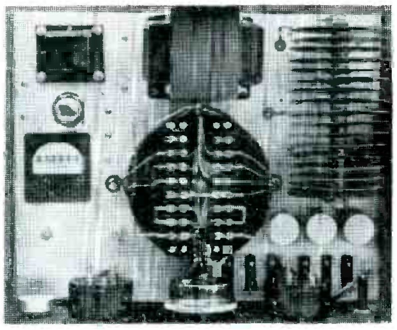


FIG. 4—Constant-line-voltage curves show regulation of output for varying output current values



Complete magnetic amplifier chassis includes necessary transformers, fuses, rectifiers, capacitors, meters and controls

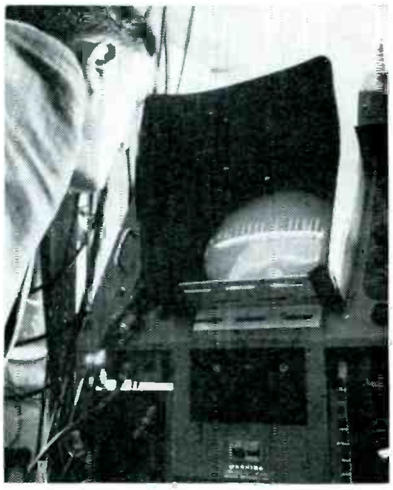
coincide within a small fraction of a percent over the entire range of line voltage (0 to 135 volts) and load current (0 to 500 ma) covered.

This article is based on the United States Atomic Energy Commission report AECD-2851 entitled, "Magnetic Amplifier Voltage Regulator" by John L. Wolff, Jr., of the Westinghouse Electric Corporation, Atomic Power Division, Pittsburgh, Pennsylvania.

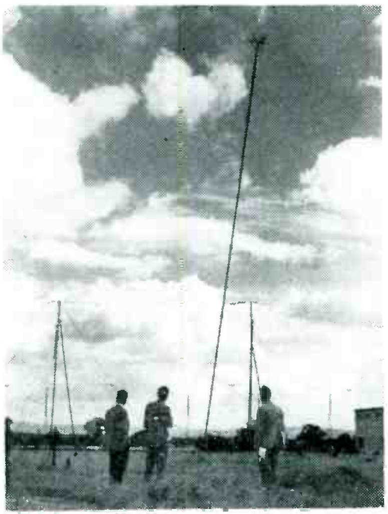
Five Million Million Million Mile DX

RADIO WAVES emanating from the great nebula in Andromeda have been measured successfully at Manchester University Physical Laboratories, Jodrell Bank Experimental Station, Cheshire, England. Using the equipment shown in the accompanying photographs, British scientists have succeeded in detecting the minute amounts of r-f power (of the order of micro-micro-micro-microwatts) that left these stars more than 750,000 years ago.

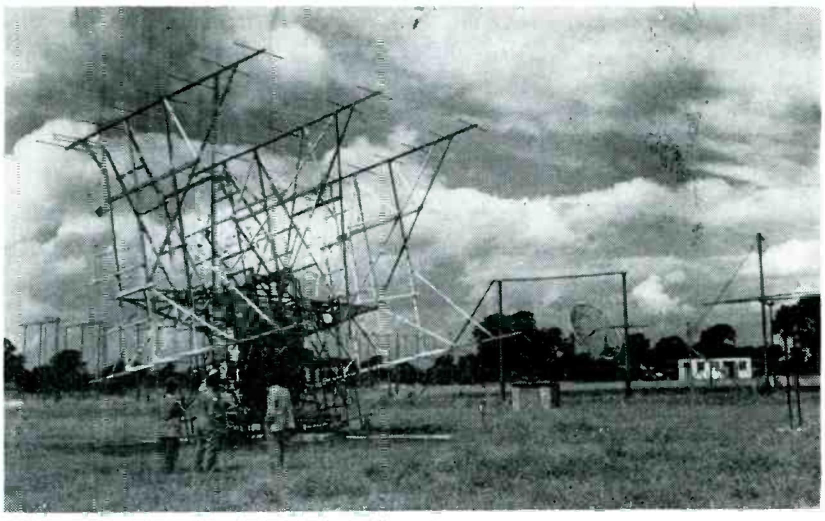
These radio stars do not coincide with any of the bright visual stars and cannot therefore be viewed with an ordinary telescope, however powerful.



Inside view shows screen where signals from outer space are displayed



Receiving antenna on 120-ft tilted pole is positioned at focus of 220-ft parabolic reflector made of fine wires



British version of moon radar is built on World War II searchlight base. Smaller type is shown at right, while in background may be seen meteor radar antennas. Location is Jodrell Bank Experimental Station, Cheshire, England

Special Tubes For Broad-Band Amplifiers

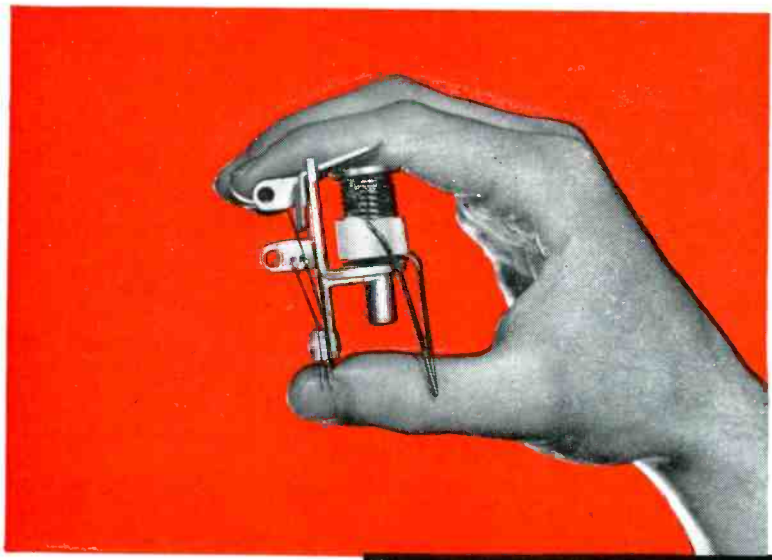
IMPROVED broad-band amplifier performance can be derived through the use of a line of special tubes recently developed for the Bell System. These tubes have higher ratios of transconductance to capacitance, brought about mainly by a new grid employing many turns of very fine wire. Gain-bandwidth products about twice that of the 6AK5 have been obtained, with transconductance values up to 45,000 micromhos.

The feedback amplifiers in which these tubes are used will transmit an 8-mc band, which can be used for 1,800 telephone channels or 600 telephone channels and one television channel.

The remarkable features of this line of tubes are obtained by reducing spacings to the limit of mounting ability. The present state of the art permits a spacing of 0.0025 inch. To keep shunt capacitance low, wire size is reduced to the limit set by wire manufacturing facilities. Tungsten is used for its high tensile strength. Figure 1 gives a graphic comparison of spacing and wire-size dimensions employed.

In fabricating the grid structures, special techniques are used. Because of the small size of the grid wires, a rigid frame must be used, as shown in Fig. 2. It is necesssary to have the wires straight and tight so the grid will present a flat uniform control surface to the cathode.

(continued on page 204)



new *Silic-O-Netic* TIME DELAY RELAY

LOOK at the qualifications the new SILIC-O-NETIC Time Delay Relay has for your requirements. Even with its small size, it's a load carrier in itself . . . in most cases eliminating the need for an auxiliary relay. The time element which is hermetically sealed has only one moving part . . . forever free of dirt, dust and moisture.

SMALL SIZE

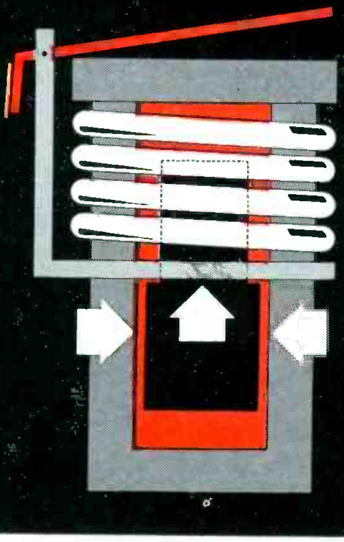
●

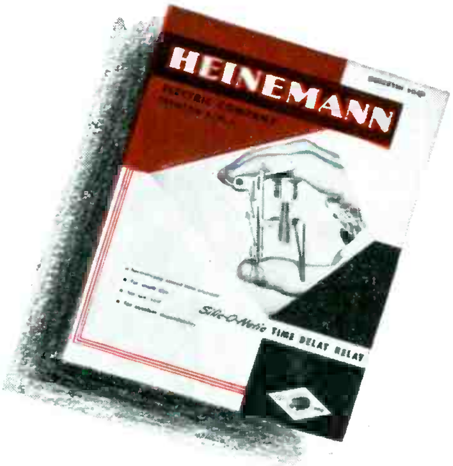
LOW COST

●

ABSOLUTE DEPENDABILITY

The SILIC-O-NETIC Time Delay Relay employs silicones . . . operates dependably on a hydraulic-magnetic principle regardless of position or frequency of operation. This relay is available with timings up to four minutes. It has a service life measured in many millions of operations . . . yet Heinemann high production techniques make it available to you at LOW COST.





COMPLETE DATA and graphic illustrations of the SILIC-O-NETIC operating principle; forms, models and timings available are included in Bulletin 5001.

A copy will gladly be sent to you upon request.

HEINEMANN

ELECTRIC COMPANY

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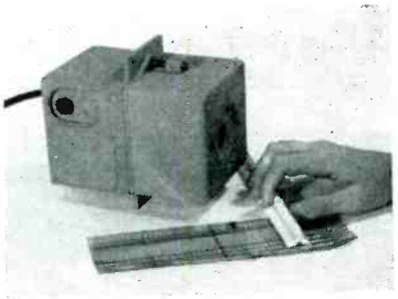
NEW PRODUCTS

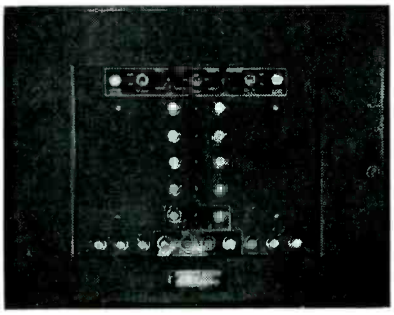
Edited by WILLIAM P. O'BRIEN

Lab and Industrial Apparatus Production Continues High . . . Miniaturization of Components Maintains Pace . . . Thirty-Four Manufacturers' Catalogs Are Discussed



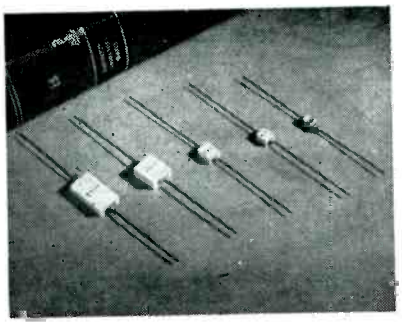
Pocket Oscillograph

CONSOLIDATED ENGINEERING CORP., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Up to nine sources of data representing vibration, pressure, velocity, strain or other phenomena, either static or dynamic, can record simultaneously on the new 5 × 5 × 8-in. recording oscillograph, type 5-118. Operating from a 28-v d-c power source, the compact instrument is ideally suited to mobile testing programs where space and weight saving are important. Developed originally for a missile-testing program, the midget oscillograph produces dynamic test records 3½ in. wide and up to 40 ft long on which the nine separate phenomena can be measured with respect both to time and to each other.



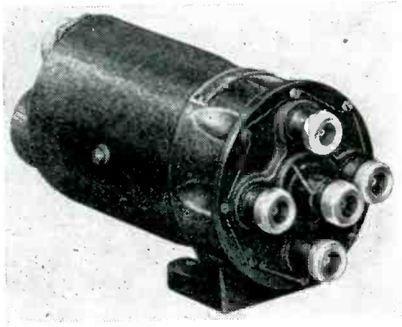
Scanning System

MINNEAPOLIS-HONEYWELL REGULATOR CO., Brown Instruments Div., Wayne & Windrim Ave., Philadelphia 44, Pa., has developed an electronic scanning system designed to automatically and continuously monitor up to 270 separate processing temperature points. The system, which records only temperatures deviating beyond a preset limit, includes an audible alarm that permits immediate correction of excess temperatures, and replaces the cost and use of several instruments and time-taking logging operations and maintenance. It is especially applicable for steam generating stations and in the manufacture of synthetic fibers and yarns where the temperature of feed material supplying spinerettes must be maintained at specific levels to eliminate costly defects in the product. Illustrated is the control unit.



Tiny Capacitor

VITRAMON, INC., Stepney, Conn., has added a new style capacitor to its series. The unit, shown on the right in the photograph, has an overall length of 0.4 in. and a maximum cross-section dimension of 0.2 in. being equivalent in size to a JAN CC20 capacitor. Designated as type 49, it is available up to 51 μμf at 500 volts d-c working and to 110 μμf at 250 volts. Included in the photograph are also the company's four stock sizes of capacitors which are supplied with ±5 percent or ±0.25 μμf tolerance from 0.5 μμf through 1,000 μμf. Operating temperatures of all are −55 C through 200 C.

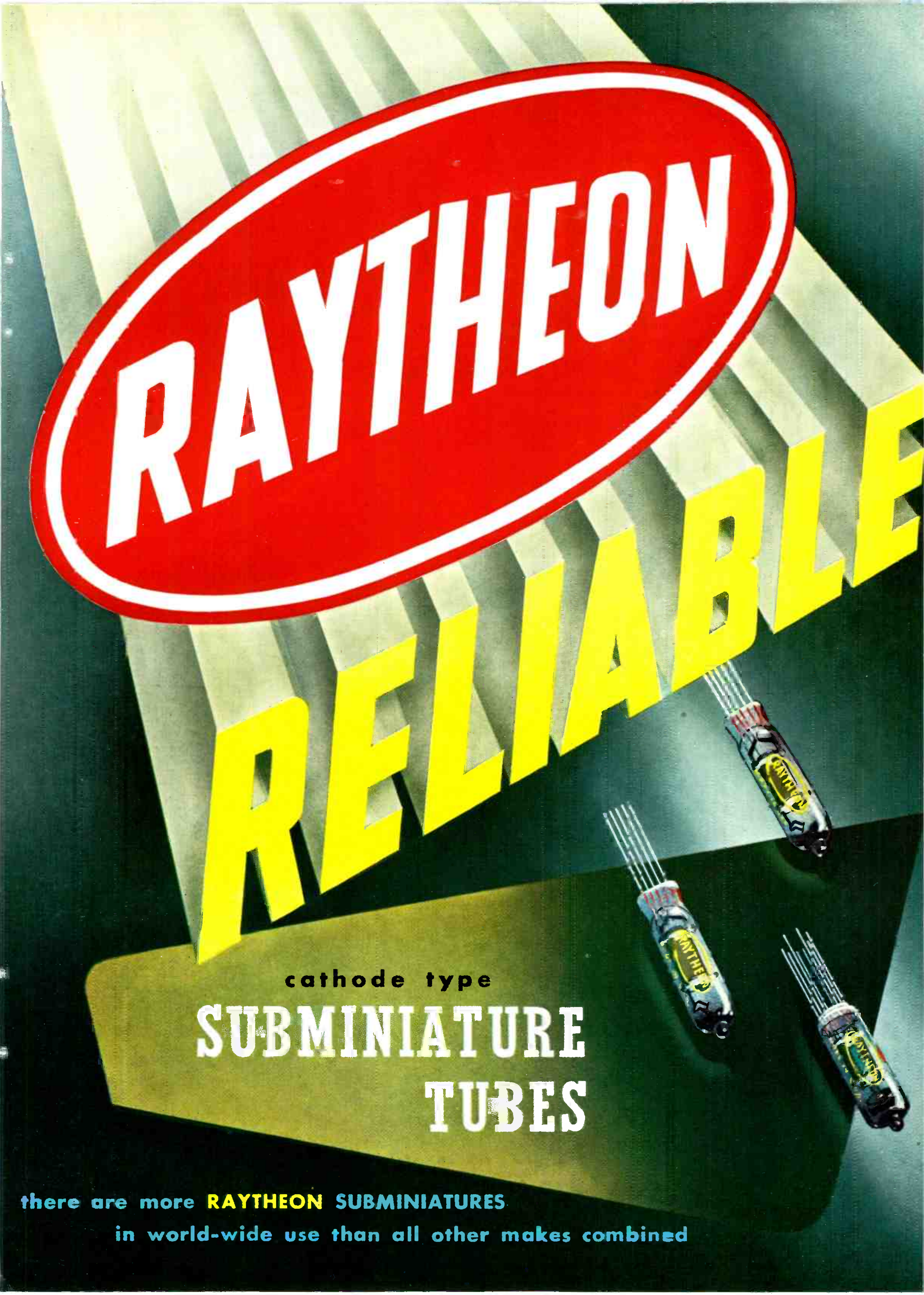


Coaxial R-F Switch

TRANSCO PRODUCTS, INC., 12210 Nebraska Ave., Los Angeles, Calif. A new compact single-pole, 4-position coaxial r-f switch for applications at radar frequencies, has a frequency range up to 11,000 mc and vswr of less than 1.5 to 1. Insertion loss is less than 0.5 db throughout operating range, and attenuation between unused connectors is 50 db minimum. Power handling capabilities are equal to improved type N connectors. Motor-driven actuator rating is 24 to 28 v d-c. Various models are available for aircraft applications.

Acoustical Lens

JAMES B. LANSING SOUND, INC., Los Angeles, Calif., is producing model 175DLH full acoustical lens for loudspeaker use which distributes a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These new Raytheon Reliable Subminiature tubes resulting from five years of continuous production of their prototypes are designed to meet the stringent requirements of vital military equipments. In addition to the rigid ratings for shock, fatigue, centrifugal acceleration, 5000 hour life, and heater cycle life, particular attention has been paid in the design and manufacture of these tubes to permit 200°C ambient temperature operation and lower noise output ratings as indicated under each type.

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CK6148
R. F. Pentode
$E_f = 6.3V.$ $I_f = 200$ mA.
Noise output 50 mV. max.
$E_b = 200$ V. max.
$E_{c2} = 150$ V. max.

CK6149
Medium Mu Triode
$E_f = 6.3V.$ $I_f = 200$ mA
Noise output 25 mV. max.
$E_b = 275$ V. max.

CK6150
R. F. Pentode – Mixer
$E_f = 6.3V.$ $I_f = 200$ mA
Noise output 100 mV. max.
$E_b = 200$ V. max.
$E_{c2} = 155$ V. max.

CK6151
High Mu Triode
$E_f = 6.3V.$ $I_f = 200$ mA
Noise output 25 mV. max.
$E_b = 275$ V. max.

CK6152
Low Mu Triode
$E_f = 6.3V.$ $I_f = 200$ mA
Noise output 25 mV. max.
$E_b = 250$ V. max.

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VARGLAS SILICONE is a sensational new electrical insulating sleeving and tubing developed by our laboratory and pilot plant during the last war. It is a product which combines Varglas and Silicone to bring revolutionary possibilities to electrical insulation.

VARGLAS SILICONE is efficient under a wide temperature range . . . to 500° F. or more in some applications, yet remains completely flexible at —85° F. It has excellent resistance to moisture; is flame resistant and self-extinguishing.

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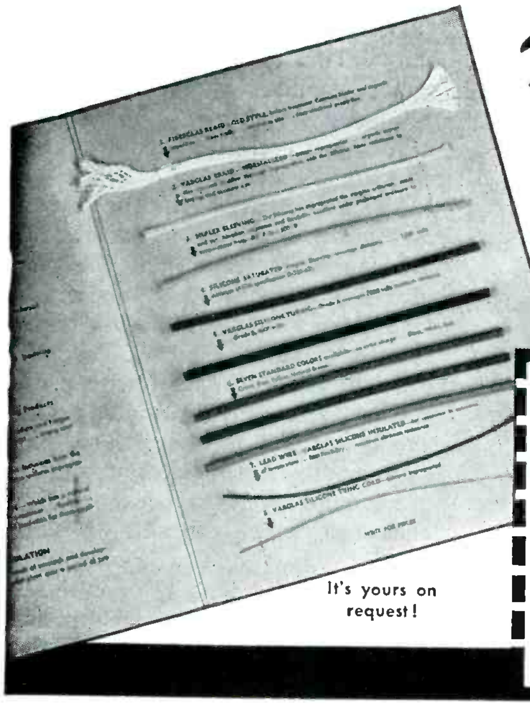
2. **NORMALIZING** — Removes binder and organic inclusions from the Fiberglas — improves electrical qualities and allows uniform impregnation.
3. **SILICONE HIGH TEMPERATURE RESIN** — Which has a natural affinity for the Fiberglas, renders it abrasion-resistant, flexible and non-fraying.

VARFLEX CORPORATION, manufacturers of electrical insulating tubing and sleeving, are insulation specialists. If you require special insulation, write us about your problems. We will gladly quote on your individual requirements or NEMA specifications. We have a complete line of sleeving and tubing, based on Fiberglas, cotton, and extruded plastics.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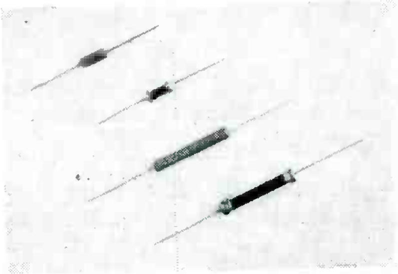
uniform sound wave over the entire audio spectrum. It smoothes out the high frequencies and gives them a mellowness unlike the multicellular horn that performs well at some frequencies but beams or distributes poorly at others. The new lens is not sensitive to frequency because the bandwidth is wider than the audio spectrum with which it is used.



Deposited Carbon Resistors

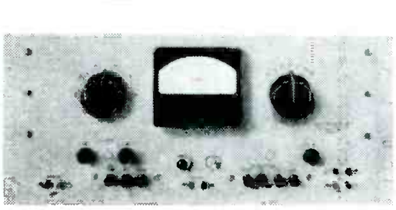
PHAOSTRON CO., 151 Pasadena Ave., South Pasadena, Calif. The Carbohm, a deposited carbon resistor, is suitable for high-frequency applications, particularly where high resistance is needed, or power dissipations up to 2 w are required. The resistors are also applicable to electronic equipment that is subject to extremes of temperature. Carbohms come hermetically sealed in glass or in humidity-impervious casing. They are available with a threaded stud or tapped hole terminal, as well as the axial lead pictured.

Cavity Resonators

MOTOROLA INC., 4545 W. Augusta Blvd., Chicago 51, Ill., has developed a precision selector cavity resonator designed to eliminate radio and tv interference caused by spurious and harmonic radiations of base station 2-way radio transmitter equipment. The cavities, intended for the 30-48 mc, 72-76 mc, 122-132 mc and 132-180 mc communications band are temperature compensated for optimum performance over wide temperature ranges. Mechanical design and element dimensions are proportioned for optimum impedance match and a low vswr. Each unit has an input and output impedance of 50-72 ohms with a 250-watt maximum power rating.

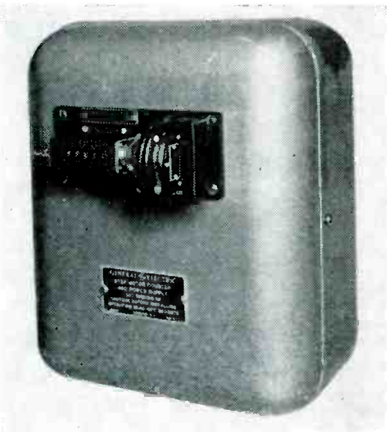
ULF Oscillator

KROHN-HITE INSTRUMENT CO., 580 Massachusetts Ave., Cambridge, Mass., announces model 400-A ulf oscillator that simultaneously provides both sine and square-wave voltages at any frequency between 0.009 and 1,100 cps. An R-C bridge sine-wave oscillator circuit is employed with special circuitry to eliminate tuning and switching transients. Other features are low hum and distortion, excellent amplitude constancy over the entire frequency range, a single scale logarithmic dial with a vernier tuning control and low input power. It is especially useful for design and test of servomechanisms, geophysical and seismological instruments and feedback amplifiers. Dimensions are 12 × 7 × 8 in. and price is $350.00.



Gain Set

THE DAVEN CO., 191 Central Ave., Newark, N. J., has available the type 12A transmission measuring or gain set, an a-c operated, rack-mounted instrument designed for the measurement of voice transmission systems. Source output and receive input are 600-ohm balanced circuits, provided with d-c blocking capacitors so that the equipment will not interfere with the normal operation of modern dial systems. The oscillator consists of a 1,000-cycle low distortion feedback type R-C oscillator, buffer and associated power amplifier. The output level is + 10 to − 35 db adjustable in 1-db steps. The receive section consists of a high-gain, wide-range amplifier whose range is variable from + 20 to − 60 db, full scale meter reading, in steps of 10 db.



Step-Motor Counter

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has developed a step-motor impulse counter to provide 100-percent accuracy up to 60 counts per sec. Designed to cover counting ranges above those possible with electromechanical counters and below those in which scalers are normally required, the device has a counting range which makes it especially useful in high-speed production counting. The unit consists of a step motor with a resetting type register, and a power supply enclosed in a steel case. The step motor and register assembly are mounted on the power supply enclosure, which contains an electronic switch and a h-v supply capable of supplying the power requirements of a phototube preamplifier. Overall dimensions of the

(Continued on page 226)

audiodiscs* For more than 12 years, Audiodiscs have consistently set the standards for the finest professional performance in instantaneous and master disc recording. Their flawless perfection, wide-range frequency response, extremely low surface noise at all diameters and complete freedom from humidity effects are just a few of the reasons why Audiodiscs are first choice with professional recordists from coast to coast. They know from long experience that they can depend on Audio for the *consistent, uniform quality* that is so essential in modern sound recording work.

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NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

Low-Power CAA Omniranges Tested

THE CAA is experimenting with two low-power omniranges—the TVOR and the LVOR. The former uses a 50-w transmitter rather than the 200-w transmitter of the standard VOR and operates without customary standby equipment. It is a relatively low-cost omnirange for terminal use where an instrument landing system is not economically justified. It will permit approaches to airports under the same minimum ceilings and low visibility conditions as low-frequency aids now used.

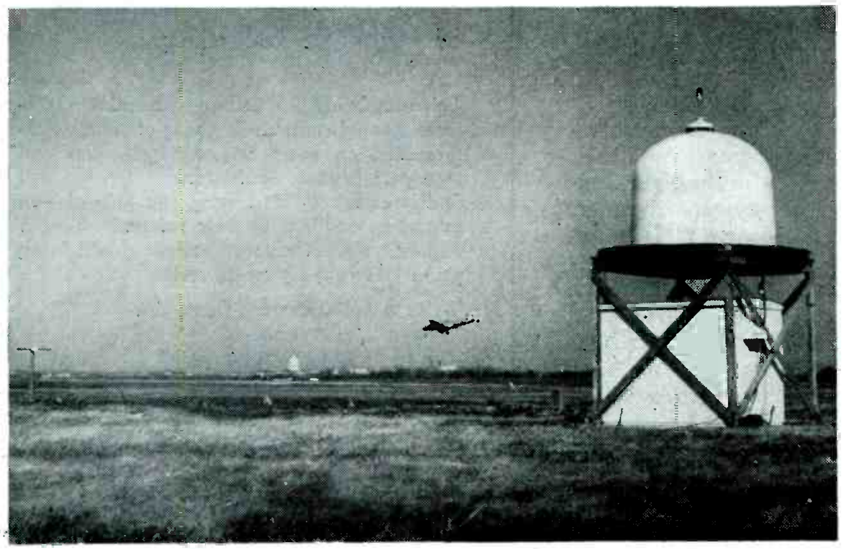
One TVOR has been installed at the Oklahoma City Airport and another is in the process of being tested at the National Airport in Washington. The one at Oklahoma has the antenna situated on a counterpoise 12 feet in diameter placed on top of the transmitter building. This building is 8 feet square; the standard VOR building is about 16 by 28 feet. The receiver in the aircraft is the same for the standard and the baby omni. A primary function of the standard VOR is to furnish enroute navigation aids; an auxiliary function is furnishing of approach guidance to the airport. The second function requires a special location. The baby omni makes this second function its primary one. It can also be used as a gap filler in the enroute navigational system. The TVOR is now being tested for use in connection with departure procedures and radar vectoring.

The LVOR, the other low-power omnirange, has a 50-w transmitter and also standby transmitting equipment. It is housed in the same type building as the standard VOR. One such facility is being installed at the airport in Toledo, Ohio.

Both baby omniranges are in the experimental stages, although LVOR is not so far advanced as TVOR. Whether or not it is advisable to go into a big LVOR program has not been decided. The CAA has no desire to become involved in complicated frequency allocations problems, and such a program might lead to this.

The components in TVOR and LVOR are substantially the same. All test facilities utilize a new type antenna that provides an improved cone over the station. This antenna can be used on all VOR's and other facilities. It narrows the cone from 90 deg to about 20 deg.

The cost of the TVOR runs about $35,000, the LVOR about $78,000, and the VOR, $93,000. This is the complete facility including structural cost, engineering equipment and installation. It does not, however, include distance measuring equipment. When available, DME will be installed at VOR and LVOR at an additional $22,000 cost.



Baby VOR (vhf omnirange) in experimental use at National Airport, Washington, D. C., for approach guidance. Monitor antenna is at left

TV Freeze Study Group Named

A DOUBLE-BARRELED study by members of the television industry to determine the effect on the national economy and the mobilization program of the lifting or continuing of the tv freeze on station construction was recently announced by the RTMA. Dr. W. R. G. Baker, chairman of the RTMA Television Committee, named a task force to study and report on the effect on materials and manpower if the freeze is lifted and the effect on the tv industry if construction of additional stations is not permitted.

Members of the task force are: William H. Chaffee of Philco Corp., chairman; Keeton Arnett of Allen B. DuMont Laboratories Inc.; Edwin D. Foster of RCA and C. W. Michaels of General Electric Co.

Reliability Group Set Up by RDB

A CLEARING house has been set up recently in the Research and Development Board of the Department of Defense to collect and disseminate information on reliability of electronic equipment.

This information, furnished to laboratories engaged in government work, is expected to result in more reliable performance of electronic equipment with a minimum of maintenance.

For example, a contractor with security clearance, who is doing government business with laboratories, can receive the RDB information by requesting it from the Service with which he is dealing. Assume X is working on a guided missile contract and he is having trouble with reliability of his electronic equipment. He can go to the Service where he has his contract and request further technical information. The Service in turn will

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MANUFACTURERS OF QUALITY WIRES AND CABLES FOR EVERY REQUIREMENT get it from the new clearing house. The Research and Development Board does not distribute material directly to the contractor.

M. Barry Carlton of the RDB secretariat, and Albert F. Murray, radio and television consultant to RDB, have been named Coordinators of Reliability and will head the group. Members include representatives of the Munitions Board, the Office of the Joint Chiefs of Staff, the Army, Navy and Air Force as well as RDB.

According to RDB officials, improvement in reliability must include the following steps which lead eventually to use of equipment in the field: military characteristics, experimental models, specifications, manufacturing control procedures, service tests, final inspection, packaging and shipping, storage, installation, operational use and maintenance.

MEETINGS

JAN. 7-8: AIEE Conference on Electronic Instrumentation in Nucleonics and Medicine, Hotel Statler, New York, N. Y.

JAN. 21-25: AIEE Winter General Meeting, Hotel Statler, New York, N. Y.

MARCH 3-6: 1952 IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.

MARCH 31-APRIL 4: Thirtieth Annual NARTB Convention, Stevens Hotel, Chicago, Ill.

MAY 16-17: Fourth Southwestern IRE Conference and Radio Engineering Show, Rice Hotel, Houston, Texas.

JUNE 23-27: AIEE Summer General Meeting, Hotel Nicollet, Minneapolis, Minn.

AUG. 27-29: Eighth Annual Pacific Electronic Exhibit, Municipal Auditorium, Long Beach, Calif.

SEPT. 8-12: National Instrument Conference and Exhibit, Hotel Cleveland, Cleveland, Ohio.

OCT. 27-29: 1952 Radio Fall Meeting, sponsored by IRE and RTMA, Hotel Syracuse, Syracuse, N. Y.

New Awards

JOHN H. NELSON, radiowave analyst of RCA Communications, Inc., who last April disclosed evidence of direct relationship between magnetic storms on earth and the position of planes in the solar system, recently received the first merit award of the Foundation for the Study of Cycles. The award, in recognition of Nelson's "notable service in the radio propagation field," was presented by George Baekeland, chairman of the committee of the Foundation and vice-president of the Bakelite Corp.

Another first of its kind is the David Sarnoff Gold Medal Award, presented to Otto H. Schade of the RCA Tube Department, for outstanding technical achievements in the field of television and motion pictures. The medal was presented by the Society of Motion Picture and Television Engineers at a luncheon opening the society's 70th semiannual convention at the Hollywood-Roosevelt Hotel recently.

Engineer Training Program

A TRAINING program aimed at meeting ever-growing needs for engineers with experience in all phases of electronic tube manufacturing is under way at major plants of the General Electric Company's Tube Department. The two-part program is meant to provide, first, a pool of engineers with a broad knowledge of tube manufacturing from which the department can draw men for engineering and supervisory positions, and second, a group of creative engineers who can help GE push forward with a program of mechanization of tube production.

Fifteen young engineers have already been picked for rotating assignments in GE tube plants in Schenectady, Syracuse and Buffalo, N. Y., and Owensboro, Ky. Trainees will be selected primarily from graduates of GE's test engineering program and from the ranks of engineering school graduates who are recommended for their special maturity and ability. All will start with a short indoctrination period in factory engineering, followed by about six months of actual shop experience.

Upon completion of the course those selected for general supervisory training will then be given assignments as functional working leaders and foremen in several fields for from one to two years.

Trainees picked as equipment development specialists will receive further assignments in tool design, methods-planning and specific equipment projects, working with the Electronics Division's Equipment Development Works in Schenectady, N. Y.

Electronic Flight Simulator Announced

FUTURE F-86D Sabre jet pilots will "shoot down" their first enemy planes without actually seeing the enemy or even leaving the ground. It's all a matter of electronics in the latest device for pre-combat training of Air Force fighter pilots.

This latest step in pilot training was revealed with successful completion of tests of the F-86D Sabre flight simulator at the Engineering and Research Corp., Riverdale, Maryland, plant, where the new earthbound trainer was designed and built under contract from North American Aviation, Inc., designer and manufacturer of the swept-wing Sabres.

Named the Sabre Flightronic by ERCO, it is the first fighter all-weather simulator delivered to the Air Force. Its delivery also marks the first time that a simulator has been put into training use concurrently with the beginning of quantity production of a new plane.

The new simulator, a 35,000-pound package of metal, wiring, electronic tubes, radar scopes and servomechanisms, is also the first to combine the simulation of two planes—the one being flown and

(Continued on page 286)

For Engineers...

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- TRANSFORMER and COIL DESIGN
- COMMUNICATIONS—
  - Microwave, Mobile Aviation, Specialized Military Systems
- RADAR—
  - Circuitry, Antenna Design, Computer, Servo-Systems, Information Display Systems
- COMPUTER DEVELOPMENT and DESIGN
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If you qualify for any of the positions listed above, write us for a personal interview—include a complete resumé of your education and experience. Write to:

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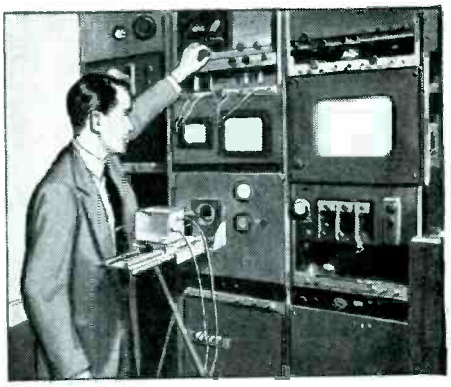
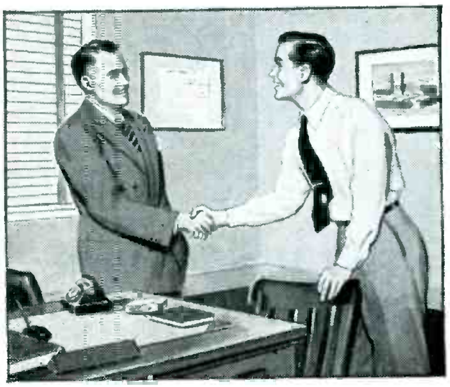
Professional Status. RCA engineers enjoy the highest professional recognition among their colleagues. You work in close collaboration with scientists and engineers who are distinguished in the industry. You receive recognition for your accomplishments.



Laboratory Facilities. At RCA, unexcelled laboratory resources and advanced technical apparatus are available. You have unlimited opportunities for the complete expression of your talents in the fields of electronics.

Good Living Conditions. You have a choice of residential locations offering suburban-convenience or quiet, countryside living. Good shopping facilities, schools, churches, medical services and modern hospitals are close by. Excellent opportunities for graduate study.

Position Security. These are not temporary positions. Activities are focused not only on the long-range national defense program, but also on a diversified line of products for commercial use. You and your family are protected by Company-paid hospital, surgical, accident, sickness, and life insurance. A modern retirement program helps provide for your future.



Rapid Advancement. Opportunities at RCA are exceptional, for you to move ahead in the career of your choice. You can advance to high-level and supervisory positions which are filled from RCA's engineering staff. Salaries, determined on the experience and ability of individual applicants, are reviewed at regular intervals for increases on a merit basis.

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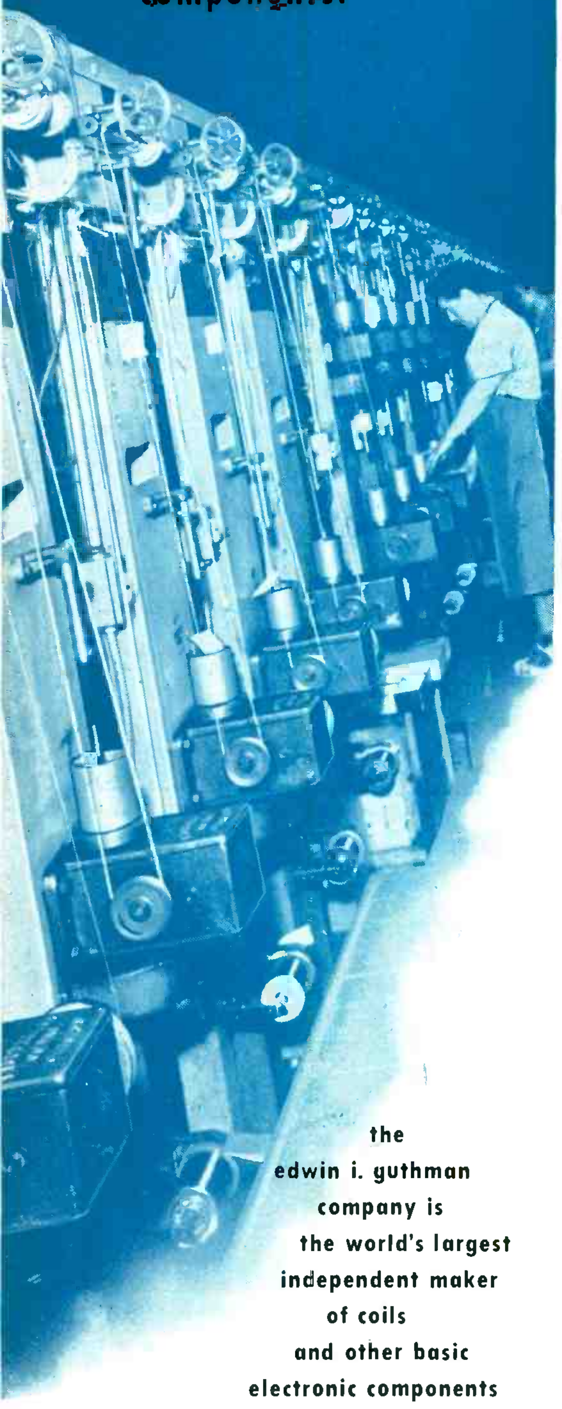


NEW BOOKS

Time Bases

By O. S. Puckle. *John Wiley & Sons, Inc., New York*, 1951, *Second Edition*, 387 *pages*, $5.00.

In essence this book is the same as the first edition with an attempt to bring to light the newer developments in time bases and some of their more diversified uses such as counting and frequency division. To this end a wealth of material has been added, including a new chapter on Miller time bases and a considerable enlargement on linearization of the trace and push-pull deflection.

Many sundry circuits and tabulations that cannot be conveniently worked into the main body of the book make up the appendices. Among the most useful information is a technique outlined under "Aids to Rapid Determination of the Shaping Effects of a Network" in which it is shown that almost all useful waveforms can be broken down into a series of step functions of either amplitude or velocity.

RELEASED THIS MONTH

An Introduction to Acoustics; R. H. Randall; Addison-Wesley Press; $6.00.

Basic Electrotechnics; B. L. Goodlet; Longmans, Green and Co.; $4.00.

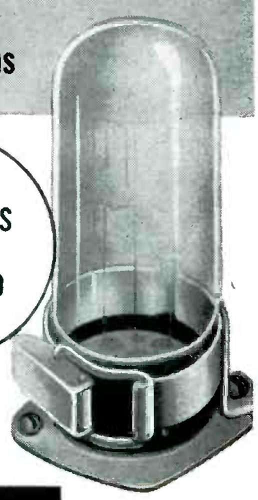
Broadcast Operator's Handbook; H. E. Ennes; John F. Rider Publisher; 2nd edition; $5.40.

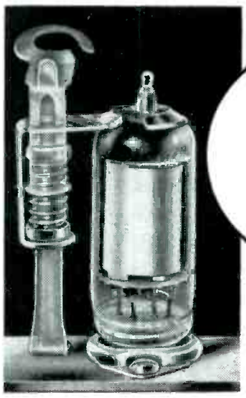
Materials Technology for Electron Tubes; W. H. Kohl; Reinhold; $10.00.

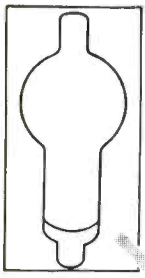
This book was well thought out and equally well edited with a minimum of errors, the most outstanding being the loose use of the words "blocking oscillator" which seems to be used wherever a transformer is used as an integral part of a time base generator.

In dealing with the actual production of time bases, the book is quite complete from the earliest neon time base down to more modern Miller capacitance time bases with their many embodiments. With

(Continued on page 302)







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SINCE 1945, DPi has been supplying manufacturers of television picture tubes with inline exhaust systems. Even with the largest tubes, this fast-production race track has been giving the high vacuum that means sharper-focus beams, longer, more reliable life.

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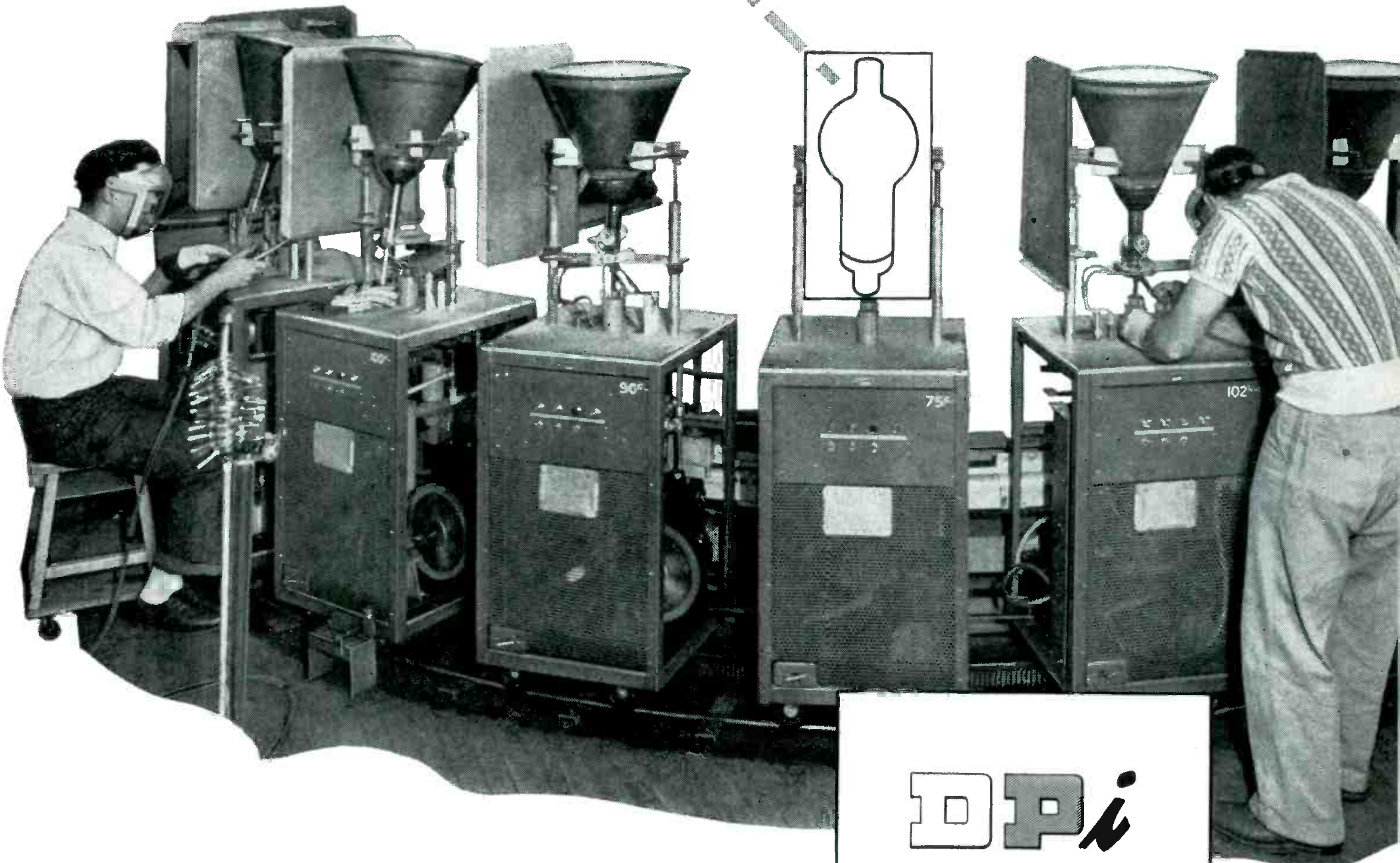
If you already have a DPi inline system and would like to consider conversion, or are interested in a new system, talk it over with our engineers. We're ready to help you meet your problem, whether it involves a single unit or the design of a complete exhaust system for a tube factory. Just write ***Distillation Products Industries***, Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).



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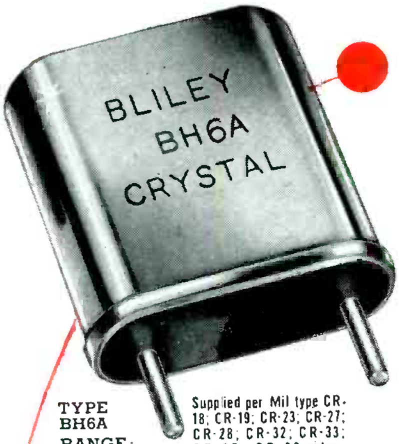


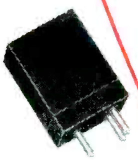
TYPE
BH6A
RANGE:
1.4 - 75.0 mc

Supplied per Mil type CR-18; CR-19; CR-23; CR-27; CR-28; CR-32; CR-33; CR-35; CR-36 when specified.

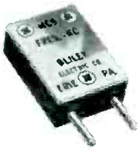
It's Knowledge

A finished crystal unit, by Bliley, typifies the accumulated know-how of 21 years experience. This includes craftsmanship and engineering, methods and techniques, production and quality.

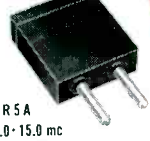
Such **knowledge** is gained **only** from actual experience. It's basic with Bliley, and, your assurance of complete satisfaction.



TYPE AR23W: RANGE: 0.080 - 0.19999 mc Supplied per Mil type CR-15; CR-16; CR-29; CR-30 when specified.



TYPE MC9: RANGE: 1.0-10.0 mc Supplied per Mil type CR-5; CR-6; CR-8; CR-10 when specified.



TYPE SR5A RANGE: 2.0-15.0 mc Supplied per Mil type CR-1A when specified.

TYPE TCO-1 Temperature Control Oven.

Bliley
CRYSTALS

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING
ERIE, PENNSYLVANIA

Backtalk

This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which ELECTRONICS has published.

More Information

DEAR SIRS:

HAVING noted the unfortunate experience of the Mount Wilson and Palomar Observatories as described by Mr. William A. Baum in "Backtalk" (October, 1951, p 154), I would like to point out that some steps have already been taken to provide more complete information on electronic parts to designers of equipment.

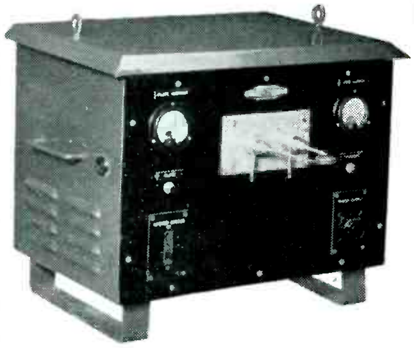
For the past several months, a program has been sponsored by the Navy Bureau of Ships at Southwest Research Institute to produce a parts index which will contain detailed design and performance features of miniature electronic parts. The Bureau and the Institute recognized that this publication will expedite the choice of suitable parts, thereby reducing the amount of valuable engineering time now wasted in this phase of equipment design.

The aim is to produce an index which is as useful as tube handbooks are presently—with all data shown in standard forms, frequent revisions as necessary, and eventually complete information on capacitors, resistors, small motors, transformers, batteries, etc. The original scope of the program was outlined in a microfilm catalog of miniature parts prepared by the Bureau.

The index is also intended to serve as a guide in the establishment of procurement specifications or the extension of existing ones, since it will indicate actually achievable performance. The program can be most successful if continued cooperation is received from

(Continued on page 311)

2 KW
VACUUM TUBE
BOMBARDER
OR
INDUCTION
HEATING UNIT



For Only $650.

Never before a value like this new 2-KW bench model "Bombarder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

Simple . . . Easy to Operate . . . Economical Standardization of Unit Makes This New Low Price Possible.

This compact induction heater saves space, yet performs with high efficiency. Operates from 220-volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only $650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following ranges of Power: 1-2-3½-5-7½-10-12½-15-18-25-40-60-80-100-250KW.

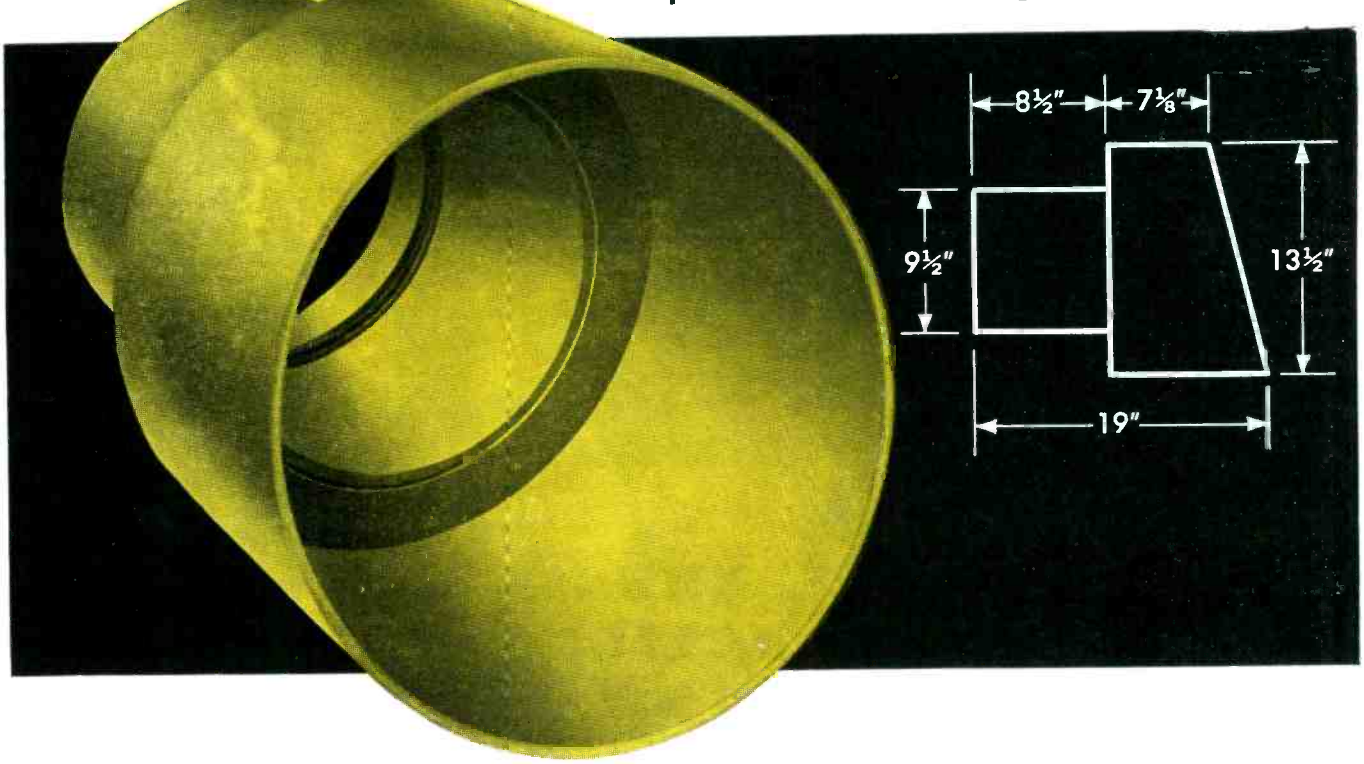
Scientific Electric

Division of

"S" CORRUGATED QUENCHED GAP CO.

107 Monroe St., Garfield, N. J.

practical imagination



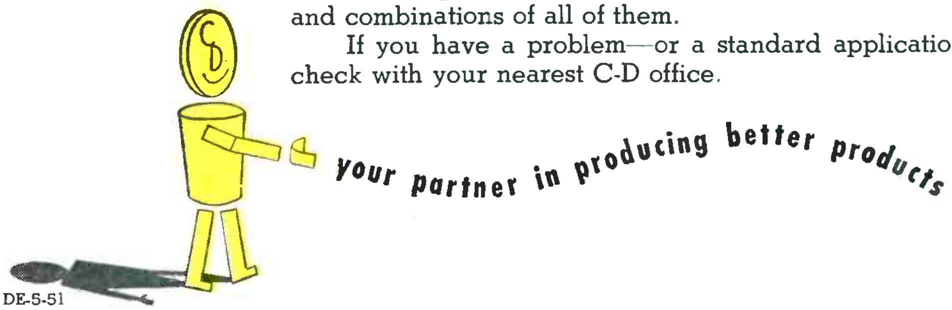
"welded" assembly makes large plastic parts practical and economical

Look at this large, laminated plastic part. It is 19" long with two concentric diameters of $13\frac{1}{2}$" and $9\frac{1}{2}$" connected by a flat ring. Think of the cost of molds for making such a piece—and then consider the fact that only a few such parts are required. The cost would be prohibitive.

It is on problems like this that Continental-Diamond's knowledge of plastics and their fabrication pays off for you. C-D engineers took two Dilecto tubes of the required diameters and wall thicknesses and then cut a ring from a sheet of Dilecto to just fit the O.D. of the smaller tube and the I.D. of the larger.

These three parts were then literally "welded" together into a strong, low cost part. The material used to do the "welding" is one of the compounds developed by C-D in their vast experience of fabricating parts of Fibre, Vulcoid, Celoron, Micabond, Dilecto and combinations of all of them.

If you have a problem—or a standard application for plastics, it will pay you to check with your nearest C-D office.



DILECTO (Laminated Thermosetting Plastic)
CELORON (Molded High-Strength Plastic)
DIAMOND FIBRE (Vulcanized Fibre)
VULCOID (Resin Impregnated Fibre)
MICABOND (Bonded Mica Splittings)

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AN CONNECTORS supplied by Amphenol insure lowest millivolt drop, extra high tensile strength, polarized shells and simple assembly. Amphenol non-rotating contact solder pockets mean faster soldering and more positive contact. Amphenol has the widest selection of AN Connectors to meet current standard MIL-C-5015 shell styles and applications.

POWER PLUGS represent a new approach to the requirements of the Signal Corps for waterproof connectors. They take up very little space and provide quick connect and dis-connect under the most adverse handling conditions.

100 CONTACT CONNECTORS for all applications where a large number of circuits must be broken quickly and easily. These connectors feature dependability and long life as well as accurate alignment of the connections and positive contact.

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NOW AVAILABLE: *Catalog B-2—A General Catalog of Amphenol Components—will be sent on request.*

AMPHENOL

TUBES AT WORK

(continued from page 138)

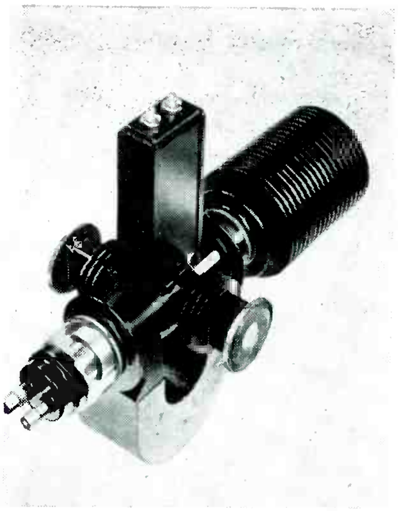


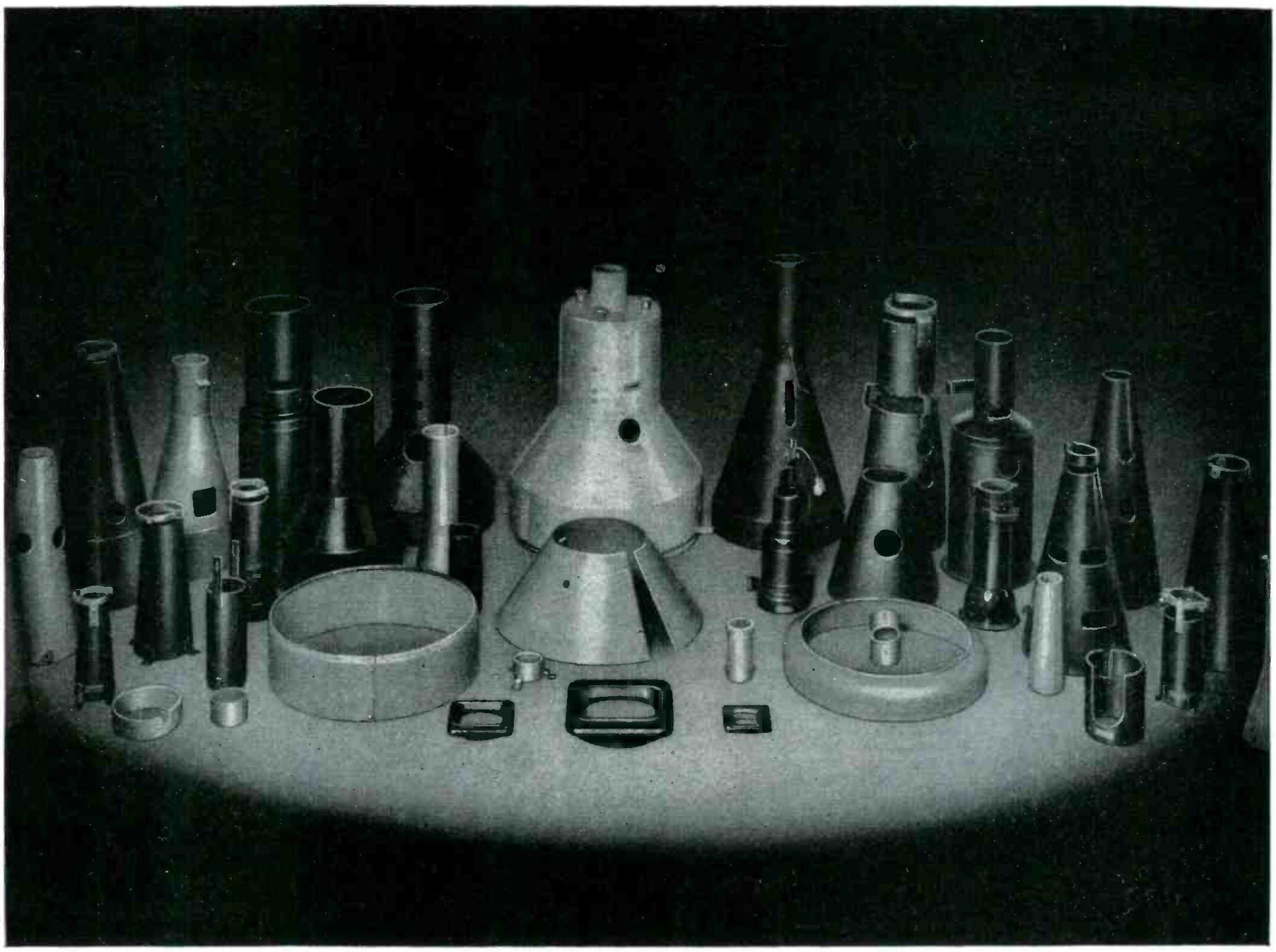
FIG. 1—SAX-22 pulse-amplifier klystron for 9,300 mc. A permanent magnet is used to focus the beam

A highly convergent beam is formed by electrostatic focusing. The beam shape follows a convergent path determined by space-charge repulsion and, in the absence of any ion focusing or magnetic field, the beam approaches a minimum diameter and then would diverge again due to space-charge repulsion. In this tube the beam converges to a minimum diameter in the normal manner but at this point enters a uniform axial magnetic field. The field produces a radial force tending to cause the beam to converge. If the magnitude of the magnetic field and the original direction of the electron motion are correct, the convergent force can be made to balance exactly the space charge forces tending to cause the beam to diverge. Under these conditions, a parallel beam entering an axial magnetic field can be maintained parallel for any desired length.

By use of this combination of electrostatic beam formation and magnetic beam control, a high beam

Table I—Typical Characteristics of SAX-22

Output power (peak)	7.5 kw
Drive power (peak)	300 w
Frequency	9,310 mc ± 30 mc
Beam voltage (peak)	17 kv
Beam current (peak)	2.5 amp
Duty cycle (max)	2.5 percent
Pulse length (max)	5 μsec
Bandwidth (optimum drive)	40 mc



Designed for Application

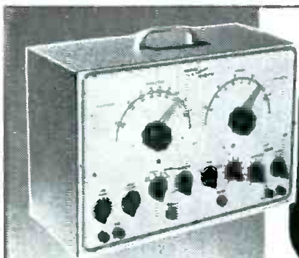
Mu Metal Shields

The James Millen Mfg. Co. Inc. has for many years specialized in the production of magnetic metal cathode ray tube shields for the entire electronics industry, supplying magnetic metal shields to manufacturing companies, laboratories and research organizations. Stock shields are immediately available for all of the more popular sizes and types of cathode ray tubes as well as bezels for 2″, 3″ and 5″ size tubes.

Many production problems, however, make desirable special shields designed in conjunction with the specialized requirement of the basic apparatus. Herewith, are illustrated a number of such custom built shields. Our custom design and fabrication department is at the service of our customers for the development and manufacture of magnetic metal shields of either nicoloi or mumetal for such specialized applications.

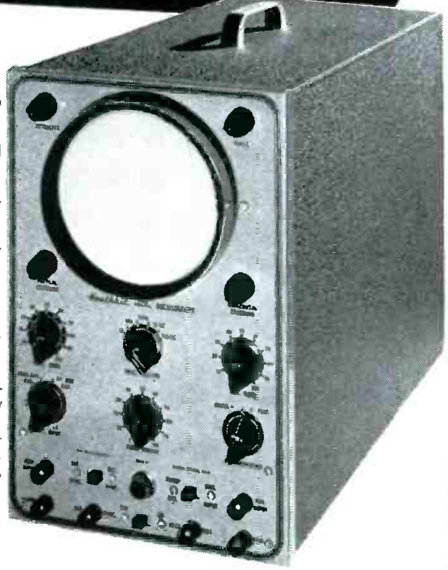
JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY
MALDEN, MASSACHUSETTS, U. S. A.

New 1952 HEATHKITS



Heathkit
TELEVISION GEN. KIT $39.50

Heathkit
5" OSCILLOSCOPE KIT



- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near
- CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 MC.
- Tremendous sensitivity .03 RMS per inch Vertical .6V RMS per inch Hor.
- Dual control in vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.
- Multivibrator type Wide Range Sweep Generator.

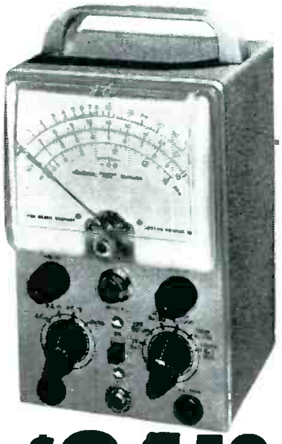
A brand new 1952 Heathkit Oscilloscope Kit with a multitude of outstanding features and really excellent performance. A scope you'll truly like and certainly want to own.

The kit is complete with all parts including all tubes, power transformer, punched and formed chassis, etc. Detailed instruction manual makes assembly simple and clear — contains step-by-step instructions, pictorials, diagrams, schematic, circuit description and uses of scope. A truly outstanding value.

MODEL 0-7
SHIPPING WT. 24 LBS.

$43.50

Heathkit VACUUM TUBE
VOLTMETER KIT



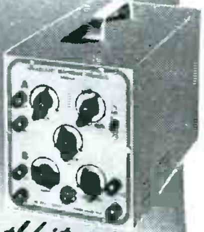
- New styling — formd case for beauty.
- New truly compact size — Cabinet 4⅛" deep x 4-1/16" wide x 7⅜" high.
- Quality Simpson 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — Reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

The 1952 Model Heathkit Vacuum Tube Voltmeter! Newly designed cabinet combines style and beauty with compactness. Greatly reduced size to occupy a minimum of space on your work-bench. Covers a tremendous range of measurements and is easy to use. Uses only quality components including 1% precision resistors in multiplier circuit for greatest accuracy, Simpson 200 microamp meter with easy to read scales for fast and sure readings.

All parts come right with kit, and complete instruction manual makes assembly a cinch.

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50



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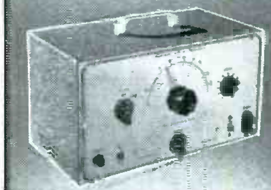
ELECTRONIC SWITCH KIT $19.50



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AUDIO GEN. KIT $34.50

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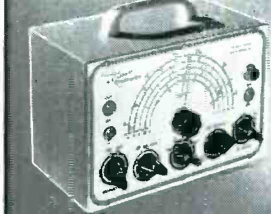
CONDENSER CHECKER KIT $19.50



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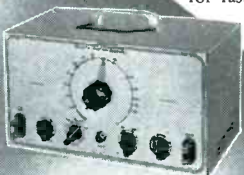
A.C. VOLTMETER KIT $29.50



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New CBS-HYTRON 12B4

New 9-pin miniature; high-perveance, low-mu triode with 6/12-volt heater for parallel or series connection. 12B4 is designed specifically for vertical amplifiers with limited primary B supply voltages. Delivers adequate vertical sweep power in proper circuit to sweep any 70° rectangular picture tube.

Characteristics of 12B4 are similar to those of 6W6GT, but 12B4 . . . for same input . . . supplies substantially more sweep power. 12B4, because of special design and processing, is also virtually free from grid emission.

New CBS-HYTRON 12BY7

New 9-pin miniature; very-high-transconductance pentode amplifier. As video amplifier in high-quality receivers, gives extended gray scale. In low-cost receivers, 12BY7 provides adequate voltage amplification for wide-band video amplifiers with primary B voltages as low as 135 volts.

Within its power capabilities, 12BY7 gives gains equal to those of 6AG7. High ratio of transconductance to interelectrode capacitances makes 12BY7 useful as video i-f or pulse amplifier for radar. High grid-to-screen transconductance suits 12BY7 (within its power handling capabilities) for class C harmonic oscillators.

Which of these CBS-HYTRON ORIGINALS can you use?

New CBS-HYTRON 5Y3WGT

New "ruggedized," full-wave filamentary-type rectifier with electrical characteristics equivalent to those of 5Y3GT . . . but 5Y3WGT is specially designed for equipment subject to high impact and shock.

New CBS-HYTRON 12A4

New high-perveance, medium-mu, 9-pin miniature triode for use as vertical amplifier, class C oscillator, or low-distortion audio output amplifier in push pull.

New CBS-HYTRON 12BZ7

New high-mu, 9-pin miniature dual triode for high-gain audio amplifiers, gating circuits, synch separators and amplifiers.

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RADIO TUBES

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HYTRON
RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

MAIN OFFICE: SALEM, MASSACHUSETTS

HYTRON RADIO & ELECTRONICS CO.
Salem, Massachusetts

Please rush me full specifications for the new CBS-Hytron types I have checked:

12B4 .... 12BY7 .... 5Y3WGT ....

12A4 .... 12BZ7 ....

Name ....
(please print)

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City and State ....

density may be obtained without requiring excessive cathode-current density. In the SAX-22, the beam density is 68 amp per square cm, whereas effective magnification reduces the cathode-current density to 1.7 amp per square cm. The requirement for a high-density small-diameter beam stems from the use of gridless interaction gaps. To obtain satisfactory coupling between the electron beam and the resonators at these frequencies, the gap necessarily is small in size. The high peak power and high duty-cycle requirements for this tube make the use of grid coupling impossible, hence the use of a gridless gap eliminates the power density consideration if the beam is properly controlled and body interception is kept small.

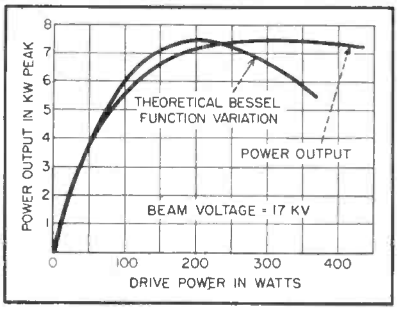


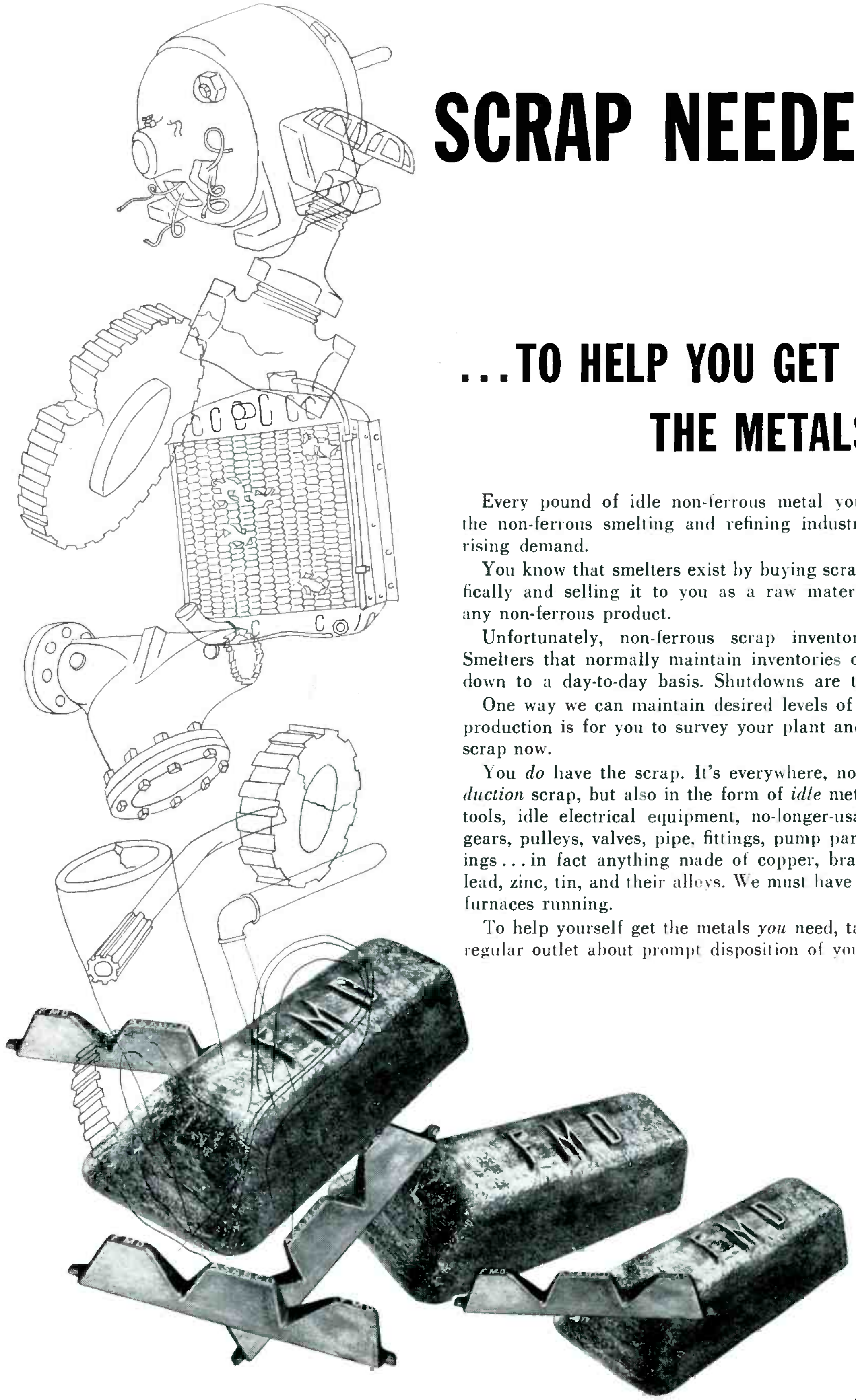
FIG. 2—Output power as a function of r-f drive power

Figure 2 shows the optimum r-f drive power to be about 300 watts. The curve is so flat that a two-to-one variation will affect the output power by only five percent. The small signal gain is about 20 db at drive powers up to 5 or 10 watts and decreases to about 14 db at maximum power output. This gives the characteristics of a linear amplifier at low level.

In Fig. 3 the power output of the SAX-22 varies approximately as the third power of beam voltage. This is a consequence of the three-halves power law for beam current in a space-charge-limited electron gun. The efficiency of the tube increases slowly with voltage, which is due to tighter coupling and relatively smaller circuit losses at the higher voltages.

It is possible, through the addition of another interaction gap and

SCRAP NEEDED...



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Unfortunately, non-ferrous scrap inventories are alarmingly low. Smelters that normally maintain inventories of several months are now down to a day-to-day basis. Shutdowns are threatened.

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You *do* have the scrap. It's everywhere, not just in the form of *production* scrap, but also in the form of *idle* metal: obsolete machines and tools, idle electrical equipment, no-longer-usable automobile radiators, gears, pulleys, valves, pipe, fittings, pump parts, old bushings and bearings... in fact anything made of copper, brass, aluminum, magnesium, lead, zinc, tin, and their alloys. We must have this *idle* metal to keep the furnaces running.

To help yourself get the metals *you* need, talk to your dealer or other regular outlet about prompt disposition of your scrap.

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(A) B-4 Booster Pump. Takes over at forepressures up to 1 mm. Handles large amounts of gas in range from 1 — 30 microns. Ideal for roughing or backing manifolds to speed up exhaust cycles or as prime pump on aluminizing equipment or wherever high speeds are required.

(B) Alphatron* Leak Detector and Control Unit for Gas Filling. The latest high speed rotary exhaust equipment demands split second vacuum control. The Alphatron Controller responds to pressure changes in about two tenths of a second. It is used to close off leaky tubes on a station with only a two second cycle. Instantaneous, accurate pressure response makes it a natural for gas filling where accuracy of fill pressure is important or where valuable gases are used.

(C) Gas Free High Purity Metals. Copper, nickel, cobalt, and iron. Special melts on request. Ingot weights up to 600 pounds.

(D) Alphatron* Vacuum Gauge. Instantaneous response with accurate gauging from 1 micron to 10 mm. A rugged metal ionization type gauge for industrial usage. Can be adapted for recording and controlling.

(E) B-1 Booster Pump. Specially designed for rotary exhaust units in miniature and subminiature tube production.

(F) Type 710 Thermocouple-Ionization Gauge Control. One control with two thermocouple gauges (1 — 1000 microns) and one ionization gauge (10^{-3} mm. to 10^{-8} mm. Hg range). Automatic input regulation and protective circuit.

(G) Type 701 Thermocouple Gauge Control. A light, portable instrument for vacuum testing in range 1 — 1000 microns — compact and rugged.

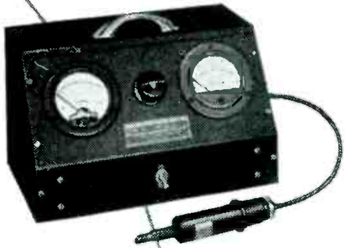
(H) H-4-P Purifying Diffusion Pump. Similar to H-2-P but with speeds of over 300 liters/sec from 10^{-3} to 10^{-5} mm. Hg range.

(I) H-2-P Purifying Diffusion Pump. Over 50 liters/sec in 10^{-3} mm. to 10^{-6} mm. range. Operates against forepressures as high as 0.300 mm. Blank-off 2 x 10^{-7} mm. Hg. For exhausting cathode ray tubes and magnetrons, and aluminizing operations on automatic equipment.

(J) Vacuum Seals. For introducing motion, power, gases, or connecting gauges.

(K) Standard Vacuum Furnace. A versatile packaged unit for many metallurgical operations under high vacuum or inert atmospheres. Temperatures to 2000° C. Useful for degassing tube parts, production of germanium crystals, research and production of improved metals for tube parts, as well as general high vacuum metallurgical research work.

G



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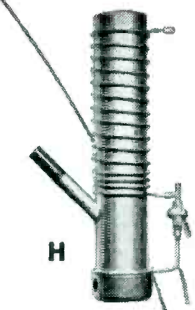

SOURCE!

L

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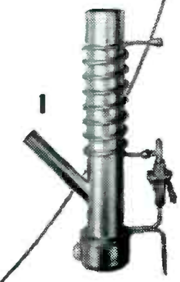

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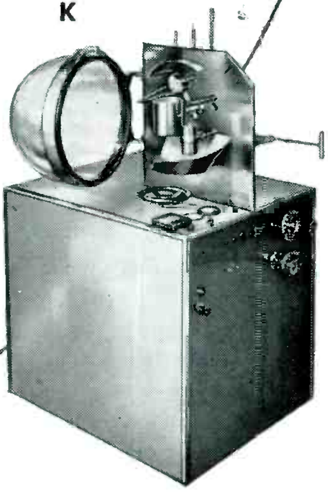

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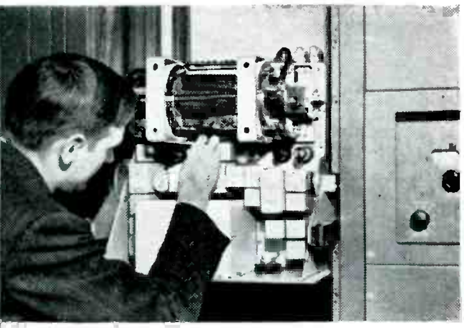
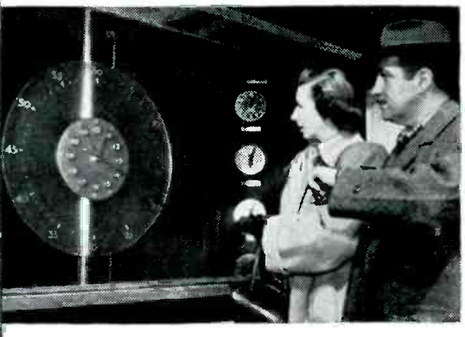
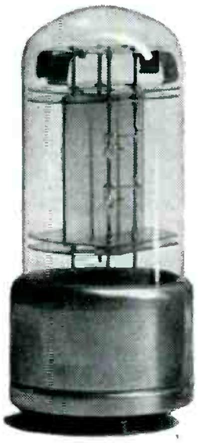


Each crystal is enclosed in a cylindrical oven which holds the crystal temperature to within 1/100 of a degree.



At the A. T. & T. building at 195 Broadway, New York, passersby set watches by the world's most accurate public clock, which is controlled by the master standard.

← Front of the new frequency-time standard at Bell Telephone Laboratories. In the rear there are 600 electron tubes and 25,000 soldered connections. Room temperature is maintained within two degrees.



The controlling quartz crystal vibrates in vacuum at 100,000 cycles per second. The standard is powered by storage batteries, with steam turbo-generator standing by, just in case of emergency.

A vibrating crystal keeps master time

Ever since Galileo watched a lamp swinging in the Cathedral of Pisa three centuries ago, steady vibration has provided the practical measure of time. In the 1920s Bell Laboratories physicists proved that the quartz crystal oscillators they had developed to control electrical vibration frequency in your telephone system could pace out time more accurately than ever before.

The Laboratories' latest master standard keeps an electric current vibrating at a frequency that varies only one part in a billion, keeping time to one ten-thousandth second a day.

Through secondary standards, a master oscillator governs the carrier frequencies of the Bell System's ship-to-shore, overseas and mobile radiotelephone services, the coaxial and *Radio-Relay* systems which transmit hundreds of simultaneous conversations, or television. In the northeastern states, it keeps electric clocks on time through check signals supplied to electric light and power companies.

The new standard also provides an independent reference for time measurements made by the U. S. Naval Observatory and the National Bureau of Standards. Thus, world science benefits from a Laboratories development originally aimed at producing more and better telephone service.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

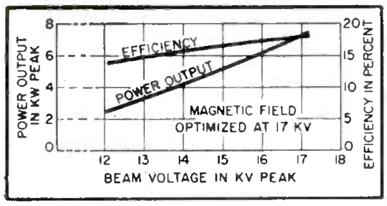
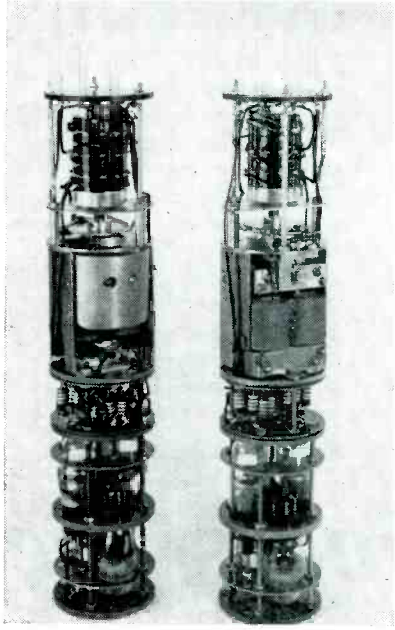


FIG. 3—Power output and efficiency versus beam voltage

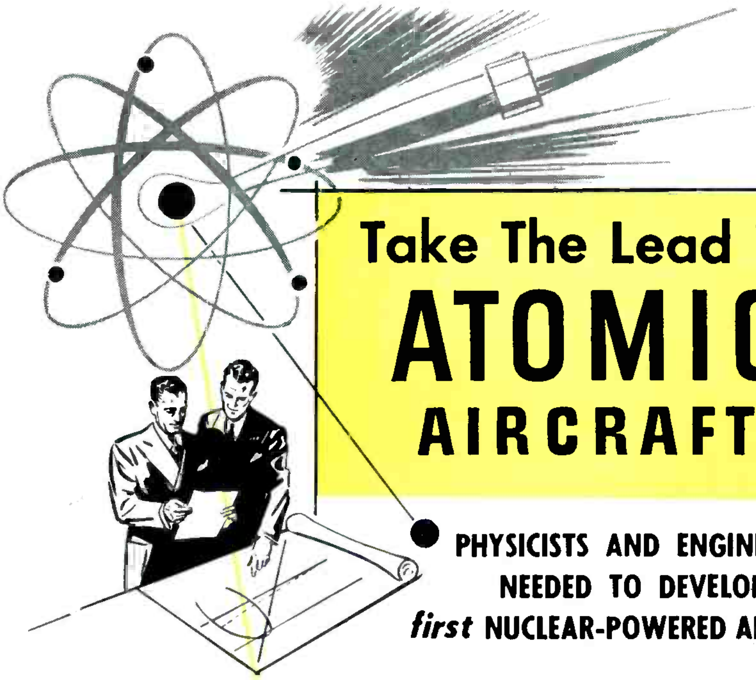
cavity along the beam, to increase the gain of the tube greatly. Other tube developments indicate that it should be possible to obtain 7.5 kw output with 3 to 5 watts drive power. Klystron frequency multipliers and a pulse amplifier are available for driving the SAX-22 at the 300-watt-drive power level.

Submerged Repeaters for Telegraph Cables

A NEW REPEATER, designed for transoceanic cable use, has been designed by the Western Union Telegraph Company. The first permanent installation was made recently in the 1 HM-BR cable, extending from Hammel, Rockaway Beach, New York, to Bay Roberts, Newfoundland. This repeater is located more than 100 nautical miles from Hammel in a depth of about 250 fathoms. Before installation of the repeater, the cable operated at a maximum speed of 83 wpm. It



Two views of the repeater switch. The switch is sealed in a steel cylinder



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A city for family life—50 parks—lakes—excellent schools—big time baseball, football, basketball, golf, rodeo—ice arena—opera and concerts—good year round climate—no smoke—Western Hospitality.

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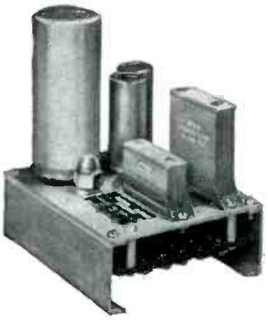
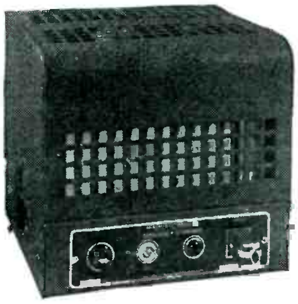


TYPE 2001-2, BASIC UNIT

Frequencies 200 to 2500 cycles. Dividers and Multipliers available for lower and higher frequencies. Miniaturized and JAN construction. Output, 6 volts.



TYPE 2005, UTILITY UNIT

Consists of Type 2001-2 and booster to provide 10 watts at 110V at precision frequencies from 50 to 500 cycles at input power frequencies of 50 to 500 cycles, 45 watts.

TYPE 2121-A, LAB. STANDARD

Outputs, 60 cycle, 0-110 Volts, 10 Watts; 120-240 cycle impulses. Input, 50-400 cycles, 45 Watts.

Precision FREQUENCIES

GUARANTEED
ACCURATE
TO 1 PART IN 100,000 (.001%)

TYPE 2111, POWER UNIT

50 Watt output. 0-110-220V at 60 cycles, or any frequency 50 to 1000 cycles. Input, 50-100 cycles, 275 watts.

THE basis of these frequency standards is an electronic fork which is temperature-compensated and hermetically sealed against humidity and barometric pressure.

Type 2001-2 and similar units are available independently. Complete instruments of our manufacture are used extensively by industry and the armed forces where unvarying, dependable high precision is required, such as for bombsights and fire control.

WIDELY USED IN SUCH FIELDS AS:

Aviation
Astronomy
Ballistics
High-Speed Photography
Viscosity Measurement
Nuclear Physics
Telemetering
Radiation Counting
Fluid Flow
Chemical Reaction
Navigation
School Laboratories
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Accurate Speed Control

WHATEVER YOUR FREQUENCY PROBLEMS, OUR ENGINEERS ARE READY TO COOPERATE. PLEASE REQUEST DETAILS BY TYPE NUMBER.

American Time Products, Inc.

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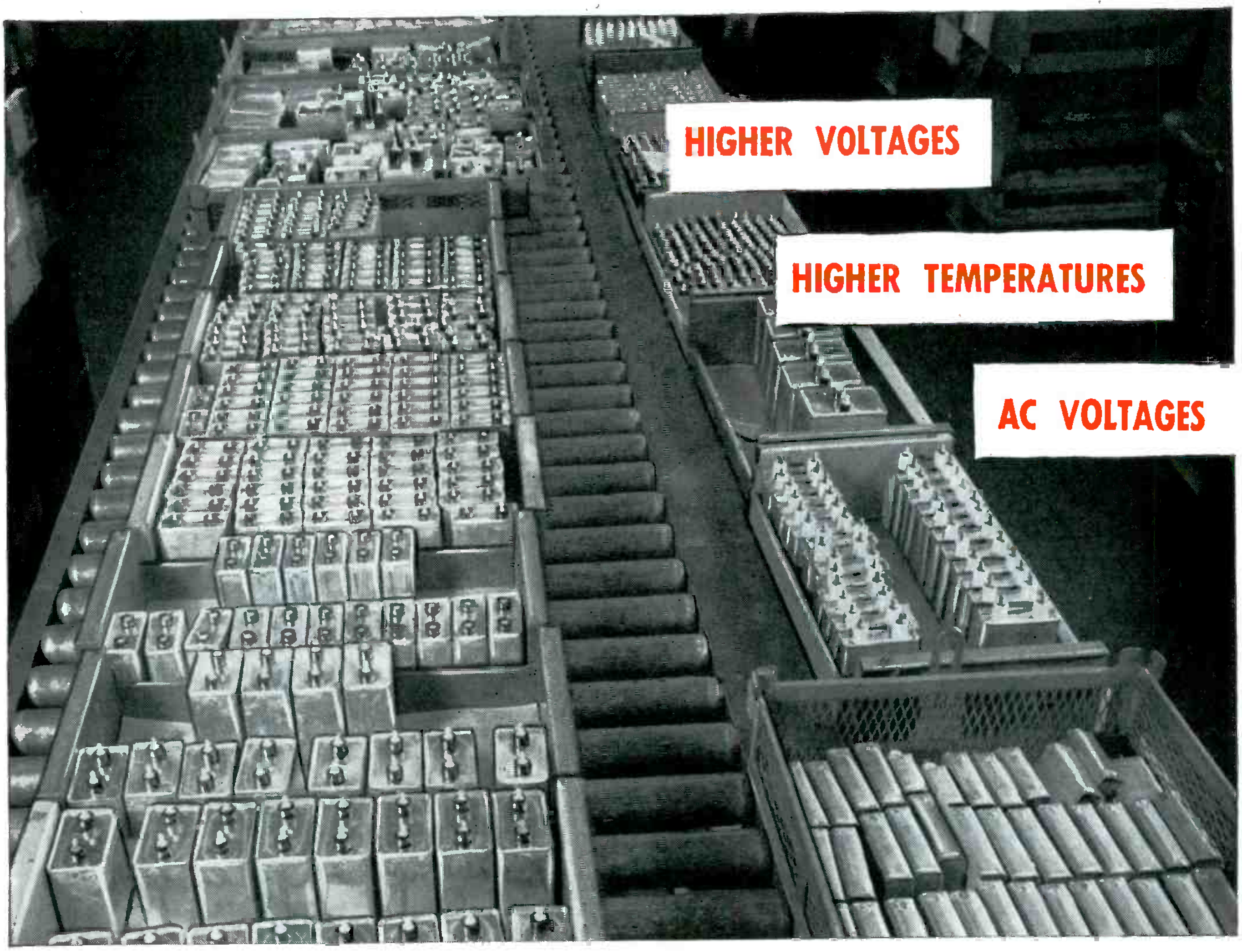


General Electric can show you how to make wider use of JAN-C-25 capacitors

From years of experience in manufacturing paper-dielectric capacitors, General Electric can show you how to make wider use of your JAN capacitors.

These capacitors are used in thousands of applications —primarily d-c at rated voltages and temperatures. However, most JAN units can be operated at other voltages and under widely varying conditions.

For example, actual life tests have shown that a General Electric 1 muf. CP 70 unit rated for a minimum life of 10,000 hours at 1000 v. d-c and 40 C or 700 v. d-c and 85 C, can also be used at:

Higher voltages—1380 v. d-c at 85 C for 500 hours.
1300 v. d-c at 85 C for 1000 hours.

Higher temperatures—105 at 525 v. d-c for 500 hours.

AC voltages—440 volts, 60 or 400 cycles
with normal JAN-C-25 derating.

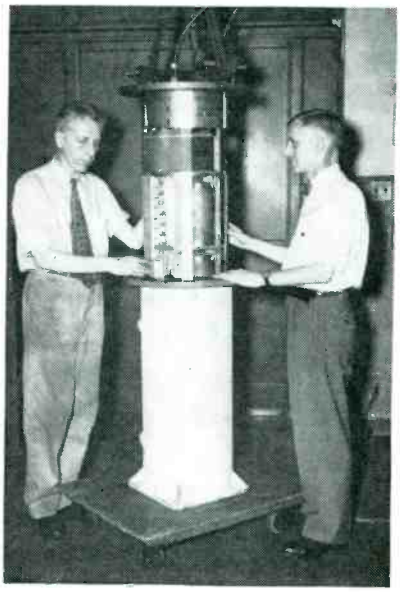
General Electric has similar data for most of its JAN units, showing how each may be operated under a variety of conditions. For information on how these standard G-E capacitors may be applied in your circuits, consult your Apparatus Sales Office, or write to Specialty Capacitor Sales, General Electric Company, Hudson Falls, N. Y.

GENERAL ELECTRIC

407-307

is expected now that a speed of 250 wpm will be obtained.

The repeater is made up of a 3-stage push-pull R-C coupled amplifier with input and output transformers. Preceding the transformer is a simple tuned signal-shaping network. All stages use Western Electric type 310-A tubes. Two tubes are connected in parallel and operated as triodes in each side of the output stages. Theoretical output undistorted is 0.25 watt. The output transformer circuit reduces the net output to a little less than 0.25 watt.



Lowering the repeater chassis into its case

Included in the repeater is a switch used to disconnect the repeater and join the cable through for operation without repeater or for cable testing purposes and to disconnect the regular amplifier in the event of failure and connect the spare amplifier. Two complete amplifiers are included in the repeater.

It is planned to install repeaters in depths of 200 to 1,200 fathoms or more or at hydrostatic pressures up to 3,000 psi. To withstand the large pressures, the repeater is filled with oil and a pressure equalizer automatically adjusts the internal pressure to the external pressure within a few psi. The most important element of the equalizer is a flexible, corrosion-resistant metal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KHX 3050
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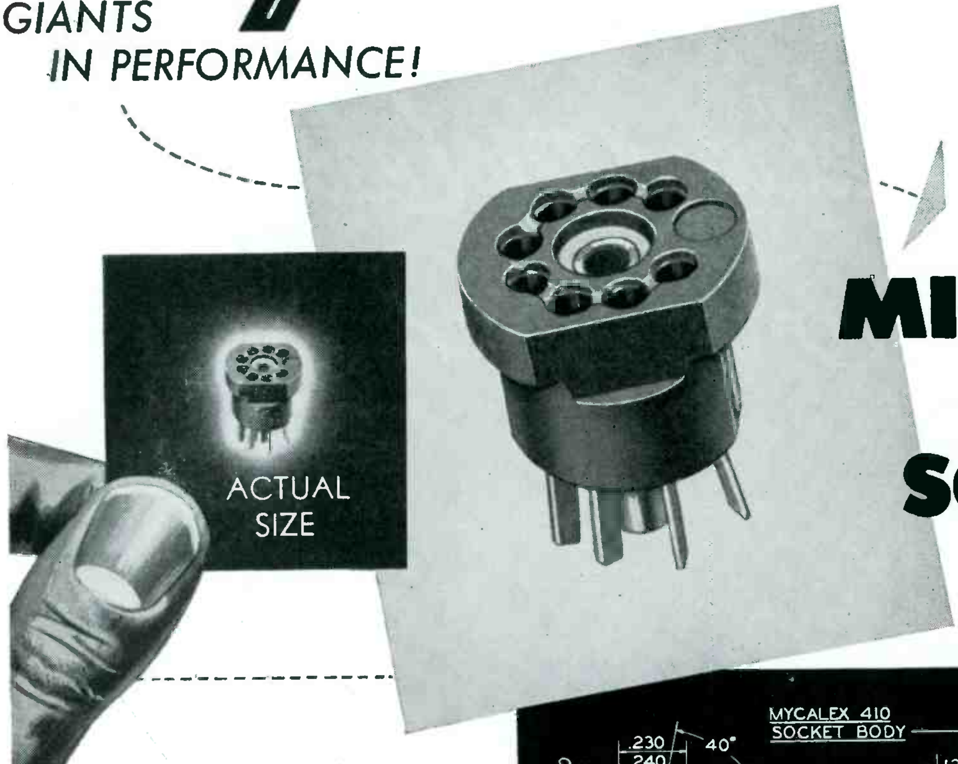
MINUTE IN SIZE... GIANTS IN PERFORMANCE!

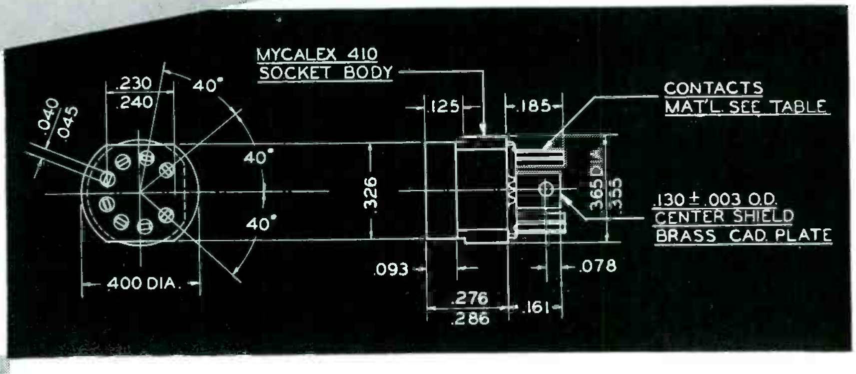
MYCALEX 410



8-PIN SUB-MINIATURE TUBE SOCKETS


TOP VIEW


BOTTOM VIEW



- LOW LOSS FACTOR OF .015 at 1 MC.
- INSULATION RESISTANCE (min.) 50,000 Megohms
- ARC RESISTANCE, ASTM SECS. 250+
- OPERATING TEMPERATURE 135°C (limitation due to contact metal)
- Q-value at 40°C—50% RH—not less than 1000
- Q-value at 40°C—90% RH min.—not less than 333

WRITE FOR DATA SHEETS

Mycalex 8-Pin Sub-Miniature Tube Sockets are fully described in the new Data Sheets. Other catalogs are available on Mycalex Insulation for every electronic or electrical application.

New MYCALEX 410 Sub-Miniature Tube Sockets are designed for use in electronic and electrical equipment where space is at a premium. Because they are extremely compact, these sockets offer a ready solution to numerous design problems involving spatial limitations. Installation is simple, mounting being accomplished without screws or rivets in shaped chassis holes.

Improved electrical performance and greater mechanical protection for the tube than are available with ordinary insulating materials are afforded by this socket through the use of MYCALEX 410 glass-bonded mica. MYCALEX 410 is rated Grade L-4B insulation under N.M.E.S. JAN-I-10. It offers superior electrical and mechanical properties in combination with practical cost per unit.

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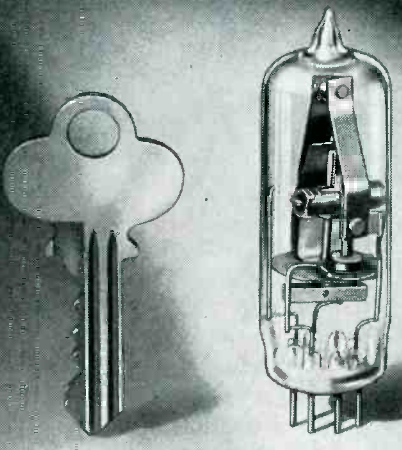

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Announcing

. . . a NEW Miniature by EDISON

EDISON announces its new Model 207 Miniature Thermal Relay — designed to meet the need for a space-saving time-delay relay.

Into the design and development of this sealed-in-glass miniature, EDISON has applied the experience of over 20 years in the thermal engineering field and has built into it many of the quality features of the widely-used EDISON Model 501 Thermal Relay. In numerous applications the two relays have similar operating characteristics.

Pilot production started in December 1951. For free bulletin, just clip coupon and mail.

Thomas A. Edison
INCORPORATED
Instrument Division • West Orange, N. J.

SPECIFICATIONS • MODEL 207

Sealed-in-glass
Arc quenching atmosphere
Precision timing — Final adjustment made after sealing by patented feature
Weight: ½ oz. (approx.)
Diameter: ¾″ (approx.)
Height: 2¼″ maximum (seated)

Standard Heater Voltages: 115v, 27.5v, 6.3v
Contact Ratings: 2.5 amps @ 125v ac., 1.0 amp @ 125v dc.
Ambient Compensation: —60 to +85°C
Nominal Heater Input: 2 watts

Mounting: Miniature Button 7-pin
Range of Delay Periods: 5 secs. to 120 secs.

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63 Lakeside Avenue, West Orange, New Jersey

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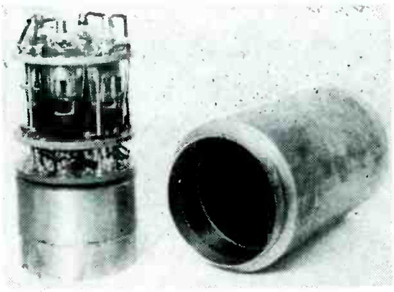

The vacuum-tube unit

bellows which expands or contracts as pressure is applied or removed.

Standard glass bulbs housing the 310-A's are not of sufficient strength to withstand the hydrostatic pressures encountered. Therefore, the tubes and related components are mounted in steel cylinders, four tubes to a cylinder. Since there are 16 tubes total in the two amplifiers, four of these cylinders are required.

Automatic Steering for Outboard Motorboats

By Samuel E. Dorsey
Electronic Engineer
Research Department
Naval Ordnance Test Station
China Lake, Calif.

An automatic steering device for an outboard motorboat is desirable to reduce fatigue resulting from continuous operation of the steering lever.

Most outboard motors are equipped with either a spring device, which causes the boat to proceed in an approximately straight line while not being steered or a variable-friction device by means of which the same thing can be accomplished. However, if the wind is strong and the water is at all rough, the boat can be very quickly thrown badly off its course. Even in calm conditions, the craft will not stay on its course for long.

In the writer's opinion, the important requirement of such an automatic steering device, nonexistent in any spring or friction principle, is that it maintain for fairly long distances and periods of time an approximately straight course, returning to it without manual aid when thrown off by wind or waves. Also, it must be simple and require very little power to operate.

The ability to automatically re-

SLANT YOUR REQUIREMENTS TO ICA FOR MINIATURE SLIP RING AND COMMUTATOR ASSEMBLIES

This ICA plant—brand new inside and out—contains the most modern and complete facilities available anywhere in the world for the exclusive production of Miniature Slip-Ring and Commutator Assemblies to precision standards. It is now in full scale production to meet your requirements in the fastest possible time at the lowest possible cost.

ICA Assemblies are produced under exclusive license by Electro Tec Corporation. They are manufactured by molding plastic blanks around the wire leads, then machining these blanks to the exact size and shape required, after which hard silver rings are electro-plated into the machined grooves. Final machining produces a one-piece assembly of extreme accuracy and free from the accumulated errors common in fabricated assemblies.

Before placing an order for assemblies of any other type, check with ICA on price and quality. Our new facilities offer exceptional advantages which should not be overlooked. Our engineering staff is at your service at all times for consultation.

TYPICAL SPECIFICATIONS:

Sizes: .045" to 24" Cylindrical or Flat

Cross-sections: .055" to .060" or More

Finish: Polish to 4 Micro-Inches or Better

Breakdown: 1000 V Hi-Pot Inter-Circuit

Ring Hardness: 60 to 70 Brinell

Rotation Speeds: To Over 12000 RPM

Surface Protection: Palladium and Rhodium or Gold Prevent Tornish, Minimize Wear

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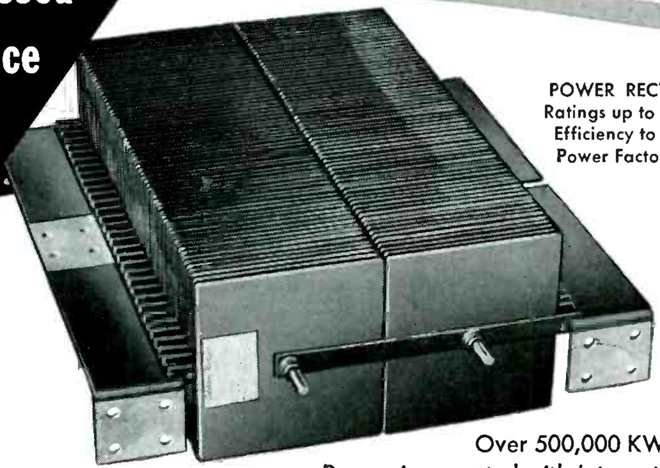

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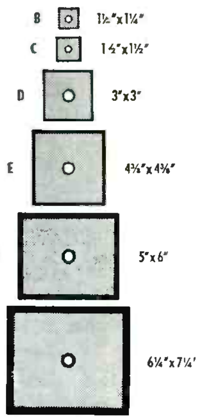

Over 500,000 KW, DC Power, is operated with *International* Selenium Rectifiers. A recent month's production included Rectifiers to supply 40 microamperes, 1,000 volts, and Rectifiers with a capacity of 140,000 amperes, 14 volts. Designed and built to meet Government Specifications. Manufactured for temperatures up to 100° C ambient—100% humidity. Owned and managed by Engineers who are specialists in the design and manufacture of Selenium Rectifiers. Submit your problems for analysis and we will be glad to offer our recommendations.

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Output up to 600 microamperes
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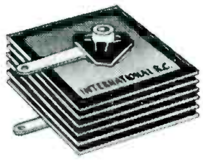

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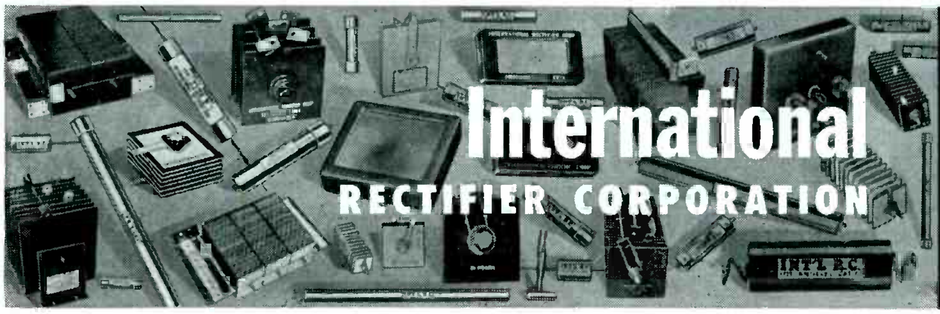
From 65 to 1,000 ma.



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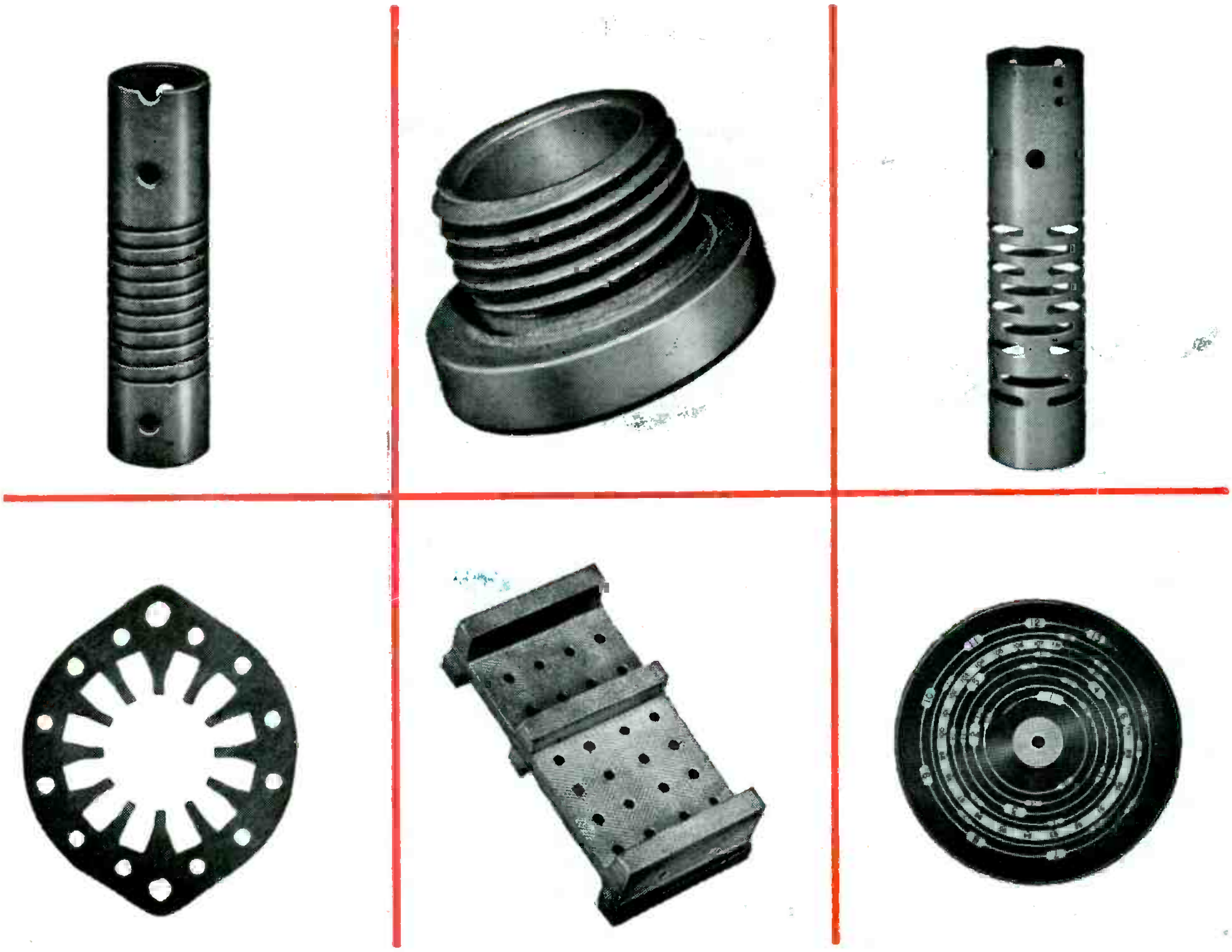

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Essential characteristics are "built-into" LAMICOID to meet the needs of *your* application—mechanical, structural and/or insulating. Because LAMICOID—a thermosetting plastic laminate – is made with fillers such as glass, nylon, fabric, paper, etc. with a variety of resins, many combinations of properties are possible.

LAMICOID is used for tube socket supports, coil forms, dials, name-plates, panels, antenna parts and many other applications. For example, in combination with synthetic rubber it is used for end seals of electrolytic capacitors to keep out moisture and provide a non-corrosive seal.

Take advantage of LAMICOID's versatility to give *your* product peak efficiency. LAMICOID can be supplied in standard sheets, rods and tubes or fabricated into parts to your specification. We will be glad to apply the knowledge gained through 58 years of experience in developing and producing electrical insulating materials to your problem. Send your blueprint and specification today for a prompt quotation.

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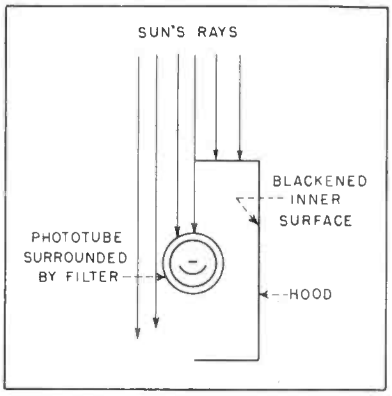
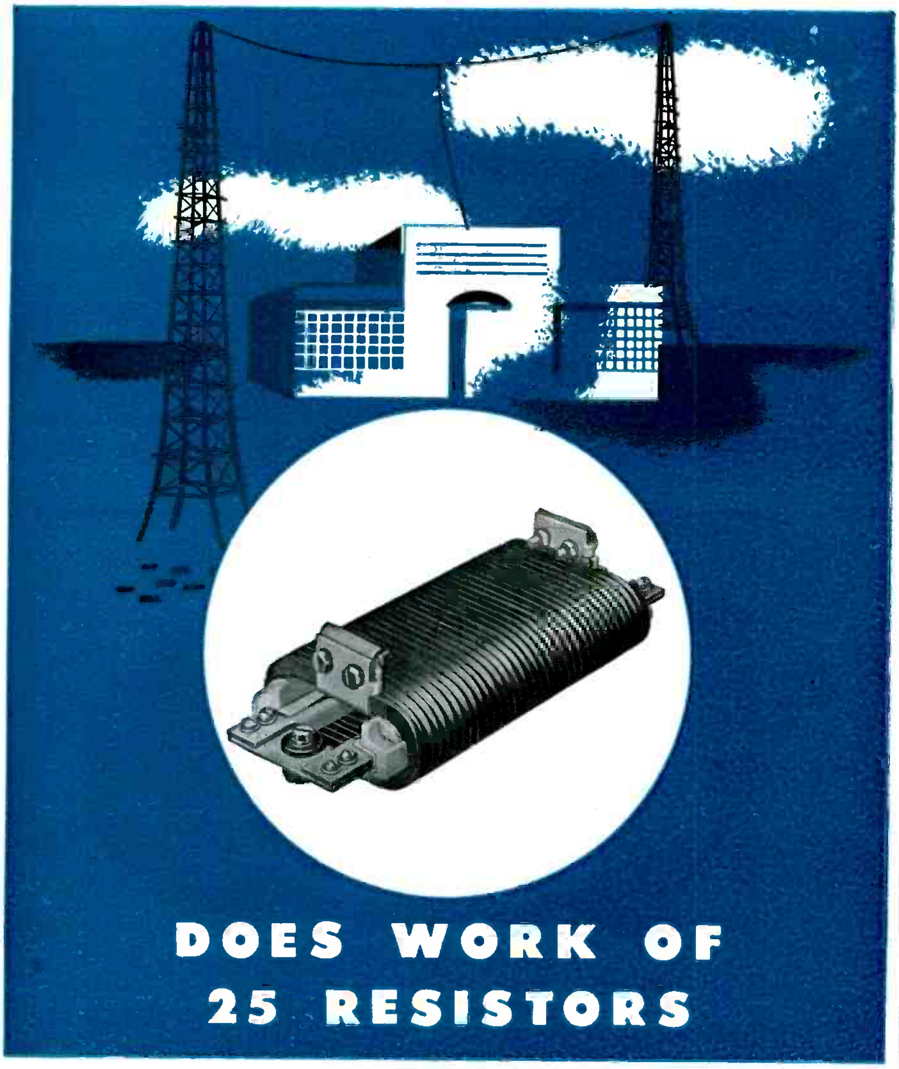


FIG. 1—Direction-sensing mechanism of experimental model

turn to the course, after once being thrown off it, can be realized only through the use of some form of servo-system. A continuous-type control, as is applied in larger automatic steering systems, might conceivably be utilized in the outboard motorboat, but an on-off or relay-type control has the advantage of simplicity and low power consumption. This paper deals with such a relay-type automatic steering system.

To describe the action of the control, a cycle of operations is followed through. Assume that the boat is exactly on its course and that the rudder is in one of its two stable positions wherein it is steering the boat gradually to the right. After the boat has turned a few degrees to the right, the rudder is changed into its other stable position, that of steering gradually to the left. Then, when the boat has turned through the course line, and a few degrees to the left, the rudder is returned to the first-mentioned position. Again the boat moves back toward the course line and the process repeats itself. Thus, the boat follows a slightly zig-zagging path around the true course set for it. On first thought, this sort of control would seem rather impractical but the system was thoroughly tested and found to operate very well.

The apparatus comprising the system may be divided into two general sections: the electronic portion and the mechanical portion. The electronic portion consists of the direction-sensing organ and a suitable amplifier, the over-all function being to translate the information of whether the craft is headed



What happened to the time?

A lot of things are scarce these days.

Steel. Aluminum. Machine tools. Raw materials. So scarce, in fact, that Uncle Sam has them on a priority list.

But in American industries today, the scarcest commodity of all is . . . *time!*

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But there's one way a manufacturer can get a "priority" on *time.*

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Air Express is first off the loading platform . . . first on the planes . . . first to arrive at destinations anywhere in the 48 states!

Whatever your business, you can profit from the regular use of Air Express. Here's why:

IT'S FASTEST — Air Express gets *top priority* of all commercial shipping services — gives the fastest, most complete door-to-door pick-up and delivery service in all cities and principal towns at *no extra cost.*

IT'S DEPENDABLE — Air Express provides one-carrier responsibility all the way and gets a *receipt upon delivery.*

IT'S PROFITABLE — Air Express service costs less than you think, gives you many profit-making opportunities.

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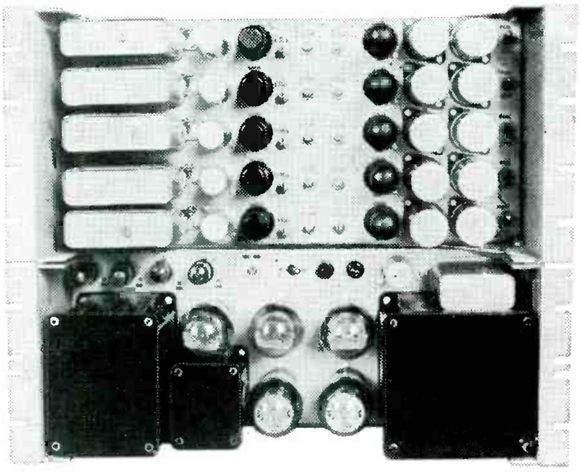
AIR EXPRESS

GETS THERE FIRST

VIDEO DISTRIBUTION AMPLIFIER

TYPE 1311



TYPE 1311 Video Distribution Amplifier is specifically designed to distribute video or synchronizing signals to several outlets. Thus, five separate equipments can be fed from a single synchronizing signal generator and monoscope combination.

The high degree of isolation between each output and each input circuit prevents interaction, even in the event of a short circuit at any one of the output lines.

Type 1311 is also commonly used to distribute picture signals from TV studios to a number of different locations.

SPECIFICATIONS

INPUT IMPEDANCE:	High impedance, for bridging 75 ohm coaxial lines.
OUTPUT IMPEDANCE:	To match 75 ohm lines.
INPUT VOLTAGE:	2 Volts peak to peak.
VOLTAGE GAIN EACH CHANNEL:	Adjustable from 0.9 to 1.1.
OUTPUT POLARITY:	Same as, or opposite of, input polarity, selectable by toggle switch.
NUMBER OF CHANNELS:	5 separate channels.
FREQUENCY RESPONSE:	Pass 60 cycle square wave undistorted. No overshoot on 100 KC square wave Down 3 DB @ 11 MC. Down 6 DB @ 13 MC.
CONNECTORS:	Both the input and output circuits use PL-259 coaxial line connectors which are not supplied.
POWER SUPPLY:	105-125 Volts, 60 cycle, single phase, 250 watts.
FINISH:	Natural sandblasted aluminum.
WEIGHT:	Amplifier: 17 lbs. net. Power Supply: 35 lbs. net.
PRICE:	$550.00 F.O.B. Plant (including power supply as illustrated).

Complete specifications available on request.

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Our reputation for producing top quality precision electronic equipment qualifies us as a reliable and capable subcontractor for manufacturers currently holding primary defense orders. Inquiries will be given our immediate attention.

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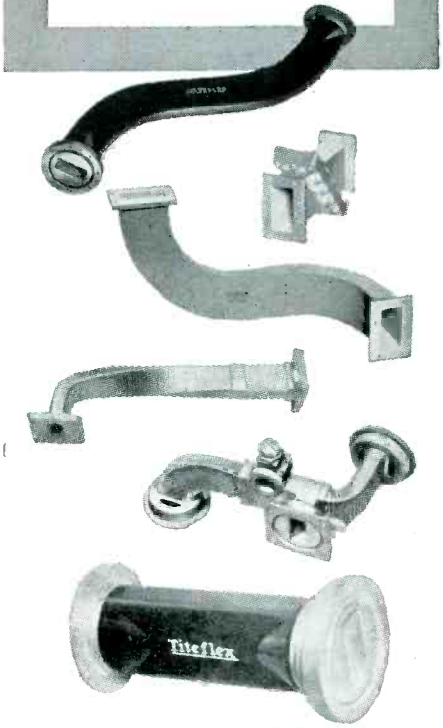

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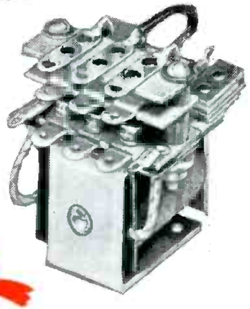

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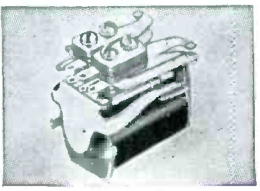

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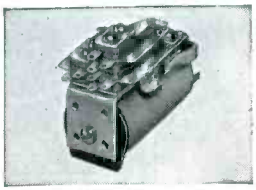

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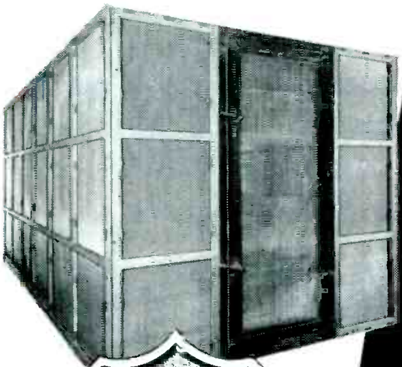


toward the right or left of the preset course into the closing or opening of a relay. The mechanical portion consists of an electric motor whose purpose is to move the steering lever of the outboard motor from side to side coupled with the necessary parts for conveying the motion to the steering lever.

A balance between extreme simplicity and greater versatility governs the choice of direction-sensing organ. Simplicity is the keynote in the experimental model. Diagrammed in Fig. 1 is a vacuum-type phototube, hooded to one side of its cathode surface. It is mounted vertically in such a way that the tube-and-hood assembly can be rotated throughout 360 deg of azimuth, with respect to the boat, and fixed to point in any direction. The phototube is surrounded by a filter to prevent ambient light from saturating it. (Two layers of masking tape serve very well.) In application, after deciding in what direction the boat is to go, the phototube cathode surface is set pointing in the azimuthal direction of the sun. Figure 1 illustrates the on-course condition. Sunlight strikes half of the phototube. It is obvious that as the boat veers to the right of the course, sunlight will impinge upon more of the phototube; to the left, less.

A more versatile direction-sensing organ makes use of a magnetic compass with some form of pickup. It is recommended that the compass be of the moving-dial type in an arrangement as shown in Fig. 2. Half of the surface of the dial is painted white, the other half a dull black. A small pencil of

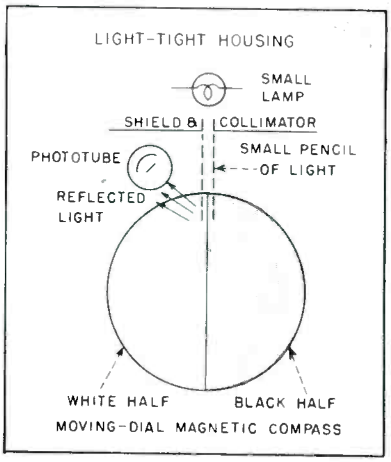
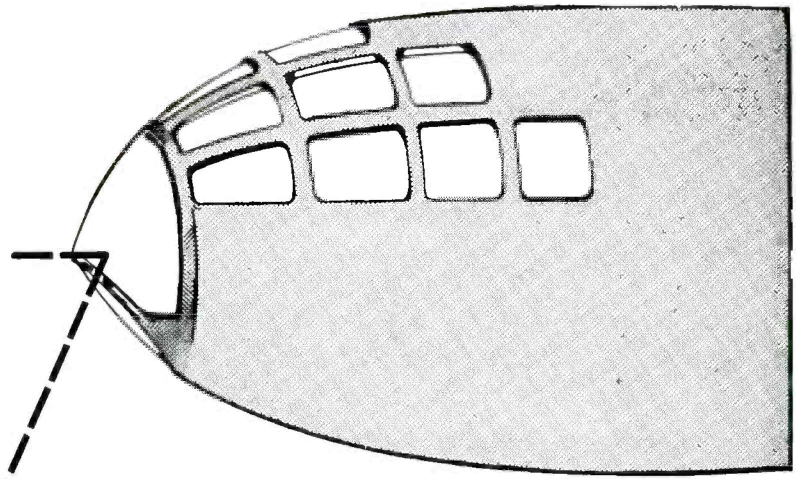


FIG. 2—More versatile direction-sensing device

VISIBILITY



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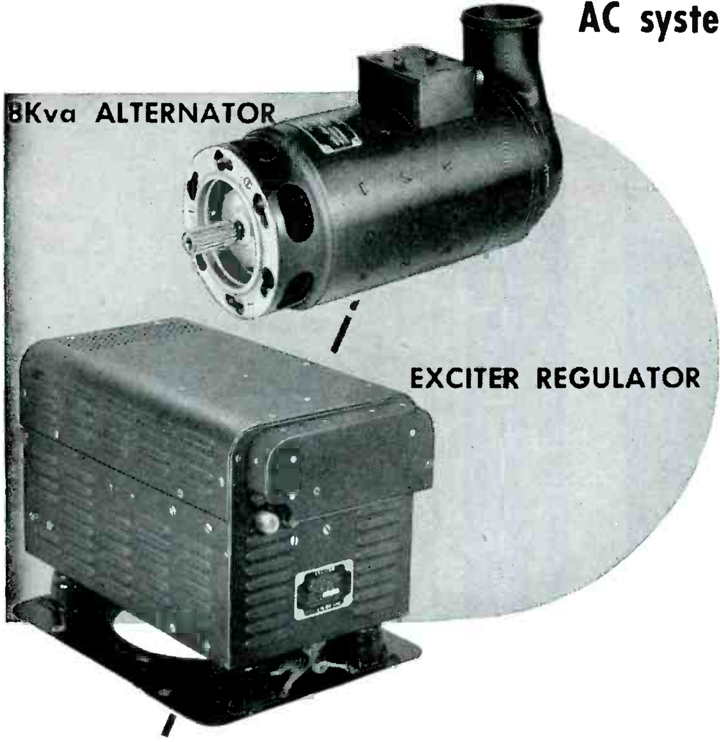

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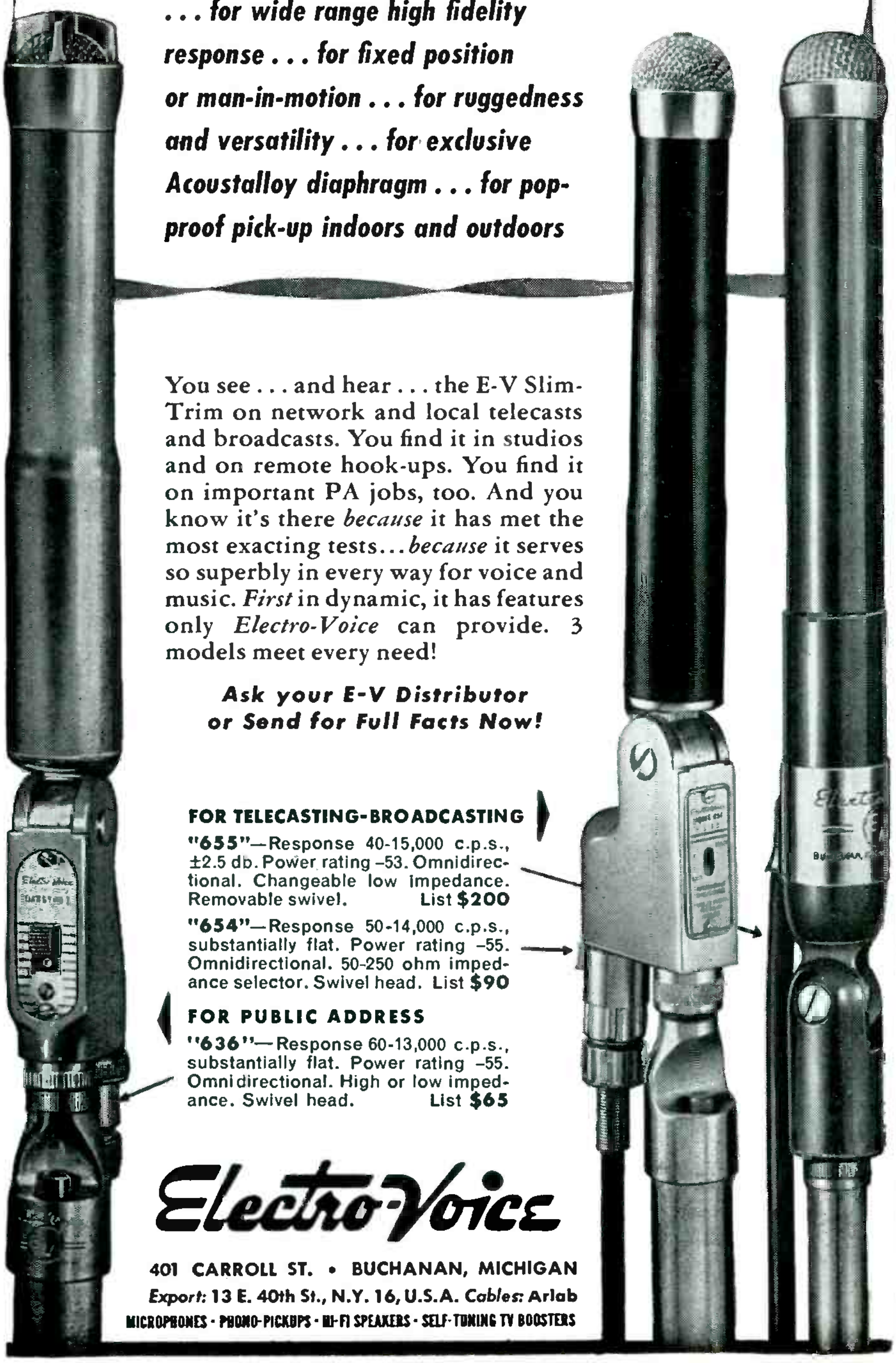

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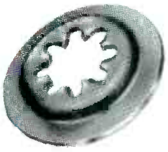
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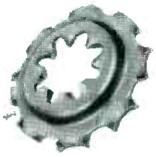
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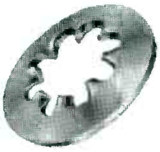
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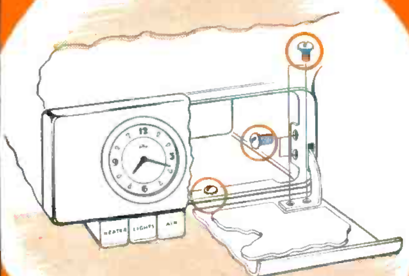

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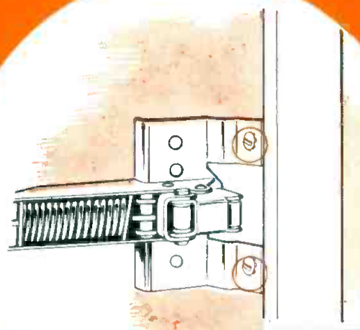

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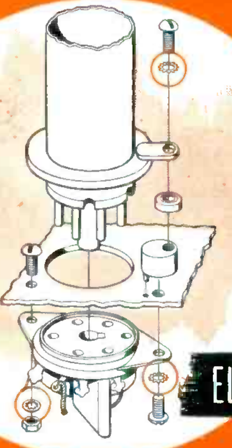
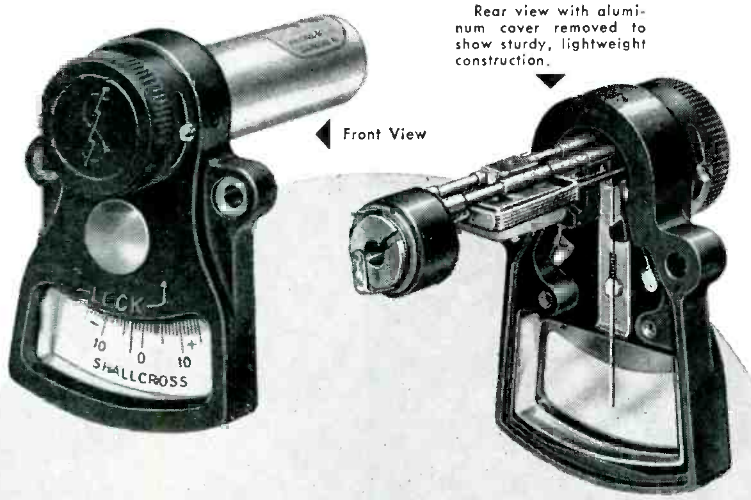


ELECTRONICS

This application is typical of the extensive use of SHAKEPROOF Lock Washers in electrical and electronic assemblies of all kinds, protecting vital fastenings against loosening and assuring efficient electrical grounding.



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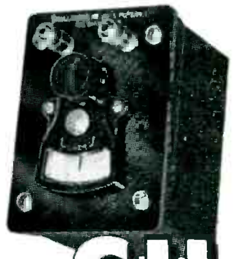

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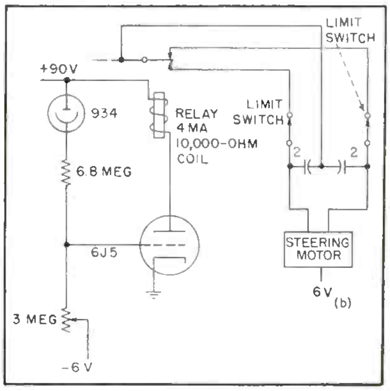
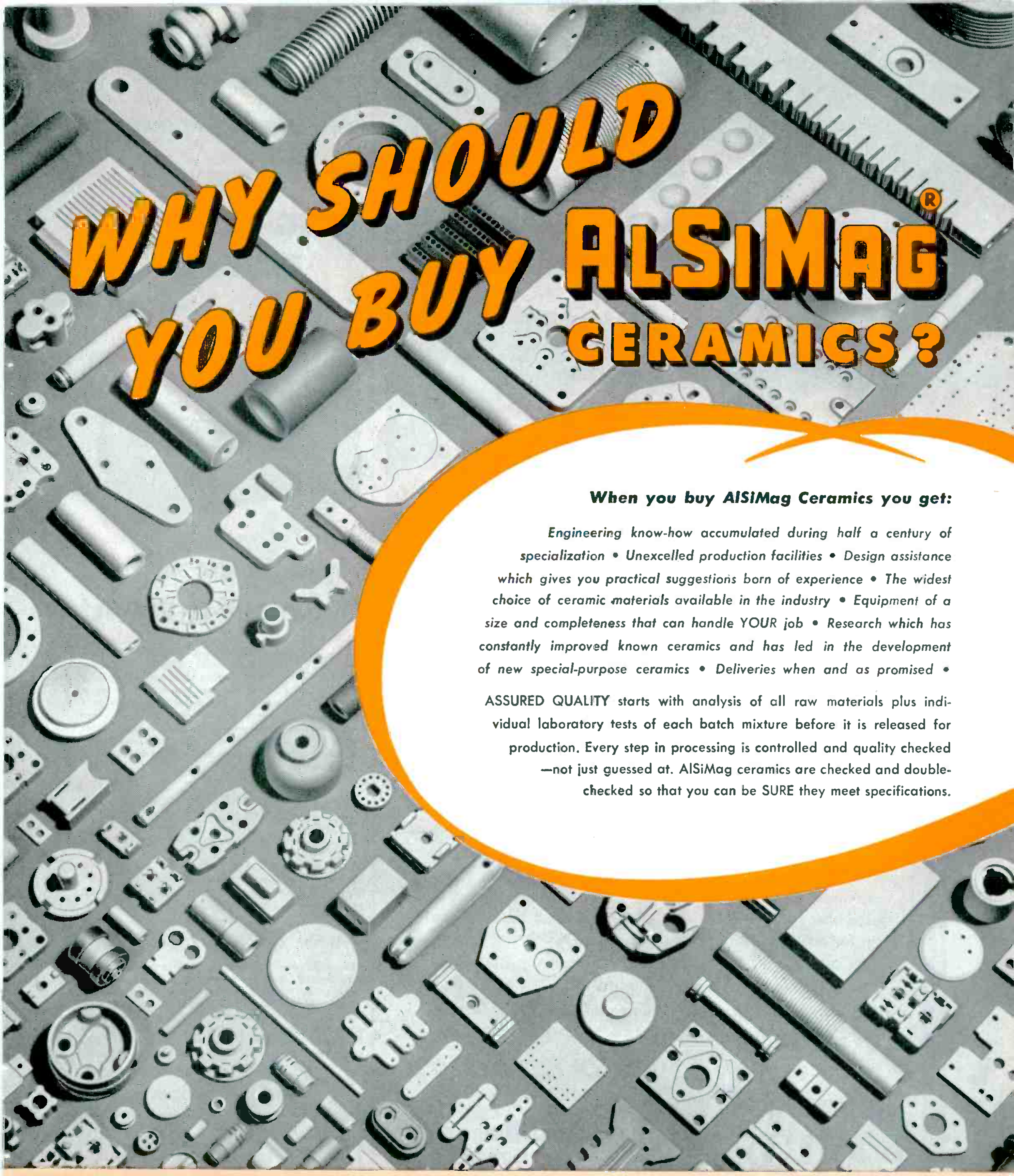


FIG. 3—Simplified diagram of experimental model

artificial light is trained on the dial and a phototube is situated so as to receive light reflected from the dial. The assembly is placed in a light-tight housing which can be rotated to change the course. As with Fig. 1, the on-course condition is illustrated. Again, it is obvious that as the boat veers to the right of its course, more light will reach the phototube; to the left, less.

The amplifier must have adequate gain and power capability to operate a relay satisfactorily from the signals generated by the phototube. The relay must be sufficiently rugged to handle the current drawn by the steering motor. Presumably, it might consist of a very sensitive relay driven directly by the phototube current, perhaps coupled to the more rugged relay. Figure 3 shows the single-stage amplifier circuit employed in the experimental model. For the more versatile sense organ, with the low light levels at which it operates, two stages of amplification may be necessary. In any case, it can be seen that the greater the gain, the smaller the angle subtended by the boat between pull-in and drop-out of the relay, with resultant less wide zigzag of the boat. In addition, some form of control of gain or bias is needed to set the points at which the relay responds.

It is almost a necessity that the steering motor be operable from a single six-volt automotive-type battery or, better still, an even smaller power source. It must be geared to a device which transmits lateral movement to the steering lever of the outboard motor, to the right when the steering motor is run in one direction and to the left when the steering motor is reversed. This



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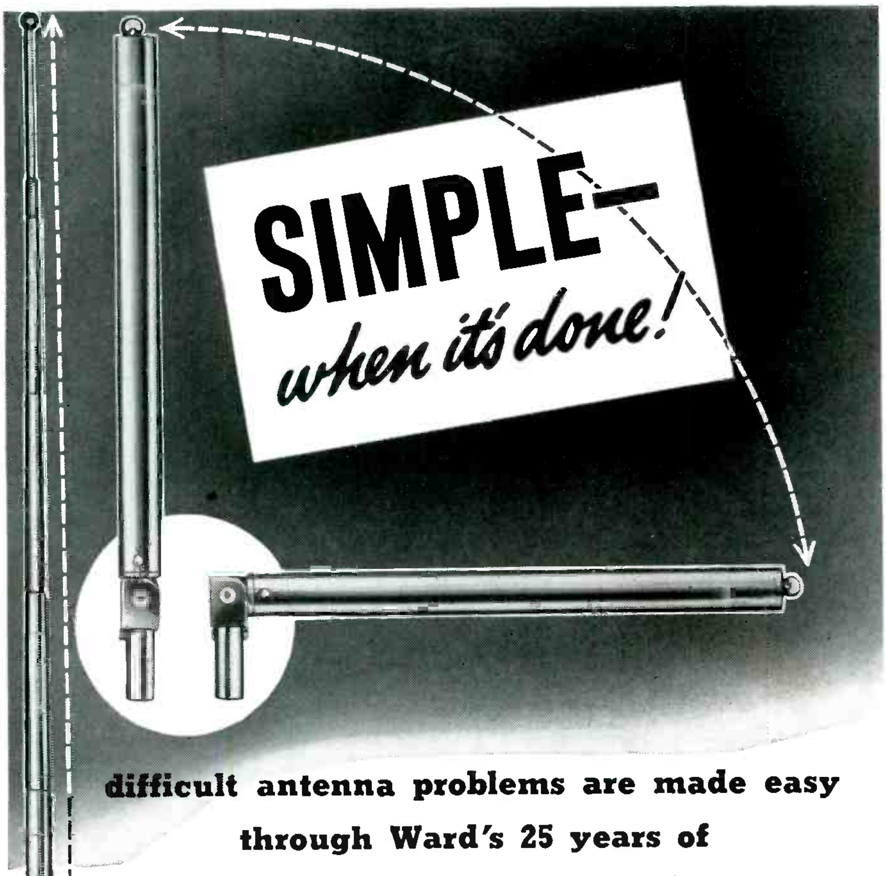

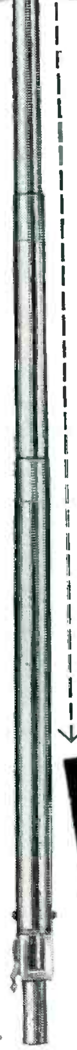

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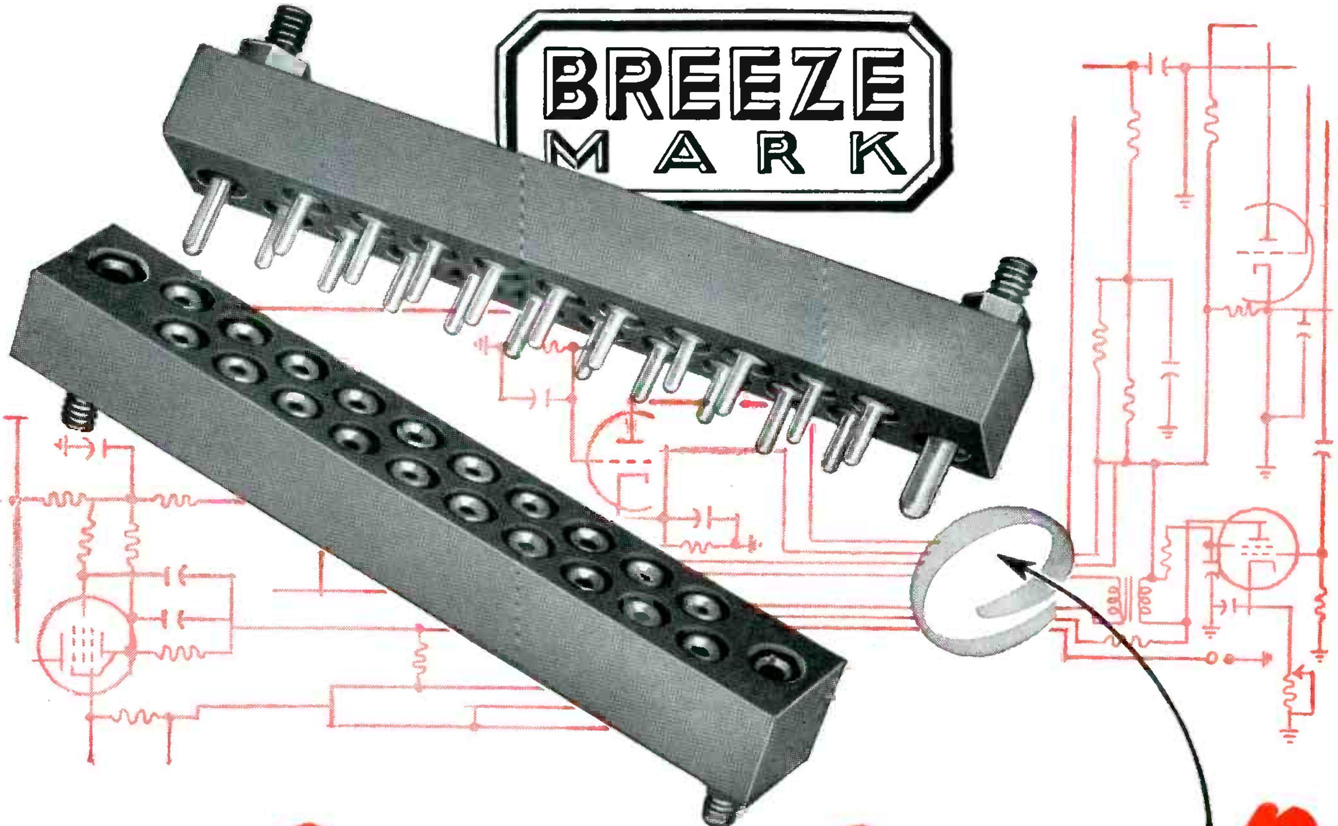

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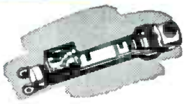

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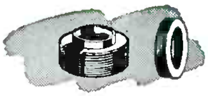

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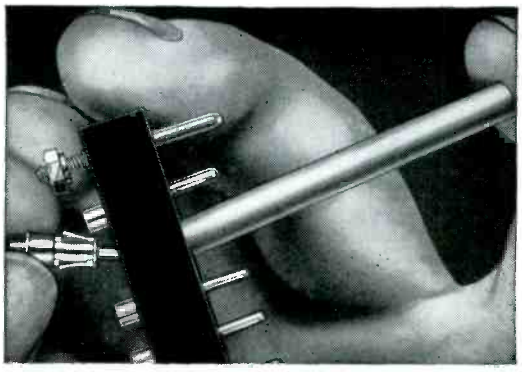

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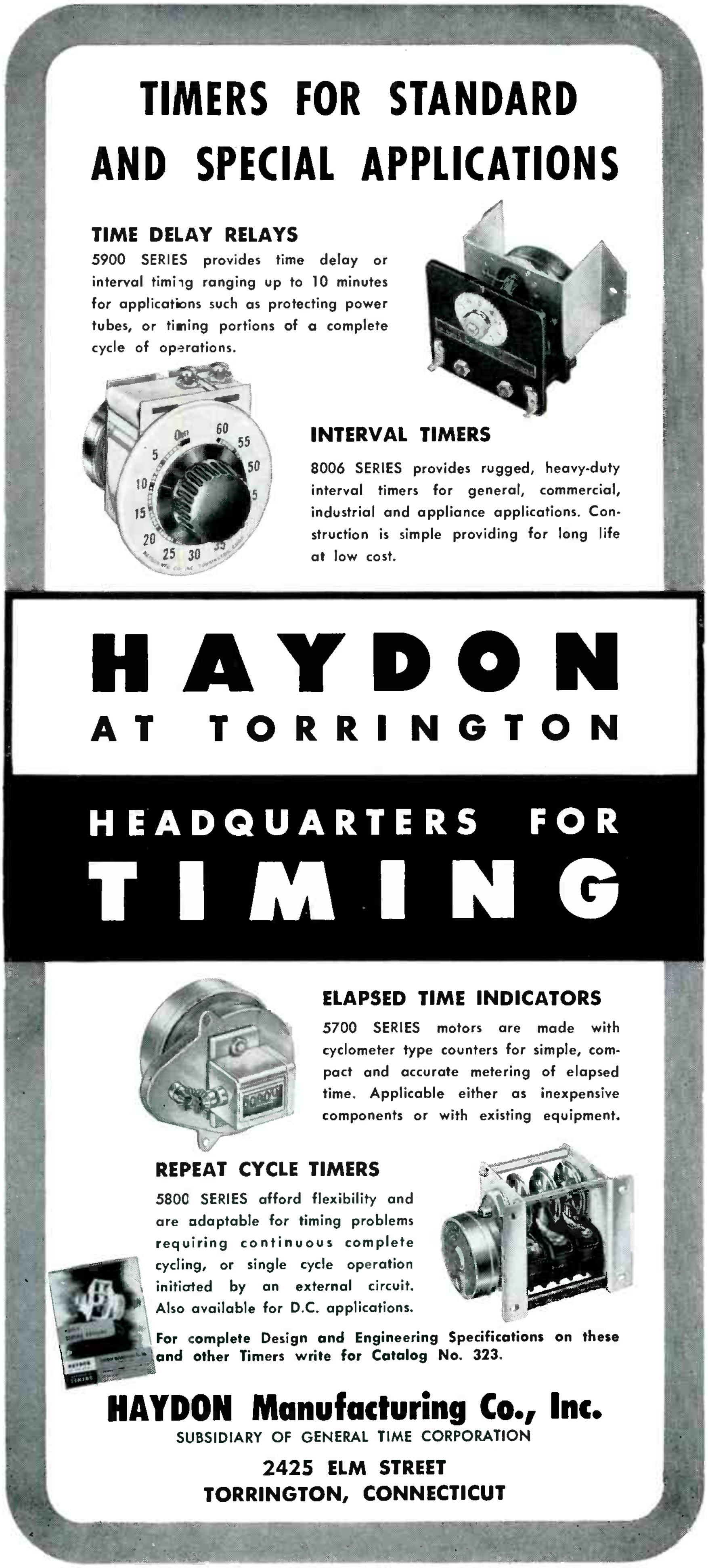


lateral movement must be fairly rapid, taking only a few seconds at most. The end-positions of the steering lever must be easily adjustable, because a larger amount of control is necessary when heading into or across a heavier swell than when riding with the swell or in calmer waters. To conserve power, limit switches should be installed so that the steering motor will cease to draw current after each lateral movement of the steering lever. Figure 3 shows this connection. The capacitors are for arc suppression. In the interests of safety, it is of utmost importance that provision be made for swift assumption of full manual control at any instant.

For the experimental model, an aircraft antenna reel assembly was obtained, a war-surplus item. The motor is designed to operate on 28 v but after removal of the clutch-brake spring, it runs on 6 v at a usable speed and with sufficient torque for the purpose. Movement of the reel-spool is limited to a half-turn by the installation of stops and limit switches. These are engaged by a projection attached to the under-side of the reel-spool. It is necessary to pad the stops with rub-

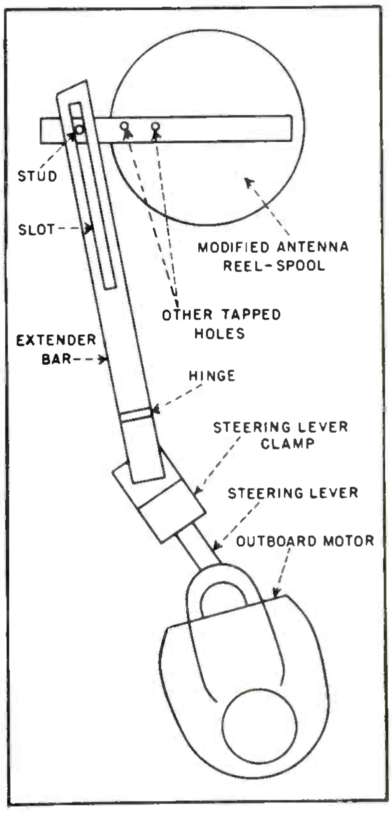
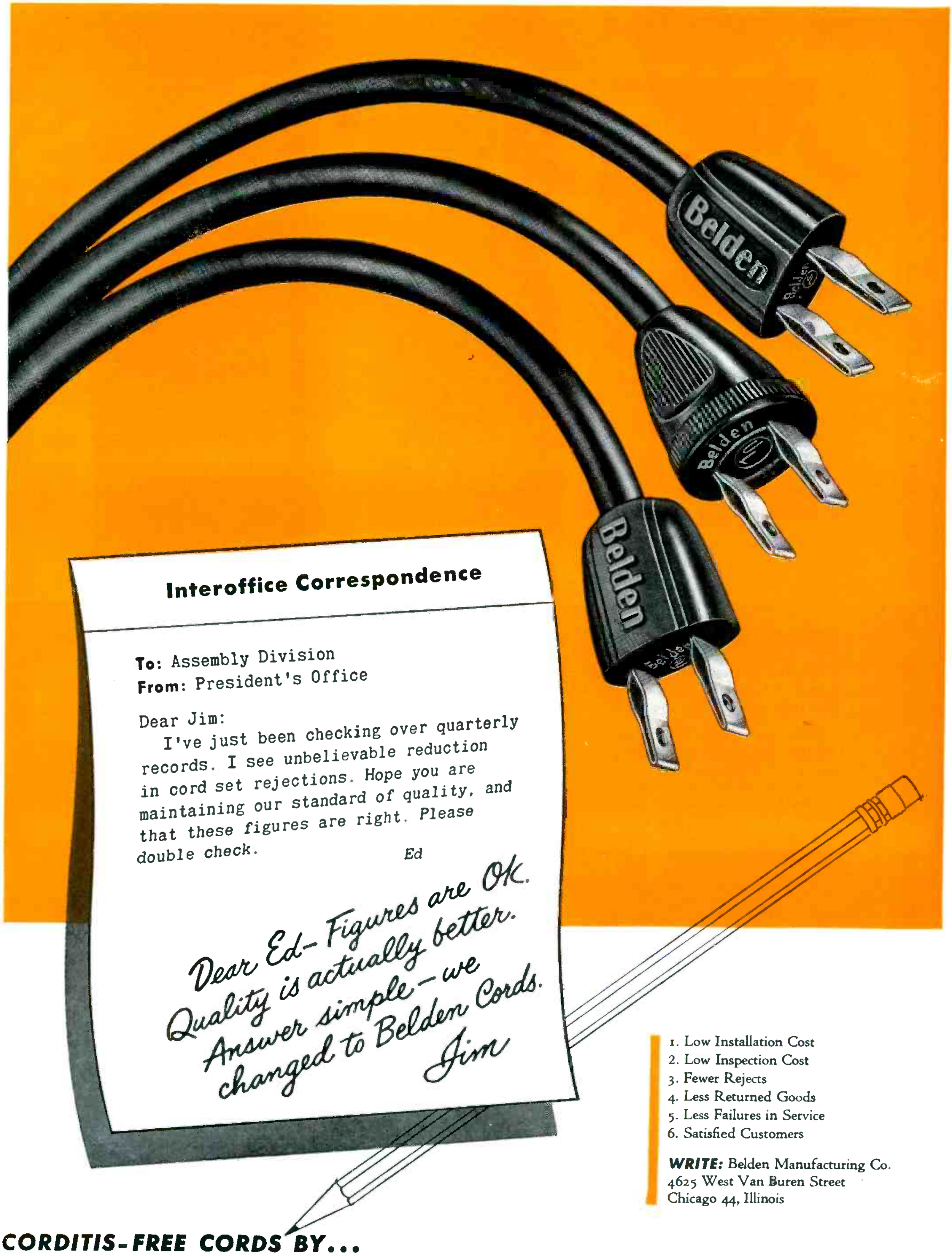


FIG. 4—Mechanical connection to outboard motor as used in first model



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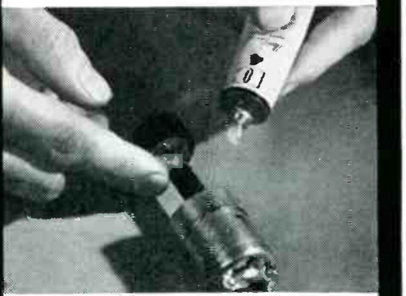
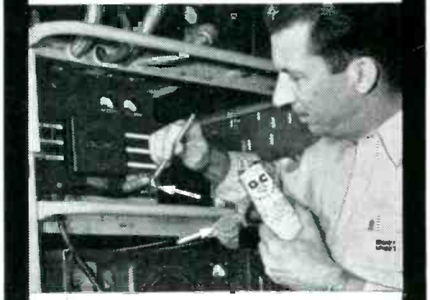


Dow Corning 4 applied by brushing to AN connector on V. H. F. Transmitter/Receiver excludes moisture without appreciable change in resistance across properly mated pin and socket connections.



Arrows show where Dow Corning 4 is used on variable inductance rollers in a Collins-Western Electric V. H. F. Transmitter/Receiver to lubricate, minimize resistance and reduce leakage losses.

Photos courtesy Braniff International Airways.

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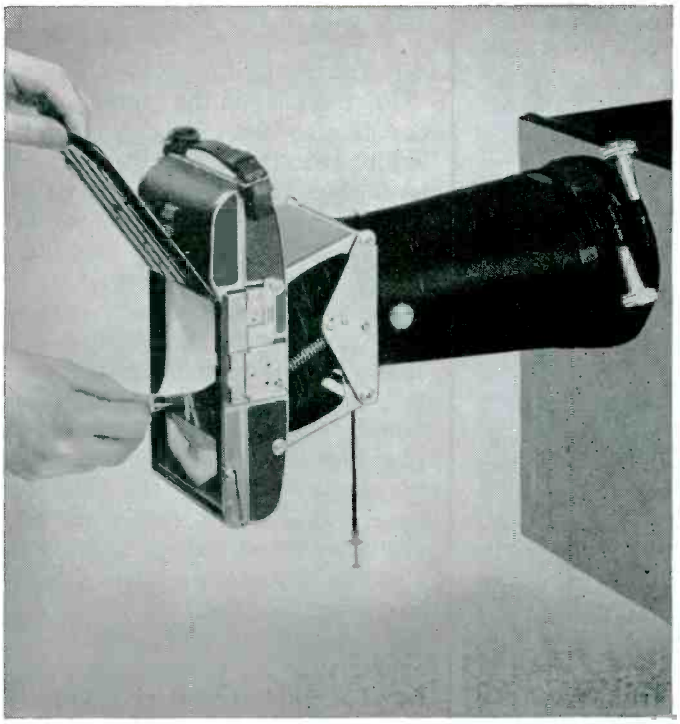

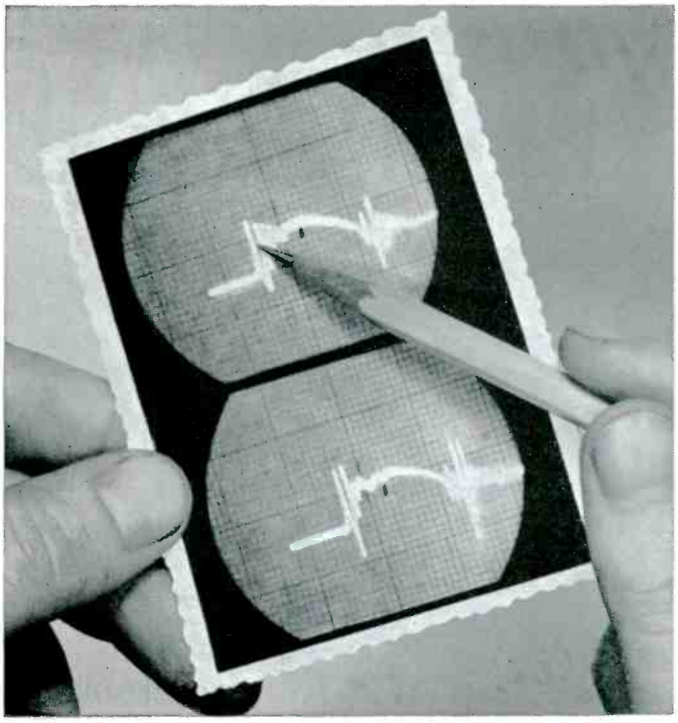

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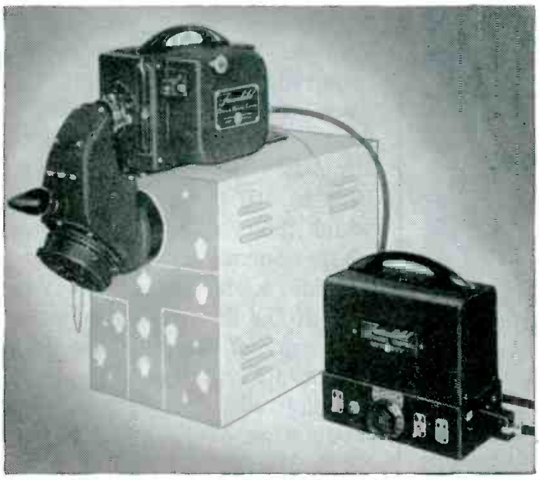

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ber. Otherwise, the gears bind.

Figure 4 shows the connection to the steering lever. The extender bar is hinged to the adjustable steering lever clamp and slotted in its forward section. The bar receives the lateral component of the half-turn of the reel-spool by the engagement of its slot with a stud on the spool. Gravity holds the bar against the stud. The stud mount on the surface of the spool is provided with tapped holes at various distances from the center for adjustment of the end-positions of the steering lever. The safety-feature of immediate manual control is brought about by simply lifting the extender bar off of the stud.

The author wishes to express his appreciation for the assistance rendered him in the construction of the experimental model by the men in the electronic and machine shops of the Ballistics Division, Naval Ordnance Test Station.

F-M Performance Measurement Form

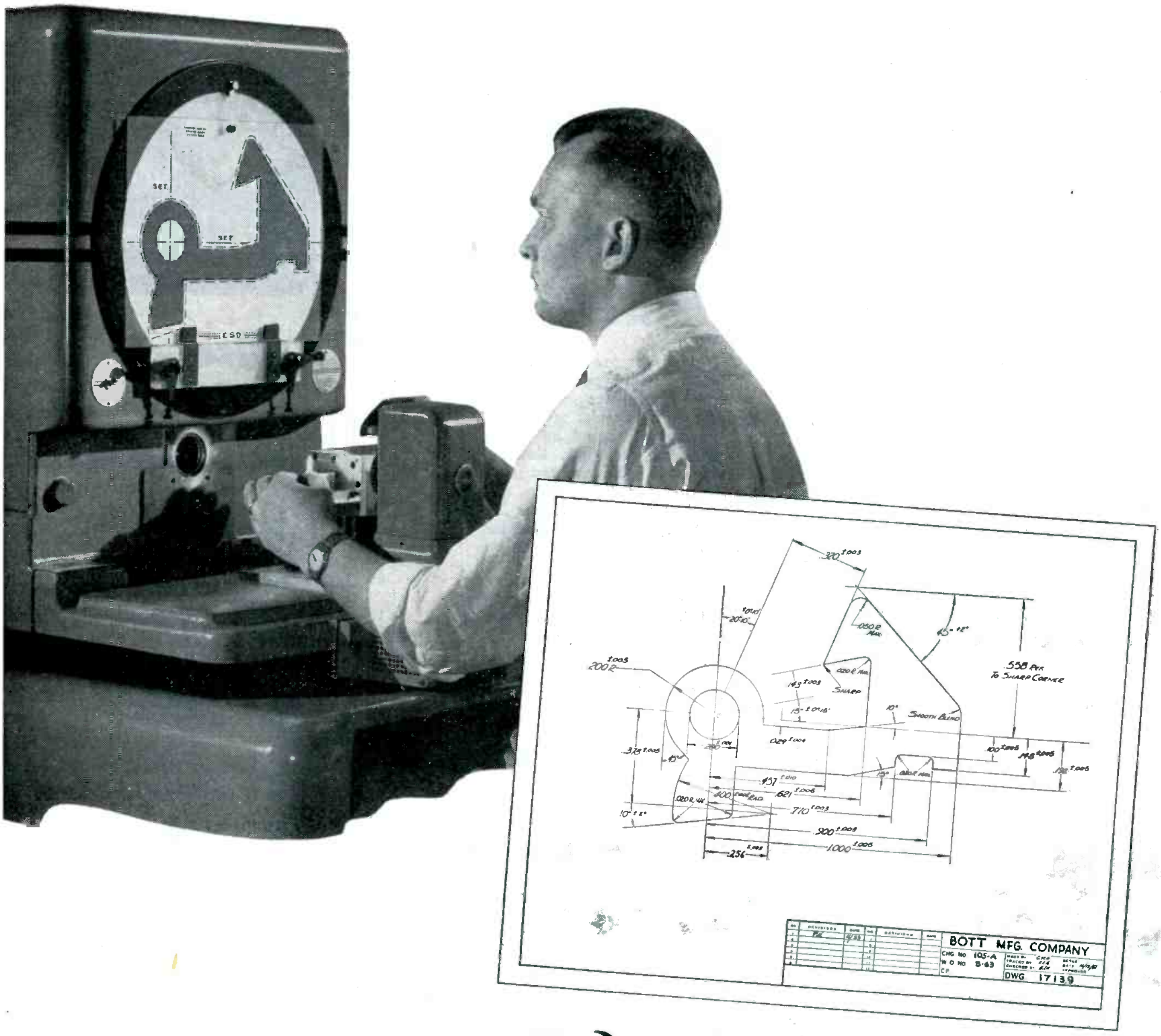
By James H. Greenwood

Chief Engineer
Station WCAE, WCAE-FM
Pittsburgh, Pa.

The FCC Rules governing f-m broadcasting stations require annual measurements of performance; distortion, frequency response and noise level. These measurements are to be plotted on suitable graphs. It is also required that the measurements show compliance with the Standards of Good Engineering Practice.

In order to assure the compliance mentioned, it is convenient to plot on the same graph with the measured response, the tolerances allowed. If adjustments are required, numerous graphs may be made on each of which the same tolerance ranges are plotted. To simplify the problem it is convenient to print special forms which include the tolerance ranges. These forms at the same time provide a business-like presentation of the final measurements.

A copy of one of these forms is shown in Fig. 1. Frequency response is required to be measured with modulation of 100, 50 and 25 percent. While maintaining the modulation at the specified level, the in-



He checks 15 DIMENSIONS 8 RADII 7 ANGLES in ONE operation

To check this part completely and accurately by usual methods, you might need as many as two dozen or more different gages—and you still wouldn't be sure all corners were sharp, all angles and radii exact. There's a much faster, more accurate way to do the job completely, one that requires no mechanical gages that can lose accuracy through wear.

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The part we show here is a relatively simple one for an optical comparator. With proper fixtures, charts, and accessories, you can measure all sorts of complex parts, large or small. Changes in specifications generally require nothing more than a corresponding change on the chart.

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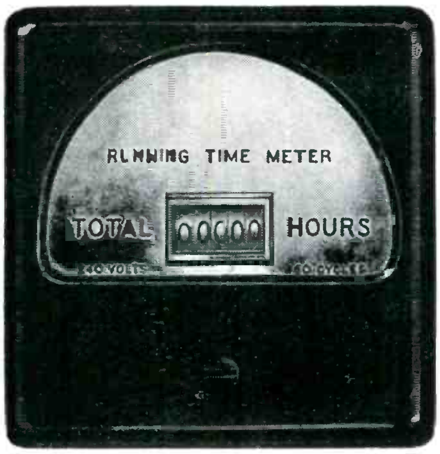

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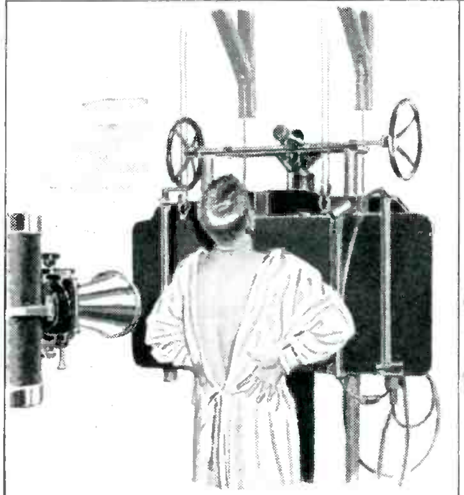
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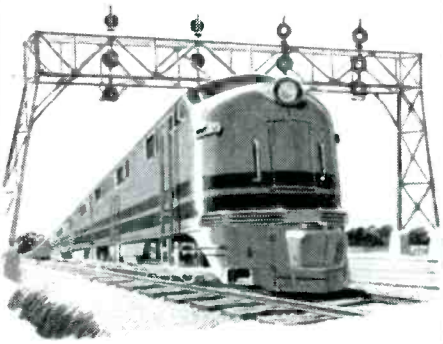
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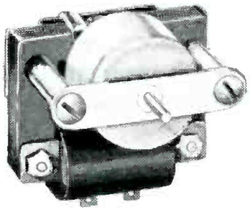
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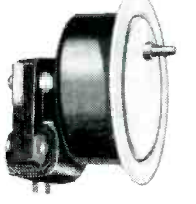
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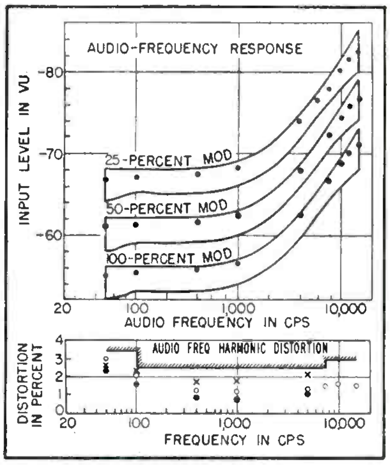

FIG. 1—Sample of performance measurement form

put level is determined for different frequencies. The graph of frequency response is therefore a plot of frequency versus input level. Three plots are made, one for each modulation level.

Since the difference between 100 and 50-percent modulation and between 50 and 25-percent modulation is 6 db, the tolerance ranges have been plotted 6-db apart. The illustrated graph has plotted on it a typical series of measurements.

Only one graph is used for plotting distortion at the various levels of modulation since the tolerances are the same. Different colors or shapes are used to indicate the measured points at the different modulation levels. Identification of the colors used should be included on the graph.

Space should also be provided on the graph (not shown) to list the type and make of measuring equipment used. In addition, it is advisable to attach to the graph a copy of the detailed instructions which were followed by the measuring personnel. These instructions will of necessity be different for various stations. They not only serve as description of the measurement technique but also assure that the measurements are made in the same manner by all personnel and are therefore always comparable.

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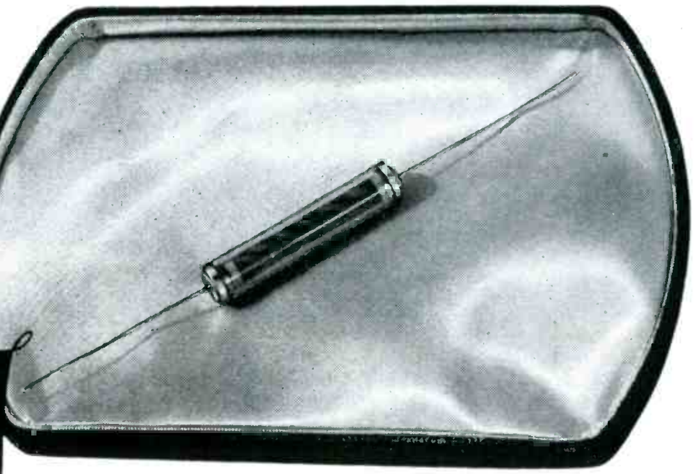

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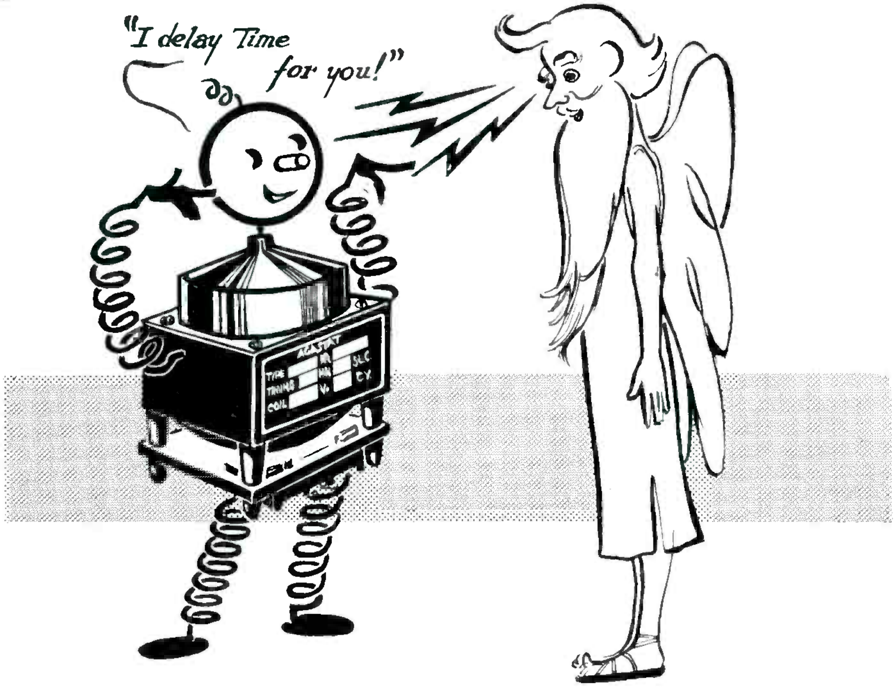

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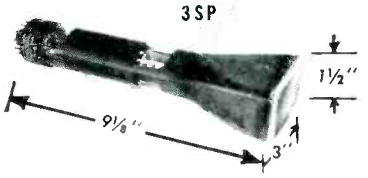

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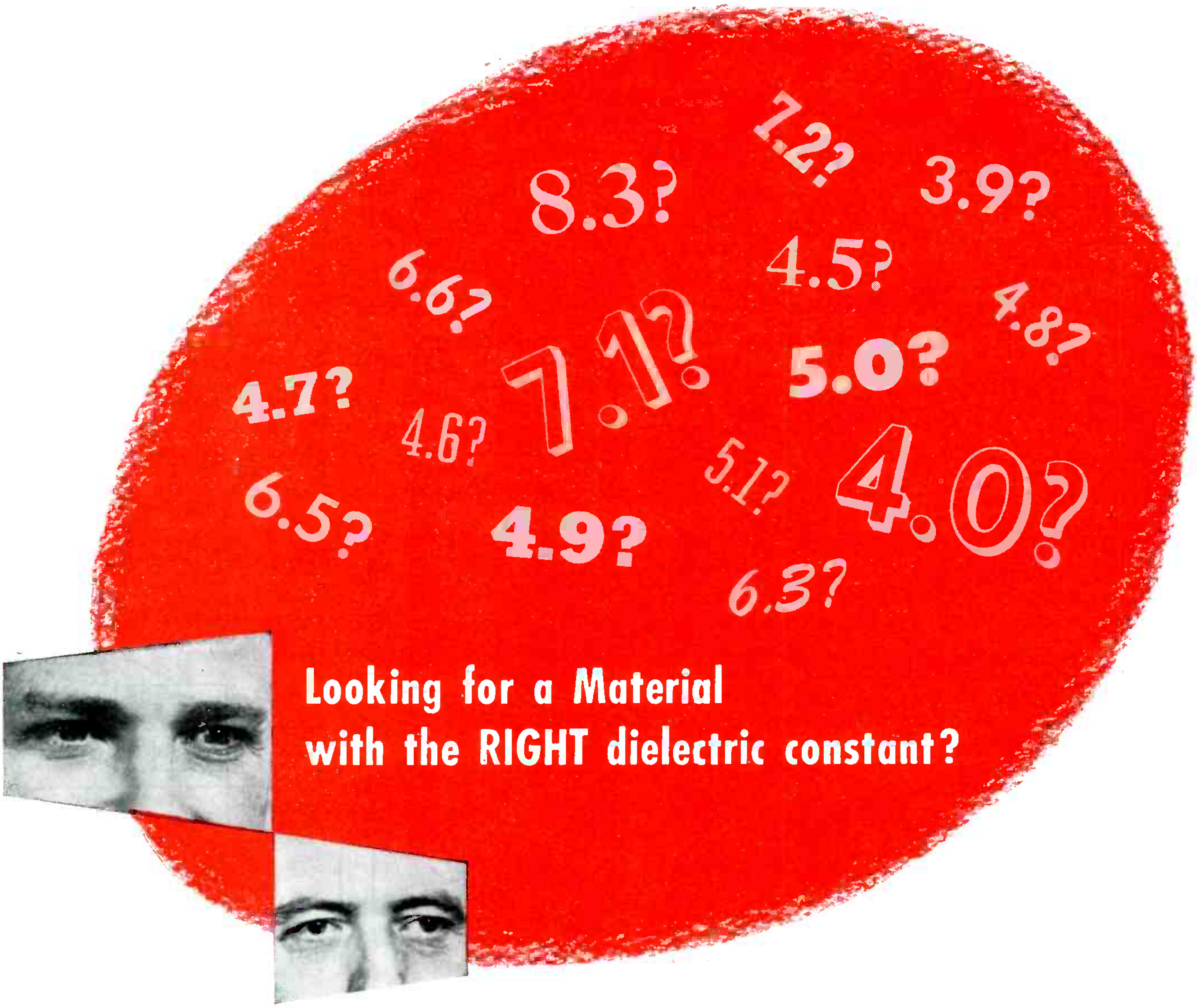

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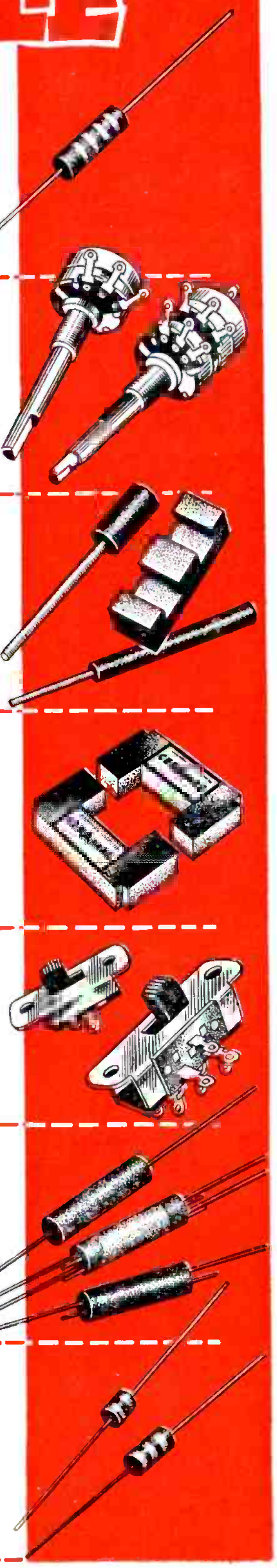

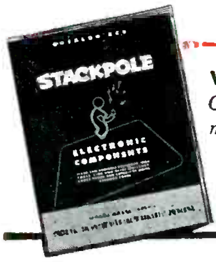

described in this article.

If the band-pass peak or the frequency of the null can be made continuously tunable without greatly affecting the amount of rejection or the amplification at resonance, the circuit will be more convenient to use. This is true because the frequency to be rejected or selected is not always known in advance. Another desirable feature is to be able to tune over as wide a frequency range as possible without the necesity for band-switching.

The R-C coupled circuit shown in Fig. 1 may be connected to a low-level stage of an audio amplifier simply by attaching a wire to the plate pin of one tube and making an a-c ground connection.

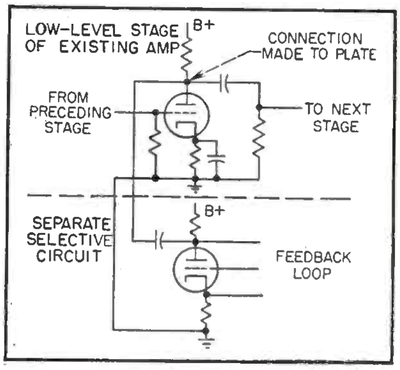

FIG. 1—Method of connecting the selective circuit to the amplifier

Since audio amplifiers are more or less standardized in design, the logical place to connect an external source of selectivity is between the plate pin of the last voltage amplifier and ground. Connection to a tube involved in a negative feedback loop is not desirable since the expected selective response will not result. In this case, it would be better to choose a lower-level stage outside the feedback loop.

Perfect rejection of a particular frequency may be obtained with the circuit. A Q of around two or three is suggested for general use and a maximum level of the order of 20 volts rms is a good operating point for the external circuit.

The material in this article was abstracted from page 726 of *The Review of Scientific Instruments* for October, 1951. The original article by O. G. Villard, Jr., was entitled "A Tunable Shunt Selector-Rejector for Audio Amplifiers".

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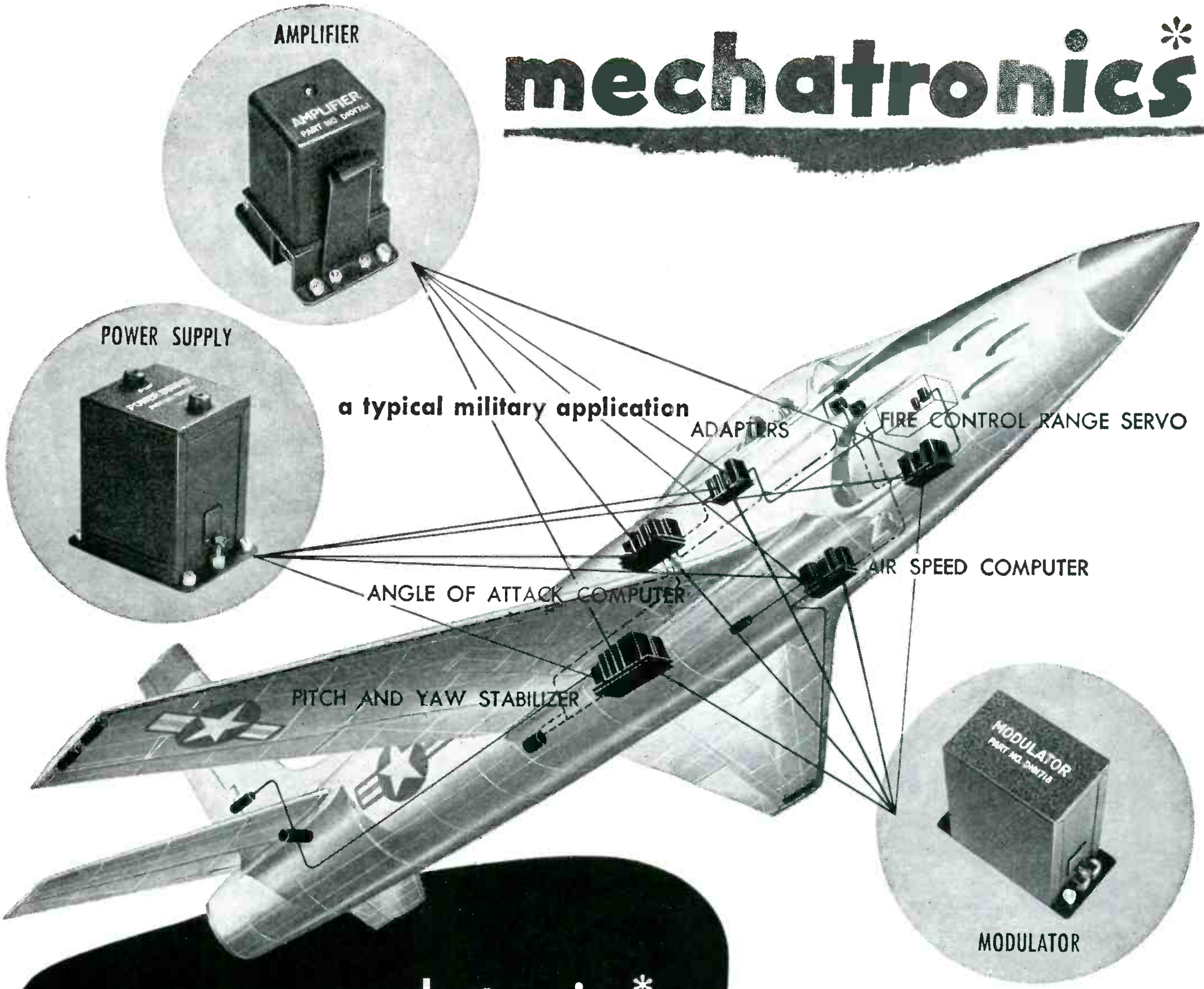

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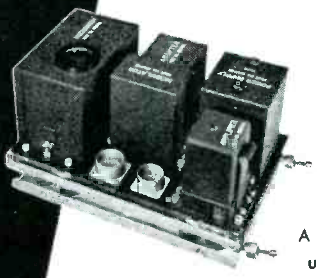

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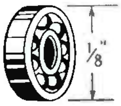

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In contrast, Ampex users find their equipment will operate continuously eighteen hours a day with but infrequent inspection. Upkeep and replacements are almost nil; heads have remarkably long life. Ampex performance is constant over long periods of continuous operation. Long life with low maintenance is assured in each Ampex recorder by high manufacturing standards and complete test of each machine before shipment. It all adds up to one sure fact—Ampex quickly pays for itself out of savings from lower operating costs and added dependability.

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Ballantine pioneered circuitry and manufacturing integrity assures the maximum in

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- All models have a single easy-to-read logarithmic voltage scale and a uniform DB scale.
- The logarithmic scale assures the same accuracy at *all* points on the scale.
- Multipliers, decade amplifiers and shunts also available to extend range and usefulness of voltmeters.
- Each model may also be used as a wide-band amplifier.

MODEL 300

MODEL	FREQUENCY RANGE	VOLTAGE RANGE	INPUT IMPEDANCE	ACCURACY	PRICE
300	10 to 150,000 cycles	1 millivolt to 100 volts	1/2 meg. shunted by 30 mmfds.	2% up to 100 KC 3% above 100 KC	$210.
302B Battery Operated	2 to 150,000 cycles	100 microvolts to 100 volts	2 megs. shunted by 8 mmfds. on high ranges and 15mmfds. on low ranges	3% from 5 to 100,000 cycles; 5% elsewhere	$225.
304	30 cycles to 5.5 megacycles	1 millivolt to 100 volts except below 5 K C where max. range is 1 volt	1 meg. shunted by 9 mmfds. on low ranges. 4 mmfds. on highest range	3% except 5% for frequencies under 100 cycles and over 3 megacycles and for voltages over 1 volt	$235.
305	Measures peak values of pulses as short as 3 microseconds with a repetition rate as low as 20 per sec. Also measures peak values for sine waves from 10 to 150,000 cps.	1 millivolt to 1000 volts Peak to Peak	Same as Model302B	3% on sine waves 5% on pulses	$280.
310A	10 cycles to 2 megacycles	100 microvolts to 100 volts	Same as Model 302B	3% below 1 MC 5% above 1 MC	$235.

For further information, write for catalog.

BALLANTINE LABORATORIES, INC.

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THE ELECTRON ART

(continued from p 142)

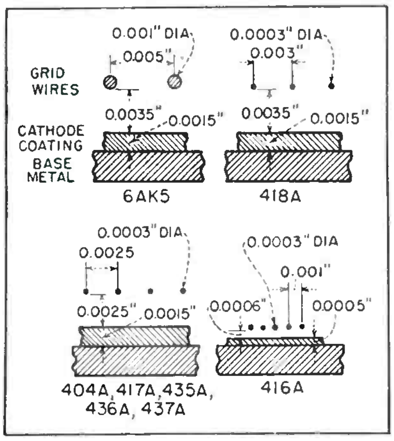


FIG. 1—Close spacing and small grid wire size provide improved transconductance to capacitance ratio

The tension must be high to minimize microphonic effects and short-circuit hazards. The wires are wound under a tension of somewhat more than half the breaking strength. There are about 300 wires, altogether, on a single grid, each under a tension of the order of 10 grams, so the total load is about 3,000 grams, or about 7 lbs. Figure 3 shows the construction of the tube, which is conventional except for the frame grid.

The molybdenum frame is fabricated by welding the cross straps to the side rods. After winding, the grid wires are secured to the side rods by spraying the contacting areas with a powdered glass suspension and heat treating. A thin layer of gold is plated onto the grid to inhibit emission of electrons.

The broad-band tubes described have been designed in such a way

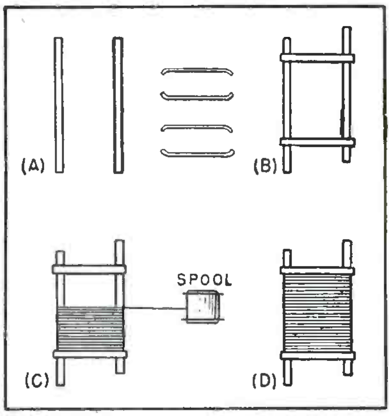
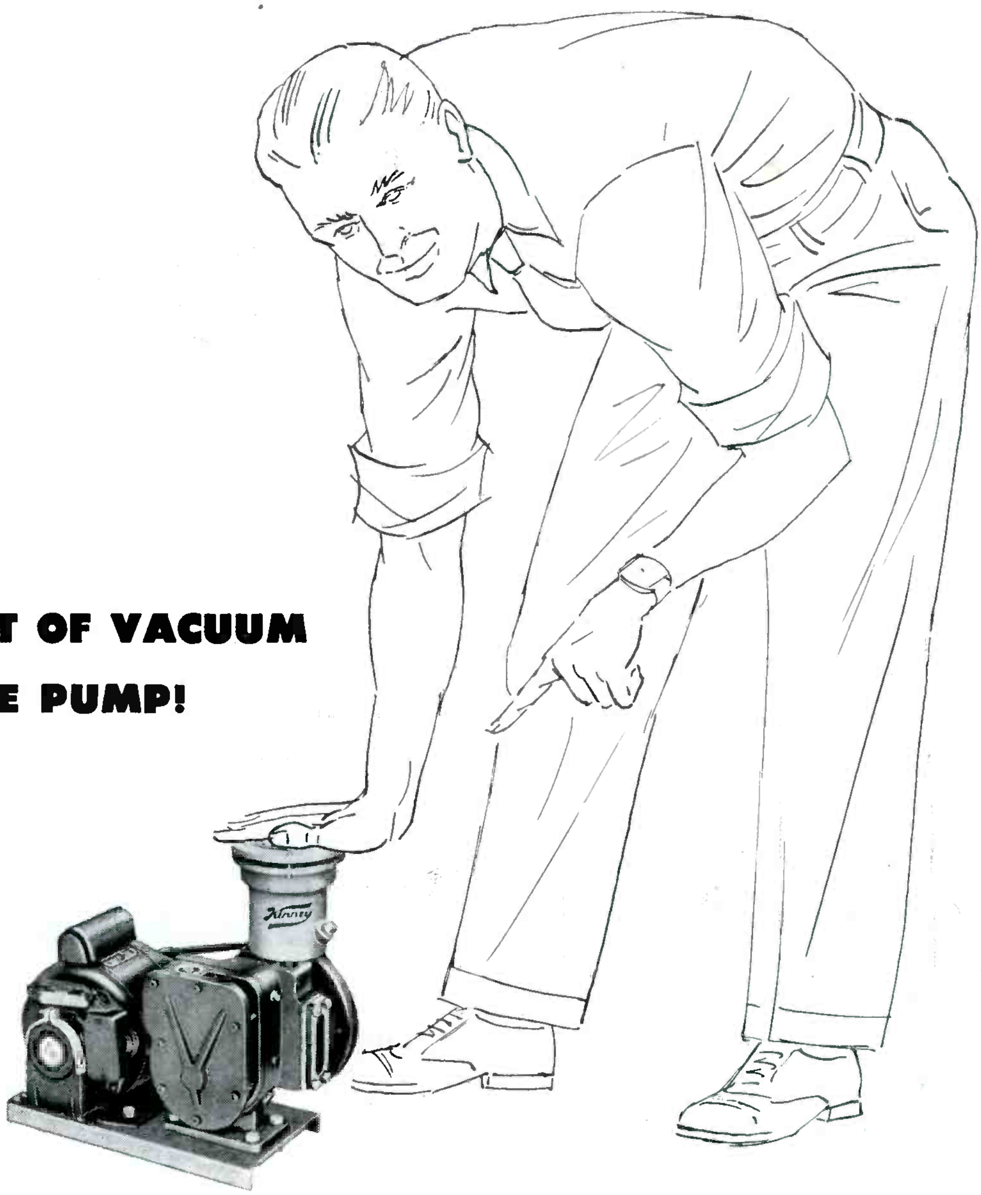
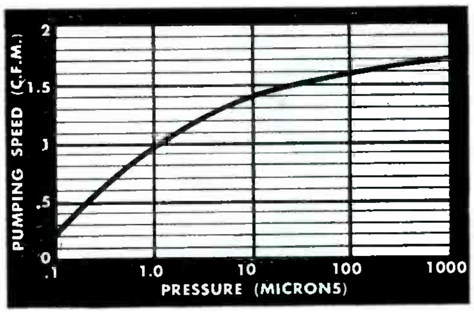


FIG. 2—Welded grid frame structure permits use of finer wire with closer spacing



THERE'S A LOT OF VACUUM IN THIS LITTLE PUMP!

Look at Kinney Vacuum Pump Model CVM 3153. It's small, yes — only about a foot high. It weighs only 70 lbs. complete with its ¼ HP motor.



Now take a look at its performance curve. See how it starts out with a free air displacement of 2 cu. ft. per min. See how large a percentage of its vacuum "pulling-power" is retained right down to the less-than-1 micron zone.

This is what you buy when you get a Kinney Model CVM 3153 — HIGH PUMPING SPEED. And this is why so many laboratories, so many production operations, so many vacuum service and test jobs are depending on this new Kinney Vacuum Pump. Send coupon for complete details and price. KINNEY MANUFACTURING CO., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Philadelphia, Los Angeles, Houston, New Orleans, San Francisco, Seattle, and foreign countries.

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Please send me Bulletin V51-A describing the new Kinney CVM 3153 Midget Vacuum Pump and price information.

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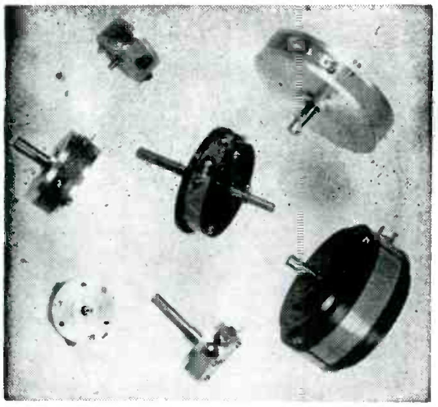

PRECISION POTENTIOMETERS

Type RL-270:

Wedding ring type . . . five sizes charted below. Gamewell Potentiometers are precision instruments in every respect. They feature close limits in electrical characteristics and mechanical construction, low electrical noise, low torque, and long life. All types operate at —55°C. to +55°C., 95% relative humidity at altitudes up to 50,000 ft. Non-linear windings are available.

CONDENSED SPECIFICATIONS	RL-272	RL-270	RL-271	RL-275	RL 277
Diameter (in.)	5	3	2	1⅝	1¼
Rating (watts)	12	6	3	2	1.5
Torque, max. (oz. in.)	1	1	1	½	½
Weight (oz.)	15	6	3	2	1
Mounting: 3 holes ⅛" deep	#8–32	#8–32	#8–32	#6–32	#4–40
Mounting circle diam. (in.)	3.250	1.750	1.250	1.000	1.000
Max. resistance (ohms) ± 10%	500,000	275,000]	160,000	105,000	64,000
Min. resistance (ohms) ± 10%	460	250	150	105	80
Max. useful angle (deg.)	358±½	356±½	354±½	352±½	350±½
Max. resolution (%)	0.05	0.08	0.15	0.2	0.25
Min. resolution (%)	0.01	0.015	0.025	0.04	0.05
Linearity (%)	±0.10	±0.10	±0.15	±0.25	±0.30

Standard Shaft: single end, ¾" extension; specify if otherwise.
Double ended shaft special; specify diameter and length.
Multiple sections can be ganged; add ⅜" to the overall length for each additional section.
Terminals will be positioned on the circumference as required for taps and winding angle.
Expected life of all types over 1,000,000 cycles.

FOR COMPLETE DETAILS SEND FOR BULLETIN F-68-A

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- **Y AMPLIFIER**
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  250 mv. rms/in.—3db 2 cy. to 250 Kc.
- **Z INPUT**
  1.5V. visible for marking
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  10 cycles to 100 Kc.
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- **INTERNAL CALIBRATOR**
  Measures 10 mv. to 500 v. P-P
- **PROBE**
  10 mmf. 2 megohms
- **Phaseable 60 cy. Sweep & Sync.**

- **$449.50 FOB N. Y. C.**

Write for detail sheet E-1-2

The TEC model T-601-B Is a general purpose high quality cathode ray oscilloscope with all the features requisite to precision laboratory equipment. Sturdy construction, highest grade components and top engineering design, the T-601-B is widely used In the country's top laboratories.

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BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Joining Copper-Base Alloys

Soldering, brazing and welding are three common methods of joining copper and its alloys both on the production line and in the maintenance shop.

In the three methods there are four prerequisites in obtaining the strongest bond possible:

1. Clean surfaces, both mechanical and chemical.
2. A good flux.
3. Close contact between the parts to be joined.
4. Correct temperature.

Cleaning

All oil, grease and other foreign matter, and oxides if present, should be removed. Visual inspection cannot be used to detect this oxide. Either a file or grinding will remove the oxide to get to the base metal. On production basis usually a bright dip is used. In some plants this is done as parts are needed on the assembly line to prevent oxidation prior to use.

Although there are acid-base fluxes which may be used to remove the oxides more readily, they are not normally accepted in production work as all of the flux must be removed promptly after soldering or brazing to prevent future corrosion of the metal.

Fluxes

With the exception of the acid-base fluxes mentioned above, the main purpose of a flux is to cover the parts with a film which will exclude air during the soldering or brazing operation since oxidation is speeded up when heat is applied. The fluxes should melt well below the melting point of the solder to protect the surface while being heated to soldering or brazing temperature.

Resin or borax are generally selected since they are considered non-corrosive and it is not necessary to remove them after joining. Sal-ammoniac and zinc chloride are also used but they must be removed after the joining is completed to prevent corrosive attack. In brazing, calcined borax and boric acid in powdered form are quite commonly used.

There are many proprietary fluxes on the market which are available for soldering and brazing and in many cases are superior.

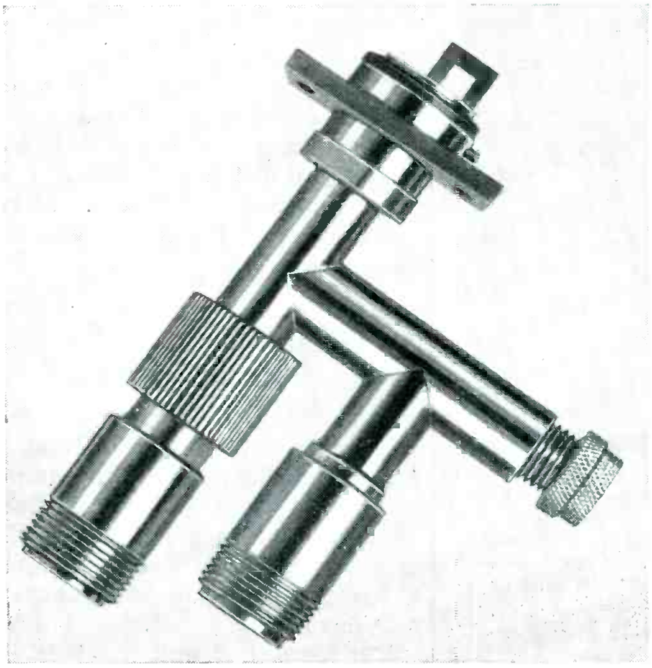


Illustration shows crystal mixer made from copper base alloy components are silver soldered together

Hold Work Closely

As solder and brazing metal flows through capillary action, it is important that the parts being joined be held closely together. Too large a space between the parts will prevent the molten bonding material from flowing and sealing tightly over the entire area. A good example of this is where corners of rectangular boxes are being soldered or brazed. It is often necessary to use a tight jig or clamp to insure intimate contact between the parts.

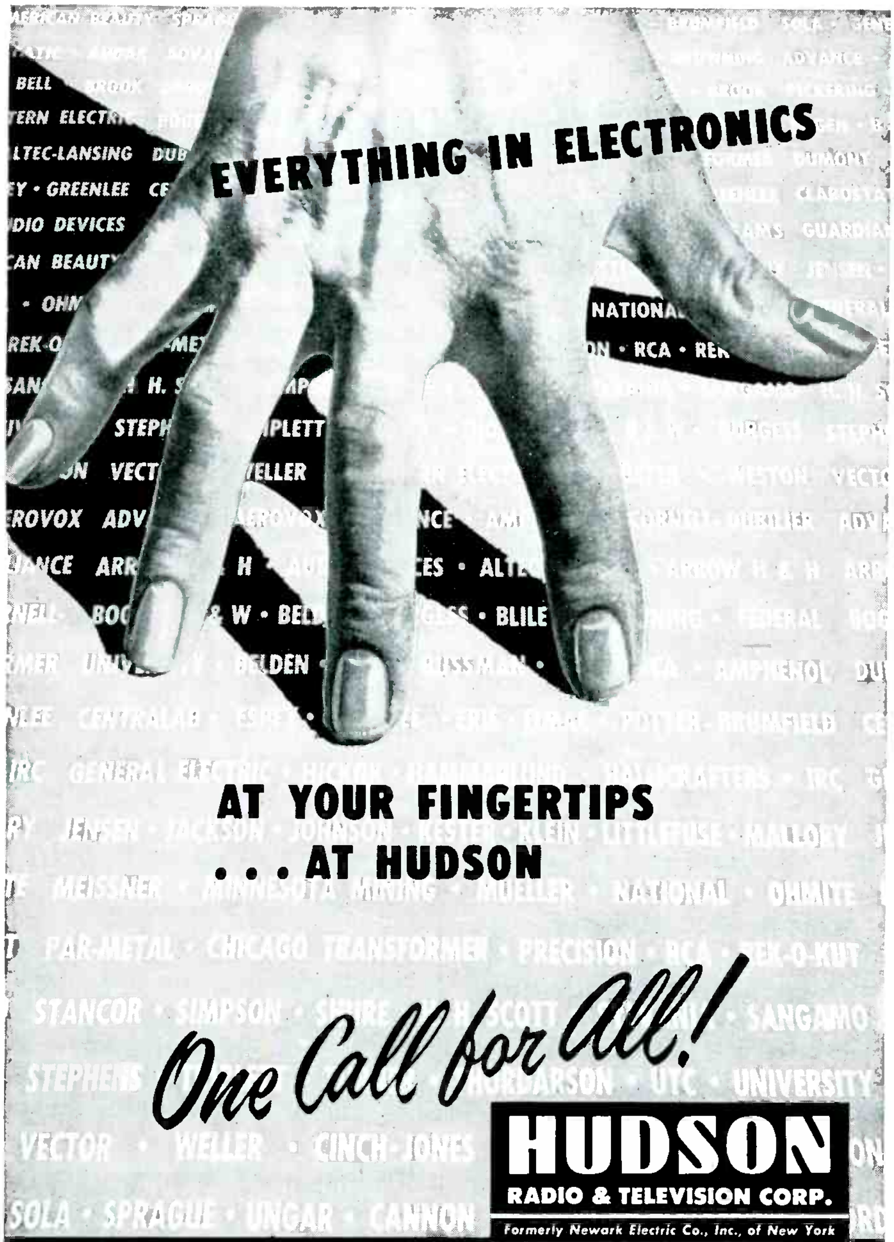
Correct Temperature

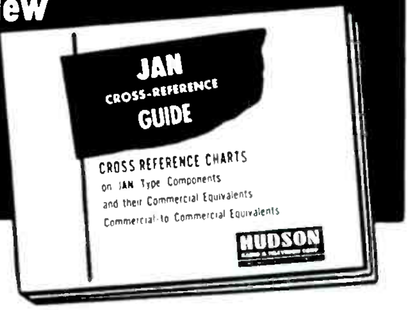
The parts being joined should be heated slightly above the melting point of the solder or brazing material. When using a soldering iron, care should be taken to insure that the copper tip of the iron is heavy enough to maintain sufficient heat to carry out the operation. When using a flame in soldering, care should be taken not to overheat the metal as oxides would form too rapidly and the flux would be burned off and the metal softened to too great a degree.

In brazing or "hard soldering" a gas-air or gas-oxygen flame is normally used, although with care oxyacetylene torches can be employed since higher temperatures are needed than in soldering. Red heat is needed for this type of joining. Again, too high a heat on the part will burn off the flux and cause the metal to oxidize thereby weakening the bond. The flame used should be a reducing one (excess of fuel in the fuel-to-air ratio) or a neutral one.

In furnace brazing a reducing atmosphere is also helpful to prevent oxidation and to remove any oxide which might be left on the metal.

(7755)





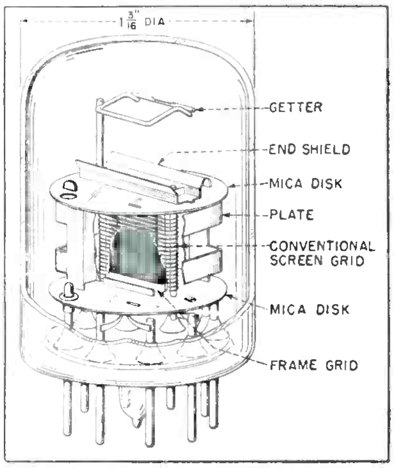


FIG. 3—Structure is rigidly supported from stem which eliminates distortion when bulb is placed over the mount

that they can be manufactured on a production line that differs very little from ordinary tube lines. Moderate cost is therefore assured. Table I shows a comparison between one of the broad-band tubes and the familiar 6AK5.

TABLE 1—Broad-Band Performance Comparison

	6AK5	435A
Plate Current	7.5	25 ma
Screen Current	2.5	8 ma
Transconductance	5,000	28,000 μmhos
Input Cap.	3.9	15.2 μμf
Output Cap.	2.85	3.3 μμf
Center Freq.	60	4 mc
Useful B-W	5	8 mc
Voltage Amp.	15	30 db
Eq. Noise Res.	1,770	210 ohms

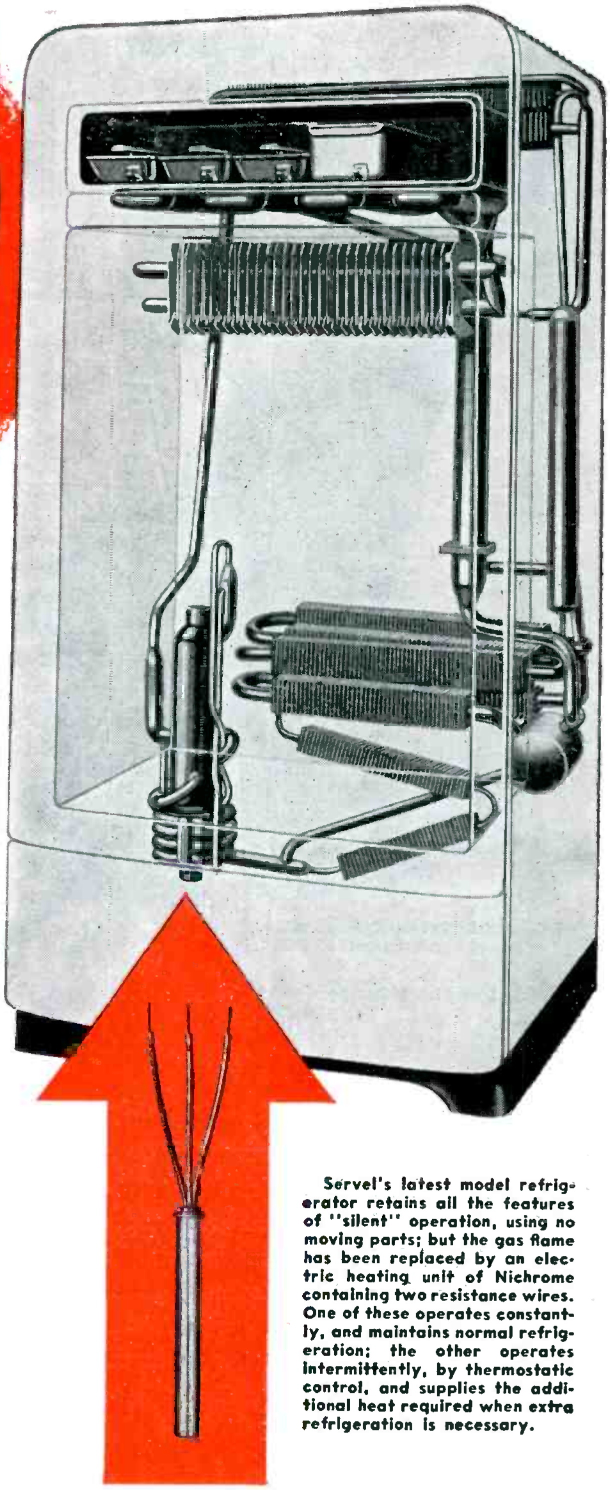
This article is based on a paper presented at the 1951 National Electronics Conference in Chicago, by G. T. Ford and E. J. Walsh of the Electronic Apparatus Development Department of the Bell Telephone Laboratories.

An Electronic Pneumotachograph

MANY difficulties arise in determining respiratory volumes and rates by conventional means. The equipment to be described does the job by means of measuring a small change in capacitance brought about by the breathing of an animal or human being.

The detecting unit used is a modified orifice meter instrument detector which relies on a compres-

Servel goes electric with NICHROME*



Servel's latest model refrigerator retains all the features of "silent" operation, using no moving parts; but the gas flame has been replaced by an electric heating unit of Nichrome containing two resistance wires. One of these operates constantly, and maintains normal refrigeration; the other operates intermittently, by thermostatic control, and supplies the additional heat required when extra refrigeration is necessary.

Now the famous silent Servel refrigerator operates on electricity. In the new refrigerator, a simple electric heating element provides heat for operating this absorption-type system. Just plug it in, and the new Servel goes to work . . . provides the *soundless* performance for which it is famous.

Since cold is obtained without a single moving part by means of heat applied to the system, the small heating element is the vital part of the new Servel. Every operation of the refrigeration cycle, indeed, depends upon the heater unit *staying on the job.*

Because of this, Servel has adopted heating elements made with Nichrome—the electrical resistance alloy that is the very heart of quality appliances everywhere. Remarkably resistant to high heat and corrosion, and able to retain its physical and electrical properties despite thermal shock resulting from intermittent operation day in and day out, Nichrome assures Servel of efficient operation and a lifetime of dependable service.

Whatever *your* requirements for electrical resistance material, it will profit you to consult with us. In addition to world-famous Nichrome and Nichrome V, we produce over 80 alloys to meet the varied needs of the electrical and electronic fields. Although strategic materials and the alloys we make from them are on strict allocation at the present time, we'll be pleased to serve you to the best of our ability.

Driver-Harris Company

HARRISON, NEW JERSEY

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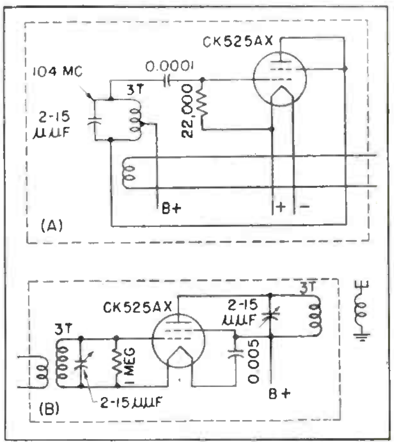

FIG. 1—Circuit of f-m oscillator and amplifier for telemetering respiratory information

sion of air on the face of a fine mesh screen to produce a local increase in pressure relative to the effluent side of the screen. The region of elevated pressure produces an increase in pressure within the orifices of the side tubes which are connected to a detector coupling. When air flow is reversed, there is a concomitant drop in pressure to less than ambient. A fine copper mesh is caused to deflect in accordance with pressure changes, and its deflection is converted into capacitance variations which in turn modulate the output of an f-m oscillator, the circuit of which is shown in Fig. 1A.

The buffer amplifier (Fig. 1B) is almost a necessity on ambulatory patients, since changing position with respect to large metallic objects would cause a misleading change in frequency if the antenna were connected directly to the oscillator. The oscillator alone weighs 430 grams complete. When assembled with the buffer amplifier the volume doubles and the weight is 780 grams. Figure 2 shows the oscillator, without buffer amplifier, and the pressure actuated capacitor.

In operation, respiratory changes cause the carrier frequency to shift about 0.01 percent during normal breathing. The f-m tuner unit used to pick up the signals is specially designed to have a linear output with respect to changes in input frequency, and limiting reduces effects of amplitude variations.

This development is described in considerably more detail in an un-

PROBLEM:

How to Prevent Contact Sticking in a Vacuum Tube

GENERAL PLATE:

Provided the Solution with a Composite Metal Combination

A leading manufacturer of radio and industrial tubes and electronic equipment was faced with a problem of finding the right metal for use as a sliding contact in vacuum tubes.

Copper provided a mechanical problem because it tended to gall.

Molybdenum was ideal but was too thick to form and too costly to machine out of solid material.

The problem was presented to General Plate whose engineers quickly found the solution by bonding *two metals into one* . . . a thin layer of molybdenum (.005") to a thicker layer of cupro-nickel (.060").

The result was a General Plate *Composite Material that was easily fabricated, gave the performance of solid molybdenum, reduced costs considerably.*

No matter what your problems, it will pay you to *check with* General Plate. Their vast experience in combining precious to base metals or base to base metals can overcome your problems . . . often reduce costs.

General Plate Products include — Precious to base metal laminations . . . Base metal laminations . . . Alcuplate (copper and Aluminum) . . . Silver solders . . . Laminated contacts, buttons, rivets . . . Platinum-fabrication-refining . . . Age-hardening Manganese Alloy 720.

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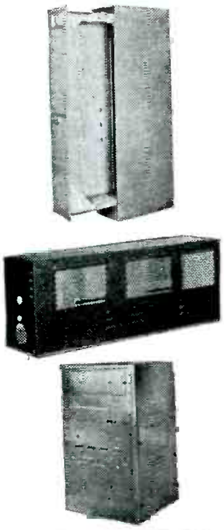


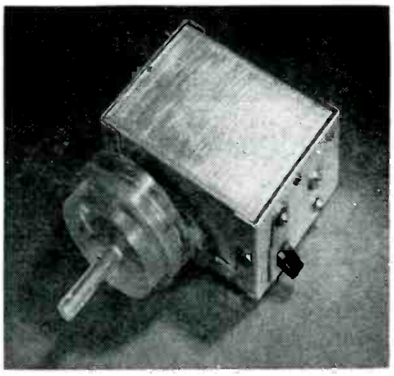


FIG. 2—The oscillator alone weighs 430 grams

classified report entitled, "A New Pneumotachograph and its Application to a Study of Human and Canine Respiration" written by Paul E. Morrow of the University of Rochester Atomic Energy Project.

Radioactive Current Source

RADIOACTIVITY can be used as a source of electric energy (at low levels) through the use of an "atomic battery" recently developed by the Ohmart Company of Cincinnati, Ohio. The conversion of radioactive energy to electrical energy is obtained by a cell made of two dissimilar materials separated by a filling gas, as shown in Fig. 1. When the cell is connected to a current-measuring device and the filling gas is forcibly ionized by exposure to nuclear radiation, the positive ions formed in the gas are attracted to the noble electrode and the electrons are attracted to the active electrode, owing to the difference in work function of the two electrodes, resulting in a generation of an electrical current.

The cell is primarily intended for use in measuring nuclear radiation, but the principle involved can

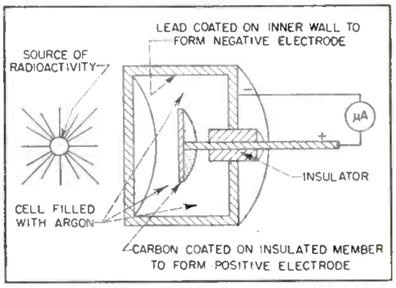
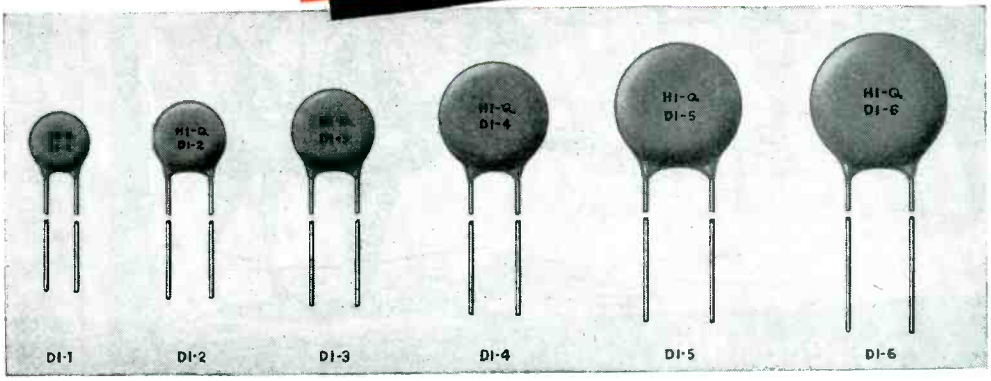


FIG. 1—Drawing shows components of battery with radioactive energy source

NEW from HI-Q*



Illustrations approximately actual size.

Temperature Compensating DISK Capacitors

Capacity range from 475 mmf on the DI-6 N1400 material down to .3 mmf on the DI-1 size with tolerances of ± 5% or greater. Conservatively rated for working voltage at 500 volts DC and flash tested at 1500 volts DC. Insulation resistance at 100 volts is well over 10,000 megohms. Electrodes are fired directly to the low loss dielectric and are coated with a non-hydroscopic phenolic for protection against moisture and high humidities. Conform to RTMA Class 1 ceramic capacitors.

Extended Temperature Compensating DISK Capacitors

Produced from a recently developed group of extended coefficient ceramics, this type of **Hi-Q** Disk permits a much wider temperature compensating range than was possible on the formerly available normal linear temperature coefficient ceramics. Specifically developed for applications requiring a very large gradient of capacity versus temperature. These new **Hi-Q** Disks exhibit relatively higher dielectric constants permitting capacities in the range intermediate between the high K and linear or normal group of ceramics. The Q (a minimum of 250 at 1 megacycle) is somewhat lower than the Class 1 ceramics. It has, therefore, not been classified by RTMA as Class 1. However, characteristics are superior to by-pass Class 2 ceramics.

ALL HI-Q DISK CAPACITORS COME IN THESE SIX SIZES

Type	Diameter	Lead Width	Thickness
DI-1	5/16" Max.	3/16" ± 1/16"	5/32" Max.
DI-2	3/8" Max.	1/4" ± 1/16"	5/32" Max.
DI-3	7/16" Max.	1/4" + 1/8" − 0"	5/32" Max.
DI-4	19/32" Max.	1/4" + 1/8" − 0"	5/32" Max.
DI-5	11/16" Max.	3/8" ± 1/8"	5/32" Max.
DI-6	3/4" Max.	3/8" ± 1/8"	5/32" Max.

Companion Lines to the Popular HI-Q By-pass DISK Capacitors

The widely used **Hi-Q** By-pass Disks are fixed ceramic dielectric capacitors which meet RTMA Class 2 specifications. They are available in the complete capacity range of from .3 mmf to 30,000 mmf. Standard tolerances of 5% thru 20% where applicable can be furnished.

Write for Engineering Bulletin Giving Details of all HI-Q DISK Capacitors

HI-Q*

* *Trade Mark Registered, U. S. Patent Office*

Electrical Reactance Corp.
OLEAN, N. Y.

SALES OFFICES: New York, Philadelphia, Detroit, Chicago, Los Angeles

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Whether your problem is uninterrupted communication halfway around the world . . . or only 100 miles . . . ANDREW offers you (1) a world-wide reputation of reliability and (2) the convenience of obtaining all necessary equipment from one dependable source.

- **Receiver Coupling Unit** efficiently distributes the output of one antenna among as many as 10 receivers. Interaction between receivers is held to negligible levels. Power gain is approximately unity (0 db) over the entire range of operation. A 4-channel unit is also available.
- **Rhombic Receiving Antenna Kit** contains in one "package" everything you need for an antenna except poles.
- **Transmitting antennas** available on special order.
- **Rhombic Antenna Coupling Transformer** is a broad band, low loss unit which matches the balanced impedance of the rhombic to the unbalanced impedance of a coaxial line.
- **Transmitting Rhombic Tuning Units** for single or multiple frequencies are available on special order.

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- **(a) Coaxial Patch Panel** has 24 jacks. Fits 19" relay rack. Facilitates switching coaxial circuits.
- **(b) ANDREW Coaxial Jacks and Plugs** are simple to install. No soldering through a window. Just remove one screw, slide the sections apart and solder.

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ANTENNA TUNING UNITS · TOWER LIGHTING EQUIPMENT

Commercial gammometer that operates on atomic battery principle

also be used for corrosion measurement, analysis of alloys, gas analysis and measurement of vacuum, pressure and temperature. According to Ohmart physicists, the atomic battery is not likely to result in a new source of electrical power for mankind since the amounts of energy so far obtainable in this way were so small. As an example, a battery capable of lighting a 100-watt electric lamp would be a 36-inch cube. However, such a cell would still be delivering current after 20,000 years. The photograph above shows a gammometer that operates on the principle described above.

Transmission-Line Tubes

CHAIN AMPLIFIERS accomplish amplification over greatly increased frequency range by distributing a stage of amplification among a number of tubes rather than attempting to concentrate it in a single tube. A series of special tubes has been proposed that will make possible the use of the chain-amplifier principle with a single tube. The tubes are best described as "homogenized" chain-amplifiers, wherein completely uniform distribution of amplification makes possible increases in gain and decreases in over-all size and power requirements and eliminates the intrinsic bandwidth limitations that exist for

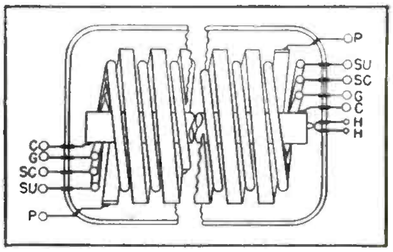
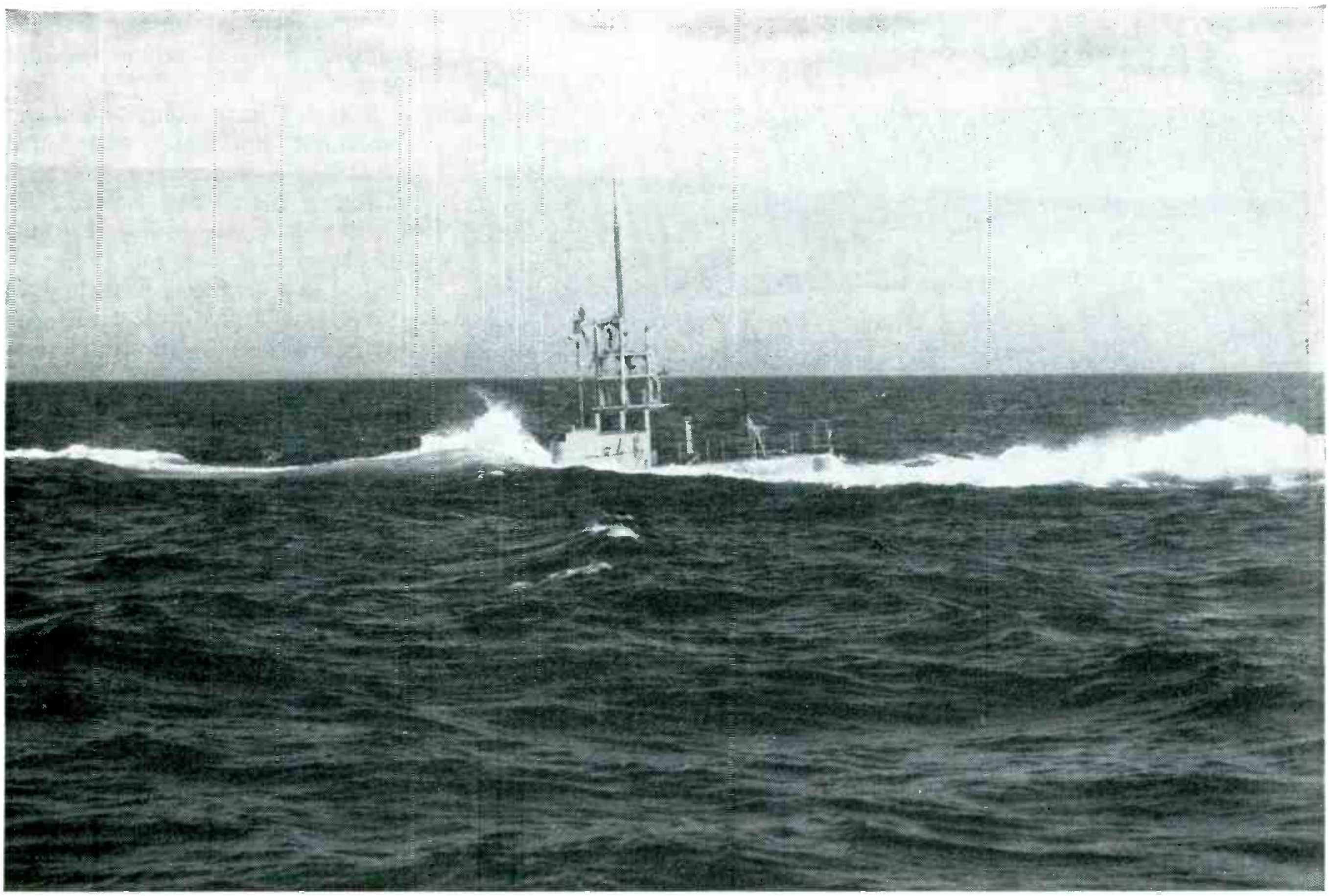


FIG. 1—Drawing showing configuration of five-element transmission line tube for broad-band amplifier applications



Official U. S. Navy Photo

going down...

but not out

Below periscope level, subs used to grope in the dark, little able to push an effective attack or to strike with accuracy at enemy vessels.

The dark depths were for hiding, not attacking.

Now sonar has changed this. Modern subs of the United States Navy, equipped with newly perfected under water detection devices can locate the enemy at great distances and press home attacks from below periscope depth.

Much of this change in submarine tactics can be traced to the electronic laboratories of the Edo Corporation where new types of sonar have been developed to make possible greater range and accuracy.

Edo has become not only a leader in the design and development of many new sonar devices but also is a major supplier of equipments which help make our Navy's fighting ships and subs the best equipped in the world.

EDO SONAR HELPS GEOLOGICAL SURVEY

The high power and extreme accuracy of latest depth sounding equipment developed by Edo, has been put to work by the Department of Interior in locating bed rock under deep deposits of sand and silt. The use of this method, first tried in Chicago harbor, and later in the Bay of Fundy, promises to eliminate the costly and time-consuming process of drilling test borings to determine how deep through sand and silt foundations must be driven to provide solid footing on bed rock for dams, piers, and breakwaters.

Over a quarter of a century of experience in the aviation, marine and electronic fields are behind the recent electronic developments which have established Edo as a leader in the whole field of sonar development. If you haven't received your copy of the book describing Edo's first quarter of a century, write to Department 1-M, Edo Corporation, College Point, L. I., New York.

Edo

EDO CORPORATION · COLLEGE POINT, N. Y.

single-tube and chain-amplifier stages.

A sketch of a simple structure combining uniformly distributed vacuum-tube transconductance with uniformly distributed isolating inductance is shown in Fig. 1. This five-element version might be described as a very long pentode with connections provided at both ends and with a helical plate rather than the conventional cylinder. The distributed transconductance is that between the grid helix and the plate helix and the isolating inductances are merely the self-inductances of those electrodes.

Theoretical studies made of this tube configuration, on the basis of five-wire transmission-line theory, reveal that interaction between lines within the tube can be responsible for useful amplification. The new type of amplification has been named "transmission-line buildup" to distinguish between it, chain-amplifier buildup, and a third type of possible amplification called vacuum-tube buildup.

One of the many possible configurations of transmission-line tubes is shown in mock-up form in Fig. 2. The grid coil form is composed of a number of ceramic beads, which are aligned and connected to each other coaxially by means of smaller ceramic dowels (not visible). Thin micas are sandwiched between adjacent beads, and the cathode is strung lengthwise through small, accurately-punched holes near the periphery of the mica discs and welded to electrodes sealed to the end discs.

After the grid is wound around the form shown in Fig. 2, the grid-cathode assembly is inserted in the

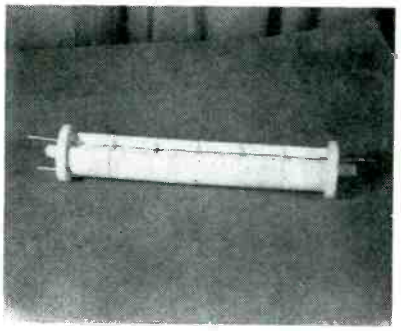
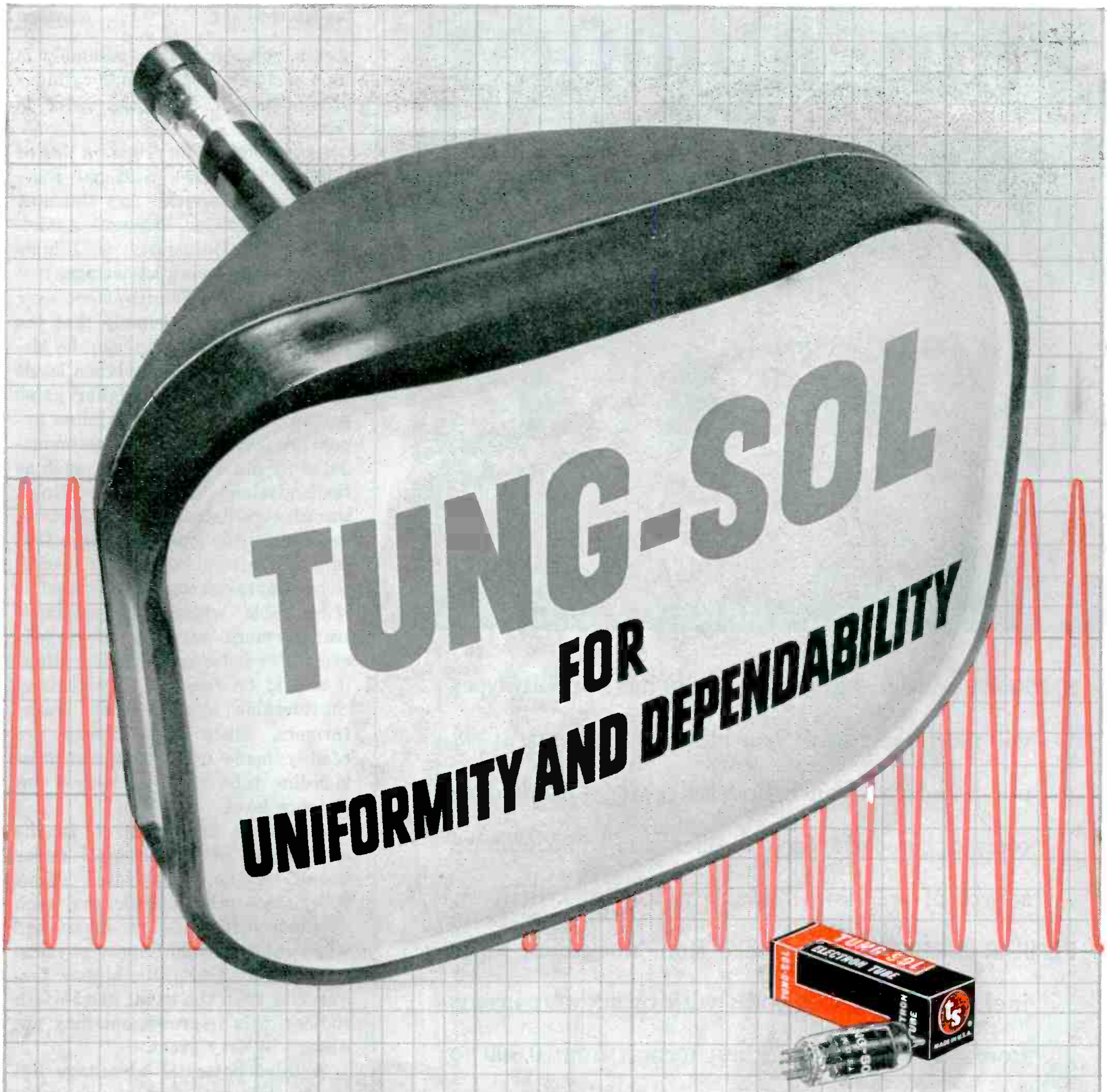


FIG. 2—Laboratory mockup shows enlarged model of grid-cathode structure proposed for use in transmission-line tubes. Grid will be wound helically around ceramic form shown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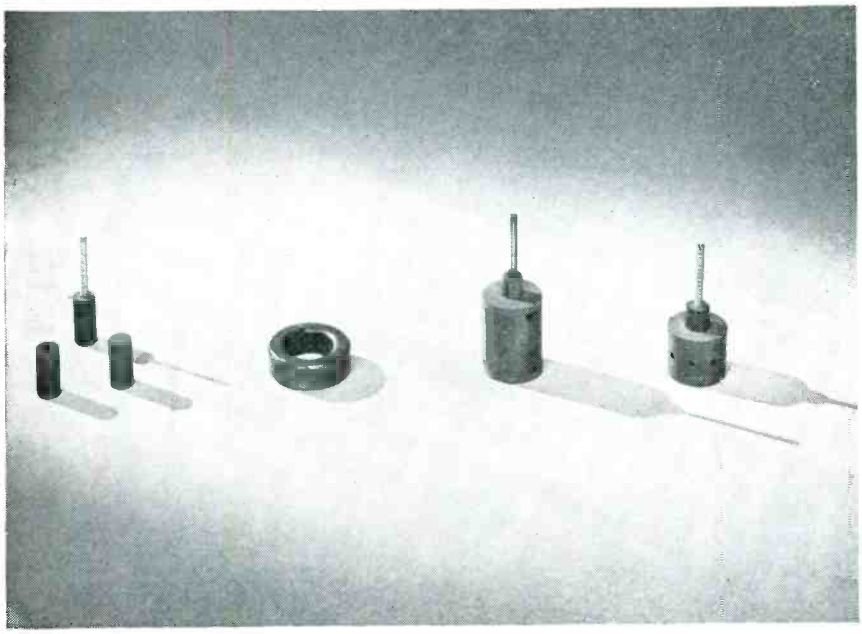


screen cylinder. This assembly is then enclosed in a ceramic cylinder around which the plate helix is wound.

In describing the proposed line of tubes at the 1951 National Electronics Conference in Chicago, Vernon J. Fowler, Research Assistant at the University of Illinois listed the following advantages:

The principal improvement over other amplifiers is simply that the transmission-line tube can be designed for higher impedance levels and consequently for higher gains per unit length. The maximum impedance level that can be accommodated by other components, such as transmission lines and couplings, transducers, detectors and antennas, determines the amount of gain that can be realized in practice. Additional improvement may be possible if suitable wide-band impedance transformers can be developed; except for noise level considerations it should be feasible to withstand considerable loss in such transformers, since such losses are readily made up in the transmission-line tube at its increased impedance level.

A second improvement is the elimination of an intrinsic upper bound on the band-width. However, since other limitations, such as electron transit-time effects and wave-guide effects, impose physical limitations at slightly higher frequencies than the usual band-width indices, this improvement may not always be very great.

A third potential advantage lies in the bilateral feature of transmission-line buildup. If the multiwire impedance matching techniques that have been developed can be proved workable, transmission-line tubes may have important future applications as broad-band bilateral repeaters.

New British Tube For High-Speed Photos

A NEW TYPE of image converter tube capable of photographing phenomena occurring at one-hundred millionth of a second was shown by Mullard Electronic Products Ltd. at the National Radio Exhibition in England. The introduction of a grid enables the new GR®

SIMPLE TO USE

VERSATILE

ACCURATE

Reads directly *in Percentage Deviation*

Matches *Pairs of Resistors*

Compares *Resistors to Standard Sample*

Adaptable *to Automatic Sorting and Inspecting*

RESISTANCE LIMIT BRIDGE

Direct Reading in Percentage Deviation over Range of ±20% from 1 Ohm to 1,111,111 Ohms

The new G-R Resistance Limit Bridge uses a conventional equal-arm Wheatstone bridge circuit, supplied from a constant voltage d-c source.

The built-in resistance standard is composed of seven Type 510 Decade Resistors, adjustable from 1 ohm to 1,111,111 ohms in 0.1 ohm steps.

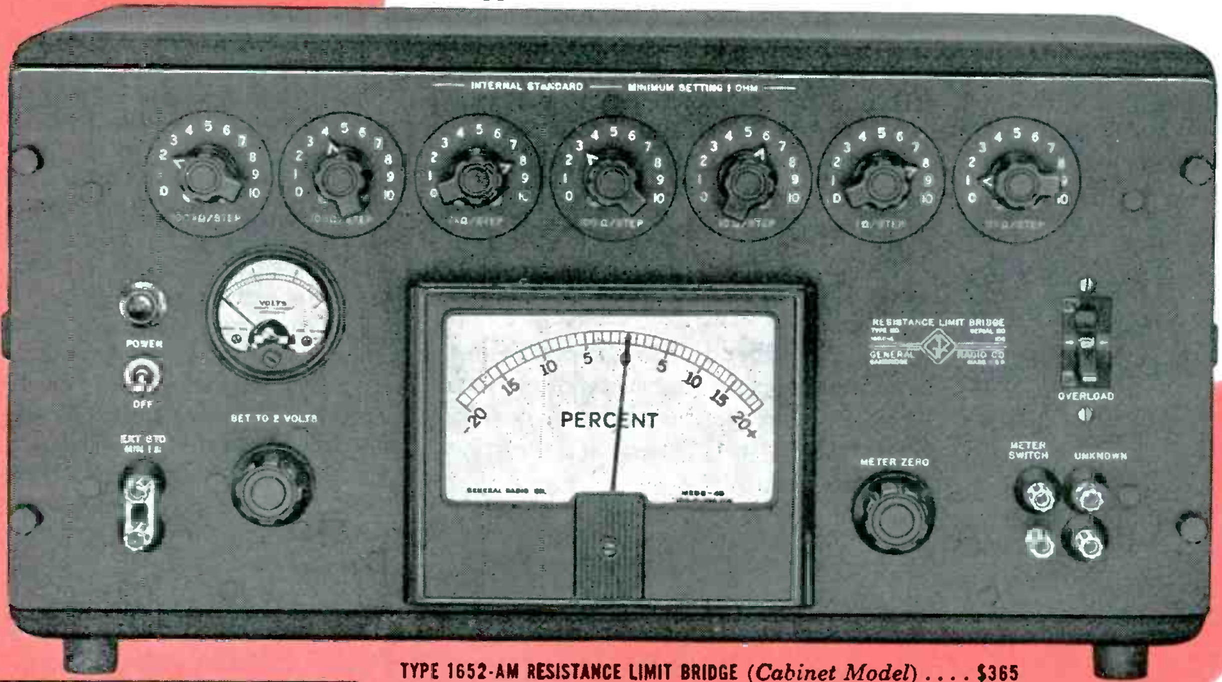
The indicating meter shows percentage difference between the unknown and the built-in standard over a range of ±20% on a meter the scale of which is colored gold for 5% limits and silver for 10% limits as an aid to rapid operation.

A sensitive relay can be substituted for the indicating meter to operate various types of rejection or selection mechanisms for automatic sorting or inspecting.

The instrument can be used as a conventional Wheatstone bridge. Its accuracy is adequate for a large majority of resistance measurements. Its ability to measure resistances up to one megohm without added booster voltages increases its utility considerably.

As a limit bridge its accuracy is ±0.5% or better; for matching pairs of resistors it is accurate to ±0.2%; for null measurements, with an external standard, between 1 ohm and 2 megohms the accuracy is ±(0.2% plus accuracy of the standard).

The instrument is a-c operated from 105–125 or 205–250 volts, 60 cycles. It is supplied in either welded aluminum cabinet or relay-rack models.



TYPE 1652-AM RESISTANCE LIMIT BRIDGE (*Cabinet Model*) **$365**
TYPE 1652-AR RESISTANCE LIMIT BRIDGE (*Relay Rack Model*) . . **365**

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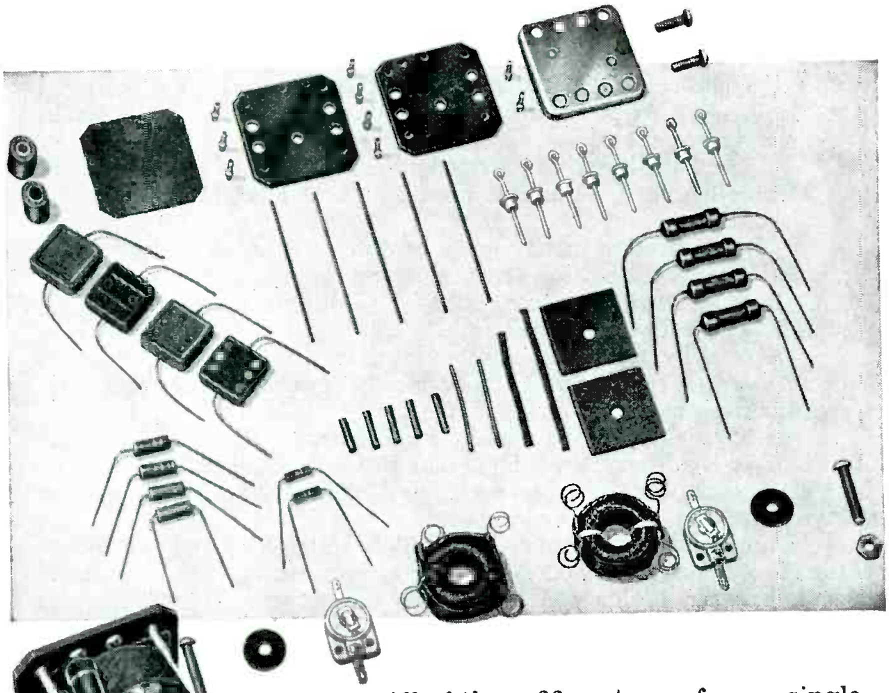
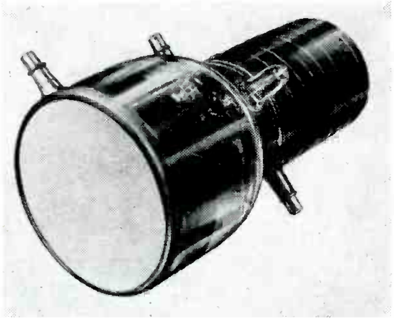


tube to act as an ultra-high-speed camera shutter. The main application of the tube to date has been the study of the rate of burning of explosives, but other uses are expected to be found.

The optical image is focused onto the photocathode. The resulting electrons are accelerated toward a luminescent screen where they form a visible image. Shutter action is obtained by pulsing the accelerating voltage, the picture appearing on the screen for the duration of the voltage pulse.

A number of problems is encountered in the application of these tubes to high-speed photography. The cesium/oxide-silver photocathode shows little sensitivity to the wavelengths of light suitable for single-shot photographic work (4,200 Angstroms). In the Mullard tube, the photocathode is made of cesium/antimony, which has a high sensitivity in the blue region of the spectrum, which is most suitable to high-speed photographic work. A green luminescent willemite screen is normally used, giving a picture of approximately 4½ inches in diameter. The diameter of the photocathode is approximately 1⅛ inches so the tube provides image magnification of four times.



New Mullard image converter high-speed photography tube

During the development of the tube it was found necessary to devise a special technique to make cesium/antimony cathodes with very low resistance in the order of a few hundreds of ohms per unit square as compared with megohms in the case of normal semitransparent cesium/antimony photocathodes as used in photomultipliers and supericonoscopes. These pho-

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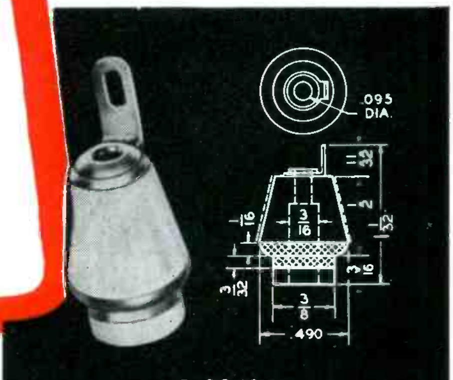
TINNED SURFACE ▩



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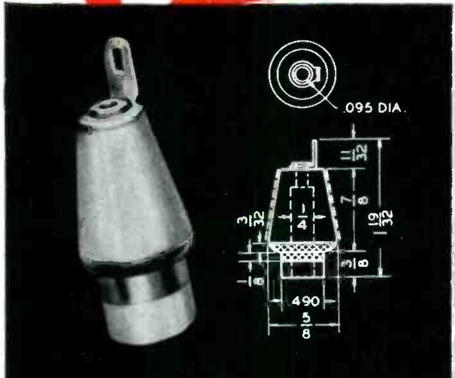

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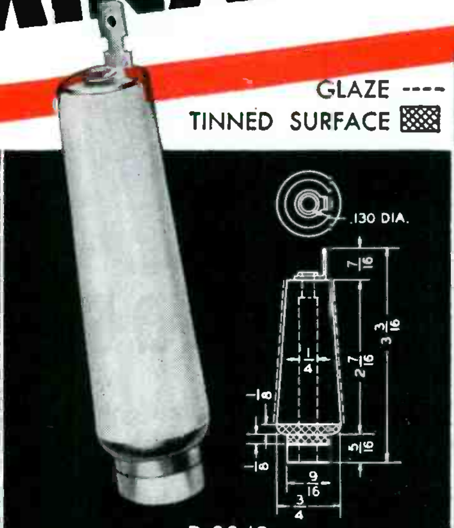

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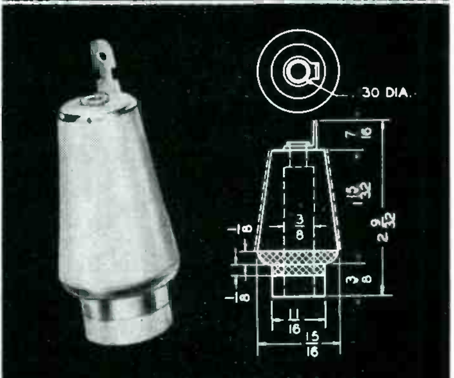

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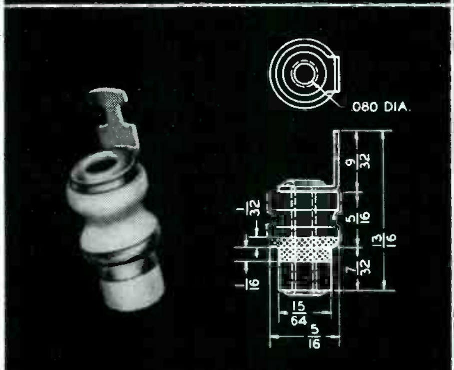

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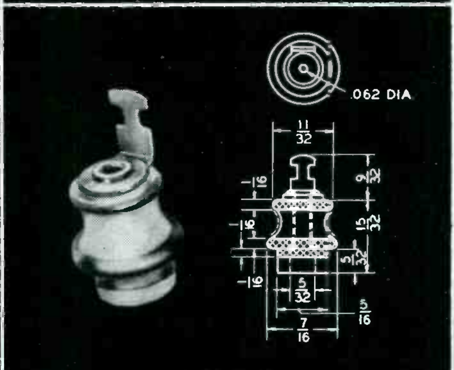

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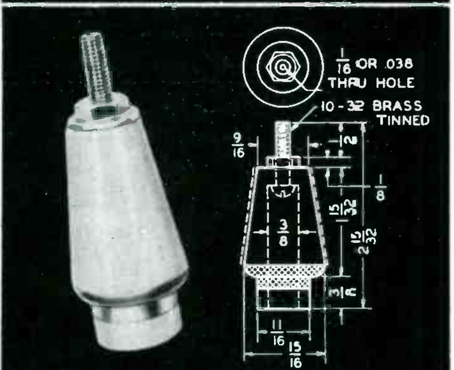

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Specify General Ceramics and Steatite for complete dependability in critical applications

General Ceramics low-loss Steatite sealed leads feature superior mechanical strength that insures permanent, positive hermetic sealing under practically any operating condition. Immune to severe thermal shock, they are easily soft-soldered to closures without developing the strains that are an incipient cause of trouble in many other types of leads. There are no rubber or plastic gaskets to deteriorate. Resistance to mechanical shock and vibration is excellent. The types shown are standard and can be supplied promptly from stock. For complete information on these and for consultation on custom-made terminals to your specification, phone, call or write today.

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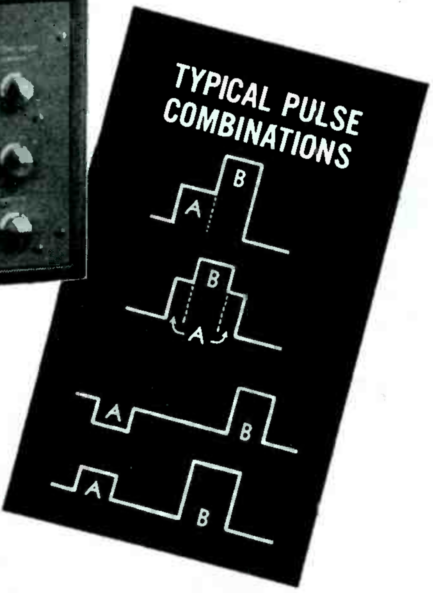
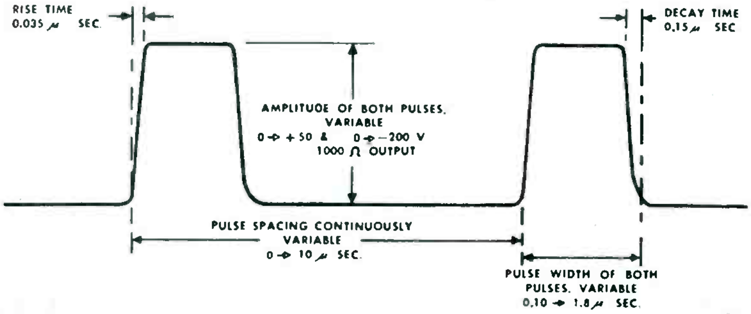




tocathodes have an average sensitivity of 20 microamperes per lumen to tungsten light at 2,700 K.

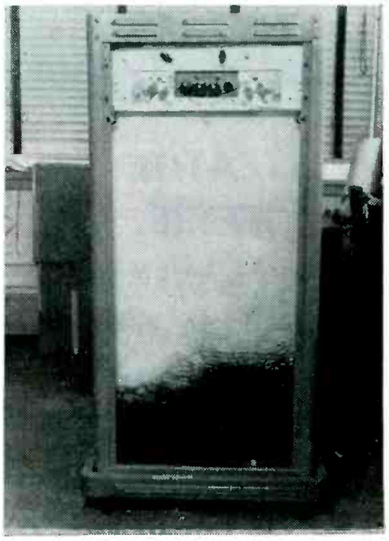
The screens used can resolve 50 lines per millimeter and the light can be efficiently recorded on high-speed orthochromatic or panchromatic emulsions.

The tubes are normally operated at 6-kv anode voltage and 3-kv screen voltage. The cathode of the tube is pulsed with a 60-volt signal. For certain applications, scanning is employed with writing speeds of 60,000 meters per second and a resolution of 1,600 lines across the field of 3½ inches diameter. In high-speed moving film work, exposures can be recorded at a rate of 200,000 frames per second or faster.

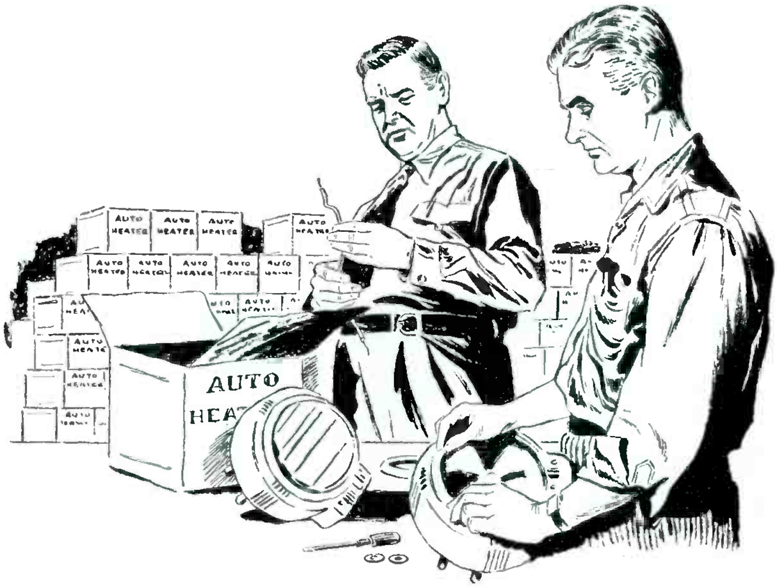
Super-Speed Tape Puller For Computer Memory

HIGH-SPEED starting, stopping and reversing with notable mechanical simplicity are features of a new magnetic tape handling machine recently developed at the National Bureau of Standards for use with the SEAC computer.

Using two large tanks for storing tape eliminates need for high-mass reels. These tanks hold 1,200 feet of tape and are just wide enough to



Fast starting and stopping are made possible by elimination of heavy reels. Tape lies loosely in two tanks (one behind the other) just wide enough to clear tape



"Net result . . . . . . no net!"

Chrome plate sparkling — baked enamel finish shining — all snugly packed in special cartons and ready to go — 20,000 car heaters. The last of the lot — at a good profit, too! Production costs had been cut to the bone. Bill Johnson was proud of that record, and of the net he would show at the end of the month. Then . . . back came some belated field test reports on a trial shipment. The new electrical insulation on the switch leads, that had cost a few cents less, wouldn't take the heat and vibration, and was cracking off. Unpack — replace insulation — repack — on 20,000 car heaters. Net result — no net!

Often it's little failures that chain react into big losses. Protect your products with BH Extra Flexible Fiberglas Sleeving — permanently flexible insulation.

Specifically designed for low voltage circuits where high heat resistance and flexibility are vital factors, BH Ex-Flex is also important as supplementary insulation. Made without hardening varnish or lacquer it is permanently non-stiffening and retains its flexibility from −67°F to 1200°F, with color retention up to 300°F. It is non-combustible. The easy-to-handle tubular shape provides maximum speed and convenience in installation. Patented braid treatment further reinforced by a special saturant allows BH Ex-Flex to be cut in short lengths, spread to cover knobs and terminals, yet prevents fraying or raveling.

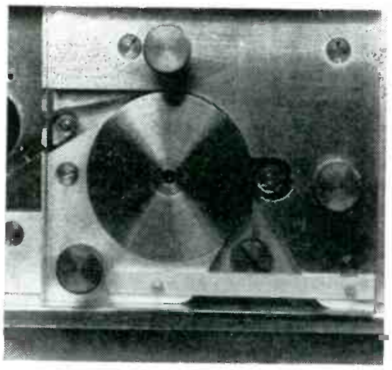
BH Extra Flexible Fiberglas Sleeving is one of a family of BH insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements — product, temperatures, voltages. We will furnish production samples for testing.

Address Dept. E-1

Bentley, Harris Manufacturing Co.
Conshohocken, Pa.

BH Fiberglas* SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.



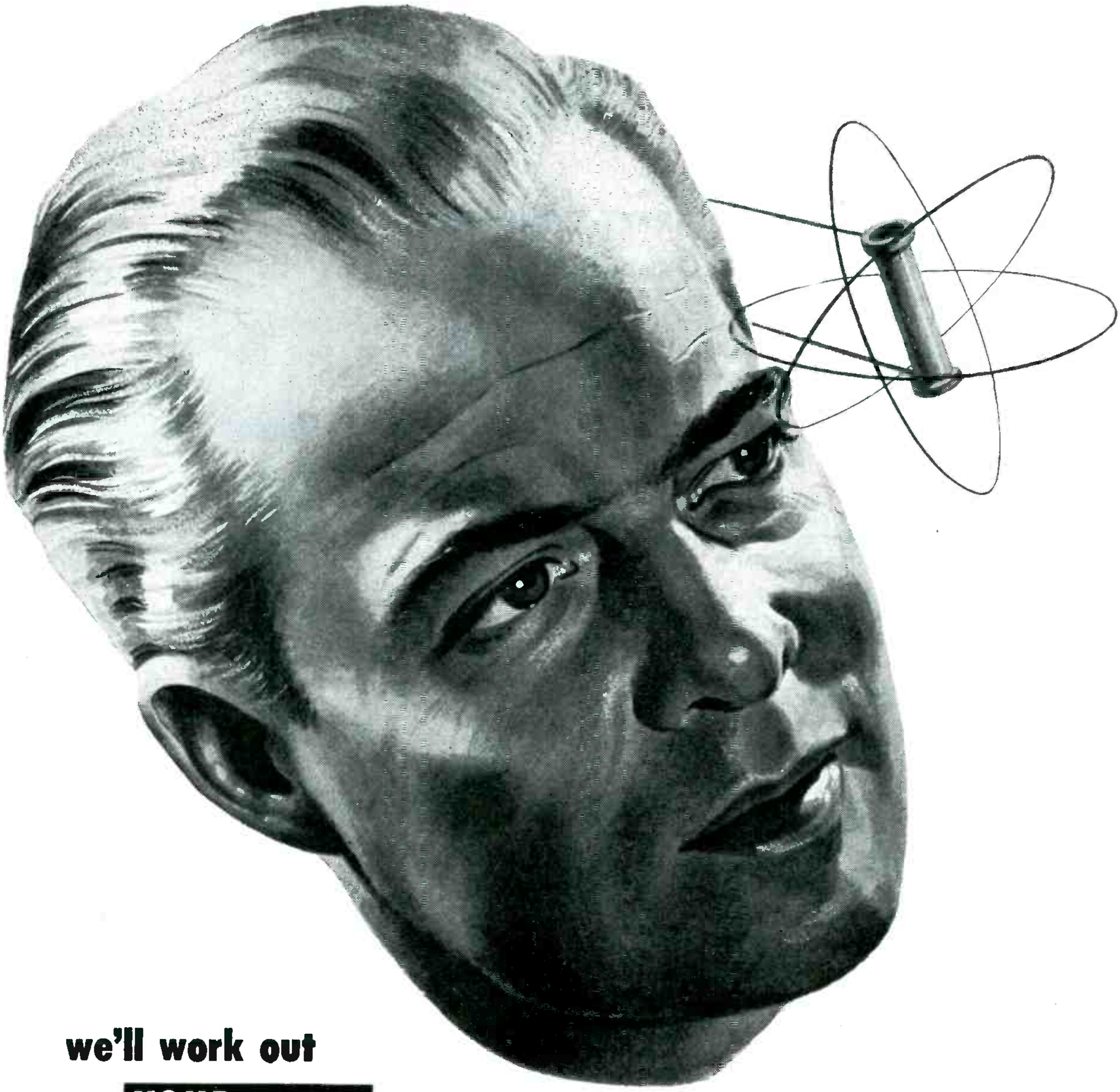
One of two continuously running rollers against which tape is pressed when movement in that direction is desired. This technique provides very fast acceleration

clear the tape, thus the tape is stored in loose folds without folding or turning.

In the new system, the magnetic tape rests lightly on two smooth-surfaced rollers that rotate continuously but in opposite direction. Between these two rollers the tape passes through magnetic heads for recording, pickup, and erase. When either of two control solenoids is energized, a low-inertia rubber-covered roller presses the tape against one of the smooth rollers. This quickly starts the tape moving in the desired direction.

Electrostatic Charge

Several problems have been encountered in developing the tape memory mechanism. For example, the tape tends to acquire an electrostatic charge as it passes through the drive mechanism. This can become quite troublesome at higher speeds, causing the tape to cling to the walls of the tank as soon as it leaves the drive mechanism. If the charge is strong enough, the tape may continue to stick at the top of the tank until it backs up into the mechanism and is damaged by a sharp fold. At present this problem is being taken care of by ionizing the air where the tape leaves the drive unit using strips of alpha-emitting polonium. The ideal solution would be to make the tape sufficiently conductive so that a charge could not collect. Experiment indicates that base material having a resistance of not more than a few megohms per unit square should be satisfactory.



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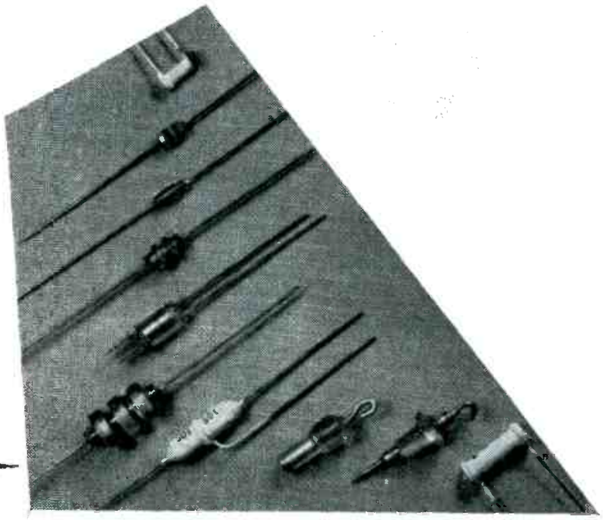
YOUR wants

...if electronic components such as tubular capacitors are your problem

Other electronic components
also built in quantity
to your most exacting specifications
for stability in service



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A SPEER CARBON COMPANY SUBSIDIARY
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Complete your Circuits with Resistors, Coil Forms and Iron Cores by Speer Resistor Corp., St. Marys, Pa. another SPEER CARBON CO. subsidiary 7665

Check THESE 7 ADVANTAGES

OF SANBORN DIRECT WRITING RECORDING SYSTEMS

1 **COMPLETE SYSTEM or SEPARATE COMPONENTS**
Sanborn equipment is available as complete 1-, 2-, or 4-channel systems *ready for use,* or as separate instruments (Amplifiers, Preamplifiers, and Recorders), to be combined or integrated by the user with other equipment.

2 **NO INK**
Permanent records are produced with heated stylus on heat responsive, continuous plastic coated chart paper. Elimination of ink permits, among many advantages, use of the recorder in any position, at any angle, and at high altitudes.

3 **RECTILINEAR RECORDS**
Records are in true rectangular coordinates (with *negligible* tangent error), permitting more accurate correlation when two or more channels are used simultaneously.

4 **HIGH TORQUE MOVEMENT**
The writing arm is driven by a D'Arsonval moving coil galvanometer with an extremely high torque movement (200,000 dyne cms per cm deflection). Sensitivity 10 m.a./cm deflection.

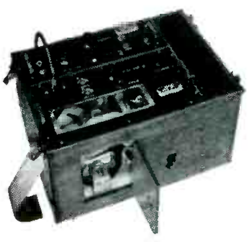
5 **WIDE CHOICE OF PAPER SPEEDS AND RECORDING CHANNELS**
Basic choice of 1-, 2-, or 4-channel models. Single channel standard speed 25 mm/sec., slower speeds available. Two channels, 10 speeds — 5 and 0.5, 10 and 1, 25 and 2.5, 50 and 5, 100 and 10 mm/sec. Four channel, eight speeds — 50, 25, 10, 5, 2.5, 1.0, 0.5, and 0.25 mm/sec.

6 **CODE & TIME MARKINGS**
All models provide a means of inserting timing pips in the record once each second independently of the paper drive, and code markings at will.

7 **INTERCHANGEABILITY**
Ready interchangeability of Amplifiers and Preamplifiers in all Sanborn systems permits a wide variety of recording combinations.

WRITE FOR COMPLETE CATALOG

If your problem involves recording any phenomena (individually, or simultaneously recording of up to four) that can be expressed electrically, you will find Sanborn equipment ideally suited to your requirements.


1-CHANNEL


2-CHANNEL

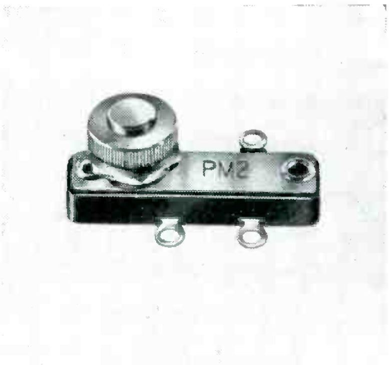

4-CHANNEL

INDUSTRIAL DIVISION SANBORN CO. CAMBRIDGE 39, MASS.

NEW PRODUCTS

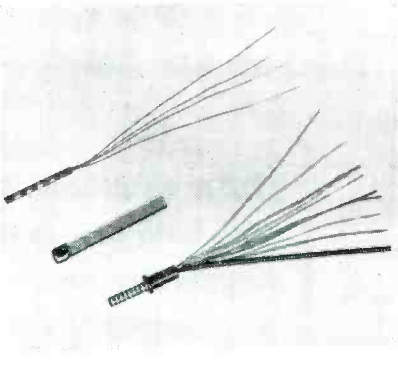
(continued from p 146)

counter are 13 × 11 × 7 in. It weighs approximately 12 lb and operates on 115 v, 60 cycles.



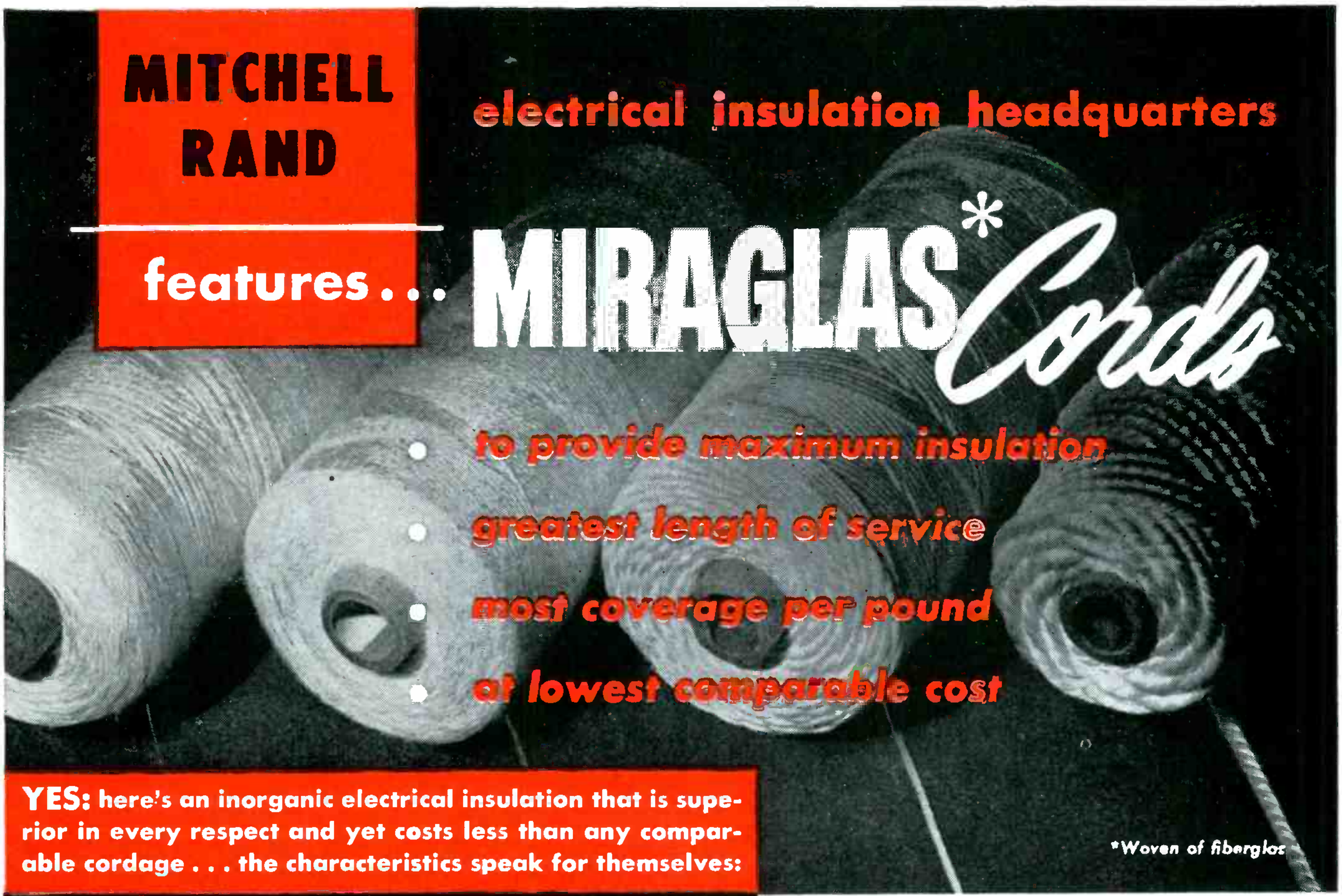
Tiny Panel Mount Switch

THE SESSIONS CLOCK CO., Tyniswitch Div., Forestville, Conn. Model PM Tyniswitch is a miniature panel mount type measuring only $1\frac{5}{8} \times \frac{7}{16} \times \frac{3}{4}$ in. and weighing approximately 17 grams. It provides precision snap action, long life and high rating at low cost. The new model is UL rated at 15 amperes at 125 v a-c and 7½ amperes at 250 v a-c. Movement differential is 0.010 max. Operating force required is 7 to 11 oz and release force is 2 to 3 oz. It provides the following circuits: spst either normally open or normally closed and spdt.



Subminiature Sliprings

NAER CORP., 631 S. Sepulveda Blvd., West Los Angeles 49, Calif., has developed a line of subminiature sliprings that are fabricated in a special mold which eliminates shrinking, swelling and temperature effects. They feature flexible leads, specially developed insulation which protects against breakdown



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features . . . MIRAGLAS* *Cords*

- to provide maximum insulation
- greatest length of service
- most coverage per pound
- at lowest comparable cost

*Woven of fiberglas

YES: here's an inorganic electrical insulation that is superior in every respect and yet costs less than any comparable cordage . . . the characteristics speak for themselves:

- *exceptional high tensile strength*
- *resistance to moisture, oils, corrosive fumes, acids, alkalis*
- *will not rot, stretch or shrink*
- *not affected by fungus*

		DIAMETER	YARDS PER LB.	TENSILE STRENGTH
TREATED	EC9-1-U	.009″	3,620	15
	EC9-2-U	.026″	702	80
	EC9-3-U	.034″	418	135
	EC9-4-U	.052″	209	220
	EC9-5-U	.076″	103	330
	EC9-6-U	.083″	87	420
	EC9-7-U	.095″	65	510
	EC9-8-U	.119″	43	725
	EC9-10-U	.149″	28	940
UNTREATED	EC9-1-N	.0105″	3,240	14
	EC9-2-N	.032″	638	62
	EC9-3-N	.039″	387	105
	EC9-4-N	.062″	193	180
	EC9-5-N	.084″	98	295
	EC9-6-N	.094″	84	340
	EC9-7-N	.110″	61	440
	EC9-8-N	.128″	42	540
	EC9-10-N	.165″	27	750

Manufacturers of electrical apparatus and appliances, repair and maintenance departments and rewind shops will find MIRAGLAS* CORDS ideal wherever a high quality binder twine or high strength tension member is required for: banding field and armature coils . . . wrapping string bands on small armatures . . . protecting front of commutator V-ring . . . reset strings . . . tying slot insulation . . . binding on V-ring extension . . . filling in winding coils . . . lashing ends of coils in large motors and generators—and when wax-treated for assembling and tying wire harnesses, etc.

- *MIRAGLAS* CORDS are made by plying fine, strong, flexible fiberglas (filaments of glass). Available either treated or untreated. Treatments: oil, neoprene or wax.*

For MIRAGLAS* CORDS as for all other ELECTRICAL INSULATIONS you can depend upon MITCHELL-RAND "Electrical Insulation Headquarters" since 1889.

Write to MITCHELL-RAND for free samples and descriptive data.

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MITCHELL-RAND INSULATION CO., INC.

51 MURRAY STREET   COrtlandt 7-9264   NEW YORK 7, N. Y.

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATING VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING

This Type MW 3 KW Westinghouse Transmitter covers a range of 2 to 30 megacycles for point-to-point communications

Photo shows two Jennings Vacuum Variable Capacitors in position in final amplifier section of transmitter which is housed in the single cubicle

JENNINGS TYPE U VARIABLE HIGH VOLTAGE CAPACITOR

AD No. 4 OF A SERIES

Another Capacitor Problem Solved—

WIDE RANGE TUNING

Simplified by the use of

JENNINGS TYPE U Capacitor

Other requirements essential for this Type MW Westinghouse Transmitting Unit which Jennings Capacitors helped to solve:

A Capacitor of small physical size. High voltage capabilities. Wide frequency range. High efficiency and long, trouble-free life under all climatic conditions.

The Jennings Flexible Type U Capacitor is used in two capacities, from 60 to 300 mmfds. in the lower frequency ranges and from 10 to 150 mmfds. in the higher frequency ranges.

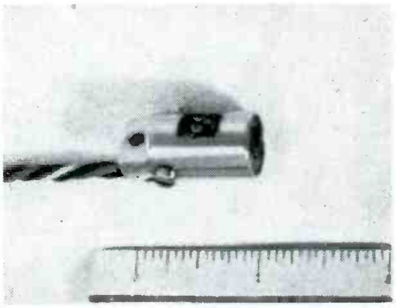
Another problem was solved by using the Jennings Type ATCS neutralizing capacitor in the final stage. This miniature unit has a range of 10 to 120 mmfds. plus the wide safety factor needed in this transmitter.

Write us for information regarding your own Capacitor problem.
Literature mailed on request

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

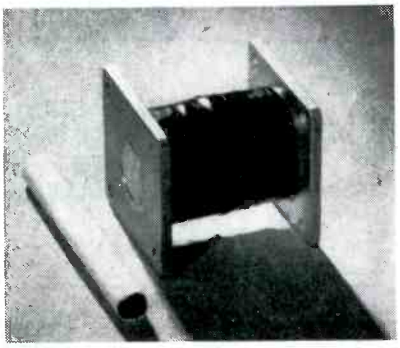
JENNINGS TYPE ATCS VARIABLE HIGH VOLTAGE NEUTRALIZING CAPACITOR

to 1,000 volts and highly polished silver rings to reduce torque friction to an absolute minimum. The rings are rhodium plated to reduce wear and retain their luster and range in diameters from 0.062 to 0.250. These tiny sliprings are highly desirable for gyros, computers, guided missiles, aircraft and many other electronic applications.



Miniature Magnetic Head

COMPUTER RESEARCH CORP., 3348 W. El Segundo Blvd., Hawthorne, Calif. Model HA102 miniature magnetic head was developed to provide higher component density in magnetic memory storage systems. The new head is only ⅜ in. in diameter and 1 in. long. It operates at frequencies up to 120 kc, having 13.8 mh total inductance and 11 ohms of d-c resistance and is stable over wide temperature ranges. It requires only 50 ma of writing current and produces 0.4 volt of playback voltage from center tap to one end.

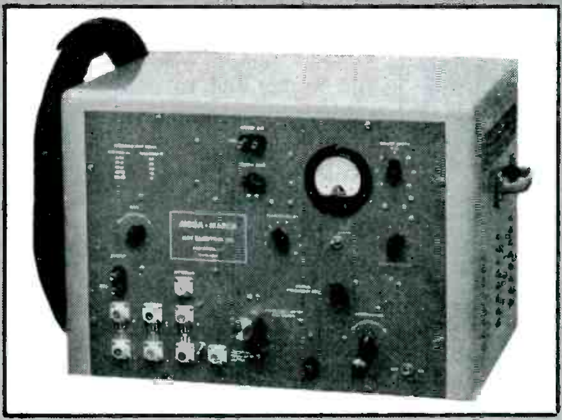


Microwave Switch

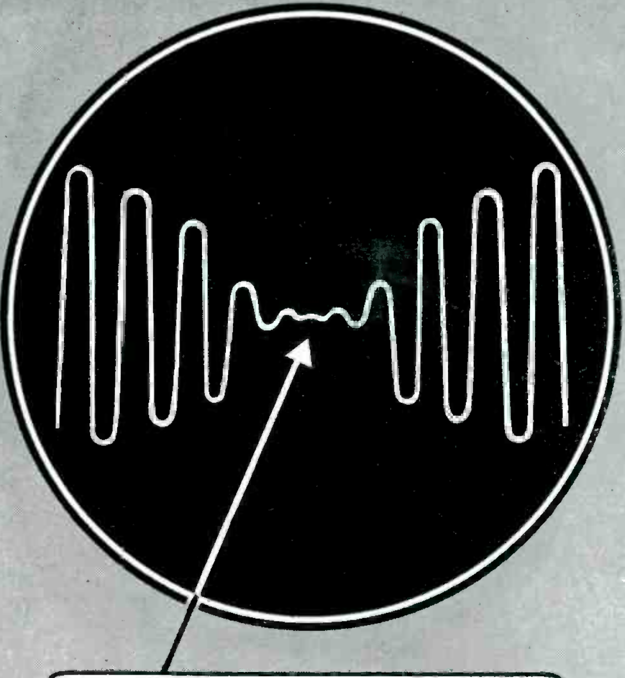
C. H. LUHRS & Co., 297 Hudson St., Hackensack, N. J., has developed a microwave switch for use at X-band. Repeated operation of the

For measurements of line terminations

USE THE MEGA-MATCH—Model UHF



WITH A BUILT-IN MEGA-SWEEP



Envelope is the curve of reflection coefficient vs. frequency over 30 mc. band

TWO INSTRUMENTS IN ONE:—

1. Impedance Match Indicator

Displays: Reflection coefficient vs. frequency over 30 mc. band.

Frequency Range: 10-1000 mcs.

Resolution: One sine wave of beat note:per mc. at low end, per 2.5 mcs. in intermediate range, per 5.0 mcs. at high freqency end.

Sensitivity: Reflection coefficients between 0.01 and 0.1 depending on frequency. Sensitivity can be improved by use of external audio filters and attenuators.

2. Wide Range Sweeping Oscillator

Frequency Range: 50 kcs. to 1000 mcs.

Sweep Widths: At least 30 mc. max.

Sweep Rate: Synchronized to power line but can be operated asynchronously to display amplifier hum.

Output: 100 mv. max. at 50 ohms.

Frequency Measurement: By calibrated coaxial wavemeter.

Available separately as:

The Mega-Sweep . . .	**$395.00**
The Calibrated Mega-Sweep	**$425.00**

UHF Mega-match complete but without indicator oscilloscope $895.00
F.O.B. factory

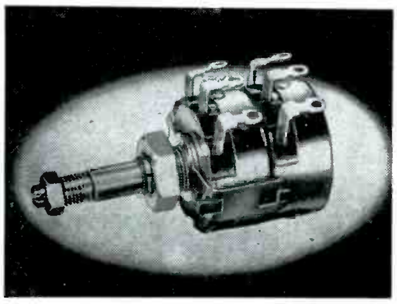
KAY

KAY ELECTRIC COMPANY

23 Maple Avenue
Phone CAldwell 6-4000
Pine Brook, New Jersey

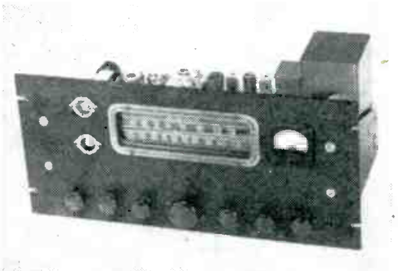
Export Department: 13 East 40th Street, New York 16, N.Y.

switch is accomplished in accordance with the following schedule: (1) With no voltage impressed upon the coil terminals, maximum attenuation is achieved. (2) Voltage is applied to coil terminals to achieve minimum attenuation. (3) Voltage is removed from coil terminals. Attenuation does not rise to the fully maximum value until a small reversed voltage is applied; the maximum attenuation figure is then again realized. Weight of the switch is 6 oz; length, 1¾ in.; maximum attenuation, 40 db; minimum attenuation, 1 db; d-c power required for operation, 6 watts.



Dual-Concentric Control

CLAROSTAT MFG. CO., INC., Dover, N. H. Adaptation of a proven design for locking shafts at a desired setting is now available on a dual-concentric control. Use of this construction will allow the replacement of two panel units requiring locked semipermanent settings. It is a dual-concentric unit where concentric operating shafts and tapered jam nuts are used for locking the individual controls at any desired settings. This type control requires one-half the panel space of two single units.

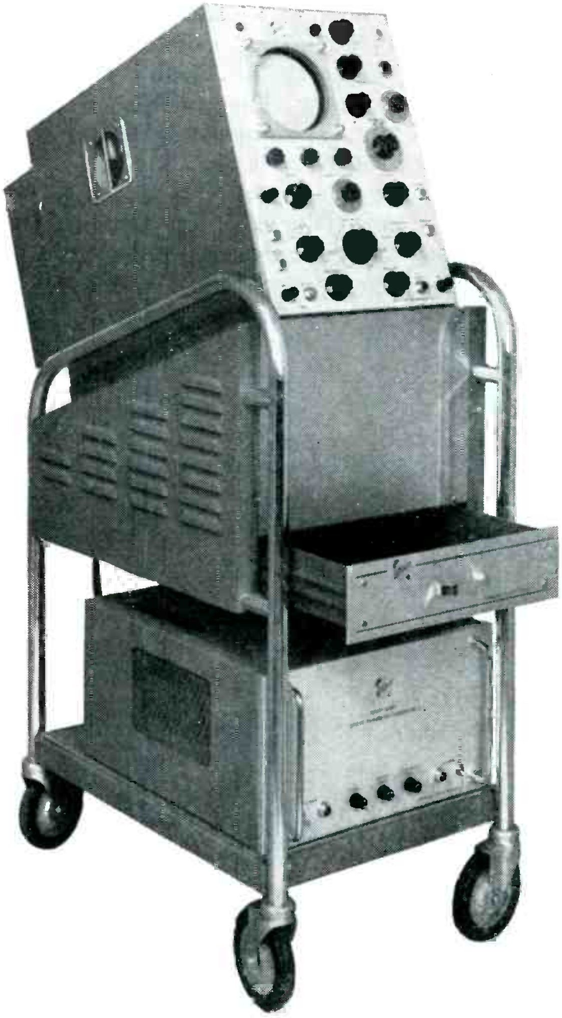


F-M/A-M Tuner

COLLINS AUDIO PRODUCTS CO., P. O. Box 368, Westfield, N. J. Type 45-S

PERFORMANCE + STABILITY

TYPE 517 OSCILLOSCOPE



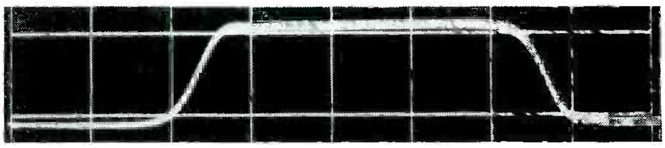
TEKTRONIX TYPE 517

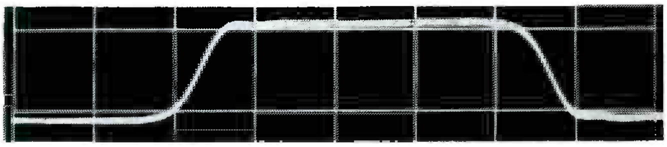
RISETIME — .007 μsec, or less (10%-90%)
SWEEP RANGE — .01 μsec/cm to 20 μsec/cm
SENSITIVITY — .1 v/cm
ACCELERATING POTENTIAL — 24kv

The Tektronix Type 517 Cathode Ray Oscilloscope has been enthusiastically accepted by research and development laboratories throughout the country. A partial explanation of this response can be given in terms of the remarkable operational stability of this instrument.

In order that usable, meaningful information can be obtained in the range of operation of the TYPE 517, it is necessary that a high degree of stability be designed into the circuits.

As an illustration, the photographs reproduced below show a .045 μsec pulse, initial rise time .001 μsec, recurring at a rate of 5cps. The sweep is being triggered by each pulse, and is operating at a rate of 0.01 μsec/cm. The photograph on the left is a continuous exposure over a twelve hour period during which the line voltage varied between 115v and 125v. The photograph on the right is a five minute exposure taken immediately after the long exposure.





Factors contributing to the excellent performance and stability of the Type 517 are:

Use of highest quality components.
Electronic regulation of indicator heaters, CRT gun voltage, and other critical voltages against both load and line changes.
Five stages of distributed vertical amplification.
A triggered, hard-tube bootstrap-type sweep circuit.
Adequate forced ventilation of both indicator and power supply units.

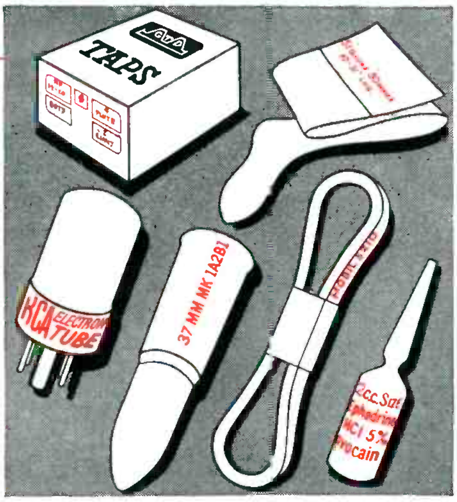
TEKTRONIX TYPE 517 CATHODE RAY OSCILLOSCOPE, $3500 F.O.B. Portland, Oregon

TEKTRONIX, Inc. **P. O. Box 831, Portland 7, Oregon**
ATwater 6357
Cables: Tektronix

MARKEM

marks them all

FROM ARTILLERY SHELLS TO MEDICAL AMPULES



MASTERS OF MARKING—Since 1911

Markem methods, machines, type and inks have been marking the products of industry for forty years. Markem machines can mark up to many thousands of pieces per hour. They make clear, durable imprints on flat, curved or irregular surfaces of paint, paper, wood, glass, metal, leather, plastic, rubber, fabric, composition and pressure sensitive tapes. No special skill is needed for their operation. Legend and color of imprint may be quickly and easily changed.

MAKE YOUR MARK WITH MARKEM

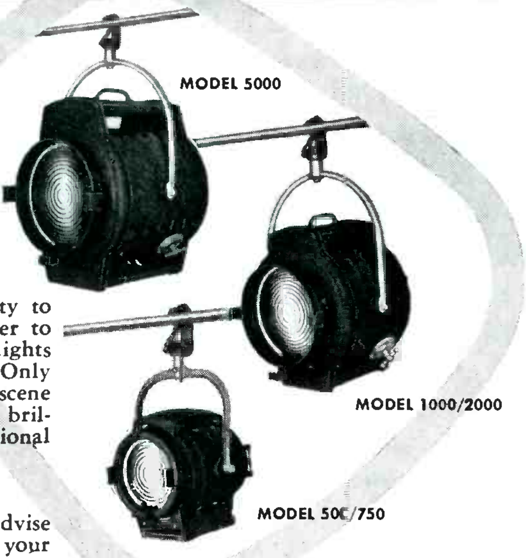
When your products need marking for Identification, Control or Market — ask Markem. Submit your problem, together with a sample of the item to be marked. Markem Machine Company, Keene 5, New Hampshire.

MARKEM BETTER MARKING SINCE 1911

Bardwell & McAlister's Line of Television Lights

TV SPOTS • Designed for Television Studios and Stages

Drawing upon their sixteen years of experience in the production of studio lights used by the motion picture industry, Bardwell & McAlister, Inc. now offers a complete new line of lights especially designed and engineered for TV stage and studio lighting.



Paint with Light

Painting with light is the ability to control the light source, in order to emphasize the necessary highlights and the all-important shadows. Only through controlled light can the scene or subject be given the desired brilliance, beauty and third dimensional effects.

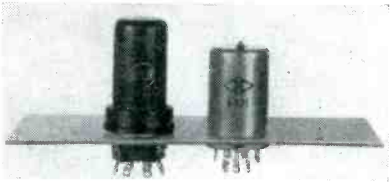
Our Specialists...

are always ready to assist and advise your engineering staff, so that your studios and stages will be fully equipped to properly "Paint with Light."

Write for complete specifications and prices of these TV SPOTS. Address Dept. 68.

BARDWELL & McALISTER 2950 ONTARIO STREET BURBANK, CALIFORNIA

f-m/a-m tuner has available two output impedances: 500 ohms through an output transformer and high impedance directly off the plate of the 6J5 through a coupling capacitor. The tuner also has an f-m squelch available. When higher sensitivity is required the squelch may be switched out allowing full sensitivity of between 5 and 10 μv. Electrical characteristics are as follows: power source, 110 v a-c, 60 cycles; power consumption, 125 w; f-m sensitivity, 10 μv average; a-m sensitivity, 80 μv average; i-f bandwidth (f-m), 150 kc; image ratio (f-m), 1,500 to 1; i-f (f-m), 10.7 mc; antenna input, 300 ohms; frequency response of audio, 50 to 15 kc plus tone control variation of 10 db up or down. Price of the unit is $295.50.

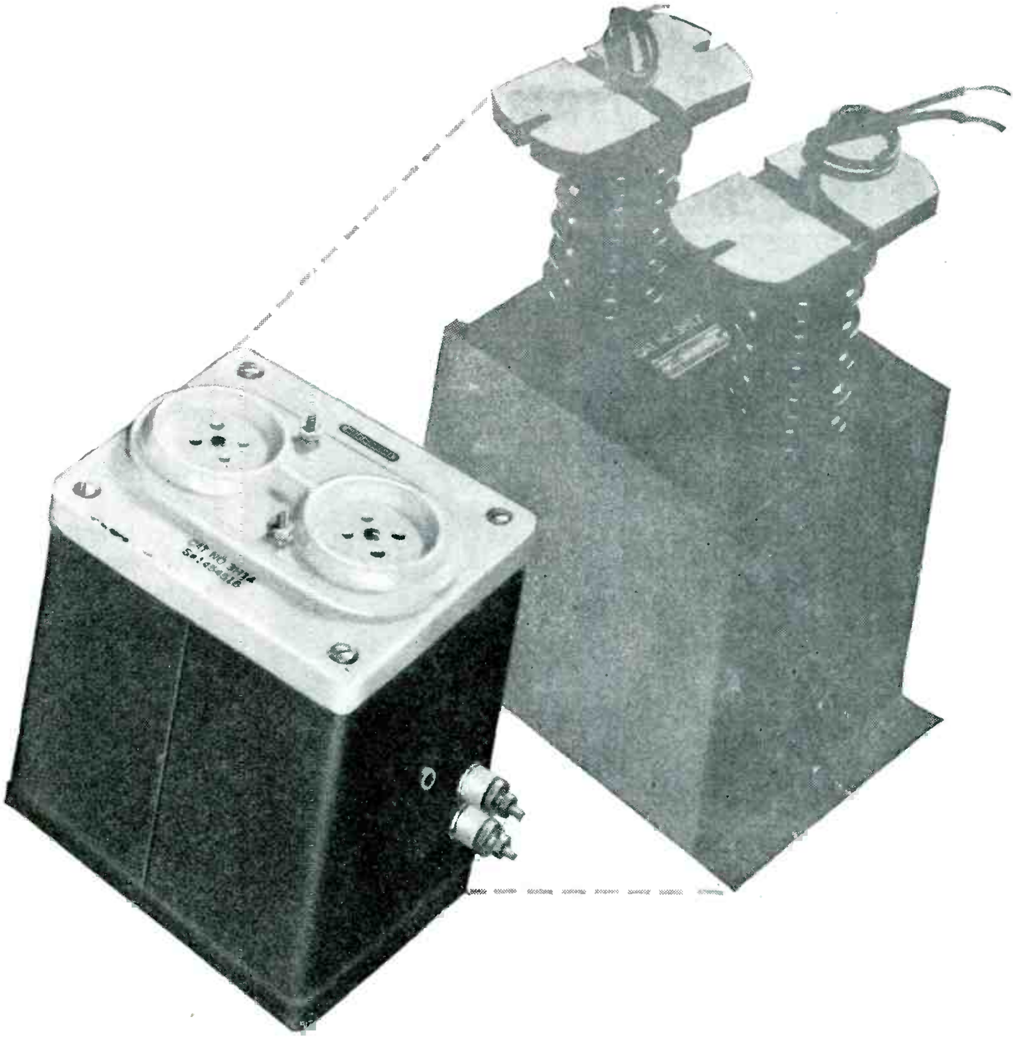


Miniature Relay

The Hart Mfg. Co., Hartford, Conn. The Diamond-H aircraft-type hermetically sealed miniature relays are 4-pole double-throw units that are designed to meet the requirements of USAF specification MIL-R-5757 and exceed several standard requirements by significant margins. The relays give operational shock resistance in excess of 50 g, and will not drop out until voltages of 7 or less are reached. Designed for operation in temperatures ranging from −65 C to +200 C, they have given satisfactory test results over a much wider span. Transit time is approximately one millisecond. Insulation resistance is in excess of 500 megohms. Contact ratings are 2 amperes, 28 v, d-c; 2 amperes, 115 v a-c including 400 cycle; inductive, noninductive and motor loading.

Synchroscope

Browning Laboratories, Inc., 750 Main St., Winchester, Mass. Model



Making little ones out of big ones . . .

Many a design problem has been simplified by the Westinghouse ability to reduce transformer size and weight.

Here, for example, is a case where a transformer was required to work in a voltage-doubler circuit at 18,000 volts. The old model created a space problem.

First step in redesigning, Westinghouse engineers applied a smaller, lighter Hipersil® Core. That, plus improved insulation, made it possible to reduce coil size and spacing. Then a wet-process porcelain cap, with integral tube sockets, eliminated the need for stand-off insulators. The net result was an over-all reduction of 30% in both size and weight of the completed power unit . . . with a great big bonus: The saving to the equipment assembler in installation costs alone made the new design highly profitable, because it was no longer necessary to wire tube sockets.

Savings like this are available to you, too. If size, weight, performance, or quantity production have any bearing on your transformer problem, call your Westinghouse representative, or write Westinghouse Electric Corporation, Specialty Transformer Department, Sharon, Pennsylvania.

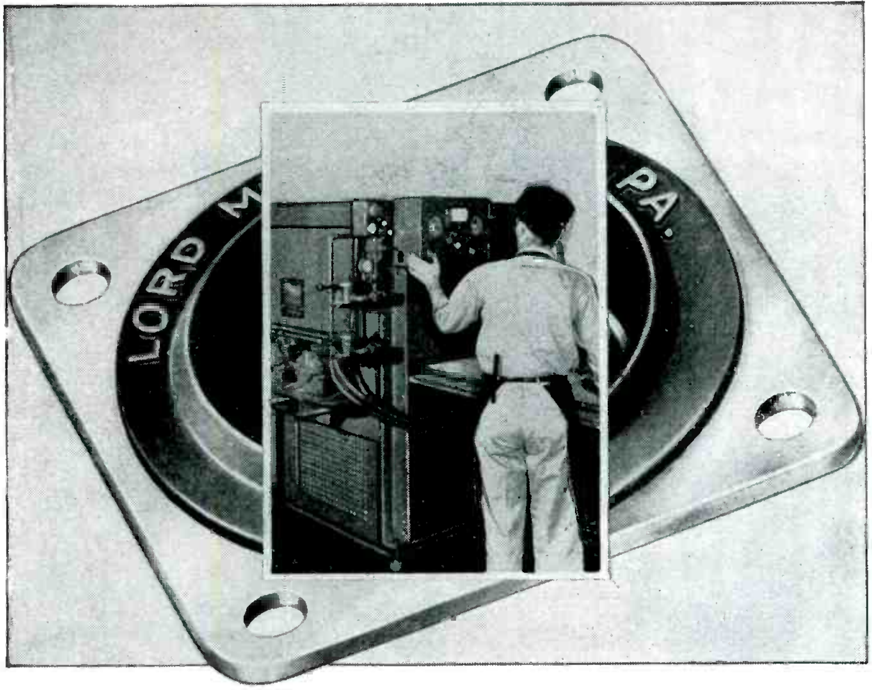
J-70610

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

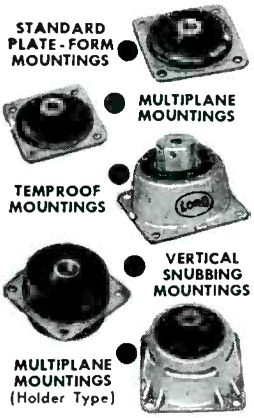
Westinghouse

TRANSFORMERS

MAXIMUM PROTECTION for
ELECTRONIC EQUIPMENT.
Lord Mountings, of Course!



HERE ARE A FEW LORD MOUNTINGS DESIGNED FOR ELECTRONIC INSTALLATION


STANDARD PLATE-FORM MOUNTINGS
MULTIPLANE MOUNTINGS
TEMPROOF MOUNTINGS
VERTICAL SNUBBING MOUNTINGS
MULTIPLANE MOUNTINGS (Holder Type)

Lord engineers are best prepared to mount your electronic equipment correctly. They have developed thousands of mountings for specific conditions to deliver maximum protection against shock and vibration.

You can draw from this reservoir of proved mountings with greatest economy and speed.

However, if your electronic equipment demands a specially designed mounting, Lord engineers will work with you to develop the most efficient and economical mounting you can buy.

Take advantage of Lord Engineering "know-how" and modern production facilities.

For immediate consultation call or write—

BURBANK, CALIFORNIA
Joe B. Hartley
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233 South Third Street
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LORD MANUFACTURING COMPANY • ERIE, PA •

LORD BONDED RUBBER
HEADQUARTERS FOR
VIBRATION CONTROL MOUNTINGS
. . . BONDED RUBBER PARTS

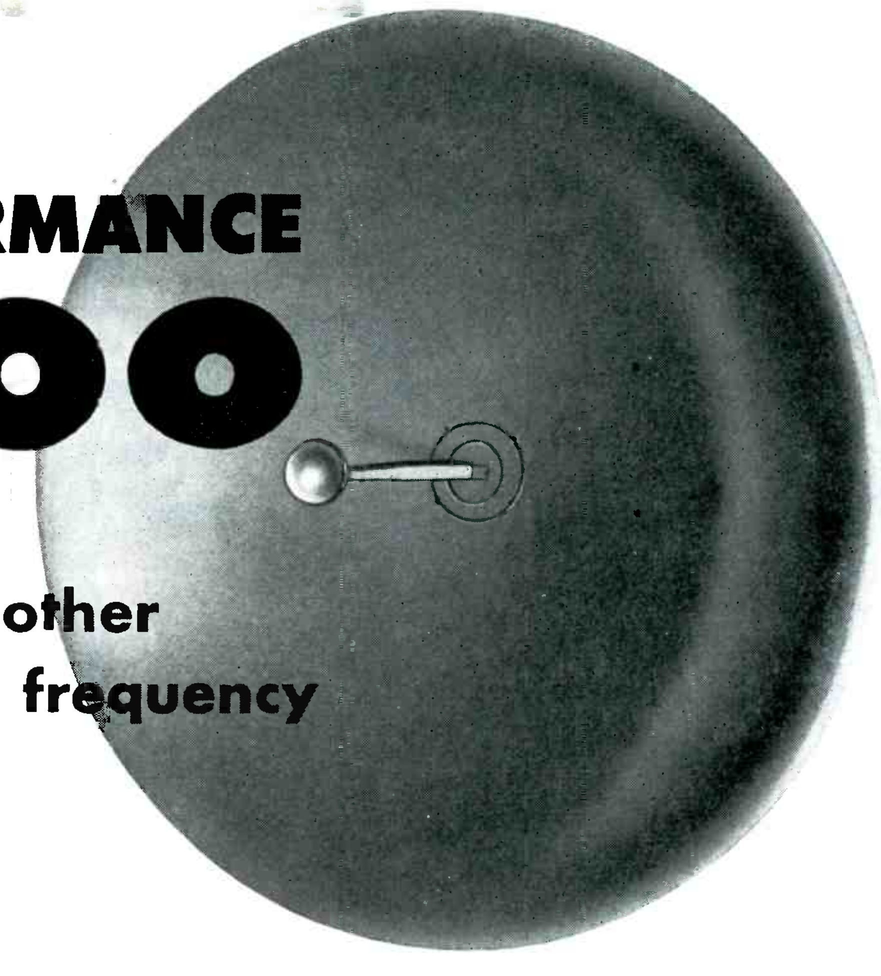
P4-EX synchroscope is designed for those applications requiring a triggered sweep. An internal trigger generator with continuous adjustment from 50 to 5,000 pps enables the scope to be used as a timing source. The triggered sweep is continuously variable and calibrated from 1.0 μsec per in. to 25,000 μsec per in. Output triggers may be phased from 500 μsec before the sweep to 500 μsec following the start of the sweep. A vertical amplifier with a flat response from 5 cycles to 5 mc makes the unit useful for examination of various pulse waveforms. The P4-EX uses a 5-in. c-r tube and is housed in a compact steel cabinet 14½ in. high, 10 in. wide and 16¾ in. deep. Weight is 50 lb.

Airborne Audio Amplifiers

GERTSCH PRODUCTS, INC., Los Angeles, Calif., has started production on its airborne audio amplifiers models AA-1A and AA-1B. The assembly includes ½ ATR rack with shock mount and has 20 watts output with controlled response. The amplifiers were developed primarily for p-a and entertainment use aboard aircraft. Both models include variable frequency response by means of a 4-position filter (for noise suppression); remotely operated level control; and dual input circuits. Model 1A weighs 20 lb and No. 1B, 23 lb. Distortion is less than 5 percent at 20 w; input level, zero db across 600 ohms, 1 mw; input impedance, 600 ohms. Input circuits are (a) 600-ohm line and (b) 600-ohm carbon microphone

TOP PERFORMANCE 7000 MCS

and every other microwave frequency



The WORKSHOP was the first manufacturer to bring out a complete line of parabolic antennas. Today these antennas are recognized as the *top performers* for all microwave frequencies. This is the result of years of specialization on all types of high-frequency antennas in laboratories with the finest research and test equipment. Normally, we can meet your requirements with our standard equipment but for special applications, reflectors can be supplied in a wide range of sizes and focal lengths.

Series 7000 Includes Models 6075, 6725 and 7275

	Model 6075			Model 6725			Model 7275		
Frequency Range	5925 to 6175 Mcs.			6525 to 6875 Mcs.			7125 to 7425 Mcs.		
Reflector Size	48″	72″	96″	48″	72″	96″	48″	72″	96″
Gain (db, approx., over isotropic radiator)	34.4	37.5	40.4	35.0	38.5	40.8	36.0	39.4	42.0
Half Power Angles (H plane)	2.86°	1.92°	1.32°	2.50°	1.74°	1.32°	2.42°	1.61°	1.21°
(E plane)	3.24°	2.04°	1.47°	2.79°	1.94°	1.47°	2.70°	1.81°	1.36°

Input Impedance	52 ohms nominal
VSWR	1.3 to 1 or better
Power Rating	1 kw. continuous
Polarization	Either vertical or horizontal available at time of installation.
Side Lobes	25 db down or better
Input Connection	UG-343/U choke flange fitting for RG-50/U (¾″ x 1½″) pressurized waveguide. Standard fitting. Special feeds and fittings on special orders only.
Dish and Feed Heaters	Available for all models. The dish heater capacities range from 400 to 4000 watts. The feed heater draws 20 watts.

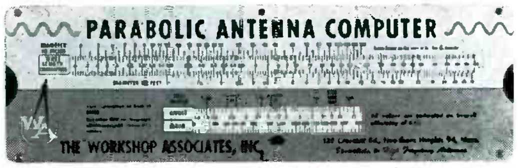
Write for Parabolic Antenna Catalog

THE **WORKSHOP ASSOCIATES**
DIVISION OF THE GABRIEL COMPANY
Specialists in High-Frequency Antennas
135 Crescent Road, Needham Heights 94, Massachusetts

OTHER STANDARD MODELS

MODEL NO.	FREQUENCY (MCS.)	GAIN* (DB.)	HALF POWER ANGLE E Plane*	HALF POWER ANGLE H Plane*
940	920-940	19.0-28.0	19.75°-7.8°	17.75°-6.9°
2000	1700-2300	27.0-34.5	10.28°-3.65°	9.2° -3.25°

*Gain and Half Power Angles are dependent on size and frequency of parabolas, — 4, 6, 8 or 10 foot diameter.



FREE SLIDE RULE—This pocket size slide rule quickly computes diameter, wavelength, angle and gain for parabolic antennas. Reverse side carries FCC frequency allocations, conversion tables and other data. Write for your copy.

ARROW HAS THEM IN STOCK!

JAN-C-25 CAPACITORS

Here's good news to all JAN users. ARROW has in stock at all times the hard-to-get JAN-C-25 Specifications Capacitors. Listed below are some of the most sought after numbers. These are products of leading manufacturers, all current production, with JAN numbers stamped on the capacitors themselves and on their cartons. Certificates of Compliance are available on request.

JAN Number	Each	JAN Number	Each	JAN Number	Each
CP27A1EF103V	.67	CP53B5EF504V	3.43	CP63B1EF504V	2.79
CP27A17F104M	.88	CP54B1EF104V	1.75	CP63B6EF104V	3.04
CP27A1EF203M	.75	CP54B1EF105V	2.24	CP63B6EF254V	3.13
CP27A1EF254M	1.18	CP54B1EF205V	2.97	CP63B6EF504V	3.58
CP27A1EF503M	.91	CP54B1EF254V	1.93	CP65B1EF104V	2.46
CP27A1EF504M	1.51	CP54B1EF503V	1.72	CP65B1EF105V	3.13
CP27A1EF602M	.67	CP54B1EF504V	1.96	CP65B1EF254V	2.62
CP28A1EF103V	.88	CP54B4EF104V	2.23	CP65B1EF504V	2.79
CP28A1EF104M	1.11	CP54B4EF254V	2.24	CP65B6EF104V	3.04
CP28A1EF203M	.97	CP54B4EF504V	2.56	CP65B6EF254V	3.13
CP28A1EF254M	1.41	CP54B5EF104V	2.49	CP65B6EF504V	3.58
CP28A1EF503M	1.02	CP54B5EF254V	2.83	CP67B1EF104V	2.13
CP28A1EF504M	1.72	CP54B5EF504V	3.43	CP67B1EF105V	2.79
CP28A1EF602M	.88	CP55B1EF104V	1.73	CP67B1EF254V	2.29
CP29A1EF103V	.87	CP55B1EF105V	2.24	CP67B1EF504V	2.46
CP29A1EF104M	1.08	CP55B1EF205V	2.97	CP67B4EF104V	2.79
CP29A1EF203M	.99	CP55B1EF254V	2.24	CP67B4EF254V	2.79
CP29A1EF254M	1.38	CP55B1EF503V	1.72	CP67B4EF504V	3.27
CP29A1EF503M	1.00	CP55B1EF504V	1.96	CP67B5EF104V	3.27
CP29A1EF504M	1.70	CP55B4EF104V	2.22	CP67B5EF254V	3.45
CP29A1EF602M	.87	CP55B4EF254V	2.23	CP69B1EF104V	2.13
CP53B1EB405V	3.99	CP55B4EF504V	2.56	CP69B1EF105V	2.79
CP53B1EF104V	1.73	CP55B5EF104V	2.49	CP69B1EF254V	2.29
CP53B1EF105V	2.24	CP55B5EF254V	2.83	CP69B1EF504V	2.46
CP53B1EF205V	2.97	CP55B5EF504V	3.43	CP69B4EF104V	2.79
CP53B1EF254V	1.83	CP61B1EF104V	2.37	CP69B4EF254V	2.79
CP53B1EF503V	1.72	CP61B1EF105V	3.04	CP69B4EF504V	3.27
CP53B1EF504V	1.96	CP61B1EF254V	2.53	CP69B5EF104V	3.27
CP53B4EF104V	2.22	CP61B1EF503V	2.23	CP69B5EF254V	3.45
CP53B4EF105V	3.16	CP61B1EF504V	2.70	CP06FA1	.54
CP53B4EF254V	2.24	CP61B6EF104V	2.97	CP06FA2	.54
CP53B4EF503V	2.16	CP61B6EF254V	3.04	CP06FA3	.54
CP53B4EF504V	2.56	CP61B6EF504V	3.51	CP06FA4	.54
CP53B5EF104V	2.49	CP63B1EF104V	2.46	CP06FA5	.54
CP53B5EF254V	2.83	CP63B1EF105V	3.13	CP06SA1	.54
CP53B5EF503V	2.26	CP63B1EF254V	2.62	CP06SA2	.54

FREE CENTRALAB'S COLOR CODE WALL CHART

We'll be happy to send you a copy of this valuable, big, 3 feet by 3 feet, color code wall chart. Illustrates over 3000 separate color code markings on all JAN-type and RMA components. You'll find it as indispensable as your slide-rule. Requests by authorized personnel on company letterheads will bring you this color code wall chart FREE.

FREE ARROW'S BIG NEW 1952 CATALOG

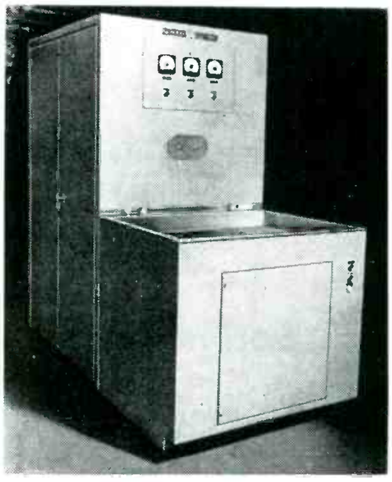
Get this big new edition of Radio's Greatest Catalog. Over 1,000 pages of Everything in Electronics, Radio, TV, Equipment, etc. Requests by authorized personnel on company letterheads will bring you this valuable new catalog FREE.

ARROW ELECTRONICS INC.
82 CORTLANDT ST., NEW YORK 7, N. Y. • DIGBY 9-4714
For Super Speed
TELETYPE NY-1-472
Direct Western Union Wire
ARROW ELECTRONICS - WUX - N. Y.

with filtered current supply; output impedance is 50-100-500 ohms.

TV Picture Tubes

ALLEN B. DUMONT LABORATORIES, INC., Clifton, N. J., has available two new all-glass 21-in. rectangular tv picture tubes. Both employ a bulb that results in a picture area of 242 sq in., with screen face made of filter-glass for minimizing reflections and improving contrast. Type 21EP4A employs the bent gun for electromagnetic focusing. A single-magnet ion trap is used. Type 21KP4A is one of the Selfocus Teletrons requiring no focus controls or circuitry. It provides absolute focus at all times. The latter type may be used as a replacement for either electromagnetic or electrostatic focusing type tubes.



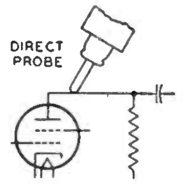
Induction Heater

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has announced an improved 20-kw induction heater featuring a nonventilated, dust-proof NEMA type 12 enclosure, and designed for use in high-speed annealing, brazing, hardening and soldering. Type HM-20L1 heater, for short-run production of a wide variety of parts, has variable power adjustment from 0 to 100 percent by means of a rheostat. For long-run, higher-production applications that do not have rapid cycling, type HM-20L2 heater (without variable power adjustment) is recommended. Units are available for operation on 230, 460, or 550-volt,

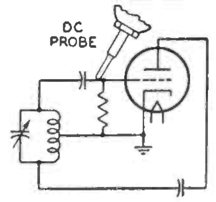
Now ...a NEW Junior VoltOhmyst*

...the WV-77A

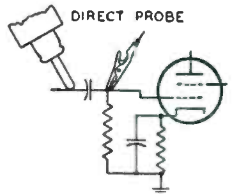
For all regular measurements and specialized measurements as illustrated.



MEASURES AC VOLTS . . . such as signal voltage on plate of af tube.



MEASURES DC VOLTS . . . such as oscillator grid bias. One-megohm resistor in probe prevents circuit loading.



MEASURES RESISTANCE . . . such as leakage in coupling capacitor up to 1000 megohms.

Just one probe cable and one slip-on probe handle all measurements.

An all-electronic ac-operated vacuum-tube volt-ohmmeter by RCA

ONLY $47.50.

Includes DC probe, AC direct probe and cable, ground lead, and alligator clip.

Check these important features . . .

- ✓ Accurate laboratory calibration.
- ✓ Meter electronically protected against burn-out.
- ✓ Metal case shielding . . . extra stability in rf fields.
- ✓ Sturdy 200-microampere meter movement.
- ✓ Carbon-film 1% multiplier resistors . . . dependability plus.
- ✓ Zero-center scale . . . for discriminator alignment.
- ✓ Frequency response flat from 30 cps to approximately 3 Mc.
- ✓ High ac input resistance for greater accuracy.
- ✓ Constant dc input resistance . . . 11 megohms on all scales.
- ✓ Negative feedback circuits for greater over-all stability.
- ✓ Ohms cable always positive . . . for quick leakage measurements of electrolytic capacitors.
- ✓ Polarity reverse switch . . . eliminates cable switching.
- ✓ ± 3% over-all accuracy on + dc scales, and ± 5% on ac and —dc scales.

Available from your RCA Test Equipment Distributor

The RCA WV-77A VoltOhmyst* provides the extra features you have tried to find in an inexpensive VTVM. Using the famous VoltOhmyst electronic bridge circuit, 200-microampere meter movement, and carbon-film multiplier resistors, the WV-77A incorporates features you would expect to find only in more expensive instruments. Sturdily built . . . calibrated against laboratory standards . . . and backed by a 12-month warranty . . . the WV-77A has the durability, versatility, and accuracy to please discriminating customers such as service technicians, engineers, amateurs, and military personnel.

As a DC Voltmeter it measures dc from 0.05 volt to 1200 volts in five ranges. Uses 1-megohm resistor in isolating probe; probe has less than 2-uuf input capacitance. Has 11-megohm input; useful for measuring high-resistance circuits such as oscillator, discriminator, and avc.

As an AC Voltmeter it measures ac from 0.1 volt to 1200 volts rms in five ranges. Uses high-impedance diode tube as signal rectifier. Frequency range is more than adequate for measurement of power line, audio, and ultra-sonic frequencies.

As a wide-range Ohmmeter the WV-77A measures resistance from 0.2 ohm to 1 billion ohms in five ranges. Requires only 1.5-volt battery as burn-out protection in measuring such low-power elements as battery-type tube filaments.

The all-new RCA WV-77A VoltOhmyst comes completely equipped with probes and cables as illustrated. For complete details, see your RCA Test Equipment Distributor today . . . or write to RCA, Commercial Engineering, Section 42AX, Harrison, N. J.

Accessories Available on Order

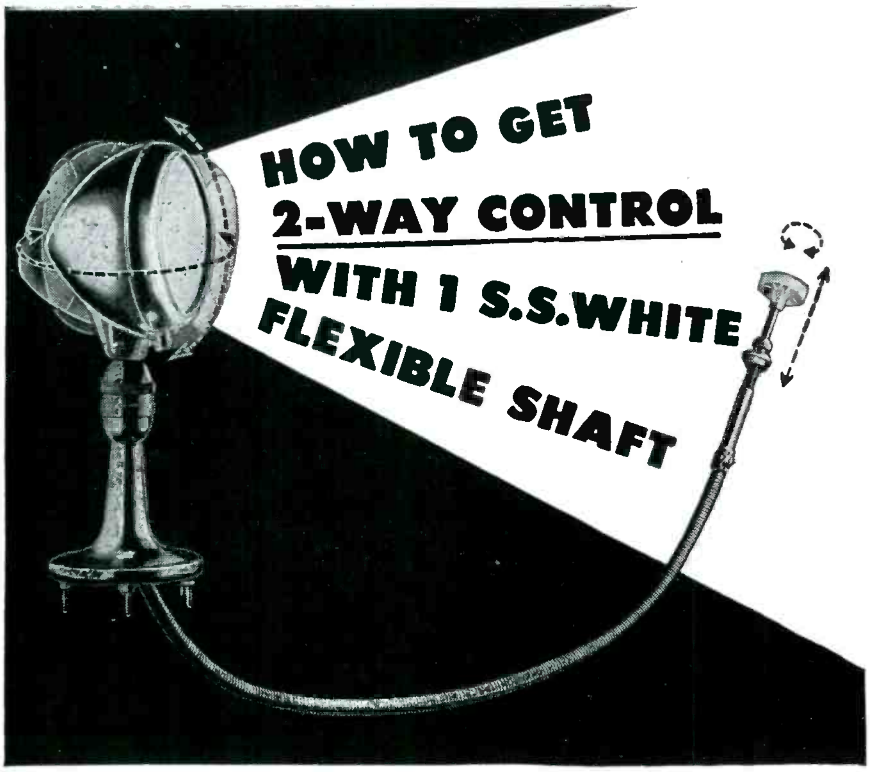
The WG-289 High-Voltage Probe and WG-206 Multiplier Resistor extend the dc range of the WV-77A to 50,000 volts.

The WG-264 Crystal-Diode Probe extends frequency range of the WV-77A to 250Mc.

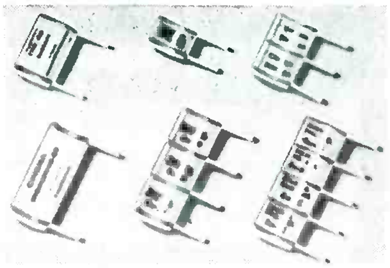
*Reg. U. S. Pat. Off.

RADIO CORPORATION of AMERICA

TEST EQUIPMENT **HARRISON, N. J.**



three-phase, 60-cycle power supply. Weight is approximately 3,600 lb.



Resistors

Cinema Engineering Co., Burbank, Calif., has added BW resistors to its resistor line. The entire series is provided with soldered lugs and have entire range sizes from single section chapron-wound to a 4-section resistor and multi-pi winding in the larger BW-1B type. Resistance values are 1 ohm to 1 megohm. Wattage rating varies from 0.25 to 1 watt. They are available in a variety of resistance wire alloys and impregnation treatments.

Oscilloscynchroscopes

Browning Laboratories, Inc., 750 Main St., Winchester, Mass., announces models ON-5A and ON-5X oscillosynchroscopes, each featuring a sweep system that may be operated in either triggered or recurrent fashion with direct-reading panel calibrations of sweep speed. Sweep writing rates are continuously variable from 1.0 μsec per in. to 25,000 μsec per in. Vertical amplifiers are flat within ±3 db from 5 cycles to 5 mc. Horizontal bandwidth is from d-c to 500 kc. A vertical deflection calibration source of 0 to 2, 0 to 20 and 0 to 200 volts provides a convenient means

Another E-I Achievement!

100,000,000

HERMETICALLY SEALED

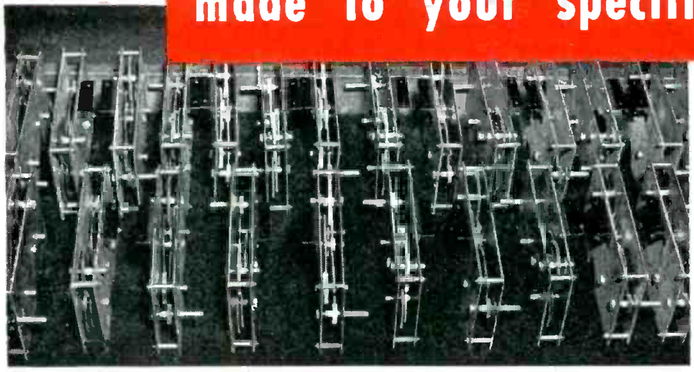
E-I MULTIPLE HEADERS AND SEALED LEADS

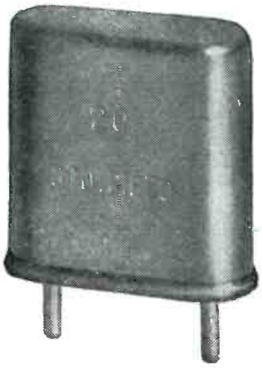
— that's the production record to date for these E-I precision-built components! Positive proof that years of specialized experience delivers a product sufficiently preeminent in quality to generate a permanent flow of repeat orders on practically every initial delivery. Designers and engineers requiring hermetic sealing components, embodying an extra measure of dependability, are invited to contact E-I for complete information. Despite their superiority, costs are competitive with ordinary types. Literature on request.

ELECTRICAL INDUSTRIES INC

E-I INC

44 SUMMER AVENUE,
NEWARK 4, NEW JERSEY

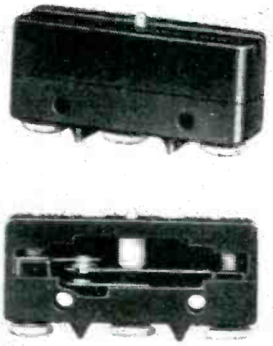




for determining amplitude of vertical input voltages.

A-C Voltage Regulator

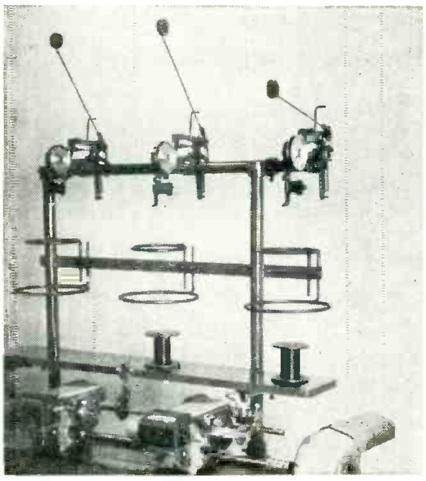
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn., Model 1001 a-c voltage regulator has a regulation accuracy of ±0.01 percent. Input is 95 to 130 v a-c, single phase, 55-65 cycles; output voltage is adjustable from 110 to 120 v a-c. Accuracy is guaranteed at room temperature, for a resistive load, an input variation of ±10 percent, and over a two-to-one load change. The unit contains only four vacuum tubes and no relays. All tube filament voltages are regulated for long dependable life.



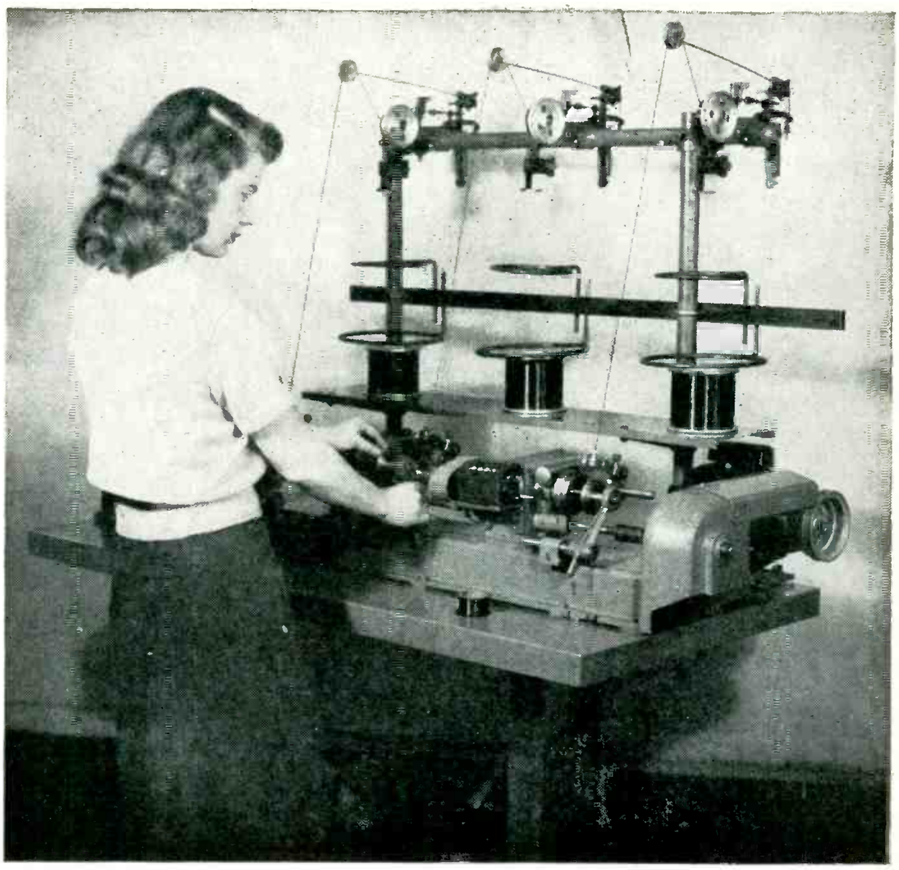
Limit Switch

GENERAL CONTROL CO., 1202 Soldiers Field Road, Boston 34, Mass., has developed the switch illustrated for use in applications requiring a compact, lightweight, long-life limit switch. As a direct-acting switch it has no inherent bounce. Mechanical lost motion, which would delay contact operation, is eliminated because instantaneous contact is made at the same fixed point of repetitive plunger travel. The centrally-located plunger permits easier cam design and acts directly on the long contact spring to insure contact transfer with maxi-

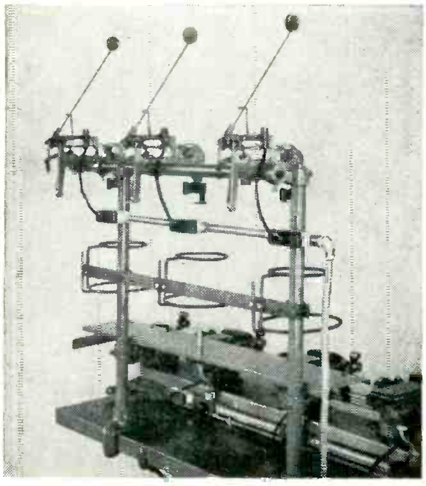
NON-INSULATED COILS WOUND AT 5000 RPM



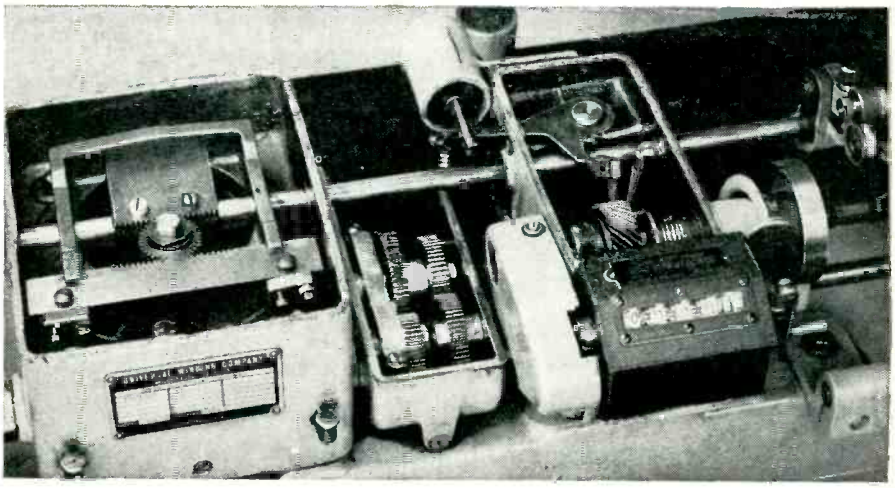
WINDING STARTS INSTANTLY WITHOUT DANGER OF WIRE BREAKAGE with the over-end tension. The first turn can be started tightly against the spool or bobbin head, improving "lay".



WHEN OPERATOR FINISHES manual procedure on one head, another coil will have just been completed. By synchronizing winding and handling time on the No. 102 Universal Hi-Speed Coil Winder, you get maximum production per operator. Coils up to 15,000 turns can as a rule be handled efficiently on a 3-head machine at a maximum of 5000 rpm.



WIRE BREAKAGE DETECTOR is optional equipment for stopping arbor promptly when wire breaks or runs out. This relieves operator of having to watch wire spool continually and prevents counting of turns when wire is not being wound.

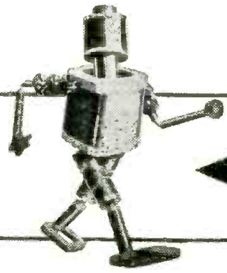


READILY-ADJUSTABLE TRAVERSE MECHANISM permits winding any length of coil from 1/16 in. to 2 13/16 in. without changing cams. A single setting applies to all the winding heads.

Write for Bulletin 102-H

UNIVERSAL WINDING COMPANY

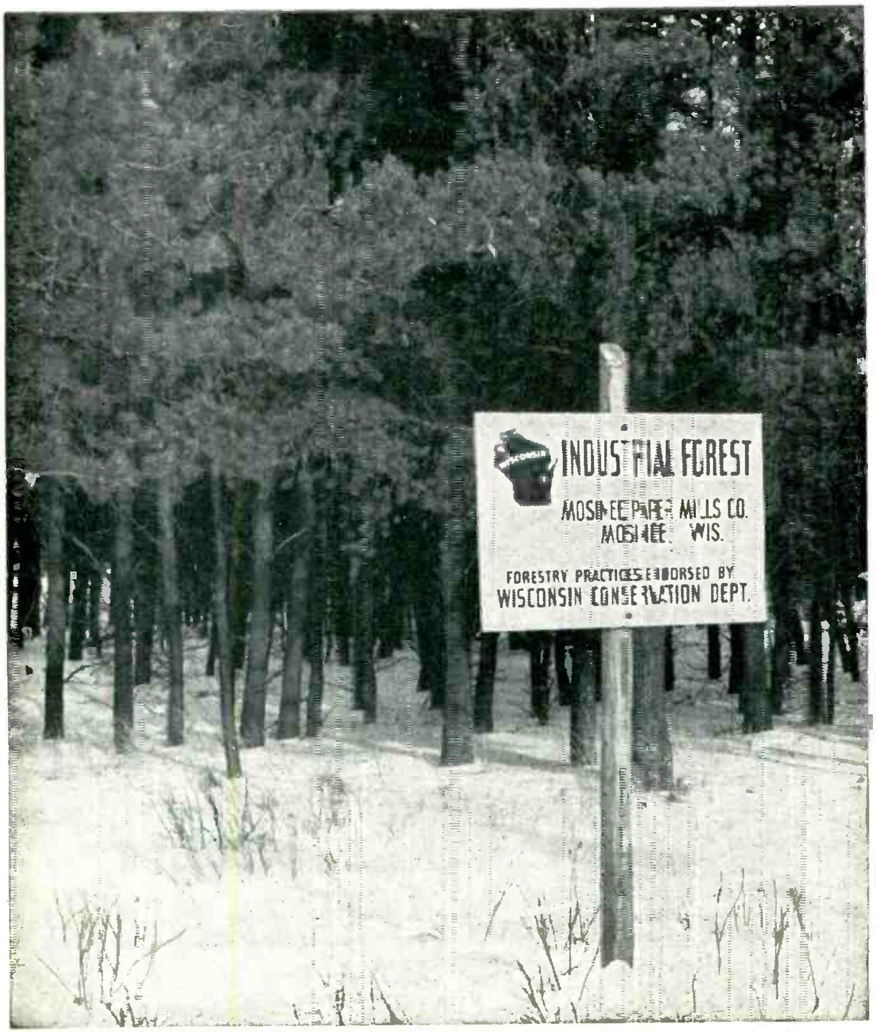
P. O. Box 1605, Providence 1, R. I.



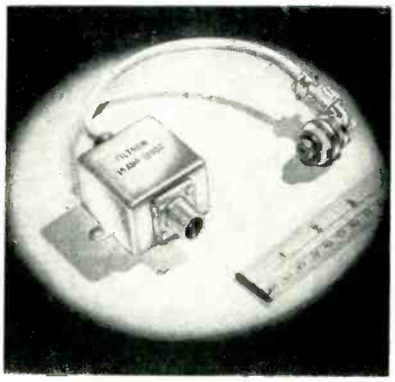
LEESONA ®

For winding coils in quantity accurately . . . automatically use Universal Winding Machines

238.1.J

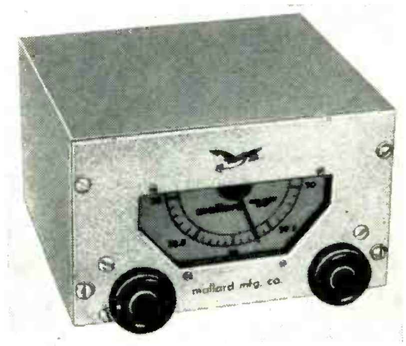


mum spring pressure. Contact arrangement is spdt, spring return. It will handle up to 20 amperes, 125 volts a-c, noninductive.



R-F Interference Filter

The Filtron Co., Inc., 131-05 Fowler St., Flushing, N. Y., announces production of a new 15-ampere, 28-volt d-c, r-f interference filter. The unit is hermetically sealed, with AN connectors, and features high attenuation from 150 kc to 400 mc. It is specially designed for aircraft applications.

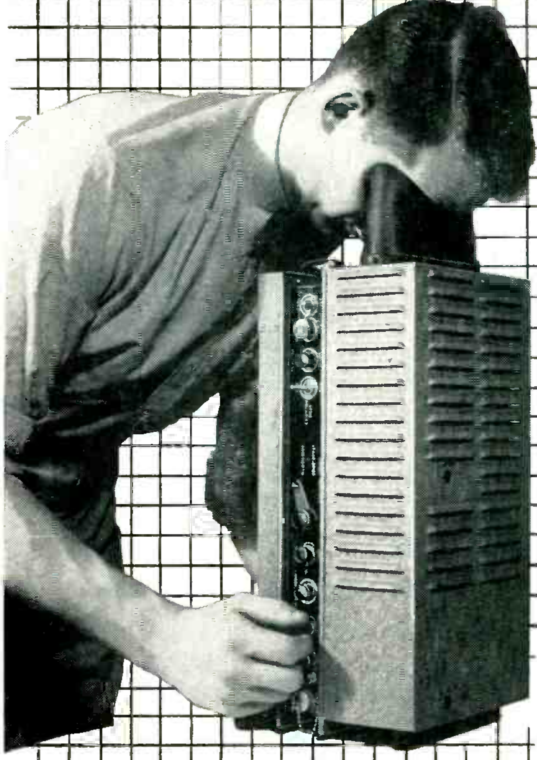


Mobile Converters

Mallard Mfg. Co., 6025 North Keystone Ave., Chicago 30, Ill. Types 10N, 20N and 75N converters, providing improved mobile operation on the amateur bands indicated by the model numbers, utilize 6AB4 oscillators which function efficiently even with low battery voltages common during subfreezing temperature periods. Model 10-20 converter provides operation on both the 10 and 20-meter bands and is available with or without built-in noise limiter. Band switching is accomplished with a new two-position sliding switch board that permits ex-

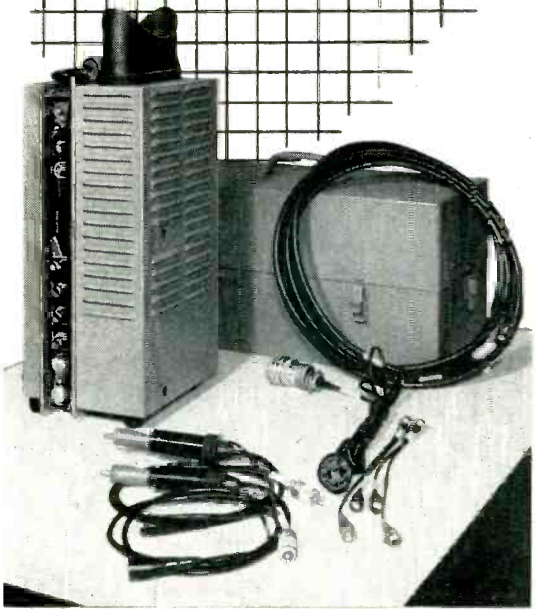
A compact, lightweight, wideband oscillograph...

the DUMONT Type 334-A for...



- field maintenance of microwave, radar, and pulsed systems.
- setting up relay links, transmission line terminations, mobile communication systems, etc.
- testing airborne equipment, as well as testing mobile ground equipment.
- trouble-shooting and maintaining electronic computers, television, telemetering, and associated circuits.

Price $750



The Du Mont Type 334-A is a small, highly portable, wideband oscillograph intended for general field engineering and maintenance.

●

Utilizes Type 2AP1-A cathode-ray tube with a magnifier, and calibrated scale with variable illumination. Produces a trace of high resolution.

●

Both driven and recurrent sweeps are provided in three ranges from 50 to 50,000 cycles per second for recurrent sweeps, and from 280 to 5 μ seconds duration for driven sweeps.

●

Inputs include a high-impedance input with three attenuator positions; a low-impedance position; and a ½-μ second delay line terminated by a 10-step attenuator with a total of 20 db attenuation in 2 db steps, plus a fine gain control. Deflection factor of vertical amplifier at full gain is 0.3 p-p volt/inch with frequency response of amplifier within 30% from 40 cycles to 2.5 MC. Pulse response, 0.14 μ second.

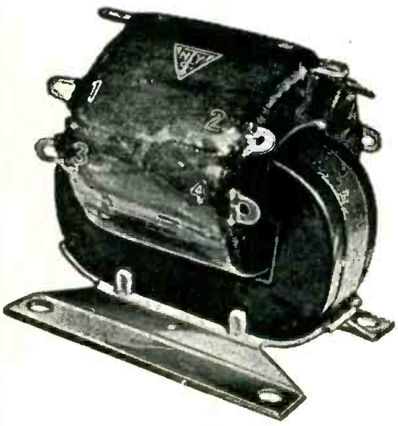
●

Weight: less than 30 lbs. Overall dimensions (including eyeshade): only 8" x 9" x 21". Operates from power source of 115 ± 10 volts at any frequency between 50 and 1200 cycles per second.

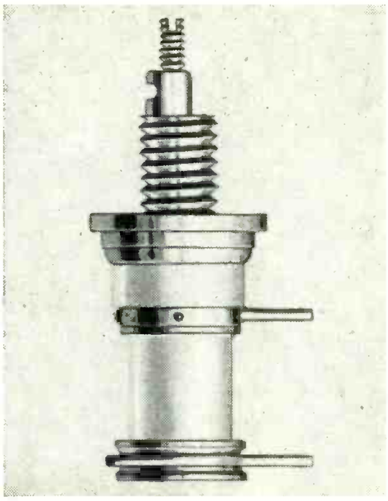
●

In addition to sturdy metal carrying case, Type 334-A is supplied with two probe assemblies, two 10-foot coaxial patching cords, and 15-foot power cord.

ALLEN B. DU MONT LABORATORIES, INC., INSTRUMENT DIVISION • CLIFTON, N. J.

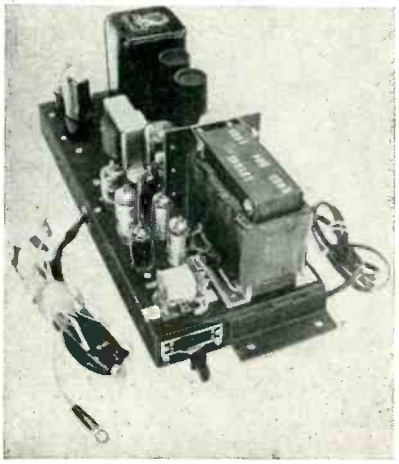


tremely short leads, thus assuring high efficiency for two-band operation. Descriptive literature is available.



Slug-Tuned Coil Form

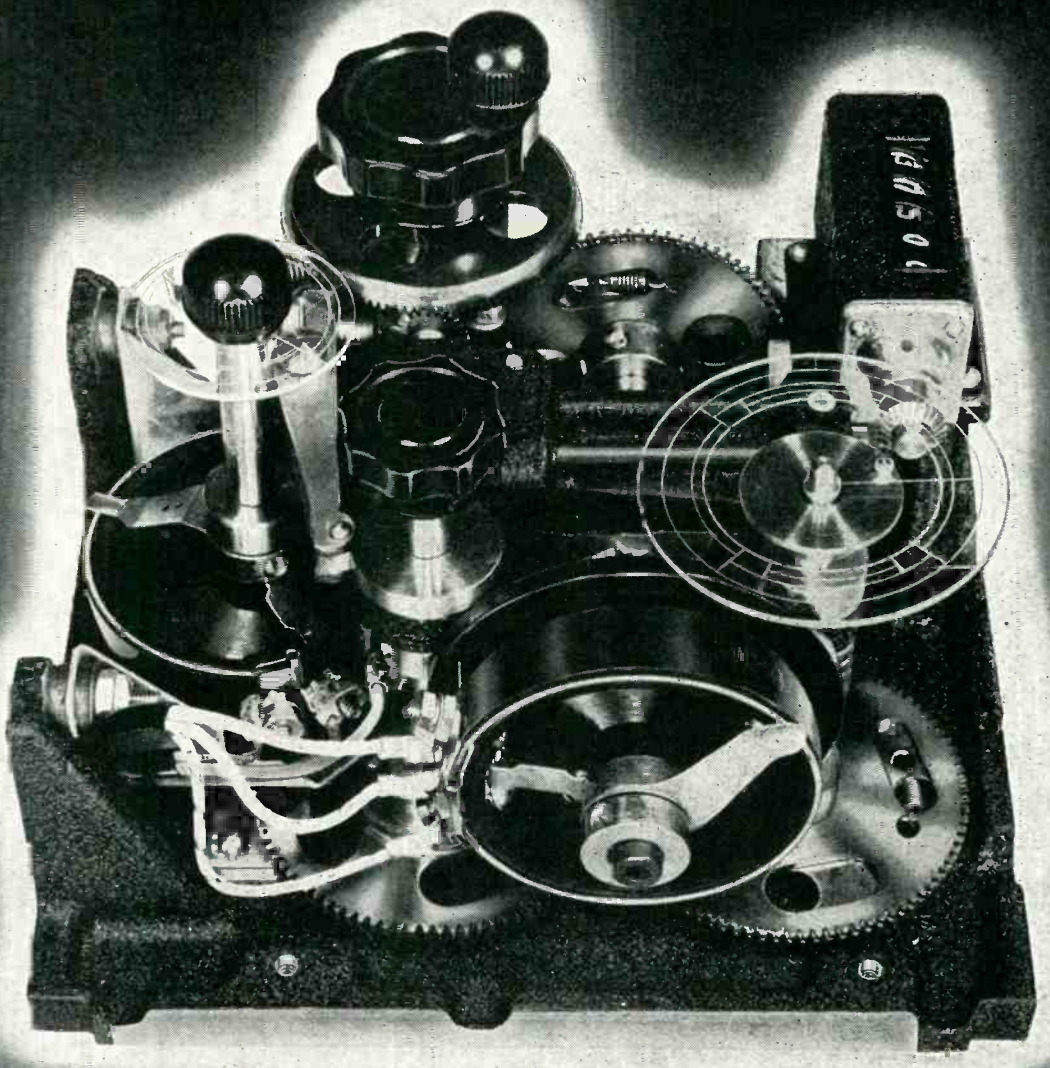
CAMBRIDGE THERMIONIC CORP., 437 Concord Ave., Cambridge 38, Mass. Type LS-8 slug-tuned coil form features silver-plated phosphor bronze clip terminals which cannot loosen. Height is 23/32 in.; maximum diameter, ½ in. Coil form is of grade L-5 silicone—impregnated ceramic. The slug is provided with a spring lock. All metallic parts except clips are cadmium plated. The unit is supplied complete with slug and all mounting hardware.



Milliampere Stabilizer

NORTH AMERICAN PHILIPS CO., 750 S. Fulton Ave., Mt. Vernon, N. Y. A new Norelco MA stabilizer is designed specifically to hold tube

Precision Electro-Mechanical Equipment ...for All Industries



ATLAS OFFERS COMPLETE ENGINEERING, PRODUCTION AND ASSEMBLING FACILITIES

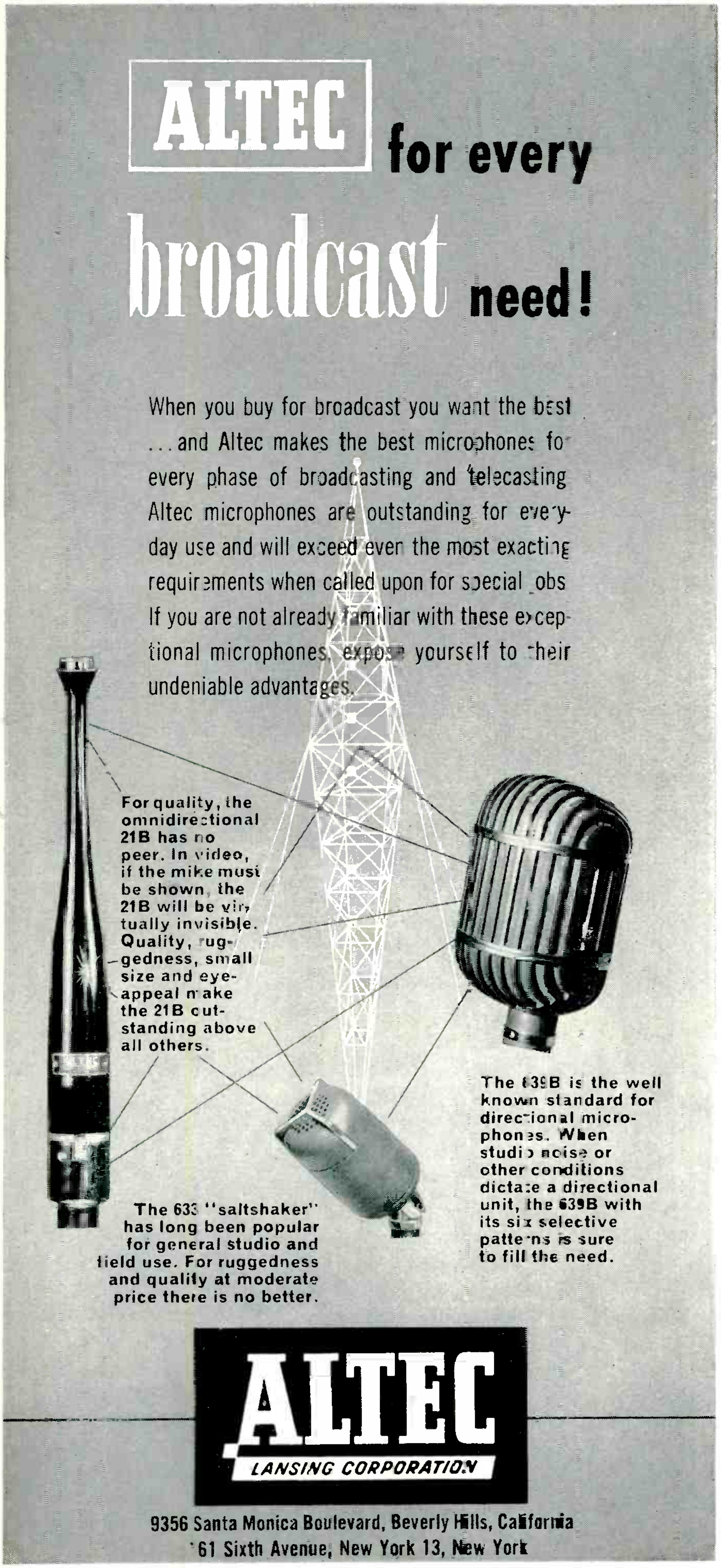
Take an intricate electro-mechanical product in the pilot stage . . ."iron out the kinks". . mass produce it . . . and assemble it with finest precision. That's the service Atlas "Precisioneers" offer American Industry. Extra hands to speed the output of vitally needed products that must be subcontracted.

Atlas has an engineering and development staff capable of designing for mass production. Skilled craftsmen of the high speed machine tools, precision grinders, gear cutters and stamping presses. Experienced and exacting operators are on every assembly line to assure precision finished assemblies.

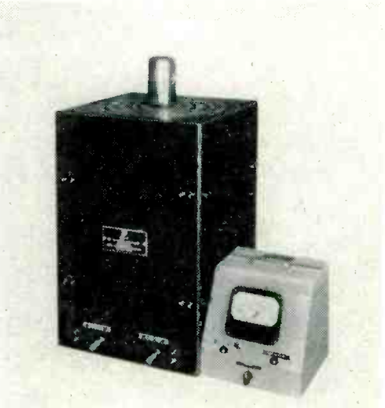
Atlas "Precisioneers" are master craftsmen of every step of the way in producing fine precision electro-mechanical assemblies — all services under one roof, under one responsibility. Whether you need a sub-contractor to mass produce assemblies for you or a source of supply for precision parts, Atlas offers you complete facilities. Speed your production — write for "Precisioneers For Industry."

ATLAS METAL STAMPING COMPANY
KENSINGTON AND CASTOR AVENUES
PHILADELPHIA 24, PENNA.

DESIGNERS ATLAS BUILDERS



current constant at any given setting when used in conjunction with the company's water-cooled x-ray diffraction equipment. For work where extremely constant x-ray tube current is important, the unit will be of great benefit since it has three ranges; 0.5 to 2 ma, 7 to 25 ma and 25 to 50 ma. The three stages are easily selected by means of a three-position lever switch mounted on the end of the stabilizer chassis. Safety circuits are employed which protect the x-ray tube filament from excessive heating and at the same time permit the regulator to be turned on by the main power switch. The stabilizer holds to within 0.1 percent any irregularities in the x-ray tube filament current due to such things as change in contact resistance or change in filament characteristics due to heat.



Kilovoltmeters

Beta Electric Corp., 333 E. 103rd St., New York 29, N. Y., announces the series 111 kilovoltmeters, medium precision units for measuring high voltage d-c up to 200,000 v. They consist of a separate multiplier case and meter cabinet. The meter multiplier is immersed in a large mass of nonhygroscopic wax, enclosed in a Bakelite cylinder. The wax renders the multiplier insensitive to changes of ambient atmospheric conditions. Guaranteed accuracy is 4 percent of full scale over the entire range of the instruments. This includes the 1-percent yearly variations due to ambient conditions. Sensitivity of the 50-kv unit is 20,000 ohms per volt; for the

TEST FOR FORWARD VOLTAGE DROP (ABOVE) REQUIRES ONLY VARIABLE A-C SUPPLY, A-C VOLTMETER AND D-C AMMETER

Easy comparison tests show G-E rectifier quality

TESTS FOR LIFE of high-voltage, G-E selenium rectifiers made on convection-cooled and forced ventilation racks (above) indicate that forward resistance increases less than 6% after 10,000 hours operation.

Make these tests yourself—and you'll keep your product out in front with G-E selenium rectifiers

Most engineers know that metallic rectifiers don't follow Ohm's law. But tests for rectifier quality and operating characteristics are easy to make. General Electric invites you to make these tests, and compare G-E selenium rectifiers with any others on the market today. You'll find G-E rectifiers outstanding in these four important qualifications.

LOWER FORWARD RESISTANCE. This means higher output and cooler operation—plus lower costs in circuit components and design.

LESS BACK LEAKAGE. For higher efficiency, as well as higher output and cooler operation.

COOLER OPERATION. Due to both of the above characteristics; because there's less heat to dissipate, less ventilation is required.

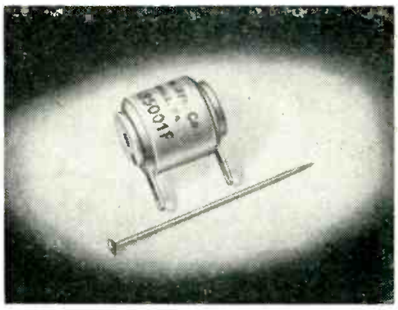
LONGER LIFE. Expected life at rated output: over 60,000 hours!

For details on comparison tests of selenium rectifiers, write for Bulletin GEA-5524 to Section 461-19, General Electric Co., Schenectady 5, N. Y., or arrange for test details and sample units through an authorized G-E agent or your nearest G-E office.

GENERAL ELECTRIC

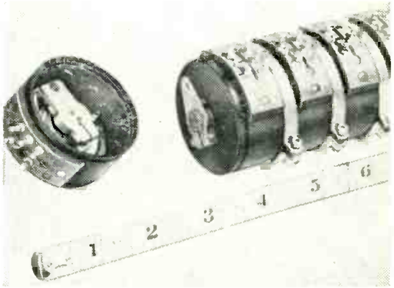
461-19

150 and 200-kv units, 10,000 ohms per volt.



Precision Resistors

SHALLCROSS MFG. CO., Collingdale, Pa., has announced a line of miniature hermetically-sealed resistors with solder lug terminals and designed to meet the requirements of JAN-R-93, characteristic A, style RB11. Known as Akra-ohm type 1180, the resistors are only 19/32 in. long × ½ in. diameter and are rated 0.25 watt at 250 v. Resistance values up to 0.1, 0.3 or 0.4 megohm may be obtained depending on the alloy wire used for the noninductive winding. This and other types are fully described in bulletin R-3b.



External Phasing Potentiometer

DE JUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City, N. Y., has added the C-200 series to its line of precision potentiometers, designed and engineered for precision instrument, computer and military applications. These units are available singly or ganged up to any number, and still maintain the same degree of mechanical and electrical accuracy in any combination of both linear and nonlinear resistance windings. Mechanical rotation is 360 deg continuous and electrical rotation 320 deg ±1 deg. Resistance range is 10 to 200,000 ohms

ALUMINUM SOLDERING REVOLUTIONISED

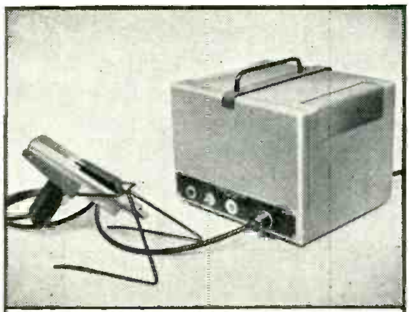
by world's first commercial *ULTRASONIC* soldering equipment

A PRODUCT OF MULLARD LTD.

IS the soldering of aluminum one of your production difficulties? Then here's the biggest — and best — news for you in years. The industrial problem of soldering aluminum and other metals that form refractory oxides has at last been overcome in a practical, commercial form by the use of ultrasonics.

The new soldering equipment developed in the Mullard Research Laboratories destroys oxide film by ultrasonic cavitation and provides a "clean" metallic surface.

The equipment comprises a small electronic amplifier for supplying the ultrasonic power, and a soldering gun. Two controls, a mains switch on the amplifier and a trigger on the gun, make the operation simple.



The Mullard Ultrasonic Soldering Gun and Amplifier. The unit operates from A.C. mains and is robustly made to suit workshop conditions.

No flux is needed and standard soft solders can be used. Unskilled workers can operate the equipment with absolute ease and safety. And, since the ultrasonic frequency employed is inaudible to the human ear, there is no discomfort to the operator.

Here is the practical solution to the tinning of aluminum and its alloys.

You can learn more about the Mullard Ultrasonic Soldering Equipment by mailing the coupon.

Deliveries can now be made immediately from stock.

Mullard

ELECTRONIC TUBES · RADIO · TELEVISION · X-RAY TUBES · LAMPS
SCIENTIFIC INSTRUMENTS · COMMUNICATIONS EQUIPMENT
MAGNETIC MATERIALS · ULTRASONIC GENERATORS

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Shaftesbury Avenue, London, W.C.2, England.

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Century House, Shaftesbury Avenue, London, W.C.2, England.
In USA—International Electronics Corp., 137 Hudson St., New York 13, N. Y.
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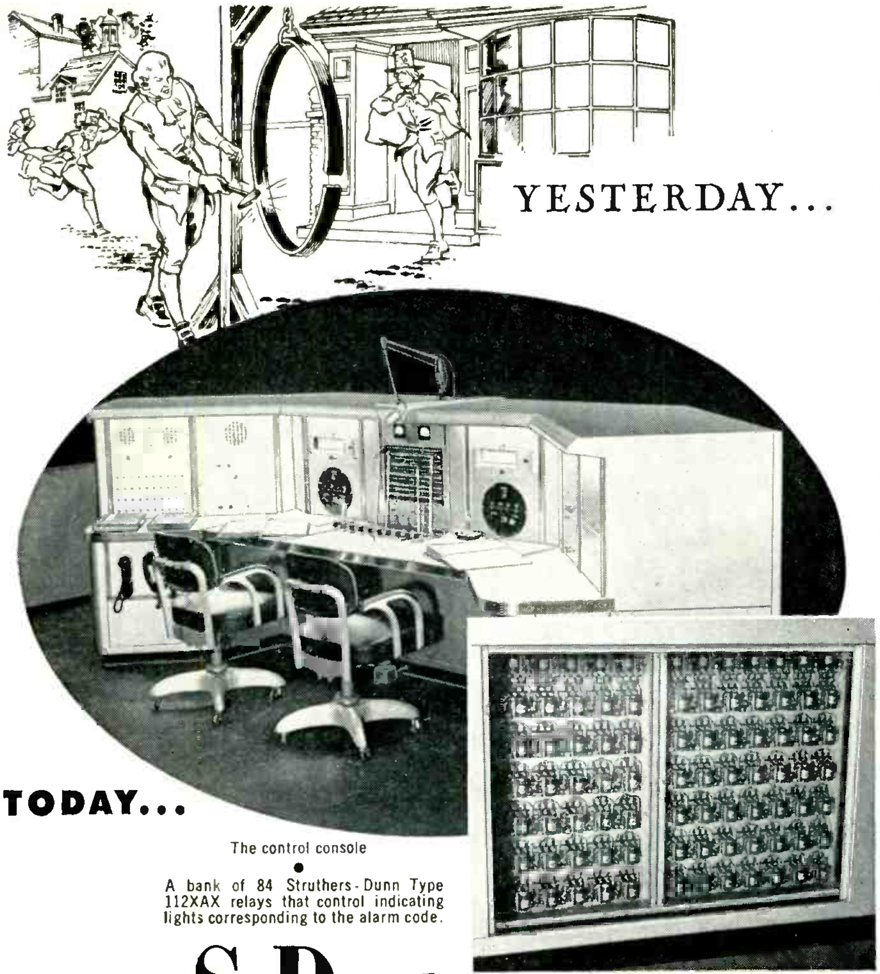
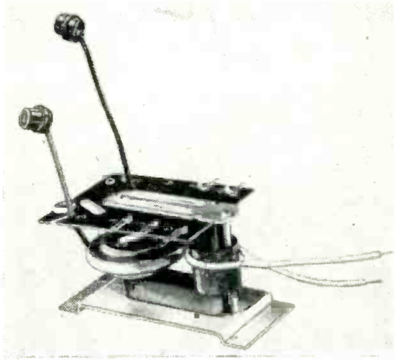
(MRE105)

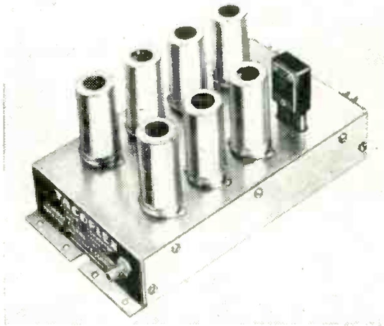


up to ±1 percent. Linearity accuracy is up to ±0.25 percent. The potentiometer is rated at 4 watts. Operational life is 1,000,000 cycles dependent on rating.



TV Autotransformer

RAM ELECTRONICS SALES CO., 7 South Buckhout St., Irvington-on-Hudson, N. Y. Type X054 replacement and conversion tv autotransformer requires less driving power than a true transformer and yet provides ample high voltage and sweep for tube sizes up to 21 in. rectangular. In sets using selenium-rectifier voltage doubler circuits with 250 volts B+ supply, the X054 produces 13.5 kv with a boost voltage of 430 v; with standard power supplies, it produces 15 kv with a boost voltage of 500 v. The unit has excellent regulation and linearity and needs no special coils. Its new high-permeability ferrite core combined with special windings results in good efficiency.



Channel Converter

TECHNICAL APPLIANCE CORP., Sherburne, N. Y., has designed a channel converter for use with the Tacoplex antenna distribution system. It beats the higher channel

VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

MODEL 815

B SUPPLY: 0-600 volts, 200 Ma.

C SUPPLY: 0-150 volts, 5 Ma.

FILAMENT SUPPLY: 6.3 volts AC, 10 Amp., CT.

DC POWER SUPPLY SPECIFICATIONS

REGULATION: ½% for both line (105-125 volts) and load variations.
REGULATION BIAS SUPPLIES: 10 millivolts for line 105-125 volts.
½% for load at 150 volts.
RIPPLE: 5 millivolts RMS.

VOLTS	CURRENT	MODEL
100-325 0-150 Bias 6.3 AC.CT.*	0-150 Ma. 0-5 Ma. 10 Amp.	131
200-500 6.3 AC.CT.	0-200 Ma. 6 Amp.	245
0-300 0-150 Bias 6.3 AC.CT.	0-150 Ma. 0-5 Ma. 5 Amp.	315
0-500 6.3 AC.CT.	0-300 Ma. 10 Amp.	500R
#1 200-500 #2 200-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 6 Amp. 6 Amp.	510
0-500 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	515
#1 0-500 #2 0-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	600
0-500 0-150 Bias 6.3 AC.CT.	0-300 Ma. 0-5 Ma. 10 Amp.	615
#1 0-600 #2 0-600 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	800
0-600 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	815
0-1000-Ripple 10 mv. 6.3 AC.CT.	0-50 Ma. 10 Amp.	1020
0-1200-Ripple 10 mv. 6.3 AC.CT.	0-20 Ma. 10 Amp.	1220
200-1000-Ripple 20 mv.	0-500 Ma.	1250
0-1000-Ripple 20 mv.	0-500 Ma.	1350
Specify your voltage and current requirements. Regulation available .5%, .1%, .01%.		SPECIAL SERIES

*All AC Voltages are unregulated. All units are metered except Models 131 and 315.

All units designed for relay rack mounting or bench use.

The Kepco Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions, within the range of the instrument. Write for specifications.

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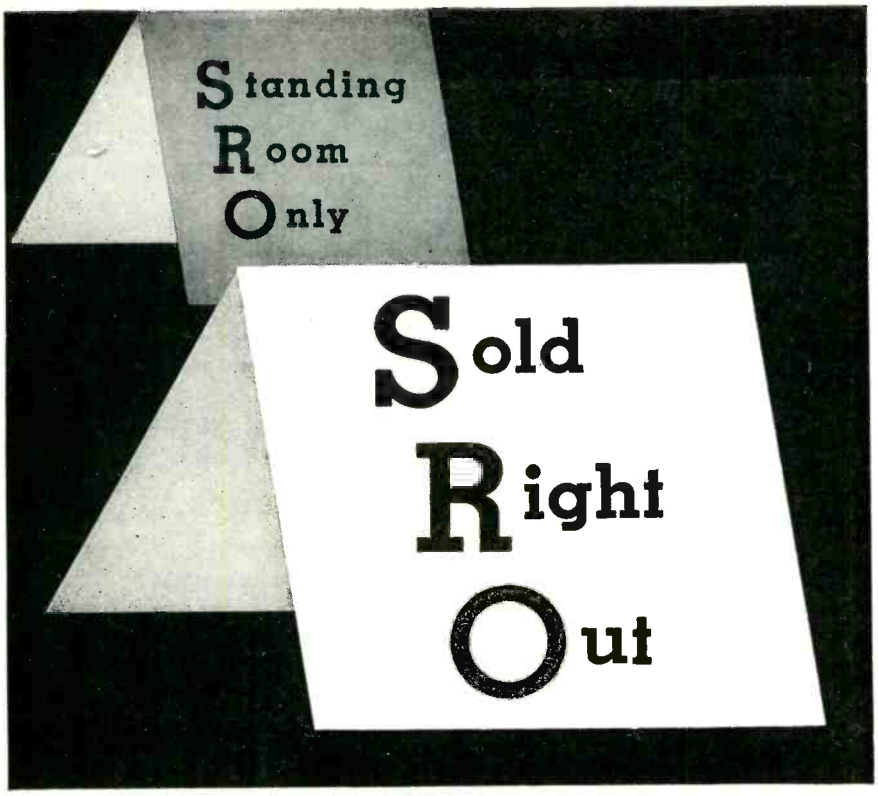
149-14 41st AVENUE • FLUSHING, N. Y.



signals down to a low-band open channel. For example, if channel 13 is operating in a region where the only other channel is 4, the channel converter located at the antenna station converts the signal to channel 2 and transmits that signal through the cables. The receiver operator tunes his receiver to channel 2 to pick up the channel 13 signal. The converting is done by means of a crystal oscillator so that there is no drift in the frequency.

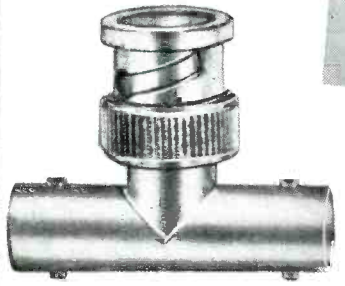
Open-Wire Transmission Line

JFD Mfg. Co., 6101 Sixteenth Ave., Brooklyn 4, N. Y., has developed the Super-Gain open-wire transmission line made of copper wire with a steel core and insulated by sturdy low-loss polystyrene spacers. It delivers ⅙ the decibel loss of regular 300-ohm twinex lead-ins. Excellent for long-line set-ups, it has a 400-lb. breaking point tensile strength. It is being packed on spools in three lengths: 100, 250 and 500 ft.

SWR & R-F Power Meters

M. C. Jones Electronics Co., 96 North Main St., Bristol, Conn., announces a new line of small, portable r-f power and swr meters. Model MM700 series Micro Match operates at power levels of 0.1 to 1,200 watts over the frequency range of 30 to 200 mc. The instrument weighs less than 2 pounds and requires no external source of power. It is desiged for use in making laboratory measurements

BNC CONNECTORS BY KINGS



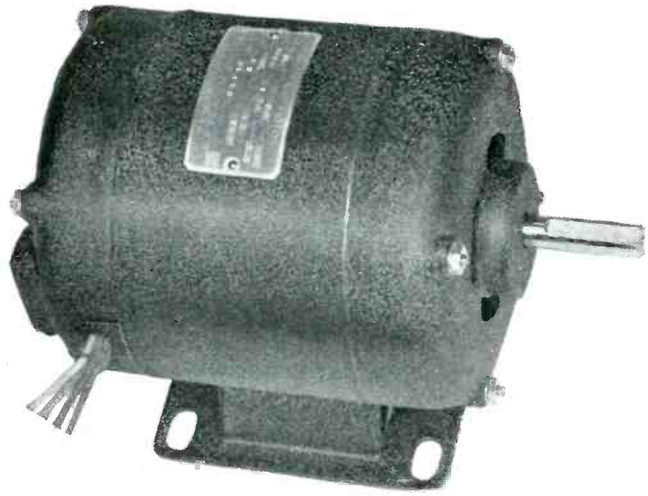
The B N C Connectors shown are small, lightweight Connectors designed for use with small cables such as RG-58/u, RG-59/u and RG-71/u. Widely used for video and aircraft test equipment, they are recommended for frequencies as high as 3000 M.C., where impedance matching is important. The B N C series is used successfully in the region of microwave frequencies.

Whether your connector requirements call for the B N C series, N series, the new C series or special adaptations of standard connectors, you can rely on Kings. Our staff of highly specialized engineers invite your inquiries.

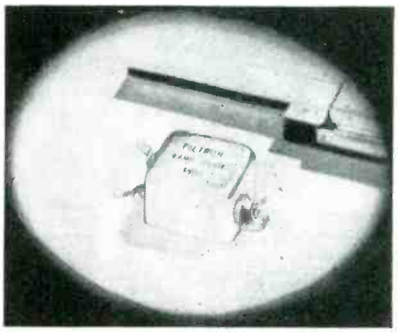
KINGS *Electronics* CO., INC.

40 MARBLEDALE ROAD, TUCKAHOE, N. Y.

IN CANADA: ATLAS RADIO CORP., LTD., TORONTO



and for monitoring both transmitter and antenna performance in the field.



R-F Interference Suppression Filter

THE FILTRON CO., INC., 131-05 Fowler St., Flushing, N. Y., has introduced a smaller and lighter 3-ampere 125-volt a-c, 400-cycle subminiature r-f interference suppression filter. It features high attenuation and is hermetically sealed with glass solder sealed terminals. The unit is designed for 100 C operation.

Portable Radiophone

MOTOROLA INC., 4545 W. Augusta Blvd., Chicago 51, Ill. A new version of the Handie-Talkie portable f-m radiophone incorporates an adjustable squelch that reduces the annoyance of tube and circuit noises normally encountered in an f-m receiver in the absence of a signal. The squelch control, mounted on the power-supply chassis, provides a normal operating range of no-squelch up to 25 to 50-db noise reduction. The portables are available with either wet or dry cell power supplies for operation in

The SELENIUM RECTIFIER DIVISION of *Federal Telephone and Radio Corporation*

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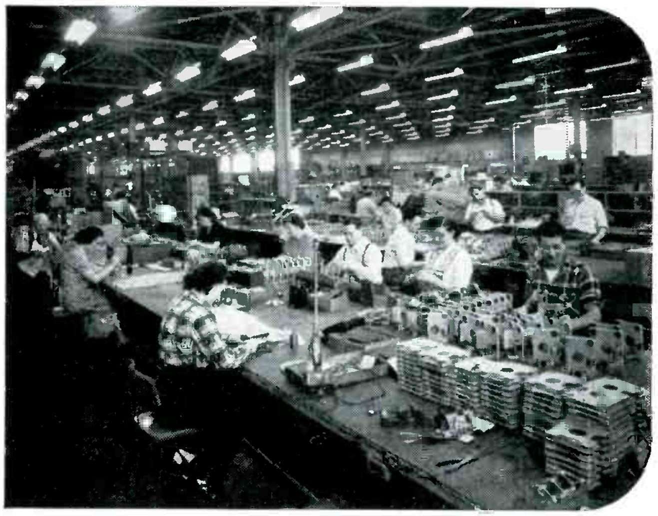

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THE Selenium Rectifier Division of Federal—the nation's headquarters for selenium rectifiers—is ready to serve you with start-to-finish production of power supplies, battery chargers, voltage regulators, engine starters, cathodic protection and other units—compact, rugged, quiet, dependable power equipments designed for *any* DC output.

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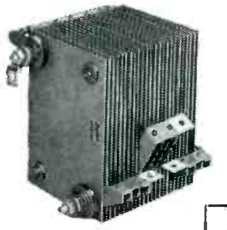
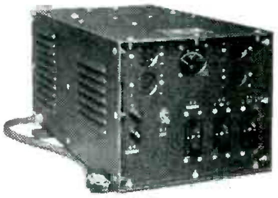
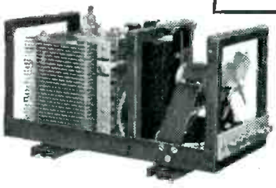


Heavy-duty Federal Selenium Rectifier

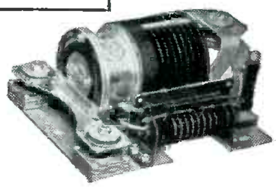


FTR 3414-AS Ground Aircraft Power Supply

DESIGNED AND BUILT BY FEDERAL



FTR 3146-BS Aircraft Power Supply



FTR 3141-CS-03 Clip-in Voltage Regulator

"America's Oldest and Largest Manufacturer of Selenium Rectifiers"

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J. . . . a unit of IT&T's world-wide research and engineering organization.

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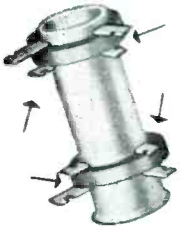
In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.

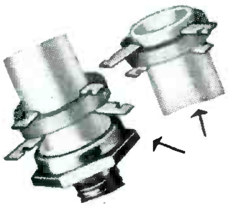
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

C.T.C.'s Nylon-Phenolic Terminal Retainers Mean More Advantages . . . *More Uses* . . . Than Ever Before

In making available ceramic coil forms with nylon-phenolic terminal retaining rings, C.T.C. now enables you to extend your use of these components considerably. The use of nylon-phenolic in no way impairs the moisture and fungus resistant qualities of the coil form assemblies. The nylon rings also provide many new benefits. For example:



Excellent For Bifilar Windings. Four separate terminals, two on each nylon-phenolic ring, mean secure individual connections for each coil lead.



New Advantage For Single Pie Windings. Terminals can be located above or below winding, as required, to shorten wiring to circuit elements.

Soldering Spaces Doubled. Shape of terminals affords two soldering spaces on each, to segregate coil terminations from circuit wiring.

Terminals Held Securely In Place. Firmly cemented nylon-phenolic rings keep terminals in exact position. No sliding up or down.

In addition, the use of nylon-phenolic rings results in an increase in Q, giving improved performance over metallic rings. All materials and finishes meet exacting government specifications. Available with LST, LS5, LS6 coil forms.

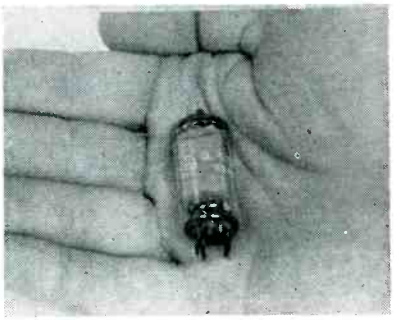
SPECIAL CONSULTING SERVICE

C.T.C.'s experienced component engineers are at your service — without cost — to help you secure exactly the *right* components. When standard parts are unsuitable they will design special units, working closely with you for economical, satisfactory results.

Call on the C.T.C. Consulting Service at any time. Just write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Massachusetts. West Coast stocks maintained by E. V. Roberts, 5014 Venice Blvd., Los Angeles and 988 Market Street, San Francisco, Cal.

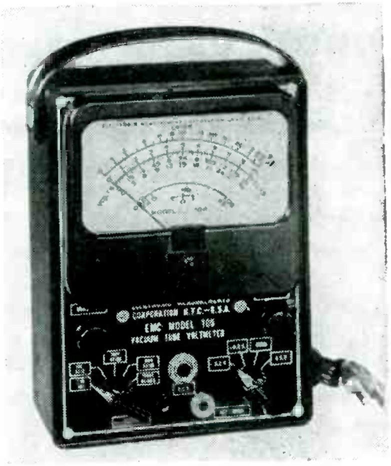
CTC *custom or standard . . . the guaranteed components*

either the 25 to 50-mc or the 152 to 174-mc bands.



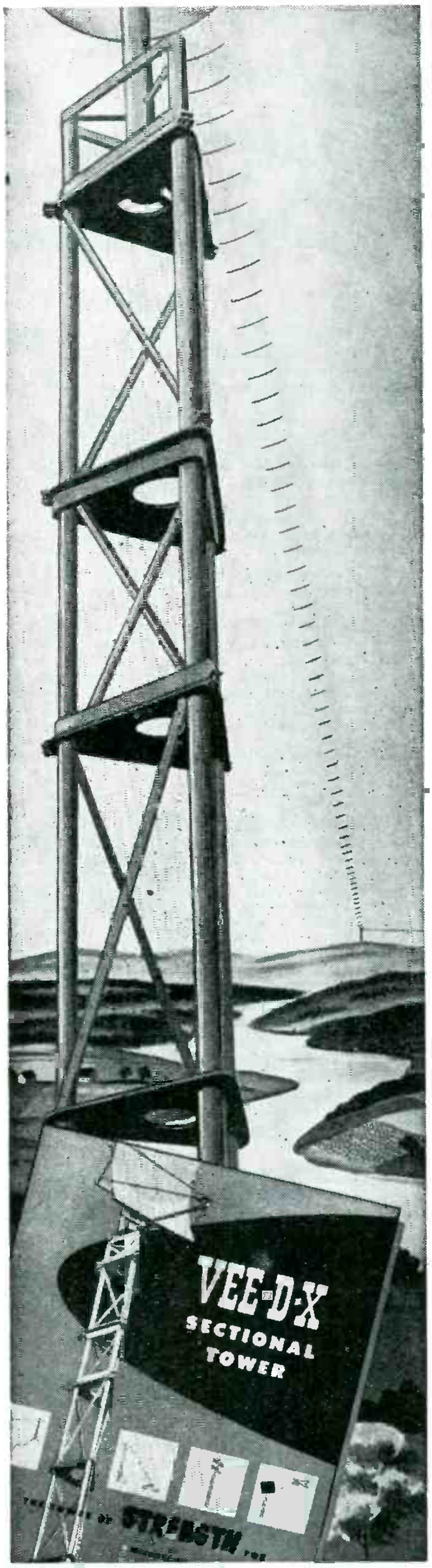
Miniature Thyratron

General Electric Co., Syracuse, N. Y. Type GL-5727 miniature thyratron tube is built for long-life use in mobile and aircraft control circuits. A four-electrode inert-gas-filled unit with negative control characteristics, it is suitable for use in relay and grid-controlled rectifier applications. The tube will operate at temperatures ranging from −75 C to +90 C. It has a high degree of mechanical strength, low grid-anode capacitance and very low grid currant. It is rated for 100-ma average plate current.



VTVM

Electronic Measurements Corp., 280 Lafayette St., New York 12, N. Y. Model 106 vacuum-tube voltmeter is specially designed for field alignment of radio and tv sets, is completely electronic on all functions and ranges and has five a-c/d-c and ohms ranges. Featuring a 1½-v range for both a-c and d-c volts, the instrument is housed in a molded Bakelite case that measures

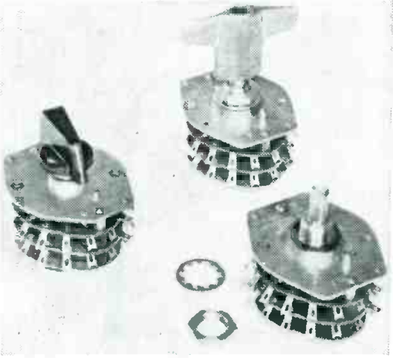


MOST ECONOMICAL
TOWER

for MICROWAVE
COMMUNICATIONS
TV and FM
RADAR

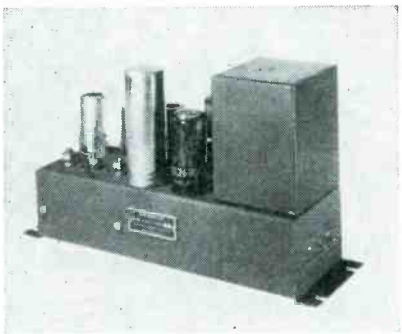
THE LaPOINTE-PLASCOMOLD CORPORATION
Windsor Locks, Connecticut

7¼ × 5¼ × 2⅞ in. with a net weight of 3 lb. Price is $35.90.



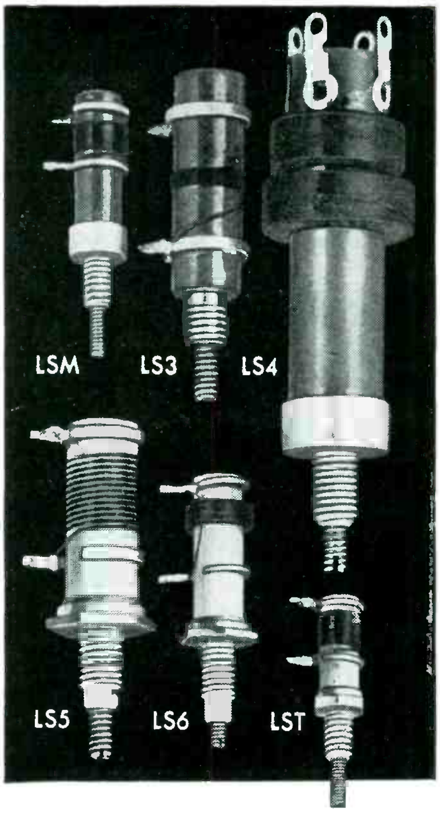
Rotary Selector Switch

United States Instrument Corp., 409 Broad St., Summit, N. J., recently announced a revised line of type JA rotary selector switches designed for applications requiring a large number of contact points with multiple decks and manufactured to meet government specifications. Each deck is self-contained, self-aligning, easily removed and replaced as required. The "O" ring seal on both shaft and mounting bushing allows watertight mounting of each switch. A catalog sheet giving general specifications is available.



Servo Amplifier

Industrial Control Co., 26–02 Fourth St., Long Island City 2, N. Y. Model 410-B is a 60-cycle servo amplifier designed to drive a motor with 5-watt output. In it the three factors of the servo loop (gain, damping and carrier phase) are controlled by slotted shaft potentiometers. This insures that a stock unit can be used in a large number of different applications without requiring additional plug-in packages or assemblies. Specifi-



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C.T.C. will furnish slug tuned coils with either single layer or pie type windings to fit your needs. Small or large production quantities. Coil forms also available.

For military contracts: the materials, methods and processes used in C.T.C. products meet all applicable government specifications.

SEND COMPLETE SPECIFICATIONS
FOR SPECIALLY WOUND COILS

COIL FORM SPECIFICATIONS

Coil Form	Material	Mounting Stud Thread Size	Form O.D.	Maunted O.A. Height
LST°	L-5 Ceramic	8-32	3/16"	19/32"
LS6	L-5 Ceramic	10-32*	1/4"	27/32"
LS5	L-5 Ceramic	1/4-28*	3/8"	1 1/16"
LS8 (not shawn)	L-5 Ceramic	1/4-28	1/2"	23/32"
LSM	Paper Phenolic	8-32	1/4"	27/32"
LS3	Paper Phenolic	1/4-28	3/8"	1 1/8"
LS4†	Paper Phenolic	1/4-28	1/2"	2"

*These types provided with spring locks for slugs.
† Fixed lugs. All others have adjustable ring terminals. LST, LS5, LS6 also available with fixed terminals secured by Nylon collars.
°LSTL same as LST but with slug locking spring.
All ceramic forms are silicone impregnated. Mounting Studs of all forms are cadmium plated.

custom or standard the guaranteed components

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437 Concord Ave., Cambridge 38, Mass.
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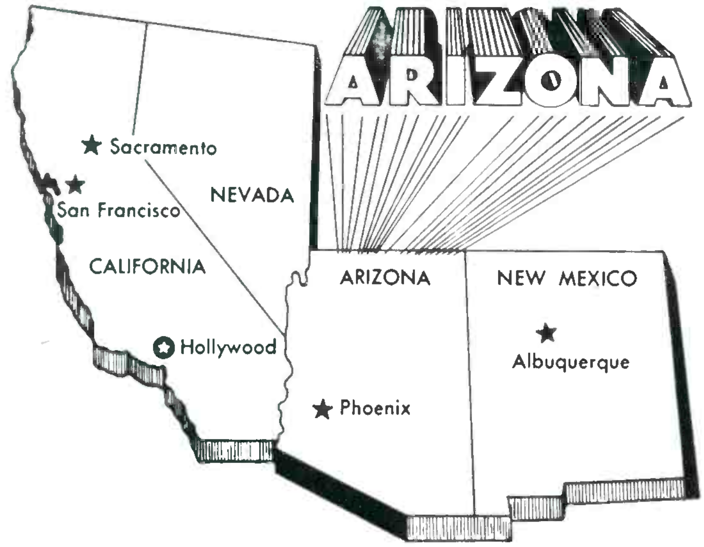

★ To better serve Arizona, we are pleased to announce the opening of our **Phoenix office, 32 West Jefferson Street,** under the direction of **William R. Saxson,** Field Engineer.

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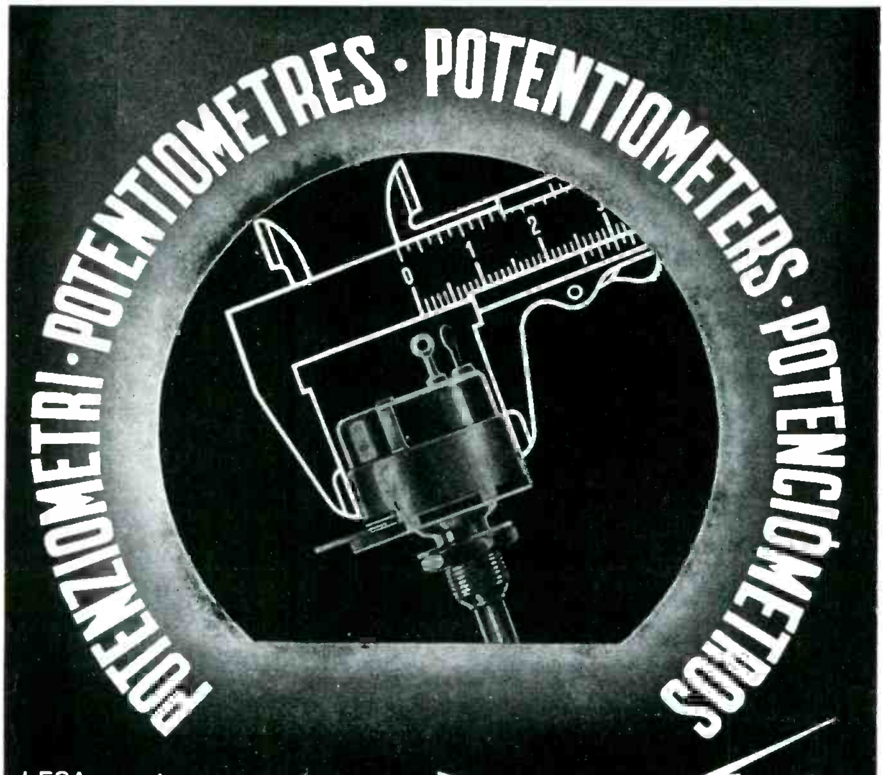

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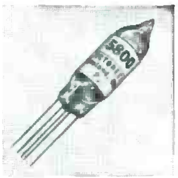
Electrometer Circuit Components

QUALITY
and
ASSURANCE

5800
ELECTROMETER TETRODE



The 5800 is a low filament power, subminiature tetrode designed specifically for electrometer applications. The envelope has been specially treated for low leakage and the emission has been stabilized for DC amplifier applications.

CHARACTERISTICS

Filament Voltage	1.25 v
Filament Current	10 ma

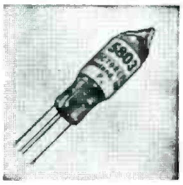
MAXIMUM RATINGS

Filament Voltage	1.5 v
Plate Voltage	50 v
Average Cathode Current	500 μ a

TYPICAL OPERATION

Plate Voltage	+4.5 v
Accelerator Grid Voltage (g_1)	+3.4 v
Control Grid Voltage (g_2)	—3 v
Amplification Factor	1
Transconductance	15 μ mhos
Plate Current	12 μ a
Accelerator Grid Current	300 μ a
Control Grid Current	10^{-15} amp

5803
ELECTROMETER TRIODE



A subminiature triode to supplement the 5800 tetrode. The same high quality construction and testing goes into both these tubes. This tube is useful in one-stage circuits to drive a micro-ammeter or a micro-relay.

CHARACTERISTICS

Filament Voltage (AC-DC)	1.25 v
Filament Current	10 ma

MAXIMUM RATINGS

Filament Voltage	1.5 v
Plate Voltage	50 v
Average Cathode Current	500 μa

TYPICAL OPERATION

Plate Voltage	7.5 v
Grid Voltage	— 1.7 v
Transconductance	150 μ mhos
Plate Current (Zero Signal Condition)	100 μ a
Grid Current	2 x 10^{-14} amp

HI-MEG RESISTORS

Victoreen's Hi-Meg Resistors have been developed for use where stability, accuracy, and high humidity operation are of prime consideration. The resistor element is vacuum sealed in a glass envelope. The glass has been treated with a silicone varnish and the resistor has been aged to prevent drift.

CHARACTERISTICS

	Min.	Max.
Resistance Range*	10^8	10^{12} ohms
Tolerance from your Specified Resistance*	—10	+10%
Tolerance from Labeled Resistance	—1	+1%
Temperature Coefficient	—.06	—.15%/°C
Voltage Coefficient	—0	—.03%/v

OPERATING CONDITIONS

	Min.	Max.
Temperature	—40	120°C
Voltage	.0001	1000v
Relative Humidity	0	98%

*Higher resistance or closer tolerances are available on special request.

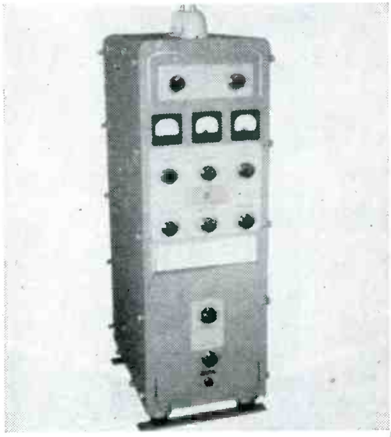
BETTER COMPONENTS
MAKE
BETTER INSTRUMENTS

Victoreen Instrument

Components Division

3800 Perkins Ave. Cleveland 14, Ohio

cations are as follows: maximum gain, 1,000; phase variable from +20 to −140 deg; internal pickup below 3 mv rms; moderate power supply requirements.

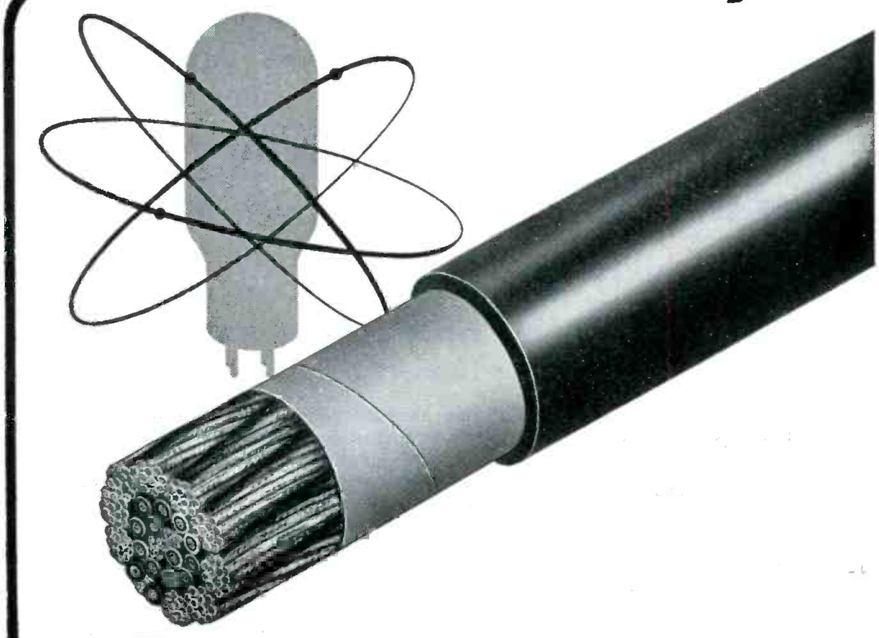


Marine Radio Transmitter

RADIOMARINE CORP. OF AMERICA, 74 Varick St., New York 13, N. Y. Model ET-8019E 200-watt high-frequency radiotelegraph transmitter employs crystal frequency control, using the new type R-6 crystals, permitting greater stability and minimum tolerances. It is designed to cover a continuous frequency range or from 2 to 22.4 mc. Provision is made for a maximum of 10 crystals, although 25 output frequencies may be obtained from only 6 crystals.

Signal Generator

RADIO CITY PRODUCTS CO., INC., 152 W. 25th St., New York, N. Y., has announced the new wide-range model 706A signal generator. The instrument provides high stability and accuracy in continuous coverage of 150 kc to 220 mc. This is accomplished in 8 ranges, 6 being



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Rome Cable can solve your special wiring problem...

The wiring in any electronic device is of vital importance. When complexity of design calls for *exacting* cable requirements, let Rome Cable give you a hand.

Rome's engineering staff, skilled in electronics and backed by competent research, can develop for you the type of cable construction most *exactly* suited to your particular requirement. Rome's manufacturing facilities are sufficiently diversified to produce *exactly* the type of cable you need. Rome's step-by-step control of quality assures you of uniformity and dependability of performance. Take advantage of Rome Cable's experience, as so many others have done.

In addition, Rome Cable manufactures a complete line of standard Underwriters' approved, as well as military type radio and television hook-up wires utilizing both rubber and thermoplastics. So, whatever your wire or cable requirements, look to Rome for dependable quality. For descriptive literature, mail the coupon below today!

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ROME CABLE ROME, N.Y.

S·S·White MOLDED RESISTORS

The All-Weather Resistors

Of particular interest to all who need resistors with inherent low noise level and good stability in all climates


TYPE 65X

Actual Size

STANDARD RANGE
1000 OHMS TO 9 MEGOHMS

Used extensively in commercial equipment including radio, telephone, telegraph, sound pictures, television, etc. Also in a variety of U. S. Navy equipment.

HIGH VALUE RANGE
10 to 10,000,000 MEGOHMS

This unusual range of high value resistors was developed to meet the needs of scientific and industrial control, measuring and laboratory equipment — and of high voltage applications.

SEND FOR BULLETIN 4906

It gives details of both the Standard and High Value resistors, including construction, characteristics, dimensions, etc. Copy with Price List mailed on request.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. R, 10 East 40th St.
NEW YORK 16, N. Y.
Western District Office • Times Building, Long Beach, California

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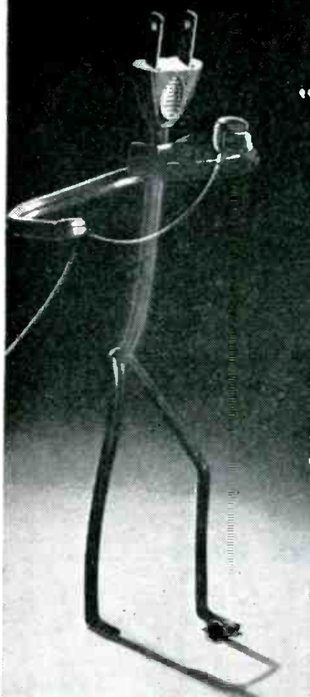
PHALO

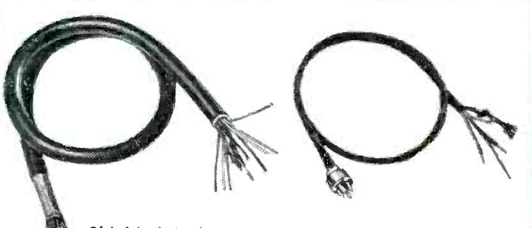


"Current's Favorite Conductor"

Provides Versatile Quality for Mobile Communication!

Year after year, hundreds of thousands of feet of shielded connecting cables bearing the famous "Current's Favorite Conductor" trademark, find their way into the nation's best mobile radio and telephone communication systems.

Phalo builds shielded cables that are as versatile as the systems they connect . . . whatever the purpose, you couldn't find a better quality answer. Next time specifications call for shielded communication cable, call for PHALO and be certain!


Shielded, jacketed mobile communication cable
Braided Assembly

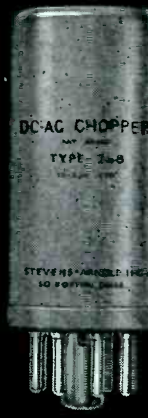
PHALO
Plastics Corporation

Manufacturers of Thermoplastic Insulated Wire, Cables, Cord Sets and Tubing to Government Specifications

CORNER OF COMMERCIAL STREET, WORCESTER, MASSACHUSETTS

DC - AC CHOPPER

A model for every use.
10 — 500 cycles AC
Meets AN Specifications
also 60 cycles
Single pole and double pole
Make-before-break contacts
Contacts in air or in liquid



These Choppers convert low level DC into pulsating DC or AC so that servo-mechanism error voltages and the output of thermocouples and strain gauges, may be amplified by means of an AC rather than a DC amplifier.

They are hermetically sealed, precision vibrators having special features which contribute to long life and low noise level.

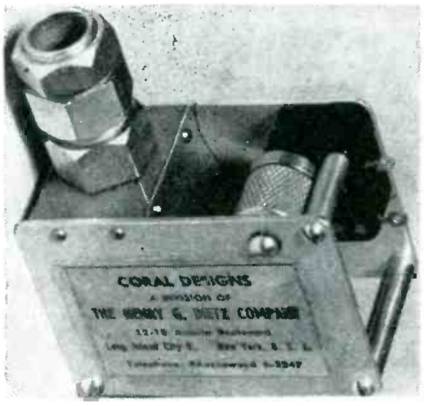
WRITE FOR THESE CATALOGS . . .
#280
10-500 cycles
#246A
60 cycles

STEVENS ARNOLD
INCORPORATED

22 ELKINS STREET
SOUTH BOSTON 27, MASS.

SA-4

fundamental frequencies covering through 55 mc. Accuracy is maintained within 1 percent of calibration. Stability and constancy of calibration is assured by special electron-coupled circuit design, permeability adjusted coils and air-trimmer capacitors.



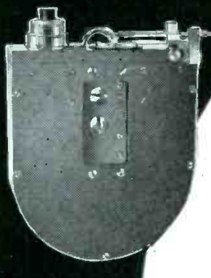
Air Flow Switch

THE HENRY G. DIETZ CO., 12-16 Astoria Blvd., Long Island City 2, N. Y., has announced the Catalog 113 vane-type pressure air flow switch for use in forced air cooling of electronic equipment. It is designed to operate a control relay to guard against tube failure in the event of blower failure or air-passage obstruction. It will operate on a minimum static pressure of 0.2 in. water gage. Electrical ratings of 5 amperes at 250 volts a-c are Underwriters' Laboratories approved. The extreme sensitivity is made possible by the use of a vane traveling in a duct which actuates a sensitive snap-action switch.

Picture Tube Checker

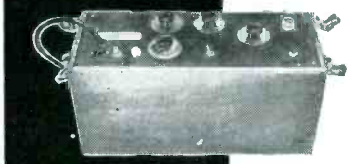
NATIONAL UNION RADIO CORP., Orange, N. J., has available a portable checker for tv picture tubes that uses a beam current test which is proportional to the light output capability of the tube. It provides also for continuity and short checking of the electron gun. The unit checks all magnetically-deflected tubes both electrostatically and magnetically focused, and all electrostatically-deflected tubes. A detailed description of the c-r tube checker may be found in a recently

Edin instruments



OSCILLOGRAPH GALVANOMETER

No's. 8001, 8002, 8003 and 8004 ink-writing galvanometers have sensitivities from 3.5 to 40 volts per cm., resonant frequencies from 15 to 120 cps., resistances from 1000 to 2000 ohms, frequency response up to 350 cps., and a single-jewel pivot construction. Units are designed for multiple operation up to 10 channels in a total width of 12 inches.



DIRECT-COUPLED AMPLIFIER

No. 8100 direct coupled amplifier has a voltage amplification of 13,000 with a maximum output of 70 volts. Frequency response from d.c. to 10,000 cps. is flat within 10%. Input impedance is 2 megohms; output impedance is 150 ohms. Input may range from 0.1 mv. to 100 volts. Stability is better than 0.1 mv. per thirty minutes, or 0.5 mv. per day. Attenuator is stepped for factors from 1 to 1000.

OSCILLOGRAPHS

Recorders can be supplied with 1, 3 or 9 chart speeds ranging from 0.1 mm./sec. to 250 mm./sec. See specifications of OSCILLOGRAPH GALVANOMETER for frequency range.

OSCILLOGRAPH AMPLIFIER

No. 8121 special amplifier has a time constant of 1 second, an exponential response to a square wave at high gain, input impedance of 1 megohm, and input form 0.1 mv. to 1000 volts. At low gain, No. 8121 becomes a DC amplifier with a voltage gain of 100 and an input of 10 mv./mm.

HIGH-GAIN AMPLIFIER

No. 8130 amplifier has a voltage gain of 1,000,000 and includes a built-in pre-amplifier. Frequency response is from 1 to 200 cps. Input may range from 10 microvolts to 100 millivolts. This amplifier is particularly suited for Biological studies.

Many other types of recording and amplifier circuits are available and special equipment can be assembled to meet particular specifications.

EDIN COMPANY, INC.
207 Main Street
Worcester 8, Mass.

Please send complete information on:

☐ RECORDERS
☐ NO. 8121 AMPLIFIER
☐ GALVANOMETERS
☐ No. 8100 AMPLIFIER
☐ No. 8130 AMPLIFIER
☐ .... SPECIAL (Enclose details)

(NAME)

(NO.) (STREET)

(CITY) (STATE)

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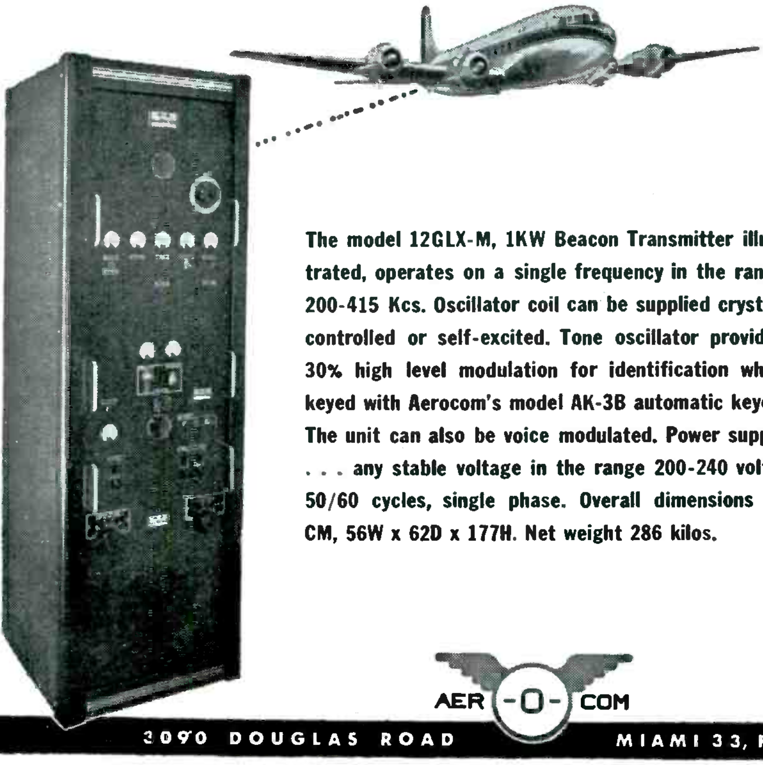
AEROCOM MEANS TROUBLE-FREE SERVICE!
From Ground To Air or Point to Point

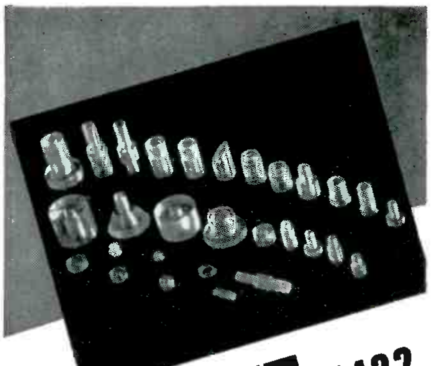


The model 12GLX-M, 1KW Beacon Transmitter illustrated, operates on a single frequency in the range 200-415 Kcs. Oscillator coil can be supplied crystal-controlled or self-excited. Tone oscillator provides 30% high level modulation for identification when keyed with Aerocom's model AK-3B automatic keyer. The unit can also be voice modulated. Power supply . . . any stable voltage in the range 200-240 volts, 50/60 cycles, single phase. Overall dimensions in CM, 56W x 62D x 177H. Net weight 286 kilos.

AER-O-COM

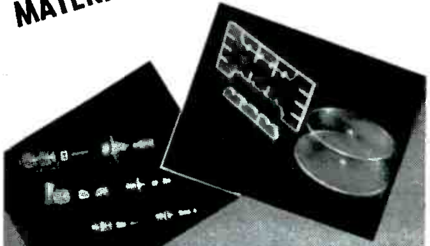
3090 DOUGLAS ROAD MIAMI 33, FLA.

Reg. U.S. Pat. Off.



REXOLITE 1422
(FORMERLY G. E. TEXTOLITE 1422)

COMBINES EVERY DESIRABLE PHYSICAL, CHEMICAL, & ELECTRICAL PROPERTY IN ONE INSULATING MATERIAL FOR U. H. F.



REXOLITE 1422

- Specifically designed to meet the growing need for a U. H. F. insulating material thats low in cost.
- Meets JAN-P-77 and MIL-P-77A specifications.
- Withstands high temperature due to its thermosetting nature.
- Has outstanding electrical properties.
- Has low specific gravity — is strong and rigid with unusually high compressive and tensile strengths.
- Has excellent impact strength and hardness allowing its use under highly abusive conditions.
- Its dimensional stability and unusual chemical inertness allow its use where other materials fail.
- Readily machinable to extremely close tolerances.
- Available as centerless ground rods in any diameter up to 1". Also cast in larger diameter rods and sheets.

Write today for technical bulletins and samples. Our engineering staff is always at your disposal.

Manufacturers of Non-strip wire, High Temperature Electrical Tubing and other extruded plastic products.

THE REX CORPORATION
65 LANDSDOWNE STREET
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The ONLY Complete line of

DECALS
for Electronic use

Decimeter Decals provide the newest, most convenient and economical method for marking electronic equipment.

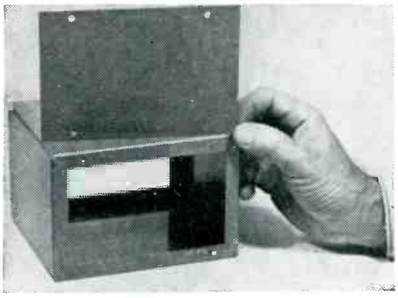
They are easy to apply—no holes to drill—and they adhere to any surface, including wrinkle and crackle finishes. Decals often fit spaces too small for other types of marking. Decimeter Decals are inexpensive—a wide assortment can be stocked for low cost.

Decimeter Decals are printed in neat, opaque letters in a tough, clear protective coating of outstanding durability. They have a high degree of resistance to wear and abrasion. Over 300 different decals are available, including television titles, dial plates, radio titles, call letters and high-voltage signs for safety. Decimeter Decals are of the self-adhering "slip-off" type, and require no cement.

Speedy application plus the low cost of individual Decimeter Decals mean substantial savings in marking any type of electronic equipment. Write for folder 4C which lists complete line available and net prices. We will also enclose handy order form for your convenience in selecting your own assortment.

DECIMETER INC.
1430 MARKET ST. DENVER 2, COLO

published catalog sheet. Price of the unit described therein is $28.75 net.

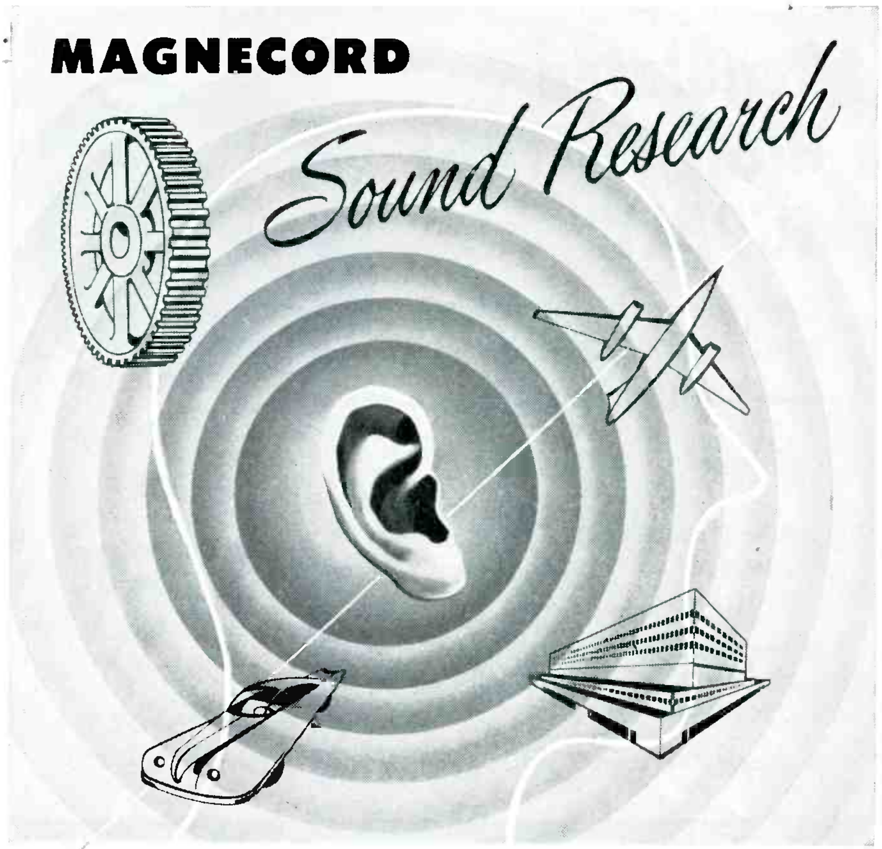


Metal Cabinets

INSULINE CORP. OF AMERICA, 36-02 35th Ave., Long Island City 1, N. Y., has announced a new line of small utility metal cabinets featuring removable front and back covers. Especially intended for amplifiers, monitors, test sets, control units and miniature receivers and transmitters, the cabinets range in size from 4 × 2 × 4 in. to 12 × 11 × 8 in., and are available in aluminum or steel. Covers are fastened by means of self-tapping screws which are included.

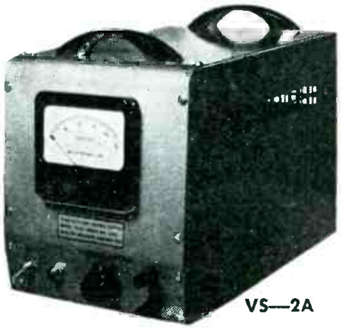
Vacuum Leak Locator

RADIO CORP. OF AMERICA, Camden, N. J., has introduced the type EMV-7 hydrogen-sensitive, ionization type leak locator, designed as a portable factory and laboratory device for detecting and locating tiny leaks during the manufacture of electron tubes or any device that can be evacuated. The instrument, weighing 31 lb, is capable of detecting leaks as small as 1×10^{-5} liter-microns of hydrogen per second. It measures 13¾ in. high, 15 in. wide



Regulated HIGH VOLTAGE SUPPLY

Continuously variable
300—2500 Volts D.C.
0—1 Milliampere


VS—2A

●

- **Line Stabilization:** ± .001% change in output for a ± 1% change in line Voltage (100 UA Load).
- **Load Stabilization:** ± .5% change in output for 1 MA at 2000 Volts or .5 MA at 2500 Volts.
- **Ripple:** Less than .1 Volt.

PRICE

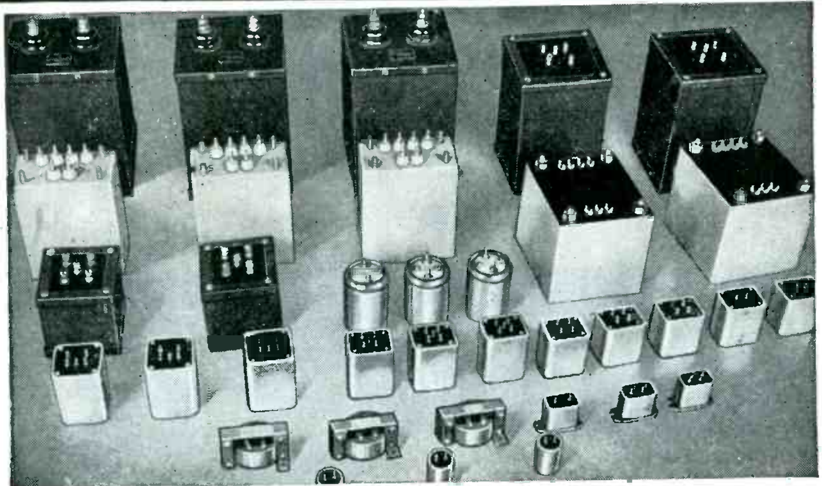
$175.00

WRITE FOR
BULLETIN VS—202

NUCLEAR RESEARCH CORPORATION
2563 GRAYS FERRY AVENUE · PHILADELPHIA 43, PA.

PERFORMANCE TESTED TRANSFORMERS

DESIGNED FOR YOUR NEEDS



QUALITY PRODUCTS PRODUCED IN QUANTITY

ACME ELECTRIC CORPORATION
311 WATER STREET CUBA, N. Y.

Acme ACME Electric
TRANSFORMERS

ONLY SPECIFIC COILS CAN DO THIS JOB-

The components of high altitude airborne radar installations must be extremely accurate because a given voltage jumps a longer distance in the stratosphere where the atmospheric pressure is lower. The focus coil, shown below, goes around the neck of the Cathode Ray Tube and focuses the beam. The nature of its use demands that it meet the most exacting electrical and physical specifications.

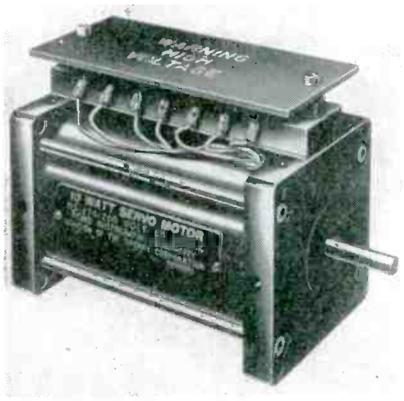
Coto SINCE 1917

Builds Them!

When you need electrical coils, why not take advantage of 34 years of experience, engineering competence, and modern production facilities. Coto coils are built for you, to your specifications.

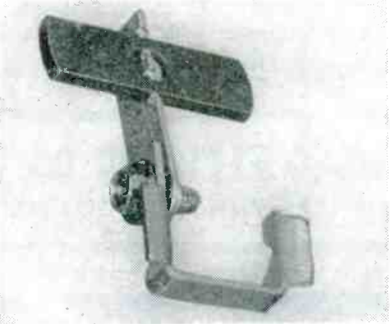
COTO-COIL CO.,INC
COIL SPECIALISTS SINCE 1917
65 PAVILION AVE
PROVIDENCE 5, R.I.

and 11 in. deep overall, and operates from a 105-125 volt, 60-cycle, a-c line.



Servo Motors

FORD INSTRUMENT CO., 31-10 Thomson Ave., Long Island City, N. Y., is now producing a complete line of low-inertia servo motors with high-voltage control windings that eliminate the need for transformers in servo amplifiers. Available in ½, 1½, 5 and 10-watt sizes, the motors also have close-coupled windings for feedback purposes. Of particular significance is the space and weight saving resulting from the elimination of the transformer. A descriptive brochure is available upon request.



TV Picture Straightener

GLASER-STEERS CORP., 2 Main St., Belleville 9, N. J., has introduced a magnet assembly for correcting a pin-cushioning effect caused by the deflection yoke and the curvature of the tube face. From one to four of these assemblies are used, depending upon the amount of distortion. The units are mounted on the conical section of the tube forward of the deflection yoke. The device is especially effective when used

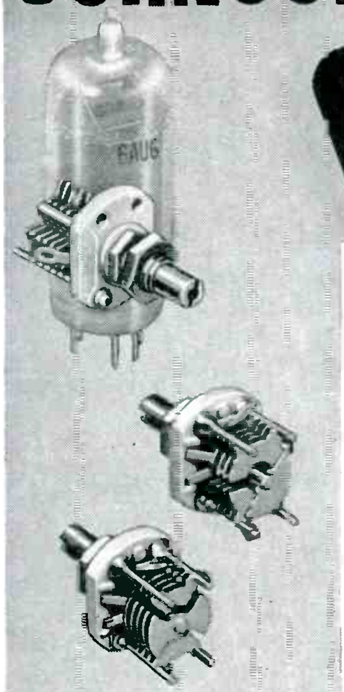
JOHNSON miniature air variables

SMALL!

2200 per cubic foot
41 weigh just a pound

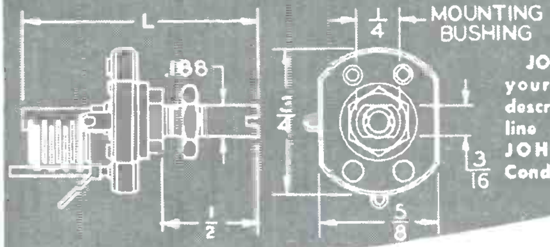
Requiring a panel area just ⅝" wide by ¾" high, these diminutive capacitors provide the answers to many problems encountered in the design of compact radio frequency equipment.

JOHNSON Miniature Air Variables are available in three types: single section, differential and butterfly. Ideally suited for portable, mobile and airborne equipment thru the VHF range of frequencies, they are designed and constructed with features that assure reliable performance throughout long service life.



Features

● Low inductance ● Soldered plates assembled with precision tools ● Split sleeve bearings ● Beryllium copper tension spring contact for permanent alignment, constant torque and low inherent noise ● Differential and butterfly types electrically symmetrical ● Excellent vibration characteristic due to low inertia ● Steatite insulation impregnated with DC-200 ● Metal parts brass, nickel plated ● Single hole mounting bushing threaded 1/4-32 with flats to prevent turning ● 3/16" shaft slotted for screw driver adjustment ● Plate spacing .017" ● Peak voltage rating, 1250



JOHNSON Catalog 701, yours for the asking, describes this miniature line as well as other JOHNSON Variable Condensors.

JOHNSON Miniature Air Variables are available in production quantities with features such as: 1. Locking bearing. 2. With 180° stop. 3. Various shaft extensions. 4. .035" spacing offering capacities up to 30 mmfd. 5. High torque.

We would be pleased to quote on your special requirements.

Cat. No.	Nominal Max.	Capacity mmf. Min.	Number Plates	L
SINGLE				
5M11	5.0	1.5	5	1- 7/64
9M11	8.7	1.8	9	1- 7/32
15M11	14.2	2.3	15	1-13/32
20M11	19.6	2.7	21	1-37/64
DIFFERENTIAL				
6MA11	5.0	1.5	7	1- 7/64
9MA11	8.7	1.8	13	1- 7/32
15MA11	14.2	2.3	22	1-13/32
19MA11	19.6	2.7	31	1-37/64
BUTTERFLY				
3MB11	3.1	1.5	7	1- 7/64
5MB11	5.1	1.8	13	1- 7/32
9MB11	8.0	2.2	22	1-13/32
11MB11	10.8	2.7	31	1-37/64

E. F. JOHNSON CO.
WASECA, MINNESOTA

Bowser High Altitude Test Chambers furnish complete yet compact facilities for the testing of aircraft instruments and equipment at any and all altitudes. Included in the chamber are provisions for testing under wide conditions of temperature ranging from +200°F. to —150°F., as well as relative humidity from 20% to 95%. Bowser Test Units produce conditions within the limits called for in all Government environmental testing specifications.

Bowser makes the only complete line of testing facilities including Sand and Dust, Explosion, High and Low Temperature, Fungus, etc. Units are available from small self-contained laboratory sizes to large prefabricated walk-in rooms. Our Engineering staff is always ready for consultation. Take advantage of Bowser's long uninterrupted experience, the broadest in its field.

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Send information on test equipment checked:

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9

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- **Bakelite Bobbin**
- **Cotton Interweave**
- **Coils for High Temperature Applications**

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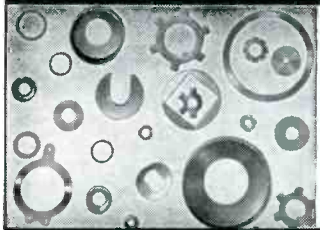
From simple electrical coil winding to specially treated coils, Dano can supply the exact coils you need to do your exact job. That's why experienced engineers with an eye toward uninterrupted production specify Dano coils.

DANO

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

WASHERS—ALL KINDS



WASHER SPECIALISTS for nearly half-a-century. Dies in stock will produce most sizes. Big runs made with automatic presses. An economical, accurate, and highly reliable source for washers, also all kinds of metal stampings. HAVE WHITEHEAD'S CATALOG ON FILE; write for it.

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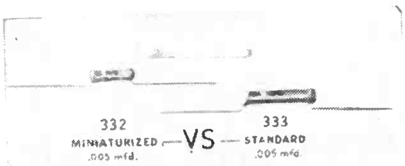
SQUARE HOLE
STAR LOCK
THRUST
TONGUE

EST. 1903 **WHITEHEAD STAMPING COMPANY**

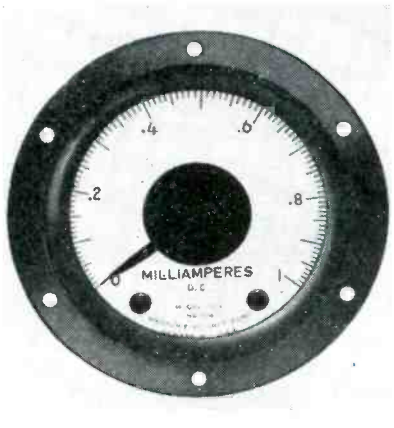
1691 W. LAFAYETTE • DETROIT 16, MICH.

with the cylindrical faced tube. Adjustment is easily made by varying the distance from the magnet to the tube axis.



Miniature Ceramic Capacitors

ERIE RESISTOR CORP., Erie, Pa., has announced a new line of miniaturized tubular ceramic capacitors, the GP3 Ceramicons. They employ a high dielectric constant ceramic material with which capacitance values as high as 0.002 µf are available on a basic ⅛ × ⅜ in. long tube, and 0.005 µf on a ⅛ × ⅝ in. long tube. Available on special order since 1949 they are now made in volume production quantities. The units are flash tested at 1,500 v d-c and are designed to withstand 700 v d-c life test at 85 C for 1,000 hours. Standard capacitance tolerance is + 80 percent, − 20 percent and power factor is 2.5 percent maximum.



Sealed Panel Instrument

WESTON ELECTRICAL INSTRUMENT CORP., 641 Frelinghuysen Ave., Newark 5, N. J. Model 1329 2½-in d-c and a-c rectifier-type panel instrument has a scale of 3.7 in. over a 250-deg deflection. The six mounting holes provided permit tight sealing of the instrument to the panel. The instrument is magneti-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Buy 1 unit or thousands
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WRITE for "MR. FED", Federated's house organ, containing latest JAN news, availability reports, etc. Send us the names of your engineers, dep't. heads on your letterhead and we'll include them on our mailing list.

FREE to PURCHASING AGENTS, CHIEF ENGINEERS!

NEW 1952 OFFICIAL PARTS & EQUIPMENT MANUAL OF THE RADIO, TELEVISION & ELECTRONIC INDUSTRY. RADIO'S MASTER — 16th edition
1,100 pages, over 7,000 illustrations, specifications and prices cross-indexed. Publisher's price $6.50.
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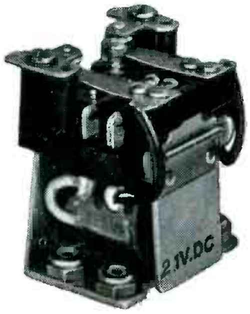
That Meets Exacting Requirements



AMRECON

TYPE: DOS

THIS LIGHTWEIGHT, COMPACT RELAY CAN HANDLE POWER LOADS USUALLY DEMANDING LARGER, HEAVIER UNITS

Tiny . . . but powerful! This general-purpose relay meets rigid aircraft requirements, and also has wide industrial application. Coils are normally rated at 2.5 watts d. c., or 3 watts, 60 cycle a.c., for voltages up to 230 volts d.c. or 440 volts a.c. Maximum standard contact combination, double-pole double-throw—others on request. Contact rating, 15 amps—at 115 volts a.c. non-inductive or 32 volts d.c. Weight, 4 oz. Size, 1-7/8″ high, 1-5/8″ wide, 1-13/32″ deep.

ALSO HERMETICALLY SEALED TYPES

WRITE FOR CATALOG R-10

American Relay & Controls, Inc.
4911 W. Flournoy St., Chicago 44, Ill.

HEAT RESISTANT WIRES FOR EVERY APPLICATION . . .

KEEP THE LINES OPEN

Keep the pipe line flowing
Even though the cold wind's blowing
And rest assured the oil will run
If your pipes and lines are protected by Lewis heating cable.
Nickel Chrome conductor and special insulation good to 500°F.

Write us about your problem

HEATING UNITS

HEATING ELEMENT

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Moisture Meter

TAGLIABUE INSTRUMENTS DIV., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. Model 8008 Moisturonic moisture meter, a portable instrument featuring an overall range of from 2,000 ohms to 20,000 megohms, measures the moisture content of lumber, wood, plaster, and many other materials of varying textures and consistencies. The instrument is available in two forms: one with a scale calibrated for use with lumber, wood and plaster and the other with linear graduations for use with materials for which no calibrations have been determined. Both versions are available as either battery operated for use anywhere, or are furnished to operate on 115 v, 60 cycles a-c.

Literature

D-C Winding-Insulation Tester. General Electric Co., Schenectady 5, N. Y. Bulletin GEC-794 describes a d-c winding insulation tester for testing d-c armatures, series field coils and low-impedance a-c stator coils. Illustrations of the unit, its chief advantages, operating instructions and specifications are given.

Audio Amplifier. Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y. A recent four-page folder de-

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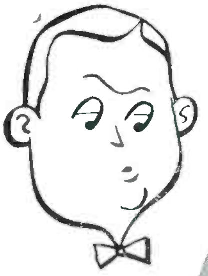

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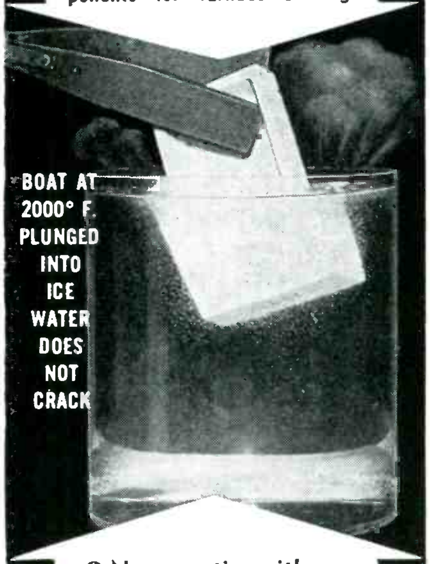

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scribes and illustrates the A-20-5 ultrahigh fidelity remote-control audio amplifier, featuring a continuously variable treble cutoff filter. Chief features and applications, photographs and characteristics charts are shown. Technical specifications are included.

Instrumentation Bulletin. Berkeley Scientific Corp., Richmond, Calif., has issued an 8-page bulletin illustrating and describing a cross-section of a complete line of standard instruments. Included are electronic counters, events-per-unit-time meters, time interval meters, preset counters, auxiliary electronic devices, nuclear scalers, count rate meters, counting rate computers, hand and foot monitors and single or double pulse generators.

Servomechanism Techniques. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Ave., Philadelphia 44, Pa. Practical applications of servomechanism techniques to a process control problem are described in a 20-page bulletin—ISA paper No. 51-8-2. The paper reviews progress in analysis of automatic control problems and illustrates a new technique exemplified by solutions to a typical flow control problem.

H-F Generators. Bogue Electric Mfg. Co., 50 Iowa Ave., Paterson 3, N. J., recently issued bulletin 440 dealing with 400-cycle power supplies designed for operation of all types of high-speed machine tools, testing of precision electronic equipment, testing and proving radar and aircraft equipment, operation of high-frequency motors, marine and aircraft power supplies, high-quality laboratory power supplies and many other uses. A line of 400-cycle generators and motor generator sets, available from 100-w output to 600-kw output, either single or three phase, is described.

Ultralow-Torque Potentiometers. Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y., has published a 4-page folder for loose-leaf binding, describing and

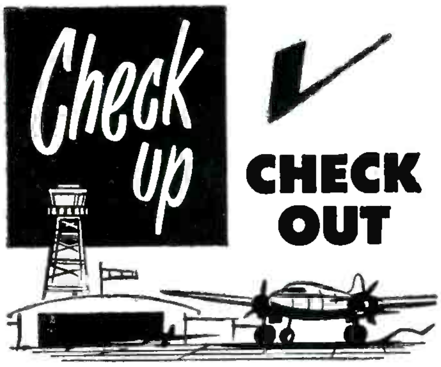
illustrating the type 1395 precision ultralow-torque potentiometers that are designed for use as transmitters in indicating or control (servo) circuits. The units described are used to convert small mechanical movements of very low force into equivalent voltages, the high electrical output usually being sufficient without further amplification. Complete technical specifications are included.

Subfractional H-P Motors. Air Marine Motors, Inc., 2183 Jackson Ave., Seaford, L. I., N. Y., has available a pamphlet covering subfractional horsepower motors, their end applications and selection. The publication was prepared with an eye toward discussing the problems pertaining to design and use of subfractional h-p motors in as complete a manner as possible without being too technical to reach and educate personnel unfamiliar with the more important aspects of problems in the rotary equipment field.

TV Picture Tubes. National Union Radio Corp., Orange, N. J., has available two data sheets dealing with the 21EP4A magnetically-focused magnetically-deflected and the 21FP4A electrostatically focused magnetically deflected tv picture tubes. Data given include general characteristics, maximum ratings, typical operation, maximum circuit values and mechanical information.

C-D Communication Equipment. General Electric Co., Syracuse, N. Y., has issued a folder containing eight technical data sheets on two-way f-m radio communication equipment for civil defense. Illustrated descriptions and specifications are included for remote dispatch units, a variety of station combinations, model 204 mobile combination, a selective dispatching system and two types of civil defense receivers. Other technical data sheets may be added to the folder as they are published.

Vibration Discriminator. Lion Mfg., Inc., P. O. Box 1348, Columbus, Ohio. The model AFS-101 vibration discriminator discussed



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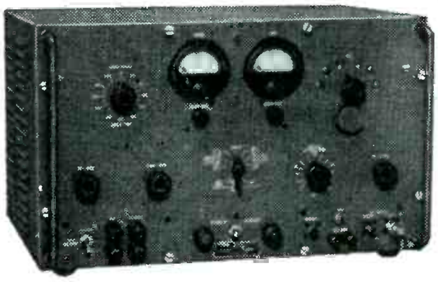

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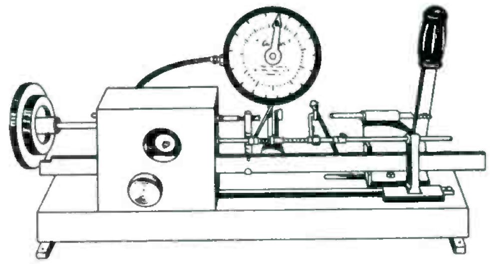

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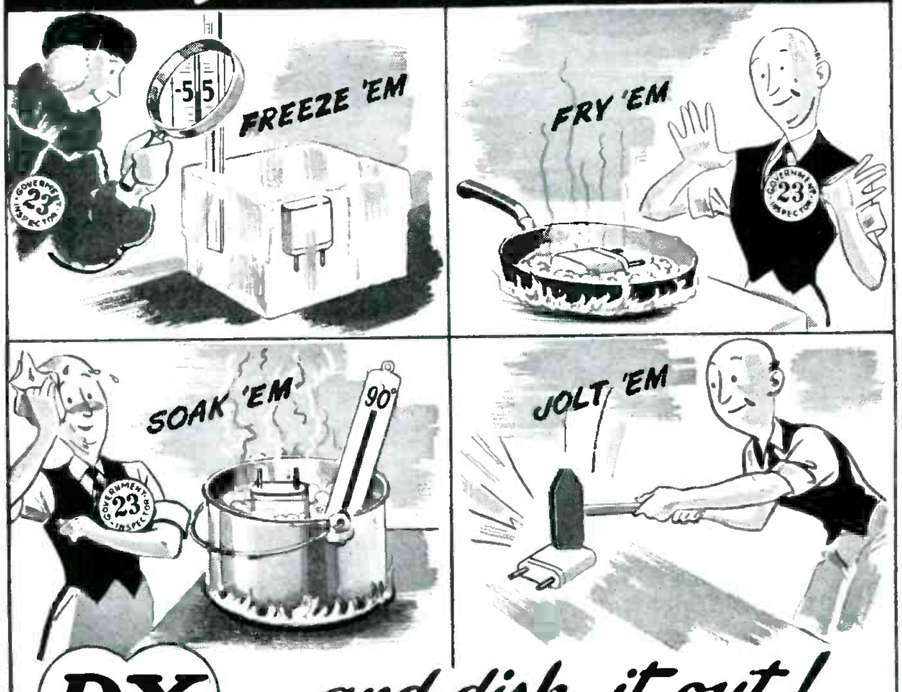

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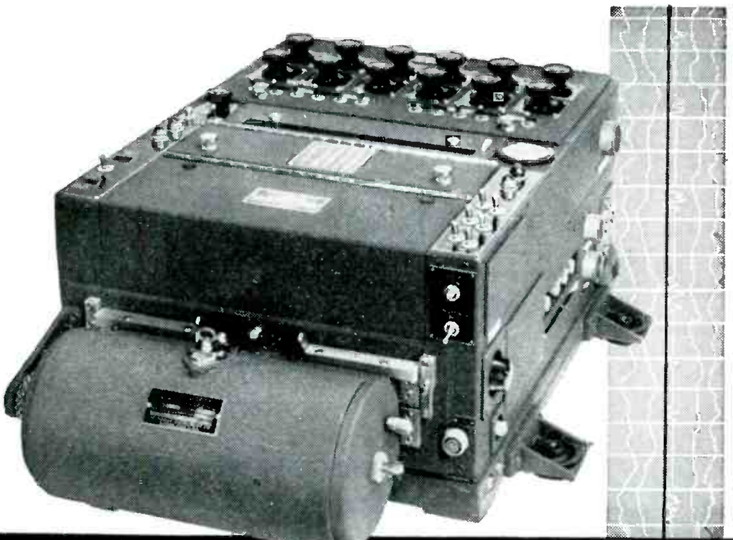

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in a recent circular is part of the company's new line of vibration analyzing equipment. Complete technical specifications of the unit and its accessories, as well as an illustrated description are included. Prices, terms and warranty information are also given.

Engineering Information Service. Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y. The first issue of a new engineering information service bulletin contains articles on (1) a 500-mc noise generator for uhf tv which uses a type 5722 noise diode, and (2) the type 300 oscilloscope calibrating standard. This engineering information service will come in the form of a periodic release suitable for binding and preserving for future use as a reference medium.

Time Delay Relay. Heinemann Electric Co., Trenton 2, N. J. Bulletin 5001 deals with the Silic-O-Netic time delay relay, a hermetically sealed time element for small size, low cost and absolute dependability. Illustrations, chief features, operating characteristics, general specifications and ordering information are given.

Precision Potentiometers. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. Catalog E-L covers a complete line of series L-400 precision wirewound potentiometers. Complete specifications are furnished in four pages for these small-size, highly accurate potentiometers showing a wide variety of applications for single and multiple-ganged units.

Industrial Retaining Rings. Industrial Retaining Ring Co., 8 W. Sidney Ave., Mount Vernon, N. Y., has available a bulletin dealing with its industrial retaining rings that are stacked for modern dispensing and speedy application. The rings described are made from carbon spring steel, heat-treated to exacting specifications, and provide shoulders on grooved, circular shafts. Included with the bulletin is an engineering specifi-

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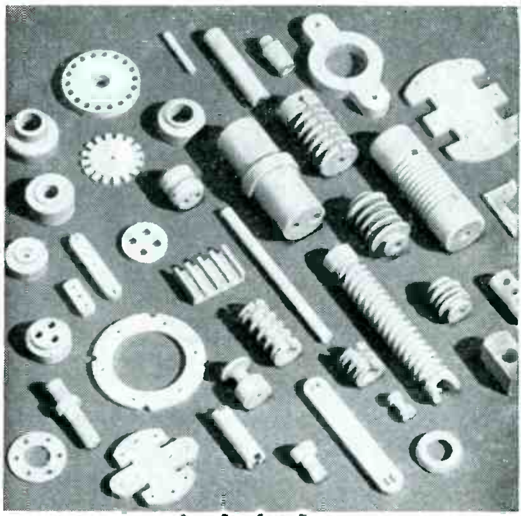

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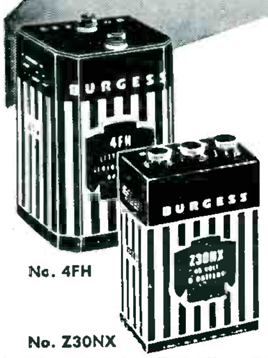

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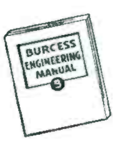

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Miniature 7 Pin Ceramic Socket	TS102C01	TSE7T102	S010C S011C	Mtg. Centers ⅞"; Mtg. Holes ⅛"; Chassis Hole ⅝".
Noval 9 Pin Plastic Socket	TS103P01	TSE9T101		Mtg. Centers 1⅛"; Mtg. Holes ⅛"; Chassis Hole ¾".
Noval 9 Pin Ceramic Socket	TS103C01	TSE9T102		Mtg. Centers 1⅛"; Mtg. Holes ⅛"; Chassis Hole ¾".
Miniature 7 Pin Tube Shield	TS102U01	TSF0T101	SOS 3	Height 1⅜"
Miniature 7 Pin Tube Shield	TS102U02	TSF0T102	SOS 6	Height 1¾"
Miniature 7 Pin Tube Shield	TS102U03	TSF0T103		Height 2¼"
Miniature 9 Pin Tube Shield	TS103U01	TSF0T104		Height 1½"
Miniature 9 Pin Tube Shield	TS103U02	TSF0T105		Height 1-15/16"
Miniature 9 Pin Tube Shield	TS103U03	TSF0T106		Height 2⅜"

Plastic insulators in above sockets are Type MFE, phenolic, per MIL P-14A. Ceramic insulators are steatite, Grade L-4B or better per JAN I-10. Contacts are silver plated copper base alloy (phosphor bronze and beryllium where specified) with terminals hot tin dipped. Shields and bases on JAN S-28 units are steel cadmium plated; S-28A and Amendment 1 parts use brass, nickel plated.

Crystal Socket

A number of METHODE products not as yet covered by JAN specifications are finding application in military equipments, such as the two prong crystal socket for holders with .050" pins on .486" centers shown. Consult METHODE for standard type sockets with special materials and performance incorporated for military applications.

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cation data sheet showing shaft size, ring dimensions and groove dimensions for the entire line.

Phono Pickup. Lindberg Instrument Co., 830 Folger Ave., Berkeley 10, Calif., has available a pamphlet introducing Fluid Sound, a new phono pickup using fluid-damping and fluid-coupling. The pickup described does not require the stylus to do the work of generating the output voltage and is almost entirely free from hum pickup. Dimensional drawings and technical data are included.

Induction Heating. Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., has available the 12-page booklet B-4782 that presents case histories of how induction heating has increased production 50 to 2,000 percent, reduced space up to 90 percent and cut production costs. Modern induction heating apparatus — generators and work handling equipment—are described as machine tools for hardening, heating, annealing or joining metals in mass or batch quantities.

Control Instruments. Assembly Products, Inc., Chagrin Falls, Ohio. Catalog No. 1A contains twelve bulletins dealing with a line of pyrometer controls and contact meter relays for operation and process controls. Technical data, illustrations, ordering information and price lists are given. Also included are a list of users and an extra bulletin on the model 351-5 millivoltmeter for checking thermocouple controls and the model 1654-A Simplytrol oven thermomenter.

Carbon and Graphite Products. National Carbon Co., A Division of Union Carbide and Carbon Corp., 30 E 42nd St., New York 17, N. Y. Products made in carbon and graphite in grades from porous to impervious for applications in the chemical and process, metallurgical, mechanical and electrical fields are fully described in the 20-page catalog section S-5005. Principal features of the products described are: resistance

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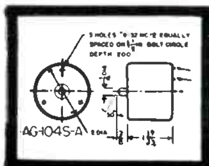

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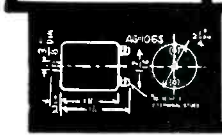

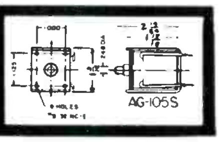

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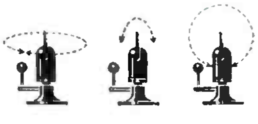

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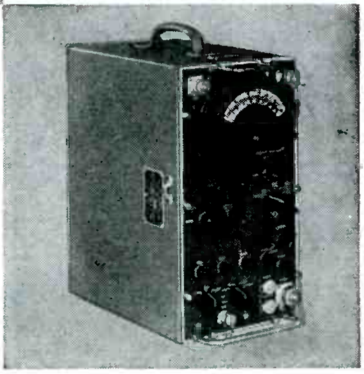

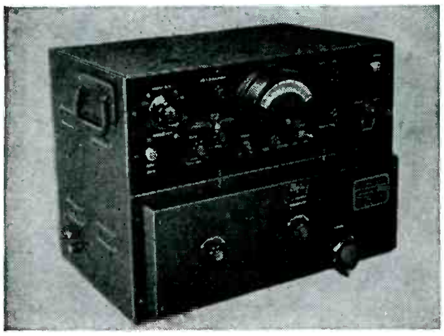

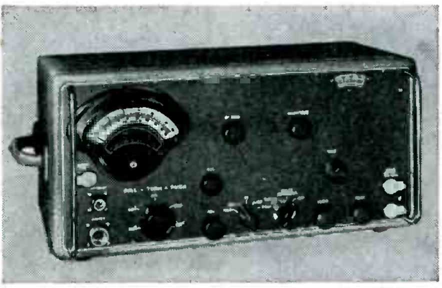

to practically all corrosive chemicals, high heat transfer of graphite products and low heat transfer of carbon products, ease of machining and fabrication, resistance to severe thermal shock, low thermal expansion, strength maintained with no deformation at high temperatures and good electrical conductivity.

Magnetic Recording. Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y., has available a booklet written by its vice-president, C. J. Lebel, entitled "Fundamentals of Magnetic Recording." Its 50-odd pages include such topics as: a brief history, tape vs wire, magnetic recording method, magnetic relations, bias, erasing, output, frequency response, distortion and noise, modulation noise, tape construction, hints on selecting a tape recorder, maintenance, recording time for various tape speeds and reel sizes, and technical data on Audiotape.

Station Planning. Allen B. DuMont Laboratories, Inc., Clifton, N. J., has published a booklet on station planning, a complete step-by-step outline directed to management and station engineers which fully explains the facilities and function of all equipment necessary to the normal operation of a well-integrated tv station. Equipment layouts suggested provide for future expansion of these facilities. Easy-to-understand renderings along with exploded views and systematic floor plan arrangements follow the text graphically. As the reader goes through the booklet he finds a complete breakdown for each equipment complement explaining the actual equipment pieces and approximate costs of the various units incorporated in that group. The booklets will be forwarded directly to all tv managers and station engineers requesting copies on their company letterheads.

Precision-Regulated Power Supply. Pedersen Electronics, Lafayette, Calif. A single-page bulletin covers the model 300 precision-regulated power supply that fea-

TEFLON MAGNET WIRE

FOR HIGHEST TEMPERATURE APPLICATIONS

Warren Wire Company is now producing in quantity Teflon insulated Magnet wire.

SIZES—14 through 45
Single, Heavy, Triple and
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We invite inquiries where requirements call for:

small SPACE FACTOR
HIGHEST ABRASION RESISTANCE
FLEXIBILITY AND ADHERENCE
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and it will withstand temperatures of 250 centigrade.

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Model 1

Convenient Height and Viewing Angle
Adjustable to Hold Portable Scopes
Ball Bearing Swivel Rubber Tired Casters
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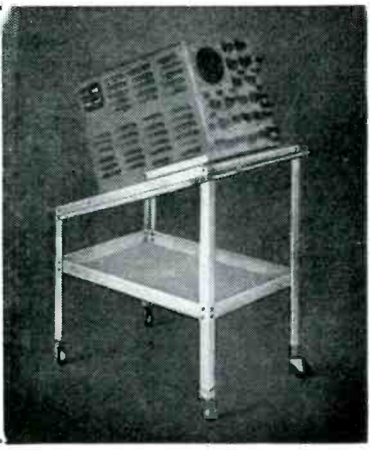

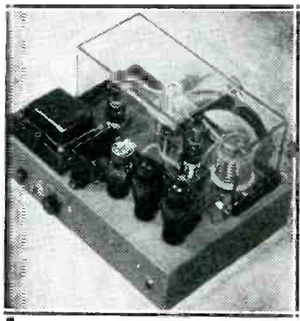

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Unique pile up arrangement reduces over-all space compared with conventional relays.

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Octal base, snap-on dust cover or hermetically sealed. Also AN connector.

NEW CONTAINER SAVES SPACE

Hermetically sealed header type: 2" h. above mounting surface, x 1⅝" w. x 1" d.

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Without obligation, please give us information regarding your HERMETICALLY SEALED RELAYS for following application:
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Company..
Name.............................Title.......................
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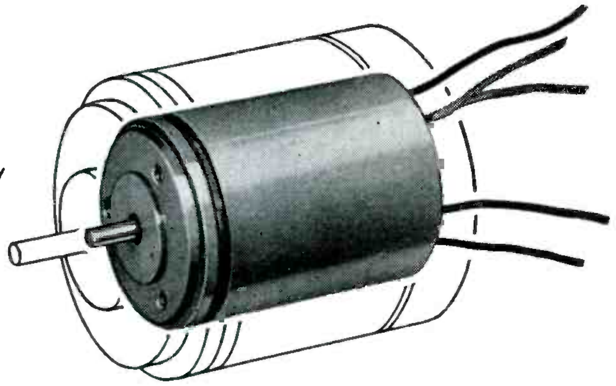
ECLIPSE-PIONEER

Announces the New Line of

PYGMY SYNCHROS



Size of pygmy as compared to AY-200 series outline

Eclipse-Pioneer has added a tiny new member to its great family of famous Autosyn* synchros. It's the new AY-500 series, a precision-built pygmy weighing only 1¾ oz. while scaling only 1.278" long and .937" in diameter (the same diameter, incidentally, as a twenty-five cent piece). Its accuracy and dependability are assured, thanks to Eclipse-Pioneer's 17 years of experience and leadership in the development of high precision synchros for aircraft, marine and industrial applications. For more detailed information on the AY-500 and other E-P Autosyns, such as the remarkably accurate AY-200 series (guaranteed accuracy to within 15 minutes on all production units), please write direct to Eclipse-Pioneer, Teterboro, N. J.

*REG. TRADE MARK BENDIX AVIATION CORPORATION

LOOK FOR THE PIONEER MARK OF QUALITY REG. U.S. PAT. OFF.

Typical Performance Characteristics

	One AY-201-3 Driving		One AY-500-3 Driving
	One AY-500-3 Control Transformer	Two AY-500-3 Control Transformer	One AY-500-3 Control Transformer
INPUT			
Voltage	26-volts, single-phase	26-volts, single-phase	26-volts, single-phase
Frequency	400 cycles	400 cycles	400 cycles
Current	88 milliamperes	110 milliamperes	55 milliamperes
Power	0.8 watts	1.2 watts	0.9 watts
Impedance	105+j280 ohms	100+j220 ohms	290+j370 ohms
OUTPUT			
Voltage Max. (rotor output)	17.9 volts	16.2 volts	14.1 volts
Voltage at null	40 millivolts	40 millivolts	40 millivolts
Sensitivity	310 millivolts/degree	280 millivolts/degree	245 millivolts/degree
Voltage phase shift	23 degrees	26 degrees	44 degrees
System accuracy (max. possible spread)	0.6 degrees	0.6 degrees	0.75 degrees

Other E-P precision components for servo mechanism and computing equipment:

Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies • remote indicating-transmitting systems and special purpose electron tubes.

For detailed information, write to Dept. C

ECLIPSE-PIONEER DIVISION of Bendix AVIATION CORPORATION

TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

tures low source impedance, utmost stability under a wide variety of load conditions, minimum ripple and negligible drift. Operating data, specifications, size, weight and prices are included.

Pure Ferric Oxides. C. K. Williams & Co., Easton, Pa., has available a data sheet on the properties of the three most popular pure red iron oxides. Actually, the company has 10 different grades but the three described will cover 98 percent of the application. Particle size, physical properties and chemical analysis are given.

Electronic Contour Follower. General Electric Co., Schenectady 5, N. Y. has announced a new four-page bulletin on electronic contour follower systems for machining irregularly shaped parts. The publication, designated as GEA-5660, covers one-, two- and three-dimension tracer control systems for use on lathes, boring mills, milling machines, drilling machines and the like. Employing many photographs and diagrams it gives a brief description of each of the systems, its components, features and operation.

Measuring Instruments. Dawe Instruments Ltd., 130 Uxbridge Road, Hanwell, London W.7., England, has issued a 6-page illustrated brochure summarizing a wide range of electronic measuring equipment manufacturing. Technical data are given for instruments for the radio and communications laboratory, as well as instruments for industrial and photographic applications.

Time Delays. Diaphlex, Div. of Cook Electric Co., 2700 North Southport Ave., Chicago 14, Ill., has published a 12-page booklet dealing with a wide line of Tarrytron time delays. Illustrations, dimensional drawings and technical specifications for each are included. Ordering information is made easy.

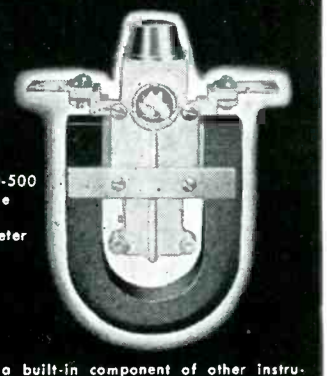
Miniature Wire and Cable. Tensolite Insulated Wire Co., Inc., Tarrytown, N. Y. Engineering and manufacturing facilities for miniature insulated stranded wires and tin-

Specify... G-M

D'ARSONVAL PORTABLE

GALVANOMETERS

AND MOVEMENTS...



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Galvanometer

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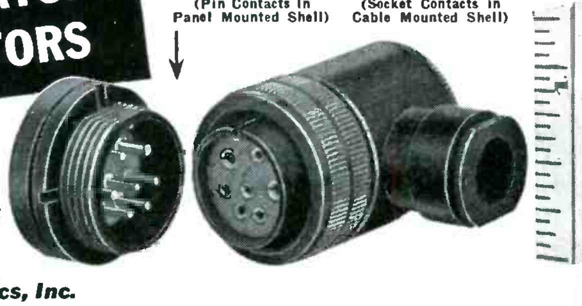
WINCHESTER ELECTRONICS, INCORPORATED

NEW MINIATURE CONNECTORS

CPRM5-2P
(Pin Contacts in
Panel Mounted Shell)

CPRM5-2S
(Socket Contacts in
Cable Mounted Shell)



...for Airborne Electronic Equipment designed and manufactured by Winchester Electronics, Inc.

Recent designs for electronic equipment in aircraft and guided missiles have required progressive miniaturization of electronic components. The above connector is typical of several recent designs we have supplied to meet this need. We have given special consideration to the following features:

1. ***Shell Enclosure*** — Die cast aluminum alloy.
2. ***Light Weight*** — Total for plug and receptacle 1.5 oz.
3. ***Small Size*** — Maximum diameter 1". Total length O.A. 1⅞".
4. ***Right Angle Cable Entry*** — For use in limited space.
5. ***Pressure Tight*** — Inserts, contacts and cable entry, individually sealed with neoprene "O" rings or special gaskets.
6. ***Contacts***—Five for #20 A.W.G. and two for #18 A.W.G. wire.
7. ***Finish*** — Olive drab, iridite.

Other contact arrangements and shell designs will be available soon — Write our Engineering Department for complete details.

These connectors also employ standard Winchester Electronics features:

1. MONOBLOC* construction.
2. Molded Melamine (mineral filled) inserts.
3. Precision machined pin and socket contacts, silver plated with gold flash over.

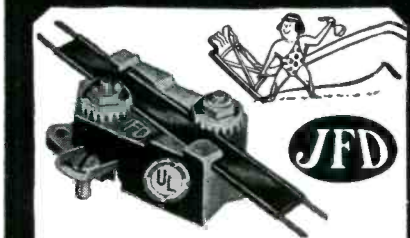
*Trade Mark.

Let us help you with your difficult connector problems. Advise us of your special requirements.

WINCHESTER ELECTRONICS
INCORPORATED

GLENBROOK, CONN., U.S.A.

PERFORMANCE
Not Size
IS WHAT COUNTS



"LITTLE GIANT"
LIGHTNING ARRESTER
PROTECTS
Against Lightning Hazards

No. AT 105
For ribbon-type and oval jumbo twin lead.

$1.25 LIST

ONLY JFD Lightning Arresters offer you these exclusive patented features . . .

1. Strain-relief Retaining Lip prevents pulling or straining of lead against contact points.
2. You actually see positive contact made with lead-in wire.
3. No wire stripping or cutting.

Write for Form No. 84 showing the damage lightning can do to a Television Installation.

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FIRST in Television Antennas and Accessories

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ALLMETAL, Specialists in Stainless, Produce Stainless Products Exclusively

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the leading source for Stainless Screws, Nuts, Bolts, Washers, Pins, Rivets. Made right, Priced right. "AN" and Standard Types carried in stock. Phillips Recessed Head Screws and Specials available too.

WRITE FOR CATALOG C

STAINLESS STEEL FASTENERS

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ALLMETAL
SCREW PRODUCTS COMPANY, INC.
33 GREENE STREET NEW YORK 13, N. Y.

sels, including a wide variety of wire and cable constructions, are discussed in a recent folder. Product classifications and engineering data are given. Four sheets of technical information on standard Tensolite flexible wires and cable are included.

Gas Dust Analyzer. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Ave., Philadelphia 44, Pa. Instrumentation Data Sheet No. 10.14-6 gives an illustrated technical description of a gas dust analyzer that operates with an Electronic potentiometer to provide continuous record of dust content. Operation and application data are included.

Mechanical Interlock. Simonds Machine Co., Inc., Southbridge, Mass. The many improved features of the new Linemaster Lektro-Lek switch are fully described in a recently issued bulletin. The mechanical interlock described which works on the seesaw principle with selective circuits, prevents both circuits from being operative at the same time; its single cord receptacle eliminates costly harness assemblies and all wiring connections are made internally. The device treated is particularly suited for sound transmission equipment such as wire or disc recorders, raising and lowering of appliances and intercommunication systems.

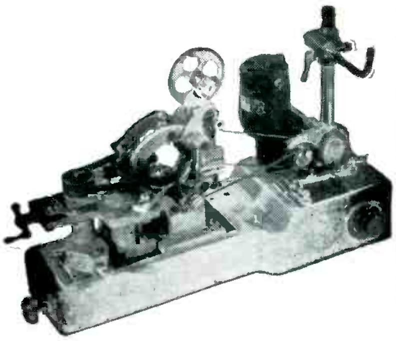
Pocket-Size Test Instrument. Pyramid Instrument Corp., 49 Howard St., New York 13, N. Y. Case histories of electricians, maintenance men, service men, engineers, and production and test personnel who do their servicing with the aid of an Amprobe Snap-around volt ammeter have been gathered into the 16-page manual No. 504. Eleven case histories in the booklet illustrate as many different uses. A working drawing of the Amprobe with its specifications and mechanical dimensions is shown.

Sonometer. Electro Products Laboratories, Inc., 4501 Ravenswood Ave., Chicago 40, Ill., has issued a single-sheet bulletin on the model 4100 sonometer, an instrument

MICO

Precision Apparatus

TOROID COIL WINDERS



Wide-range, laboratory-type machines available for winding samples and small production runs of toroid coils. Production machines built to meet specific requirements.

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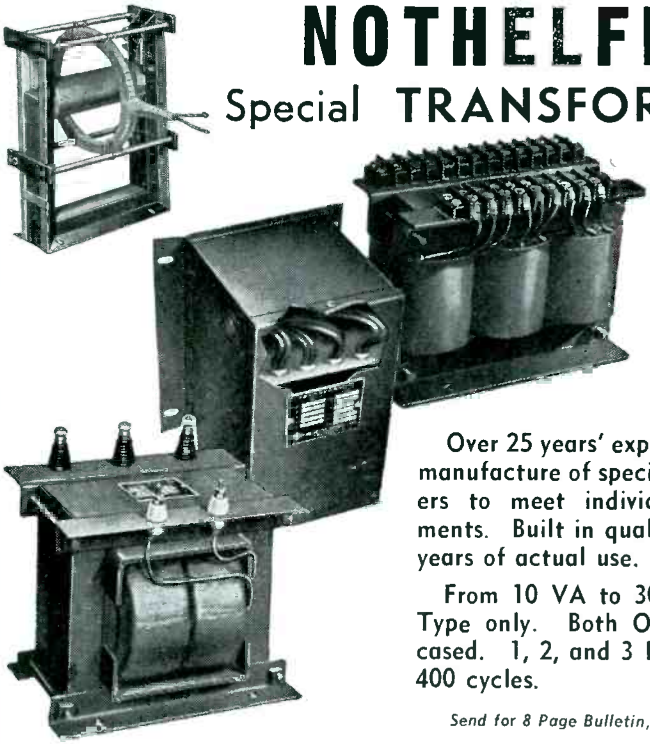

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From 10 VA to 300 KVA Dry-Type only. Both Open and Encased. 1, 2, and 3 Phase. 15 to 400 cycles.

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THE SOUND CHOICE OF ENGINEERS

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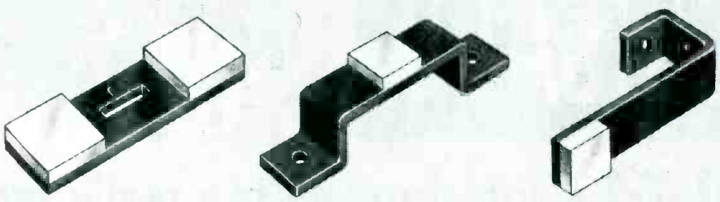
The sound line that quality built

NEWCOMB AUDIO PRODUCTS CO.

Dept. L, 6824 Lexington, Hollywood, Calif.
AMPLIFIERS, SYSTEMS, RACK EQUIPMENT, TRANSCRIPTION PLAYERS, PHONOGRAPHS



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used for determining the resonant frequency of any solid mass or material where strength is an important factor. Exclusive features, specifications and some typical applications are described and illustrated.

Sound Equipment. Bell Sound Systems, 555 Marion Road, Columbus 7, Ohio. Catalog 5152 gives a 20-page illustrated description of an extensive line of sound equipment. Topics listed in the general index include: high-fidelity amplifiers; tape and disc recording equipment; 10, 15, 25 and 50-watt amplifiers; p-a systems; inter-communication equipment; and accessories.

Variable Ratio Speed Changer. Metron Instrument Co., 432 Lincoln St., Denver 9, Col. Technical data sheet No. 4C page 1 discusses a miniature variable speed drive with push rod ratio control. Applications of the unit described include timers, recorders, controllers, computers, indicating mechanisms and similar low power devices requiring remote or automatic control.

Wire-Wound Resistors. Cubic Corp., 2841 W. Canon, San Diego 7, Calif. A single-sheet bulletin deals with a line of circular form wire-wound resistors, originally developed for use as signal pickoff devices for servomechanisms, but which may find use in many other applications. Typical example types are shown and specifications are given.

Industrial Tape Uses. Polyken Industrial Tape, Dept. of Bauer & Black, 222 W. Adams St., Chicago 6, Ill., has just released the Polyken Standard Industrial Classification Manual. Nearly 80 pages in length, it contains 21 major group classifications (based on the U. S. census breakdown), 175 detailed industry classifications, and approximately 1,500 distinct and specific uses for industrial tape. A variety of tape numbers, widths and applications for communications equipment and related products, radio and radar equipment and tv equipment are listed.

For:

RF SHIELDING
RADAR REFLECTION
MASSIVE SURFACE CONDUCTIVITY

Investigate

M. SWIFT & SONS
metallized textiles

For further information write:

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FOR HIGH-SPEED INDUSTRIAL SOLDERING

Use G-E

Calrod* Soldering Irons

HERE'S WHY THEY ARE PREFERRED BY . . .

PRODUCTION MEN . . . because they are built tough for long, continuous production line soldering. With calorized or ironclad tips, they stay clean, solder fast and can be easily disassembled.

MANAGEMENT MEN . . . G-E irons last longer and need less service. Exhaustive tests by some of the world's largest soldering iron users show that G-E irons save them money.

MAINTENANCE MEN . . . because superior features, like the cord-strain insulator which withstands a pull of 35 pounds, makes far less maintenance necessary. When it's occasionally necessary, the dependable G-E cartridge heater slips right out for servicing—just pull a pin.

FOR FREE BULLETIN, GEA-4519, ask your nearby G-E distributor, or write to: Sect. 720-66, General Electric Co., Schenectady, New York.

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GENERAL ELECTRIC
720-66

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STURTEVANT TORQUE WRENCHES

Read by Sight, Sound or Feel.

- Permanently Accurate
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in inch ounces . . . inch pounds . . . foot pounds All Sizes from 0-6000 ft. lbs.

Every manufacturer, design and production man should have this valuable data. Sent upon request.

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INSULATION

FORMVAR • FORMEX • ENAMEL

STRIPPED CLEAN IN SECONDS

with X-VAR

IN

1. DIP WIRE in X-VAR for 3 seconds.

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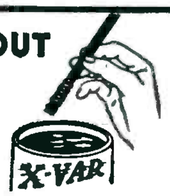

2. WITHDRAW and watch coating disintegrate.

WIPE

3. WIPE CLEAN. Operation completed in seconds.

X-VAR is non-corrosive, non-creeping — leaves wire ready for soldering. Now in use by leading manufacturers of electrical products. Write for FREE SAMPLE for testing.

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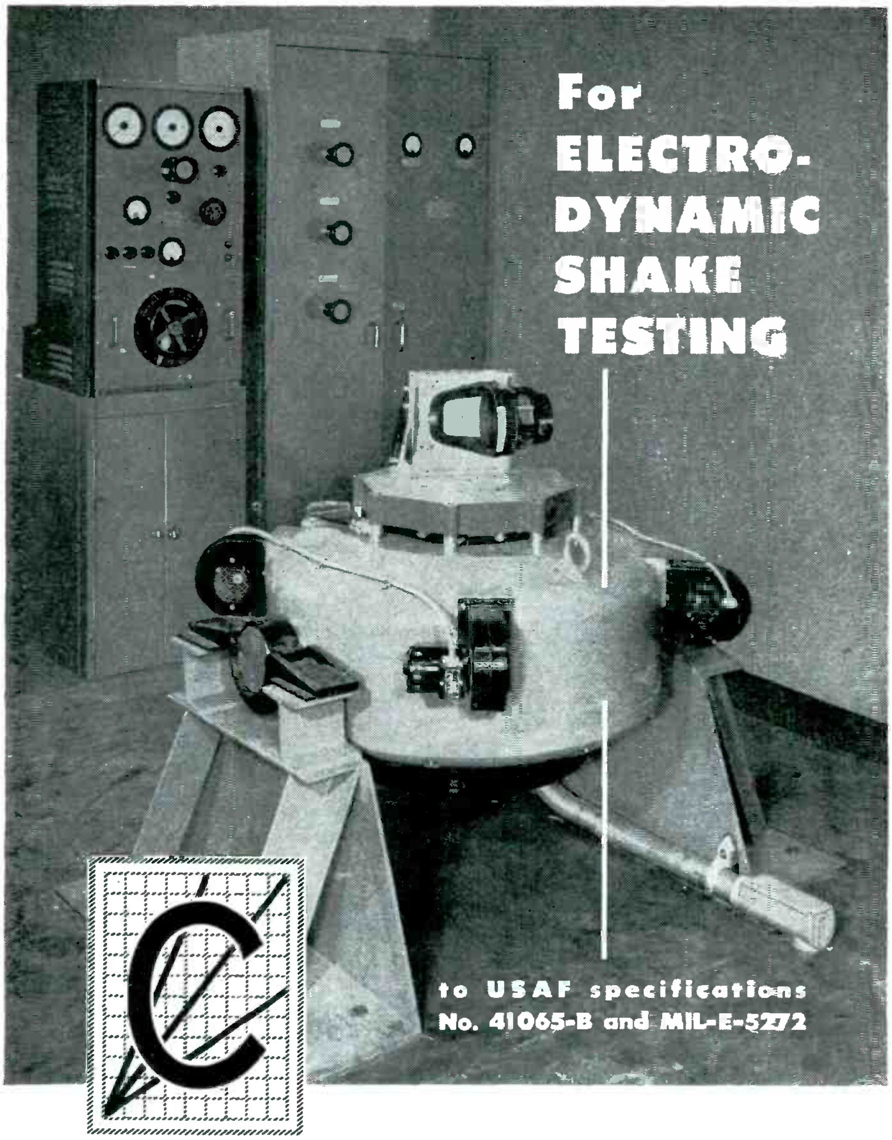


NEWS OF THE INDUSTRY

(continued from page 150)

an approaching enemy plane. Thus the jet fighter pilot of tomorrow will not only learn how to handle his plane without taking it off the ground, but also how to bag an enemy plane as it approaches him at the speed of sound.

The electromechanical trainer contains 1,152 electronic tubes, 60 miles of wiring, takes up 600 feet of floor space and stands 10 feet high. Over 100,000 engineering hours went into its design and it will take between 500 and 600 printed handbook pages to explain its operation and design.

Its cockpit will duplicate in every detail that of the F-86D Sabre. Heart of the trainer, and separate from the cockpit, is a battery of analog computers. Out of them come the answers to how the pilot "flew the plane." If the pilot makes a mistake the computers automatically change the cockpit instrument readings to conform to the actual conditions. Unless the pilot corrects a mistake, the conditions will automatically carry through to its logical end, which may well be a fatal crash.

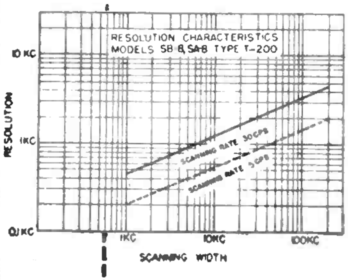
The Sabre simulator requires two instructors, one for flight performance and the other for radar operations. The latter also controls the simulated target, or enemy plane, which the pilot is required to attack.

Sarnoff Fellowship Established

A PREDOCTORAL fellowship in electrical engineering, providing an annual grant of $2,700, was established by the Radio Corp. of America last month in the College of Engineering at New York University. The award will be known as the David Sarnoff Fellowship in honor of the chairman of the board of RCA. Selection of the first student to receive the fellowship will be made in February 1952.

Other RCA resident fellowships are available for outstanding graduate students in electrical engineering at Princeton University, California Institute of Technology and University of Illinois. In each university the selection is made jointly

when MAXIMUM SIGNAL RESOLUTION IS A "MUST"...SO ARE



PANORAMIC PANALYZOR SB-8 AND PANADAPTOR SA-8

These instruments enable spectrum analysis of signals so close in frequency that their corresponding indications would normally mask one another.

FEATURES—*Continuously variable resolutions • Continuously variable scanning width • Long persistence cathode-ray tube . . . 5" Screen • Intensity grid modulation for pulse analysis • Synchronous and non-synchronous scanning • Variable scanning rates • Linear and log amplitude scales.*

Let a Panoramic specialist advise you on your individual problems.

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RADIO PRODUCTS, INC.

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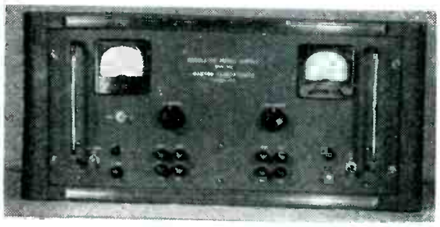

Model #530

Voltage Regulated D. C. POWER SUPPLIES

Input: 105 to 125 Volts A.C.

Output: 80 to 350 volts D.C. @ 275 ma. regulated.
0 to –150 volts D.C. @ 5 ma. VR tube regulated
6.3 volts at 10 amps., C.T. unregulated

Hum: less than 5 millivolts

Regulation: Better than ½% from no load to full load

Write for fully detailed bulletin.

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Model #520: 80 to 325 V. at 150 ma.
Model #540: 80 to 375 V. at 450 ma.
Model #550: 0 to 5 KV at 300 ma (unregulated)

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MODEL 307R,C
MODEL 302C
MODEL 300C,S,R
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Also available from RADIO SHACK: Ampex recorders in 1 to 14 tracks using ¼" to 1" tape — for telemetering and other industrial scientific and professional use. Write for prices and details.

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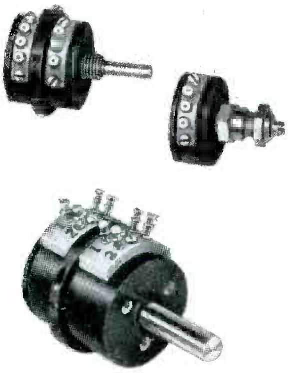
RV ⅞* available with linear resistance elements *only* — nine standard resistance values from 100 to 25,000 ohms. Power rating 6 watts at 25°C. Illustration shows RV ⅞ with threaded bushing . . . servo mounting available if desired.

RV 1-1/6* available with linear or non-linear resistance elements — nine standard resistance values from 100 to 50,000 ohms. Illustration shows RV 1-1/16 with 3 tapped hole mounting . . . servo mounting or threaded bushing if desired.



Type RV1⅝* and RV2* High Precision Potentiometers . . . semi-standardized types of precision machined aluminum base potentiometers with exceptionally high electrical accuracy and mechanical precision. For both linear and non-linear functions. Designed for precision instrument, computer and military applications. Accurate phasing of individual units possible with clamp-ring method of ganging.

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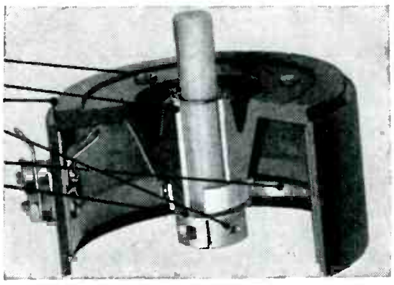
*Numbers refer to diameter of bases.

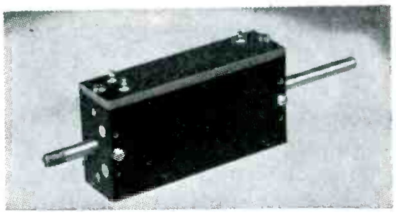


Sine and cosine potentiometers available in RVP3* and RV2* bases.

Type RV3* Bakelite Base Precision Potentiometers . . . available in models for either linear or non-linear functions. Stock resistance values ranging from 100 Ω to 200,000 Ω and power ratings of 8 and 12 watts. 360° mechanical rotation or limited by stops as desired. Potentiometers of this type available to widely varying accuracy requirements (linearity to ±0.25%) — see TIC Bulletin RV3-250. Special models available for high humidity applications.

Type RVP3* High Precision machined aluminum base Potentiometers . . . available in models for either linear or non-linear functions with standard resistance values up to 200,000Ω. Linearity to ±0.1%. Eleven gang assembly available, example of TIC's potentiometers multi-ganged with TIC's adjustable clamp ring. Can be supplied to meet various mounting requirements — single hole, 3 tapped hole mounting or servo mounting as desired.

Type RVT Translatory Potentiometers . . . actuated by longitudinal instead of rotary motion providing linear electrical output proportional to shaft displacement. Used as a position indicator, high amplitude displacement type pickup and for studying low frequency motion or vibration. Features exceptionally high linearity and resolution. Available in various lengths and resistance values.



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by the academic officers and the RCA education committee.

IRE Elections and Awards

AT an IRE board of directors meeting held in November election of the following officers and directors was announced:

President, 1952—Donald B. Sinclair of General Radio Co., Cambridge, Mass.

Vice-president, 1952—Harold L. Kirke of the British Broadcasting Co., London, England.

Directors-at-large, 1952-1954—John D. Ryder of the University of Illinois, Urbana, Ill.; and Ernst Weber of Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Regional directors, 1952-1953: Region 1—Glenn H. Browning of Browning Lab. Inc., Winchester, Mass.; Region 3—Irving Wolff of RCA Laboratories Div., Princeton, N. J.; Region 5—Alois W. Graf of Chicago, Ill.; Region 7—Karl Spangenberg of Stanford University, Stanford, Calif.

The following IRE awards were also made at the board meeting:

Morris Liebmann Memorial Prize, 1952—William Shockley of Bell Telephone Laboratories, Murray Hill, N. J.

Browder J. Thompson Memorial Prize, 1952—H. W. Welch, Jr. of University of Michigan, Ann Arbor, Mich.

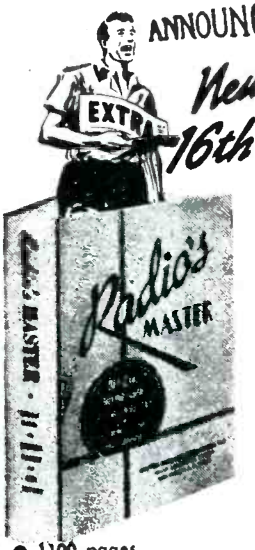
Vladimir K. Zworykin Television Prize Award, 1952—B. D. Loughlin of Hazeltine Electronics Corp., Little Neck, N. Y.

Editor's Award 1952—Jerome Freedman of Watson Lab., Griffiss A.F.B., Rome, N. Y.

NOL's New Cold Roll Mill

THE NEW Sendzimir cold roll mill, which produces extra-thin tapes used in pulse transformers, magnetic amplifiers, radar equipment and other high-frequency operations, is now in use at the Naval Ordnance Laboratory, White Oak, Md.

The mill, capable of rolling metals to a thinness of a few tenths of a thousandth of an inch, was built at a cost of $75,000. It was installed in the spring of 1951. Work on control



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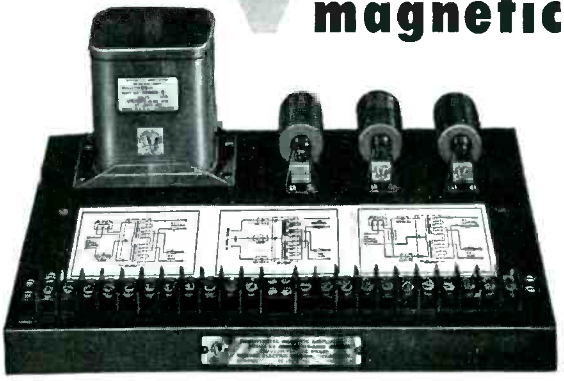
VICKERS educational magnetic amplifier



Permits study of all three basic single phase self-saturating circuits

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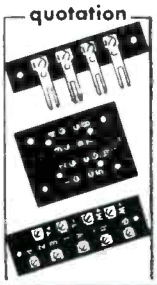

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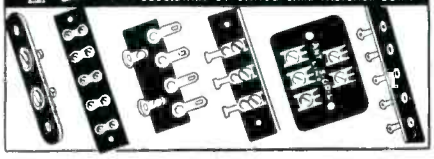

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APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION adjustments and electrical circuits continued through the summer under the direction of engineers from Armzen Co., designers and engineers for Tadensz Sendzimir, inventor of the mill, and GE engineers who built complicated electrical controls.

The first test run gave a thinness of 0.0005 in. with magnetic alloys which were rolled from 0.05 beginning thickness. Chief advantage of the new mill, in addition to the very fine gage achieved, is the fact that it will handle wider strips of magnetic alloys than will the mill previously used.

There are only four other such mills in operation in the U. S. at present. They are located at Westinghouse, General Electric, The Hamilton Watch Co. and North American Phillips.

Government Appointments

LONG experienced in the electronics field, George W. Henyan of Schenectady, manager of General Electric Industrial and Transmitting Tube operations for the past three years, has accepted a temporary appointment as chief of the components branch of the National Production Authority's Electronics Division. A veteran of 33 years with General Electric, he will make his headquarters in Washington.

Another recent appointment is that of Leslie E. Neville, at one time editor of McGraw-Hill's *Aviation* Magazine, to director of the Department of Defense's newly organized Armed Services Technical Information Agency. ASTIA will be responsible for collecting, cataloging and storing scientific and technical information from all available sources. It will also provide a scientific and technical bibliographic service to military agencies and their contractors.

Franklin Lamb, vice-chairman of the board of Tele King Corp., New York, and a member of the Electronics Board of National Production Authority, has been appointed assistant to the Director of Defense Mobilization.

Robert McCurdy, associated with the National Production Authority since March 1951, has been ap-

• Electronics

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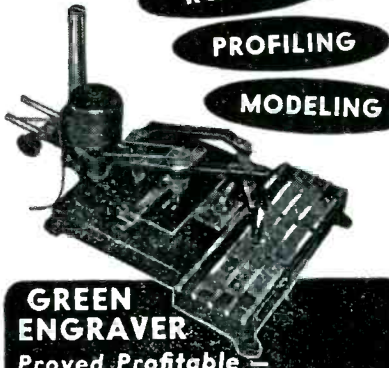

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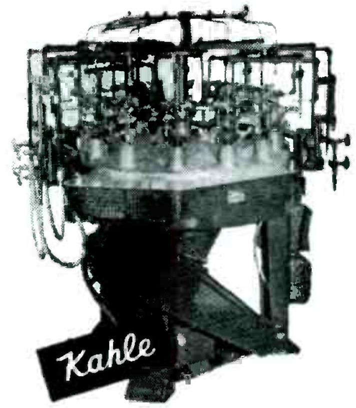
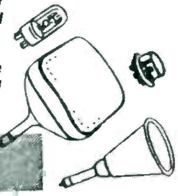
Kahle's 40 years of experience eliminate trial orders and experimental set-ups. Standard toolings for all tube manufacturing eventualities *already* have been tested and approved. This means that Kahle can assemble machines for everything from sub-miniature to largest TV picture tubes to your exact specifications . . . *at lower costs!*



#1375 SUB-MINIATURE SEALING MACHINE (12-HEAD). Also for hearing aid tubes. Kahle Standard Dual motor drive. Indexing by barrel cam and rollers. Heads have self-centering bulb holders.

Machinery for all types of electron tubes and related glass products.

Consultations invited. Write today for our new catalog with complete details.



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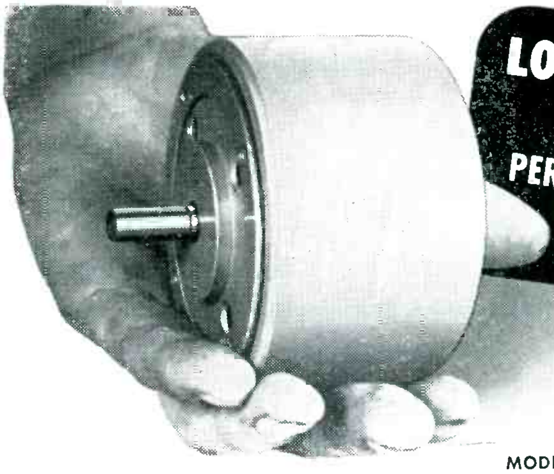

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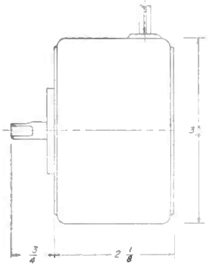
MODEL N2B

EAD



Originally designed and manufactured to operate into EAD synchronous motors in precision test equipment. Will meet all military specifications—high and low ambient temperature, humidity, altitude, dust, tropicalization, vibration and corrosion.

SPECIFICATIONS

Output 7 volts and 30 cycles, at 1800 RPM. Extremely low harmonic distortion, continuous duty, ball bearings.

This alternator may be modified to meet your individual requirements in 1, 2 or 3 phase for wide voltage ranges at required frequencies.

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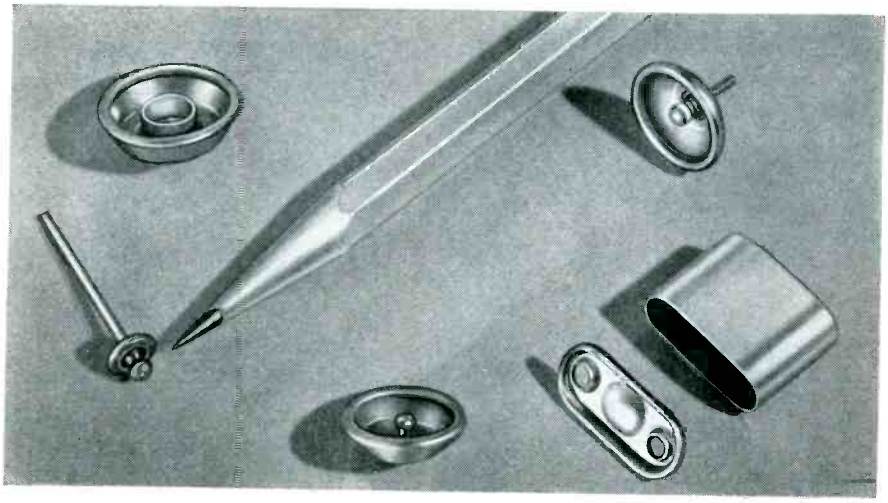


pointed deputy director of the Scientific and Technical Equipment Division of NPA.

Norman L. Winter, chief sales engineer for Sperry Gyroscope Co., Great Neck, N. Y., has been appointed chairman of the Navigation Technical Group of the Research and Development Board, Department of Defense.

Lauriston S. Taylor has been promoted from assistant chief to chief of the Atomic and Radiation Physics Division of the National Bureau of Standards, and Coordinator of Atomic Energy Commission Projects at NBS.

WMIT (F-M) Reopens

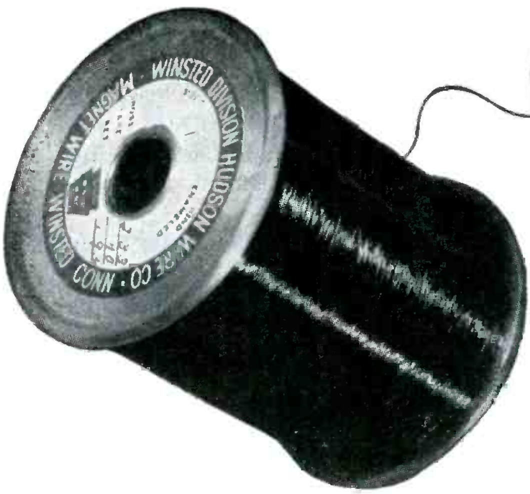
THE HIGHEST radio station in the eastern United States is again on the air 18 hours a day. WMIT, located on Clingman's Dome, Mount Mitchell, N. C., is the world's most powerful f-m station by virtue of its effective radiated power of 300 kw.

The pioneer station, off the air since early 1950, has new owners, a new 8-bay doughnut antenna array, and a new 50-kw Symmetron-type final amplifier (described on p 68, May 1949 ELECTRONICS).

New REA power lines and transformers, already installed, will allow the station to increase its erp to 325 kw, not feasible while using diesel power plants at the transmitter.

The top of the antenna pole is 6,773 feet above mean sea level, but because of the generally high level of the surrounding terrain within a radius of ten miles, its height is figured as 3,076 feet by FCC. A 100-foot fabricated tower is surmounted by the 80-foot pole carrying the doughnut elements and their deicers. These are of a new type tuned with stubs rather than capacitors and are adjusted for optimum operation in fog. Clear-weather or icing conditions throw them out of resonance but with a negligible standing-wave ratio.

Preliminary surveys of reception show that signals are far above predicted values. At High Point, N. C., on the 50-microvolt contour, the actual signal is in the order of 1,200 microvolts. A station in Myrtle



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Tungsten Leads are important factors of the tube. High quality leads make quality tubes. Engineering Co. makes the finest leads. No leakage or breakage when you buy our leads. Parts made to customers specification.

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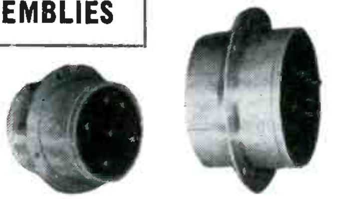

Quality tubes depends on quality bases and caps. We make all types including also an all glazed ceramic base.

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E = Breakdown voltage
e = Rated d.c. working voltage

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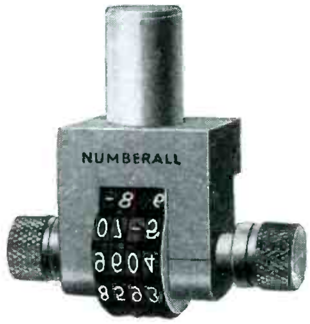
Can be furnished with any number of wheels up to 20. Two wheels—The unit wheel and the tens wheel can be turned by using the two outside knobs to quickly set the required number. This greatly facilitates consecutive numbering. Model 86 has all wheels, quick change. Bulletin E85.



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Multi-Wheel Numbering Machine

MACHINE AND SHANK ALL ONE PIECE

Model 70

The most efficient method of stamping numbers into metal. Repeats the same numbers until changed. Model 70 NUMBERALL Machines are used in all industries to mark various parts. Stamps numbers, etc., quickly . . . neatly. Perfectly aligned. Much better marks are reproduced by these machines than by single stamps or steel type, and at a far lower cost. Shank for Hand or Press and with any number of wheels from 3 to 20. Bulletin E-70.

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Hand or Press style. Type can be easily, quickly loaded and unloaded. Simplest construction . . . Just a sturdy pin holds the type securely. No screws nor springs. Super-quality steel type made in various sizes: 1/32" up to 1/2" figures and letters.

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Programs broadcast from WMIT are received by microwave link from the studios in Charlotte, N. C.

Expansion for Military Production

THE General Electric Company's Electronics Division at Electronics Park recently announced that it will use two buildings and part of a third at Bridgeport, Conn., for the design and manufacture of military electronic equipment. Floor area to be devoted to the new production will total 150,000 sq ft. Employment at the three locations is expected to reach 1,000 people by next fall. Several types of electronic equipment, including radar, will be manufactured in Bridgeport for the armed services.

Other expansions recently noted are as follows:

The Electronic Engineering Co. of California has moved to a new building at 176 South Alvarado St., Los Angeles. The new structure provides three times the size of former quarters. The company, active in the field of guided missile instrumentation, owes much of its growth to the awarding of additional armed services contracts.

Computer Research Corp., manufacturer of a ferroresonant flip-flop that has wide application in the guided missile and telemetering fields, has moved to 3348 W. El Segundo Blvd., Hawthorne, Calif., increasing available plant space approximately eight times.

Computer Research Corp.'s new building

Bendix Aviation Corp. has purchased the Utica, N. Y., plant of the Continental Can Co., Inc., to facili-


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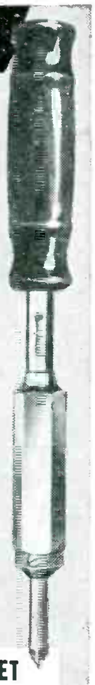
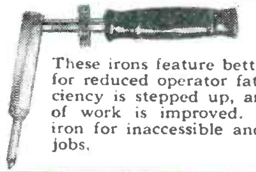
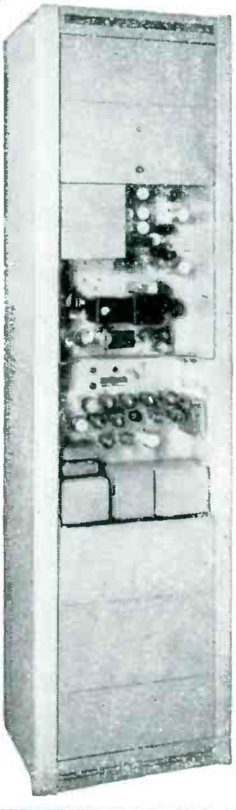
4 mmf/ft.







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TERMALINE
COAXIAL LOAD RESISTORS
51.5 ohms DC to 4000 mc – 5 watts to 2500 watts

The constant resistance (Low VSWR) of the TERMALINE resistor make it the ideal dummy load and standard resistor at UHF and VHF. Design is such that normal reactance is put to work producing a pure resistance over an extremely wide frequency range. Acting as a "bottomless pit" for RF energy, thousands of TERMALINE units are in daily use with high frequency transmitters.

SIX MODELS AVAILABLE

Model	Cont. Power Rating	Input Connector
80-5F	5 watts	UG-23B/U
80-5M	5 watts	UG-21B/U
80A	20 watts	UG-23B/U
81	50 watts	UG-23B/U
81B	80 watts	UG-23B/U
82	500 watts	Adaptor to fit UG-21B/U supplied.
82C	2500 watts	

Other adaptors or cable assemblies for any standard coaxial line available.

All TERMALINE units, except Model 82C, are self-cooled and require no auxiliary power. Substantial quantity discounts.

LITERATURE UPON REQUEST

Size 3⅜" x ¾" dia.
Very handy in lab and production test. At signal generator levels and below 5 watts, this is the last word for low VSWR.

MODEL 80-A 4"x4"x1"

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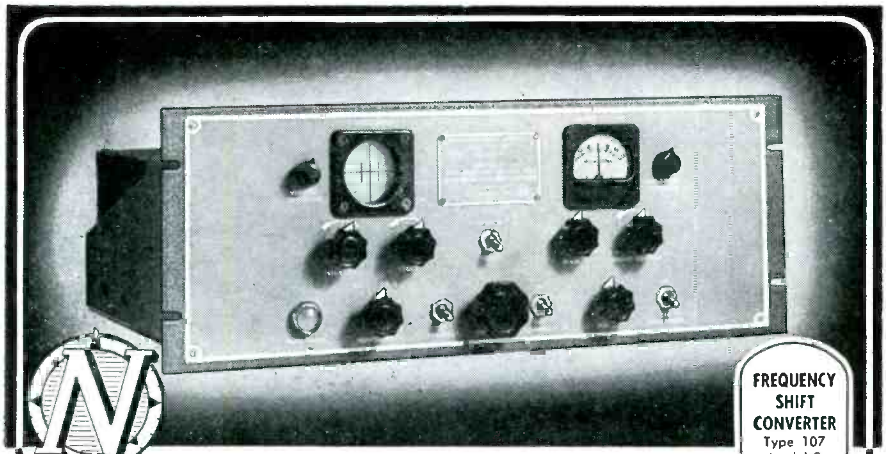

FREQUENCY SHIFT CONVERTER
Type 107
Model 2

BIGGEST PERFORMANCE–Smallest Size

Four *exclusives* are yours with the Northern Radio FREQUENCY SHIFT CONVERTER —utmost simplicity of operation, precision tuning, highest quality performance, and smallest size in the industry.

For single and diversity FS receiving systems, this dual channel unit converts mark and space tones into DC pulses, and drives teleprinters and other recorders directly. Its unique 2" oscilloscope provides the industry's most meaningful tuning pattern for precise receiver adjustment—during initial setup *and* while keying. Its specially designed limiter and discriminator afford an exceptionally high degree of performance. Polar or neutral output is available. Keying speeds up to 600 w.p.m. It's only 19" wide x 7" high x 15" deep.

This unit may also be used as a make and break CW or ICW demodulator.

See the specifications on this outstanding model in the 1951 Electronics Buyers Guide. For complete data on the precision-built Northern Radio line, write today for your free latest Catalog **E-1.**

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tate expanded production of precision equipment required by the military services.

Electronic Positions Available

HOLLOMAN Air Force Base, near Alamagordo, New Mexico, has openings for positions in electronic engineering and physics. Openings also include numerous positions as electronic scientists, physicists, mathematicians, electronic laboratory technicians, radar technicians, telemetering technicians and others.

Applicants with education and experience in these fields are urged to submit Application for Federal Employment, Standard Form 57, to the Civilian Personnel Office, Holloman AFB, New Mexico. This application form can be obtained from most first or second-class postoffices or from U. S. Civil Service Commission.

BUSINESS NEWS

MAGNECORD, INC., Chicago, Ill., manufacturers of high-fidelity professional tape recorders, have formed a new corporation, Magnecord International Ltd., to handle all the company's business outside of the Western Hemisphere.

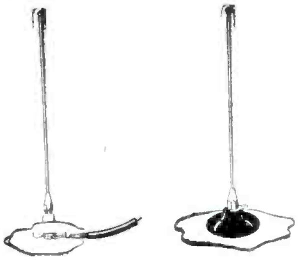
VARIAN ASSOCIATES of San Carlos, Calif., developers and manufacturers of electronic products, have leased approximately ten acres of Stanford University land. Construction of a 30,000-sq ft million-dollar research and development laboratory is expected to start early in 1952 and be completed within one year.

ASTRON CORP., East Newark, N. J., has consummated a long-term lease for additional space which virtually doubles production facilities for its capacitors and r-f interference filters.

LINDBERG INSTRUMENT CO., Berkeley, Calif., has moved to larger headquarters in that city to begin full mass production of Fluid Sound, a new phonograph pickup cartridge that applies the princi-

Civil Defense

RADIO ANTENNA



Mobile operations in 1¼, 2 and 6 meters are working surprisingly well with low mobile power — particularly with Premax low-cost VHF Antennas. Illustrated are two roof-top jobs, the one at left requiring a single ½" hole for one-man installation. The one at the right utilizes suction cup mounting requiring no holes and yet is always available for service.

Write for Bulletin and prices.

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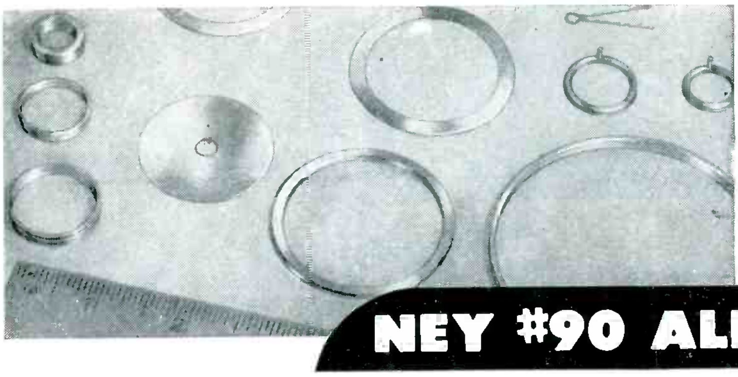

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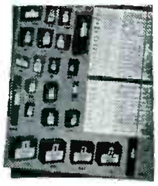

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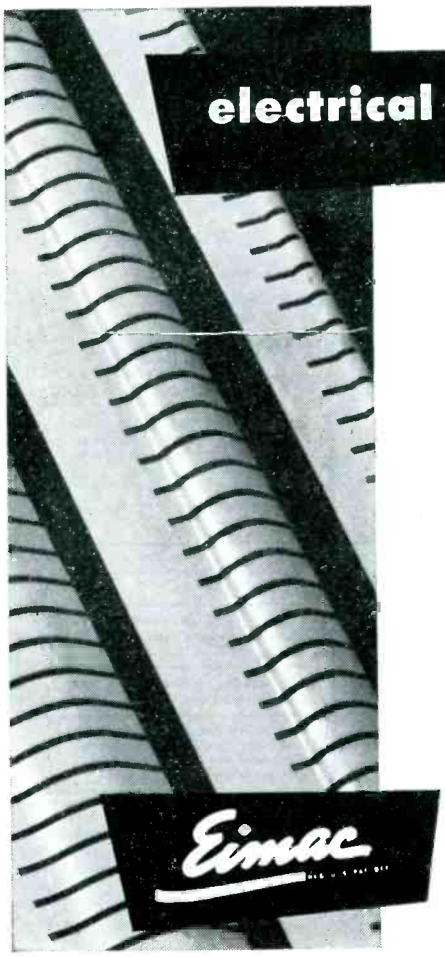

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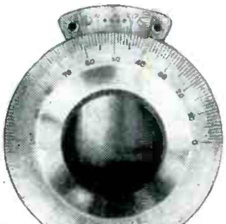
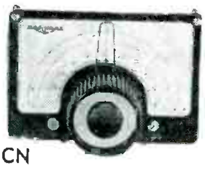

N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Many dials, like the N and ACN dials shown, can be specially calibrated or supplied with blank scales for commercial application. Write for drawings and prices.

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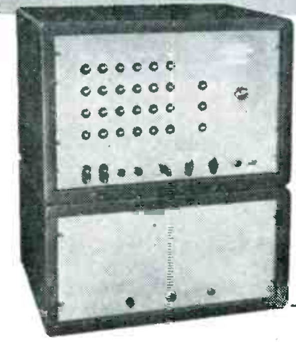

Universal 6-in-One
MEGACYCLE FREQUENCY-TIME COUNTER

Model 801
by Potter

Now, the Potter Instrument Company offers all in one equipment, the features heretofore available only in separate counting systems. Two complete counting channels, a 100 kc crystal oscillator time base and unique gating circuits are combined to provide the new FREQUENCY-TIME COUNTER.

FREQUENCY MEASUREMENTS	0 to 1 mc range by counting cycles per pre-selected time or by measuring time per pre-selected count. Accuracy 0.001% minimum.
TIME INTERVAL MEASUREMENTS	0 to 10 seconds ± 10 microseconds.
FREQUENCY RATIO MEASUREMENTS	Ratio of two external frequencies can be measured.
SECONDARY FREQUENCY	100 kc crystal oscillator with divided frequencies available at 10, 1 kc and 100, 10, 1 cps.
TOTALIZING COUNTER	Six decades, pulses 0 to 1 mc, sine wave 10 cps to 1 mc.
DIRECT RPM READING TACHOMETER	Through the use of an external 60 count per revolution photoelectric disc generator an accuracy of ± 1 rpm is obtained.

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STACKPOLE CARBON CO., St. Marys, Pa., has opened a new 45,000-sq-ft branch plant in Kane, Pa., for the manufacture of electronic components.

RADIO RECEPTOR CO., INC., Brooklyn, N. Y., manufacturer of radio and electronic equipment for governnment and industry, is increasing its plant capacity to manufacture germanium diodes.

UNION PLASTICS CORP., New York City, recently opened a new plant at Secaucus, N. J., that includes the newest development in machinery for the extrusion of Polychlorotrifluoroethylene.

AMPEX ELECTRIC CORP., manufacturer of magnetic tape recorders, has moved to a new plant in Redwood City, Calif. The new factory will include special departments for telemetering and instrumentation development.

GENERAL RADIO CO., manufacturer of electronic, radio and electrical laboratory apparatus, has begun construction of a new 72,000-sq-ft plant in Concord, Mass. All of its Cambridge facilities are still being maintained.

PERSONNEL

ROBERT DRESSLER, for the past five years in charge of various aspects of tv research for Paramount Pictures Corp., has been appointed director of research and development for Chromatic Television Laboratories, Inc., New York City.

STANLEY F. PATTEN, until recently director of mobilization planning for the Government Department of Allen B. Du Mont Laboratories, Inc., has been elected vice-president of the corporation.

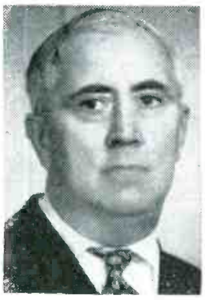
L. R. LUDWIG, with Westinghouse Electric Corp. since 1925, was recently appointed director of engineering and research for the company's atomic power division in Pittsburgh, Pa.

HARRISON JOHNSTON, formerly with General Electric Co., has been appointed manager of the newly created product engineering division of Ampex Electric Corp. His headquarters will be at the company's Redwood City, Calif., factory.

HENRY F. ARGENTO has been elected an assistant vice-president of Raytheon Mfg. Co., Waltham, Mass., and named assistant manager of the company's power tube division. He had served since 1941 as sales manager of the division.

EDWARD J. DUCKETT was recently appointed to the expanding development laboratories of Fisher Scientific Co., Pittsburgh, Pa. He will be in charge of the work of the electronics laboratory in the development of new laboratory instruments, apparatus and techniques.

JAMES B. FERGUSON, with Link Radio Corp., New York, N. Y., as consulting engineer since June 1950, has been appointed chief engineer of the organization.


J. B. Ferguson


A. W. Friend

ALBERT W. FRIEND, formerly a member of the research staff of RCA Laboratories at Princeton, N. J., was recently appointed director of engineering for the Daystrom Instrument Division of Daystrom, Inc., Elizabeth, N. J.

WILLIAM A. EDSON has been promoted from professor of electrical engineering to director of the school of electrical engineering at Georgia Institute of Technology, Atlanta, Ga.

SOL LEVINE, associated with Edo Corp., College Point, N. Y., for the past five years, was recently appointed chief engineer of the company's electronics division.

E. G. SHOWER, formerly a member of the technical staff of Bell Telephone Laboratories, has joined the staff of Radio Receptor Co., Inc., Brooklyn, N. Y., as chief engineer of its newly formed germanium division.

CARL F. MILLER, inventor of the Loktal radio receiving tube that locks in its socket, has been named manager of Westinghouse receiving tube development and design engineering.

MURRAY WEINSTEIN, former consulting engineer in the electronics industry, is now associated with Regal Electronics Corp., New York, N. Y.

PALMER M. CRAIG has been promoted from director of engineering in the electronics division of the engineering department to vice-president—engineering for the television and radio division of Philco Corp., Philadelphia, Pa.

HAROLD R. TERHUNE, formerly vice-president of the Mycalex Tube Socket Corp., Clifton, N. J., was recently appointed administrative engineer at Federal Telecommunication Laboratories, Inc., Nutley, N. J.

H. R. Terhune

W. R. MacGregor

WALLACE R. MACGREGOR, formerly on the FCC staff as common-carrier engineer, has joined Lenkurt Electric Sales Co. as manager of government sales for carrier telephone and telegraph systems.

W. L. PARKINSON of General Electric Co. has been named chairman of the RTMA Service Committee.

W. A. LAUDER, chief engineer of Unimax Switch Division of The W. L. Maxson Corp., New York, N. Y., has been elected chairman of the Precision Snap-Acting Switch Section of the National Electrical Manufacturers Association.

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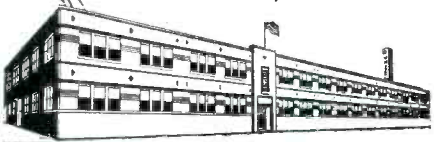

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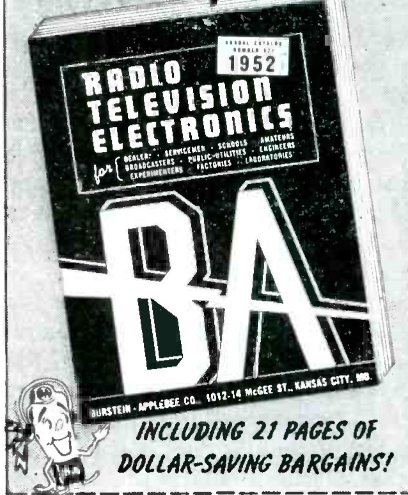

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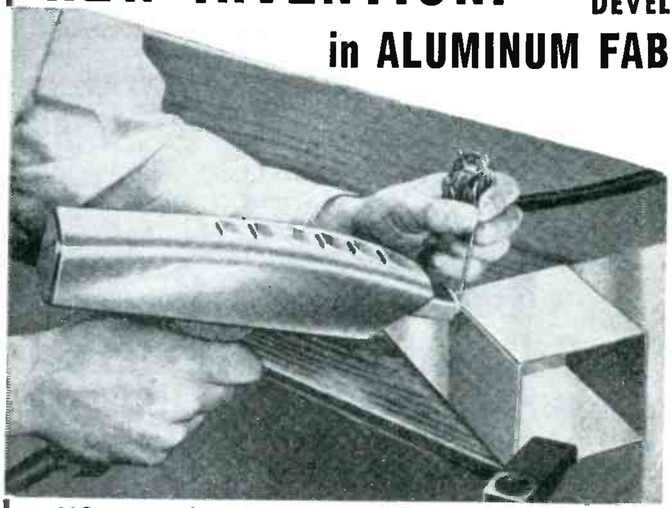

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(Continued from page 152)

the exception of saw-tooth generators and some notes on the cathode-ray tube there is little directly applicable to modern television deflection systems.

This is an ambitious attempt to incorporate in one volume a complete reference on time bases and their applications. As a result, one may not find adequate coverage on his particular problem. He will, however, find a wealth of background material and ample references.

Because of the ever-increasing use of time bases this book is almost certain to find an even greater acceptance than the widely used first edition.

R. F. Casey,

Development Engineering Section, Instrument Division, Allen B. Du Mont Laboratories, Inc.

Television Principles

By Robert B. Dome. *McGraw-Hill Book Company, New York,* 1951, 291 *pages,* $5.50.

An easily followed introductory text, on the engineering level, to the problems of television transmission and reception. As each of the successive portions of the complete television system is taken up, a discussion of the relevant theoretical principles is given. This discussion is followed immediately by the practical considerations encountered in the application of the principles and by problems for the student to solve. The range of the topics treated is broad enough to insure that any engineer who has gone through the text carefully will have had an effective introduction to the problems of the television art.

From the point of view of its use as a reference book, a sort of handbook of television engineering, the book is less satisfactory. The very plan of organization which is successful in making the book a readily followed introductory textbook requires the presence of large amounts of expository material. It also tends to distribute through the body of the book information which should preferably be kept together if the book were primarily intended for reference purposes. For example, the FCC Standards of Good

Engineering Practice are distributed in a number of places throughout the book rather than being in a single place for convenient reference.

A. V. LOUGHREN,
Director of Research, Hazeltine Corp.

The Earth's Magnetism

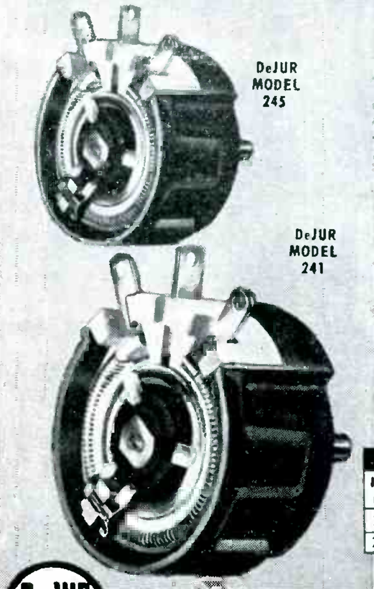
BY SYDNEY CHAPMAN. *Methuen's Monographs on Physical Subjects, John Wiley & Sons, Inc., New York, 1951, 127 pages, $1.50.*

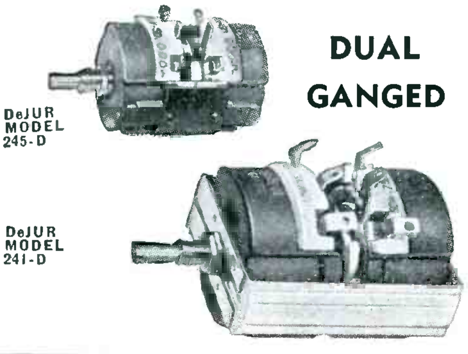
THIS pocket-size monograph is a revision of the one published in June 1936, and contains "a brief but fairly broad account of our present knowledge of the earth's magnetic field and its changes." Written by one of the foremost authorities, this book can be recommended as an excellent summary of an introduction to the subject, which the reader can supplement, if he so desires, by reference to the published works mentioned on page 117 of the monograph.

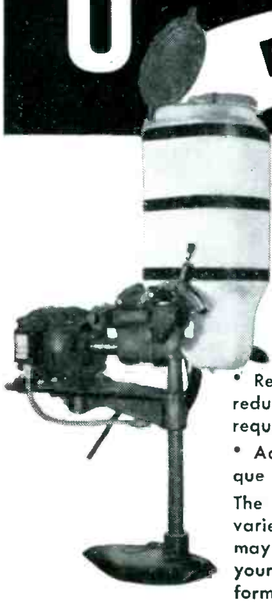
The book is largely descriptive, but also includes some theoretical material on the nature and causes of the earth's magnetic field and its variations. The book covers the main magnetic field of the earth and its variations—annual, secular and sunspot-cycle variations, solar quiet-day variations, lunar daily variations, and variations during magnetic storms—together with the relationships between magnetic disturbances and solar phenomena.

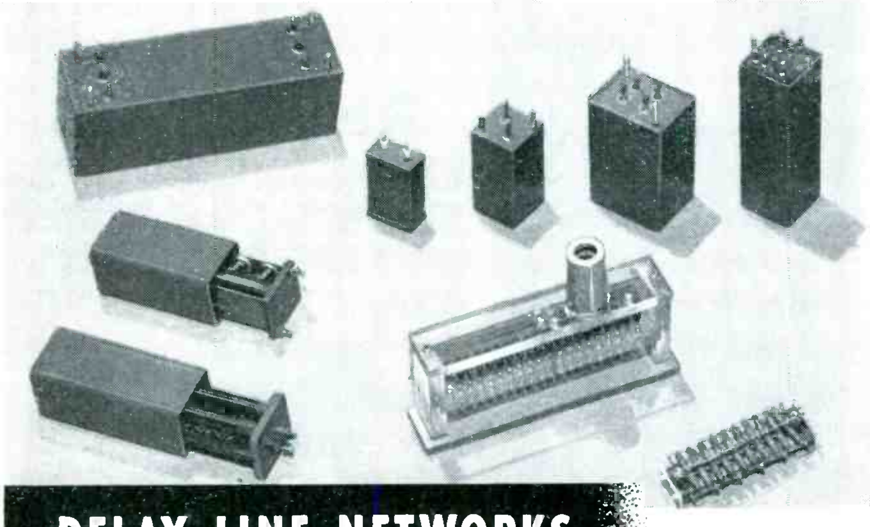
The new material which has been added since the first edition includes notes on the initiation of a magnetic storm and the ring current, the association of magnetic effects and sudden ionospheric disturbances, the recurrence tendency of weak and moderate storms, the association of great storms with solar outbursts, correlation with cosmic rays and ionospheric phenomena, the magnetic field anomalies at Huancayo, and an idealized picture of the portion of the disturbance field due to external causes. A number of sections have been rewritten to bring them into agreement with current theories, such as the theory of the origin of the solar quiet-day variations.

The mathematical development is









touched only briefly, and only passing reference made to the aurora, earth currents, or the importance of radio research in the study of the earth's magnetism. The book is well and clearly written and can well serve as an introduction to the subject for the layman as well as a pocket reference book for the more experienced person.—NEWBERN SMITH, *Chief, Central Radio Propagation Laboratory, National Bureau of Standards.*

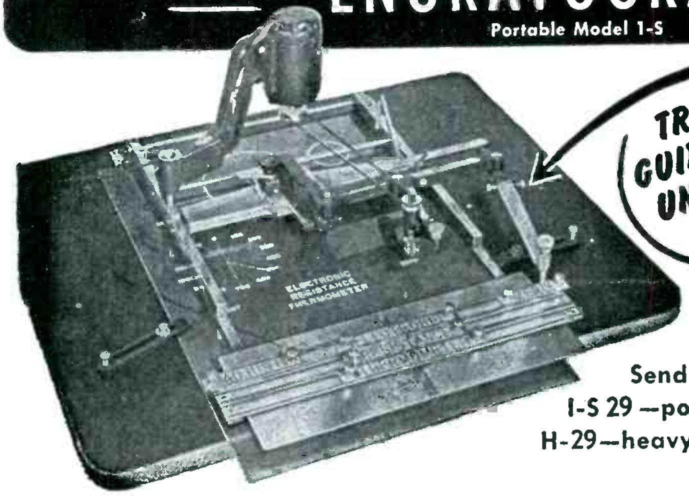
The High Pressure Mercury Vapor Discharge

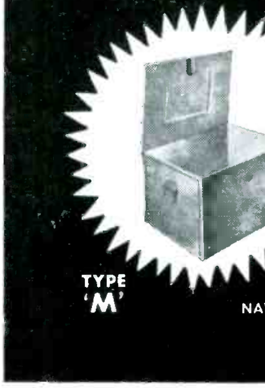
BY W. ELENBAAS. *North-Holland Publishing Company, Amsterdam; Interscience Publishers Inc., New York,* 1951, 173 *pages,* $4.00.

THIS book from the pen of one of the outstanding workers in the field of high-pressure vapor discharges, W. Elenbaas of the Philips Laboratories, Eindhoven, Holland, should be of great interest to scientists, engineers and others who are concerned with research and development or application of high-pressure lamps. Since the use of high-pressure vapor lamps for general illumination as well as for ultraviolet irradiation processes has been expanding very rapidly in the last several years, and promises to continue to do so in the foreseeable future, the appearance of this book is especially timely and welcome.

The author limits his book to high-pressure discharge phenomena in mercury vapor only. Most of the theory, however, applies to other high-pressure discharges as well. Temperature equilibrium in the arc has been assumed as a general principle. The excitation of atoms and electrons is then governed by Boltzmann's Law, i.e., the laws of thermodynamics, and the concentration of electrons and positive ions is then determined by the Saha equation. Based on these two equations the theoretical treatment yields results which are in general in excellent agreement with observation.

The book is divided into ten chapters. The first one deals with the history, definition and the mechanism of the high-pressure mercury vapor discharge. The second, third and fourth chapters dis-


ELECTRONIC RESISTANCE THERMOMETER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cuss the elementary theory and the temperature of the discharge and its distribution within it. Chapter five is devoted to the interesting problem of convection in the high-pressure vapor discharge. Other factors affecting the discharge, such as longitudinal and transverse magnetic fields and the addition of rare gases and vapors of other metals, are treated in chapter six. Compact arc sources, which are becoming increasingly important, are briefly referred to in chapter seven. The spectrum of the radiation emitted by high-pressure lamps is treated quantitatively and qualitatively in chapter eight.

The remaining two chapters deal with miscellaneous subjects, as for example the electrodes, modulation and dimensioning of lamps and a discussion of the equilibrium state.

Extensive use is made of mathematics to explain the physical phenomena and interpret measurements of radiation characteristics and other observations associated with high-pressure discharges. To the reader who is sufficiently equipped to follow the mathematical treatment, the results obtained are most illuminating and satisfying. To the average engineer who may be insufficiently trained in mathematics, some of the most interesting and important chapters could perhaps be made better accessible by placing more emphasis on the physical phenomena and the fundamental processes underlying them. This is by no means meant as a criticism of this excellent book, but rather as a suggestion for consideration in future editions.

J. H. LAUB,
Vice-President,
Hanovia Chemical & Mfg. Co.

Electronics

BY JACOB MILLMAN AND SAMUEL SEELY. *McGraw-Hill Book Co., Inc., New York*, 1951, *second edition*, 598 *pages*, $7.25.

IN GENERAL, the content and philosophy of the first edition have been retained in this second edition. The approach is fundamentally theoretical, and the information presented provides a thorough foundation for specialized work in any branch of electronics.

It should be emphasized that the

book is primarily intended to furnish theory, and not practical fundamentals. Little is presented that would benefit the practicing circuit designer directly. Studied alone, the book would leave the reader knowing much about electron phenomena, but his ability to apply his knowledge in the practical sense would be limited.

As a text for a basic college level course in the physical concepts of electronics (for which the book is intended), "Electronics" is as good, or probably a bit better, than most. After being used as a text for such a course, it fits into an engineer's library as a reference source.

The two chapters on audio amplifiers in the first edition have been omitted from the second. This is not too great a sacrifice, since audio amplifiers are well treated in the books that normally would be purchased subsequently for more advanced and specialized study.

—J. D. F.

Fundamentals of Atomic Physics

By Saul Dushman. *McGraw-Hill Book Company, New York, 1951, 294 pages, $5.50.*

The material of this volume was originally intended as an aid to a group of high school teachers of science in enlarging their "grasp of new developments in the physical sciences". Inasmuch as somewhat more than one third of the book is devoted to nuclear physics, including a 43-page chapter on particle accelerators, it would seem that "A Brief Survey of Modern Physics" might be a more fit title than the one used.

Many subjects are treated in this small volume, most of them necessarily with extreme brevity. Examples are the first chapter, correctly entitled "A Brief History of Physics", in which little more than a listing of scientists and their accomplishments can be given, and the second, "Mathematical Introduction", in which algebraic and trigonometric functions, differential and integral calculus, as well as partial differential equations, are discussed in 22 pages. It seems un-

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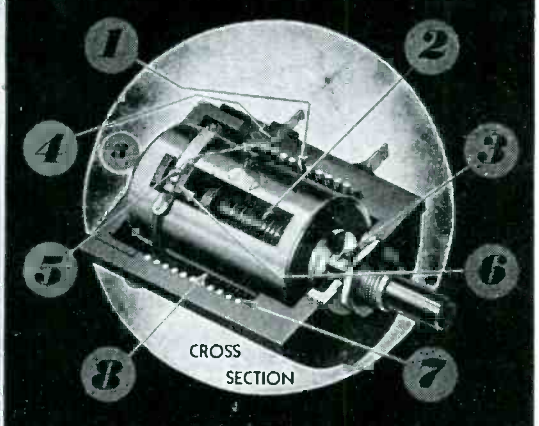

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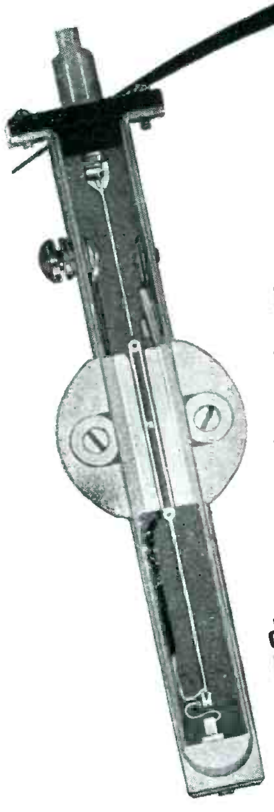

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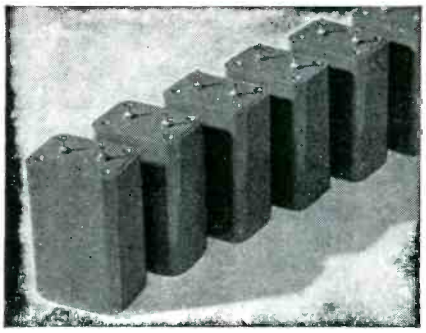
likely that teachers of science would profit by the cursory treatment of these subjects.

After the introductory material, two chapters are devoted to kinetic theory. An impressive number of equations is given, although they are usually made plausible, rather than derived. It is obvious that the author understands the subject in great detail but the impression is created that he must hurry along to complete his task in the allotted time. Chapter 5 through 11 cover the standard material of atomic physics—properties of the electron, photoelectric effect, x-rays, optical spectra and electron diffraction. Many quantitative relations are again given with brief derivation but with clear understanding and accuracy. The coverage is very wide and probably quite useful, as a review, to one who has already studied undergraduate courses in optics, mechanics, and electricity, but certainly too superficial for a student exposed to the material for the first time. The last part of the book, chapters 12 through 14, is devoted to nuclear physics, and gives an accurate review of this field, especially of the "big machines", including those not yet in operation. Excellent diagrams illustrating the operation of those accelerators, as well as simple explanations of the principles involved, are given in each case.

In covering the wide range of topics, the author often resorts to direct quotations, apparently in an effort to gain authenticity. These quotations add nothing to the value of the book and certainly are distracting in their frequency. As an example, the chapter on accelerators, consisting of 43 pages, contains 25 quotations, ranging from a sentence to over a page. In a different connection (p 227) a sentence from another author's condensation of the Smyth report is used. Judging from those sections containing no quotations, one is convinced that the author's own words are quite effective, and that he could do very well with them alone.

This book is certainly not a substitute for those texts in specific fields that it quotes, and would not



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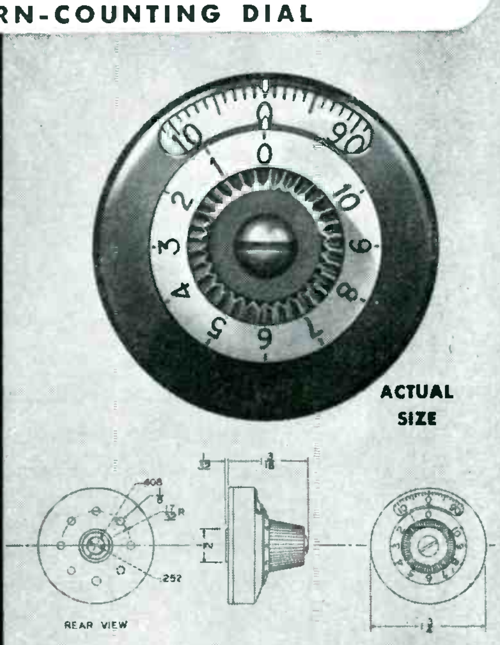

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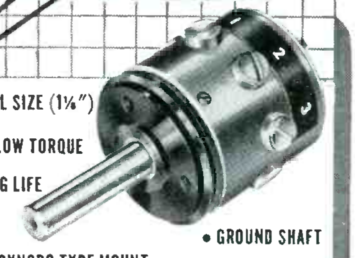

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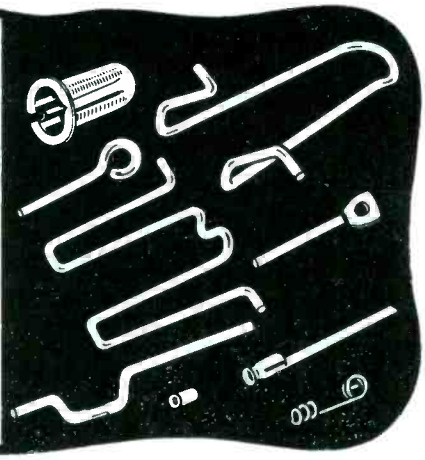

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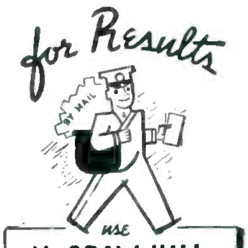

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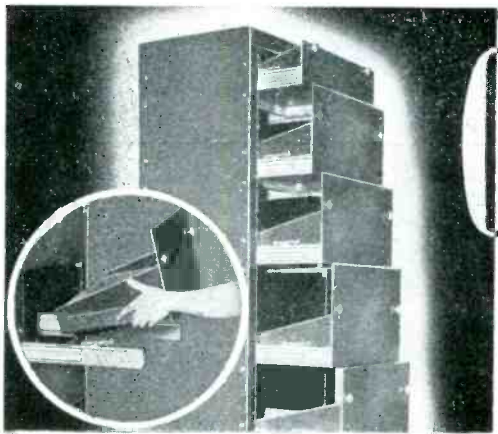

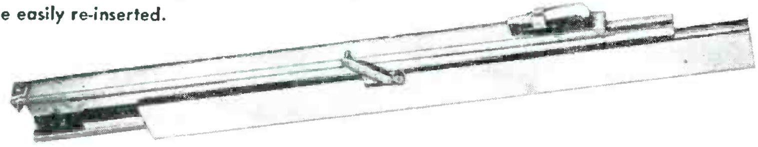

be useful for a student majoring in physics. However, it will serve very well as a review of modern developments for those already in possession of a general knowledge of physics, such as teachers of science or engineers.—D. J. HUGHES, *Brookhaven National Laboratory, Upton, Long Island, New York.*

THUMBNAIL REVIEWS

THEORY AND DESIGN OF VALVE OSCILLATORS. Second Edition. By H. A. Thomas. Chapman & Hall Ltd., 37 Essex St. W.C.2, London, 1951, 317 pages, 36s. Expansion of 1939 edition with five new chapters on uhf oscillators, velocity-modulated oscillators, magnetron oscillators, R-C oscillators and crystal oscillators.

THE PREPARATION OF PROGRAMS FOR AN ELECTRONIC DIGITAL COMPUTER. By Maurice V. Wilkes, David J. Wheeler and Stanley Gill. Addison-Wesley Press, Inc., Cambridge, Mass., 1951, 169 pages, $5.00. Procedure for building up a library of subroutines for carrying out standard mathematical processes on a machine such as the EDSAC, to make use of the machine feasible for problems requiring only a few hours of computing time. Covers types of machines, order codes, binary-decimal conversions, checking facilities, types of subroutines, proofreading of programs, tape punching, examples and specifications.

COLOR TELEVISION. By Edward M. Noll. Paul H. Wendel Pub. Co., Indianapolis, Ind., 1951, 45 pages, $1.00. Paper-cover booklet giving fundamentals of various proposed systems; intended as practical reference for experimenters and television servicemen.

HERBERT H. DOW. By Murray Campbell and Harrison Hatton. Appleton-Century-Crofts, Inc., New York, 1951, 168 pages, $3.50. An account of one man's share in the founding and building of The Dow Chemical Company.

ANALYSIS AND DESIGN OF TRANSLATOR CHAINS. By H. Ziebolz. Askania Regulator Co., Chicago, Ill., Second Edition, 1951, two spiral-bound volumes (Vol. 1—285 pages text; Vol. 2—392 diagrams), $6.00 per set. Intended to establish a systematic approach to the classification of mechanical, hydraulic, electric and electronic devices and thereby permit development of a number of alternate possible solutions to measurement and control problems.

200 MILES UP. By J. Gordon Vaeth, U. S. Navy Special Devices Center, ONR. The Ronald Press Co., New York, 1951, 207 pages, $4.50. History of upper air research with rockets and balloons, principles of rocket flight, V-2 operations at White Sands, and declassified information on Aerobee and Viking high-altitude sounding rockets. Intended as nontechnical but accurate summary of recent research.

CLEAR WRITING FOR EASY READING. By Norman G. Shidle. McGraw-Hill Book Co., New York, 1951, 176 pages, $3.00. Emphasis is on clear and simple writing using short sentences and short words. Examples and specific instructions are largely slanted toward engineers and technical writers.

CIVIL DEFENSE IN MODERN WAR. By Augustin M. Prentiss, Brigadier General, U. S. Army (Retired). McGraw-Hill Book Co., New York, 1951, 429 pages, $6.00. Text dealing with methods of protecting civil population and industrial plants against atomic, bacterial and chemical warfare. Includes recommendations on communications for civil defense.

BACKTALK

(continued from page 154)

all manufacturers of parts so that the Institute receives information as requested.

Suggestions as to the information and format which would be most useful for each category of miniature parts will be welcomed from interested potential users of this index. They may be sent either to Mr. William A. Mussen, Supervisor Electronics Laboratory, Southwest Research Institute, or to Mr. Wasyl Zaricki, Code 839, Bureau of Ships.

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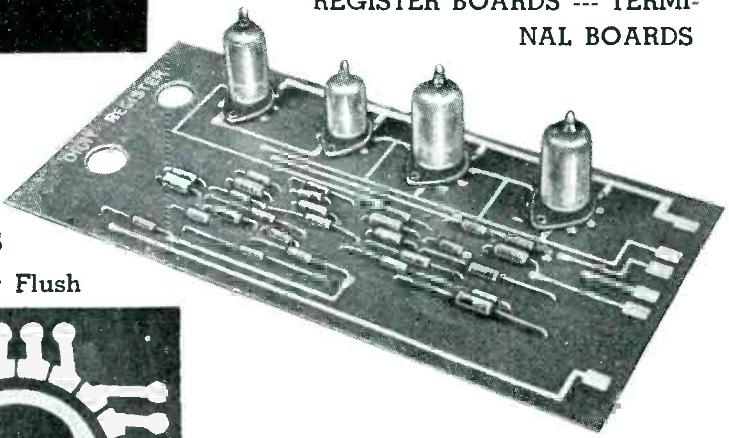
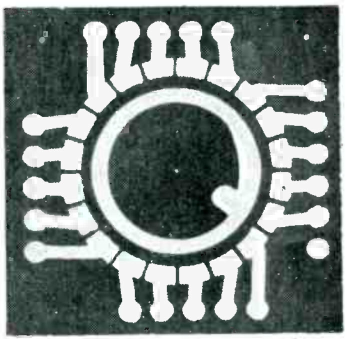
Audio Damping

DEAR SIRS:

AN ARTICLE entitled "Audio Amplifier Damping" by Robert M. Mitchell in the September 1951 ELECTRONICS (p 128) has provoked the thought that the term "damping factor" (D), conventionally defined by the author as the ratio of load impedance to generator impedance is an inept and somewhat misleading term. According to this definition, decreasing amplifier output resistance results in increasing damping factors with no limit applying. Since increasing the damping factor does not result in increasing the damping in the same proportion, erroneous conclusions as to the significance of damping factor might be made by people not having an understanding of the technical factors involved. For example, if in two amplifiers of otherwise equal specifications, one had a damping factor of 20 and the other a damping factor of 30, it is not apparent to the uninitiated that the difference in damping would be insignificant.

The necessity of keeping the output impedance of amplifiers low in comparison to the impedance of the speaker has been recognized ever since the advent of the tetrode and pentode output tubes. This reduction of output impedance is most easily obtained by the use of negative feedback. It is easy to achieve damping factors of the order of 10 with either triodes or tetrodes (or





pentodes) with uncomplicated and stable circuit arrangements. This practice is so general as to be incontrovertible.

The point of interest now rises as to how far this increase of damping factor should go without becoming absurd. It is our contention that increasing the damping factor beyond the order of 10 (for sake of the damping factor alone*) is not warranted from an engineering standpoint. This can most clearly be shown by redefining damping factor in such a way as to make more apparent its practical significance.

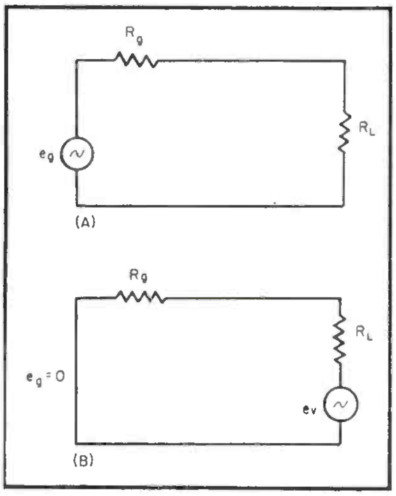


FIG. 1—Equivalent circuits showing audio amplifier damping

For this purpose it seems as though an electrical-damping figure of merit ϕ defined as

$$\phi = \frac{R_L + R_g}{R_L}$$

would provide a clearer understanding of the situation. This choice is not purely arbitrary but represents a figure as nearly in line with the actual principle of electrical speaker damping as possible. To see why this is so, let us review briefly the effect of the output impedance on the speaker.

Speaker damping is necessary because the moving parts of the reproducer (the voice coil) constitute the elements of a mechanically resonant system. This system is

---

* The increase of feedback for the purpose of reducing distortion or increasing the bandwidth may cause increase of damping factor to a greater order as a concomitant result.

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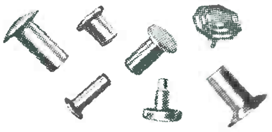

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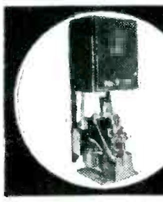

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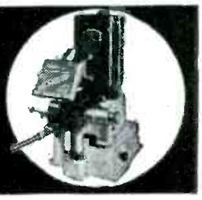

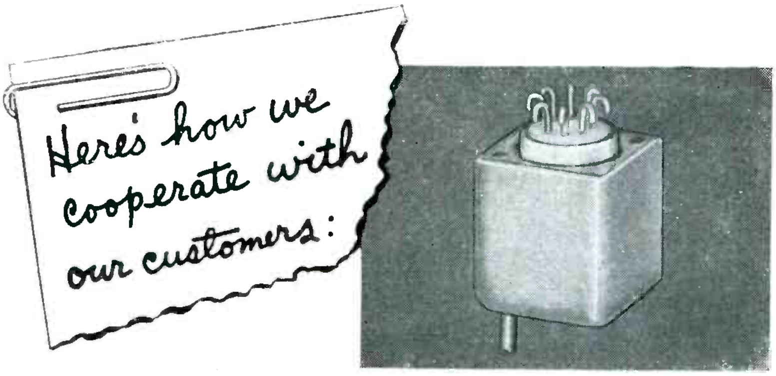

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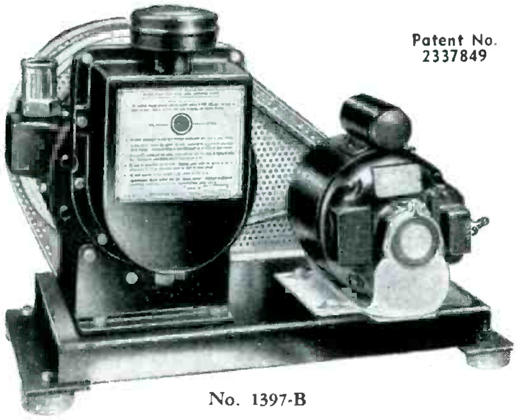

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damped acoustically by air, mechanically by friction, and electrically by the amplifier. When the speaker has been electrically excited by signals having frequency components in the vicinity of the mechanical resonance, the resulting vibration may persist after the electrical signal has ceased. This has been called "hangover effect". In the condition where the speaker cone is vibrating after the signal from the amplifier has ceased we may replace the conventional output circuit representation of Fig. 1A by Fig 1B in which the kinetic energy stored in the vibrating system causes a voltage to be generated in the voice coil (e_v).

Note that for both cases the electrical damping is provided by R_g in series with R_L. As R_g is reduced by feedback or other means, the total electrical damping resistance approaches R_L as an asymptote. Unless a means could be devised of making R_g negative, the damping resistance can never become less than R_L. This is why reduction of the amplifier output impedance beyond the point where it is small compared to R_L (corresponding to a large damping factor) runs into the law of diminishing returns. It can be seen that the hereby proposed term of "electrical damping figure of merit" approaches unity as a limit as amplifier impedance decreases, where unity could be considered the normalized speaker impedance.

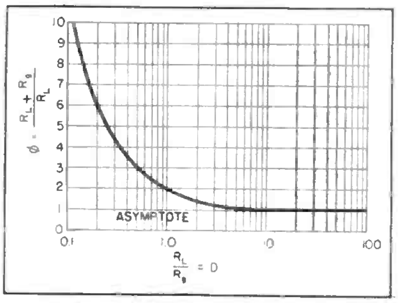

FIG. 2—Curve showing relationship between gain reduction factor and electrical damping figure of merit

In Fig. 2, Mitchell's Fig. 5 has been translated to the one of gain reduction factor versus electrical damping factor of merit. Compar-

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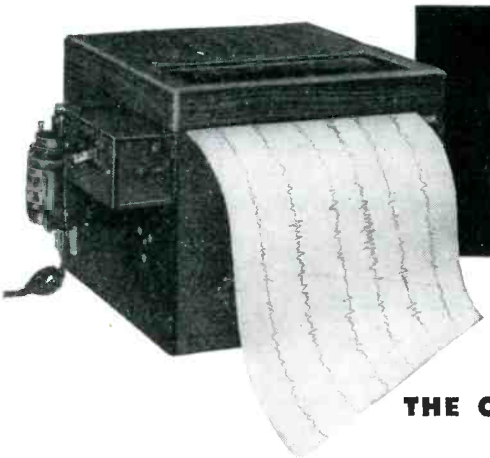

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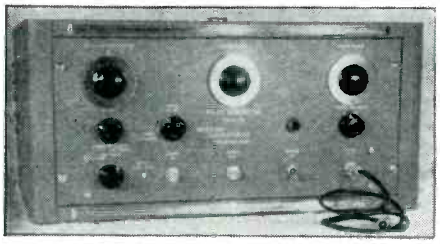

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ing the two curves it is seen that in Fig. 5 of Mitchell's article, the curve might well have been captioned "Note lack of superiority of triodes" instead of "Note superiority of triodes".

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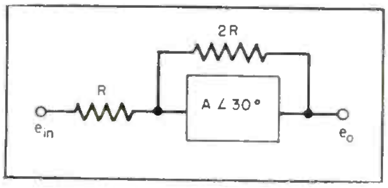
I WOULD appreciate very much your printing the following in *Backtalk* of the next available issue: "The article entitled 'Strain-Testing Railroad Bridges', appearing in the September, 1951 issue of ELECTRONICS, is based on a thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering at Purdue University."

A. D. M. LEWIS
Instructor in Structural Engineering
Purdue University

Electronics Quiz

BELOW is shown a quiz problem submitted by John J. Antul of the Transducer Corporation of America. The correct solution for this problem, as furnished by the author, will be published in next month's ELECTRONICS.

Given the amplifier shown in the circuit diagram, with an open-loop gain of A at an angle of thirty degrees leading. Introducing feedback $2R$ as shown, what is the maximum value of $|e_o|/|e_{in}|$?



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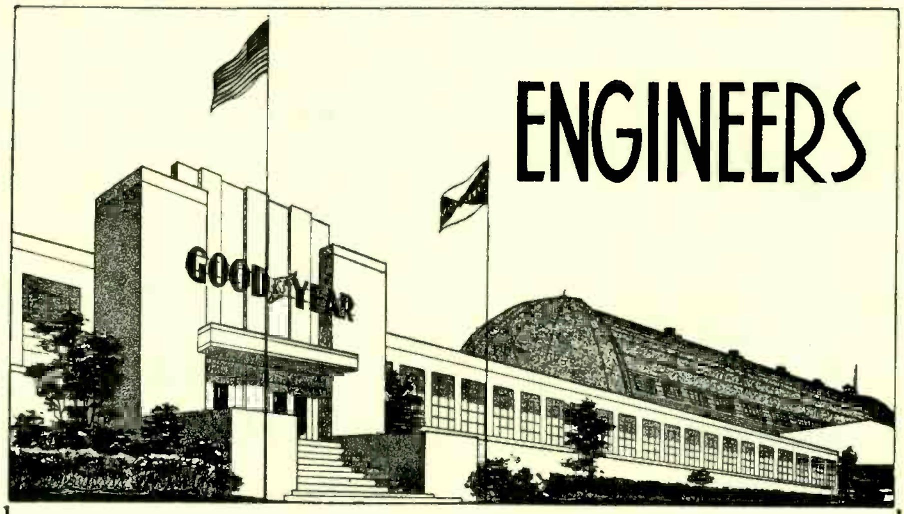

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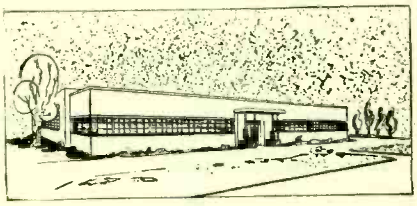

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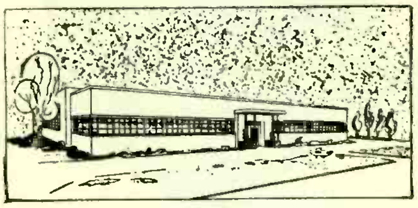

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PROJECT ENGRS.—Sonar, Servos, Propulsion, Guided Missiles, Fire Control, Radar, Cameras, Thermodynamics, etc. .... V-HIGH

PATENT ATTORNEY—Electronics......... HIGH

GROUP LEADERS—Electro-Mechanical devices, Circuitry Research, Cold Cathode Tubes, Instrumentation, Computers .... $7500-$8500

RESEARCH ENGRS—Magnetic Devices, Circuit & Transistors Design & Lab exp.......... HIGH

MATH.-LOGICIANS: Digital Comp...... $6600 up

SEND DUPLICATE RESUMES

FRANKLIN
225 S. 15th St. Phila. 2, Pa.

ENGINEER WANTED

BOSTON AREA

We are seeking an engineer who has shown ingenuity in the field of small electro-mechanical devices, switches, relays and the like, and who is able to analyze electronic circuits in which they are used.

The man who can satisfactorily demonstrate his ability to us will qualify for the position of assistant chief engineer in our firm. Formal education is not important to us, but ingenuity is.

The man we want has a strong conviction that his future lies in a company of one hundred employees or less where his work will be seen and will be appreciated.

Our company, located in Boston, is well established and preeminent in its field. Our employees know of this advertisement. If you think you qualify, please telephone our advertising agency, Hancock 6-3565, who will arrange for an interview with our chief engineer, or write

P-2689, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED MANUFACTURER'S REPRESENTATIVES

Territories Open in the Entire South, Midwest and parts of Iowa, Mich. and Ohio.

Prominent New York electronic manufacturer wants representatives now contacting manufacturers and laboratories to sell 5" wide-band high-gain oscilloscope in the $400 class.

Please write full details of lines now handled, area covered and other pertinent facts.

RW 2621 ELECTRONICS
330 W. 42nd St., New York 36, N. Y.

MILITARY TRAINING INSTRUCTORS

The Signal School located at Fort Monmouth, New Jersey, has a number of attractive civilian openings for military training instructors in communications and electronics, such as theory of electricity, mobile and fixed station radio, microwave radio relay, repeater and carrier, radar, and motion picture techniques.

Current vacancies are at all levels ranging from trainee positions grade GS-5 to senior instructors grade GS-9. Attractive salaries ranging from $3410 to $5060 and good promotional opportunities are offered.

These civilian instructers will train officer and enlisted military personnel in the theory, installation, repair, maintenance and operation of communication, electronic and associated equipment, as indicated above.

Applicants hired as trainees will be given an accelerated training course in teaching techniques. Those who satisfactorily complete this training may be promoted progressively to senior instructor positions grade GS-9 within 8 to 12 months.

Applications may be obtained from 1st and 2nd Class Post Offices. Mail to:

Civilian Personnel Division
SIGNAL CORPS CENTER AND FORT MONMOUTH
Fort Monmouth, N. J.

CORNELL AERONAUTICAL LABORATORY, INC.

an affiliate of Cornell University

employs about 700 people on vital research work in all branches of aeronautical science. We are gradually expanding our scientific staff, and have several permanent positions open for:

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FLIGHT RESEARCH
DEVELOPMENT ENGINEERING
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THERMODYNAMICS

Minimum requirement is a B.S. Advanced degrees are even better, but experience to back up the degree is really best. We pay industrial salaries. Other tangible advantages here (for example, our self-sponsored internal research policy) should be of particular interest to men with intelligence, ingenuity, and initiative. Send us your resume; all inquiries are strictly confidential. Promising candidates will be invited to Buffalo for interviews at Laboratory expense.

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Development Engineers

With Several Years Design Experience or Advanced Degrees

for Permanent Positions with

IBM
TRADE MARK

Endicott, N. Y. Poughkeepsie, N. Y.

Fields of Electronics, Circuitry, Mechanisms and Micro-Waves

Excellent working and living conditions, good salaries, exceptional employee benefits.

Write, giving full details, including education and experience to: Mr. R. H. Austin, Personnel Director, International Business Machines, 1723 North Street, Endicott, N. Y.

INTERVIEWS ARRANGED IN YOUR CITY

AC SPARK PLUG DIVISION of GENERAL MOTORS CORPORATION

PRECISION INSTRUMENT PLANT

Positions now available for highest caliber personnel in the field of airborne automatic electro-mechanical control equipment.

MECHANICAL DESIGN ENGINEERS
ELECTRONIC ENGINEERS
SERVO ENGINEERS
ELECTRONIC DESIGNERS
MECHANICAL DESIGNERS

New and expanding division of an established firm with 20 years of successful experience in the instrument field. Work involved deals with the manufacture and development of highly complex equipment of the most advanced type.

Write or Apply

AC Spark Plug Division
GENERAL MOTORS CORPORATION
1925 E. Kenilworth Place
Milwaukee 2, Wisconsin

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radio test ENGINEERS and TECHNICIANS

for alignment, test and trouble-shooting of complicated radio equipment. These jobs require thorough theoretical knowledge and extensive experience in practical radio. Pay is excellent (many technicians earn up to $120.00 a week), working conditions are of the finest, opportunities for advancement are good, and you'll like the employee benefits. Write for an interview or send resume of qualifications to B. V. Mayrhauser.

THE TURNER COMPANY

909 17th St. N. E.
Cedar Rapids, Iowa

METERS

3MA DC 2½" R—Simpson black scale	$3.35
500 Microamps, DC—2½" round—Sun	4.30
1ma. DC Fan type—4" scale (rem. from equipt)	3.95
500 ma. DC 2½" R.—General Electric	2.95
2 amp. RF 2½" Sq.—Simpson	3.15
5 amp. AC 4½" R.—JBT	4.11
30 V DC 2½" R—General Electric	3.95
3 amp. RF 3½" R.—Weston	6.00

OIL-FILLED 35 KV AND 50 KV ISOLATION TRANSFORMERS

Pri. 460V 60 cy. Sec. 115V 200 VA Insulated for 50KV DC—G. E. Form EIR—36"H x 13"D $125.00

Pri. 115V 60 cy. Sec. 115V 250 VA Insulated for 35 KV DC—G. E. Form EIR—29"H x 12½"D $125.00

VOLTAGE DIVIDER

G.E. Cat. 8248886G-1 and 9001934G-1 17.246,400 ohms 35KV 70:1 ratio wire wound shielded oil-filled 40"H x 12"D $77.50

2φ LOW INERTIA SERVO MOTORS

KOLLSMAN Type 937-0240—85/68V 100 cy 5 watts 2650 RPM—new $12.95

DIEHL. Type FPE-25-11 75V 60cy 4 watts — new $34.50

OIL FILLED CONDENSERS

MFD	VDC	Price	MFD	VDC	Price
2	400	$.55	.1–.5	2000	.95
5–5	400	1.65	.25	2000	1.50
1	600	.55	.3	2000	1.30
2	600	.69	1	2000	1.95
2	600R'd	.69	12	2000	8.95
4	600	1.65	1–1	2500	3.85
4	600R'd	1.65	32	2500	15.80
5	600	1.75	.5	3000	2.40
6	600	1.85	.03	4000	1.25
8	600R'd	1.85	3 x .2	4000	2.95
8–8	600	1.95	.1	5000	1.60
4–4–4	600	2.50	.2	5000	2.50
4 x 3	600	2.50	1	5000	4.88
1	1000	.65	.01–.03	6000	1.65
2	1000	.90	.1	7000R'd	1.79
2	1000R'd	.95	.1	7500	2.85
3.5–.5	1000	1.85	1	7500	12.50
4	1000	1.95	.1	12KV	8.95
6	1000	2.50	.045	16KV	4.70
8	1000	3.25	.05	16KV	4.95
1	1200	.85	.075	16KV	8.95
1–1–1	1200	1.85	.25	20KV	19.95
.1	1500	.59	10	330VAC	3.95
.5	1500	1.25	5	440VAC	3.10
4	1500	2.95	7	660VAC	4.25
			8	660VAC	4.50

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy. Sec. 6250V 80 MA—12.5 KV Ins. $18.50

G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA 12.5 KV Ins. $18.50

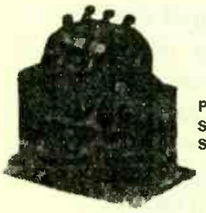
Raytheon—Pri. 115V 60 cy. Sec. 8500/6450V CT 43 MA Hermetically sealed $22.50

CRYSTAL DIODES

1N21	$1.19	1N23	$1.95	1N34	$ .79
1N21A	1.69	1N23A	3.25	1N34A	.95
1N21B	4.00	1N23B	5.25	1N45	.94
1N22	1.09	1N27	1.79	1N52	1.05

ANTENNAS

AT-38A/APT (70 to 400MC)	$13.70
AT-49/APR-4 (300 to 3300MC)	13.70
AN-74B (125 to 150MC)	3.25
AN-65A (P/O SCR-521)	1.50
AN-66A (P/O SCR-521)	1.75
A1A-3CM conical scan	125.00
ASB Yagi—5 element 450 to 560MC	7.00
ASB Yagi—Double stacked 6 element	12.70
ASA Yagi—Double stacked 370 to 430MC	29.40



WESTINGHOUSE HYPERSIL TRANSFORMER

PRI-115V. 60CY ¾ KVA
SEC #1 - 240V - 1.56A
SEC #2 - 240V - 1.56A
WT. 30 LBS.

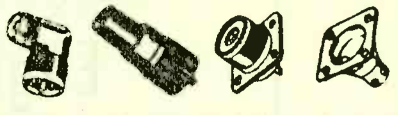
$14.50 EACH

GENERATORS

- Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output—AC 115V 10.4A 800 to 1400cy. 1φ: DC 30 Volts 60 Amps. Brand New $38.50
- Eclipse-Pioneer type 1235-1A. Output—30 Volts DC 15 Amps. Brand New—Original Packing..$15.50

Terms 20% cash with order, balance C. O. D. unless rated. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

COAXIAL CONNECTORS



83-1AC	$ .42	83-1RTY	$ .65	83-22R	$ .68
83-1AP	.30	83-1SP	.50	83-22SP	1.15
83-1F	1.30	83-1SPN	.60	83-22T	1.95
83-1H	.10	83-1T	1.30	83-168	.15
83-1HP	.25	83-2AP	1.95	83-185	.15
83-1J	.80	83-22AP	1.40	83-765	.24
83-1R	.40	83-22F	2.10	83-776	.85
		83-22J	1.50		

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS

IN STOCK

UHF—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG-83/U	$1.85	UG-185/U	$1.60
UG-12/U	.95	UG-85/U	1.75	UG-191/AP	.80
UG-15/U	1.50	UG-86/U	2.50	MX-195/U	.75
UG-18/U	1.25	UG-87/U	1.60	UG-197/U	2.80
UG-19/U	1.80	UG-88/U	1.60	UG-201/U	1.95
UG-21/U	.95	UG-89/U	1.60	UG-203/U	.85
UG-21A/U	1.50	UG-90/U	1.60	UG-206/U	1.80
UG-21B/U	1.35	UG-98/U	1.85	UG-224/U	1.40
UG-22/U	1.35	UG-102/U	1.15	UG-236/U	3.85
UG-22B/U	1.65	UG-103/U	.68	UG-245/U	2.30
UG-23/U	1.20	UG-104/U	1.40	UG-254/U	2.75
UG-23B/U	1.90	UG-106/U	.15	UG-255/U	2.45
UG-24/U	1.30	UG-108/U	2.60	UG-260/U	1.60
UG-25/U	1.35	UG-109/U	2.60	UG-261/U	1.60
UG-27/U	1.30	UG-146/U	2.55	UG-262/U	1.60
UG-27A/U	2.95	CW-159/U	.60	UG-273/U	2.25
UG-29/U	1.55	UG-166/U	32.50	UG-274/U	2.75
UG-30/U	2.30	UG-167/U	5.85	UG-275/U	5.50
UG-34/U	16.50	UG-171/U	2.80	UG-276/U	2.75
UG-36/U	17.50	UG-173/U	.40	UG-290/U	1.60
UG-37/U	17.50	UG-175/U	.15	UG-291/U	1.75
UG-57/U	2.30	UG-176/U	.15	UG-306/U	2.95
UG-58/U	.80	UG-177/U	.24		

QUOTATIONS UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358
M-359
M-359A
M-360
MC-277
MC-320
PL-258
PL-259
PL-259A
PL-274
PL-284
PL-293
PL-325
SO-239
SO-264
TM-201

93-C
93-M
49120
49121A
D-163950
D-166132
ES-685696-5
ES-689172-1

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
60	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8"
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1 Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

DUAL "JJ" POTENTIOMETERS

50	SS	500	SS	1 Meg	SS
100	SS	1K	SS	2.5 Meg	SS
250	SS	2500	SS	5 Meg	SS
330	SS	10K	SS	1K/25K	3/8"

TRIPLE JJJ POTENTIOMETERS

100K/100K/100K—⅜" 20K/150K/15K—⅝"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A-260 W.E. D-173013
A.E. GL832BA0
ANY TYPE—$14.88 EACH

TS-10 Type Handsets ....$8.92 ea.

F. W. BRIDGE SELENIUM RECTIFIERS

AC Volts Input — 18		AC Volts Input — 40	
DC Volts Out — 14.5		DC Volts Out — 34	
1.3 Amps	$3.85	0.6 Amps	$4.60
2.4 Amps	4.95	1.2	5.95
6.6 Amps	7.75	3.2	8.95
13.0	12.75	6.0	15.50
17.5	15.75	9.0	17.60
26	22.75	12	26.95
39	35.50	18	32.50
52	38.50	25	42.50
70	49.50	36	55.50

130 VAC ½ WAVE STACKS

75MA	$.88	150MA	$1.30	250MA	$1.75
100MA	$1.10	200MA	1.57	400MA	2.60

3 PHASE INVERTERS

Voltage and Frequency Regulated
Eclipse Pioneer Type 12121A

DC Input—24 Volts 18 Amps
AC Output—115 Volts 1.25 Amps 3 Phase
250 VA 0.7 P.F. 400 Cycles
12,000 RPM 65°C Temp. Rise

Brand New $225.00

TEST EQUIPMENT

• I-222A Signal Generator	* $79.50
• I-72K Signal Generator	$48.50
• C-D Quietone Filter Type IF-16 110/220V AC/DC 20 Amps.	* $9.00
• TS-127/U Freq. Meter w/spares	$69.50
• TS-143/CPN Oscilloscope	* $95.00
• Dumont 175A Oscilloscope	*$225.00
• LM-20 Frequency Meter	* $49.50
• Gen. Radio 757-PI Power Supply	* $27.00
• TS-6/AP Frequency Meter	* $42.00
• I-130A Signal Generator	* $85.00
• A.W. Barber Labs. VM-25 VTVM	* $86.00
• TS-10A/APN Delay Line Test Set	$45.00
• TS-19/APQ-5 Calibrator	$75.00
• REL W-1158 Frequency Meter 160-220 MC	$32.95
• CWI-60AAG Range Calibrator for ASB, ASE, ASV and ASVC Radars	$39.95
• CRV-14AAS Phantom Antenna for Transmitters up to 400 MC	$11.75
• 3 CM Pickup Horn Antenna. AT-48/UP	$9.95
• I-138A Signal Generator—10 cm	*$185.00
• BC-221 Frequency meter	* $95.00
• BC-221 Freq. Meter (with modulation)	*$125.00

All items New Except Where noted * (Exc. Used Condition)

MISCELLANEOUS EQUIPMENT

Amperex 1B98 Gamma Counter	$ 9.87
Powerstat 1226—115/230V Input—0-270V out @ 9 amp.	37.00
EIMAC 35T Ionization Gauge	5.95
ATR Inverters 6VDC to 110 VAC 60 cy 75W	22.95
ID-6/APN-4 Indicator	29.50
R-7/APS-2 Receiver	49.50
R-78/APS-15 Receiver	49.50
FL-8 1020 cycle filter	2.95
RM-29 remote control unit	8.95
RM-14 remote control unit	8.95
RTA-1B 12/24 V dynamotor	40.00
BC-1206-CM2 Receiver	12.95
CY-230/MPG-1 Radar Console	575.00
ASB-4 Radar equip. Complete	69.75
T-9/APQ-2 less tubes	16.50
RCA AVR-15 Beacon Recvr	18.50
TBY Trans-Recvr	29.95
Pioneer Type 800-1B Inverters—28VDC to 120V 800 cy 7 amp AC (used)	22.65
G.E. Inverter—28VDC to 120 VAC 800 cy 750VA 1 φ	39.50
Navy SD-3 Radar complete	1200.00
Navy DP-14 Direction Finder complete	385.00

PULSE TRANSFORMERS

UTAH 9262 9278 9280 **UTAH** 9318 9340 9350

G.E. 68G-627
G.E. 68G828
G.E. 68G929G1
G.E. 80G13
G.E. K-2469A
G.E. K-2744B
AN/APN-9 (901756-501)
AN/APN-9 (901756-502)
AN/APN-9 (352-7250)
AN/APN-9 (352-7251)
Westinghouse 132-AW
Westinghouse 139DW2F
Westinghouse 187AW2F
Westinghouse 232-AW2
Westinghouse 232-BW-2
AN/APN-4 Block Osc.
Philco 352-7149
Philco 352-7150
Philco 352-7071
Philco 352-7178
Raytheon UX-7350
W.E. D-161310
W.E. D-163247
W.E. D-163325
W.E. D-164661
W.E. KS-9563

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power Input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.

Originally designed to record pulse or sine-wave modulated signals received by AN-APR-1, AN/APR-2, AN-APR-4, AN/APR-5. BC-348. S-27, SX-28. BRAND NEW $147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS, 67 ohms Imped. 3 sections $4.30

7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 microsec. 200 PPS, 67 ohms Imped. 3 sections $6.75

7.5 E4-16-60-67P, 7.5 KV, "E" Circuit 4 sections. 16 microsec. 60 PPS. 67 ohms Imepd $8.25

15 E4-.91-400-50P. 15KV. "E" circuit .91 microsec. 400 PPS. 50 ohms Imped. 4 sections $16.50

15-A-1-400-50P, 15KV, "A" Circuit, 1 microsec. 400 PPS. 50 ohms imped $37.50

15 E7-2-200-50P. 15KV "E" Circuit, 2 microsec. 200 PPS, 50 ohms imped., 7 sections $42.00

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715-19 ARCH ST. PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3

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GUARANTEED
BRAND
NEW

TUBE SPECIALS

STANDARD
BRANDS
ONLY

Receiving Tubes

OOA	$1.50
O1A	.67
OZ4	.74
OZ4A	.90
1A3	.99
1A5GT	.72
1A6	.99
1A7GT	1.10
1AB5	.96
1B3GT	.99
1B4P	1.17
1C5GT	.99
1C6	.69
1C7G	.69
1D5GP	.69
1D7G	.69
1D8GT	1.17
1E5GP	1.17
1F4	.69
1F5G	.69
1G4GT	.69
1G5G	.69
1G6GT	.69
1H4G	.89
1H5GT	.74
1H6G	.99
1H6GT	1.10
1J6G	.99
1J6GT	1.10
1L4	.74
1LA4	1.10
1LA6	1.10
1LB4	1.10
1LC5	.99
1LC6	1.10
1LD5	1.10
1LE3	1.10
1LH4	1.10
1LN5	.91
1N5GT	.93
1N6G	.97
1P5GT	.99
1Q5GT	.99
1R4	.69
1R5	.89
1S4	.93
1S5	.93
1T4	.93
1T5GT	.99
1U4	.93
1U5	.81
1V	.88
1X2	1.20
2A3	1.28
2A5	.79
2A7	.89
2B7	.79
2E5	.94
2X2	.89
2X2A	1.85
3A4	.65
3A5	1.89
3A8GT	2.25
3B7	.69
3C6	1.15
3D6	.69
3LF4	1.10
3Q4	.93
3Q5GT	1.10
3S4	.93
3V4	.93
5AZ4	.69
5T4	1.92
5U4G	.69
5V4G	1.20
5W4	.82
5X4G	.87
5Y3GT	.59
5Y4G	.75
5Z3	.87
5Z4	1.20
6A3	1.29
6A4	1.35
6A6	1.17
6A7	1.05
6AB4	.99
6AB7	1.39
6AC5GT	1.35
6AC7	1.45
6AC7W	3.25
6AD6G	.98
6AD7G	1.39
6AE6G	.89

6AF6G	1.19
6AG5	1.19
6AG7	1.59
6AH6	1.56
6AJ5	2.50
6AK5	1.85
6AK5W	3.05
6AK6	.99
6AL5	.69
6AL5W	2.90
6AQ5	.89
6AQ6	.79
6AS6	3.65
6AS7G	4.53
6AT6	.63
6AU6	.69
6AV6	.63
6B4G	1.60
6B5	1.20
6B7	1.19
6B8	.99
6B8G	.85
6BA6	.72
6BC5	.88
6BE6	.72
6BF5	1.10
6BG6G	1.92
6BH6	.99
6BQ6GT	1.26
6C4	.65
6C5	.75
6CB6	.89
6C6	.88
6C8G	1.35
6CD6G	2.40
6D6	.88
6D8G	.99
6E5	1.10
6F5GT	.83
6F6	.99
6F6G	.99
6F7	1.05
6F8G	1.60
6G6G	1.06
6H6	.83
6H6GT	.83
6J5	.75
6J5G	.64
6J5GT	.64
6J6	1.19
6J7	.99
6J7GT	.79
6J8G	1.28
6K5GT	.99
6K6GT	.69
6K7	.88
6K7G	.88
6K8	1.22
6K8GT	.96
6L5G	1.06
6L6	2.13
6L6G	1.99
6L6GA	1.75
6L7	1.08
6L7G	.95
6N7	1.44
6N7GT	1.20
6P5GT	.96
6Q7	.99
6Q7G	.89
6R7	.99
6S7	1.06
6S7G	.99
6SA7	.99
6SA7GT	.89
6SB7Y	1.05
6SC7	1.20
6SC7GT	1.05
6SD7GT	1.10
6SF5	.83
6SF5GT	.80
6SF7	.69
6SG7	.91
6SH7	.99
6SH7GT	.99
6SJ7	.89
6SJ7GT	.89
6SK7	.89
6SK7GT	.89
6SL7GT	1.05
6SN7GT	.89
6SN7WGT	2.30
6SQ7	.75
6SQ7GT	.75
6SR7	.81

6SS7	.99
6ST7	1.25
6T7G	1.09
6T8	1.28
6U5	1.19
6U7G	.88
6V6	1.60
6V6G	.89
6V6GT	.79
6W4GT	.72
6W6GT	.99
6X4	.59
6X5GT	.59
6Y6G	1.19
6ZY5G	.89
7A5	1.08
7A6	.89
7A7	.89
7A8	.89
7AD7	1.44
7AH7	1.08
7B4	.89
7B5	.89
7B6	.89
7B7	.89
7B8	.89
7C4	.69
7C5	.89
7C7	1.08
7E5	1.20
7E6	.79
7E7	1.06
7F7	1.09
7F8	1.59
7G7	1.32
7H7	.99
7J7	1.32
7K7	1.32
7L7	1.32
7N7	1.09
7Q7	.99
7S7	1.32
7V7	1.32
7W7	1.32
7Y4	.89
7Z4	.89
10	.45
12A	.79
12A6	.89
12A6GT	.79
12A7	1.16
12A8GT	.89
12AH7GT	1.32
12AT6	.59
12AT7	1.15
12AU6	.79
12AU7	.95
12AV6	.63
12AX7	1.08
12BA6	.72
12BA7	.95
12BE6	.70
12C8	.89
12F5GT	.79
12H6	.69
12J5GT	.69
12K8	.99
12Q7GT	.89
12SA7	.89
12SA7GT	.89
12SF5	.79
12SF5GT	.79
12SF7	.79
12SG7	.99
12SH7	.89
12SJ7	.89
12SJ7GT	.89
12SK7	.81
12SL7GT	1.03
12SN7GT	.99
12SQ7GT	.79
12SR7GT	.89
12X3	1.19
12Z3	.89
14A4	1.32
14A7	1.09
14B6	1.09
14B8	1.09
14C5	1.29
14C7	1.15
14E7	1.29
14F7	1.09
14H7	1.15
14J7	1.29
14N7	1.29

14R7	1.29
14W7	1.29
14X7	1.29
19	.89
19T8	1.16
22	1.16
24A	.79
25A6	1.16
25L6GT	.89
25Z5	.99
26	.79
27	.69
28D7	1.35
30	.72
30 Spec.	.48
31	.62
32	.99
32L7GT	1.29
33	.99
34	.99
35/51	.79
35A5	.89
35B5	.99
35L6GT	.89
35W4	.55
35Y4	.89
35Z4GT	.69
35Z5GT	.59
36	.69
37	.69
38	.69
39/44	.59
41	.99
42	.89
43	.89
45	.89
45Z5GT	.79
46	.99
47	.99
48	1.60
50	1.41
50A5	1.09
50B5	.88
50C5	.88
50L6GT	.79
50Y6GT	.92
53	.95
55	.99
BK55B	.40
L55B	.32
56	.69
57	.89
58	.89
59	1.24
70L7GT	1.52
71A	.79
75	.89
76	.69
77	.69
78	.79
79	.89
80	.65
81	1.41
82	1.19
83	1.59
83V	1.45
84/6Z4	.79
85	.79
89Y	.55
117L7GT	1.89
117P7GT	1.89
117Z3	.74
117Z6GT	.97
FM-1000	1.59

Cathode Ray Tubes

2AP1	$9.75
2AP5	9.75
3AP1	10.25
3AP4	10.25
3BP1	7.95
3CP1	2.25
3DP1	4.85
3DP1A	6.75
3EP1	4.95
3FP7	2.95
3GP1	4.95
3HP7	4.91
4AP10	4.75
5AP1	5.95
5AP4	4.75
5BP1	5.75
5BP4	5.75
5CP1	4.95
5CP7	7.95
5FP7	2.85
5HP1	5.75
5HP4	5.75
5JP1	26.50
5JP2	26.50
5JP4	26.50
5LP1	19.75
5LP5	19.75
5MP1	10.65
7BP1	8.75
7BP7	7.95
7BP12	14.95
7BP14	14.95
7CP1	14.95
9GP7	12.85
9LP7	9.95
10BP4	18.50
10FP4	24.50
12DP7	16.50
12GP7	16.50
12HP7	16.50
902PI	9.95
905	4.45

Photo Cells

1P23	$4.10
1P24	1.27
918	1.65
919	1.95
923	1.35
927	1.85
931A	6.95
1645	1.95

Thyratrons & Ignitrons

OA4G	$1.32
EL-C1A	4.75
2A4G	1.25
2B4	2.10
2C33	4.95
2D21	1.80
3C23	9.95
3C31/EL-C1B	3.95
3C45	17.50
4C35	28.75
EL-C5B	9.95
5C22	53.45
C6J	8.95
FG-17/5557	5.25
FG-33	17.50
FG-41	122.50
FG67	14.80
FG-81A	4.95
91	7.85
FG-95/5560	25.00
FG-104/5561	24.60
FG-105	19.50
FG-166	95.00
FG-172	39.50
FG-178	14.50
RX-233A	4.95
FG-235A/5552	94.50
FG-271/5551	62.50
393A	6.75
394A	4.77
GL-415/5550	39.50
KU-610	12.50
KU-623	39.50
KU628	22.25
KU-634	39.50
WL-652/5551	62.50
WL-654/659	82.00
WL-672	22.00
WL-677	39.50
WL-681/5550	39.50
722A	3.75
884	1.85
885	1.90
1665	1.80
1904	13.95
2050	1.80
2051	1.15
5545	32.50

Transmitting & Special Purpose Tubes

OA2	$1.69
OA3	1.51
OB2	1.88
OB3	1.29
OC3	1.20
OD3	1.15
1B21A	2.85
1B22	3.25
1B23	9.95
1B24 (West)	12.95
1B24 (Sylv)	18.95
1B26	3.75
1B27	19.50
1B29	2.90
1B32	3.95
1B35	12.50
1B36	12.50
1B42	9.80
1H20	.88
1S21	9.50
1Z2	3.75
2B22	2.20
2C21	.75
2C22	.75
2C26	.49
2C26A	.49
2C34	.49
2C39	22.00
2C40	8.95
2C42	26.50
2C43	22.50
2C44	1.50
2C46	29.50
2C51	5.75
2E22	1.85
2E24	4.10
2J21A	9.95
2J22	9.95
2J26	26.50
2J27	24.50
2J31	39.50
2J32	42.50
2J33	39.50
2J34	39.50
2J36	85.00
2J37	13.70
2J38	17.50
2J39	49.50
2J40	39.50
2J41	175.00
2J48	27.50
2J49	65.00
2JB51	2.50
2J55	87.50
2J56	150.00
2J61	45.20
2K23	37.50
2K25	33.50
2K26	135.00
2K28	34.50
2K29	26.00
2K33	295.00
2K45	145.00
2K54	135.00
2K55	135.00
2X2A	1.85
3B22/EL-1C	2.95
3B23	4.75
3B24	5.25
3B24W	7.95
3B25	4.50
3B26	3.75
3B27	3.95
3C24	1.85
3D21A	1.98
3E29	14.50
3J31	95.00
4-125A	29.50
4A1	1.18

4B22/EL-5B	8.95
4B24	5.75
4B25/EL-6CF	8.95
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4J36	150.00
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4J50	375.00
4J52	400.00
5D21	26.50
5J23	24.50
5J29	18.50
6-8B	.85
6AR6	3.35
6C21	29.50
6C24	52.50
6J4	7.95
7-7-11	1.19
10T1	.88
10Y	.45
15E	2.35
15R	.95
REL-21	2.25
24G	1.85
RK-25	3.82
FG-32/5558	6.75
RK-34	.49
35T	4.95
35T (Ion gauge)	5.95
35TG	4.95
REL-36	.78
RK-47	4.92
EF-50	.79
VT-52(Br)	.65
53A	5.60
RK-59	2.44
RK-60	1.95
VT-62(Br)	1.15
RK-63	22.50
RK-69	2.25
72	1.32
73	1.32
VR-75/OA3	1.51
75T	5.80
VR-78	.64
VR-90/OB3	1.29
VT-98 (BR)	115.00
C100E	2.30
100R	2.90
100TH	10.25
WE-101D	1.65
WE-101F	3.62
VR-105/OC3	1.20
WE-113A	1.32
WE-117A	.95
F-123A	8.95
WE-124A	3.80
F-127A	22.50
VT-127A	3.60
AB-150	12.50
VR-150/OD3	1.15
FG-190	12.15
HF-200	16.50
203A	7.40
203B	6.33
204A	49.50
WE205	1.85
CE-206	3.15
211	.75
WE-211D	12.50
WE-211E	12.50
212E	42.50
WE-215A	.24
221A	1.95
227A/5C27	4.60
WE-231D	2.25
232CH	240.00
WE-244A	5.20
WE-245A	2.35
WE-249B	3.50
WE-249C	3.50
WE-252A	5.65
WE-254A	5.90

WE-257A	3.77
WE-271A	6.75
WE-275A	6.95
WE-283A	4.25
WE-285A	5.57
WE-286A	7.90
WE-294A	5.75
WE-301A	5.95
304TH	15.00
304TL	15.00
307A	5.50
WE-309A	6.45
WE-310A	7.50
WE-313C	4.15
316A	.89
327A	4.25
WE-331A	9.75
WE343A	185.00
WE-346A	2.75
350B	4.95
354C	19.50
WE-356B	5.45
361A	4.75
371A	.95
371B	.95
388A	2.95
WE-399A	4.70
417A	16.95
434A	17.50
446	1.95
446A	1.95
446B	2.25
450TH	42.50
450TL	42.50
451	1.39
471A/1B21A	2.75
SS-501	12.50
503AX	1.65
506AX	1.47
507AX	1.47
527	12.25
530	17.20
531	8.25
532A	3.95
WL-533	115.00
559	2.20
561	3.50
HY615	.49
WL670A	8.70
700A	24.50
700B	24.50
700C	24.50
700D	24.50
702A	2.95
702B	4.25
703A	6.95
704A	.95
705A	2.75
706AY	45.00
706BY	45.00
706CY	45.00
706FY	45.00
706GY	45.00
707A	9.95
707B	22.50
708A	4.85
709A	4.87
710A	1.70
713A	1.45
714AY	6.95
715A	6.75
715B	12.75
715C	26.50
717A	1.47
718AY	45.00
718BY	45.00
WE-719A	26.50
720DY	75.00
721A	4.90
723A	9.95
723A/B	16.95
724A	3.22
724B	3.22
725A	8.95
726A	8.50
726B	29.50
730A	25.00
731A	2.45
WL-787	9.80
788Y	1.40
800	1.88
801A	.48
803	3.87
804	8.95

805	4.50
806	24.50
807	1.70
808	2.65
809	2.40
810	10.95
811	3.60
813	9.50
814	3.95
815	2.75
816	1.45
826	1.45
828	13.48
829	9.95
829A	14.50
829B	14.50
830B	3.95
832	7.95
832A	9.95
836	3.50
837	1.58
838	3.25
841	.49
843	.59
845	5.75
849	29.50
851	67.00
852	22.60
860	4.95
861	24.50
864	.39
865	1.28
866A	1.48
869B	35.00
872A	2.95
874	1.45
876	1.60
878	1.85
954	.39
955	.49
956	.49
957	.49
958A	.69
959	1.50
991	.45
1003	.90
CK-1005	.79
1201	1.20
1203	.69
1291	.69
1294	.69
1299	.69
1602	2.25
1612	2.70
1613	.95
1614	2.00
1616	1.07
1619	.39
1622	2.30
1624	1.95
1625	.45
1626	.39
1629	.39
1630	.95
1631	1.38
1636	3.10
1638	.70
1641	1.95
1642	.75
1644	1.17
1655	1.90
1960	.70
5611	135.00
5654	5.85
UX-6653	.65
7193	.75
8005	5.95
8011	.87
8012	2.60
8013	2.75
8013A	4.90
8014A	29.50
8020	1.39
8025	6.95
9001	1.75
9002	1.50
9003	1.75
9004	.55
9005	1.95
9006	.35
189048	3.79
189049	3.79
199698	2.69

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7DG
7G
A
B
M
N
X
2J1F1
2J1G1
2J1H1
C-44968-6
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C-69405-2
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Robins and Myers Motor Generator Units. Operate at 110 Volts, AC, single phase, 60 cyc. and deliver 32/40 Volts, DC. Can be used with field rheostat to supply 24/28 VDC for the operation of aero equipment from lighting line. Rated at 40 watts but will deliver 200 watts for intermittent operation. Gear head built into one end rotates external shaft at 225 RPM. An exceptional value at $18.75 each. With field rheostat $20.00. Also available for operation at 115 VDC at $12.50 and with rheostat at $13.75 each. Both units have 1/4 HP Motor. Stock up on these sets while they are available. Special price on quantity. Rebuilt.

CENTURY MOTOR GENERATOR SETS

7.5 KVA: 230 Volts, DC to 115 Volts, AC, single phase, 60 cycles. Complete with automatic controller and push button station....$445.00

KATO ROTARY CONVERTERS

Type 1205A Model 26KA54 Input: 24 VDC 28A. 1800 RPM. Output: 115 VAC 1 phase, 60 cy. 1 KVA. Compact and ruggedly built for cont. duty oper. Filtered. Shock mounted. New $90.00

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Air cooled lightweight aluminum construction (18 lbs.) 2700 to 3800 R.P.M., Precision built, covered by manufacturer's warranty, 1 cylinder, 2 cycle..................$29.00

Marathon Generators can be used with above engine, have output of 110 Volts AC. 1 ϕ 60 cy. 300 Watts, rebuilt, self-exc. Price $42.50

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G. E. DC Motor, type BY, 1/17 HP, 2100 RPM, sh. wdg., BB., price..............................$3.00

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Operate at 220 Volts, DC to deliver 110 Volts, 3.5 amperes. Two of these units can be used on 220 VDC to obtain 110-0-110 Volts DC. **Special Price** $18.50

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Four Bearing Marine Units: 25 HP 230 Volts, DC coupled to alternator 18.75 KVA; 80% PF; 1800 RPM. Output: 115 Volts, AC. Single Ph. 60 cycles. Ball Bearings. 4 bearing set; marine duty. Brand New.....................$545.00

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General Electric Synchronous Motor or Alternator; excitation 2 Volts; operating at or delivering 110 volts, 3 phase. 60 cycles at 1800 speed; no name plate, but lab tests determined specs as above $9.95

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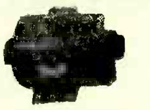
110 VA. Input: 110 VDC; Output: 110 VAC, single phase, 60 cycles; 3600 speed. With filter for elimination of radio interference. Reliably Rebuilt. Special Price........$19.95

TAPE WINDERS

These tape winders consist of a motor operative at 110 volts D.C., .6 amperes; 1800 speed. A motor which is separable from the rest of the unit and which can be employed for a multitude of purposes, alone or with the gear reduction box to which it is connected. Motor is shunt wound and the speed thereof is controlled by a built-in rheostat. This makes an invaluable laboratory unit. Special Price $10.99

G. E. ROTARY CONVERTERS



Dynamotor Model 5D46AB8 78 Volts, DC input to deliver 110 Volts, AC, single phase, 60 cycles, 1.5 amp. **SPECIAL PRICE (Rebuilt)** $9.95

G. E. OIL FILLED OUTDOOR TRANSFORMERS

Brand New. 3 KVA; Type HS 3000/5200Y-115/230. Also 6000/10,400Y-115/230. Brand New. Either type Special $44.00

WE CAN FURNISH M.G. SETS OF ANY SPECIFICATIONS FOR ANY APPLICATION. SEND US YOUR REQUIREMENTS.

GE LOW VOLTAGE MG SETS. Motor: 1 HP. 220/440-3-60 direct conn. to Gen. 500 watts, 18-28 VDC. with control panel including field rheo. ammeter and voltmeter. PRICE $150.00

ALLIS-CHALMERS MG SETS. Input: 230 VDC,7 amp. 3600 RPM, BB, Output: 115 VDC, 1.25 KVA, 1ϕ, 60 cyc. Centrifugal automatic controller permits line-start operation. Fully enc. Rebuilt like new. Price..........$85.00

GE LOW FREQ. MG SETS. Motor: 230 VDC 3 HP. 860 RPM 12 amp. Direct conn. to Alternator: 110 Volts, 1ϕ, 15 cycles. 21.8 amp. 2.4 amp. self. exc. Price.....................$385.00

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Newark Transformers, 3.2 KVA. 550/110 Volts. PRICE $49.75

G. E. Autotransformers. 500 VA. 110-220 Volts, for wall mounting. PRICE NEW $17.35

Raytheon Transformers. 750 VA. Pri: 220/440 Sec: 110. PRICE...............................$22.00

LV MOTOR GE GENERATOR Motor: 550/3/60, 25 HP direct connected to 27 V, 550 amps., 15 KW Generator. Price..............$675.00

LV ESCO DC MOTOR 28.8-35.2 V, 212-182 A, 7 HP, 1800 RPM, BB. Price..........$195.00

SELSYN MOTORS GE MODEL 5MJ365AK1, RPM 1200/400, primary stator 440/3/60, 3 KVA, 16 A, secondary rotor 93.5 V, 54.5 A, 32.8 FT.LS. Price...........................$225.00

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ESCO LV CONVERTER Pri. 32 VDC, 8 A, Sec. 110/1/60, 150 W, 1800 RPM. Price.....$58.50

GE HV MG SET Motor: 220/440/3/60, direct connected to Dc Gen. 8000 V, 2.5 A, 20 KW, 1800 RPM. Price.........................$675.00

LV GE MG SET Motor: 220/440/3/60, 1 HP, 1800 RPM, direct connected to DC Gen., 24V, 18 A, complete with rheostat and voltmeter and ammeter. Price $175.00

With single phase motor.....................$225.00

VOLTAGE REGULATOR GE, MOTOR CONTROL Cat. #837625, Type AIRS, .568 KVA, 60 cycles, primary volts 115, low amps. 16.2, indoor service, voltage controlled by motor 110/1/60, 1/40 HP. Price..................$39.50

WELDING TYPE TRANSFORMERS Pri. 440 V, 60 cycles, Sec. 8/10/12 V, 10,000 watts. Price $130.00

KIMBLE MG SETS 2 Bear. B.B., 220/3/60 to 500 VDC, 2 amps. Price.....................$165.00

ESCO DC/AC MG SETS Motor: 12 HP. 230 VDC, 31 amps., div. connected to Alternator: 440 V, 3 phase. 60 cycles, brand new. Price $545.00

WESTINGHOUSE M-G UNITS

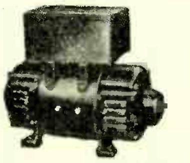
Compact two bearing units consisting of a repulsion-induction motor, type 2H; 110/220 volts, single phase. 25 cycles, 1425 rpm. 5.4/2.7 amperes. Continuous duty. The generator has a rating of .08 KW. 40 volts, 2 amperes, D. C. Compound winding, type FK. Rebuilt like new. Price $22.50

ESCO CONVERTERS

Rebuilt like new. Input: 86 VDC 2.85 amp. 3600 R.P.M. Output 115 VAC, 2.18 amp. .50 P.F. Ball Bearings. Base for table or side mounting. Special $9.80

GENERAL ELECTRIC 8 KW High Voltage Generators; Rebuilt like new, double commutator type each rated at 4000 Volts, DC, 2.5 amperes; can be connected in series to give 8000 Volts, DC at 2.5 amperes or 4000 volts, 5 amperes in parallel. Separately excited. Units weigh about 800 pounds. Offered at a fraction of their original cost.....................$175.00

KUHLMAN OIL COOLED TRANSFORMERS. 230 Volt primary to 115/230 Volt secondary; 1½ KVA. Brand New in original cases. SPECIAL PRICE $32.50



Janette Rotary Converters. 12 volts DC to deliver 110 volts, AC. Rated: 212 VA. With radio filter.

Special Price ...$72.00

Special Series Motors; no name plates, ¼ HP operate at either 110 Volts DC or AC; ½" shaft. Reconditioned..................$9.85

RAYTHEON VARIABLE VOLTAGE TRANSFORMER. Primary: 220 volts, 3 phase with output by selector snap switch giving voltage outputs from 140 to 220. Brand new. Price $35.00

WESTINGHOUSE TRANSFORMER CONTROLLER. Contains 300 watts, 120-220 volt transformer with multi-taps. The transformer with tap switch alone is worth more than the special price..............................$7.50

Esco AC Motors: built-in magnetic brake for quick reversing. Double shaft, ball bearings. Rated: 2½ HP—30 minutes, marine duty: 440-3-60. Brand new in original cases. **SPECIAL PRICE** $37.50

ESCO DC/AC MG SETS. Motor: 115 Volts, 1½ HP line start; built in voltage regulator, frequency control, filtered; ideal for television, radar or any application requiring constant voltage and frequency. Output: 115 V.A.C. 1 ϕ, 60 Cyc. 460 V.A. Brand New......$120.00

Watthour Meters. 110/110 Volt DC operation. Uesd but in A1 condition. 5 amp......$3.75 10 amp ..$4.35 15 amp..$5.00 25 amp..$6.00

Crompton-Parkinson Alternators. 3 KVA. .7 PF. 110 VAC, 1ϕ, 60 cyc. 1800 RPM. sep. exc. Price $170.00

DC Manual Controllers, mfg. by Marconi Co. of England. Enc. type. For starting duty of 24 VDC Motors, rated at .7 HP. A really hard-to-get unit at a give-away price. SPECIAL $4.60

PIONEER DYNAMOTOR. Type PS250. Input: 12 VDC, 4.9 amp. Output: 350 VDC, .100 amp., brand new. Price.........................$14.00

BRITISH DC/AC MG UNITS. Operate at 100/110 VDC, 4 amps., 3000 RPM. Output: 230 VAC, .87 amp., 50 cyc. Wt: 132 lbs. Brand new. Price $42.50

With field rheostat for 60 cyc. output. Price $50.00

G.E. 3 PH. TRANSFORMERS. 3 KVA, 418/429/440 Pri. 140 volts, 3 ph. Sec. Price..$45.50

GE Relays: 110 VAC—10 Amp. 60/60 cy. in steel case 5 x 5 x 6½..........................$3.90

GE DC Generators. Consists of three separate generators in one unit. 3600 RPM. Delivers 1200 V., 450 V. .25 a. and 115 V. 1.3 amp. Price $24.00

G.E. Motor Starting Reactors Type 11K2840G2: Rated at 440 V. 3 Ph. 60 Cy. 16.8 Amp. Only a 3 Pole Double Throw Switch is necessary with this unit to make a 15-20 HP compensator starter. Useful for any purpose requiring three phase choke. **SPECIAL PRICE**..$25.00

GAS-DRIVEN GENERATORS

Mfgr.	Cap.	Volts	Price
Airco	2500 W	115/230/1/60	$395 NEW
Airco	500 W	115 VDC	$125 NEW
Onan	5 KW	115/1/60	$550
Duplex	7½ KW	125/1/60	$690
Contin.	3 KVA	110/3/60	$475

H.V. M.G. SET—5 Hp. 220/440 V motor direct coupled to 2000 VDC. 2KW generator...PRICE $275.

GE AIR-COOLED TRANSFORMERS

New. cat. 61G29 460/230-230/115 1 KVA..$33.50

IF IT'S FROM ONE FREQUENCY TO ANOTHER; FROM DC TO AC OR AC TO DC,
IF IT'S FROM ONE VOLTAGE TO ANOTHER, THEN CALL ON US.

Established in 1922
409 ATLANTIC AVE.

WILLIAM I HORLICK COMPANY

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BOSTON 10, MASSACHUSETTS

HIGH FREQUENCY M-G SETS AND AMPLIDYNES FROM

AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

HIGH FREQUENCY CONVERSION EQUIPMENT

GENERAL ELECTRIC HF MG SETS. Motor 120 VDC Generator: 115 VAC. 1φ. 1050 cy. 2 KVA. 2 Bear. BB unit. Price $220.00

ONAN 400 CYCLE MG SET. Motor: 220V. 3φ. 60 cy. V belted to self-excited alternator with output of 4 KVA. 115 Volts. single ph. 400 CPS. Mounted on base with voltage regulator connected. Components all brand new ....PRICE, $712.00

PE118 Units; Operate at 28 VDC, 100 Amp. Output: 115 VAC, 1φ. 400 CPS, 1500 VA. with filter system built-in ....PRICE, $29.50

THREE PHASE 400 CYCLE SETS. Consist of motor operative at 220/440-3-60 V belted to self excited alternator made by Holtzer-Cabot with output of 500 VA. 115 VAC. 3φ. 400 cycles....................PRICE $295.00

BOGUE THREE PHASE MG SETS. Consist of Motor operative at 220/440-3-60, Self-exc. alternator with output of 120/208V. 3φ. 400 cyc. 5 KVA. Brand New ....PRICE $1850.00
With Voltage Regulator....................PRICE $1950.00

KATO 400 Cycle 3φ. Consists of Synchronous motor, V Belted to self excited Alternator with output of 120/208 V. 3φ. 400 v, 40 KVA. W/motor compensator. PRICE $4990.00

5 KVA BRITISH MG SETS. Motor: 7½ HP. 220-3-60 V belted to self exc. alternator with output of 115 Volts, 1φ. 400 cycles....................PRICE, $975.00

BRITISH DC/AC MG SETS. Input 230 VDC. Output 180 VAC, 1φ. 500 Cyc. 5 KVA....................PRICE, $265.00

50 KVA MG SETS. Mfg. by GE. Consist of Motor: 75 HP. 220/440-3-60 direct connected to Alternator with output of 50 KVA; 115 Volts. single ph. 400 CPS. complete with auxiliary exciter MG set, field rheostat and starting compensator....................PRICE $5950.00

HIGH FREQ. UNIT. Motor: 24 VDC 50 amp. Alternator: 17 VAC, 1300-1600 cyc. sep. exc. at 24 VDC. 1.25 BHP. 4000 RPM. Made in Canada by Electric Tamper & Equ....................PRICE, $49.00

H.F. MOTOR GENERATOR, G.E. Model 5LY126A4. Motor: 115 VDC direct connected to Generator 24-32 VDC, 78 amps., and to alternator 120VAC, 720 cycles. 1 ph. KW-2¼....................PRICE, $245.00

ELECTRIC SPECIALTY FREQUENCY CHANGERS Type BFS52/BFRS354 Input: 220 Volts, 3 Ph. 60 cy. 3600 RPM. Output: 250 Volts, 20 Amps, single ph. 180 Cyc. 5000 VA. 3000 Watts. Brand New. Compact ball bearing units for operation of Hi-cycle equipment. SPECIAL PRICE $160.00

ONAN 800 CYCLE MG UNIT. Employing 5 H.P. Motor operative at 220/440 Volts, 3φ, 60 Cy. V belted to self-exc. generator with output of 1.5 KVA. 115 Volts, single ph. 800 CPS, and secondary output of 500 Watts 28.5 VDC 17.5 amperes. PRICE....$289.00

ECLIPSE 800 CYCLE GENERATORS. Flange mounting with spline shaft. Output is 115 VAC 10.4 Amp. 90% P.F. 800 Cycles, 1200 V.A. with secondary output of 28.5 VDC, 60 Amperes. Self excited.
Price $39.00

BRITISH MADE 500 CYCLE MG SETS. Motor: 230 Volts, 3 PH—50 Cycles. Alternator: 5 K.W. 180 Volts, 27.8 Amp. 500 Cycles, Excitation—110 VDC. When used at 60 Cycle current, Output is 600 cycles, 220 Volts. Price $353.00

WINCHARGER PU-7/AP; Input: 28 VDC, 160 Amps. Output: 115 VAC. single ph. 2500 V.A. 400 C.P.S. Frequency and voltage regulation built-in.
Price $87.00

WESTINGHOUSE HIGH FREQUENCY UNITS. Input: 115 Volts, D.C. 2.7 Amps. Output: 14.4 Volts. .139 Amp. 450-2550 Cycles. Frequency variation is obtained with built-in controller on end of unit.
Price $48.50

GE DUAL OUTPUT MG SETS. Consist of Motor rated 3 H.P. 220/440 V. 3φ, 60 Cy. directly coupled to 2 generators. Output .5 K.W. 220 Volts, 2.27 Amp. 525 Cycles. Also .5 K.W. 110 Volts, D.C. 4.55 Amp. 3 separate units mounted on common bed plate.
Price $150.00

WESTINGHOUSE 180 CYCLE ALTERNATORS. 750 V.A. Output: 110 Volts, 3 Phase, 180 C.P.S. 3000 R.P.M. Separately excited at 110 VDC. Price..$44.00
Also available with built-in exciter. Price......$78.00

GENERAL ELECTRIC HIGH FREQUENCY UNIT. Operating at 440-3-60 .75 amp. Output. 70 Volts, 3 ph. 148 cyc. 220 Watts, 1.8 amperes. An ideal unit for experimental work or for operation of equipment. SPECIAL PRICE $34.50

BENDIX-ECLIPSE 800 CYCLE AERO UNIT. Input: 24-28 VDC, 75 amps. Output: 115 V. 10.5 Amp. 800 C.P.S. Complete filter system mounted thereon.
Price $22.50

INVERTER UNIT PE206A. Input: 27.5 VDC. 28 amp. Output: 80 Volts, single ph. 800 CPS. 500 VA.
Price $19.00

RLX DUAL GENERATORS. Flange mounted. Output: 500 Watts, 1300-2600 Cycles, also 12-14 VDC 750 Watts.
Price $25.50

ELECTRIC SPECIALTY HIGH FREQUENCY CONVERTER UNIT. Primary: 32 VDC, 16 amperes. 3000 R.P.M. Ball Bearings. Secondary: 350 volts, 1500 cycles. .75 amps. 275 V.A. Single Ph. Built-in frequency control. Specially Priced at....................$30.00

BENDIX POWER MG SET. Consists of G.E. 2 HP Rep-Ind Motor, 115 volts, single phase, 60 cyc. directly connected to Bendix alternator with output of 120 volts, 700 cyc., 600 watts and DC output of 14.5 volts, DC, 22 amp. Brand new. Price....................$225.00

LOUIS-ALLIS 3 UNIT MG SET. Consists of 5 HP motor operative at 220/440-3-60 directly coupled to alternator with output of 115 volts, 1 ph., 400 cyc. and with exciter unit all mounted on steel base.
Price $565.00

LOUIS ALLIS FREQUENCY CHANGER SETS.
Pri: 25 H.P., 220/440-3-60; Sec. 15/10.8 K.W. 3300/2200 RPM. 306/220 Volts 35/35 Amps. 2 ph. 500/360 C.P.S. Price $1050.00
Pri. 10 H.P. 220/440-3-60: Sec: 7.5 K.W. 440/220 V. 17/8 Amp. 3000/1200 RPM. 360/180 Cycles, 2 ph. Price $750.00
We can supply these units for 400 cycle output and with transformers to supply 3 phase, wye output. Write for further information.

CONTINENTAL DC/AC SET. Motor: 1.5 HP, 230 VDC, 3440 RPM. Output: 120 VAC, 6.6 amps., 8 KW. 800 cyc., 1 ph., also output of 14 VDC, 4 amps., Model CG21637. Compact 2-bear. units. Completely rebuilt. Price $89.00

WINCHARGER PU-16/AP INVERTER. Type MG750. Input: 28 volts, 60 amp. Output: 115 volts, 6.5 amp., 400 cyc., 1 ph. Brand new. Price....................$69.50

HOLTZER-CABOT MG 221. Compact 2 bear. units for low current 400 cyc. Operates at 32 VDC, 8.5 amp. Output: 110 volts. 1.0 amp., 1 ph., 100 watts. 400 cyc. Brand new. Price....................$69.50

HOLTZER-CABOT MG 218. Operates at 115 VDC. 2.3 amp. with same output. AS MG 221....................$79.50

LELAND INVERTER TYPE MG 4A. DC Input: 27.5 volts, 38 amp., 6000 RPM. Output: 115 volts, 1 ph. 400 cyc., 500 VA. Like new and fully guaranteed. Price $39.50

GENERAL ELECTRIC MODEL 5D21NJ3A. Input: 27 volts, 35 amp. Output: 115 volts, 485 VA. 1 ph., 400 cyc. Price $31.50

ESCO DUAL FREQUENCY UNITS. Motor operates at 120 VDC, 10 amperes. Delivers 70 Volts at 120 Cycles or 200 Volts at 720 Cycles. Price.......$95.00

GE MG UNITS. Motor: 110 Volts, D.C. 31.5 Amperes. In a single compact unit with output of 120 Volts, 20.8 Amp. single ph. 500 cycles. Like New. Price....$95.00

CROCKER-WHEELER 500 CYCLE SET. Operate at 110 Volts, D.C. 29.6 Amps. Output: 120 Volts, single ph. 500 cycles 2.5 KW. Price....................$146.95

HOLTZER-CABOT TYPE CAJ-211168 MG UNITS. Compact 2 bear. operative at 115 volts, 1 ph., 60 cyc., ½ HP. Output: 115 volts, 4 amp., 233 cyc., 3 ph., also 24 VDC at 5 amp. Brand new. Price.....$36.00

NORMAND ELEC. CO. (BRITISH MFG.) MG UNIT. Motor: 220 VDC, 8.8 amp., 2 HP, 4200 RPM, directly connected to H. F. alternator with output of 1400-2800 cyc. 1200 watts. Exc. 24 VDC. Price..........$70.00

MARCONI MG UNIT. ¼ KW, operates at 110 VDC to deliver 110 VAC, 300 cyc., supplied with field rheostat for variable frequency output. Price.......$70.00

PIONEER MG UNIT. Input: 115 VDC, 3.4 amp. Output: 140 VAC, 1.2 amp., 350 cyc. Complete with field rheostat for variable frequency output.
Price $60.00

ESCO MG UNIT. Operative at 120 VDC, 25 Amp., 4 HP. Delivers 115 VAC, 1 ph., 1050 cyc., 2 KW. An exceptionally fine machine for laboratory use. Can be used with field rheostat for frequencies up to 2000 cycles. Price $175.00

ESCO INVERTER UNIT. Prim: 12 VDC, 20 amp., 1800 RPM. Sec: 140 VAC. 1 amp., 140 VA. 360 cyc. With field rheostat for frequency outputs up to 800 cyc. Price $69.50

HOLTZER-CABOT MG UNIT. Operates at 115 VDC, 8.2 amp. to deliver 55 VAC, 6 amp., 195 cyc., 3 ph., 1950 RPM with field rheostat for frequencies up to 400 cyc., 3 ph. Price....................$80.00

HOLTZER-CABOT MG UNIT. Motor: 120 VDC, 5 amp., 2500 RPM. Output: 75 VAC, 9 amp., 500 cyc., 675 VA, 1 ph. Price....................$49.00

BRITISH ALTERATORS. 1.5 KVA., 230 Volts, 1φ 400 CPS. sep. exc. Price....................$115.00

ONAN 400 CYCLE MG SET. Motor: 5 HP, 220/3/60. Generator: 2 KW, 115 volts, single phase, 400 CPS, self excited with secondary output of 26 volts DC, 200 watts. V-belt drive. Price....................$635.00

ONAN 400 CYCLE MG SET. Motor: 7½ H.P. operative at 220/440 V 3φ, 60 cy. V belted to self-excited alternator with output of 4 KVA. 115 Volts, single ph. 400 C.P.S. Alternator is self-excited with secondary output of 14 VDC 40 Amp. With Voltage Regulator built-in. Price $712.00

G.E. MG SET MODEL 5LY56AB5A. Motor: 1.1 HP. 250 VDC. 4 amp. Generator: 600 watts, 125 VAC, 4.8 amp., 500 cyc., 1 ph. Price....................$89.50

GENERAL ELECTRIC 400 CYCLE UNITS. Operate at 26 VDC 100 Amp. Output: 115 VAC 1φ. 400 CPS. 1500 V.A. With filter system built-in. Price....$29.50

MARCONI MG UNITS. Operative at 110 VDC to deliver 500 VAC, 6 amp. 3 K.W. 240 cycles. Extending shaft permits driving complete unit to obtain dual self-excited generator. Price....................$89.00

CROCKER-WHEELER 500 CYCLE MG SET. Compact 2 bearing Unit. Operative at 120 VDC, 7.3 amps. Output: 250 Volts. 5 amp. 500 cycles. Rebuilt Price $88.88

WESTINGHOUSE AMPLIDYNE TYPE MG SETS

Motor: Type CS, Fr. 204, 208 v, 3 ph., 60 cyc., 4 amps. 1.5 HP, directly connected to 2 DC gen. (1) 125 VDC, 2.8 amp., .35 KW. Gen. (2) 250 VDC, 2 amp., sep. exc. 35 volts. The 3 units are contained in one housing. Brand new. The generators have similar characteristic of an amplidyne with a set of control fields and are completely enclosed with rubber gaskets on the enclosing covers, which can be removed for increased KW output. An exceptional value at....................$183.00

GEN. ELECTRIC AMPLIDYNES

Model 5AM73AB89; Input: 115 VAC, 1φ. 60 cycle, 9 amp. Output: 375 K.W. 250 VDC, 1.5 amp.....$86.00

Model 5AM65FB2A; Input: 115 VAC, 3φ. 60 cyc. 5 amp. Output: 500 watts, 250 Volts, 2 Amp....$144.00

Model 5AM49AB30; Input: 440 Volts, 3 phase, 60 cyc. 1 amp. output: 115 Volts, D.C. 3.25 amp. 3450 RPM. $88.00

Model 5AM31NJ18A; Input: 27 VDC, 44 amp. 8300 RPM. Output: 60 VDC, 8.8 amp. 530 watts....$12.95

Model 5AM78AB19; Input: 32 VDC, 60 amp. 2 H.P. 2200 RPM; Output: 250 Volts, D.C. 3 amperes; 750 Watts $190.00

Model 5AM45DB26; Input: 440 V. 3φ, 60 cyc. Output: 125 V.D.C. 1.0 Amp....................$55.00

Model 5AM49AB7A; Input: 440 Volts, 3φ, 60 Cyc. Output: 375 Watts, 250 V.D.C. 1.5 Amp. Price $100.00

Model 5AM45DB5, DB15, DB20. Input: 440V, 3φ. 60 cyc. Output: 250 VDC. .6 amp.......PRICE $65.00

Model 5AM78AB47; Input: 440V. 3φ, 60 cyc. Output: 250 VDC, 3 amp. With control generator direct conn. on common base rated .75 KW. 60 VDC, 12.5 amp. ....PRICE $285.00

Model 5AM78AB50A or 79; Input: 440V., 3φ, 60 cyc. Output: 250 VDC, 6 amp....................PRICE $285.00

Model 5AM78AB16; Input: 440V, 3φ, 60 cyc. Output: 250 VDC, 3.0 amp....................PRICE $185.00

Model 5AM73AB58; Input: 115/230, 1φ, 60 cyc. Output: 250 VDC, 1.5 amp....................PRICE $100.00

G.E. Amplidyne Generator Model AM701. 25 KW, 125 amps., 200 volts, 1785 RPM, special duty cycle, 450 volts, 220 amps....................PRICE $975.00

G.E. AMPLIDYNE GENERATOR Model 5AM628A. 460 volts, 33 amps., 1700 RPM.........PRICE $790.00

BOGUE ELECTRIC AC/DC MG SET. Consists of 7.5 HP motor in center directly connected to 2 12 volt 160 amp. generators. Will deliver 24 volts at 160 amp. or 12 volts at 320 amp. Condition like new.
Price $375.00

GENERAL ELECTRIC Type B Flange Motor for hoisting duty. 6¾ H. P. separately excited. Marine Duty. Brand new, original cases; 235 Volts, DC. 1100 RPM. $85.00

WINCHARGER WIND GENERATOR. 12 volts, 250 watts, complete with all fittings including propeller. Excellent for battery charging. Price....(New) $70.00

GARDNER DRY TRANSFORMER. 3.42 KVA, 230/115 to 5.7 volts, 600 amperes. Price....................$48.75

RAYTHEON VOLTAGE STABILIZER (CONSTANT VOLTAGE TRANSFORMER). Input 190-200 volts. Output 230 volts, 250 VA. Price....................$31.75

RAYTHEON CONSTANT VOLTAGE TRANSFORMER. .5 KVA. Input 180-269 volts. Output 220-230 volts. Price $67.50

ACME AIR-COOLED TRANSFORMER. Primary: 500 volts. Secondary: 14,840 volts with C.T., 3 phase, 60 CPS, 18.2 KVA, brand new. Price............$390.00

ALLIS-CHALMERS MG UNIT. .94 KVA, input 24 VDC. 63 amperes. Output 120/60/1. 7.82 amperes, 3600 RPM. New. Price....................$149.90

50 CYCLE FREQUENCY CHANGER Motor: 15 HP, 220/440/3/60, V-belted to 8 KVA. 220 V. 50 CPS, 3 ph., British made alternator..........PRICE $575.00

LV DC MOTOR GENERATOR SET. Motor: 220/440/3/60, direct connected to DC Esco generator 20 V, 100 amps., 1750 RPM. ....PRICE $340.00

15 KVA GENERAL ELECTRIC TRANSFORMER. 440/220/110 V, 1 phase, 60 cycles, Type H, Form N, oil cooled ....PRICE $102.00

HV MOTOR GENERATOR SET. Motor: 220/440/3/60, V-belted to Crompton generator 500 VDC, 6.5 A. PRICE $495.00

WE CAN SUPPLY MOTOR-GENERATOR SETS TO ANY FREQUENCY SPECIFICATIONS AND FOR ANY APPLICATION.

CONSULT OUR ENGINEERING DEPARTMENT.

IF IT'S FROM ONE FREQUENCY TO ANOTHER; FROM DC TO AC OR AC TO DC, IF IT'S FROM ONE VOLTAGE TO ANOTHER, THEN CALL ON US.

Established in 1922
WILLIAM I HORLICK COMPANY
Tel. HAncock 6-2480
409 ATLANTIC AVE.
BOSTON 10, MASSACHUSETTS

25 WATT POTENTIOMETERS

Ohm	Bush	Shaft	Cat ♯	Price
2	5/8s	1/8sd	O-H	$1.04
3-3	1/2	1/2	I	1.04
15	3/8	1"	C	1.04
15	3/8	1-1/8	D-245	1.04
15	1/2	1-1/4	I	1.04
20	1/2	1/2F	D-245	1.04
25	3/8	1	D-245	1.04
30	3/8	1	C	1.04
50	3/8	1-1/8	D-245	1.04
50	5/8	1/8sd	O-H	1.04
75	1/2	7/16	O-H	1.04
100	3/8	1	D-245	1.04
350	3/8	1-1/8	O-H	1.04
500	3/8	11/16	D-245	1.04
1K	1-2	1/2	O-H	1.17
3K	3/8	1-3/16	D-245	1.20
5K	1/2	1/8sd	I	1.24
5K	3/8	7/8f	D-245	1.24
20K	1/2	1/8sd	D-245	1.40

These excellent wirewound controls are manufactured by the leading companies and are in the original cartons. Priced ridiculously low, only 20% of list. SATISFACTION GUAR.

50 & 100 WATT POTENTIOMETERS

Ohm	Watt	Cat. ♯	Price
75	100	O-K	$2.19
500	50	O-J	1.41
500	50	D	1.41
500	100	O-K	2.19
800	50	O-J	1.48
1.5K	100	O-K	2.34
2.5K	50	O-J	1.48
5K	50	O-J	1.56

COMPUTER POTENTIOMETERS $22.50

Cat.	Resistance	Taps	Funct
D170547	20,368 (♯1)	4	Sine-
	13,980 (♯2)	4	Cosine
D170561	26,000	1	Non-L
D170692	4,000 (♯1)	1	Linear
	866 (♯2)	1	Linear

CHOKE. Conservatively rated 165 MA. 5 Henries 160 ohm dc. 2 Inch High, 3 ⅝" Mtg. Ctr. Worth $3. SALE PRICE

89 cents

TURRET LUGS

For making mounting boards. Swaging tools for each different style $3.

For various thickness boards add the following:

A—1/32" C—3/32"
B—1/16" D—1/8"

Number Our	Other	Price for 100
1200	x1548	$1.38
1210		1.70
1220	x1143	2.76
1230		3.31
1250		3.05
1260		2.34
1280	X1558	1.38
1290	X1463	1.68
1300	X1724	1.38
1310		2.05
1320	X1579	2.90
1330	X1798	2.02
1340	X1457	1.30
1350	X1245	2.00
1360	1081	3.13
1391	X1578	2.40
2000	X1785	2.90
2010		1.78
2020		3.15
2030		1.95
2040		3.46
2050		3.39
2060	X1604	1.65

RG8/U COAXIAL CABLE, poly. 1200 ft. reels 14¢ per foot. Less at 16¢ per foot.

WIREWOUND POTENTIOMETERS

Leading Makes Ohm	Bush	Shaft	Clean New Cat ♯	Watt
10	3/8	1-5/8	I	2
10	3/8	2	C	2
20	1/2s	1/8sd	CTS	2
20	3/8	3/8	M	4
20	3/8	1-1/4	CTS	4
50	3/8	3/8sd	M	4
100	5/8	3/8f	I	2
100	3/8	5/16	CTS	4
200	3/8	7/8	CTS	2
200	5/8s	1/8sd	CTS	4
200	3/8	2-1/16	CTS	4
255	1/2s	1/8sd	CTS	2
350	3/8	1-1/8	I	2
350	3/8	1/2	CTS	2
400	3/8	1-1/4sd	CTS	4
750	3/8	1/8sd	CTS	4
1K	3/8	3/8	I	2
1K	3/8	3/8	CTS	2
1K	3/8	3/8sd	CTS	4
2K	1/4	1/8	CTS	2
2K	1/2s	5/16sd	CTS	2
2K	3/8	1-1/16	CTS	4
2K	1/2	1-1/2	TRF	4
3K	3/8	1/2	CTS	4
3K	3/8	1-1/2f	C	4
5K	3/8	7/16sd	CTS	2
5K	1/2	1/2sd	TRF	4
5K	1/2	1-7/8	TRF	4
5K	7/16	1-7/16	C	4
7.5K	1/2	3/8	CTS	4
10K	3/8	1/2sd	CTS	2
10K	3/8	3/8f	I	2
15K	3/8	1/2sd	CTS	4
20K	5/8	3-3/16	CTS	4
20K	5/8	5/8	CTS	4

ONLY 45¢ EA.

PRECISION WW POTS.

Ohm	Cat ♯	Price
10	D-292	$1.20
12	301AS	1.20
1K	314	2.25
1.5K	D-281	2.25
2K	D-260	2.25
5K	314	2.25
10K	D	2.25
20K	D-260	1.70
50K	314	3.50

RELAYS

Coil	Cont.	Cat. No. Description	Price
6 dc	dpdt	SK5032 sealed	$3.95
16dc	dpdt	2Z7717.8, 60 ohm	1.50
12vdc	dpst & spdt	micalex board 2023 MXF	1.50
21vdc	dpdt	small 300 ohm	.95
24vdc	spst	contacts only touch ceramic on relay good for high impedance circuit	.90
24vdc	spst	small relay, big contact 3 amp. 24VDC INDUCTIVE	.95
24vdc	dpdt	BJ25OP	1.55
24vdc	dpdt	BJ400P	1.55
24vdc	dpdt	3 amp contact very neat single stud mtg. POt B	1.75
28vdc	dpdt	SD 10XBX102, 7 amp	.90
25vdc	dpst	Ceramic 1074	.95
24vdc	spst	200 amp contactor	5.00
1000 ohm, 22.5 vdc telephone type	dpst	each double point	.95
1200 O	spdt	10MA tiny	.95
1500 O	dpdt	25MA Advance 1049	1.90
13500 Ohm	dpdt & 2NC, 3MA		2.75
24vac	dpdt	Allied BJ	1.85
115ac	4pno	Leach 2124 SMX	3.50
Ledex Stepping 8pole 6 position			5.95
115ac time delay relay adjustable 1-1/2–58 minutes clock mtr			6.95

OIL FILLED CAPACITORS

Mfd.	Volt	Size	Price
.02	600	BT 1 x 1-3/4 x 3/4 CD side...	$.95
.1	300ac	5/8" dia. w mtg strap tub.....	.45
.1	400	tubular w strap type NHJ....	.30
.1	660	BT side 1 x 1-3/4 x 3/4 Aero..	.95
.1	7500	PO12 1/4" dia x 5" high, bkt..	4.95
.1-.1	400	BT top 1-3/4 x 7/8 x 3/4 CD.	.60
.1-.1	660	BT side Fast..................	.75
.25	600	1 5/8 x 1 1/4 x 5/8 invert mtg.	.95
.25	600	BT bottom lug aero..........	.95
.25	600	OM625 with bkt...........	.95
.25	600	BT top terminal..........	.95
.5	400	BT top terminal cd.........	.60
.5	600	2 x 3/4 x 1 1/4 upright mtg...	.95
.5	400	BT CP50B1DE504KK......	.95
.5-.5	400	2 1/2 x 1 1/4 x 5/8 inverted aero	1.60
1	500	23F207 invert channel........	.95
1	500	23F206 upright channel......	.95
1	600	CP68B1EF105V............	.95
1	600	BT lugs on opposite ends edge mtg, 1-3/4 x 1-1/2 x 7/8.........................	.98
1	600	OM601 w bkt up or down.............	.95
1-1	600	side term type 630 Bathtub..............	2.10
2	600	1-3/16" sq x 2-3/8 high top terminal.......	1.39
2	600	BT side term 2 x 2 x 1-1/8 cd............	1.79
2	600	OMT TOBE..........................	1.79
2	600	1-3/8" rd x 3-3/8" high 610M..............	1.79
2	1000	TJ10020 in ctn.........................	2.45
5-5	400	Oilmite RAL300 invert...................	.75
8-8	600	Filtermite 2-3/4" sq 3-3/4" high..........	1.95
10	220vac	equal to 600vdc 2 1/2" rd 3-7/8".........	1.65
20	220vac	1-3/4 x 3 3/4 x 4 3/4......................	3.95

TURRET SOCKETS

SAVE TIME
BETTER CIRCUIT

Socket	Height	Stock ♯	Price
Octal	2 1/2"	10-0-9T	$.59
Octal	2	8-0-9T	.57
Octal	1 1/2	6-0-9T	.54
Min.	3"	12-MB-12	.73
Min.	2"	8-M-9T	.63
Min.	1 1/2	6-M-6T	.60
Min.	1"	4-M-6T	.59
Noval	?"	.2-NB-12	.78
Noval	2"	8-N-9T	.66
Noval	1 1/2	6-N-6T	.65
Noval	1	4-N-6T	.63

DO'S Speed Delivery

COAXIAL CONNECTORS

Type	Price
UG9/U	$1.20
UG10/U	1.20
UG12/U	1.20
UG13/U	1.20
UG18B/U	1.95
UG21/U	1.20
UG22/U	1.30
UG23/U	1.50
UG24/U	1.30
UG25/U	1.25
UG27/U	1.30
UG29/U	2.15
UG30/U	2.50
UG58/U	.80
UG85/U	2.25
UG87/U	1.50
UG88/U	1.50
UG97/U	4.00
UG97A/U	4.20
UG98/U	2.25
UG104/U	1.80
UG105/U	1.50
UG106/U	.10
UG107/U	3.50
UG131/U	4.50
UG167/U	2.00
UG173/U	.43
UG175/U	.17
UG176/U	.17
J-201	4.50
UG203/U	.85
UG224/U	1.45
SO-239	.40
SO239 Y	.60
UG245/U	2.95
UG255/U	2.25
PL258	.95
PL259A	.55
PL259	.60
UG260/U	1.50
UG262/U	1.50
UG274/U	4.50
PL274	1.35
UG275/U	4.50
UG290/U	1.80
UG296/U	3.75
UG306/U	3.50
UG335/U	3.75
UG342/U	2.25
M359	.35
49547	1.20
UG422/U	3.25

HIGH VOLTAGE GLASS METAL SEAL

10¢ each. $7.50 per 100. $65 per 1000

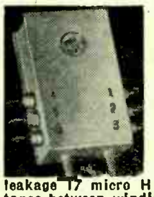
PULSE FORMING

DELAY LINE 15-E4-91-400-50P, Sprague #S92-5245, H623, 4x5x7 inch oil filled with 3½ inch insulators. 0.91 Microsecond, 15KV $9.90

TINY 10 AMPERE FILTER

60 db. att. .15 to 30 Mcs. Permalloy core. D170738 ....$3.00

PULSE TRANSFORMERS



UTAH 9287D

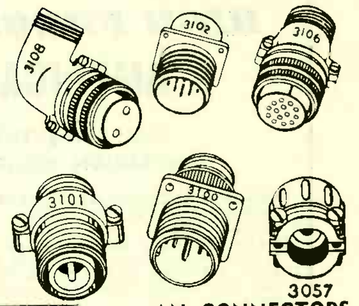
Windings: three D.C. res: 4.2, 4.4, 4.8.
L.: tot. pri. 3.2 mh true pri. 1.6 mh leakage 17 micro H Dist. capacitance between windings: 90.
Ze: 430 ohms.
Turns: 100.
Core: 16 strips .002" hypersil wound in three turns.
Optimum pulse width: 0.9 microseconds.
Sharpest pulse: (B.O.) 0.25 microseconds.

Write for prices, giving exact quantity required

901756-501, RCA, 15/16 dia. x 1⅝" high, 165 turns on primary, 330 turns secondary, core is ¼" stack of .007 inch "F" laminations. Magnetic Metals Co. Audio 58, used to form 7.3 microsecond pulses $1.50
901756-502, RCA, same core & can as 501, 100 to 200 turns, used to form 2.2 microsecond pulses $1.50
A117012, Bendix, 1 ⅞ x 1 7/16 x 1 13/16" can, nine terminals, Hypersil core $1.50
C12A-1318, Jefferson, 50 millihenry & 10 millihenry, 2¾ x 3 x 3¼ $1.95
D161310, WE frequency response 50Kc to 4 Mc, Video input, 120 to 2350 ohm. Perm. core...$2.50
K2468B, GE Magnetron pulsing bifilar.
250KVA peak power at ¼ microsecond pulse, 1000/1' duty cycle. 385KV into 50 ohm pulse cable socket gives 17.3 KV to built-in Mag. socket. Cost $223. SALE PRICE $18.00
UTAH 9289 ....$7.50
RAYTHEON UX7307 ......$7.50

SELENIUM RECTIFIERS

VDC	VAC	AMP	Price
10	13	2	$3.05
10	13	22	10.10
20	26	6	8.00
40	52	2	10.10
40	52	12	19.05
40	52	22	34.30
100	130	.5	9.85
120	156	2	23.95
130AC		35MA	.62
130AC		100MA	.98
130AC		250MA	1.68



AN CONNECTORS

COMPLETE NEXT PAGE →

VITAMIN Q TUBULAR CONDENSERS

Cat. No.	Mfd.	Volt	Qu.	Price
774-606A *	.0033	600	231	$.95
G191P10391	.01	100	60	1.50
G91P10392	.01	200	250	1.60
G88P10394	.01	400	180	1.65
G191P22391	.022	100	20	1.65
G191P68352	.068	200	454	1.65
G91P82394	.082	400	48	1.65
G91P15491T	.15	100	199	1.65
G191P22491	.22	100	49	1.65
G191P27491	.27	100	23	1.65
G191P4791	.47	100	140	1.75
G91P56492	.56	200	28	1.75
G91P68492	.68	200	30	2.10
G91P10592	1	200	78	2.20
XFC 1889 *	1	600	20	2.20

* not Vitamin Q but similar

THESE ULTRA HIGH QUALITY CONDENSERS ARE MADE BY LEADING MANUFACTURERS.

Feature

- 20,000 Megohm or More
- Subminiature
- Glass Seal Terminals
- Up to $7.70 regular

26 CONDUCTOR CABLE made up by Western Electric in 50 foot lengths with S324CCT connectors on each end. Each conductor is #22 standard and rubber covered. Although the O.D. is only 9/16 inches there is a heavy live rubber jacket.
Per length, only............$9.95

POWER SUPPLY, PE204A, Radiart to operate from 12 volts DC to supply plate & screen & DC filament volts to telephone repeater EE99 & TY14. Sealed in original packing cases with spare vibrator, cable, schematic, etc. Approx. 50 MA............$5.95
CONVERTER, Electronic Labs Model 1485, 26 VDC input, 115 volts, 60 cy., 50 watts output, complete with NSB 1341 vibrator $9.95

TOGGLE SWITCHES

Molded Bakelite — 7/16" Bushing
N.P. Bat Handle

Contact	Current	Stock ♯	Price
SPST	6A	110B	$.39
SPDT	3A	112	.44
DPST	3A	216	.60
DPDT	3A	316	66
DPDT	Center off 1A	138	.60

AN CABLE CLAMP

AN No.	FITS SHELL	NET
3057-3	8S, 10S-L	$.36
3057-4	12, 12S	.36
3057-6	14, 14S	36
3057-8	16, 16S	.42
3057-10	18	.42
3057-12	20, 22	.42
3057-16	24, 28	.48
3057-20	32	.96
3057-24	36	.96
3057-28	40	1.08

AN CAPS

9760-8	$ .50
9760-10	.50
9760-10P	.50
9760-12	.50
9760-14G	.50
9760-14	.50
9760-16	.50
9760-18	.55
9760-18G	.55
9760-20	.55
9760-22	.60
9760-22G	.60
9760-28	.65

NOTE: PRICES ON THIS PAGE ARE NET

Widely Known for Fair Dealing and Good Service

HAROLD H. POWELL
2104 MARKET STREET
PHILADELPHIA 3, PENNA.
PHONE LOcust 7-5285

AN CONNECTORS—DISCOUNT: 50% PHENOLIC, 40% MELAMINE

Insert	Shell and 1947 List Price				
	3100	3101	3102	3106	3108
8S-1S	$1.59	1.63	1.19	1.59	2.61
8S-1P	1.53	1.59	1.19	1.59	2.67
10S-2S	1.48	1.53	1.08	1.39	2.47
10S-2P	1.43	1.48	1.08	1.48	2.52
10SL-3S				1.73	2.67
10SL-3P	1.73	1.77	1.43		
10SL-4S				1.53	2.76
10SL-4P	1.59	1.63	1.19		
10S-656S	1.48	1.53	1.08	1.59	2.81
10S-656P	1.43	1.43	1.04	1.53	2.72
12S-3S	1.63	1.73	1.19	1.97	2.72
12S-3P	1.68	1.68	1.24	1.97	2.87
12S-4S	1.39	1.53	1.04	1.59	2.72
12S-4P	1.39	1.53	1.04	1.59	2.72
12-5S	1.59	1.92	1.39	1.97	3.01
12-5P	1.53	1.73	1.24	1.92	2.81
12S-6S	2.37	2.37	1.84	2.67	3.73
12S-6P	3.14	3.49	2.61	3.79	4.56
12SL-844S	NA	NA	NA	2.60	3.94
12SL-844P	2.50	2.65	1.95	NA	NA
14S-1S	1.77	2.03	1.33	2.37	3.16
14S-1P	1.77	2.03	1.33	2.32	3.16
14S-2S	1.88	1.97	1.43	2.41	3.25
14S-2P	2.08	2.17	1.63	2.37	3.50
14-3S	2.03	2.08	1.43	2.17	4.15
14-3P	2.08	2.12	1.43	2.57	3.95
14S-4S	1.70	1.70	1.43	2.27	3.16
14S-4P	1.39	1.48	1.08	1.97	2.81
14S-5S	2.12	2.32	1.57	2.47	3.71
14S-5P	2.12	2.37	1.59	2.81	3.71
14S-6S	2.57	2.47	2.17	3.07	4.20
14S-6P	2.61	2.61	2.08	2.96	4.09
14S-7S	2.23	2.23	1.63	2.76	3.76
14S-7P	1.97	1.97	1.43	2.27	3.16
14S-9S	2.08	2.08	1.53	2.37	3.56
14S-9P	1.97	1.92	1.43	2.23	3.36
14S-11S	2.17	2.17	1.63	2.52	3.65
14S-11P	2.37	2.37	1.83	2.72	3.85
14S-12S	2.08	2.08	1.53	2.37	3.56
14S-12P	—	—	—	—	—
16S-1S	2.61	2.87	2.23	3.21	3.85
16S-1P	2.87	2.87	1.88	3.21	4.40
16-2S	2.27	2.32	1.68	2.72	3.56
16-2P	2.08	2.12	1.48	2.47	3.56
16S-3S	1.83	1.92	1.24	2.23	3.41
16S-3P	1.83	1.92	1.24	2.23	3.41
16S-4S	1.92	2.03	1.39	2.37	2.92
16S-4P	1.92	2.03	1.39	2.32	3.56
16S-5S	2.17	2.37	1.73	2.76	3.56
16S-5P	2.17	2.23	1.59	2.57	3.76
16S-6S	2.17	2.37	1.53	2.67	3.91
16S-6P	2.12	2.17	1.53	2.52	3.71
16-7S	2.67	2.72	2.08	2.61	4.15
16-7P	2.37	2.52	2.32	2.81	3.91
16S-8S	2.37	2.72	2.08	3.07	3.65
16S-8P	2.61	2.47	1.92	2.87	3.71
16-9S	2.72	2.87	2.12	3.25	4.29
16-9P	2.57	2.67	2.03	3.01	4.05
16-10S	2.61	2.76	2.12	3.11	4.09
16-10P	2.27	2.37	1.73	2.72	3.85
16-11S	2.37	2.52	1.83	2.47	3.91
16-11P	2.27	2.37	1.59	2.72	3.80
16-12S	2.67	2.72	2.08	3.07	4.15
16-12P	2.37	2.47	1.77	2.76	3.85
16-13S	2.96	3.02	2.19	3.02	4.74
16-13P	4.21	4.32	3.50	4.69	5.92
16S-15S	2.03	2.08	1.43	2.37	3.60
16S-15P	—	—	—	—	—
18S-1S	3.65	3.80	2.87	3.91	5.19
18-1P	4.00	4.15	3.16	4.49	5.72
18-2S	3.51	3.16	2.08	3.71	4.69
18-2P	2.61	2.72	1.63	3.80	4.25
18-3S	2.76	2.52	1.63	3.65	4.44
18-3P	2.72	2.47	1.48	2.96	4.25
18-4S	2.87	2.92	1.83	3.11	3.95
18-4P	3.07	2.96	2.03	3.16	4.55
18-5S	2.76	2.76	1.83	3.16	4.44
18-5P	2.96	2.67	1.68	2.96	4.44
18-6S	2.87	2.92	1.83	3.31	4.40
18-6P	2.72	2.81	1.73	2.96	4.25
18-7S	3.36	3.11	2.03	3.60	4.64
18-7P	2.87	2.68	2.08	3.16	4.55
18-8S	3.71	4.00	2.96	4.00	4.99
18-8P	3.60	3.65	2.61	3.71	4.93
18-9S	4.00	3.56	3.41	4.89	4.40
18-9P	4.09	4.20	2.92	4.35	5.19
18-10S	4.00	3.71	2.37	4.84	5.24
18-10P	3.56	3.25	2.17	3.41	4.75
18-11S	3.60	3.36	2.47	4.35	5.39
18-11P	3.21	2.96	2.32	3.95	4.93
18-12S	3.11	3.24	2.52	3.36	4.64
18-12P	3.71	3.16	2.23	3.36	4.99
18-13S	4.64	4.40	3.41	5.43	6.03
18-13P	3.45	3.16	2.23	3.95	4.84
18-14S	3.85	3.60	2.52	4.09	5.09
18-14P	3.36	3.16	2.32	3.60	4.99
18-15S	4.98	4.56	3.26	5.33	6.99
18-15P	7.94	7.58	6.34	8.90	9.36
18-16S	3.07	2.67	1.73	3.25	4.35
18-16P	2.87	2.61	1.68	3.11	4.25
18-17S	4.00	3.71	2.61	4.49	5.28
18-17P	4.09	4.09	3.01	4.35	5.59
18-18S	2.91	3.71	2.61	4.89	5.19
18-18P	4.09	4.09	3.01	4.35	5.59
18-19S	15.90	15.25	13.50	15.75	16.30
18-19P	7.60	7.00	6.20	7.10	8.20
18-20S	2.96	3.11	2.08	3.21	4.49
18-20P	3.31	2.92	2.12	3.76	4.99
18-22S	3.51	3.16	2.08	3.71	4.69
18-22P	2.61	2.72	1.63	3.80	4.25
18-29S	3.60	3.25	2.17	4.40	4.79
18-29P	3.80	3.45	2.37	4.59	4.99
18-30S	2.96	3.11	2.08	3.21	4.49
18-30P	3.31	2.92	2.12	3.76	4.99
18-31S	2.96	3.11	2.08	3.21	4.49
18-31P	3.31	2.92	2.12	3.76	4.99
18-404S	7.20	7.30	6.30	8.90	9.10
18-404P	4.85	4.95	3.95	6.55	6.75
20-1S	4.44	4.69	3.60	4.75	4.84
20-1P	5.63	6.32	3.91	5.92	5.97
20-2S	3.25	3.36	1.92	4.05	4.25
20-2P	3.11	3.31	1.83	3.45	4.20
20-3S	3.71	3.76	2.23	4.25	4.69
20-3P	3.41	3.56	1.97	3.80	4.84
20-4S	3.36	3.36	2.08	3.76	4.93
20-4P	3.16	3.20	1.92	3.71	4.84
20-5S	3.07	3.16	1.68	3.45	4.40
20-5P	2.87	2.92	1.43	3.56	4.20
20-6S	3.25	3.45	2.08	3.60	4.40
20-6P	3.25	3.31	1.83	3.60	4.20
20-7S	3.51	4.15	2.87	3.80	5.09
20-7P	4.35	4.69	3.25	4.64	5.59
20-8S	4.40	4.44	3.01	5.33	5.33
20-8P	4.20	4.29	2.81	4.89	5.09
20-9S	4.29	4.40	2.92	4.79	5.28
20-9P	4.15	4.20	2.76	4.64	5.09
20-10S	3.36	3.36	2.08	3.76	4.93
20-10P	3.16	3.20	1.92	3.71	4.84
20-11S	4.66	4.76	4.02	5.49	7.77
20-11P	3.57	3.66	2.93	4.39	6.72
20-12S	3.56	3.60	2.17	4.44	4.49
20-12P	3.36	3.45	2.03	3.80	4.35
20-13S	3.65	4.75	2.27	4.84	4.59
20-13P	3.11	3.76	2.27	3.45	4.59
20-14S	4.40	4.44	3.11	5.59	5.39
20-14P	3.91	4.44	2.92	4.15	5.28
20-15S	4.55	4.69	3.21	5.19	5.53
20-15P	3.95	4.09	2.61	4.89	4.93
20 16S	4.55	4.79	3.31	4.89	5.63
20-16P	4.44	4.49	3.11	4.89	5.43
20-17S	4.44	4.55	3.11	5.63	5.43
20-17P	4.20	4.29	2.81	4.59	5.19
20-18S	4.84	4.93	3.41	5.83	5.83
20-18P	4.25	4.29	2.81	5.43	5.24
20-19S	4.20	4.25	2.81	5.39	5.19
20-19P	3.91	4.15	2.72	4.21	5.04
20-20S	4.25	4.29	2.81	4.40	5.24
20-20P	3.80	3.91	2.41	4.40	4.79
20-21S	4.59	4.75	3.25	4.93	5.63
20-21P	4.44	4.44	3.11	5.43	5.43
20-22S	4.44	4.55	3.11	5.43	5.43
20-22P	4.25	4.35	2.87	4.55	5.24
20-23S	3.71	3.80	2.32	4.64	4.69
20-23P	3.36	3.45	2.03	3.80	4.35
20-24S	3.91	4.00	2.57	5.04	4.89
20-24P	3.71	3.80	2.32	4.35	4.69
20-25S	4.44	5.04	3.60	4.75	5.92
20-25P	5.63	6.03	4.59	5.92	6.92
20-26S	3.85	3.91	2.47	5.04	4.84
20-26P	3.45	3.71	2.23	3.80	4.55
20-27S	4.05	4.50	3.15	4.00	5.25
20-27P	3.40	3.85	2.55	3.45	4.60
20-28S	4.44	5.04	3.60	4.75	5.63
20-28P	5.63	5.97	4.49	5.92	6.57
20-29S	7.07	6.63	5.93	7.82	9.41
20-29P	4.52	4.07	3.37	5.30	6.85
22-1S	3.71	3.71	2.03	4.25	5.04
22-1P	3.41	3.45	1.88	4.00	4.79
22-2S	4.29	4.35	2.87	5.24	5.63
22-2P	3.95	4.00	2.57	4.40	5.33
22-3S	3.71	3.76	2.32	4.79	5.04
22-3P	3.36	3.36	1.97	3.95	4.75
22-4S	4.00	4.09	2.52	4.55	4.89
22-4P	3.71	3.91	2.37	4.09	5.04
22-5S	3.95	3.95	2.57	4.15	5.33
22-5P	3.71	3.71	2.27	3.91	5.09
22-6S	3.80	3.85	2.37	5.04	5.19
22-6P	3.56	3.56	2.12	4.29	3.56
22-7S	3.85	3.85	2.47	4.75	5.24
22-7P	3.41	3.41	2.03	4.00	4.79
22-8S	3.71	3.91	2.52	4.15	5.24
22-8P	2.96	3.11	1.68	3.41	4.44
22-9S	3.71	3.76	2.27	4.93	5.04
22-9P	3.21	3.25	1.92	4.00	4.15
22-10S	3.16	3.76	2.17	3.56	4.84
22-10P	3.41	3.45	2.03	3.91	4.79
22-11S	3.45	3.56	2.12	4.09	4.84
22-11P	2.87	3.36	1.97	3.25	4.49
22-12S	4.20	4.29	2.76	4.79	5.53
22-12P	3.85	3.91	2.47	4.59	5.24
22-13S	4.29	4.29	2.87	5.33	5.63
22-13P	3.60	4.00	2.57	4.05	5.28
22-14S	5.19	5.97	4.64	5.59	6.81
22-14P	5.88	5.88	4.44	7.06	7.21
22-15S	5.19	5.24	3.76	6.37	6.52
22-15P	3.95	4.09	2.67	4.35	5.39
22-16S	4.93	4.99	3.51	6.08	6.32
22-16P	4.35	4.40	3.01	5.59	5.73
22-17S	4.25	4.79	3.31	4.64	5.88
22-17P	4.44	4.49	3.07	5.09	5.83
22-18S	4.09	4.35	2.87	4.55	5.63
22-18P	3.91	3.91	2.52	5.09	5.28
22-19S	4.49	5.24	4.00	4.89	6.17
22-19P	4.89	4.93	3.45	6.07	6.27
22-20S	3.85	4.44	3.07	4.25	5.48
22-20P	4.09	4.15	2.67	4.55	5.19
22-21S	4.55	4.79	5.56	5.04	6.32
22-21P	4.09	4.20	2.72	4.55	5.48
22-22S	4.35	4.40	2.92	5.24	5.68
22-22P	4.20	4.20	2.76	4.79	5.48
22-23S	4.99	5.04	3.60	6.17	5.83
22-23P	4.40	4.40	3.01	5.33	5.77
22-24S	4.15	4.09	2.72	4.20	5.48
22-24P	3.65	3.71	2.23	3.95	4.99
22-25S	4.15	4.20	2.72	5.24	5.48
22-25P	3.80	3.80	2.37	4.40	5.19
22-26S	4.49	4.49	3.11	4.79	5.83
22-26P	4.20	4.25	2.81	4.75	5.52
22-27S	4.89	5.09	3.71	5.33	6.43
22-27P	4.29	4.84	3.31	4.75	5.92
22-28S	4.55	4.55	3.16	5.77	5.92
22-28P	3.80	3.85	2.37	4.98	5.19
22-29S	4.79	4.84	3.41	5.39	6.12
22-29P	4.49	4.49	3.11	5.43	5.83
22-33S	3.95	4.20	3.11	4.40	5.77
22-33P	4.20	4.25	2.81	5.13	5.53
22-34S	4.15	4.20	2.72	4.89	5.48
22-34P	3.80	3.95	2.52	4.29	5.28
22-36S	7.07	7.56	6.67	8.04	8.48
22-36P	13.00	13.48	12.59	13.96	14.41
22-404S	18.80	18.95	17.80	20.35	20.80
22-404P	11.70	11.85	10.25	11.00	15.10
24-1S	4.44	4.35	2.67	5.28	5.59
24-1P	3.71	4.00	2.57	4.55	5.48
24-2S	4.89	4.79	3.07	5.63	5.97
24-2P	4.09	4.29	2.57	4.49	5.48
24-3S	4.29	4.69	3.01	5.04	5.88
24-3P	3.80	3.80	2.61	4.49	5.53
24-4S	4.64	4.79	3.07	5.63	5.97
24-4P	4.05	4.25	2.57	4.84	5.48
24-5S	4.69	5.43	4.40	5.39	6.57
24-5P	5.19	5.63	3.91	5.13	6.86
24-6S	5.09	4.99	3.31	5.88	6.17
24-6P	4.35	4.35	2.67	5.04	5.59
24-7S	5.48	6.37	4.69	6.23	7.45
24-7P	5.28	6.03	3.76	6.03	7.21
24-9S	4.93	5.24	4.00	5.77	6.96
24-9P	3.85	4.09	2.47	4.64	5.39
24-10S	5.53	5.48	3.76	6.37	6.86
24-10P	5.43	5.39	3.65	6.27	6.57
24-11S	6.03	5.92	4.25	6.81	7.16
24-11P	4.89	5.28	3.56	5.68	6.47
24-12S	5.04	5.83	4.75	5.77	7.01
24-12P	4.64	4.79	3.07	5.43	5.97
24-14S	4.99	4.93	3.21	5.83	6.12
24-14P	4.00	4.25	2.72	4.79	5.63
24-15S	4.69	5.43	4.40	5.39	6.67
24-15P	5.77	5.63	3.95	6.57	6.92
24-16S	5.28	5.19	3.45	4.69	5.92
24-16P	4.20	4.55	2.81	4.20	5.04
24-17S	5.73	5.63	3.16	5.68	6.86
24-17P	3.80	4.05	2.52	4.59	5.43
24-18S	4.49	4.44	2.72	5.33	5.63
24-18P	3.45	3.71	2.17	4.25	5.13
24-19S	5.59	5.53	3.80	5.48	6.72
24-19P	4.55	5.04	3.31	5.33	6.27
24-20S	5.63	5.63	3.80	5.92	6.47
24-20P	6.12	6.08	4.44	6.61	7.06
24-21S	4.84	4.84	3.65	5.68	5.73
24-21P	4.59	4.55	3.11	5.04	6.37
24-22S	5.95	6.00	5.63	6.10	9.47
24-22P	8.60	8.65	7.45	8.80	10.63
24-23S	5.96	5.93	4.22	6.81	7.07
24-23P	5.15	5.11	3.41	6.00	6.26
24-24S	4.69	5.43	4.40	5.39	6.67
24-24P	6.23	5.63	3.95	6.57	6.92
24-27S	4.44	4.41	2.70	5.26	5.56
24-27P	4.41	4.37	2.67	5.22	5.52
24-28S	7.30	7.25	5.63	8.09	8.25
24-28P	9.28	9.18	7.56	9.48	10.22
24-691S	5.28	5.19	3.45	4.69	5.92
24-691P	4.20	4.55	2.81	4.20	5.04
24-835S	9.09	9.04	7.25	9.88	10.22
24-835P	5.04	4.98	3.25	5.88	6.17
24-865S	6.40	6.60	5.00	8.30	8.50
24-865P	4.00	4.17	2.56	5.80	6.10
28-1S	5:77	6.61	4.25	6.57	7.45
28-1P	5:13	5.83	3.56	5.68	6.76
28-2S	5.59	6.43	4.09	6.17	7.65
28-2P	5.24	5.88	3.56	5.88	7.13
28-3S	5.53	5.73	3.41	6.57	6.96
28-3P	4.35	4.64	2.52	5.39	6.03
28-4S	5.09	5.83	3.56	5.88	6.72
24-4P	4.59	5.24	2.92	5.33	6.23
28-5S	5.88	5.88	3.60	6.81	7.16
28-5P	4.89	5.13	2.92	5.88	6.52
28-6S	6.03	6.03	3.76	6.96	7.36
28-6P	4.75	5.04	3.07	5.43	6.57
28-7S	5.33	5.33	3.01	6.17	6.57
28-7P	4.25	4.49	2.57	5.24	6.12
28-8S	5.48	6.32	4.00	6.37	7.60
28-8P	5.13	5.88	3.65	6.08	7.21
28-9S	6.32	7.25	5.43	7.21	8.64
28-9P	5.39	5.97	3.71	6.27	7.21
28-10S	6.47	6.47	4.20	7.41	7.76
28-10P	5.97	6.08	3.80	6.96	7.86
28-11S	7.41	8.09	5.83	6.76	9.33
28-11P	7.01	7.21	4.93	7.06	8.49
28-12S	6.52	7.50	5.92	7.45	8.84
28-12P	7.10	7.76	5.48	7.56	9.04
28-13S	6.52	7.50	5.92	7.45	8.84
28-13P	7.80	7.80	5.48	8.69	9.09
28-14S	5.04	5.28	4.35	6.03	7.60
28-14P	5.77	5.77	3.45	6.67	7.06
28-15S	8.54	8.78	7.16	9.53	10.76
28-15P	9.28	9.28	7.01	10.22	10.61
28-16S	5.77	6.61	5.13	6.67	8.05
28-16P	6.86	6.86	6.23	7.76	8.09
28-17S	5.09	5.88	4.44	5.97	7.41
28-17P	5.43	6.17	3.91	6.17	6.17
28-18S	6.12	6.37	4.55	7.10	8.14
28-18P	5.59	5.83	3.71	6.57	7.21
28-19S	5.33	6.12	3.85	6.12	7.06
28-19P	4.64	5.39	3.11	5.59	6.61
28-20S	6.32	7.25	4.99	7.10	8.00
28-20P	5.48	6.32	4.00	6.27	7.56
28-21S	10.86	10.86	7.45	11.80	12.14
28-21P	9.58	9.58	7.16	8.89	10.81
28-22S	6.81	6.81	4.49	7.65	8.05
28-22P	6.37	5.97	8.76	6.96	7.25
28-410S	6.55	6.90	6.67	7.41	9.00
28-410P	6.10	6.45	5.67	6.63	8.30
28-766S	9.90	10.30	7.55	11.25	12.00
28-766P	7.30	7.70	5.37	8.60	9.35
28-833S	4.30	4.52	2.89	5.07	5.59
28-833P	3.96	4.19	2.56	4.70	5.22
28-840S	8.80	9.20	6.85	10.90	12.35
28-840P	7.30	7.75	5.40	8.80	9.40
28-880S	21.40	21.80	19.40	23.20	23.60
28-880P	22.60	23.00	20.50	24.30	24.70
32-1S	6.67	6.86	4.40	7.90	8.34
32-1P	5.82	6.32	3.91	6.72	7.76
32-2S	7.65	7.90	5.53	8.64	9.42
32-2P	6.08	6.32	3.95	7.06	7.90
32-3S	7.25	7.41	4.93	7.25	8.89
32-3P	6.57	6.81	4.44	7.45	8.34
32-4S	7.30	7.56	5.92	8.29	9.42
32-4P	6.92	7.01	4.64	8.05	8.54
32-5S	6.32	7.25	4.25	6.67	8.20
32-5P	5.09	5.77	3.36	6.03	7.01
32-6S	10.76	10.86	8.44	11.90	12.40
32-6P	9.33	9.42	7.06	9.62	10.96
32-7S	10.61	10.72	8.29	11.76	12.29
32-7P	9.73	9.82	7.16	9.43	11.41
32-8S	9.73	9.88	7.45	10.86	11.41
32-8P	8.98	9.13	5.83	10.12	10.66
32-9S	8.40	8.64	6.61	9.38	10.46
32-9P	7.45	7.56	5.09	8.54	9.09
32-10S	7.80	8.14	5.73	8.69	9.68
32-10P	6.23	6.72	4.35	7.10	8.09
32-12S	7.76	7.90	5.48	8.89	9.38
32-12P	6.86	7.01	4.55	8.05	8.54
32-13S	10.60	10.80	8.85	11.60	11.80
32-13P	8.45	8.70	6.80	9.05	9.75
32-15S	7.63	7.70	6.07	9.56	9.70
32-15P	7.33	7.41	5.78	9.26	9.41
32-16S	10.76	10.86	8.49	11.90	12.44
32-16P	9.38	9.53	7.10	10.52	11.01
32-17S	12.78	13.30	11.19	13.41	14.63
32-17P	12.48	13.04	10.93	12.82	14.37
32-101S	13.77	15.50	12.74	14.66	15.65
32-101P	11.36	11.50	9.09	12.49	12.89
32-102S	11.56	11.65	9.24	12.44	13.18
32-102P	9.04	9.13	6.67	10.12	10.66
36-1S	8.84	9.28	6.99	9.13	10.96
36-1P	8.20	8.34	5.28	8.64	10.08
36-2S	7.60	8.29	6.12	9.04	9.97
36-2P	7.25	7.56	5.33	8.34	9.28
36-3S	8.44	8.58	6.43	9.77	10.02
36-3P	7.59	7.80	5.53	8.58	9.42
36-4S	8.00	8.09	5.92	9.24	9.73
36-4P	6.72	7.01	4.99	7.80	9.09
36-5S	7.94	8.09	5.92	9.28	9.77
36-5P	6.96	7.10	4.84	8.29	8.78
36-6S	9.42	9.62	7.60	10.76	11.30
36-6P	8.34	8.58	6.37	9.38	10.17
36-7S	12.89	10.04	10.81	12.34	14.72
36-7P	10.26	11.90	8.64	13.09	13.58
36-8S	10.92	12.40	9.97	11.90	14.22
36-8P	11.50	11.70	8.78	12.89	13.48
36-9S	12.60	12.78	10.52	13.97	14.46
36-9P	9.48	11.01	8.44	12.14	12.49
36-10S	12.56	12.56	10.56	14.67	14.15
36-10P	15.04	15.04	13.04	17.15	16.63
36-13S	8.58	8.74	6.12	9.93	10.42
36-13P	7.60	7.76	5.09	8.89	7.01
36-14S	9.62	9.77	7.16	10.85	11.45
36-14P	6.86	7.01	4.35	8.14	8.64
36-15S	8.89	10.17	8.00	9.88	11.06
36-15P	10.12	10.26	7.65	11.16	11.94
36-19S	11.89	9.04	9.81	11.34	13.72
36-19P	9.26	10.90	7.64	12.09	12.58
36-20S	11.89	9.04	9.81	11.34	13.72
36-20P	9.26	10.90	7.64	12.09	12.58
36-853S	8.75	9.55	7.50	9.07	10.52
36-853P	8.70	9.30	7.10	9.33	10.19
40-1S	12.29	12.49	9.04	13.73	12.93
40-1P	10.81	11.01	6.57	11.10	11.57
40-2S	10.32	10.57	7.50	10.86	11.80
40-2P	9.73	9.88	6.37	11.70	12.29
40-3S	11.85	12.05	8.29	13.62	14.61
40-3P	10.61	10.81	7.06	11.80	12.78
40-4S	12.69	12.93	9.33	14.72	15.30
40-4P	11.70	11.85	8.14	18.58	14.22
40-5S	13.88	14.08	10.32	15.80	16.40
40-5P	12.09	12.34	8.58	13.33	14.32
40-6S	12.09	12.34	8.78	12.64	13.58
40-6P	11.21	9.77	7.65	13.13	13.73
40-7S	10.42	10.66	7.85	10.92	11.90
40-7P	13.93	12.40	10.52	15.80	14.61
40-9S	17.24	17.44	13.68	19.21	19.85
40-9P	14.76	15.01	11.26	16.78	17.38
40-10S	15.26	15.76	11.76	17.28	17.88
40-10P	13.93	14.12	10.37	15.85	16.49
40-11S	13.04	14.66	10.61	16.44	17.04
40-11P	11.86	12.05	8.34	13.82	14.42
44-1S	14.72	16.54	10.86	15.16	16.54
44-1P	15.06	15.30	9.09	15.06	13.73
44-2S	18.37	16.44	10.46	17.18	16.93
44-2P	13.88	14.42	8.44	14.12	15.65
44-3S	15.90	12.34	10.17	15.90	8.64
44-3P	14.52	14.72	8.74	14.52	15.26
44-4S	18.86	18.37	13.13	18.02	18.81
44-4P	16.40	16.60	10.46	16.34	17.82
48-1S	15.94	16.29	9.58	19.85	18.46
48-1P	13.97	14.22	8:20	15.36	16.93
48-2S	15.94	16.29	9.58	19.85	18.46
48-2P	13.97	14.22	8.20	15.36	16.93
48-3S	15.94	16.29	9.58	19.85	18.46
48-3P	13.97	14.22	8.20	15.36	16.93
48-4S	15.94	16.29	9.58	19.85	18.46
48-4P	13.97	14.22	8.20	15.36	16.93

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120 V.D.C. to 120V A.C. 60 cy. 1Ph., .4PF. Complete with Magnetic Controller, 2 Field Rheos and Full Set of Spare Parts including Spare Armatures for Generator and Motor. Full spec. on request. New........$285.00

2 KVA O'Keefe and Merritt. 115V DC to 120V AC. 50 cy. Idles at 3 Ph. syncs motor on 208V, 50 cy. New. Export crated........................$165.00

1.25 KVA Allis-Chalmers. 230 DC to 120 AC. 60 cy. 1 Ph. Fully enclosed. Splashproof. Ball Bearings, centrifugal starter. New, complete with kit of Spare parts................................$175.00

M.G. 164, Holtzer-Cabot Motor: 440V, 3Ph. 60 cy., 90A. 1/3HP, 1750 RPM. Generator: 70V, 3Ph, 146 Cy., .140KVA. Exciter: 115DC. 1A. New...$67.50

Type CG-21302. 440V AC. 60 cy., 3Ph., 1500 VA to 875 DC and 300V DC. New.................$69.50

INVERTERS

Onan MG-215H. Navy type PU/13. Input 115/230. 60 cy. 1 Ph. Output 115, 480 c. 1 Ph. 1200W and 26V DC at 4 amps. New..................$295.00

G.E. Model 5D-21NJ3A. Input: 24V, DC, Output: 115V, 400 cy., 485 Va. New................$29.50

Leland Elec. Co. Model PE206A. Input: 28V, DC. 38 Amps. Output, 80V., 800 cy, 485 VA. New $22.50

G.E. J8169172. Input: 28V, DC, Output: 115, 400 cycles at 1.5 KVA..........................$32.50

DYNAMOTORS

Navy-Type CAJO-211444, 105/130V DC to 13V DC at 40A or 26V DC at 20A. Radio Filtered. Complete with Line Switch. New..............$89.50

Elcor. 64V DC to 110V AC, 60 cy. 1 Ph. 2.04 Amps. New $24.50

Elcor. 32V DC to 110V AC, 60 cy, 1 Ph, 0.43 Amps. New $22.50

Type PE94C. For use with SCR522 Transmitter-Receiver. Brand new in export cases........$15.00

Carter 6V DC to 400V DC at 375 mils. New $39.50

AMPLIDYNES

G. E. Model 5AM21J17. 4600 R.P.M. Motor Compound wound. 150 Watts. Input: 27V DC. Output: 60V DC. Sig. Corps. U. S. Army MG-27-B. New $34.50

Edison type 5AM31NJ18A. Input: 27 volts, 44 Amps., 8300 RPM. Output: 60V DC at 8.8 amps. 530 Watts. New.............................$22.50

SMALL D.C. MOTORS

G.E. Model 5BA50LJ2A. Armature 27V D.C. at 8.3A. Field 60V DC at 2.3A. RPM 4000. H.P. 0.5 New $27.50

Electrolux Corp. of Canada. P/O vent fan assembly for SCR-602-T6. 1/35HP, 28.5V, 2.15 amps., 2200 RPM. Price..........................$16.50

Oster type E-7-5, 27.5V, 1/20HP, 3650 RPM. Shunt wound. Price.........................$15.00

Dumore Co. Type EBLG, 24V DC, 40-1 gear ratio, for use with type B-4 Intervalometer. Price $17.50

Ford Inst. Co. Type 5SDG. Brand New....$22.50

Electrolux Torque Motor....................$16.50

FL BLOWER SYNCHROS

Westinghouse 115v. 400 cy. 17 c.f.m. Includes capacitor. Price $12.50

BASIC SCOPE UNIT

For 80/115V, 400/2600 cycles
Part of Panadapter AN/APA-10

Consists of two chassis containing complete high and low voltage supply, 150V DC and 300V DC filtered and regulated and 400V DC and 1200V DC filtered. CR tube socket part of chassis. Uses 31B1, 2-VR150, 5R4G, 2x2 and 6AK5 DC reinserter tube. Has controls for intensity, focus, aux. focus. Brand New less tubes..........$29.50

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets less tuning units.
R111A/APR-5A Receiver—1000 to 6000 MC.
AN/APR-4 Tuning Units TN-17 (76300 MC).
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
BC1203 APN-4 Test Sets.
AN/APA-10 Panoramic Adapters 115V/60 cycles.

RADAR

Antenna-Trans-Rec Unit ASG-1,
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUZ-50AGD (SD-5 Radar)
Radar Crystal Units 98.35kc, Raytheon.
1N21B Sylvania Diodes.
Repeater Adapters CBM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.
SG Rectifier Power Units CRP-20ABN.
SG Rectifier Power Unit CRP-20ABM.
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SG Complete trans. RF Coupling Assemblies.
SG Power Control Chassis.
SG Driver Modulator Assemblies.
SG Complete sets equipment spares.
SG Load Divider Modernization kits.

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5910 - 6350 - 6370 - 6470 - 6510 - 6610 - 6670 - 6690 - 6940 - 7270 - 7350 - 7380 - 7390 - 7480 - 9720 Kilocycles. Available in quantity.
Price ....$1.25 each

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We can supply for above models only:
All coils for Ant., RF., Det. and Osc. bands.
All I.F. trans., including C. W. Osc. and xtal filters.
4 gang condensers, engraved front panels, complete dial mechanism assemblies, etc.
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GE Servo type 2CV1C1 400 cycle
Constant Output Line BC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

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Coast Guard MR-162 Whips 23½ ft.
Microwave types AT-49, AT-38, AS-125
APT-2 Dipole Antennas
TDY Radar Jammer Horns
Paraboloids, Magnesium Dishes 17½" dia.
SCR 634-A (Part of RC-153-B Antenna).

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

RECTIFIERS

G.E. No. 6 RC89F16 for 54 cells 10 amps.
G.E. No. 6 RC133F2—In: 110/220/60/1. Out: 15/30V-75-150A
Mallory APS-20—In: 115/230/60/3. Out: 12/24V-65-130A
Turret Trainer Supply. In: 220/60/3. Out: 28V-130A
RA20 Vibrator Power Supply
Complete specs on request

MISCELLANEOUS

SCR522 Transmitter Receivers Brand New
TCR Transmitters 125 watt Ship to Shore
BC966A Transponders
RT7-AN/APN-1 Receivers
BC-423B Modulators
BC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.

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400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat No. 80G184.
KVA .945S-520P Volts 460/345/200/115. New $4.95
FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/115/125V. Output: 5V3A/.5V3A/5V3A/5V3A 5V6A/5V6A/6.3V6A/6.35A. New $2.95
THRYRATRON POWER. 400/1600 cy. Raytheon UX-8876, 400/1600 cy. Pri: 115, Sec: 50-0-50V at 1.5A, 6.3V at 1.2A. Test r.m.s. 1780. New....$2.75
PLATE WECO KS9560, 400/800 cy. Pri: 115V, Sec: 1350-0-1350 at .057A (2700 V Total). Elecstat shlded. Wt. 2.3 lbs. New...................$2.95
Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV insulation. Brand new...............$49.50
PLATE & FIL. WECO KS9555. 400 cy. Pri: 115V. Sec #1: 930-0-930. Sec #2: Three 6.3V windings $3.95
FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shdld. Wt. 0.5 lbs. New...........................$1.95
PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A (ins. 1500V)/5V2A/5V2A $4.95
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA. $1.75

60 CYCLE TRANSFORMERS

FILAMENT. Raytheon Hypersil Core, Pri: 115V. Sec: 6.3V22A/6.3V2.4A/6.3V2.25A/6.3VO., 6A Ins. for 1700V $5.95
High Rectance Trans. G. E. type Y-3502A.—60 cy. Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. 8318065G1. New $89.50
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PULSE TRANSFORMERS

PULSE. WECO KS-9563. Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wdg. 1.3=.082H at 100 cps.....$5.00
PULSE. WECO KS-161310, 50 KC to 4MC, 1¾" Dia. x 1⅞" high. 120 to 2350 ohms. New....$1.95

RAYTHEON VOLTAGE REGULATOR

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V., 60 Watts, ½ of 1% Reg. Wt. 20 lbs. 6⅛" H x 8¼" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized. Special.........$14.75

RELAYS

Struthers-Dunn 1BXX129, 110 D.C.
Advance type 455C, SPDT, 115 A.C.
Leach type 1154A, SPDT, 115 A.C.
Leach type 1054, BSN 20-28V D.C.
Clare Plug-in base No. 30FMX 115 A.C.
G.E. Plug-in base Sensitive K27J853
Allied Control type BJ 452-1128
Western Electric D-163781 Plug-in
Guardian Time Delay type B-9-SPDT
Haydon Time Delay 17717 110V/60

SONAR EQUIPMENT

Hoist Train Mechanisms, Navy type 78219, for Model QBG, Underwater Sound equipment. Purpose: To lower or raise projector. Travel 2'3". Includes 1 partial set of spare parts. 1 wooden box per set; Weight and cube per box: 427 lbs., 42.0 cu.

MISCELLANEOUS

Cathode Ray Shields for 3" tube	$3.75
Variac type Motor Controls 600 watt	$13.50
10 CM Waveguide 90° elbow	$20.00
Adel Clamps assorted types—write for samples	
Shock Mounts Lord #20	$.40
Shock Mounts U. S. Rubber #5150C	$.30
Commando Pole Jacks (Cook Elec. Co.)	$1.00
Fusetron (Bus FRN 50 Ampere 250V)	$.25
Switchboard Lamp Receptacles & Jewels	$.40

SOUND POWERED PHONES

Western Electric No. D173312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable........$17.50
Automatic Elec. Co. No. GL843AO. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable $16.00
U. S. Instrument Co. No. A-260. Complete with 20' cable and plug. Brand new..............$17.50
W. E. type TS-10M Handset. New..........$16.50

HI-VOLT CAPACITORS

.25 Mfd., 20KV	$26.50
.25 Mfd., 15KV	$22.50
.5 Mfd., 25KV	$34.50
1 Mfd., 15KV	$34.50
1. Mfd., 7.5KV	$12.50
2 Mfd., 6.0KVA	$14.50

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INC.

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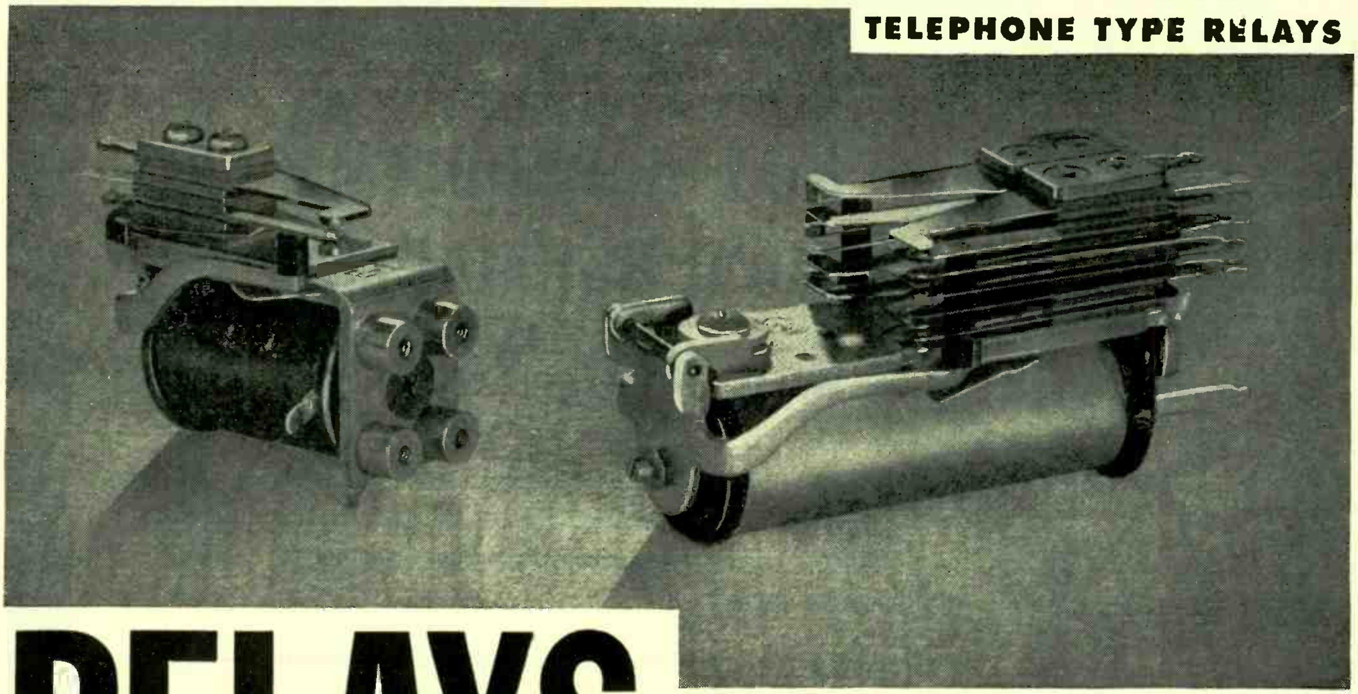
ID-14/APN-1	$14.50
I-82A	$9.75
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual	$246.00

TELEPHONE TYPE RELAYS



RELAYS

This list represents only a small part of more than a million relays in our stock—one of the world's largest. All relays are standard, brand new in original packing, and fully guaranteed by Relay Sales.

Send us your relay requirements. If the items are in stock we can make immediate delivery at substantial savings in cost to you.

SHORT TELEPHONE RELAYS

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	UNIT PRICE
R-635	12 VDC	100	1C&1B	$1.35
R-308	12 VDC	100	2C @ 4 Amps	1.85
R-343	12 VDC	100	1C	2.00
R-826	12 VDC	150	2C, 1B	1.55
R-770	24 VDC	150	1A/10 Amps	1.45
R-368	8/12 VDC	200	1B	1.40
R-771	24 VDC	200	1A/10 Amps	1.45
R-603	18/24 VDC	400	2A	1.55
R-575	24 VDC	500	2C	2.40
R-764	48 VDC	1000	1C&2A	2.00
R-417	5.5 ma	5800	2C	2.50
R-563	60/120 VDC	7500	1A	2/3.10
R-213	5/8 VAC 60 Cy.	....	2A	2.50
R-801	115 VAC	....	NONE	1.45
R-589	12 VDC	125	2A	1.30
R-113	12 VDC	150	4A	1.55
R-689	12/24 VDC	255	1C	1.55
R-799	24 VDC	500	NONE	1.00
R-115	24 VDC	500	1C	1.70
R-110	24/32 VDC	3500	1C	2/3.45
R-121	150 VDC	5000	2A&1C	2.05
R-122	150 VDC	5000	2C/Octal Base	2.50
R-634	150/250 VDC	6000	1A&1B	2.45
R-369	8/12 VDC	150	2A, 2B	1.60
R-908	6 VDC	15	4A @ 4 Amps	1.50
R-800	12 VDC	150	2C&1A	1.55
R-537	12/24 VDC	150	2C&1B	2.00
R-750	24 VDC	400	1A	1.60
R-367	10/16 VDC	195	2C	2.50
R-335	20/30 VDC	700	2A, 1C	2.00
R-366	30/120 VDC	4850	1C	2.50

STANDARD TELEPHONE RELAYS

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	UNIT PRICE
R-806	115 VAC	900	1A	$2.05
R-161	6 VDC	10	2B&1A	1.10
R-873	6 VDC	12	3C-3A MICALEX	3.00
R-305	12 VDC	50	2A Split Cerm.	1.35
R-360	24 VDC	200	1C	1.50
R-484	24 VDC	200	2A, 1C	1.35
R-337	24/48 VDC	1200	1A, 2B Split	2.65
R-101	24 VDC	1300	2A	2.50
R-868	30/162 VDC	3300	1C	1.90
R-365	52/162 VDC	3300	4C	3.95
R-518	85/125 VDC	6500	1C	3.60
R-918	52/228 VDC	6500	1C	3.60
R-852	52/228 VDC	6500	1C, 1A	3.00
R-341	75/228 VDC	6500	4C @ 4 Amps	3.65
R-633	180/350 VDC	10,000	1C @ 5 Amps	2.90
R-344	72/300 VDC	11,300	3A, 1B	2.45
R-332	100/350 VDC	40,000	2A	3.50
R-664	110 VAC	...	2B&1A/OCT.SOCKET	2.45
R-667	6 VDC	.75	1B/10AMP. 1A/3AMP.	1.45
R-632	6 VDC	12	5A&1C	3.25
R-154	6/12 VDC	200	1A	1.50
R-517	12 VDC	250	2A	1.50
R-116	85 VDC	3000	1B	3.05
R-631	100/125 VDC	3300	2A	1.90
R-545	110/250 VDC	7000	1C	2.40
R-124	300 VDC	12,000	1A	1.55
R-511	24 VDC	200	W/MICRO N.O.	3.05
R-160	6 VDC	12	3C&3A	3.00
R-851	52/228 VDC	6500	1C, 1A	3.00
R-591	6 VDC	40	1B&1C	1.35
R-155	12 VDC	100	4A&4B	1.45
R-520	200/300 VDC	14,000	2C	3.45
R-159	6 VDC	50	2A	1.35
R-158	6 VDC	50	4A Cerm.	1.85
R-381	6/8 VDC	100	1A Split	2.50
R-382	6/12 VDC	200	1B Split	2.50
R-153	12 VDC	200	1C&1A	1.55
R-304	12 VDC	200	4A Split Cerm.	2.50
R-383	6/12 VDC	500	1A Split	2.50
R-385	6/12 VDC	500	1B Split	2.50
R-384	6/12 VDC	500	3A Split	3.00
R-576	12 VDC	200	2A	2.50
R-316	24 VDC	200	1C	1.50

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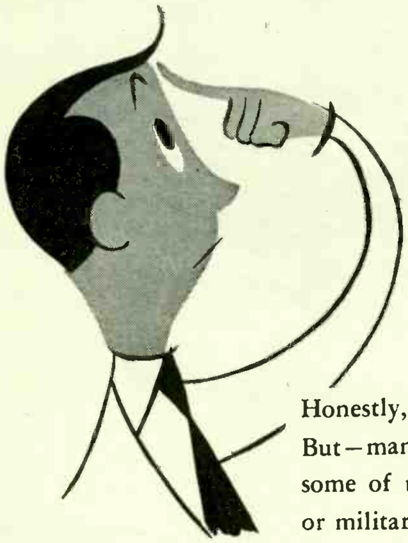

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- *10SL-656S*
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- 12S-1S
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- 24-21P
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- *24-24P*
- *24-24S*
- *24-25P*
- *24-25S*
- 24-26P
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- 24-28P
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- 24-684P
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- 24-691P
- 24-691S
- *24-710P*
- *24-710S*
- 24-835P
- *28-1P*
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- 28-745S
- 28-840P
- 28-840S
- 28-852P
- 28-852S
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- *36-17P*
- *36-17S*
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- 36-18S
- 36-19S
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- *40-11S*
- *40-13P*
- *44-1P*
- *44-1S*
- 44-2P
- 44.2S
- *44.4P*
- *44-4S*
- *44-5P*
- *44-5S*
- *44-6P*
- *44-6S*
- 44-9S
- *48-1P*
- *48-1S*
- 48-3S

3108-B

AN 3108-A

AN 3106

AN 3102

AN 3101

AN 3100

AN 3057

PURCHASING AGENTS: MAKE USE OF OUR TRANSMITTING AND RECEIVING TUBE DEPARTMENT

K-RK-PL CONNECTORS

"K" & "RK"

- WK
- -1-
- M.2
- C.3
- -4-
- S.4
- -6-
- SK
- C.2
- L.3
- C.7
- S.2
- V.7
- C.9
- M.10
- C.16
- -19-
- GK
- -1-
- C.3
- S.3
- C.4
- M.5
- C.8
- -9-
- -12-
- NK
- L.5
- S.10
- -12-
- M.16
- L.20
- C.23
- -27-

AVAILABLE AT THIS TIME

- FK
- D.2
- M.3
- V.3
- L.5
- -10-
- R.14
- L.15
- G.15
- V.15
- B.18
- IK
- V.9
- -26-
- R.26}
- M.30}

"K" & "RK"

- LK
- N.27
- L.36
- -37-
- A.53
- AK
- D.39
- G.52
- AF
- C.8
- D.2
- D.4
- T.8

SHELLS

21
21.C

22
22.C

23
23.C

24
24.C

31.S
31.SL

32.S
32.SL

"PL"

- PL-U-9-U
- PL-112
- PL-122
- PL-123
- PL-147A
- PL-149
- PL-151A
- PL-152A
- PL-153A
- PL-156A
- PL-P-200
- PL-208
- PL-213
- PL-216
- PL-Q-227
- PL-P-230
- PL-Q-230
- PL-254
- PL-P-256
- PL-P-257
- PL-259A

WE SPECIALIZE IN PROMPT DELIVERY

SPECIAL ATTENTION GIVEN TO "DO" ORDERS

WILGREEN INDUSTRIES

99 MURRAY ST., N. Y. 7, N. Y.
TELS. WORTH 2-7423-4-5
NEW PHONES WORTH 4-2490-1-2

324 CANAL ST., N. Y. C., 13, N. Y. • WAlker 5-9642

Universal general corp.

Over 300,000 RELAYS in our Vast Stock-

YOUR RELAY HEADQUARTERS

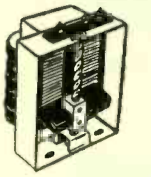
●

LARGE STOCKS OF

AN Connectors
APC's
Binding Posts
Cable
Capacitors
Ceramicons
Ceramics
Chokes
Circuit Breakers
Coils
Controls
Crystals
Filters
Fuses
Hardware
Iron Core Slugs
Knobs
Potentiometers (sine-cosine)
Pulse Xfmrs.
Relays
Resistors
Servo Xfmrs.
Shock-Mounts
Sockets
Spaghetti
Switches
Transformers
Tubes
And Others

SEE OUR PREVIOUS ADS FOR LISTINGS

VOLTAGE REGULATOR



Amertran Transtat

90 to 130 V. 50-60 cyc. 17.5 Amps, #T282 .... $17.50

103 to 126 V. 50-60 cyc. 2.17 Amps, #T283 ...... $9.95

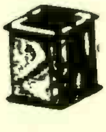
W. E. D122855. 92 to 115 V. 400 cyc. 5.5 Amps, #T281 $6.75—10 for $60.00

2.5 AMP H.D. FILTER REACTOR

Amertran Type PBN 0.5 Hy, at 2.5 A. 2.3 Ohm. 2.5 KV insul, 5½ x 7 x 8" overall, Heavy Shield, #T284 .... $12.95

SERVO OUTPUT XFMRS

PP6L6 to Servo Mechanism with 10% Feed-Back Winding. Mu-Metal Core. Shielded #T285 .... $3.50



PP6V6 & 6SN7 (Dual Unit) to Servo Mechanism with 10% Feed-Back Winding. Mu-Metal Core. Shielded. #T286 $3.95

AUDIO XFMRS

Multiple Line & Voice Coil to Multiple Line & Voice Coil. Good Fidelity. Kenyon S20130. Shielded. #T287 .... $2.25

Input Line to Single or P.P. Grids. 500-ohm C.T. Primary. Overall Ratio 1:13.7. Kenyon 213089-1. Shielded. #T288 .... $2.25

Multiple Line or Mike to Single Grid. 300-ohm C.T. Primary. Overall Ratio 600:1. Kenyon 213307-2. Shielded. #T289............ $2.25

P.P. INTERSTAGE. Single or P.P. Plates to P.P. Grids. Ratio 1:1.2. Hi-Fidelity. Stancor 87A15. Shielded. #T112.............. $2.50

120 CYCLE FILTER

Input Impedance: 1000 ohm, Output Impedance: 1000 ohm. Kenyon 213104-1. Shielded. #T289 .... $3.95

SWINGING CHOKES

5 to 30 Hys, 125 Ma, 200 Ohm. S.C. Stock #4G1668C/R1. 2000V Test. Shielded. #T111 $3.49

5 to 20 Hys, 300 Ma, 90 Ohm. 2000V Test. Shielded. #T290 $3.95

SHOCKMOUNTS

Series	Mfgr	Lb	Ea	Series	Mfgr	Lb	Ea
100	Lord	1	.10	200	Lord	35	.38
100	Lord	2	.10	200	Lord	45	.45
100	Lord	4	.12	200PH	Lord	6	.35
100	Lord	8	.15	200PH	Lord	10	.35
100	Lord	9	.18	200PH	Lord	12	.38
150	Lord	8	.20	250PH	Lord	15	.40
150	Lord	10	.20	250PH	Lord	45	.45
150	G'year	25	.25				
150PH	Lord	4	.25				
150PH	Lord	6	.25				
200	Lord	10	.28				
200	Lord	20	.30				
200	Lord	25	.35				

OTHER MOUNTS

VX1021 Harris 2 oz	.10
3/4" Dia Lord 2 Lb	.10
279 Series 250 Lord	1.00
C2030 Barry	1.00

MICROSWITCHES 10 Amp 125 V

Type	Action	Actuator	Ea.
YZ2R5	SPST n.o.	Pin	.59
BZ2R5	SPDT	Pin	.69
V312	SPST n.o.	Wire	.69
WZ3RTC	SPST n.c.	Pin	.59
APR201	SPST n o.	Plunger	.79
WZR21	SPST n.c.	Plunger	.79
WZE7RQNT	SPST n.c.	Plunger	1.50

Enclosed Type*

ACRO SWITCHES

2MC31A	SPST n.c.	Pin	.59
2MD21A	SPDT 6A	Pin	.69
2MD31A	SPDT	Pin	.79
XC72L	SPST n.c.	Leaf	.79

OTHER SENSITIVE SWITCHES

C-H 8911K524 DPST n.o. Plunger	.79
MuSwitch DGBP32 SPST n.o. Plunger	.95

TOGGLE & PUSH SWITCHES

Contacts	Mfgr. & No.	Description	Amps	Ea
SPST	Carling	Small Toggle	3A, 110V	.15
SPST	A, H&H	Toggle	A, 250V	.29
SPST	C-H B5A	Aircraft	35A, 24V	.29
SPDT	C-H B9A	Aircraft	35A, 4V	.29
SPDT	A, H&H	Toggle	3A, 125V	.29
DPST	A, H&H	Toggle	3A, 125V	.39
1 B*	A, H&H	Momentary	5A, 125V	[illegible]
1 B*	T&M Co.	Push	3A, 125V	.29
1 A*	Square D	Push	15A, 24V	.49

* 1A = SPST n.o. *1B = SPST n.c.

20% off in lots of 100 or more

GLASS TO METAL SEALS HIGH-VOLTAGE FEED THRU

Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory cost.

110V 60 Cyc TIMING MOTORS

INGRAHAM 8 RPM Fully Enclosed	$1.95
TELECHRON 3.6 RPM	2.50
GILBERT With Gear Train for 6 RPDay	1.95
GILBERT 60 RPM (1 RPS)	1.75

OIL FILLED CAPACITORS

BATHTUBS

Mfd.	WVDC	Term	Ea	Mfd.	WVDC	Term	Ea
2x0.1	600	Bot.	.35	2x0.64	600	Side	.45
3x0.1	600	Bot.	.40	1.0	400	Side	.55
0.2	440AC	Side	.40	2x1.0	600	(2)Side	.65
0.25	600	Top	.40	2.0	600	Bot.	.65
0.5	600	Bot.	.45	4.0	50	(1)Side	.65
0.5	600	Top	.48	100	25	(2)Side	.65
0.5	400	Side	.45	50	25	(1)Side	.30

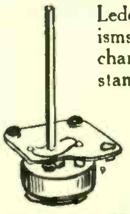
CHANNEL

Mfd.	WVDC	Term	Ea	Mfd.	WVDC	Term	Ea
0.015	600	Top	.28	2x0.5	200	(2)Bot.	.35
2x0.1	600	Bot.	.35	0.5	400	Bot.	.40
3x0.1	400	Bot.	.40	0.5	600	Bot.	.48
3x0.1	600	Bot.	.45	1.0	400	Bot.	.48
2x0.25	600	(2)Bot.	.48	1.0	400	Top	.48

RECTANGULAR

Mfd.	WVDC	Ea	Mfd.	WVDC	Ea
2x0.1	7000	1.69	1.0	2000	1.85
0.2	5000	2.25	1.5	330AC	.89
0.25	4000	1.95	5	25	.49
0.75	1000	.69	7	600	1.45
1.0	400	.30	3x8	5	1.95
1.0	600	.65	17.5	330AC	3.25
1.0	1500	1.49	Filterette	50V3A	.59

ROTARY RATCHET RELAYS



Ledex D.C. Impulse operated mechanisms rotate in 30 steps. Ratchet mechanism has ¼" shaft with flats for standard switch wafers.

#33 Mechanism only, 24V. 200 ohm, #R597 .... $1.50

#76-2945 Mechanism & Ratchet & 3" long shaft, 6V, ½ ohm, #R598 .... $3.50

#75-3576 Mechanism & Ratchet & 4" long shaft, 6V, ½ ohm, #R599.......... $3.75

#25 Mechanism Only, 12V, 4.5 ohm, #R824 $1.50

#26 Mechanism Only, 6V, 2 ohm, #R825 $1.50

Miniature Mechanism Only, 12V, 35 ohm, #R826 .... $1.50

Miniature Mechanism Only, 6V, 10 ohm, #R827 $1.50

TERMS WRITE US YOUR NEEDS FOR IMMEDIATE QUOTE. ALL PRICES F.O.B. OUR PLANT. MIN. ORDER $5.00.

WANTED! WANTED!

MILITARY TEST SETS & EQUIPMENT

TS-12, 13, 35, 14, 15, 146, 174, 175, 263, 268, etc. APR, ARC, ART, APS, APA, SCR, BC equipment and parts. Also TUBES, any quantity. WRITE, WIRE OR CALL.

R·H·S

SPECIALS OF THE MONTH

Coaxial Relay K-101 SPDT—24v DC5	$ 4.95
Set of 83-1SP Coax-Connectors for Above	1.35
1000 KC Crystal BT cut	3.95
VS-2 Vacuum Switch	6.95
Sigma Plate Relay 8000 ohm SPDT	2.49
RG-59/U Coaxial Cable—75 ohm 150′ roll......$11.95, 800′ roll	22.50
3″ Scope Shield	1.29
2000-0-2000 V @ 800 MA Xformer	24.95
15 HY @ 800 MA Choke	6.95
2 mfd 8000 V Condenser	4.25

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

OA3/VR75	$1.69
OB3/VR90	1.29
OC3/VR105	1.49
OD3/VR150	1.29
1B22	3.45
1B23	12.50
1B24	19.95
1B26	3.95
1B27	24.50
1B29	2.75
1B32	8.95
1B36	24.96
1B38	32.50
1N21 Xtal	1.25
1N21A "	2.25
1N21B "	4.25
1N22 "	1.35
1N23 "	2.25
1N23A "	3.25
1N23B "	6.95
1N26 "	5.95
1N27 "	1.69
1N34A "	1.40
1P23	3.95
1P24	1.79
1P36	2.95
1S21	6.95
2AP1	11.95
2C21/RK33	.69
2C22/7193	.49
2C26A	.49
2C34/RK34	.89
2C39	24.30
2C40	12.95
2C43	14.95
2C44	1.49
2C46	7.50
2C51	6.95
2D21	1.79
2E22	1.95
2E24	4.89
2E26	3.69
2E30	2.29
2J21A	9.95
2J22	8.45
2J26	29.50
2J27	29.50
2J30	99.50
2J31	39.50
2J32	39.50
2J33	39.50
2J34	39.50
2J36	97.50
2J37	12.75
2J38	12.75
2J39	39.50
2J40	39.50
2J46	39.50
2J48	29.50
2J49	39.50
2J50	22.50
2J54B	39.50
2J55	97.50
2J61	49.50
2J62	49.50
2K25/723AB	29.50
2K28	36.25
2K29	24.50
2K33	310.00
3AP1	12.95
3B22/Elic.	2.95
3B23/RK22	4.85
3B24	5.95
3B24W	7.95
3B25	4.65
3B26	3.95
3B27	3.95
3B28	8.95
3BP1	8.95
3C22	64.50
3C23	9.95
3C24	$2.25
3C27	4.95
3C31/C1B.	3.49
3C45	19.95
3CP1	2.25
3CP1S1	2.95
3DP1	4.95
3DP1A	6.95
3DP1-S2A.	8.95
3D21A	1.98
3E29	14.95
3FP7	3.95
3GP1	4.75
3HP7	3.95
4-65A	14.21
4-125A	26.95
4-250A	29.95
4AP10	4.95
4B22/EL5B	9.95
4B24/EL3C	7.95
4B25/6CF.	8.95
4B26/2000	8.95
4B28	4.95
4B32	9.95
4C27/CV92	9.95
4C35	34.50
4E27/257B	17.95
5AP1	3.69
5AP4	3.69
5BP1	5.95
5BP4	5.95
5CP1	4.93
5CP7	12.95
5C22	55.00
5D21	24.50
5FP7	3.25
5GP1	4.95
5JP1	24.45
5JP2	24.45
5JP4	24.45
5J23	12.95
5J29	12.95
5J30	49.50
5J32	98.50
5LP1	15.95
5NP1	5.95
6AS6	3.69
6C21	24.50
6F4	5.95
6J4	6.95
7BP7	8.95
7DP4	17.95
9GP7	14.95
9JP1	14.95
9LP1	19.95
9LP7	14.95
10BP4	22.50
10	.49
12DP7	16.95
12GP7	16.95
12HP7	16.95
12LP4	22.50
15E	1.19
15R	.89
16AP4	42.50
16CP4	42.50
19T8	2.90
23D4	.45
28D7	1.35
30 Special.	.39
35TG	4.95
45 Special.	.39
53A	5.95
75TL	6.95
100R	.89
100TH	9.95
121A	2.98
203A	8.95
204A	69.50
211	.69
212E	49.50
215A	.19
2170	$8.95
227A/5C27	5.95
249C	3.95
250R	12.95
250TH	22.50
250TL	21.50
274A	5.50
274B	2.65
276A	9.95
293A	2.98
294A	5.75
300B	9.95
304TH	14.95
304TL	14.95
305A	34.95
307A/RK75	5.95
310A	8.95
316A	.65
323A/B	24.50
327A/5C37	4.95
328A	8.95
331A	12.95
350A	8.95
350B	4.95
368AS	7.95
371A	1.49
371B	.98
388A	2.75
393A	6.95
394A	4.95
417A	12.95
434A	4.95
446A	4.95
446B	4.95
450TH	47.50
450TL	47.50
527	12.75
559	1.39
562	97.30
575A	13.95
701A	5.95
702A	3.95
703A	7.95
704A	1.05
705A	2.95
706BY	39.50
706CY	39.50
706FY	42.50
706GY	42.50
707B	17.95
708A	4.95
709A	3.95
710A/8011	1.75
713	1.43
714AY	6.95
715A	7.95
715B	9.75
715C	29.95
717A	1.69
721A	2.59
722A	2.95
723A	14.95
723A/B	22.50
724B	3.89
725A	7.95
726A	6.95
726B	29.50
730A	30.50
750TL	79.50
800	1.95
801A	.49
802	4.49
803	4.49
804	9.95
805	4.49
806	29.95
807	1.98
808	7.25
809	2.45
810	9.95
811	3.25
812	2.95
812H	$6.90
813	8.95
814	3.95
815	2.95
816	1.30
826	.98
828	12.75
829	12.95
829B	14.95
830B	3.95
832	12.95
832A	12.95
833A	41.50
836A	3.95
837	1.69
838	2.95
841	.45
843	.39
845	4.95
849	39.50
851	69.50
852	29.95
860	6.95
861	29.50
864	.39
865	1.45
866A	1.39
866JB	1.29
869B	49.50
872A	2.98
874	1.49
876	.59
878	2.25
884	1.85
885	1.49
905	3.59
902A	10.95
905	3.59
908	12.95
918	1.69
919	2.79
922	.98
923	1.05
927	1.59
930	1.20
931A	4.95
954	.39
955	.45
956	.45
957	.45
958	.45
959	.69
991/NE16	.39
1603	5.25
1613	1.25
1614	2.25
1616	.98
1619	.35
1622	3.25
1624	1.98
1625	.45
1626	.45
1629	.35
1630	.98
1631	1.29
1632	.79
1633	.75
1634	.75
1636	3.25
1638	.65
1641	2.25
1644	.98
1654	2.39
1655	1.50
1665	1.45
1851	1.69
1960	.79
1961	4.99
2050	1.90
2051	1.45
5670	8.95
8005	5.95
8008	$7.95
8011	1.75
8012	3.95
8013	2.95
8014	29.95
8020	1.29
8025	5.95
9001	2.25
9002	2.25
9003	2.25
9004	.75
9005	2.95
9006	.49
C1JA	9.95
C5B	9.95
C6A	7.95
C6J	6.95
C100D	1.49
CK502AX	2.95
CK503AX.	2.95
CK505AX.	2.25
CK506AX.	2.25
CK507AX.	2.25
CK512AX.	2.25
CK517AX.	8.45
CK1005	.89
CK1006	3.25
E1148	.35
EF50	.69
F123A	8.75
F127A	22.50
F128A	89.50
F606	37.50
F660	79.50
FG17	3.95
FG27A	8.75
FG32	7.95
FG57	14.95
FG81A	3.95
FG105	22.95
FG172	34.50
FG146	8.95
FG434A	4.95
FG451	.89
FG502A	1.85
FG562	97.50
FG592	14.95
GL502	1.65
HF125	14.95
HF300	19.95
HY114B	.79
HY115	.79
HY615	.29
KC4	37.50
KU610	6.95
ML101	69.50
REL21	3.95
RK20	9.95
RK25	4.49
RK33	.69
RK34	.89
RK48A	4.49
RK59	1.49
RK60/1641	2.25
RK65	24.30
RK72	.59
RK73	.59
RX21A	2.95
RX120	8.95
V70D	6.95
VR78	.69
VR91	1.49
VR92	.98
VT127A	3.95
VT158	14.95
VU29	2.95
VU111	1.49
WL468	12.95
WL530	12.75
WL531	12.75
WL532	2.95
WL578	1.29
WL616	$37.50
WL619	18.95
WL677	34.50
WL681	22.50
OA2	1.55
OA4G	1.20
OB2	1.65
OZ4	.75
O1A	.73
1A3	.73
1A4P	1.30
1A5GT	.73
1A6	.85
1A7GT	.95
1AB5	.80
1B3/8016.	1.25
1B4	1.15
1B5/258	.95
1B7GT	1.25
1C5GT	.85
1C6	.73
1C7G	.73
1D5GP	.73
1D7G	.73
1D8GT	.73
1E5GT	.73
1E7G	1.19
1F4	.73
1F5G	.73
1G4	.73
1G6GT	.73
1H4G	.89
1H5GT	.75
1H6GT	1.05
1J6	.98
1L4	.73
1LA4	.89
1LA6	1.15
1LB4	1.06
1LC5	.89
1LC6	.98
1LD5	.98
1LE3	.85
1LG5	.85
1LH4	.89
1LN5	.95
1N5GT	.89
1P5GT	.79
1Q5GT	.73
1R4	.73
1R5	.95
1S4	.73
1S5	.85
1T4	.83
1T5GT	.73
1U4	.89
1V	.72
1X2	1.18
2A3	.95
2A4G	1.25
2A5	.73
2A6	.73
2A7	.75
2B7	.75
2V3G	.79
2X2	.65
2X2A	1.60
3A4	.65
3A5	.90
3B7/1291.	.59
3D6/1299.	.59
3LF4	.95
3Q4	.79
3Q5GT	.85
3S4	.85
3V4	.90
5R4GY	3.75
5T4	1.95
5U4G	.73
5V4G	1.12
5W4	.81
5X4G	.89
5Y3GT	.63
5Y4G	$0.73
5Z3	.89
5Z4	.89
6A3	1.25
6A4LA	1.35
6A6	.92
6A7	.99
6A8	1.05
6AB7	1.05
6AC5GT	1.20
6AC7	1.25
6AD7GT	1.35
6AE6G	.89
6AF6G	.95
6AG5	.89
6AG7	1.55
6AH6	1.40
6AJ5	1.15
6AK5	1.50
6AK6	1.10
6AL5	.82
6AQ5	.92
6AQ6	.87
6AR5	.79
6AT6	.73
6AU5	1.25
6AU6	.93
6AV6	.72
6B6G	.99
6B7	.98
6B8G	.85
6BA6	.85
6BC5	.98
6BE6	.85
6BF6	.79
6BG6G	1.18
6BH6	.97
6BJ6	.97
6BQ6	1.35
6C4	.79
6C5	.79
6C6	.79
6C8G	.98
6CB6	.98
6D6	.85
6D8	.89
6F5	.79
6F6	.95
6F7	.89
6F8G	.95
6G6G	1.15
6H6	.95
6H6GT	.79
6J5	.75
6J5GT	.69
6J6	1.20
6J7	.82
6K5GT	.89
6K6GT	.79
6K7	.73
6K8	.73
6L5G	.87
6L6	3.00
6L6G	1.75
6L6GA	1.75
6L7	.98
6L7G	.95
6N7	.89
6Q7	.95
6R7	.85
6S7G	.98
6S8GT	1.05
6SA7	.85
6SC7	1.30
6SD7GT	.98
6SF5	.89
6SF5GT	.89
6SF7	.98
6SG7	.98
6SH7	.73
6SJ7	.89
6SK7	.89
6SL7GT	$0.98
6SN7GT	.98
6SQ7	.75
6SR7GT	.85
6SS7	.95
6ST7	1.10
6SU7GTY	2.15
6SV7	1.25
6T7G	1.20
6T8	1.18
6U5G	.95
6U6GT	.98
6U7G	.59
6V6	1.55
6V6GT	.89
6W4	.85
6W7G	1.05
6X4	.73
6X5GT	.75
6Y6G	.98
6Y7G	1.25
6ZY5G	.89
7A4/XXI	.79
7A5	.89
7A6	.85
7A7	.85
7A8	.89
7B4	.85
7AG7	1.05
7B5	.85
7B6	.85
7B7	.85
7C4	.79
7C5	.85
7C6	.85
7C7	.85
7E5	.75
7E6	.59
7E7	.89
7F7	.85
7H7	.85
7K7	1.20
7L7	.98
7N7	.98
7Q7	.83
7R7	.95
7S7	.98
7V7	.95
7W7	1.05
7X7	1.10
7Y4	.75
7Z4	.85
12A	.65
12A6	.73
12A7	1.05
12A8GT	.79
12AH7GT	1.27
12AL5	.93
12AT6	.73
12AT7	1.25
12AU6	.95
12AU7	1.15
12AV6	.73
12BA6	.85
12BE6	.87
12C8	.79
12F5GT	.79
12H6	.82
12J5GT	.55
12J7GT	.82
12K7GT	.79
12K8	.89
12Q7	.69
12SA7GT	.93
12SC7	.99
12SF5	.89
12SF7	.89
12SG7	.79
12SH7	.73
12SJ7	.79
12SK7	.98
12SL7	$1.05
12SN7	.98
12SQ7	.85
12SR7	.85
12Z3	.85
14A4	.98
14A7	.95
14B6	.95
14F7	.95
14F8	.95
14H7	.95
14J7	.95
14N7	.95
14Q7	.95
14R7	.95
19	.69
24A	.78
25L6GT	.85
25Z5	.79
25Z6GT	1.05
26	.80
27	.49
28D7	1.95
30	.45
31	.85
32	.95
32L7GT	.89
33	.93
34	.89
35/51	.83
35A5	.89
35B5	.89
35C5	.98
35L6GT	.88
35W4	.69
35Y4	.75
35Z3	.85
35Z4	.73
35Z5	.69
36	.79
37	.79
38	.60
39/44	.40
41	.75
42	.75
43	.75
45	.89
45Z3	.89
45Z5	.80
46	.82
47	.89
48	.98
49	.95
50A5	.95
50B5	.95
50C5	.95
50L6GT	.85
50Y6	.85
53	.98
56	.65
57	.80
58	.85
59	.95
70L7	.95
71A	.75
75	1.25
76	.55
77	.60
78	.79
80	.73
82	.89
83	1.15
83V	1.15
84/6Z4	.85
85	.89
89Y	.45
117L7/M7.	1.35
117N7	1.35
117P7	1.35
117Z3	.89
117Z6	.90

RADAR—COMMUNICATIONS—TEST EQUIPMENT

AN/APA10 Panoramic Adapter	$175.00
AN/APA11 Pulse Analyzer.	
AN/APN-4B Receiver	39.95
AN/APR4 Radar Search Receiver.	
AN/APR5 Radar Search Rec. 1000-31000 mcs.	375.00
AN/APS3 Airborne X-Band Search Radar	875.00
AN/APS15 X-Band R.F. Head	99.50
AN/APT5 300-1500 mcs Xmitter	149.50
AN/CRT3 Dual Freq Victory Girl	129.50
AVR-15 Aircraft Receiver	19.95
AN/PPN-1 Portable Radar Beacon.	
BC221AK Freq. Mtr. with Modulation	149.50
BC-433G Compass Receiver	39.95
BC-639 Receiver	285.00
BC-640B 100-156 mcs ground Xmitter	1300.00
BC-733D Receiver	29.95
BC-1016 Tape Code Recorder	459.50
BC-1206 Beacon Receiver	4.95
MN-26Y Compass Receiver	24.95
PE-75 2½KW Gasoline Generators	450.00
RA-34 Power Supply	250.00
SCR269G Automatic Radio Compass	129.95
SCR504 Portable D.F. 100 KC-65MC	
SCR522 Airborne VHF Transceiver.	
SCR536 Handi-Talkie.	
SCR694 Lightweight Field Radio.	
SK-1M Radar Receiver Indicator	89.50
SQ Portable Radar 10 CM	360.00
T-50 Portable Radiotelegraph Xmitter	275 0
TCS Marine 2 Way Radio	
TRC-1 Complete Antenna System.	
ARA 500-1500KC Receiver, good	24.95
R28/ARC-5 Receiver	29.95
BC455B 6-9 mcs. Receiver	19.95
BC433 200-1750KC Compass Rec.	29.95

AN/ARR-2X RECEIVER

Secret Transmission Receiver for reception of double modulated carrier. Will receive 235-258 mcs signals that have been modulated by a 600-750 KC signal. When carrier is heard on a standard receiver no modulation is heard on the carrier when actually speech is being transmitted. 12V DC input. Excellent condition.

SO-13 S-BAND MARINE RADAR

Compact Sea Search Radar for small vessels. P.P.I. indication is provided. Complete in original cases with complete sets of spares. Excellent condition.

ARR-2 234-258 mcs. Receiver	$19.95
BC-454 3-6 mcs. Rec. w/tubes. New	16.95
T23/ARC-5 Xmitter	49.95
BC696-A 3-4 mcs Xmitter	29.95
TYPE @ 5, 3-7 mcs Xmitter	9.95
AVT-23 300-13-000KC Complete, New	79.50
BC-95CA 100-156 mcs. Xmitter, New	59.95
BC-456 Modulator, good	2.25
BC-450 Control Box (3 Rec.) used	1.25
BC-451 Control Box (Xmitter) used	.98
BC-442 Relay Unit (Ant) Used	1.95

FLEXIBLE SHAFTING AVAILABLE

HRU-28 28V 2000W Gasoline Generator	
RG-8U Coaxial Cable. Per Thousand Feet	585.00
SCR-518 Altmeter. Complete installation	29.98
SCR-522 Trans Rec. Complete installation 28V Input; 12V Input avail.	129.50
RCA Sound Powered Chest & Headsets. Pair	29.95
Trailing Wire Antenna Feed Tube	5.95
Goniometer for SCR277 Direction Finde	39.95
HS-30 Headsets	3.95
FT-154 (BC-348 Shock Mount)	2.98
HS-33 Headsets	4.95
BC-608 Automatic Keyer for SCR522	5.95
BC1284 Lighthouse Tube Preamplifier	69.95
APA-17 D.F. Antenna; 300-1000 MC	59.00
BC-996 Interphone Amplifier	9.95
ART-13 Loading Condenser	4.95
CU-25 Loading Box for Art-13	49.95
PS-27/ARN5 Antenna	4.95
SA-1/ARN-1	2.95
1D-80/APA-17 Indicator	129.95
RM-29 Romote Control	18.95
RA-300 FM Exciter	32.50
A-55 Dummy Antenna	2.25
BC-1365 Control Box	3.95
FL-8 Filter	3.95
FL-5 Filter less Cables	2.65
3C-16D G5A P Gun Camera Computer, complete.	19.95
AT-2/APN-2 Antenna	4.95
CG-(172/173)CPN-8 10CM Patch Cable	4.95

AN/ARC-1 TRANS/REC.

Provdes Radio-Telephone Communication between Aircraft or Aircraft & Ground. Complete with Shock Mount & Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS. Checked out.

TS3/AP S-Band Freq & Power Meter.	
TS10/APN Altimeter Test Set, Ex.	$35.00
TS11/AP.	
TS12/AP V.S.W.R. Test Set for X-Band.	
TS13/AP XA Band Sig Gen Pwr & Freq Mtr.	
TS14/AP SA Band Sig Gen.	
TS15/AP Flux Meter.	
TS16/AP Altimeter Test Set	$29.95
TS19/APQ5 Range Calibrator.	
TS23/APN Test Set for SCR718 Altimeter.	
TS32/TRC-1 70-100 mcs Sig Gen used to check ANTRAC Equipment.	
TS33/AP X-Band Freq. Meter.	
TS34/AP Synchroscope.	
TS35/AP X-Band Sig Gen Pwr Mtr Freq Mtr.	
TS36/AP X-Band Power Meter.	
TS45/AP X-Band Sig Gen.	
TS47/APR Sig Gen 40-500 Mcs.	
TS59/APN Altimeter Test Set.	
TS61/AP S-Band Echo Box	$140.00
TS62/AP X-Band Echo Box.	
TS67/AP I.L.S. Test Set.	
TS69/AP Freq. Mtr. 300-1000 mcs	$72.50
TS89/AP Voltage Divider.	
TS102/AP Range Calibrator.	
TS110/AP Echo Box.	
TS111/AP S-Band Freq. Meter.	
TS125/AP S-Band Power Meter.	
TS126/AP Synchroscope.	
TS155/UP S-Band Sig Gen Pwr Mtr Freq. Mtr.	
TS164/AR A.C. Version of BC221.	
TS170/ARN I.L.S. Test Set.	
TS174/AP Freq. Mtr. 40-400 Mcs	$385.00
TS175/AP Freq. Mtr. 300-1000 mcs.	
TS184/AP	
TS189/AP	
TS226/AP 300-1000 mcs Pwr Mtr.	
TS268/AP Xtal Diode Test Set.	
TS278/AP AN/APS13 Test Set.	
BC-221 Frequency Meter.	
1E-19 Test Set for SCR522.	
1E-36 Test Set for SCR522.	

AN/TPS-3 PORTABLE RADAR

Lightweight Portable Search Radar for detection of aircraft, in the frequency range of 600 MCS. power input: 115v 400 cyc. 1330 watts. 28V DC 400W. Complete installation. Excellent condition.

RADIO HAM SHACK Inc.

189 GREENWICH STREET . NEW YORK, N. Y.

PHONE DIGBY 9-0347

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IMMEDIATE DELIVERY — Servo-Tek — FULLY GUARANTEED

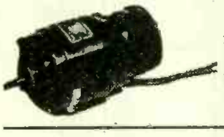
SYNCHRONOUS MOTOR

W.E. S-1283228.
For 2 phase
240 cycle
operation.
55 volts.

Stock #SA-317. **Price $9.75 each.**

BODINE NSHG-12 MOTOR

Constant speed



27 v. D-C Governor controlled 3600 rpm. 1/30th hp. Stock #SA-39. **Price $17.50 each.**

SELSYN SPECIALS

General Electric types 2J1F1, 2J1G1, 2J1H1 and type 2J1F3 aircraft units. 400 cycle units designed for use with turret control systems. Prices on Request.

Subfractional Horsepower AC Motors

Eastern Air Devices-J-72B—115 v. 400 cy. 1/50 hp. Cont. duty 4700 rpm.
E. A. D. J-31—115 v. 400 cy. 1/100 hp.
E. A. D. J-49B—115 v. 400 cy. 1/250 hp.
E. A. D. J-33—115 v. 3ϕ 400 cy. sychronous.
Diehl FBF-24-1—115 v. 400 cy. 1/100 hp.
Synchron-600—110 v. 60cy. 1 rpm.
Haydon 36228—115 v. 60cy. 1 rpm.

PM MOTOR

Sampsel 27 V DC PM motor. Type S—151273. One in./oz. torque at 7000 rpm. 1½" x 1½" x 2¾" Lg. Stock #SA-283. **Price $12.75 each. Quantity available.**

REVERE CAMERA MOTOR

27 v. D-C Split field series. Approx. 2½" sq. x 2½" lg. Stock #SA-315.

Price $6.75 each.

JA1 MOTOR (D-C)

Electric Specialty. ¼ hp. 24 v. D-C. (Wing flap motor.) Stock #SA-325. **Price $19.50 ea.**

PERMANENT MAGNET GEARHEAD MOTORS

Delco type 5069600—27.5 v. DC. 250 rpm output shaft speed. 12 in/oz.
Delco type 5071895—27.5 VDC. 250 rpm.
Delco type 5069230—27.5 VDC. 145 rpm.

C1B THYRATRON

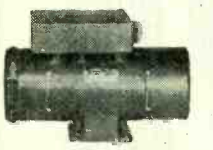
Special offer — Large quantity C1B thyratrons available. New, original packing. Write for quantity quotation.

DC Motor Special

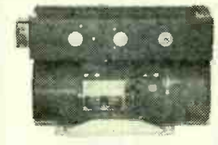
1¾ hp. 28 v. DC. motor. Magnetic brake. Electric Specialty Co. type HCA32B. **Large Qty. Available.**

INVERTERS

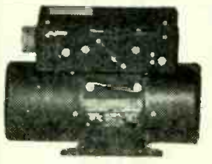
Wincharger PU-7/AP Input 28 VDC at 160 amps. Output 115 v. 400 cy. 1 ϕ at 2500 VA. Voltage and frequency regulated. Cont. duty. Stock #SA-164. **Price $89.50 each.**



G.E. 5AS131NJ3 (PE-118) Input 26 VDC at 100 amps. Output 115 v. 400 cy. 1 ϕ at 1500 VA. PF 0.8 W.E. Spec. KS-5601L1. Stock #SA-286. **Price $29.50 ea.**



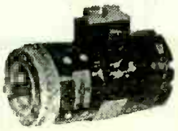
PE-218EInverters Russel Electric and Leland. Input 28 VDC at 92 amp. Output 115 v. 400 cycles at 1500 VA. PF 0.9. Stock #SA-112A. **Price $49.50 each.**



Pioneer 12130-4-B Input 28 VDC at 14 amps. Output 120 v. 400 cy. single phase at 1.15 amps. (140 VA.) Voltage and frequency regulated. Made 1949. Stock #SA-304. **Price $89.50 each.**

Leland SD-93—(10285)—Input 28 volts DC at 60 amps. Output 115 volts three phase 400 cycles at 750 va. 0.90 P.F. Second output voltage of 26 volts 400 cycles at 50 V.A. Voltage and frequency regulated. Designed for use with various autopilots. Stock #SA-209. **Price $99.50 each**

Aircraft Generator Eclipse NEA-3



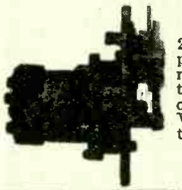
Output 115 VAC; 10.4 amps 800 cycles at 2400 rpm. Also 30 VDC at 6 amps. Stock #SA-306. **Price $39.50 each.**

DC MOTORS

Haydon-0666. ½ rpm. 29 v. d-c. 100 ma.
General Electric 5BA50LJ66—½ hp. 27 v. field. Arm. v. 60, Amplidyne controlled.
Delco-A-7155—1/3 hp. 3600 rpm. Governor controlled.
W. E. KS-5603-LO2—1/100 hp. 4 lead shunt.
National Mineral—90600. 1 hp. Int. duty. Fan cooled.
Diehl FDE-53-5—3600 rpm. Governor controlled. 1/30 hp.
G. E. 5BA25MJ409—24 v. 7500 rpm. Cont. duty.
Airsearch—Actuator—25800-24. 2" travel.
Barber Colman—Actuator—YLc-2066-2. 200 in/lb. 135 degrees in 45 seconds.
Airsearch—Actuator (Manual Flap) 25080.
Airsearch—Actuator—(Automatic Flap) 25040.
Holtzer Cabot—RBD-2220—½ hp. 27 v. 3600 rpm.
Arma Latitude Motor — 8413-30 (Step motor)
Elinco B-64—1/165 hp. 3100 rpm. 27 v. f. 80 v. armature. (Thyratron control)
John Oster—A-21E-12R—Split field series reversible. 28 v. 0.4 amps. 2 watts output.
General Electric 5PS56HC18 — Split field series rev. 60 v. 1.4 A. 5500 rpm.

D-C ALNICO FIELD MOTORS

AC-SERVO MOTORS

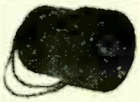


Pioneer Type CK-2

26 v. 400 cycles fixed phase, var. phase 49 v. max. 1.05 in/oz. Stall torque. Rotor moment of inertia 7 gm/cm: With 40: 1 gear reduction. Large Qty.

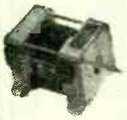
Prices on Request

PIONEER CK-17



400 cycles 2 phase, 26 v. fixed phase. 45 v. max. variable phase. Built in gear reduction. Output shaft speed approx. 4 rpm. Stock #SA-287. **Price $16.50 each.**

FORD SERVO MOTOR



115 volt 60 cycle two phase low inertia motor. 15 watts output. BuOrd. 207927. Stock #SA-291. **Price $49.50 each.**

Pioneer Servo Motor

Type 10047-2A. 2 ϕ 400 cycle low inertia. 26 v fixed phase. 45 v. max. variable phase. Stock #SA-90. **Price $12.50 each.**

MICROWAVE ANTENNA

AS-217/APG 15B. 12 CM dipole and 13 inch Parabola housed in weatherproof Radome 16" dia. 24 v. DC spinner motor for conic scan. Stock #SA-95. Shipping wt. 70 lbs. Original boxes.

Price $14.50 ea.

A-5 Autopilot Indicator

Autosyn type Pilot Indicator for A-5 Autopilot. 26 v. 400 cycles. Stock #SA-299. **Price $12.50 each.**

Radio Compass Indicator

I-82F. Compass Indicator. 0-360°-5 in. dial. 26 v. 400 cy. 8-12 v. 60 cy. Ideal position indicator. Stock #SA-284.

Price $6.50 each

MAGNESYNS

Pioneer Type CL-3, 6 power.
Pioneer 1006-1E-B1 Indicator. AN-5730-2.

400 CYCLE AC BLOWERS

E. A. D. J-151—115 v. 400 cy. 22 c.f.m.
Westinghouse Type FL—115 v. 400 cy. 17 c.f.m.

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1SF, 1G, 5G, 5F, 5CT, 5HCT, 5SDG, 5DG, 5SG, 5SF, 5HSF, 6G, 6DG, 7G, 2J1F1, 2J1G1, 2J1H1, 2J5FB1, 2J5R1, 2J1-F3, XX1, X, XV, VII, II, 5V, etc.

Servo-Tek products co.
4 Godwin Ave. Paterson, N. J.

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TELECHRON SYNCHRONOUS MOTOR, Type B3, 110 V., 60 Cy., 4 W., 2 RPM.
PRICE $5.00 EA.

TELECHRON SYNCHRONOUS MOTOR Type BC, 110 V., 60 Cy., 6 W., 60 RPM.
PRICE $4.00 EA.

EASTERN AIR DEVICES, Type J33, Synchronous, 115 V., 400 Cy., 3 ϕ, 8000 RPM.
PRICE $15.00 EA.

HAYDON TIMING MOTORS 110 V., 60 CY.

Type 1600, 2.2 W., 4/5 RPM. PRICE $3.00 EA.

TYPE 1600, 2.2 W., 1/240 RPM.
PRICE $3.00 EA.

TYPE 1600, 2.3 W., 1 RPM. PRICE $3.00 EA.

TYPE 1600, 2.2 W., 1-1/5 RPM.
PRICE $3.00 EA.

TYPE 1600, 3.5 W., 1 RPM. With shift unit automatic engaging and disengaging shaft.
PRICE $3.75 EA.

TYPE 1600, 2.2 W., 1/60 RPM.
PRICE $3.00 EA.

SERVO MOTORS

CK1, PIONEER, 2 ϕ 400 Cy. PRICE $10.00 EA.

CK2, PIONEER, 2 ϕ, 400 Cy. PRICE $14.00 EA.

CK2, PIONEER, 2 ϕ, 400 Cy., with 40:1 reduction gear. PRICE $15.50 EA.

10047-2-A, PIONEER, 2 ϕ, 400 Cy., with 40:1 reduction gear. PRICE $10.00 EA.

MINNEAPOLIS HONEYWELL Type B, Part No. G303AY, 115 V., 400 Cy., 2 ϕ, built-in reduction gear, 50 lbs. in torque.
PRICE $10.00 EA.

MINNEAPOLIS HONEYWELL Amplifier Type G403, 115 V., 400 Cy., Used with above motor. PRICE $10.00 EA. WITH TUBES

REMOTE INDICATING COMPASSES 26 V., 400 CY.

PIONEER TYPE AN5730-2 Indicator and AN5730-3 Transmitter.
PRICE $40.00 PER SET

KOLLSMAN TYPE 680K-03 Indicator and 679-01 Transmitter. PRICE $15.00 PER SET

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JAEGER WATCH CO. TYPE 44K-2 Contactor Motor, 3 to 4.5 V. Makes one contact per second. PRICE $3.50 EA.

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PRICE $10.00 EA.

BARBER-COLMAN CONTROL MOTOR, Type AYLC 5091, 27 V., 0.7 Amps., 1 RPM. Contains 2 adj. limit switches. 500 in. lbs. torque. PRICE $9.50 EA.

WHITE RODGERS ELECTRIC CO., Type 6905 No. 3 ,12 V., 1.3 Amps., 1½ RPM, torque 75 in. lbs. PRICE $10.50 EA.

ENGINE HOUR METER

John W. Hobbs Model MI-277. Records running time up 1000 hours. 20 to 30 volts D.C.
PRICE $15.50 EA.

INVERTERS

WINCHARGER CORP. PU-16/AP, MG750. Input 24 V. D.C., 60 Amps. Output 115 V., 400 Cy., 1 ϕ, 6.5 Amps.
PRICE $100.00 EA.

HOLTZER CABOT TYPE 149F, Input 24 V. D.C. at 36 Amps., Output 26 V. at 250 V.A., 400 Cy., and 115 V., 400 Cy. at 500 V.A., 1 ϕ,
PRICE $75.00 EA.

PIONEER TYPE 12117. Input 12 V. D.C., Output 26 V., 400 Cy. at 6 V.A.
PRICE $30.00 EA.

PIONEER TYPE 12117. Input 24 V. D.C., Output 26 V., 400 Cy. at 6 V.A.
PRICE $30.00 EA.

PIONEER TYPE 12116-2-A. Input 24 V. D.C., at 5 Amps. Output 115 V., 400 Cy., 1 ϕ at 45 watts. PRICE $100.00 EA.

GENERAL ELECTRIC TYPE 5D21NJ3A. Input 24 V. D.C. at 35 Amps Output 115 V., 400 Cy., 485 V.A., 1 ϕ. PRICE $35.00 EA.

LELAND PE 218. Input 24 V. D.C. at 90 Amps. Output 115 V., 400 Cy., 1 ϕ at 1.5 K.V.A.
PRICE $47.50 EA.

PIONEER AUTOSYNS

TYPE AY1, 26 V., 400 Cy. PRICE $8.50 EA.

TYPE AY5, 26 V., 400 Cy. PRICE $8.50 EA.

TYPE AY14G, 26 V., 400 Cy. PRICE $15.00 EA.

TYPE AY14D, 26 V., 400 Cy. PRICE $15.00 EA.

TYPE AY54D, 26 V., 400 Cy. PRICE $10.00 EA.

TYPE AY131D Precision Autosyn.
PRICE $35.00 EA.

PIONEER AUTOSYN POSITION INDICATORS & TRANSMITTERS

TYPE 5907-17. Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $30.00 EA.

TYPE 6007-39. Dual Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $50.00 EA.

TYPE 4550-2-A Transmitter, 26 V., 400 Cy., 2:1 gear ratio. PRICE $20.00 EA.

VOLTAGE REGULATORS

LELAND ELECTRIC CO. TYPE B, Carbon Pile type. Input 21 to 30 V. D.C. Regulated output 18.25 at 5 Amps. PRICE $6.50 EA.

WESTERN ELECTRIC TRANSTAT VOLTAGE REGULATOR Spec. No. V-122855, Load K.V.A. 0.5. Input 115 V., 400 Cy. Output adjustable from 92 to 115 V.
PRICE $10.50 EA.

RATE OR TACHOMETER GENERATORS

EASTERN AIR DEVICES J36A, .02 V. D.C. per RPM. Max. speed 5000 RPM.
PRICE $17.50 EA.

ELECTRIC INDICATOR CO. TYPE B68 Rotation Indicator, 110 V., 60 Cy., 1 ϕ.
PRICE $14.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-1. Variable frequency, 3 ϕ output. PRICE $25.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-2. Variable frequency, 3 ϕ output. PRICE $30.00 EA.

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2J1F3 GENERATOR, 115 V., 400 Cy.
PRICE $10.00 EA.

2J1G1 CONTROL TRANSFORMER, 57.5/57.5 V., 400 Cy. PRICE $10.00 EA.

2J1F1 GENERATOR, 115 V., 400 Cy.
PRICE $10.00 EA.

2J1H1 DIFFERENTIAL GENERATOR 57.5/57.5 V., 400 Cy. PRICE $10.00 EA.

5SDG DIFFERENTIAL GENERATOR, 90/90 V., 400 Cy. PRICE $20.00 EA.

5G GENERATOR, 115 V., 60 Cy.
PRICE $50.00 EA.

W. E. KS-5950-L2 Size 5G, 115 V, 400 Cy.
PRICE $10.00 EA.

D C ALNICO FIELD MOTORS

DIEHL TYPE S.S. FD6-23, 27 V., 10,000 RPM.
PRICE $10.00 EA.

DELCO TYPE 5069466, 27 V., 10,000 RPM.
PRICE $15.00 EA.

DELCO TYPE 5069370, 27 V., 10,000 RPM.
PRICE $15.00 EA.

DELCO TYPE 5072400, 27 V., 10,000 RPM.
PRICE $15.00 EA.

BLOWER ASSEMBLIES

JOHN OSTER TYPE MX215/APG, 28 V. D.C., 7,000 RPM, 1/100 H.P. PRICE $10.00

WESTINGHOUSE TYPE FL, 115 V., 400 Cy., 6,700 RPM, Airflow 17 C.F.M.
PRICE $10.00 EA.

DELCO TYPE 5068571 Motor and Blower Assembly, B.M. Motor, 27 V., 10,000 RPM.
PRICE $15.00 EA.

GENERAL ELECTRIC D C SELSYNS

8TJ9-PAB, TRANSMITTER, 24 V.
PRICE $4.50 EA.

8DJ11-PCY, INDICATOR, 24 V. Dial marked —10° to +65°. PRICE $6.00 EA.

8DJ11-PCY, INDICATOR, 24 V. Dial marked 0 to 360°. PRICE $7.50 EA.

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Hammett Electric Mfg. Co., Model SPS-130, Input Voltage AC 208 or 230, 60 cycle, 3 phase, 21 amps. Output 28 Volts, 130 amps, continuous duty. 37" high, 22½" wide, 21" deep. Contains DC Volt meter, DC amp meter and 8 point tap switch for variable output voltage. Brand new. Price $350.00.

MISCELLANEOUS

SPERRY A5 CONTROL UNIT, Part No. 644836.
PRICE $7.50 EA.

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PRICE $5.50 EA.

SPERRY A5 DIRECTIONAL GYRO, Part No. 656029, 115 V., 400 Cy., 3 ϕ.
PRICE $25.00 EA.

PIONEER TYPE 12800-1 GYRO SERVO UNIT. 115 V., 400 Cy., 3 ϕ. PRICE $20.00 EA.

ALLEN CALCULATOR TYPE C1 TURN & BANK INDICATOR, Part No. 21500, 28 V. D.C.
PRICE $15.00 EA.

TYPE C1 AUTO-PILOT FORMATION STICK, Part No. G1080A3. PRICE $15.00 EA.

PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, 115 V., 400 Cy.
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OA2	$2.00	2J27	29.95	5BP1	6.95	310A	7.95	722A	3.95	861	39.50
OA3	1.50	2J31	29.95	5BP4	6.95	311A	7.95	723A/B	17.95	866A	1.79
OB2	2.00	2J32	69.95	5CP1	6.95	312A	3.95	724A	4.95	869B	37.50
OC3	1.75	2J36	105.00	5D21	27.50	323A	25.00	724B	6.95	872A	3.95
OD3	1.50	2J38	17.95	5JP1	27.50	327A	3.95	725A	9.95	878	1.95
C1A	4.95	2J42	150.00	5JP2	19.50	328A	9.95	726A	6.95	884	1.95
C1B	6.95	2J49	109.00	5JP4	27.50	350A	7.95	726B	56.00	885	1.75
1B21A	2.75	2J50	69.50	6C21	29.50	350B	5.95	726C	69.00	889R	199.50
1B22	3.95	2J61	75.00	C6A	3.95	357A	20.00	728AY	27.00	914	75.00
1B23	9.95	2J62	75.00	C6J	10.95	368AS	6.95	730A	28.95	931A	6.95
1B24	17.95	2K25	47.50	7BP7	7.95	371B	2.95	801A	1.00	954	.35
1B26	2.95	2K28	37.50	7DP4	10.00	385A	4.95	802	4.25	955	.55
1B27	19.50	2K29	27.50	12AP4	55.00	388A	2.95	803	7.95	956	.69
1B32	4.10	2K45	149.50	15E	2.95	394A	7.95	804	13.50	957	.29
1B38	33.00	2V3G	2.10	15R	.95	MX408U	.75	805	5.95	958A	.69
1B42	19.95	3B24	5.50	NE16	.45	417A	27.95	806	25.00	959	1.69
1B56	49.95	3B24W	7.50	FG17	6.95	434A	19.95	807	1.69	991	.65
1B60	69.95	EL3C	5.95	RX21	3.95	446A	1.95	808	3.50	E1148	.35
1N21	1.35	3C24	1.95	35T	4.95	450TH	45.00	809	2.45	1280	1.95
1N21A	1.75	3C31	5.95	45 Special	.35	450TL	45.00	810	11.00	1611	1.95
1N21B	4.25	3DP1A	10.95	RK39	2.95	464A	9.95	811	3.15	1613	1.38
1N22	1.75	3E29	15.50	VT52	.35	471A	2.75	813	8.95	1616	2.95
1N23	2.00	3N4	5.50	RK72	1.95	527	15.00	814	3.95	1619	.89
1N23A	3.75	4A1	1.75	RK73	1.95	WL530	7.50	815	3.50	1622	2.75
1N23B	6.00	4B26	10.95	100TH	9.00	WL531	22.50	816	1.45	1624	2.00
1N26	8.00	4C27	25.00	FG105	19.00	700A/D	25.00	829	12.95	1625	.45
1N27	5.00	4C28	35.00	F123A	8.95	701A	7.50	829A	13.95	1851	1.85
1N48	1.00	4E27	17.50	203A	8.95	703A	6.95	829B	15.95	2050	1.85
1S21	6.95	4J25	199.00	211	.95	705A	3.95	830B	11.50	2051	1.80
2B22	4.95	4J26	199.00	217C	18.00	707A	17.95	832	7.95	8012	4.25
2B26	3.75	4J27	199.00	242C	10.00	707B	27.00	832A	9.95	8013	2.95
2C34	.35	4J31	199.00	249C	4.95	714AY	7.95	833A	49.95	8013A	5.95
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2C43	27.00	4J33	199.00	274B	3.00	715B	18.00	836	4.95	8025	6.95
2C44	.90	4J37	199.00	304TH	15.00	715C	25.00	837	2.95	9001	1.75
2D21	1.75	4J38	89.00	304TL	14.50	717A	1.95	838	6.95	9002	1.50
2E22	3.75	4J39	199.00	307A	4.95	718AY/EY	48.50	845	5.59	9003	1.75
2E30	2.75	4J41	199.00			719A	29.50	849	52.50	9004	1.75
2J26	27.75	C5B	3.95			721A	3.95	851	80.50	9005	1.90
								860	4.95	9006	.35

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TSKI-SE Spectrum Analyzer

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- TS 12 Unit 2 Plumbing for above
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- TS 35 X Band Pulsed Signal Generator
- TS 36 X Band Power Meter
- TS 146 X Band Signal Generator
- TS 62, TS 102, TS 168
- X Band Tunable Crystal Mounts
- TVN #3EV Bridge Cy 94

S Band 3000 MC

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- TS 125, TS 155, TS 127
- RF 4 Electrically Tuned S Band Echo Box
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- PE 102 High Power S Band Signal Generator

L Band

Hazeltine 1030 Signal Generator 145 to 235 Megacycles

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- Short Wave Adapter for 162C
- TS 174 Signal Generator

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- Supreme 564
- APA10, APA28
- TS 34 Oscilloscopes WE
- TS 126

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- General Radio V T Voltmeter 728A
- Calibrator WE 1-147
  - General Radio 1000 cycles type 213
  - Limit Bridges
  - Boonton Standard instructions
- Model 40 Pyrometer
  - Rawson, meters 0-10 Microampere 0-2 Millivolt

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APS 3—APS 4—R-111/APR5A

Prices Subject to Change

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COAXIAL WAVEMETER, W.E. Transmission type, using type "N" fittings. Calibrated between 3400-4500 MC	$99.50
LHTR. LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated	$49.50
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MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated	$45.00
SIGNAL GENERATOR, using 417A klystron. 2700-3300 mc. Output approx. 50 mw. 115 vac power supply. With tubes, new	$425.00
REGULATED POWER SUPPLY for GL 446 type lighthouse tubes (2C40, etc.) 115 vac. 60 cycles. Panel Mounting. Less tubes	$32.50
RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2C40, 2C43, 1B27 lineup) w/Tubes.	
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S BAND SIGNAL GENERATOR, complete with calibrated attenuator, W. E. coax. wavemeter, McNally Klystron Cavity. Regulated power supply operates from 115 V.A.C., 50-1200 Cycles. Manufactured by W. E.	$650.00
OAJ ECHO BOX, 10 CM, TUNABLE	$22.50

⅞" RIGID COAX—⅜" I. C.

RIGHT ANGLE BEND, with flexible coax output pickup loop	$8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple	$3.00
RIGID COAX to flex coax connector	$3.50
STUB-SUPPORTED RIGID COAX, gold plated 5' lengths. Per length	$5.00
RT. ANGLES for above	$2.50
RT. ANGLE BEND 15" L. OA	$3.50
FLEXIBLE SECTION, 15" L. Male to female	$4.25
FLEX COAX SECT. Approx. 30 ft	$16.50
⅞" RIGID COAX, BULKHEAD FEED-THRU	$14.00

3 CM Research Equipment

1" x ½" Waveguide

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover	per length, $7.50
Rotating Joints supplied either with or without deck mounting. With UG40 flanges	each, $17.50
2J42 Magnetron Pulse Modulator, 14kw max. rating 7kw min. Plate voltage pulsed 5.5kv 6.5 Amp. 1001 duty cycle, 2.5 usec pulse length max. filament 6.3V .5 Amp. Includes magnetron mtg. and blower. Requires 3C45 and 2-3B24. New	$75.00
TS 268 Crystal Checker	$35.00
Bulkhead Feed-Thru Assembly	$15.00
Pressure Gauge Section 15 lb. gauge and press nipple	$10.00
Pressure Gauge, 15 lbs	$2.50
Dual Oscillator-Beacon Mount, P/O APS 10 Radar for mounting two 723A/B klystron with crystal mts. matching slugs, shields	$42.50
Dual Oscillator, Mount. (Back to back) with crystal mount, tunable termination attenuating slugs	$18.50
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2K25/723 AB Receiver local oscillator Klystron Mount, complete with crystal mount. Iris coupling and choke coupling to TR	$22.50
TR-ATR Duplexer section for above	$8.50
CU 105/APS 31 Direction Coupler 25 DB	$25.00
723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder	$12.00
Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius. 90 deg. bend	$4.50
Twist 90 deg. 5" choke to cover w/press nipple	$6.50
Waveguide Sections 2½ ft. long silver plated with choke flange	$5.75
Rotary Joint choke to choke with deck mounting	$17.50
3 cm mitred elbow "E" plane unplated	$12.00
UG 39 Flanges	$ .85
UG 40 Chokes	$1.00
90 degree elbows, "E" or "H" plane 2½" radius	$12.50
90 degree twist 6" long	$8.00
45 degree twist	$8.00
40KW X BAND Radar, complete as described and illustrated in July 1951 PROC. IRE	
APS-4 Under Belly Assembly, less tubes	$375.00

1¼" x ⅝" WAVEGUIDE

BI Dir-Coupler WG output calibrated—25 db nominal	$17.50
Mitred Elbow H Plane UG51-UG52	$12.00
6" St. sect. choke to choke	$3.50
CG 98B/APQ 13 12" Flex. Sect. 1¼" x ⅝" OD	$10.00
X BAND Wave GD. 1¼" x ⅝" OD. 1/16" wall aluminum	per ft., 75¢
Slug Tuner Attenuator W.E. guide, Gold plated	$6.50

1.25 CM RESEARCH EQUIPMENT

COMPLETE 24,000 MC RF HEAD, including 2K33 Klystron, 3J31 Magnetron and Magnet, all plumbing, and associated circuitry in standard A-N pressurized housing. New	$1100.00
Low Power Load	$20.00
Shunt Tee	$35.00
Waveguide Lengths, 2" to 6" long, gold plated with circular flanges and coupling nuts	per inch, $2.25
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Right Angle Bend E or H Plane, specify combination of couplings desired	$12.00
45° Bend E or H Plane, choke to cover	$12.00
Mitred Elbow, cover to cover	$4.00
TR-ATR-Section, Choke to cover	$4.00
Flexible Section 1" choke to choke	$5.00
"S" Curve Choke to cover	$4.50
Adapter, round to square cover	$5.00
Feedback to Parabola Horn with pressurized window	$27.50
90° Twist	$10.00
"K" Band Directional Coupler	each, $49.50

PULSE EQUIPMENT

MIT, MOD 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp.) Duty Ratio: .001 max. Pulse duration: 5. 1.0, 2.0 microsec. Input voltage: 115 v 400 to 2400 cps. Uses: 1-715B, 4-829-B, 3-'72's, 1-'73. New	$110.00
APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. Pwr. cut 35 KW Energy 0.018 Joules	$49.00
TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk): pulse rate 200 PPS, 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers, 115 v. 400 cycle input. New with all tubes	$49.50
APS-1C MODULATOR DECK. Complete, less tubes	$75.00

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec 400 PPS, 50 ohms imp.	$42.50
G.E. #6E3-5-2000-501P2T, 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS. 50 ohms impedance	$6.50
G.E. #3E (3-84-810) (8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit; Unit 1. 3 sections, 84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS. 50 ohms imp.	$6.50
7.5E3-1-200-67P. 7.5 KV, "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance. 3 sections	$7.50
7.5E4-16-60, 67P, 7.5 KV. "E" Circuit, 4 sections 16 microsec, 60 PPS, 67 ohms impedance	$15.00
7.5E33-200-6FT, 7.5 KV, "E" Circuit, 3 microsec 200 PPS, 67 ohms imp. 3 sections	$12.50

PULSE TRANSFORMERS

G.E.K.-2745	$39.50
G.E.K.-2744-A. 11.5 KV High voltage. 3.2 KV Low Voltage @ 200 KW oper. (270 KW max.) 1 microsec, or 1/microsec. @ 600 PPS	$39.50
W.E.-KS 9800 Input transformer. Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s., Permalloy core	$6.00
W.E. #D169271 Hi Volt input pulse Transformer	$27.50
G.E. K2450A. Will receive 13KV. 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100KW G. E.	$34.50
G.E. K2748A. Pulse Input line to magnetron	$36.00
Ray UX 7896—Pulse Output Pri. 5v, sec. 41v	$7.50
Ray UX 8442—Pulse inversion—40v + 40v	$7.50
Ray UX 7361	$5.00
PHILCO #352-7250, 352-7251.	
UTAH #9262, 9332, 9278.	

MICROWAVE TEST EQUIPMENT

X BAND POWER METER

Consists of thermistor mount and bridge, microammeter, rough attenuator. X-Band Waveguide thruout. For power measurements anywhere in the 9000 MC band.

BROADBAND TEST OSCILLATOR

Freq. coverage 50-3000 MC. By direct calibration and interpolation anti-backlash gear drive; compact, portable. Operates from any 115V source or battery source. New, with all tubes $425.00

- TS 56A/AP
- CW60-ABM
- LU-1
- LU-3
- TS 159
- CS60-ABW
- I-158
- I-222
- I-185
- TS 268/U
- TS 102/AP
- TS 47/APR
- TS 36/AP
- TS 12 UNIT 2
- Q. METER
- TS 69/AP
- TS 226
- TS 250/APN
- TS 89
- I-203-A
- TS 11/AP
- BC 438

SEND FOR FURTHER INFORMATION AND PRICES

RADAR INDICATORS

ID6/APN-4 LORAN INDICATOR

Uses 5CP1. Includes all indicator circuitry and controls associated with Loran $75.00

BC 929 INDICATOR

IFF indicator, uses 3BP1 with an 0-10/50/100 mile range. Includes lobe-switching motor, 8 tubes. New, in original cases $75.00

R78A/APS-15

Indicator console, 5FP7 PPI, 2AP1 "A" Scope. Includes receiver behind local oscillator. Uses 39 tubes, 3 meters—also 30 MC IF Strip $175.00

BC 931 INDICATOR

Uses 5FP7, 4/20/50/100 Mile Range. "B" presentation includes remote amplifier with 2 tubes, linear potentiometer, mounting rack and visor. $35.00

ID-11/APQ-13

5"" PPI, in used but good condition $45.00

SK-1M

12" (12GP7) PPI indicator console. Complete table ass'y, with all indicator circuitry and servomechanisms. New, in original export packed cases $375.00

SCR 535

IFF Set. Includes all parts:

- 1 each Radio Receiver BC-647-B
- 1 each Control Box BC-648-A
- 1 each 50amp. Fuse
- 2 each 15 amp. Fuse
- 2 each 28 volt lamp
- 1 each Instruction Book

Brand new $275.00

SO-7 RADAR

Complete surface search Truck-Portable 10 C. M. Radar with Plan Position Indicator. Operating from 115V-60 Cy. AC. Write for price and information.

RADAR SETS

APS-2, Airborne, 10 CM, Major Units, New
APS-4, Airborne, 3 CM, Compl.
APS-15, Airborne, 3 CM, Major Units, New
SD-4, Submarine, 200 MC, Compl., New
SE, Shipboard, 10 CM, Compl., New
SF-1, Shipboard, 10 CM, Compl., New
SJ-1, Submarine, 10 CM, Compl., Used
SL-1, Shipboard, 10 CM, Compl., Used
SN, Portable, 10 CM, Compl., Used
SQ, Portable, 10 CM, Compl. Used
SO-1, Shipboard, 10 CM, Compl. Used
SO-7, Portable, 10 CM, Assault
SO-8, Shipboard, 10 CM, Compl. Used

THERMISTORS

D-166283	$1.50
D-167332 (tube)	$1.50
D-170396 (bead)	$1.50
D-167613 (button)	$1.50
D-164699 for MTG "X" band Guide	$2.50

VARISTORS

D-167176	$ .95
D-172155	$2.25
D-172307	$1.70
D-168687	$ .95
D-171812	$ .95
D-171528	$ .95
D-162356(308A)	$1.50

MAGNETRONS

Tube
2J27
2J31
2J21-A
2J22
2J26
2J32
2J38 Pkg.
2J39 Pkg.
2J49
2J61
2J62
3J31
5J30
718DY
720BY
725-A
730-A
QK 62
QK 59
QK 61
QK 60
700 A, B, C, D
706 AY, BY, DY, EY, FY, GY

All merchandise guaranteed. All prices F.O.B. N.Y.C. Send M.O. or Check. Only shipping charges sent C.O.D. Rated concerns send P. O.

COMMUNICATIONS EQUIPMENT CO.

131 Liberty St., New York, N. Y. Dept. E-1
Phone: Digby 9-4124

CONDENSERS

and ELECTRONIC COMPONENTS—IMMEDIATE DELIVERY

OIL CONDENSER SPECIAL

10 mfd.—600 V.................... $ .89

Three term, bat. mntg. channel type. Dims. 3¾" x 3½" x 2". Two 5 mfd. sections rated 400 V at 72 deg. "C". 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs. "C". Ideal for filter or power factor application where ruggedness and durability are paramount. Carton of 24, weight 42 lbs. .... **$.79**

MFD	VOLTAGE	PRICE
.004-.905-.01	10 KV	$3.75
.012	25 KV	15.90
.02	20 KV	14.90
.075-.075	7.5 KV	7.90
.08	12.5 KV	10.90
.1	1500 V	.59
.1	2500 V	1.20
.1	3000 V	1.75
.1	7500 V	1.95
.1	7500 V	4.25
.1-.1	7500 V	6.25
.1	10 KV	8.95
.1	15KV	19.95
.1	25 KV	25.95
.15-.15	8000 V	1.95
.2	10 KV	10.95
.25	600 V	.37
.25	2000 V	1.25
.25	3000 V	2.25
.25	6000 V	1.75
.25	18 KV	15.95
.25	20 KV	19.95
.25	32.5 KV	31.95
.4	10 KV	12.95
.5	400 V	.25
.5	500 V	.41
.5	1000 V	.65
.5	1500 V	1.02
.5	2000 V	1.39
.5	3000 V	2.69
.5	25 KV	45.50
.5-.1	2000 V	.85
.5-.5	600 V	.69
1	400 V	.45
1	500 V	.65
1	600 V	.65
1	1000 V	.69
1	1500 V	.97
1	2000 V	1.95
1	2500 V	2.25
1	3000 V	3.50
1	5000 V	4.65
1	6000 V	5.35
1	15 KV	25.95
1	20 KV	55.95
1	25 KV	69.95
2	600 V	.59-.79
2 TLA	600 V	.80
2	1000 V	.95-1.45
2 TLA	1000 V	1.49
2	1500 V	1.65
2	2000 V	2.80
2	2500 V	63.39
2	3000 V	4.69
2	4000 V	5.69
2	5000 V	10.95
2	12.5 KV	33.95
2-2	600 V	1.20
3	600 V	.59
3	4000 V	6.95
3-3	150 V	.25
3-3-3	400 V	.75
3.75	1000 V	1.59
4	400 V	.85
4	600 V	1.25
4 TLA	600 V	1.40
4 TLAD	600 V	1.55
4	1000 V	2.15
4	1500 V	2.69
4	2000 V	4.25
4	2500 V	4.95
4	3000 V	7.95
4	4000 V	9.95
4-4	1000 V	2.49
5	330 VAC	1.75
5	660 VAC	2.49
5	600 V	1.25
5	10 KV	41.50
5-5	400 V	.89
5-5	600 V	1.49
6	600 V	1.35
6	330 VAC	2.49
6	1000 V	2.49
6	1500 V	3.25
6	2000 V	3.95
7	600 V	1.45
7	800 V	1.90
7	1000 V	3.15
8	500 V	1.35
8	600 V	1.98
8	660 VAC	4.75
8	1000 V	3.55
8	2000 V	4.95
8-8	600	1.75
10	400 V	.89
10	600 V	1.29-2.50
10	1000 V	4.55
17 TLAD	25 V	.69
12	1000 V	4.85
15	1000 V	5.35
24	1500 V	8.50

BATHTUB CONDS.

MFD	Voltage	Price	MFD	Voltage	Price
.05-.05	600 V	.30	.3	400 V	.24
.1	600 V	.39	.5	400 V	.40
.1	1000 V	.45	.5	600 V	.32-.45
.1-.1	1000 V	.51	.5-.5	600 V	.58
.1-.1	600 V	.39	1	300 V	.30
.2	1000	.19	1	400 V	.48
.25	600 V	.41	1	600 V	.56
.25-.25	600 V	.45	2	400 V	.68
.25	1000 V	.45	2	600 V	.91

SPECIAL BATHTUB KIT...... 15 @ $1.00

CHANNEL CONDS.

MFD	Volt	Price	MFD	Volt	Price
.05-.05	600 V	.36	.4	600 V	.39
.1	600 V	.4	.5	600 V	.49
.1	2500V	1.20	.5	400 V	.19
.1-.1	400 V	.38	1	500 V	.58
.1-.1	600 V	.41	1	600 V	.65
.1-.1-.1	400 V.	.41			
.25	600 V	.43			

MICA CONDENSERS

5, 6, 8, 10, 15, 25, 30, 34, 39, 50, 70, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 390, 400, 470, 500, 510, 600, 650, 700, 750, 1000, 1200, 1250, 1400, 1500, 2000, 2200, 2400, 3000, 3300, 3700, 3900, 4000, 4700, 5000, 5100, 6000, 6200, 6500, 7900, 7950, 7960, 8000 & 9100 mmfd.

PRICE SCHEDULE

5 to 750 mmfd	5¢
2000 to 5100 mmfd	11¢
1000 to 1500 mmfd	7¢
6000 to 8000 mmfd	12¢

Special Mica Kit—100 @ $3.50

SILVER MICA CONDENSERS

7, 24, 25, 33, 50, 60, 75, 95, 100, 120, 150, 170. 200, 270, 300, 330, 390, 400, 450, 500, 750, 800, 1000, 1400, 1450, 1700, & 2500 mmfd,

PRICE SCHEDULE

7 to 95 mmfd	8¢
1000 to 1700 mmfd	14¢
100 to 800 mmfd	9¢
2500 mmfd	16¢

SPECIAL S.MICA KIT-100 @ $6.50

CERAMICON CONDS.

10, 56 & 100 mmfd @	.05
1000 to 5000 mmfd @	.06

MOLDED PAPER CONDS.

(W.E.)

.01 400 V Type CN 35		.09 ea.	$ 7.50 per "C",
.01, .05, .06	400 V.	4¢ ea.	$ 3.50 per "C",
.004, .01, .03	600 V.	5¢ ea.	$ 4.50 per "C",
.1	1000 V.	8¢ ea.	$ 7.50 per "C",
.01	1000 V.	15¢ ea.	$13.50 per "C"

COAX CONNECTORS

83—1R	.50	83—IT	$1.30
83—1AP	.22	83—ISP	.52
83—1J	.69	83—1SPN	.52

Coax assembly RG—59/U-6" in length. connected with 83 1SPN, 83—1J and Amphenol #8-M Connector. $ .89. Less 83-1J $ .32.

TYPE "AB" POTS

$1.35

OHMS	Shaft	OHMS	Shaft
50	1/8 S	15000	1/8 S
60	1/8 LS	20000	1 1/4 & 1/8 LS
150	1/4 S	25000	3/8 & 1/8 S
300	3/8 S	3000	1/8 S
500	3/8 & 1/8 S	40000	1/8 LS
1000	1/8 S	50000	1/4 & 1/8 S
1500	1/4 S	50000	1/8 LS
2000	1/8LS & 3/8S	100000	1/2"
2500	1/8 S	150000	2 1/8
3000	1/8 LS	200000	1/8 LS
6000	1/4	250000	1/8 LS, 9/16 & 1/8 S
5000	1/8 LS & 3/8	300000 (2 terms.)	1/8 S
10000	3/8 & 1 1/7	1 Meg.	1/8 S & 1/8 LS
10000	5/16		

DUAL "AB" POTS—$2.75

OHMS	SHAFT	OHMS	SHAFT
1500	5/16"	20K	7/16"
1-5 meg	1/2"	1 meg	1/2"
		2 meg	1/8 S

New Toggle Sws. Jan Style

Type	Jan	Price	Jan	Price
DPST	ST52K	.82	ST50K	.90
DPDT	ST52N	.94	ST50N	1.03
DPDT	ST52P	.94	ST50P	1.03
DPST	ST52M	.99	ST50M	1.08

All SWS. 15A. 125 VAC; 10A. 250 VAC To Jan-5-23 Spec. Qua. Discounts.

Toggle Sw. Special

DPST	AH&H 3/8" bushing, Bat Hand.	$.55
DPDT	AH&H 1" bushing, Bat Hand.	.59
DPDT	C-H #8824 K4 7/16" bushing Bat. Hand.	.70
SPST	C-H #8800 K4 7/16" bushing Bat Hand.	.60
SPST	3A. 250 VAC 3/8" bushing	.08

TRANS. MICA CONDS.

MFD	WVDC	Price	MFD	WVDC	Price
.01	600 V	.33	·0003	6000 V	.99
.01	1200 V	.55	·004	2500 V	.40
.0125	6000 V	7.50	·005	1200 V	.40
.02	2000 V	.90	·0001	3000 V	.89
.03	600 V	.49	·0002	5000 V	1.18
.001	8000 V	3.60	·00025	1200 V	.20
.001	2500 V	.40	.0006	5000 V	1.38
.0024	5000 V	1.55			

RELAYS

3PST Sters Dunn # 1CXX 100
DPDT Sters Dunn # 1X5X 103
115 V. 6A. Conts........$2.69
115 V. 6A. Conts........$2.39

NEW BC 906 FREQ. METER

Range 150-225 MC—Bat. operation with precision velvet vernier dial, tuning charts, 0-500 D.C. microammeter, diode-Triode and plug-in antenna. Contained in black aluminum carrying case 12½ x 8¾ x 6½. Price **$18.95**

New—Tubes—Boxes

3C-24	.89	832 A	9.25
954	.29	838	3.25
1616	1.35	872 A	1.95
9004	.45	12C8	.98
1B29	1.25	2J39	30.00

25 WATT POWER RHEOSTATS

Ohms	Shaft	Price	Ohms	Shaft	Price
1.3-1.3	1/8 S	1.00	225	1/4 S	.89
15	1/2	.79	225	1/8 LS	.89
20	1/2	.79	300	1/2	.89
25	1/2	.79	500	1/4 S	.89
50	1/8 S	.79	500	1/8 S	.89
50-50	1/2	1.50	1500	1/2 S	.99
75	1.0	.79	2000	3/8	.99
100	1/2	.79	2500	1/2	1.25
125	1/2 S	.89	5000	1/8 S	1.15
175	1/2	.89	5000	1/2	1.15

100 ohm type Lots of 100....54¢

MONMOUTH RADIO LABORATORIES

BOX 159 Long Branch 6-5192 OAKHURST, N.J.

DYNAMOTORS

Type	Input Volts	Input Amps.	Output Volts	Output Amps.	Radio Set
PE86	28	1.25	250	.060	RC36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA0515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK II
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-E: Input: 25 28 vdc. 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. Dim. 17"x6½"x10". New $49.50

PE-218-H: Same as above except size: 16⅛"x6"x10". New $49.50

PE206: Input: 28 vdc. 38 amps. Output: 80 v 800 cy. 500 volt-amps. Dim: 13"x5½"x10½"....$22.50

PRECISION RESISTORS

OHMS	OHMS	OHMS
5	150	7,500
5.05	250	10,000
10	430	12,000
18	468	17,000
82	800	20,000
120	920	30,000
125	1100	35,000
128	4300	84,000

30¢ each ....**10 for $2.50**

100K　120K　150K　220K

40¢ each ....**10 for $3.50**

I Megohm ....**each .75¢**

B-19 MKII TRANS-RECEIVER

Less Power Pack..$32.50
B-19 Power Pack.. 8.95

ID-24 ARN-9

Dual 0-200 Microamp, Movement in 3" Case. ILS Equipment $9.95

ARC5 MODULATOR

MD7/ARC5

Plate Modulator w/dynamotor complete w/Tubes 1 — 12J5, 2 — 1625, 1 — VR50. Good cond.

Price $6.95

ANNOUNCING...

Our New New Ham Dept. Featuring:—

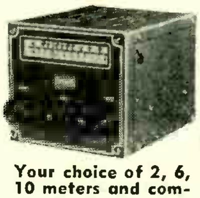
SONAR MOBILE MB-26 Xmtr

Like SR-9 Rcvr, this crystal-controlled 6-tube Xmtr goes everywhere, fits anywhere, employs latest v.h.f. techniques! Lets you send clear signal, no matter how grueling the going. Output: 6 watts. Power consumption: equivalent to car bright lights. Just 6½" high, 7" wide, 5⅞" deep. Built-in antenna relay system, power filter network. Low maintenance — standard tubes. Power and antenna coax connectors on front panel.

8 or 24 Mc. crystal, overtone type. Screwdriver adjusted tuning control.

$72⁴⁵

SONAR MOBILE SR-9 Rcvr



Your choice of 2, 6, 10 meters and commercial frequencies, AM and FM.

$72⁴⁵

Indispensable when you must hear what's coming through, in mobile or fixed operation, CD, CAP or emergency activity. More than a monitor, more than a converter—it's a 9-tube superhet receiver with over-all sensitivity better than 1.0 micro-volt. Tiny—only 4-9/16" high, 5-3/16" wide, and 5-11/16" deep. Yet SR- 9 gives you built-in automatic noise limiter, voltage regulated oscillator, precision slide rule dial.

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps input.

CT 77B	5500V/.002A, 2.5V/2A 12KV TEST 6.3VCT/.6A—4600V TEST			$12.95
CT 75B	1200VCT/600MA, 2X5VCT/6.2A 6.3VCT/3A, 6.3V/.3A			14.95
CT-825	360VCT	.340	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160	2.5/12, 30/.100	9.95
CT-15A	350VCT	.070	6.3/.6, 6.3/1.8, 3 lbs.	2.95
CT-071	110V	.200	33/.200, 5V/10, 2.5/10	4.95
CT-378	2300V	4 MA	2.5/2	6.95
CT-367	580VCT	.050	5VCT/3A	2.25
CT-721	550VCT	.100	6.3/1, 2.5VCT/2	2.95
CT-99A	2x110VCT	.010	6.3/1A, 2.5VCT/7A.	3.25
CT-403	350VCT	.026 MA	5V/3A	2.75
CT-931	585VCT	.036	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002 MA	2.5V/2.1A, 2.5V/1.75A	4.95
CT-137	350VCT	.026 MA	5V/3A	2.75
CT-866	330V	.065	6.3V/1.2, 6.3V/600 MA	1.75
CT-456	390VCT	30 MA	6.3V/1.3A, 5V/3A	3.45
CT-160	800VCT	100 MA	6.3V/1.2A, 5V/3A	4.95
CT-319	660VCT	.085A	5V/2A, 6.3/7.5A, /6.3/3A	3.25
CT-931	585VCT	86 MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75 MA	5V/2A, 10VCT/2A, 60V/200 MA	3.85

Filament Transformers—115V/50-60 cps input.

Item	Rating	Each
FT-781	866 Trans. 2x2.5/5A	$2.25
FTG-31	2.5V/2.5, 7V/7A (Tape @ 2.5V/2.5A), 16 lbs.	9.95
FT-674	8.1V/1.5A	1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	17.95
FT-104	6V, 5A	4.79
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	12.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT 55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT 986	16V @ 4.5A or 12V @ 4.5A	3.75
FT 38A	6.3/2.5A, 2 x 2.5V/7A	4.19
FT A27	2.5V/2.5A, 7V/7A TAP 2.5V/2.5A 16KV TEST	18.95
FT 340	2 x 2.5V/3A, 7V/7A—23KV TEST	24.95
FT 038	6.3V/500A WELD	29.45

Plate Transformers—115V/50-60 cps input.

Item	Rating	Each
PT-919	1200-0-1200 200 MA	$8.95
PT-976	Auto: 120VCT/10 MA	.69
PT-31A	2x300V/5 MA	.79
PT-46A	4080VCT N.L. 3% to 18" Hx6" Wx7" L 20 lbs.	29.95
PT-75-2	3780/3446/3112VCT/77 MA	10.95
PT-28-1	4600VCT/.077	12.95
PT-403	Auto: 70V/1A	2.29
PT-160	1120VCT/770 MA, 590VCT/82 MA, 25 lbs.	24.95
PT-170	Auto: 156/146/137/128—.71A	3.29
PT-31A	2x300V/5 MA	.79
PT-976	120VCT/10MA	.79
PT-12A	280VCT/1.2A	2.95
PT-614	4730VCT/500MA 12KV INS	29.95

AUDIO TRANSFORMERS

AT501 HI-FI Special: PRI: 3000 ohms P-P/Sec: 4/16/12/50/200 ohms 60-10,000 CY.—1 db 50W as shown $3.49

AT152 HI-FI Driver Pri: 10,000 ohms Sec: 40,000 ohms PP Grids 50-15 KC/1 db....$1.49

AT063 Output to H.S. or line PRI: 14,200 ohms SEC: 8000/600 ohms $1.19

AT449 HI-FI Driver (5000 ohms) to P.P. output grids (4,000 ohms) 100-10,000 CY. 10 W. 6V6 to PP 805's $2.39

AT666 Intercom Input: Spkr (-4-8 ohms) to grid (250,000 ohms) $0.69

AT415 Plate (18,000 ohms C.T.) to line (125 ohms) 175 w.—500-600 CY....$1.95

AT858 Plate (10,000 ohms C.T.) to line V.C. (500/125/30 ohms) HI-FI—50 W....$6.95

AT070 Mike-or-Line (250 ohms) to grid (250,000 ohms C.T.) $1.29

AT765 Mike-or-Line (600 ohms) to grid (50,000 ohms C.T.) $0.89

MOBILE MODULATION KITS

T-103 Mike to 6J5 grid.
T-102 6J5 to Modulators. PP 6V6 or PP 6L6.
T-104 Mod. Trans. PP 6V6 or PP 6L6 to 829, 832, or 2E26. All components miniature, ruggedized, and hermetically sealed. COMLETE KIT & DIAGRAM $3.50

UNIVERSAL POWER TRANSFORMER

Pri: Vibrator Input @ 6/12/24/110VDC
AC Input: 110/220V, @ 60 CY.
Sec: 230-0-230V — 40MA, 6.3V — 1.8A
Ea....... **$1.49**

HI-FI UNIVERSAL OUTPUT TRANSFORMER

Amertran Silcor. PRI: 20,000/16,000 / 5000 / 4000 ohms. Sect. 500/15 / 7.5 / 5 / 3.75 /1.25 ohms. 30 db. contin. Flat to 20,000 CY.

w/Diag $4.75

FILTER CHOKES

Stock	Description	Price
CH-250	SWING. 2.5-24H/.4-.05A 10KV Test	$7.95
CH-8-19	SWING. .006H/5A-.035H/.5A .032 ohms DCR, 1KV TEST	3.95
CH-776	1.28 H/130 MA/75 ohms	2.25
CH-344	1.5 H/145 MA/1200V Test	2.35
CH-854	1 HY/80 MA	1.29
CH-43A	10 HY/15 MA—850 ohms DCR	1.75
CH-999	15 HY/15 MA—400 ohms DCR	1.95
CH-511	6 H/80 MA—310 ohms DCR	2.45
CH3-501	2x.5H/400 MA	2.79
CH-188M	5 HY 200 MA	1.79
CH-488	10 HY .030A	1.19
CH-791	Dual 1.75-.125 HY 100 MA	1.27

FULL WAVE BRIDGE SELENIUM RECTIFIERS

Up to 18v. RMS a.c. Input—Up to 14v. d.c. output

Max. d.c. amps.	Price
2	$2.50
4	4.00
6	6.00
10	7.50
12	9.00
20	15.00
24	18.00
30	21.00
36	27.00

Up to 36v. RMS a.c. Input—Up to 28v. d.c. output

1	3.00
2	4.00
4	8.00
10	14.50
12	18.00
20	28.00
24	36.00
30	42.00
36	54.00

Up to 54v. RMS a.c. Input—Up to 42v. d.c. output

2	6.50
4	8.50

Up to 115 v. RMS a.c. Input—Up to 100v. d.c. output

2	11.00
10	48.00
12	60.00

SPECIAL RECTIFIERS ON REQUEST

Low-Voltage Transformers Primaries 115v., 60 Cycle

36V-40V at 3.5 amps	$3.75
24V-1.5A	1.95
8V-1.5A	.98
16V-4.5A	3.75

HI CAP. FILTER CONDENSERS

Cap. Mfd.	WVDC	Price
800	15	$1.35
2000	6	1.85
500	200	2.00
250	150	1.45

A.C. ELECTROLYTICS

CAP.	VAC.	PRICE
13-15	220-	$1.20
20-24	110-	1.00
26-30	220-	1.35
43-65	110-	1.25
43-48	110-	1.25
50-75	110-	1.25
53-60	220-	1.50
61-69	320-	1.60
64-72	110-	1.25
72-87	110-	1.25
75-84	110-	1.25
88-106	110-	1.50
107-129	110-	1.65
130-157	110-	1.75
130-150	70-	1.50
130-180	110-	1.85
158-191	110-	1.85
161-180	110-	1.75
189-210	110-	1.95
200-220	110-	1.95
270-300	110-	2.10
324-360	110-	2.40
378-420	175-	3.00
432-480	110-	2.75
485-540	110-	2.85

OIL CONDENSERS

Mfd.	Volt.	Price
5	50	$0.45
650	80	1.95
15	220 AC	2.20
0.5	750 AC	1.59
0.5	1000	.69
2x0.5	1000	.70
1	1000	.75
1.5	1000	.85
2	1000	.90
4	1000	1.75
3x.01	1200	1.35
1	1500	1.30
1.5	1500	1.40
2	1500	1.45
0.15	4000	1.20
2x0.1	4800	1.20
0.1	6000	2.39
1.5	6000	17.50
2x0.1	7000	2.95
.015	16000	3.95
.0016	15000	5.95
.25	20000	
1	25000	
.5	25000	
1	7500	

MANY OTHERS

Special Filament Transformers

Item	Pri.	Output	Price
STF-638	230	5V/9A 5½" H x 4½" x 3¾"	$1.25
STF-05A	115/230	2 x 5V/7.57" H x 7" x 5" D.	4.25
STF-682	220	30-25-20V/1 MA	.69
STF-968	230	2.5V/6.5A	1.45
STF-370	220/440	3 x 2.5V/57, 2.5V/15A, 5½ x 5 x 4½	5.25
STF-11A	220	2 x 40V/.05/2 x 5V/6A, 12.6/1A	2.95
STF-631	230	2 x 5V/27A 2 x 5V/9A, 100/4H x 5 x 7 30 lbs.	24.95
STF-96B	230	2.5/6.5A	1.95
STF-370	220/440V	3 x 2.5V/5A, 2.5V/15A	9.95
STF-085	220/440V	2.5V/60 ACT	15.95
STF-083	220/440V	5VCT/30A, 3000V TEST	17.50

115 V—400 CY XFMRS

Stock #	Ratings	Price
901699-501	2.77V @ 4.25A	$3.45
901698-501	900V/75 MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80 MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300VCT, 135 MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3V/2.9A, 1.25V/.02A	2.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT, .00006 KVA	1.75
D-167254	6.4V/8A, 6.4V/1A	2.79
302433-A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4V/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600 VCT/36 MA	2.65
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 2000V/NL, 465V/.6A, 44V/10A, 6.3V/23.5A, 6.3V/1.8A, 5V/9A, 2X2.5V/1.75A	17.95

All merchandise guaranteed. All prices F. O. B. N.Y.C. Send M. O. or Check. Only shipping charges sent C.O.D. Rated concerns send P. O.

COMMUNICATIONS EQUIPMENT CO.

131 Liberty St., New York, N. Y. Dept. E-1 Chas. Rosen Phone: Digby 9-4124

Niagara • ONE OF AMERICA'S GREAT RADIO STORES

"An" Connectors, Large Variety in Stock at Tremendous Savings Quotation Requests Invited.

HEART OF THE BC-221 FREQ. METER

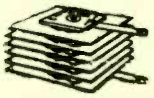
This VFO Sub-Assembly, used in BC-221 Freq. Meter, FULLY WIRED and mounted on sturdy aluminum sub-chassis, ready for installation. Brand new—in original packing. Very special.

EACH **$4.50**

BRAND NEW HEINEMANN CIRCUIT BREAKERS

Amps	Volts	Part No.	
7	24 D.C.	AM1510M-7	**1.49** Each
10	40 D.C.	P-0322	
.220	24 D.C.	PAM-1510RWM0220	
.010	24 D.C.	B-20C-2826	
40	24 D.C.	AM1510RWM-40	
7.5	24 D.C.	T-128	
8-25	230 A.C. (Dual)	0322	**2.49** Each

FAMOUS MAKE SELENIUM RECTIFIERS



All first quality, guaranteed brand new fresh factory stock. Buy now while still available. All 130 V.

D.C. MA.	SINGLY EACH	LOTS OF EACH
65	.66	.63
75	.78	.75
100	.96	.92
150	1.17	1.10
200	1.35	1.27
250	1.50	1.42
275	1.65	1.55
300	1.89	1.75
350	2.15	2.01
400	2.54	2.43
450	2.64	2.52

Special Application. Stacks Made To Your Specs. Write for Quotation.

"CIF" TYPE FERRULE RESISTORS LARGE SELECTION AT LOW PRICES. SEND US YOUR QUOTATION REQUEST TODAY!

NEW V.T.V.M.

By DELTA

Model 10A

The most versatile test instrument offered to the electronic industry in years. A superb instrument, designed by engineers with years of "know-how". Intended for use in laboratories where precision is of paramount importance. Ruggedly built for dependable use on production line or general servicing.

- 28 Non-skip resistance and voltage ranges.
- Negative feed-back and patented bridge circuit for high stability.
- Measures R.M.S. and peak to peak voltages of complex wave forms.
- Zero center for discriminator and bias indications and any galvanometer applications.
- 250 Mc. coverage with the probes FURNISHED (At no extra charge).
- High-impedance frequency compensated attenuator.
- Automatic differentiation between A.C. and D.C. allowing A.C. to be read with a D.C. component and vice versa.

MODEL 10A DELTA V.T.V.M. with all probes and leads. Further information available upon application **$69.95**

ATTENTION! Industrial Buyers

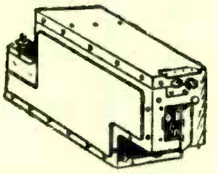
Niagara can supply your entire requirements in the electronic field. We are large scale suppliers of tubes, parts and equipment. Our large adequate inventory of standard lines of merchandise as well as surplus materials, enables us to serve you promptly.

You are invited to send us your quotation requests. Urgent orders will be shipped immediately upon receipt of order via phone, mail or wire.

Please address all inquiries to;

Mr. J. J. Garrettson
Industrial and Wholesale Div.

ARC-5/R-28 RECEIVER 100—156 Mcs.



New or used

Here is the aircraft superhet you have been looking for. Absolutely one of the best available today. Tunes from 100 to 156 mcs. in four crystal channels. Accurately calibrated dial on front panel. Contains the following tubes: 717a—R.F., 717a—Mixer, 2—12SH7—1st and 2nd I.F. (16.9 mc.), 12SL7—Det., AVC, Squelch, 12SL7—1st audio and squelch amplifier, 12A6—2nd audio, 12SH7—R.F. Osc. and 4th harmonic gen., 717a—trip. 12th Harmonic gen., 717a—Dblr. 24th Harmonic gen. (all tubes are included.)

New, in sealed cartons	**$24.95**
Used, excellent condition	**$20.95**

T23/ARC-5 TRANSMITTER

FAMOUS AIRCRAFT TRANSMITTER. COMPANION TO ABOVE RECEIVER.

A desirable VHF transmitter with turret switching coils for all stages. Uses the following tubes; 1625 Osc., 1625 Tripler, 832 Tripler, 832 Final amplifier. Range; 100 to 156 Mcs. Four crystal channels are provided.

Brand new with all tubes, less crystals $39.95

SPECIAL! FREE! with purchase of either of above two items, one copy of Volume 2 "Surplus Radio Conversion Manual" (Reg. price $2.50). This book contains full information and circuit diagrams of both the ARC 5/R-28 receiver and T23/ARC-5 transmitter.

SYNCHRO-SELSYNS

all brand new

Machine aluminum housing and case. Bakelite end cap with coded screw terminals. ¼" shaft.

C-78249 Cal. 11280 Synchro Differential 100 V. 60 Cycle. Price **$3.75**

C-78473 Cal. 13920 Repeater type XX 50 V. 50 Cycle. Price **3.75**

C-78411 Cal. 11925 Transmitter 50 V. 50 Cycle. Price **3.75**

The below listed type is similar to above, but contained in a solid machined bronze housing. 5 leads 5 ft. long, of color coded fiber glass insulation are provided.

C-56776-1 Ca-4460A-4 Repeater type II-5 110 V. 50 Cycle. Price **$7.50**

Niagara ONE OF AMERICA'S GREAT RADIO STORES

RADIO SUPPLY CORP. Dept.

Digby 9-1132-3-4

160 Greenwich Street, New York 6, N. Y.

Reliance Specials

TIMING MOTOR

8 RPM 115V 60 cyc
E. Ingraham Co.
$1.95

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenters dream!..................Only $6.50

VERNIER DIAL or DRUM (From BC-221)

DIAL—2⅝" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0-50 in 180°. Black with silver marks ....either 85¢

SOUND POWER HANDSET

Brand New!

Includes 6 ft. cord.—No batteries or external power source used. $17.60 pr.

Sound Powered Chest Set With 24 Ft. Cord

Variac—General Radio 100W removed from equipment **$10.00**

400 CYCLE INVERTERS

Leeland Electric Co.

#10800 In: 25-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 380-500 Cyc. 1 phase, 1500 V.A. 90 PF............$24.95

3AG FUSES

AMP	Per 100	AMP	Per 100	AMP	Per 100
1/8	$4.00	1/4	$4.00	6	$3.00
3/8	4.00	1	3.00	10	3.00
1/2	4.00	5	3.00	15	3.00

DELAY NETWORK—ALL 1400Ω

T 114—Approx. 2.2 micro sec. delay............ } 95¢
T 115 Similar to T 114 with tap brought out.... } each

BEARINGS

Mfg. No.	ID	OD	Thickness	Price
MRC5028-1	5 1/2	6 1/2"	1"	$3.50
MRC7026-1	5 5/64	6 15/64	9/16	3.50
Timken 37625	4 5/16	6 1/4	29/32	4.25
MRC-7021-200	4 1/8	5 9/32	23/64	2.95
Norma A 545	2 1/16	2 5/8	1/4"	1.00
MRC 106 M2	1 17/64	2 7/16	25/64	1.75
MRC 106 M1	1 13/64	2 7/16	25/64	1.60
Federal LS 11	1 1/8	2 1/2	5/8	1.75
Norma S 11 R	1 1/8	2 1/8	3/8	1.25
Fafnir B 541	1 1/16	1 1/2	9/32	.55
Hoover 7203	5/8	1 9/16	7/16	.90
Norma 203 S	5/8	1 9/16	7/16	.90
SCHATZ	3/4	1 3/4	9/16	1.00
N5 5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	1 5/32	11/32	.55
Norma S 3R	3/8	7/8	7/32	.45
MRC 39 R1	11/32	1 1/32	5/16	.45
NDCW 8008	5/16	5/16	13/32	.45
MRC 38 R3	5/16	55/64	9/32	.45

NEEDLE BEARINGS

TORRINGTON B108 ½" wide ⅝" 13/16" 30¢

Brand New METERS—Guaranteed

0-10 ma. D.C. 3½"... 3.95 | 0-80 Amp. D.C. 2½"..$2.25

SELENIUM RECTIFIERS

Full Wave 200 MA 115V.........................$1.79
Half Wave 100 MA 115V.........................91

SPAGHETTI SLEEVING—assortment—99 feet.....$1.00

TYPE "J" POTENTIOMETERS

60	SD	1500	SD	5000	3/8"	70K	SD
100	SD	2000	SD	10K	3/8"	80K	SD
150	SD	2000	SD*	10K	SD*	100K	3/8
300	SD	2000	3/8	15K	1/4"	200K	SD*
400	3/8	2500	1/2"	15K	SD*	200K	3/8
500	3/8	2500	SD	25K	3/8"	250K	SD*
1000	SD*	3000	3/8	30K	SD*	250K	3/8*
1000	3/8	4000	3/8	50K	SD*	1 Meg	SD

* Split locking bushing $1.50 each

JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2–140Y	$0.13	4–141W	$0.24	9–141W	$0.64
3–140¾W	.19	5–141	.26	9–141Y	.64
6–140	.25	5–141¾W	.37	7–142	.42
10–140¾W	.53	7–141	.36	3–142	.21
3–141¾W	.24	7–141¾W	.49	12–142	.72
3–141W	.24	8–141¾W	.58	2–150	.39
		10–140W	.53	3–150	.54

TIME DELAY RELAY

Eagle Signal Corp., Moline, Illinois
115 V., 60 Cycle

2½ second recycling time—spring return • Micro-switch contact, 10A • Holds ON as long as power is applied • Fully Cased • ONLY.......................$6.50

AN CONNECTORS

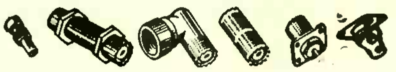
IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

NEW COAXIAL CABLES

	Price per 1,000 Ft.		Price per 1,000 Ft.
RG 7/U....	$85.00	RG 29/U....	50.00
RG 8/U....	150.00	RG 41/U....	295.00
RG 9/U....	250.00	RG 55/U....	85.00
RG 10/U....	245.00	RG 57/U....	125.00
RG 11/U....	150.00	RG 58/U....	70.00
RG 22/U....	150.00	RG 59/U....	70.00
RG 23/U...	175.00	RG 62/U....	100.00
RG 25/U....	425.00	RG 77/U....	100.00

Add 25% for orders less than 1,000 feet.
*No minimum order—others 250' minimum.

COAXIAL CABLE CONNECTORS



15¢ UG 175/U · $1.30 83-1F · 30¢ ANGLE · 80¢ 83-1J · 40¢ 83-1R · 10¢ HOOD

83–1AC	$0.42	83–22AP	$1.10	UG 57/U	$2.30
83–1AP	.30	83–22R	.68	UG 58/U	.63
83–1F	1.30	83–22SP	1.15	UG 60/U	2.40
83–1H	.10	UG 13/U	1.75	UG 85/U	1.75
83–1J	.80	UG 21/U	1.20	UG 87/U	1.60
83–1R	.40	UG 21B/U	1.45	UG 88/U	1.60
83–1SP	.60	UG 23B/U	1.65	UG 167/U	2.05
83–1SPN	.60	UG 22/U	1.30	UG 175/U	.15
83–168	.15	UG 24/U	1.30	UG 176/U	.15
83–185	.15	UG 25/U	1.25	UG 206/U	1.60
83–2AP	2.00	UG 27/U	1.30	UG 260/U	1.60
83–2R	1.30	UG 30/U	2.50	UG 281/U	.77
				UG 290/U	1.60
				UG 499/U	1.25

UG 255	2.45	UG 59A/U	2.25
UG 224/U	1.40	UG 306/U	2.95

DIFFERENTIAL

115 V., 60 Cyc. $3.95 ea.
#C78249

3⅜" dia. x 5⅜" long

Used between two #C7824's as dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted)........$4.50
Mounting Brackets — Bakelite for selsyns, and differentials shown above...............35¢ pair

2J1G1 SELSYNS

BRAND NEW 400 CYCLE

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
7	23	50	82	180	470	800	.001625	.0044
7.5	24	51	90	220	500	820	.002	.0056
8	25	56	100	240	510	910	.0027	.0062
8.2	26	60	110	250	560	.001	.003	.0065
10	30	62	120	300	580	.0011	.0033	.0068
15	39	68	125	350	600	.0012	.0035	.0082
18	40	70	130	370	620	.0013	.0036	.01
20	43	75	150	390	650	.00136	.0039	
22	47	80	160	400	680	.0015	.004	
			175	430	750			

Price Schedule

8.2 mmf to 910 mmf...............................5¢
.001 mfd to 001625...:...........................8¢
.002 mfd to .0082 mfd............................15¢
.01 mfd..28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
.8	39	75	150	270	430	700	.0026	.005
10	40	82	155	275	466	800	.0027	.0051
18	47	100	170	325	470	875	.00282	.0056
20	50	110	180	350	500	.0011	.002826	.006
22	51	115	208	360	510	.0013	.003	.0068
23	60	120	225	370	525	.0015	.0033	.0082
24	62	125	240	390	560	.0016	.0036	
27	66	130	250	400	570	.0022	.0039	
30	68	135	260	410	680	.0023	.004	

Price Schedule

10 mmf to 900 mfd................................10¢
.0011 mfd to .0023 mfd...........................20¢
.0026 mfd to .0082 mfd...........................50¢

PULSE TRANSFORMERS

UTAH—9278 9262 9280
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9365, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—K2731 80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1-229621-60

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.32	14.98	62.54	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89	32	123.8	366.6	50,148
6.68				125	414.3	59,148

PRECISION RESISTORS—½ WATT—35¢

.25	15	87	389	3,995	12,000	33,000
.334	18.75	97.8	397	4,000	14,825	33,300
.444	25	125	400	4,101	15,000	35,888
.502	34.75	147.5	723.1	4,285	15,750	36,000
.557	44.73	148.7	855	4,300	15,755	37,000
.627	45	178	970	4,451	15,810	41,700
1.	46	179.5	1,100	4,750	16,000	45,000
2.04	49	180	1,264	5,714	16,700	47,000
3.25	52	210	1,375	5,900	17,000	50,000
3.7	55.1	220	1,400	6,500	19,860	56,000
5.24	60	235	1,490	7,000	20,150	59,000
5.26	61	240	1,500	7,300	21,300	59,905
5.89	65	260	2,250	8,000	25,000	68,000
10.58	66	270	2,500	8,500	26,667	70,000
11.1	66.6	286	2,500	8,800	30,000	79,012
13.15	69	290	3,400	8,909	32,700	100,000
13.8	75	298.3	3,427	10,000	32,888	180,000

PRECISION RESISTORS—1 WATT—45¢

.1	2.55	15	71	2,250	8,000	65,000
.11	2.58	18	80	2,413	8,250	68,000
.2	2.61	27.4	250	2,500	9,000	70,000
.31	2.66	28	270	3,300	10,000	84,000
.4	3.1	35	312	3,800	12,000	95,000
.861	3.39	38	420	4,000	12,420	
1.01	4.29	48.6	425	5,000	12,500	
1.106	4.3	45.5	1,800	5,221	50,000	
1.21	5.21	54.25	2,200	7,000	55,000	
2.1	12.8	60	2,215	7,800	56,000	

PRECISION RESISTORS—1 WATT—60¢

100,000	145,000	296,000	376,000	560,000
105,000	150,000	300,000	390,000	590,000
120,000	166,100	310,000	399,000	600,000
128,000	220,000	320,000	413,000	645,000
130,000	250,000	340,000	520,000	650,000
149,500	260,000	348,000	522,000	700,000
132,000	270,000	375,000	550,000	876,457

1 MEGOHM 1 WATT 1%—$1.50—5%—60¢

PRECISION RESISTORS—2 WATT—75¢

4,385 5,000 6,000 10,000 19,917 23,000

UNIVERSAL JOINTS ALUMINUM

3/16" hole x ⅝ O.D. 1-⅛" long— **50¢**
¼" hole x ½ O.D. 1-⅛" long— **75¢**

OIL FILLED

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.1	25,000	25.95	1	1,500	1.50
.25	20,000	19.95	3	1,000	1.59
.15–.15	8,000	2.75	4	1,000	1.95
.1	7,500	1.95	2	1,000	.90
.03	7,500	1.69	1.02	1,000	.65
.1–.1	7,000	1.98	1	1,000	.65
.1	7,000	1.85	7	800	1.98
.02–.08	7,000	1.40	1	800	.55
.1	6,000	2.75	10	600	2.95
.03–.03	6,000	1.35	8–8	600	1.69
.01–.08	6,000	1.35	8	600	2.05
2	4,000	4.95	7	600	1.75
.3 x .2	4,000	2.50	4	600	1.63
.1	4,000	2.25	4 x 3	600	1.95
.06	4,000	1.45	2	600	.69
.1	3,500	1.95	2 x 2	600	1.40
.25	3,000	2.25	8	500	1.55
8	2,000	4.95	4	500	.98
6	2,000	4.65			
3	2,000	3.75			
.5–.1	2,000	1.95			
.5	2,000	1.95			
.3	2,000	1.75			
.1–.1	2,000	1.65			
.02	2,000	.79			
4	1,500	2.95			
2	1,500	1.79			

2 mfd.
4,000
V.D.C.
G.E.
$4.95

OIL FILLED A.C. CONDENSORS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
.2	750	$ .69	30	330	$6.50
8	660	4.95	25	330	5.95
6	660	4.95	20	330	5.50
5	660	4.50	15	330	4.50
4	660	4.25	10	330	3.95
2	660	3.25	4	330	1.95
1	660	2.35	3	330	1.25
15	440	4.95	2.5	330	.98
6	440	3.50	2	330	.65
5–3	440	3.95	10	220	2.95
4.4	375	2.15			

1N34 Crystal Diode 79¢

300 Twin Lead...............02½ per ft. $18.95 per M.

Dynamotor DM 33A...............................$3.75 ea.

Chokes: 30 Hy. 8MA @....$1.29; 6Hy. 8MA @ ....78¢

Power Tap Switch—OHMITE # 312-5—5 Taps non-shorting 25A 150 V. A.C. $3.95

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A. C. Fully cased Plugs into octal socket $6.50

BC-224-D Rec'vr 13 Volts D. C. 1.5 mc to 18 mc. Brand new. Includes tubes, dynamotor, shock mts....$125.00

Mike connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated..........................25¢

Minimum Orders $3........All orders f.o.b. PHILA, PA.

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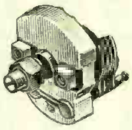


Fig. A

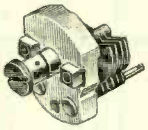


Fig. B

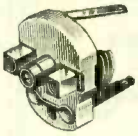


Fig. C

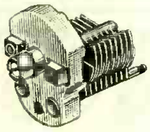


Fig. D

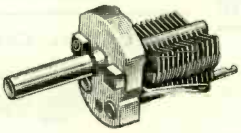


Fig. E

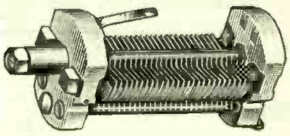


Fig. F

STOCK NO.	CAPACITY Min.	CAPACITY Max.	MANUFACTURER'S NUMBER	FIGURE	SHAFT LENGTH	POST LENGTH	GROUND LUG	PRICE EACH
2397	2.5	7	Hamm 250034	D	5/16	3/32	Right	18¢
5716*	3	8	ASP 17A224	A	9/16	3/32	Top	25¢
5717	3	10	ASP 22G192	A	9/16	3/32	To Post	18¢
4090	2	15	ASP 482212	E	1'x1/4' D	3/32	Left	25¢
2939	3	15	ASP 217-2	C	5/16	1/4	Top	20¢
5718	3	15	Telrad 682070-30	D	5/16	3/32	Right	20¢
5719	3	15	Hamm 682070-30	D	5/16	3/32	Right	20¢
231	3	25	CAIM 481881	A	9/16	3/32	Left	25¢
5720	3	27	Hamm 11725-1	D	5/16	3/32	Right	25¢
5721	2.5	28	Comar M420864-6	D	5/16	3/32	Top	25¢
5722	3	29	QAK 22G190	A	9/16	3/32	To Post	25¢
5723	3	29	ASP 22G190	A	9/16	3/32	To Post	25¢
2940	2	30	ASP A8H-501	D	5/16	5/16	To Post	30¢
5724	4.5	30	OB7751E-25	D	5/16	5/16	Right	30¢
5086	5	30	Hamm SBL-72265-3	B	1/2	3/32	Bottom	30¢
2941	4.5	35	Hamm ESA682070-37	D	5/16	3/32	Left	30¢
232	5	54	Hamm ESA682070-35	D	5/16	3/32	Left	40¢
5087	5	54	Hamm BL 72265-4	B	1/2	3/32	Right	40¢
5725	4.5	55	Sickles M7466880-2	D	5/16	3/16	Right	40¢
5088	6	100	Hamm SBL72265-6	B	1/2	3/32	Bottom	50¢
5674	5	100	Hamm APCIE100	E	1 1/16"x1/4"D	3/32	Right	75¢
236**	8	140	ASP 19A34504	D	5/16	3/32	To Post	55¢
5675	6	150	Hamm APCIE150	E	1 1/16"x1/4"D	3/32	Right	75¢
5726	9	204	OAK 114M510	F	9/16	3/32	Top	95¢

* Double spaced plates.
** Adjusts both ends, some available w/dust cover.
Fig. A Round Shaft Screwdriver adj. w/locknut.
Fig. B Bakelite Knob Ins. Screwdriver adj.
Fig. C Round shaft Screwdriver adj.
Fig. D Hexnut Screwdriver adj.
Fig. E ¼ Round Shaft.
Fig. F Double End Plate.

BUTTERFLY CONDENSERS

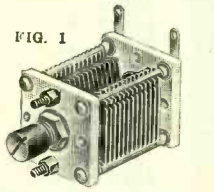


FIG. 1

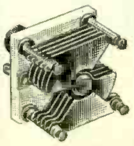


FIG. 2

9-62 mmfd per section. 6-34 mmfd sections in series. Double ceramic end plates and bearings. ¼" diam. shaft, 5/16" long. 065 Plate spacing end plates 1-⅜" square.

Stock No. 5076-A FIG. 1 Price Each **90¢**

4-22 mmfd per section. 3-12 mmfd sections in series. Single ceramic end plate 1-⅜" square. ¼" diam. x ¼" long shaft.

Stock No. 5077-A FIG. 2 Price Each **60¢**

TOGGLE SWITCHES

STOCK NO.	MFG.	ACTION	RATING	PRICE
5443A	H & H	S.P.D.T.	6A-125V	35¢
5281A	Carling	S.P.S.T.	10A-125V	39¢
5444A	C-H (B6B)	S.P.S.T.	5A-125V	25¢

OTHER TYPES AVAILABLE

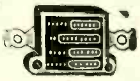
OIL FILLED CONDENSERS

.045 MFD—16,000 Volt Vitamin "Q". One Ceramic Insulated Screw Terminal 1¾" x 3½" x 4¾" High Can.
Stock No. 5399A. **$4.95**

Standard Brand. MFR. Name on Request

TRANSMITTING MICA CAPACITORS


A


B


C


D


E


F

Stock No.	Cap.	Test Volts	Fig.	Type No.	Price Each
5493A*	.01	1000	B	1445	$1.35
5494A	.02	1000	B	1445	2.40
5495A	.006	1200	A	A 2	3.40
5496A	.0001	1500	C	BE 15	4.20
5497A	.0005	1500	C	BE 15	5.20
5498A	.004	2500	B	4	6.30
5499A	.001	5000	A	F	7.60
5600A	.0036	5000	A	A2	1.00

* Supplied with Meter Bracket

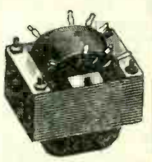
HEAVY DUTY

Stock No.	Cap.	Test Volts	Fig.	Type No.	Price Each
5601A	.15	1000V	E	XS	$1.90
5602A	.00007	2500V	E	3	90¢
5603A	.00005	3000V	E	15L	1.00
5604A	.0001	5000V	E	F2L	1.00
5605A	.0008	5000V	E	F2L	1.00
5606A	.000025	10,000	D	PL-341	1.95
5607A**	.00015	10,000	F	PL-315	7.95

** D.C. Working Voltage

STANDARD BRAND. MFR. NAME ON REQUEST. OTHER TYPES AND SIZES AVAILABLE

6.3 VOLT FILAMENT TRANSFORMERS



Primary 115 Volt 60 Cycle 1600 Insulation Three 6.3 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.5 Amps.
6.3 Volts @ 1.1 Amps.

Stock No. 5254 A

Horizontal Half Shell Mounting. 2¼" x 2 13/16" Mounting Centers. 2 13/16" x 3⅜" Core Size. 2½" above Chassis. Solder Lug Terminals—All Terminals Marked.

Price Each **$2.65**

Terms: Open Account to rated or acceptable reference accounts. Others Pre-payment or 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject prior sale.

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We carry a complete line of diodes available for immediate delivery

1N48	$ .75
1N48	2.49
1N51	.48
1N52	1.53
1N52	4.05
1N63	3.30
1N63	7.65
1N75	2.85
1N75	6.66
1N64	.66
1N65	.72
1N72	4.20
1N73	19.05
1N74	14.25
1N69	1.23
1N70	3.15
G5A or G6	2.25

TRANSISTORS
SX-4A

Z-2	17.40

We carry all Nationally Advertised Brands of Radio and Electronic Parts.

Tubes and Equipment.

TRY US FOR YOUR NEEDS

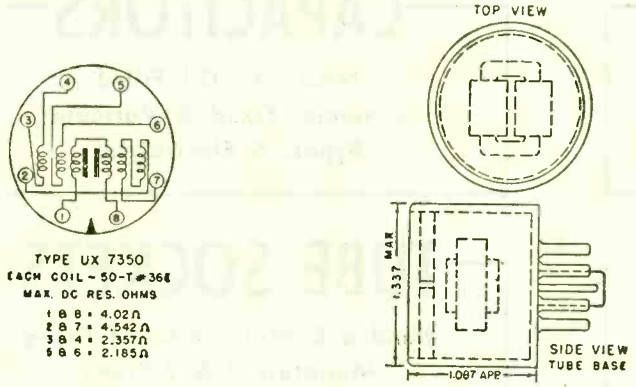
RESISTORS
½—1—2w 5—10% Tol.
All standard brands
Immediate Delivery

Complete stock of
J and JLU pots
for immediate delivery.

PULSE TRANSFORMERS

Tube base plug in type

Here are precision made, high quality compact pulse transformers wound on hypersil cores. They are built in octal bakelite tube bases and can be adapted to many uses. Kindly distribute this data to key personnel in your Electrical Engineering Department, to your Technical Library, to your Electronic Equipment Buyers and to any person who should have knowledge of this item.



OTHER DATA

- ★—Completely impregnated and sealed.
- ★—Physically small, measuring only 1.377" dia. x 1.087" high.
- ★—Convenient to use—merely plug into an octal socket—simplifies production.
- ★—Schematic of winding sequence and connection pressed into disc covering top of tube base. Schematic designates socket connections.
- ★—The coils are wound on high-grade tested hypersil cores.
- ★—Used in some of the Navy's modern and highly accurate Radar and Direction Finding Equipment.
- ★—Standard types—Manufactured by Raytheon Manufacturing Company.
- ★—Quantities available—immediate delivery.

SUGGESTED USES

- ★—Blocking Oscillator, Multivibrator and Scope Circuits.
- ★—Wherever Accurate Timing and Triggering are necessary.
- ★—Unexcelled in circuit applications for generating low power and low voltage pulses.
- ★—Can be used in circuits utilizing repetition rates from 0 to well over 1 MC and pulse widths ranging from .05 Microsecond up.

PRICE $4.50 EACH—Immediate Delivery

A Few of Our Many Specials.

SHIELDED SCOPE TRANSFORMER

Pri—115V
Sec—2400—5MA
6.3—1A
6.3—1A
3 3/' high
3 1/4" deep

@1.95

Amphenol 80 C connectors......$.12 ea.

MICA CONDENSORS

MMF	TOL.	CASE	PRICE
68	5%	CM19	$12 a 100
150	5%	CM19	$12 a 100
390	10%	CM19	$6 a 100
470	10%	CM19	$6 a 100
220	10%	CM20	$6 a 100

GR 371A Pot 2000 ohms 15W...... $1.25
GR 214 Pot 1000 ohms 10W........$1.25

Westinghouse NA-35 3" round zero—150 V A.C. $5.95

Hermetically sealed—low power audio transformer
Primary 600 ohms at zero MADC
Secondary 6 ohms at same .95

.01—100V
molded paper waxed
diffed capacitors
$.05

Hi-Q Induct. choke
½ mil. rating
$.99

Jan 832 A
$6.95

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PRECISION RESISTORS

These are standard manufacture; priced ridiculously low. All are brand new, non-inductive, non-aging wire-wound types, insensitive to wide temperature variations. Sizes not listed below can readily be made up by series, and/or parallel arrangements at a fraction of the cost of precision resistors available elsewhere.

500K 1% WMAL $.55
100K 1& WMAL .55

FOLLOWING SIZES ARE
35¢ each;—$27.00 per 100

800K	1%	WW5	600K	1%	WW4
750K	1%	WW5	125K	1%	WW5
700K	1%	WW5	120K	1%	WW3

FOLLOWING SIZES ARE
25¢ each; $19.50 per 100.

220K	2%	WW5	7.5K	1%	WW3
92K	1%	WW1	6250 ohms	1%	WW4
84K	2%	WW4	5K	1%	WW3
80K	1%	WW4	4.5K	1%	WW4
74975 ohms	1%	WW4	4.3K	2%	WW3
50K	1%	WM4L	4K	1%	WW3
46K	1%	WW3	4K	2%	WW3
33K	1%	WW3	2.2K	1%	WW3
33K	2%	WW3	1.5K	1%	WW5
25K	1%	WM4L	1K	1%	WM3L
20K	1%	WW3	750 ohms	1%	WW3
17K	1%	WW3	500 "	1%	WM3L
17K	2%	WW3	165 "	1%	WW3
15K	1%	WW3	130 "	1%	WW3
14975 ohms	1%	WW3	110 "	1%	WW3
12.5K	1%	WW3	30 "	1%	WW3
10K	1%	WW3	22 "	1/10%	WW4
10K	2%	WW3	22 "	1%	WW4
10K	2%	WW4	14 "	1%	WW4
8K	1%	WW1	12 "	1/10%	WW4
			10 "	1%	WW4

FOLLOWING SIZES ARE
15¢ each; $12.50 per 100

150K	5%	WW1	280 "	1/10%	WW3
54.5K	1%	WW3	272 "	1%	WW3
26.5K	1%	WW3	235 ohms	2%	WW3
17.3K	1/10%	WW5	70 "	5%	WW3
15K	5%	WM13	50 "	5%	WW3
2.5K	5%	WW3	40 "	5%	WW3
2230 ohms	1%	WW3	30 "	5%	WW3
475 "	1%	WW3	6 "	3%	WW4

FOLLOWING SIZES ARE
10¢ each; $8.50 per 100

53.96 ohms	½%	WW4	4.3 ohms	1%	WW4
23.29 "	1%	WW4	3.94 "	3%	WW4
13.52 "	½%	WW3	3.5 "	5%	WW4
13.333 "	1%	WW4	2.56 "	½%	WW4
5.1 "	1%	WW4	.29 "	3%	WW4
4.4 "	1%	WW3	.25 "	5%	WW4
4.35 "	1%	WW3			

RELAYS

Part No.	Description	Unit Price
1002	Struthers Dunn #61BXX104 D.P.S.T. relay, contacts 25 amp., Coil 12 V.D.C. 17 ohms	.65
1003	GE type K27J851 Antenna switch over relay. Coil 30 ohms 10V.D.C. Contacts D.P.D.T. with double-break for high voltage use. All isolantile insulation.	.85
1004	Western Electric #D-166878. Telephone type relay. D.P.D.T. plus D.P.S.T. normally open. Plus D.P.S.T. normally losed. Heavy duty contacts. Coil 180 ohms. Operates from 6–12 V.D.C.	.85
1005	Telephone Type Relay. S.P.D.T. plus S.P.S.T. normally open. Coil 100 ohms 10–12 volts D.C.	.35
1006	Sensitive subminiature Relay, S.P.D.T. measures ⅞"x1"x1⅛". Coil 110 ohms. Easily by means of two threaded holes. Operates with less than 1½ V.D.C., can be used as plate relay. Operates with less than 15 milliamperes.	
1007	GE #D106F3. Antenna switchover relay. D.P.D.T. Coil 28V.D.C. 1000 ohms. Isolantite insulation	.35
1019	Allen-Bradley type B5 Starter relay. Coil 24V.D.C. 100 ohms. 50 amperes contacts. S.P.S.T. normally open	.65
1021	Square D type B5 Starter Relay Coil 24VDC. 50 ohms. Contacts S.P.S.T. normally open. 50 amperes	.65
1022	GE #B100F3—D.P.D.T. relay coil 10 V.D.C. 165 ohms	.65
1031	6V.D.C. coil 30 ohms, fully adjustable contacts S.P.S.T. normally open, plus S.P.S.T. normally closed, adjustable spring contact pressure. Solid copper binding posts, includes a 500 ohm 30 Watt resistor for operation on 110 Volts. D.C. coil consists of 1000 ft. of #24 solid enamel wire. Mounted on ¼" bakelite base 6½"x8x⅝".	1.25
1032	RCA Vacuum relay. Relay contacts will break 3000 volts and carry 10 amperes. Solenoid resistance. 200 ohms' 24 volts D.C. excellent R.F. antenna relay	.95
1033	Clare #818062. D.P.S.T. Miniature type. Coil 140 ohms. Will operate from 10 V.D.C. or 20 V.A.C.	.25
1036	Miniature relay RBM #55526. SPDT plus S.P.S.T. Normally open coil 250 ohms 12–24 V.D.C.	.55
1037	Thermal Vacuum type. Time delay relay. S.P.S.T. Coil 100 ohms 24 V.D.C./A.C.90 second delay.	.95
1042	Allied type BJX. Operates on 12 V.D.C. Contacts S.P.S.T. Small size	.85
1053	Guardian #34420 type B2. Coil 24 VDC. 180 ohms. Heavy duty double break contacts	.85
1054	Leach type 5053. Starting relay. Coil 24 V.D.C. coil resistance 10 ohms in series with 50 ohm, 15 Watt holding resistance. Very heavy contacts, 1-A and 1-C plus holding contact.	.85
1058	Guardian time delay relay, 24 volts D.C. 200 ohms coil. Contacts make 1, break 1. Delayed starting effected by four 1" diameter, ⅛" wide, copper slugs under armature end of coil	.95
1060	GE #B105C36. Coil 9000 ohms will operate on 8MA. Contacts double break, double throw	.95
1063	Leach type 1227 relay, Single pole, double break. Coil 24 V.D.C. 180 ohms	.85
1064	Telephone type relay #452—1041. D.P.D.T. Contacts doubled for positive action. Operates on 7 MA. Contacts pressure and armature throw fully ad'ustable. Lanienated core.	.95
1088	Allied control #BOY-X5 coil 6V.D.C. contacts D.P.D.T. plus S.P.S.T. N.C. heavy contacts	.85

TRANSFORMERS

We present a variety of Transformers, chokes, etc., some surplus, some suitable for small production runs, or laboratory, experimental, or replacement purposes.

POWER TRANSFORMERS

Part No.	Description	Unit Price
L730	Pri. 115V 60 cycles Sec. 700 V.C.T. 150 MA., 5. OV. @ 3A., 6.3V. @ 4.6A—half shell type	3.45
E1108	Pri. 115V. 60 cycles K63J132 Sec: 600 V.C.T. 200 MA. 6.3V. @ 3A, 6.3V. @ 4A 5.0V. @ 3A, Standard Shell Construction	4.95
L2013	Multiple section Power transformer Pri: 117V. 60 cycles Sec: 1000V. C.T. @ 100 MA. 500V. C.T. @ 100 MA. 5.0V. @ 3A., 5.0V. @ 2A 6.3V. @ 8A., 12V. @ 1A Full shell construction with leads	4.95
L4582	Oscilloscope or T.V. transformer Pri: 115V. 60 cycles Sec: 4500V. @ 2MA 2.5V. @ 5 Amperes Housed in hermetically sealed case	3.45
L1112	Heavy duty—Power Transformer Pri: 115V. 60 cycles Sec: 800V. C.T. 300 Ma. 2.5V. C.T. 10A. Housed in shielded metal container	3.95
6072J	Power Transformer Pri. 115V. 60 cycles Sec. 750V. C.T. @ 180 MA. 2.5V. @ 3A., 2.5V. @ 6A., 5V. @ 3A., Shielded in metal upright c se	2.45
L3335	Oscilloscope or T.B. Power Transformer Pri. 115V. 60 cycles, 825V. Sec: 2000V. @ 10 MA. C.T. 110 MA. 6.3V & 6A., 6.3V. @ 6A. 5V. @ 3A., 2.5V. @ 1.75 A., 2.5V. @ 1.75 A., 6.3V. @ 3.5 A., Hermetically sealed with porcelain insulated stud terminals	4.95
L2133	Heavy duty multiple tapped plate transformer Pri: 117V. 60 cycles Sec: The following tapped windings can feed three rectifiers simultaneously at the indicated load currents: 1460V.C.T. 200 MA. 940V.C.T. 110 MA. 650V.C.T. 130 MA. Open mounting with wire leads	6.95
L2134A	Pri: 110V. 60 cycles Sec: 55V. @ .002A 55V. @ .002A 55V.C.T. @ .002A Hermetically sealed in metal case with porcelain insulated stud terminals #UX-8301C Pri: 115V. 400 cycles Sec: 600 V. @ .175 A., 1780 V. Test Hermetically insulated, sealed in metal case with porcelain insulated stud terminals	75

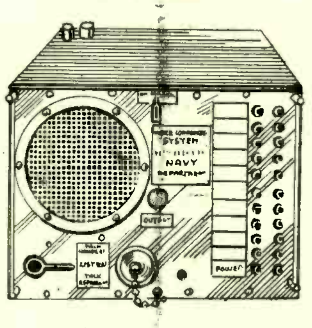
HEAVY DUTY PLATE TRANSFORMER

Type CRP 30363	Pri: 220/440V. 60 cycles Sec: 440V. @ 7.75 AMPS. 440V. @ 7.75 AMPS Unshielded with porcelain insulated terminals 12" high, 8½" wide, 13" length	39.50
1085	Tapped line TRANSFORMER An auto transformer for thousands of uses with the following taps at 60 cycles: Taps wired to male and female octal plugs; 110, 122, 200, 230V. overall dimensions 3x2x2½". Unshielded type	1.25

FILAMENT TRANSFORMERS

L2132	Pri: 115V. 60 cycles 5V. @ 3A 5V. @ 3A Hermetically sealed in metal case with porcelain insulated stud terminals.	.95
L2133	Pri: 115V. 60 cycles 6.3 @ 3.6A., 15V. @ 4 MA. 15V. @ 4 MA. Hermetically sealed in metal case with porcelain insulated stud terminals.	
L2134	Heavy duty Filament transformer #631 Pri: 117V. 60 cycles Sec: 18V. @ 8A., 1500V. test open 6.3V. @ 8A., 1500V. test mounting 5.0V. @ 2A., 1500V. Test with wire 5.0V. @ 2A., 2000V. Test leads 5.0V. @ 2A., 2500V. Test Unshielded type	2.95
L2122	Filament transformer with high voltage insulation Pri: 115V. 60 cycles Sec. 6.3V. @ 7.8A., 1500V. Test 2.5V. @ 4.75A., 7500V. Test 2.5V. @ 6.0 A., 4000V. Test * 6.7V. @ .72A., * 7.5V. @ .77A., * 8.2V. @ .82A., *10.8V. @ 1.0 A., * Not simultaneous Housed in hermetically sealed case with solderceramic terminals	2.25

10 STATION INTERCOMMUNICATING SYSTEM



An unusual offering in a 10 station intercommunicating system for factory and interoffice communications.

Built for the U. S. Navy Type I-A for 115 volt 60 cycle operations with the following outstanding features:

Operates individually, and separately, by push button control, 10 sub-stations.

Pilot light identification of each substation, on master unit.

Transformer coupled 6V6's in push pull to provide up to 10 watt output.

Amplification provided by 2-6SL's transformer controlled

Rectification by 2-5V3 tubes.

A high voltage test, power transformer providing filament and plate voltage to all six tubes.

Hayden 24 R.P.M. Motor, 10 VAC actuates the switch which blinks pilot light along each substation.

Jensen type NF 101 6½" high fidelity speaker. Weatherproofed.

Tubes and audio transformers mounted, on a shock proof sub-chassis.

Entire unit mounted in a sturdy grey finished steel cabinet 15" x 11" x 10. Weight 48 lbs. net. Each packed in wooden crate.

This unit is priced at a fraction of original government cost.

Price $59.50 each

Substations for above consisting of a 4", 2.70Z magnet, Goodman, (British make) high fidelity packed in wooden crate.
cabinet.

Price $6.50 each

We have substantially large quantities of desirable electronic materials at bargain prices listed in our catalogue #ED5.
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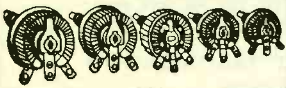
U. S. GOV'T. SURPLUS

POWER RHEOSTATS



Ohms	watt	ea.	Ohms	watt	ea.
.5	25	1.98	250	25	2.23
.5	50	2.81	250	50	2.53
.5	150	5.93	300	50	2.53
1	50	2.81	300	100	4.27
2	50	2.81	350	25	1.98
2	100	4.68	350	100	4.26
2	300	8.42	370	25	1.98
3	100	4.67	378	150	6.59
3	225	6.58	400	25	1.98
3x3	300	29.95	400	75	3.90
4	225	6.60	500	25	1.98
5	25	1.97	500	75	3.95
5	100	4.68	500	50	2.53
6	25	2.23	500	100	4.39
6	75	3.90	500	150	4.68
7	25	1.98	500	300	8.49
8	50	2.53	585	150	6.60
10	25	2.23	750	25	2.23
10	100	4.27	750	150	5.95
12	25	2.23	1000	25	1.98
12	50	2.53	1200	225	7.20
15	25	1.98	1250	50	2.66
15	75	3.90	1250	150	6.59
15	100	4.38	1500	25	2.53
20	50	2.53	1500	50	2.65
25	25	2.23	1800	150	6.24
50	25	1.98	2000	25	2.23
50	50	2.53	2000	50	2.53
60	25	1.98	2250	150	6.24
75	25	1.98	2500	150	6.24
75	75	3.90	2500	50	2.53
75	100	4.39	2500	100	4.68
80	500	12.46	3000	25	2.39
100	25	1.98	3000	100	4.68
100	50	2.53	5000	25	2.53
100	100	4.39	5000	50	2.85
125	25	2.53	7500	50	2.85
150	50	2.53	7500	100	5.31
175	25	2.53	10000	50	3.12
185	25	1.98	10000	100	5.51
200	25	1.98	15000	25	3.29
200	100	4.27	20000	150	8.43
225	50	2.53			

SELECTOR SWITCHES

Pole	Pos.	Deck	Type	Each
1	11	1	Bak-n/shtg	.60
1	21	3	Bak-n/shtg	.89
2	2	1	Cer-shtg	.50
2	6	2	Bak-n/shtg	.60
2	11	2	Cer-shtg	1.25
3	4	2	Bak-/shtg	.58
5	3	2	Cer-n/shtg	.98
6	11	6	Bak-n/shtg	1.95
10	5	5	Cer-shtg	2.25
16	2	4	Bak-n/shtg	1.35

Many other types in stock

"AN" CONNECTORS

Large Variety Available
At Great Savings

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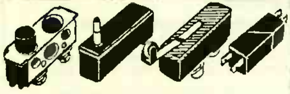
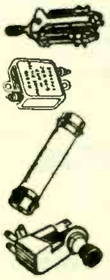
#926-C10
#926-C24
#929-1
#930-12
#930-18
#930-19
#930-21



MICROSWITCHES

MISCELLANEOUS



A. MOSSMAN LEVER SWITCHES
B. NOISE FILTERS
C. GLASS FERRULE RESISTORS
D. MALLORY SERIES 2000 PUSH SWITCHES
E. WE-I—PRECISION RESISTORS

See Dec. Issue for Complete Listings of above.

OIL CONDENSERS

Mfd.	Voltages Avail
.1	3-6-20K
.25	2-3-3¼-4-5K
.5	600-1½-3K
1	600-1-1½-2-5-6K
2	400-600-1-1½-2 3-4K
4	600-700-1-1½ K
6	400-600-1½-2 K
8	600
10	600-2½K
15	600-1K
30	90-vac. 3-ph
100	230-vac. 3-ph
3x4	500
3x8	600
4x3	600
4x8	600
3x10	90-vac.

Special Prices on Request

BATHTUBS

Mfd.	Voltages Avail.
.033	400
.05	2-4-600
.1	4-6-1K
.15	600
.25	2-4-600
.35	400
.5	4-6-1K
.75	600
1	1-2-4-6-1K
2	4-600
4	50-100
8	500
25	25-50-75
40	25
50	25
100	15
200	12
300	6
2x.01	2-400
2x.02	6-1500
2x.045	600
.046x.055	600
.2x.05	6-1500
.1x.05	200
.1x.5	400x50
2x.1	4-600
2x.16	600
2x.2	600
2x.25	4-600
.3x.5	500
2x.5	4-600
1.x.05	500
1.x.1	300
1.x5	200
2x1	600
2x10	25
2x200	9
3x.001	600
3x.05	600
3x.1	4-600
3x.25	4-600
3x.5	100-600
015x.03x.045x.06x.12/ 600	

Also available CHANNEL Types. Special Price on request.

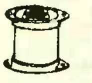
TERMINAL BOARDS

5 terminal	98¢
8 terminal	1.67
12 terminal	2.49

SHOCKMOUNTS

100P-1.....	1 lb.	.15
100P-2.....	2 lb.	.15
100PR-2...	2 lb.	.15
100P-3.....	3 lb.	.15
100P-6.....	6 lb.	.20
150P-4.....	4 lb.	.20
150PH-8...	8 lb.	.45
100PL-1...	1 lb.	.15
150P-7.....	7 lb.	.25
156P-6.....	6 lb.	.35
200PD-15..	15 lb.	.59
200PHN-35	35 lb.	.75
204P-112...	112 lb.	.98

HIGH POWER TR. MICA



G-1 TYPE	
.0001	5KV
.00015	5KV
.0002	6KV
.0008	6KV
.0047	6KV
.005	5KV
.01	4KV
.032	2KV
.04	1KV
.08	1.5KV
.09	1.5KV

G-2 TYPE	
.0001	10KV
.00015	10KV
.0002	10KV
.000247	12KV
.0003	10KV
.000375	10KV
.0004	5KV
.0005	10KV
.00065	10KV
.001	6KV
.003	8KV

G-3 TYPE	
.0001	20KV
.003	20KV
.0004	20KV
.00045	15KV
.0005	20KV
.001	20KV

.0011	20KV
.00124	15KV
.004	12KV
.25	1.6KV
.25	6KV
.001	20KV
.00047	20KV
.015	3KV
.0012	20KV

G-4 TYPE	
.0002	30KV
.0025	25KV
.005	8KV
.01	15KV

TYPE #5S	
.000155	30KV
.000533	30KV
.0004	30KV
.001	30KV

TRANSMITTING MICAS

mfd.	wv	type	ea.	mfd.	wv	type	ea.
.0001	600	4	.36	.0015	600	4	.36
.0003	600	4	.36	.00162	600	4	.42
00005	600	4	.29	.002	600	4	.39
.00005	2500	9	.57	.002	1200	4	.72
.0001	600	4	.29	.0025	600	4	.39
.0001	2500	9	.57	.003	600	4	.43
.00015	600	4	.36	.004	600	4	.45
.0002	600	4	.29	.005	1200	9	.99
.00025	600	4	.29	.0047	600	4	.47
.0005	600	4	.29	.005	2500	9	1.86
.0005	2500	4	.75	.006	600	4	.54
.0005	2500	9	.77	.01	600	4	.65
.0006	2500	9	.85	.01	1200	9	1.41
.0007	600	4	.36	.02	600	4	.92
.00075	600	4	.36	.02	1250	9	2.12
.0008	600	4	.36	.025	600	4	1.08
.0009	600	4	.36	.03	300	4	.99
.001	600	4	.36	.03	600	4	1.34
.001	1200	4	.54	.043	600	4	1.75
.001	1200	9	.57	.05	300	4	1.19

(Many other sizes in stock)

"UG" and "UHF" CONNECTORS

UG-9/U
UG/10U
UG-12/U
UG-14/U
UG-15/U
UG-16/U
UG-18/U
UG-19/U
UG-20/U
UG-21/U
UG-22/U
UG-24/U
UG-25/U
UG-27/U
UG-58/U
UG-87/U
CW-123/U
UG-206/U
83-1AG
83-1F
83-1H
83-1J
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83-1D
83-1SPN
83-22R
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PRICES ON REQUEST

TYPE "J" POTENTIOMETERS

TYPE "J" $1.50
TYPE "JL" $1.75
TYPE "JJ" $2.95

ohms	ohms	ohms	ohms	ohms
65 *†	4000†	75 K†	500-500 *†	130K-130K *
300†	5000†	80 K†	600-600†	150K-150K†
400 *†	6500†	100 K *	1500-1500†	250K-250K†
500†	10 K *†	100 K†	2000-50K *	350K-5K†
600 *†	12K†	125 K *	2200-24K†	350K-25K†
750†	15 K *†	250 K *	6K-45K†	300K-300K†
1000 *†	20 K *†	2meg *	20K-2000†	350K-350K *
1400†	25 K *†	2meg†	25K-10K†	800K-75K *
1500 *†	30 K *†		35K-5000†	2meg-2meg†
2000 *†	50 K *†		50K-25K†	4meg-4meg†

TYPE "JJJ" $4.95

ohms	ohms
20K-200K-20K†	750K-750K-750K†
45K-27K-2500†	800K-800K-800K†
700K-700K-700K†	1meg-1meg-1meg†

* 1/8" screwdriver slotted shaft.
† Knob type shaft.

JONES Connectors

Jones BARRIER STRIPS

P-101-1/4
P-101-3/8
P-306-AB
P-306-CCTL
P-308-FHTL
P-310-CCT
P-312-AB
P-312-CCTL
P-315-CCT
P-315-CCE
P-315-EB
P-318-CCE
P-321-AB
P-324-AB
P-324-EB
P-324-CCT
P-330-SB
P-402-SB
P-406-AB
P-408-LAB
P-410-CCE
P-2410-SB
P-412-DB
P-412-CCE
P-2412-SB
P-502-DP

P-504-DB
P-506-DB
P-508-CE
P-510-CE
P-512-CE
S-101-D-MOD
S-302-AB
S-304-CCT
S-306-CCT
S-306-CCTL
S-308-AB
S-308-CCTL
S-315-EB
S-315-CCT
S-318-AB
S-321-CCE
S-330-AB
S-404-AB
S-406-CCT
S-408-CCT
S-408-LAB
S-2408-SB
S-410-AB
S-410-CCE
S-2412-CCE
S-502-DB

S-504-DB
S-504-CE

2-140-Y
3-140
10-140-3/4W
10-240
18-240
3-141
4-141-W
4-141-3/4W
6-141
7-141-Y
10-141-Y MEL
12-141-Y
15-141-Y
20-141-3/4W MEL
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- BC-221 Frequency meters without modulation.
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- I-100A Test sets for SCR-269.
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- W-110 B Army field telephone wire.
- RC-58-B Army Tape Facsimile transmitters-receivers.
- Link radio transmitters-receivers 1498 including remote control and antenna, reconditioned.
- Link-50 UFS transmitters, receivers including remote control and antenna. New.
- BD-72 army field telephone switchboards, twelve lines. Reconditioned, like new.
- BD-71 army field telephone switchboards, six lines. Reconditioned, like new.
- Army Field Telephones, Type EE8. Excellent.

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WALKIE-TALKIE normal range 3 miles or more depending on operating conditions. Frequency range: 40.0 to 48.0 mcs. Brand new. Complete.

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34-58 mcs. Brand new. COMPLETE WITH RACK AND CONTROL BOX.

AN/CRT-3

EMERGENCY RADIO TRANSMITTER. T-74/CRT-3 DUAL FREQUENCY OPERATED TRANSMITTER. Operates on both 8280 kc. and 500 kc. Power output 2½ W. on 500 kc and 2 W. on 8280 Kc. BRAND NEW. COMPLETE WITH PARACHUTE, KITES, LAMP, BALLOON and GENERATOR.

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Complete Line!

Signal Generator 804-C
DuMont 224-A Oscilloscope
1-77 Hickok Tube Checker
1-208 FM Signal Generator
RPC Model 644 Multimeter
Ferris Microvolter Mod. 18-C

IE-36 (New)
I-122
I-139 METER
I-212
I-222
TS-3/AP
TS-5/AP
TS-10B/APN
TS-19/APQ-5
TS-24A/APR-2
TS-34/AP
TS-36/AP
TS-61/AP
TS-62/AP
SL-1 Slotted Line Test Set

TS-100/AP
TS-102A/AP
TS-111/CP
TS-126
TS-127/U
TS-170/ARN-5
TS-175/UP
TS-182/UP
TS-184A/AP
TS-204/AP
TS-250/APN
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With Coupling Heads BC--1201 & BC-1202

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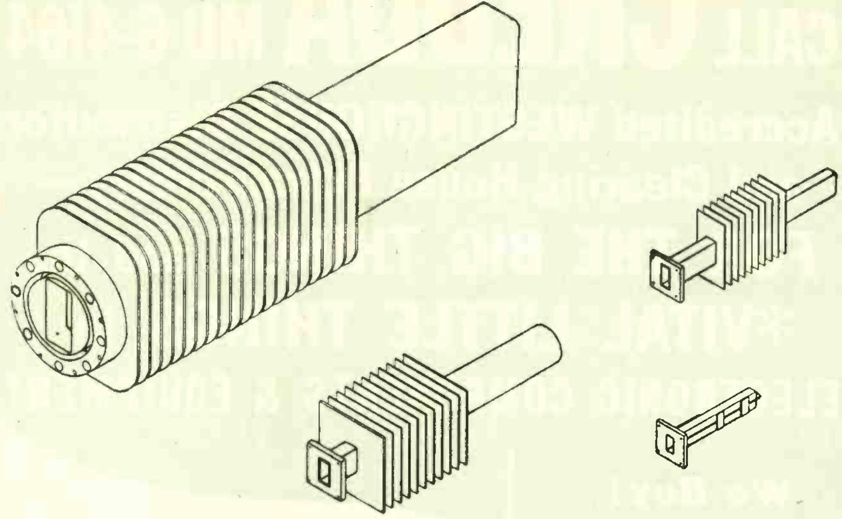
TEST EQUIPMENT



HI-POWER DUMMY LOADS

X Band, 1¼" x ⅝" guide, choke or plain flange, dissipates 350 watts average power continuously in still air, VSWR less than 1.15 between 7 and 10 KMC, weight 5¼ pounds.

X Band, ½" x 1" guide, choke flange, dissipates 250 Watts average power continuously in still air, VSWR less than 1.15 between 8.2 x 12.4 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 200 watts average power continuously in still air, VSWR less than 1.15 between 7-10 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 150 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band, 1½" x 3" guide dissipates 1,200 watts average power in still air, VSWR less than 1.15 between 2.5 to 3.7 KMC, choke flange, weight 13 pounds.

TS-30, X Band Power Meter, measures 1 milliwatt to 1 watt of X Band average power for ⅝" x 1¼" wave guide,—$200.00.

TS-155 S Band Signal Generator and Power Meter.

X Band Frequency Meter, 8,500 to 9,600 megacycles, direct reading within 25 megacycles; within 4 megacycles with correction chart. Transmission type for ⅝" x 1¼" wave guide.

X Band Power and Frequency Meter for 8,500 to 9,600 megacycles measures 1 to 1,000 milliwatts average power. The frequency meter is direct reading within 25 megacycles and within 4 megacycles with correction chart; commercial equivalent of TS-230 B/AP.

TS-33/AP X Band Frequency Meter, 8,700 to 9,500 megacycles,—$150.00.

TS-62/AP X Band Echo Box,—$150.00.

TS-110/AP S Band Echo Box,—$150.00.

TS-89 Voltage Divider,—$30.00.

TS-12/AP (Unit 2) X Band slotted line with adapters and probes—$175.00.

TS-100 Synchroscope

T-85/APT-5, 300-1,600 megacycles Noise Modulated Transmitter, 40 watts C. W.

Waveguide Below Cut-Off Attenuator L 101-A, U. H. F. Connectors at each end, calibration 30-100 db,—$25.00.

Amplifier Strip AM-SSA/SPR-2 contains I. F. amplifier, detector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2 bandwidth 10 megacycles, center frequency 30 megacycles, sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac, 60-2, 600 cps 1.3 amps. Send for schematic—$65.00 less tubes.

Tuning Units for APR-4 Receiver

TN 16 30- 80 megacycles
TN 17 80-300 megacycles
TN 18 300-1,000 megacycles
TN 19 1,000-2,200 megacycles
TN 54 2,200-4,000 megacycles

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Wire—Aeronautical
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Wire—Hook-up
Wire—Magnet

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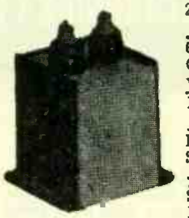

2 MFD. 5000 VDC $12.95

6 MFD. 600 VDC CP 70 BIFF 605K with Brackets. $1.69

100 MFD. 1500 VDC $27.50

BATHTUB CONDENSORS CP53BIFF504K .5MFD—600V. . .$.64

STANDARD BRAND INNERTEEN CAPACITORS 3MFD 8000 VDC size 12" x 4" x 12". .$35 each

HAYDON SYNCHRONOUS MOTOR

110 V.A.C.
½ R.P.M.
3.6 Watts
$2.47 each

2.2 watt 1-120 RPM. . . . .$1.68 each
Minimum order 5 pieces on synchronous motors

WESTON WATTMETER Model 641 0-4 KW 250 V. $23.85

Rheostat Type J 150 Ohm 50 Watt #5381 . . . .$2.15 each

RHEOSTAT Type K 100 Watt 25 Ohm $3.78

RHEOSTAT Type H 25 Watt 15 Ohm $1.65

LINE CORD AC manufactured by G.E. molded rubber plug, 12' lengths. $25 per 100 pcs.

Amplifier Navy Model CM 21103 for Syncro equipment, completely new with following tubes 2—6L6, 16SK7, 1—6F6, 1—6H6, 1—5U4 made by Bendix. $24.95

UG Connectors UG 352U . . . . .$6.00 each
UG 9/U . . . . . . .95 each
3-1SP . . . . .40 each

Relays, mfd. by Sigma 12 volts DC, S.P.D.T. size 2¼" x 1⅝" . . . . . .$.77 each

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FILAMENT TRANSFORMER, 6 Volt, 5 amp. 110 V, 60 cycle primary. 4⅜" High x 3⅜" Wide x 2½" deep. Shipping wt. 6-lbs. Brand new $1.95*

12-V FILAMENT TRANSFORMER. Tapped at 13, 12, 11, 10, 9 at 3 amps. 3¾" high x 3⅛" wide x 2¾" deep. Shp. wt. 4½-lbs. Brand new $1.49*

50-WATT MODULATION TRANSFORMER. Matched 2 807's class AB to 807 Class C RF or 2000 ohm RF Load. 5" high x 5" wide x 4" deep. Shp. Wt., 12-lbs. Brand new $2.95*

6-V. VIBRATOR TRANSFORMER. Output 340 volts @ 130 amps. Brand new. Sizes: 4⅜" high x 3-1/16" wide x 2¾" deep..$1.49*

FILAMENT TRANSFORMER. 2½ volts, 10-amps, 60-cycle primary. Insulated 5000 volts. 5" high x 4½" wide x 3" deep. Shipping wt., 8-lbs....................$3.95*

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NEW STANDARD BRAND CHOKES

SWINGING CHOKES

Hy	Mils	Ohms	Price	Voltage	Case	Wt.
8–40	175	100	$2.75*	3KV	Closed	3.5
8–30	200	80	3.25*	3KV	Closed	4.5
5–25	200	100	4.95*	2KV	Closed	5
5–25	300	90	9.95*	5KV	Closed	18
8–25	300	80	5.95*	5KV	Open	8½
5–25	500	60	12.95*	7KV	Closed	28
8–40	1 amp.	50	39.95*	10KV	Closed	58
SMOOTHING CHOKES						
5	500	600	4.95*	2KV	Closed	4
7	150	200	1.25*	2KV	Open	2
10	500	60	12.95*	7KV	Closed	28
12	300	80	5.95*	5KV	Closed	9
12	400	400	6.95*	2KV	Closed	15
15	200	120	2.95*	3KV	Open	4.5
20	300	80	5.95*	4000	Closed	9
20	400	85	6.95*	5KV	Closed	14
20	300	125	12.50*	15KV	Closed	40
16 Ser.	175	96	5.95*	2.5KV	Closed	15
4 Par.	350	24				
26 Ser.	200	112	6.95*	3.5KV	Closed	15
6.25 Par.	400	28				

BC442 ANTENNA RELAY. Contains 50 Mmfd, 5000 Volt vacuum condenser and 0 to 10 amp RF meter. With Antenna transfer switch, transmitt to receive. Brand new....................$3.95*
Used.................... 2.95*

CONDENSOR 5-5 Mfd. 400 V, DC Type KS-8976C. 3⅝" high x 3-5/16" wide x 2" deep. Shipping wt., 2-lbs. Brand new..........75¢*

WARNING BELL. 24-volt, 3" diameter. Shipping weight, 2-lbs. Brand new....................$2.95*

BD77 DYNAMOTOR. 12 V. input, 1000 V. 300 MA DC output. Brand new....................$19.50*

BC348 Antenna Tuning Cans. Contains band switch and coils. Brand new....................$2.49*

AS-65 ANTENNA. APQ-2A. Complete with 7 sections. New $14.00*

BC1145A CONTROL BOX. Part of SCR-729. Brand new $4.95*

CD318A CORD for connecting Throat Mike. Has JK48, PL68 Plugs and SW141 V Switch..$1.95*

NON-INDUCTIVE RESISTORS. IRC type MPR. 100-watts. All brand new, 18½-inches long complete with lug terminals. Available in quantity in 95, 72 and 120 ohms..........$3.00 ea.*

RC266 RADAR ANTENNA. Part of SCR-717. Brand new, crated and ready to ship. Approx. wt. 335 lbs....................$49.50*

MG 149F INVERTOR. Brand new..........$74.00*
Used, good condition....$25.00*

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T4/FRC, with Modulator
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PP-1/FRC, Power Supply.
RCA-ET 4332 and 4336.
TDE, TBK, 8010, 8003, for Ships.
ATD, for Aircraft.
BC-319, BC-604, BC-684, etc.

RCA-2.5, KW. Converted to R. F. Heater, 2.5 KW output. Freq. range 10.7 to 14.4 mc. Consists of 2 cabinet units; Oscillator unit uses two 827R tubes forced air-cooling; Power supply uses six 872A rectifiers, with requisite meters and relay controls. Operates from 230 or 460 V., 50-60 cycles, 3 phase A.C. **PRICE AS IS**............**$1,400.00**

TSI 500W. Simultaneous Radio Range and Telephone Transmitter. Frequency 200-400 KC. Mfd. for CAA by Federal Tel. Co.

BC-797, 50 Watt AM Transmitter. Freq. 110 to 130 MC, Xtal Control. Operation—110V. 60 cycles AC.

TDQ Transmitters, 100-156 MC, 45 watts AM output. Reconditioned to like new.

MANY OTHERS!

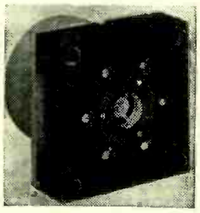
TRANS-RECEIVERS

TBY, MAB (Walkie-Talkies), SCR-509 & 510, SCR-511, SCR 609 & 610, SCR-522, LINK Model 1498, TCS with 12/24/230 DC and 110V, AC Power Supplies, SCR-508/528/608/628.

Jefferson Travis, Model 350-A, Transmitter-Receiver, 50 W. output, 1.5 to 12.0 mc, 5 channels operation—1 VFO and 4 X'tal—both transmitter and receiver. Power Supply operates from either 12/24/32/115 V.D.C., or 115 V. AC, 60 cycles. With Ant. Loading Coil unit, handset, key, & instruction book. Complete.

AUDIO SOUND

Beachmaster 250 W.; Western Elec. Model HLAS—500W.; RCA 25W. (12V.) Mobile; RCA MI-2817-E Amplifier. 1,000 Watts (2—500 watt Channels); **W.E. Speaker Units** D-173246 (25-30 Watts) and D-173232A (50-60 Watts), considerable quantity available, see illus. below.



TEST EQPT.

BC-221, I-222-A Signal Generator, 100-156 MC, with crystal calibrator, for 115 V. 60 cycles AC. **TU-56. TU-57, TS-45, TS-143, I-148. TS-305, TS-143/CPM - 1 Synschroscope. Others.**

RADAR

SCR-545-A, Complete in Trailer Trucks, with or without 25 KVA Gas-Engine Generator Unit.

MARK V Training Radar, for schools, training.

Hundreds of radar components, plumbing, magnets, tubes, transformers, etc.

RECEIVERS

RBM, RBS, BC-224, DZ-2 Direction-Finders with Loops, **SCR-206** Direction Finders with Loops, **SCR-291 Indicators** and Accessories, **R-2/ARR3.** Others.

CRV-46136, 100 to 1500 KC, part of DP-13 Radio Eqpt.

R-89/ARN-5A Glide-Path Receiver, with crystals. NEW.

RT-3/ARN-1 Radio Receivers, New.

Model ZB-3, Aircraft Homing Adapters, with plugs and accessories. New Eqpt.

SPECIALS

Wilcox 36A Rectifier-Power Supply, for 3 KW modulated transmitter. Designed for use with 4 or more 96C 3 KW Transmitters and 50A Modulator. New, Unused.

RADIOSONDE AN/AMQ-1, Meteorological Balloon transmitter with self-contained instruments. New Units, with slide-rule temperature evaluators and spare (sealed) humidity elements. Large quantity available. Receiving and Recording supplementary eqpt. also available. Type AN/FMQ-1.

"SNOOPERSCOPE" TUBES, British Infra-Red Image Converter Tubes, with matching Bausch & Lomb front-end Lens.

SOUND-POWERED HEAD-CHEST SETS, RCA-MI-2454-B, all New, export-packed.

32V. DC to 110V. AC KATO Converters, NEW, good to 300 watts.

115V. DC to 115V. AC., 60 cycles, Motor-Generators. 500 Watts output; mfd. by Esco, and Holtzer-Cabot.

RC-163 Radio Beacon Eqpt., designed for use with SCR-508/608/528/628/510/610 Transmitter-Receivers, 20 to 40 mc. Complete, export-packed, NEW equipment.

TE-54A & TE-55A Cable Vulcanizing Units.

AT-49/APR-4 Antennas.

General Electric Voltage Regulator & Power Supply, Model 3GVD14B3, Output 750 volts up to 100 ma; complete power supply using 8 tubes, with selector switch for regulating or non-regulating. Operates from 110 V., 60 cycles AC. NEW units, less tubes, with operational data and diagram. **EACH..$24.50**

Tuned Filter Chokes, 120 cps, 40 H., D.C. res. 410 ohms, with 0.177 mfd (600 w.v.) capacitor. N. Y. Transf. type T-OD-8035. New. Hermetically sealed. Dim: 5¼H. x 4¾" x 3½". **EACH............$2.95**

Amertran Filter Chokes, type W, 0.04 Henries at 2.4 amps, 10 kv RMS test. New units. **EACH....$3.95**

Screw Plug Heating Elements, Chromolux SCB. Metal encased, 150 W. 110 volts. 5½" long, 1⅜" dia. New. **EACH....................$0.75**

GE D & W Oil Fuse Cutouts, Model 9F2D2, rated 50 amps/5,000 V. or 100 amps/2,500 V. grd. Y. New Units. **WRITE FOR PRICE.**

BD-72 Switchboards, Excellent Condition. **EACH $55.00**

Dynamotor DM-28, for BC-348 Receiver. New. **EACH $7.25**

MP-22A Mast Base, w/insulator spring-loaded for swiveling and quick return. New units. **EACH $4.95**

T-9/APQ-2 Radio Transmitters. Noise-modulated Jamming Transmitter, using Electron-Multiplier Photocell. For Jamming certain types radar eqpt. New unused transmitters only, with Electron-Multiplier tube, less other tubes. **EACH..........$32.50**

SB-23/GTA-2 & SB-14/GY Switchboards & Power Supply, for operation from 110V. 60 Cycles AC (with storage batteries). Each in individual metal cabinet. NEW. **Price, Each Set....................$300.00**

Eclipse Pioneer Type C-14 Magnesyn Unit. Per W.E. Spec., KS-5899-L01 excitation 26 volts 400 C.P.S. current drawn 200 to 500 MA. Shaft locking arrangement overall dim. 2¼" dia. 2¼" long. .812" x 2.562" Mtg. centers. NEW Units. **Price, EACH.......$7.50**

Deck Entrance Insulators, bowl and flange type, 8-⅞" dia. with heavy galvanized metal flange and bell. Top bell 6-¼" dia. x 11"; brass feed-thru rod. very high voltage insulation. Individually packed in cartons, all NEW. **12 FOR..............$24.00**

TS-48AP Echo Boxes. UNUSED. **EACH.....$20.00**

SCR-584 Sector Scan Units. Unused. **EACH....$9.00**

QBE-3 Control Rectifiers, Type CBM-20223. Unused. **EACH $27.50**

BC-689A Radio Transmitters. Unused. Less tubes. **EACH $22.50**

Reversible ½ HP Aircraft Motor, GE Model 5BA50-LJ57, 4,000 RPM. Volts—24 Field and 60 V. Armature. Wt 13 lbs. NEW units, individually packed. Approx. 300 available, at **$10.00 Each**

Standard Brand Capacitors. Type 18F75, 150 Mfd., 90 V. AC, 60 cps. All NEW, packaged capacitors. Large quantity available.

Capacitor-Transformer, GE Model 69-G-210, 132/200 Volts, Kva 1.42/.23, 140/10 Watts, 60 cycles. NEW units, packaged.

Overload Relay, GE type CR-5882-C1G, rated at 250 V. max. NEW, individually packaged.

Low Pressure Switches, GE type 2927D100J1. NEW.

Radar Fil. Transf. WE. Spec. D-122882, RMS Test 30 Kva, Pri.—115 V., 50/70 cycles, Operating max D.C. 15 Kv., Sec. #1 5V. at 10 amps., #2 5V. at 10 amps., #3 5V. at 20 amps. New Units, cased.

Remote Antenna Drive RM-55, Hand-crank driven assembly, with illuminated azimuth scale, couples to any directive antenna by means of flexible drive shaft and permits remote control. NEW units, in wooden chests.

Aircraft—High Pressure Axial Flow Fans, 24-28 V. DC, capacity 200 cfm, 1/15 HP. Model 4581A2A. NEW units, packaged.

Purchasing Agents! We have thousands of oil condensers, transmitting micas, resistors, transformers, transmitting tubes, etc. Check with us for any special requirement.

EXTRA—SPECIAL!!! GE 872-A Rectifier Tubes, packed 25 to each carton. NEW, original cartons. 25 for $75.00, while they last.

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DYNAMOTERS & INVERTERS

TYPE	INPUT VOLTS DC	OUTPUT VOLTS DC	MILLS
DM-21	14	235	90
ARC-11029	28	250	60
3412	12	220	100
5055	12/24	225/440	100/200
DM	14	240	80

MOTOR-ALTERNATOR

5AS121LJZ
Input 27V DC
Output 120V 800 Cycles 1 Phase

MOTOR GENERATOR

PU-7/AP
Input 28V DC
Output-115V AC 21.6 Amps
400 Cycles 1 Phase

BLOWERS

24V DC 1/100 hp—7000 RPM

MOTORS

24V DC-6000 RPM-UTAH .003 HP
24V DC-6000 RPM-Redmond .003 HP
24V DC- 300 RPM—Excel
2J1G1—Selsyns

POWER SUPPLYS

All with Cut Cords
Complete with tubes and vibrators
PE 97A PE 117A PE 120A

400 CYCLE TRANSFORMERS

CAT #68G665X
68G666X
68G667

NOISE SUPPRESSOR CAPACITORS

.1 MFD. 200 Volt

OIL FILLED CAPACITORS

MFD.	VOLTS
.005–.005–.01	10,000
.01–.01	12,000
.03	6,000
.03	7,500
.01	12,000
. 1	7,500
. 1	4,000
. 1–.1	7,000
. 2	10,000
.3–.3	7,500
.4	10,000
.6–.6–.6	90V 60 CY
.10–.10–.10	90V 60 CY
.15	12,000
.20–.20– 20	90V 60 CY
.25	3,000
3	330VAC 60 CY
3 5	250V 60 CY
9	90V 400 CY
30	90V 60 CY
1.75	330V 60 CY
1	7500V
5	600V
2x5	1000V

Also many other sizes and all size bathtub condensers.

CIRCUIT BREAKERS

24 Volts DC .220 AMPS
115 Volts AC 15 AMPS
24 Volts DC 150 AMPS

T. V. HIGH VOLTAGE CONDENSER

500 MMF—10,000 Volts

POWDERED IRON TUNING SLUGS.
ALL SIZES.

CONTROL BOXES

CAY-23219
J-17/ARC 5
BC 422
CRV 2356
J-23/ARC 4

FERRULE TYPE RESISTORS

Ohms	Dia.	Length
12,500	3/8	4 1/2
50	1/2	2 1/2
500	1/2	3
2000	1/2	2 3/8
5500	1/2	2 1/4
12,000	1/2	3
315	5/8	3
1500	5/8	3
3500	5/8	5
800	1	10
6300	1	7 1/2
16,000	1	5 1/2

Also many other sizes.

ALTITUDE GAIN CONTROLS #55586

Contains 140K ohm ½ watt. Type J. Pot. Control is coupled to an aneroid chamber, setting automatically varies with altitude.

GYRO CONTROL

Contains a motor driven gyroscope friction plate silverstat and resistors. The gyro motor is a 115 V 240 cycle 3 phase 1400 RPM induction motor.

GYRO MOTOR GENERATOR

Is a 115 Volt 60 cycle 3 phase, 3400 RPM motor driving a DC generator with 2 fields. The output of the generator is from 0 to 35 volts. The polarity of the output voltage depends upon which field receives the greater excitation. The magnitude of the output volt is determined by the net excitation of the field.

SERVO MOTOR—24V DC SHUNTWOUND

Gear box for above equipment

A-DI66173 W.E. Video Transformer Frequency response 10KC to 2MC Impedance ratio 50 to 900 ohms; 7-7/32 high x 5-3/4" dia.

BUD MIDGET CONDENSERS

Cat. No.	Cap. Per Sect. Max.	Min.	Air Gap
913	35	5	.060
329	35	9	.095

N. C. 800—NATIONAL NEUTRALIZING CONDENSER

STEP-DOWN LINE CORD

For operation of 110 volt AC-DC radio sets from 220 volts AC-DC. Supplied complete with plug and cord.

CHROMALOX AND VULCAN HEATER ELEMENTS

Watts	Volts	Dia.	Length	Mfg.
450	115	3/4	7 3/4	C
280	115	3/4	7 5/8	
175	115	3/4	7 5/8	V
175	115	3/4	7 5/8	C
350	115	3/4	6	C
315	115	3/4	7 5/8	V
200	115	3/4	7 5/8	
300	115	3/4	7 5/8	V
250	110V	3/4	7 5/8	V

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COILS • RELAYS • GEARS • SPRINGS • SCREWS • WASHERS • EYELETS

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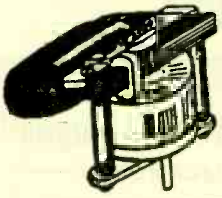
NUTS

TERMINALS • TUBING • RIVETS • PINS • BRACKETS • WIRE • CABLE • SW.

Genuine TELECHRON Motors



2 RPM	$2.90
3 RPM	3.90
3.6 RPM	3.15
1 RPM	3.95
60 RPM	4.30

One of each $15.00

ZENITH 1951 TV Remote Control Motor Units

Reversing switch on end of 17 foot cable. Powerful 4 RPM clutch motor.

Will drive anything

Can be used for door opener, window raiser, model RR turntable. Complete with transformer.

$12.90

6 for $70.00

MARKTIME 5 HOUR SWITCH

A 10 amp. timing device. Pointer moves back to zero after time elapses. Ideal for shutting off radios and TV sets when you go to bed. Limited supply at this special PRICE.... **$4.90**

Also available in 15 min., 30 min., 1 hr. at $5.90

Single Pole 6v. Very Small Relay	$ .60
Veeder-Root Counter, Rotary	.90
Veeder-Root Counter, Ratchet	2.25
No. 18 Enameled Copper Wire, 1¾ lb. coil	2.00
Solenoid, works on 24v. D.C. and 115 v. A.C.	1.50
½ amp. 6 v. Transformer	1.15
4½ amp. sealed 6 v. Transformer	2.75
MU and ACRO Switches assorted	4 for 1.00
115 v. A.C. Motor, for fan or experiment	1.50
1800 RPM, 115 v. A.C. Motor	4.50
Guardian, No. 4, 115 v. A.C. Solenoid	3.50
Guardian No. 2 6 volt DC Solenoid	1.90
Price Bros. No. 1A, 115 v. A.C. Solenoid	1.50

Eby bakelite Binding Posts	.12
TELETYPE 1/40 H.P. 110 v. D.C. Motor	2.90
W-L, 100 watt fixed, 1000 ohm Resistor	.60
Arrow-H & H, DPDT Toggle Switch	.65
C/H Off center, SPDT Toggle Switch	.35

ANTENNA ROTATOR or DOOR OPENER

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3 Wire Rubber Cable for Above	Ft. .03½
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Coil	Contacts	Will Close At	Price
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2) 6500 ohms	1A-1C	3.2 MA	2.75 ea.
3) 6500 ohms	3A	4.0 MA	3.00 ea.
4) 6500 ohms	3A-1B	4.0 MA	3.00 ea.

CLARE TYPE G SENSITIVE HALF-TELEPHONE RELAYS

1) 6500 ohms	2A	5 MA	$2.50 ea.
2) 5800 ohms	3A	5 MA	2.50 ea.
3) 5800 ohms	2B-1C	5 MA	2.50 ea.
4) 4800 ohms	1A-2C	6 MA	2.50 ea.
5) 3600 ohms	1C	6 MA	2.00 ea.

All above Relays may be used for continuous duty operation on 110V. D.C.

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(B) Normally closed set of contacts.
(C) Single pole double throw set of contacts.

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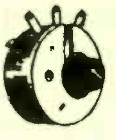

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TYPE 12604-3-A: Contains CK5 Motor coupled to output shaft through 125:1 gear reduction train. Output shaft coupled to autosyn follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15:1 **$70.00 ea.**

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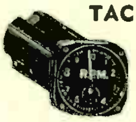

Sensitive Type, Kollsman Mark V; Range 0-3500 RPM in 3½ revolutions of the indicating pointer. **$9.95 ea.**

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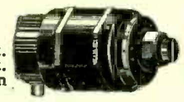

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General Electric-Type 5BA10AJ37: 27 volts, DC; .5 amps, 8 oz. inches torque; 250 RPM; shunt wound; 4 leads; reversible **$12.50 ea.**

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Output: 115 VAC; 400 cycle; 3-Phase; 115 VA; 75 PF. **Inpnt:** 28.5 VDC; 12 amp. ....**$80.00 ea.**

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AMMETER: DC; 2" 100-0-100, complete with external shunt.............**$5.95 ea.**

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1A3	1.10
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1B36	14.75
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1E7GT	.89
1F4	.59
1F5G	.69
1F6	.79
1G4GT	.79
1G5G	.79
1G6GT	.69
1H4G	.79
1H6G	.69
1J6G	.69
1J6GT	.69
1L4GT	.65
1LA4	.89
1P5GA	.69
1R4/1294	.89
1T4	.69
1T5GT	.89
2A4G	.89
2A6	.59
2A7	.59
2C21/1642	.65
2C22/7193	.30
2C26	.19
2C26A	.39
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2C40	5.95
2C44	1.00
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2E22	2.95
2E24	4.85
2E26	3.49
2J22	7.50
2J26	24.50
2J27	24.50
2J30	69.50
2J31	24.50
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2J36	89.50
2J40	37.50
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2V3G	.98
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805	3.75
807	1.60
808	2.95
809	2.39
810	12.75
811	3.25
812	3.25
813	8.50
814	3.75
815	2.89
828	11.95
829	10.95
829B	14.95
830B	3.25
832A	9.50
833A	48.75
836	4.75
837	2.49
838	3.95
843	.25
846	49.95
851	48.75
860	6.50
861	23.25
864	.75
865	1.25
866A	1.35
869B	39.50
872A	2.35
GE872A	3.95
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876	.59
879	1.43
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954	.35
955	.45
956	.69
957	.45
958A	.59
CK1005	.75
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1619	.45
1624	1.49
1625	.40
1626	.40
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1—**Friez Psychrometer,** (Humidity) Cat. # 573, complete with 110 volt 60 cycle motor and tables.
1—**Friez Thermograph,** —20 deg to plus 120 deg Fahrenheit, complete with set of gears for different chart speeds. Chart 4⅜ High.
1—**Taylor Anemometer,** Velocity in feet, 4" diameter, large sweep dial 0-100 feet, and a 3 dial register, 0-10 in hundreds, 0-10 in thousands, and 0-10 in ten thousands, with carrying case, and correction charts.
1—**Alnor velometer,** 0-300 and 0-3000 feet, also 0-2 inches of water. Type 3002 complete with 3 jets for above ranges in a carrying case.

These instruments have been used but are in good condition. Subject to your inspection and acceptance. All five instruments, as a lot only. List price over $1,400. Your net cost $400.00.

SPECIAL METERS

Decibel, —10 to 6, Weston 301-61 3½" rd..@ $11.50
Rect. Milliammeter, 1.1 MAAC Weston 545-81, sp scale ....@ $6.50
Micromhos meter, 1.4 MADC Simpson 3½" rd @ $6.50

TEST INSTRUMENTS

Simpson 260 Set Tester..........@ ** $38.95
Simpson 240 Hammeter..........@ ** 26.35
Simpson 230 V.O.M.A..........@ ** 24.95

RECORDING INSTRUMENTS

Send for complete details

A.C. Voltmeter, 220 volt, Westinghouse type U @ $65.00
A.C. Voltmeter, 220 & 440 volt, Westinghouse type U ....@ $75.00
A.C. Ammeter, 5 Amp, Westinghouse type U @ $65.00
A.C. Voltmeter, 500 volt, Westinghouse type GY-40 @ $125.00
Polyphase wattmeter, 230/460 volts, 5 amps, Westinghouse GY-40 ....@ $150.00

MISCELLANEOUS

Frequency meters, 58-62 cycles, 115 volt, switchboard type, Westinghouse HY.......... ..@ $50.00
Port. Tachometer, Jones Motorola, 3 ranges from 300 to 12,000 RPM..........@ $37.50
Gasoline Heater, GN-3-24..........@ $22.50
Radio Receiver BC-1161-A..........@ $34.50
Radio Transmitter BC-1160-A..........@ $29.50

A.C. VOLTMETERS

15 **Westinghouse** 3½" rd..........@ $5.50
15 **General Electric** 2½" rd. 800 cycles.....@ $3.95
40 **Westinghouse** 2½" rd metal, bl. scale, 60 cycles @ $4.50
40 **Westinghouse** 2½" rd metal, bl. scale, 400 cycles @ $3.50
40 **Weston** 2½" rd metal bl. scale, 400 cycles @ $4.50
75 **Weston** 2" rd metal non-flanged, ring mtd @ $6.00
150 **Simpson** 3½" rd..........@ ** $9.60
300 **Simpson** 3½" rd..........@ ** $9.60
300 **Triplett** 2½" rd metal..........@ $6.00

A.C. AMMETERS

100 **milliamp Weston** 3½" rd 400 cycles......@ $7.50
250 **milliamp General Electric** 2½" rd made for DACO @ $3.50
1 **Amp Simpson** 3½" rd..........@ ** $8.10
3 **Simpson** 3½" rd..........@ ** $8.10
5 **Simpson** 3½" rd..........@ ** $8.10
15 **Simpson** 3½" rd..........@ ** $8.10
25 **Simpson** 3½" rd..........@ ** $8.40
50 **Simpson** 3½" rd..........@ ** $9.30
200 **Simpson** 3½" rd. 5 Amp less transf...@ ** $8.10
Current Transformer Weston 200/5..........@ $7.50

D.C. MICROAMMETERS

50 **Simpson** 3½" rd. 2000 ohms..........@ ** $11.85
100 **Weston** 643 4½" rd. approx. 1500 ohms..@ $21.00
200 **Simpson** 3½" rd. 1000 Ohms..........@ ** $9.60

R. F. AMMETERS

1.5, **General Electric,** 2½" rd. metal case, bl. scale @ $3.50
1.5 **Weston,** 2½" rd. metal case, bl. sc......@ $4.50
2, **Weston,** 3½" rd..........@ $8.50
2.5, **Simpson,** 3½" rd..........@ $5.50
2.5, **Weston,** 3½" rd..........@ $8.50
2.5, **McClintock,** 3½" rd..........@ $5.50
2.5, **Westinghouse,** 3½" rd..........@ $6.00
3, **Westinghouse,** 3½" rd..........@ $6.50
3, **Weston,** 3½" rd. with ext. couple..........@ $9.50
5, **General Electric,** 3½" rd. with ext. couple @ $8.50
5, **General Electric,** 3½" rd..........@ $7.50
6, **General Electric,** 2½" rd. bl. sc..........@ $4.50
8, **General Electric,** 2½" rd..........@ $5.50
8, **Simpson,** 2½" rd..........@ $5.50
8, **Westinghouse,** 3½" rd..........@ $7.50
10, **Weston,** 3½" rd. JAN..........@ $9.50
10, **Weston,** 3" square..........@ $8.50

D. C. MILLIAMMETERS

1, **McClintock,** 3" square..........@ $6.00
1, **Simpson,** 3½" rd..........@ ** $8.70
2, **Westinghouse,** 3½" rd..........@ $5.50
3, **Gruen,** 2½" rd. spec. sc..........@ $3.50
5-0-5, **Western Electric,** 3½" rd. spec. sq., concentric mvt. ....@ $4.00
15, **General Electric,** 4" X 4½" case..........@ $4.95
15, **Simpson,** 3½" rd..........@ $6.00
25, **General Electric,** 3½" rd..........@ $5.50
100, **Simpson,** 3½" rd..........@ ** $8.70
150, **General Electric,** 3½" rd..........@ $5.50
150, **General Electric,** 3" square..........@ $5.50
150, **Gruen,** 2½" rd..........@ $3.95
150, **Triplett,** 2" square, bl. scale..........@ $3.95
150, **Electel,** 3½" rd..........@ $4.00
150, **Beede,** 3½" rd..........@ $4.00
200, **Simpson,** 3½" rd..........@ $5.95
200, **Marion,** 3½" rd..........@ $4.00
300, **Gruen,** 3½" rd..........@ $4.95
300, **Simpson,** 3½" rd..........@ ** $8.70
300, **Simpson,** 3" square..........@ ** $8.70
400, **Triplett,** 3½" rd. made for Garfield Med. App. Co...........@ $4.50
500, **Simpson,** 3½" rd..........@ ** $8.70
500, **Simpson,** 3" square..........@ ** $8.70
500, **General Electric,** 2½" rd. metal case....@ $3.95
500, **General Electric,** 2½" rd. bl. scale......@ $3.95
500, **Dejur,** 3" square..........@ $5.00
800, **General Electric,** 3½" rd..........@ $5.50
800, **Dejur,** 3½" rd..........@ $4.50
1000, **Western Electric,** 3½" rd. concentric Style @ $4.00
1000, **Electel,** 3½" rd. scale "100 X 10".....@ $3.50

D. C. AMMETERS

1, **General Electric,** 3½" rd..........@ $5.50
1, **Westinghouse,** 3½" rd..........@ $6.00
30-0-30, **Triplett,** 2½" rd. metal..........@ $3.00
30-0-30, **Beede,** 2½" rd. metal..........@ $3.00
30-0-30, **General Electric,** 2" rd. metal......@ $4.50
200, **Weston,** 2½" rd. with shunt..........@ $7.50
200-0-200, **Weston,** 2½" rd. with shunt......@ $7.50

D. C. VOLTMETERS

5/125, **DUAL RANGE,** Weston, 2" rd. metal, non-flanged case ....@ $4.00
15, **Simpson,** 3½" rd..........@ ** $8.85
30, **Gruen,** 2½" rd. metal case..........@ $3.50
150, **Hoyt,** 3½" rd. metal case..........@ $6.00
150, **General Electric,** 3½" rd. 1000r/v.....@ $7.50
300, **Simpson,** 3½" rd..........@ ** $8.85
300, **Sun,** 2½" rd 1000 r/v, JAN..........@ $7.00
500, **Weston,** 2½" rd. 1 MA, with resistor...@ $9.50
2 **KILOVOLTS,** General Electric, 3" square, 1 MA, with precision multiplier..........@ $10.95
4 **KILOVOLTS,** Dejur Amsco, 3½" rd. 1 MA, less multiplier ....@ $4.50

*** Indicates New Factory Guaranted Stock. All other items are Surplus New unless SPECIFICALLY indicated otherwise. All items are fully guaranteed.*

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6B8	.60	12F5GT	.48
6B8G	.55	12K8GT	.50
6J8G	.65	50	.65
6L7G	.65	70L7GT	.85
6S7G	.60	85	.57
6U7G	.50	807	1.40
12A6	.50	1619	.40

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PLATE TRANSFORMER

5000 volt AC, center tapped, 350 MA. Primary 115 volt, 60 cycle. Unmounted and not potted, overall dimension 6½ inches x 6 inches x 7 inches, weight 37 lbs.
New. $25.00

PULSE TRANSFORMER

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PLUGS

TELEPHONE PLUG, Equivalent to PL-55, with Screw Terminals Inserted. Samples furnished to quantity users....New. $.30

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Antenna Tuning Unit Condenser (C-302) for TN-17, 74-320 MC, in original package
$12.50

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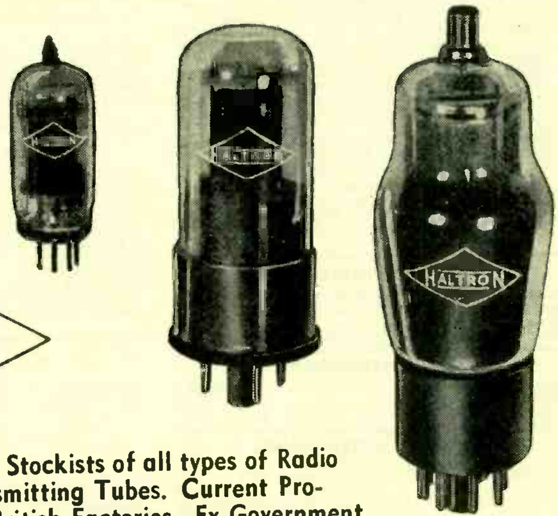

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Cables: HALLECTRIC. LONDON

GENERAL PURPOSE GERMANIUM CRYSTAL DIODES

Size ¾" x ¼"
Length of each Pigtail
2¾"

Price ea. 63¢

Type	TRANSFORMERS			Price Ea.
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Isolation........	Bell Housing Upright 2½"x2½"x3"	115 AC. 60 cycle	115 V, 35 Watts with 6.3 Tap	$1.95 each
Isolation........	Fully Enclosed Upright with Female Receptacle & Heavy Duty Line Cord 8" x 7" x 6¼"	115 AC. 60 cycle	115 V 1000 Watts	$19.95 each
Navy Modulation #CRV-301-849	Hermetically Sealed Case 3⅞H x 2½"D	Pri. Imp. 2800 ohms	Secondary Imp. 2400 ohms Tertiary Imp. 4.7 ohms	$2.95 each
	Turns Ratio Tertiary to Pri. 1 to 24.5 Tertiary to Sec. 1 to 30.0			

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Type	Characteristics	
1633	Replaces 6SN7 except has 25 Volt Fil. @ .150 Amp...	$1.30
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954		1.10
6BA6	Jan	1.00

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Type	Capacity	
Mica 402-C Western Electric	10,000 MMF	.50
Plug-In Electrolytic Octal-Base	40/40/80 @ 450 V	1.25

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MINIMUM ORDER $5.00 NET CASH FOB N. Y.

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New!! (Minimum Order $25.00) Guaranteed!!

1A5 gt	.65
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5Z3	.60
6AC7	.65
6AG7	1.55
6C5	.60
6C6	.39
6C8G	.59
6F6	.75
6H6	.59
6J5	.45
6K7	.70
6L6	1.60
6L6G	1.50
6L6GA	1.30
6L7	.95
6R7	.80
6SC7	.90
6SH7	.75
6SJ7	.65
6SL7 gt	.75
6SN7 gt	.70
6SQ7	.65
6SU7 gty	1.25
6V6	1.65
6V6 gt	.55
6Y6G	.65
700A	14.50
707B	11.00
714AY	4.50
720BY	45.00
721-A	2.25
723A/B	9.50
724B	2.00
725-A	6.50
726-A	4.50
801-A	.45
829-B	10.50
832-A	6.75
851-A	45.00
931-A	3.95
954	.19
955	.45
10Y	.35
19	.35
35/51	.35
39/44	.35
VT4C	.49
VT-52	.45
1616	.75
1619	.29
1642	.40
REL-21	2.00
9003	1.25
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AS97/ART—Ant. System. 54" tapered whip with matching section in shielded base. 52 Ohm. coax input ....New **$1.25** ea.

TUNING UNITS—For TCE-1 Transmitters. Contains Tank Condensers, Coils, Dials, etc. Ideal for V.F.O. or 100 watt xmtr. Freq. Range:
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(C) 6200-9050 Kc .... $5.75 ea.
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BC-610 EXCITER COIL SET. TU-47, 48, 50, 51. Please specify unit number desired. New **$18.50**

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EQUIPMENT: Consists of the following: I ANTENNA-DETECTOR (CMD-66AFH) has variable length antennas (2), diode detector, and silver plated tuning stub with calibrated scale: I AMPLIFIER (CMD-50ADC) has three stage pulse amplifier, a trigger circuit, a pulse rate counter circuit and audio amplifier, a visual signal indicator and a rectifier power supply which is operative on 115 Volts AC, single phase, at 60 to 2400 cycle current regulated; I TEST OSCILLATOR (CMD-60ABG) has cavity frequency of 400 cycles with selection of four pulse repetition rates. With the above are included all cables with fittings. accessories, and shock mounted rack, a steel chest with complete spare parts and 200% additional tubes and 2 technical manuals. Gross weight 113 pounds.

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Price, each......$225.00

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AVT/R/A OR 110/220 AC

Mfged by RCA, 6-10 Watts phone and CW 2300 to 6700 Kcs. Small compact for 6 & 12 V.D.C. NEW & COMPLETE with power supply, mike, key & antenna.

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TCS . . Collins 18 Q Transmitter and Receiver

Freq. 1.5 to 12.0 mcs with all cables, tele. key, microphone, antenna loading box, Remote control unit optional. Input 12v or 110/220v.a.c. models with appropriate power supply.

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5 WATT, Model JT-52

by Jefferson-Travis, 2 channel, crystal controlled recvr-transmitter, built-in speaker, hand microphone, 6 Volt DC power supply. Freq: 2000-3000 KCS, in compact steel cabinet, complete less xtals. New in original cartons. In dealer quantities.

BENDIX 70 WATT TRANSMITTER AND RECEIVER

for 24/28 Volt DC operation, complete and NEW with all accessories and spare parts.

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S/N Portable Radar

10 cm. Complete. Brand new. With steel spare parts chest. Input 110v. ac or dc. Mfg. by Gen. Elec. Range 5 to 25 miles.

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TRANSMITTER & RECEIVER & COMBINATIONS

TDE—US Navy, 300-18, 100 Kcs, 125 W on CW. 35 W phone NEW

BC-325—Phone/CW 400 Watts Medium Freq. NEW

BC-365—Radio Range 350 Watts, Low Freq. NEW

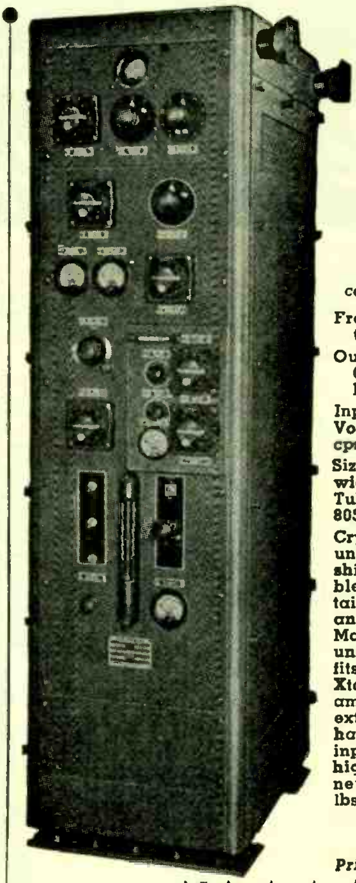
WE-34A—Carrier Shift CW 350 Watts. NEW

TWT PB-50A—Portable Broadcast Transmitter. NEW

RBZ—Portable Short Wave Receiver. NEW

SCR-508; **SCR-509**; SCR-510; SCR-511; SCR-528; SCR-608; SCR-609; SCR-610; SCR-628; WALKIE-TALKIES and HANDY TALKIES, Test Sets IE-36 and I-135.

Maintenance spare parts for most of the units on this page.



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R.C.A. Model MI-8167 TRANSMITTERS

Point-to-point communications

Freq. Range: 2000 to 20,000 Kcs.

Output: 350 Watts C.W. 250 Watts Radio telephone

Input: 190 to 250 Volts AC 50/60 cps.

Size: 60" high, 17" wide, 27" deep

Tubes: 807s, 813s, 805s, 866s

Crystal Oscillator unit built-in, fully shielded and stable. All self contained including antenna network. Master Oscillator unit (available) fits in place of Xtal unit. Speech amplifier is only external unit and has 110/220 v. AC input, four stages, high gain. Total net weight, 625 lbs.

Complete! New! Quantities! Prices on Request.

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Other Choice Selected Transmitters, Receivers and Combinations. Handy-Talkies, Walkie-Talkies, Portable Radars Also Available.

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RELAYS, 115v 60cy adjustable 10 sec. to 2 minutes Cramer TD2-120S. Also TD60S 10 to 60 sec..$12.95
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- **BLOWER MOTOR** 400-1800cy. 115v EAD J31C.$9.95
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- **CHOKE** 4H 70ma.70 ohms @ 69¢. 2H 70ma.100 ....$ .49
- **.1 MFD** 7500vdc Oil Cond. Type 7512 Hyvol.$3.55
- **SILVER BUTTON MICA**, .0024—5% M37 ...$ .99
- **J POT** 1 Meg log.taperw/switch, ¾" shaft...$1.95
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- **GRID WIRE, SHIELDED** 1 cond.GE,per1000ft.$22.50
- **SILVER MICAS**,mmf.5,33,100,150,500,.001etc.$.09
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- **BINDING POST**, Eby ½"diam.bake.⅜" stud.$ .08
- **BIRTCHER** 926A @ 15¢; Alden AC recept....$ .09
- **MINISHIELDS** 1⅜,#8660, 1¾,#8661.....$ .08
- **3AG FUSES** ¼,⅜,1,2,3,5,6, amp. 140 ma...$ .04
- **AN3106-10S-2S**,PL259A Jan,PL-68,JK33&34,83-1H
- **AN/TRC-1 SPARE PARTS**, Link 5FRX-W, MN5 spares etc.
- **SCR-522** term. boards, XXX fabricated phenolic, etc.
- **BC-1296A SPARE PARTS** (D-151828 unit for SCR296A)
- **AN/TPN-2 SPARE PARTS, MARK II** Radar spare parts.
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- **S8T** octal & other sockets, MICAS, BATHTUBS, OILS
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TEST EQUIPMENT

TS-3
TS-6
TS-10
TS-14
TS-15
TS-16
TS-19
TS-24
TS-26
TS-27
TS-33
TS-35
TS-36
TS-45
TS-47
TS-59

TS-61
TS-62
TS-74
TS-76
TS-91
TS-92
TS-98
TS-100
TS-102
TS-111
TS-118
TS-125
TS-126
TS-127
TS-131

TS-146
TS-153
TS-159
TS-203
TS-206
TS-218
TS-226
TS-268
APA-11
BC-221
BC-376
BC-638
BC-905
BC-906
BC-978
BC-1236

BC-1277
CLQ-60
D-150637
I-143
I-196
I-203A
I-208
I-212
I-223
LM-8
LM-15
LS-1
LW
OAP-1
OAV-1

W-1158

TRANS.
APQ-2
APT-1-2-5-5A
ARQ-8
ART-2-7
AXT-2
TPS-2

RECVRS:
APM-9
APR-5A
ARN-8
ARQ-8

RECEIVERS CPN-3 RA 10 DB TPS-2 RT-48ATPX-1
COMMUNICATIONS, BEACON, LORAN, IFF AND RADAR
SCR-717B; APS-(2)(3)(4)(15); APQ-13

MAGNETRONS POWER UNITS ANTENNAE INDICATORS
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Specialists in Test Equipment

This month we feature the 3CM favorites, TS-12 and 13. The TS-12 being a complete SWVR set in two parts including a slotted line detector and amplifier, while the TS-13 as its companion signal generator provides both a wave meter and power monitor. This device generates either pulsed or CW power over the range of 9305-9445MC/sec. Built in pulsing circuits permit triggered or self synchronous operation while direct reading of power may be had from a temperature compensated thermister bridge. A calibrated attenuator and voltage regulated power source make this an outstanding piece of laboratory equipment.

Other pieces available include:

TS-1ARR
TS-3A/AP
TS-8A/U
TS-10A/APN-1
TS-11/AP
TS-12
TS-13
TS-14
TS-15B/AP
TS-16/APN
TS-19
TS-23/AP
TS-27/TS
TS-32A/TRC-1
TS-33/AP
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TS-36/AP
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TS-56/AP
TS-61/AP
TS-62/AP
TS-69/AP
TS-76/APM-3
TS-87/AP
TS-89/AP
TS-96/TPS-1
TS-98/AP
TS-100/AP
TS-101/AP
TS-102/AP
TS-108/AP
TS-110/AP
TS-111/CP
TS-117/GP
TS-118/AP
TS-125/AP

TS-127/U
TS-131/AP
TS-144TRC-6
TS-153
TS-155A/AP
TS-170/ARN-5
TS-173/UR
TS-174/U
TS-175/U
TS-184/AP
TS-197/CPM-4
TS-203/AP
TS-204/AP
TS-220/TSM
TS-226A
TS-233/TPN-2
TS-251
TS-263
TS-268
TS-270A/UP
TS-281/TRC-7
I-95/A
I-106/A
TS-487/U
TS-421/U
TS-314/FSM-1
I-56
TS-389/U
TS-301/U
I-122
TS-323
I-130A
I-145
I-177
I-178
I-208/A
I-212
I-222/A
I-225
I-233
TS-324/U

IE-21/A
IE-36
IF-12/C
IS-185
AN-PNS-1
BC-221(*)
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BC-638
BC-906/D
BC-949/A
BC-1060/A
BC-1066/A
BC-1201/A
BC-1203
BC-1236/A
BC-1255/A
BC-1287/A

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LAD
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CK1007	1.20	6BQ6	1.29	12SQ7	.85
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1629	.35	6C6	.75	33	.90
2051	1.15	6F6	1.00	35W4	.59
7193	.50	6H6	.85	50B5	.96
8011	1.70	6J5GT	.63	50C5	.89
9006	.30	6J6	1.29	50L6GT	.69
C5B	9.75	6J7	1.05	75	1.15
CEQ72	1.30	6K7	.85	77	.75
CK70	4.25	6L7	1.15	78	.90
CRP-72	1.30	6SC7	1.35	79	.90
E-1148	.35	6SD7GT	.90	80	.68
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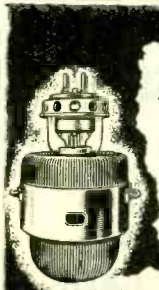

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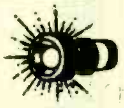

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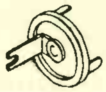
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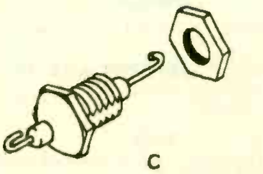
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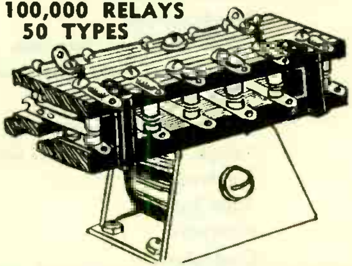

Six-Pole Double Throw Allied # BN-18D-39 has 10 AMPERE CONTACTS 2800 ohm coil operates on 30 mills DC.............................. $6.95

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TS251
TA-2J24
R132/TPS10
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RC213
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2 Amps.	$2.40	3.75	$6.95	$10.50
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				(2½ A.)
6 Amps.	5.65	9.00	.....	19.00
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12 Amps.	8.50	14.00	.....	58.00
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Designed for bridge or center-tap use. These transformers are not surplus, but are made to our specs by a leading m'fr.

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OZ4-A	.65	35-TG	3.00	829-B	13.50
1B22	2.25	35-T, ION	4.00	832-A	9.75
1B23	8.00	101-D(WE)	1.25	837	1.50
1B26	2.50	101-F(WE)	1.25	866-A	1.55
1B27	15.00	101-L(WE)	1.25	872-A	2.25
1L21 (G.E.)	4.00	102-D(WE)	1.25	892-R	199.50
1N21	.85	102-F(WE)	1.25	954	.27
1N21B	3.50	102-L(WE)	1.25	955	.40
1N23	1.45	104-D(WE)	1.25	956	.37
1N23A	2.50	211	.65	958-A	.65
1N23B	4.00	242-C	4.00	1613	.90
1N34	.65	274-B(WE)	3.50	1616	.75
1P24	1.60	275-A(WE)	4.50	1625	.40
2C40	5.75	310-A(WE)	6.50	1626	.40
2E24	4.75	311-A(WE)	7.50	1629	.30
2E26	3.75	313-C(WE)	1.25	1631	.75
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2K45	"WRITE"	400-A(WE)	2.50	5686	3.95
3AP1	10.75	403-A(WE)	1.90	5910	.75
3B24 (WE)	3.75	403-B/5591	3.25	9004	.44
3BP1	7.25	408-A(WE)	3.25	9005	1.50
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3C23	9.75	700-A, B, C,		100-TH	8.50
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5V4-G	1.10	715-B	9.00	RK-34	.27
6AJ5	1.50	715-C	22.95	RK-47	5.00
6AK5	1.25	723A/B	14.00	RK-59	.75
6B4-G	1.25	725-A	6.95	RKR-72	1.25
6C4	.65	807 or 807-A	1.65		
6J6	.95	812	2.75	T-40	3.00
10-Y	.45	813	7.85	VR-105	1.25
15-E	1.45	814 (G.E.)	3.50	KU-676	25.00

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6AC7
6AG5
6AG7

6AK5
6AQ5
6C5
6F6
6H6
6J5
6J6
6K7
6L6
6L6GA
6L7
6Q7
6SC7
6SF5

6SH7
6SJ7
6SK7
6SL7GT
6SN7GT
6V6GT
6X5GT
6Y6G
12AX7
12SG7
41
42
78
80

2C40
2E22
3A4
3BP1
3C24
4C35
5D21
6J4
100TH
250TH
304TL
394A
450TH
723A/B

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807
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2A3	1.45	6BA6	.79	12A6	.70
5U4	.79	6BG6E	1.89	12AT7	1.19
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5Z4	1.20	6C4	.85	12AX7	.95
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		6J7GT	.80	12BE6	.69
6AC7	1.29	6K6	.75	12H6	.59
6AG5	.90	6N7M	1.20	12JGT	.65
6AG7	1.65	6R6	1.50	12SK7GT	.79
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All tubes are standard brands and fully guaranteed!

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OB2	2.55	1630	.75	274B	2.49	2J32	27.95	446A	4.79	722A	2.49	841	.44	959	1.21	8012	2.45
15E	1.09	1639	1.49	253A	9.95	2J34	34.95	53A	4.95	723AB	17.95	843	.42	9-3	.19	8020	1.79
15R	.79	1642	.89	264C	.39	2K25/723AB	27.45	517C	14.95	725A	11.95	837	1.79	AB150	2.75	8025	4.99
18C	.39	2X2	.74	269A	9.95	2V3G	1.86	703A	5.95	807	1.69	864	.36	CE-1	.79	9004	.59
120A	.69	24R	4.95	2B22	3.19	371B	.89	704A	.99	811	2.89	865	1.15	CEP-120	1.09	9006	.39
1B29	2.75	231D	1.69	2C26	.39	3B27	3.49	705A	1.49	813	8.25	866A	1.39	CEP-220	1.29	9002	1.39
1B32	4.39	2051	1.22	2C22/7193	.39	3C24	1.69	713A	.95	803	3.59	872A	2.79	CJ6	5.85	304TH	12.95
1851	1.69	801A	.59	2C40	4.85	3C28	4.69	714AY	4.99	805	3.49	876	.27	CK1005	.59	304TL	12.95
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1616	.95	5814	3.35	2J61	42.25	3D23	4.69	715B	9.95	814	3.59	924	1.39	F-123A	7.62	394A	5.50
1619	.32	205B	3.69	2J62	42.25	3EP1	5.19	715C	19.95	815	3.25	954	.35	HF 100	6.99	3A5	1.69
1624	1.69	211	.66	2J22	7.90	4D23	7.95	718AY	39.95	830B	3.69	955	.42	RK 34	.59	VR-105	1.79
1625	.38	217A	7.95	2J21	9.49	4A11	.19	718CY	39.95	832	5.95	956	.42	RKR72	1.04	VR-150	1.69
1626	.38	276A	9.55	2J26	17.95	471A	2.69	718DY	39.95	832A	11.95	957	.42	VR124	.69		
		227	3.95														

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HIGH FREQUENCY EQUIPMENT

Holtzer-Cabot MG set, 800VA, 3 phase, 400 cycles. 115V. Self-excited. Belt-driven by 2 HP motor, 220V, 3 ph., 60 cy. with voltage regulator & variable speed sheave. Output: 120/208V. $395.00

Ballantine MG set. NEW 1KVA single-phase, 400 cycle alternator. 115V. Separately excited. Belt-driven by 2 HP motor, 220V, 3 ph., 60 cy. With voltage regulator & variable speed sheave. .$250.00

Newton MG set. 3½KVA, single-phase, 400 cycle. Belt-driven by 7½ HP motor, 220V, 3 ph., 60 cy. With voltage regulator & variable speed sheave. $795.00

Pioneer-Gen-E self-excited alternator, 115V, single-phase, 400 cycle, 1.25 amps. Belt-driven by 220V single-ph., 60 cy. synch. motor. With voltage regulator & variable speed sheave. Frequency variation less than 2%..................$145.00

Continental DC to AC 800 cycle MG set. Motor: 230V DC. Generator: 120V AC. .6KW single-phase and 14V DC......................$95.00

Raytheon Voltage Stabilizer, Spec. #W-5799. Input: 225V±10%. 8.7 amps. 60 cy. single ph. Output: 11.0/11.0/220V. 1620 watts. PF: 100 $150.00

American Plate Transformer. Type OISC. 10.4 KVA cont. 60 cy., single ph. Add. polarity. %IZ-75°C-4.0. Indoor service. Primary volts 115. Secondary volts 17,600. With retard coil....$150.00

10 ASSORTED CIRCUIT BREAKERS—G.E., I.T.E., and De-Ion.

1 unit —15 amp.	1 unit — 50 amp.
2 units—25 amp.	3 units—100 amp.
2 units—35 amp.	1 unit —200 amp.

Price for lot $100.00

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GEneva 6-6278

FOR SALE

1 REL Model 600 FM Broadcast Modulation and Fraquency Monitor

Like new. Frequency of monitor, 100.3 mc. Cost $750. Will sacrifice for $350. Contact: L. C. Sigmon.

KMPC
Los Angeles 28 California

DYNAMOTORS OFFERED

D401
DA1A
Dm21
Dm 28
DM 32
Dm 33
Dm34
DM36
Dm37
Dm53
BD77
BD69
BDAR93
PE73
PE86
PE101
Pe94
DM19
PE55
ML 3420
Dy22
DA1F
SP175
ML4520
DA7A
651
D101
Dy82
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And other numbers. (Send us the numbers you need. All types of DC motors, Generators.

Wanted DM32-35-36-40-41-42-43-53 Dynamotors. State quantity, condition & price. Need BC620-788 SCR 522. Units and component Parts also ART-13 equipment.

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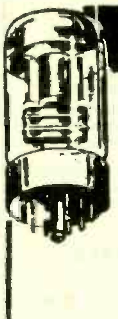
Cy. 8904



WE HAVE LARGE QUANTITIES OF RADIO TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OZ4A	$0.70	6B8G	$0.93	6SK7GT	$0.96
1G6GT	0.72	6BE6	1.20	6SN7GT	1.20
1LN5	0.80	6C4	0.86	6SS7	0.95
1R5	0.90	6C5GT	0.51	12A6	0.48
1S4	0.86	6C6	0.75	12SH7	0.96
1T4	0.86	6H6	0.94	12SK7	0.98
5U4G	0.80	6J5	0.60	12SQ7GT	0.90
6AB7	0.90	6J5GT	0.51	12SR7	0.90
6AC7	1.20	6K6GT	0 91	35Z4GT	0.85
6AL5	1.00	6K7GT	0.70	35Z5GT	0.75
6AQ5	1.40	6SG7	0.90	50L6GT	0.90
6B8	0.93	6SK7	0 96	42	0 76

TYPE	PRICE
2E22	$2.50
6C21	30.00
307A	3.75
357A	22.50
805	2.90
808	1.70
830B	3.00
9005	1.30

This offer subject to change and prior sale.

SPECIAL SALE TYPE 805 OUR PRICE: **$2.90**
List Price: $13.50

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Quantity	Gauge	Strip Width	Build Up	Window Width	Window Height
11,365	.003	1⅛	½	7/16	3
3,741	.003	⅞	⅜	7/16	3

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Molded Bakelite case 7" x 4½" x 3"

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Available in multiple range combinations

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We'll go the limit to buy your parts or equipment. Send us a description of the type and condition of equipment you have—tell us your top dollar asking price—and be pleasantly surprised at the fast action you'll get!

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Approx. 9 cu. ft. plus or minus. Cold and Hot minus 65° F. to plus 125° F. with controls Indicators preferred.

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WE NEED YOUR SURPLUS ELECTRONIC COMPONENTS OR EQUIPMENT

WE PAY TOP $$$$$$ FOR:

Radio Components
Instruments
Relays
Tubes
Signal Corps Equipment
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Transmitters
Television Components
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Selsyns or Synchros
Autosyns
Motors or Generators
Transformers, Air Cooled
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Kindly send us your listing of materials available or place our name on your mailing list to receive any listings you may issue.

TECHNICAL MATERIALS COMPANY
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HEADSET
BANDS
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We BUY and SELL all types
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YOUR SPARE SURPLUS EQUIPMENT
DYNAMOTORS • SELSYNS • AUTOSYNS • INVERTERS • TRANSMITTERS
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Please send list stating condition and lowest price.
No Quantity Too Small or Too Large!

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QUARTZ CRYSTAL UNITS

in holders, FT-171; FT-241; FT-243; FT-500. Any quantity. Advise condition.

W-2317, Electronics
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EQUIPMENT WANTED!

We want to buy all types of surplus electronic equipment. We are one of the largest buyers in U. S. We buy more because we give every seller top prices and a fair deal. TELL US WHAT YOU HAVE. USE COUPON BELOW—*AND MAIL TODAY!*

Use following numbers to indicate conditions: N-1, brand new; N-2, used, like new; N-3, used.

ITEM	CONDITION	PRICE WANTED

To: COLUMBIA ELECTRONICS LTD., 524 S. San Pedro St., Los Angeles 13, Calif.

Name..

Address..

SEE COLUMBIA ELECTRONICS AD ON PAGE 349

WANTED

Absolute top cash prices paid for new or surplus special purpose tubes and X'tal diodes. The following are urgently needed *immediately!* Any quantity, 1 to 3000.

2K25/723A/B: 393A: 1Q26: 1S21: 2K39: 3C22:
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If you have any merchandise that you think we would be interested in; write AT ONCE, enclosing FULL DETAILS, TO:

MICROWAVE
ATTN: JOS. ANZINO
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WANTED

Sweep Radar Assembly Heavy type English design type 3107

Sweep Radar Beacon (English design) type Eureka II

Same as above (American type) AN:PPN2 Eureka II

HUBERT J. BURKE
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Additional Wanted Advertising on the opposite page

G.E. HEAT UNIT
Cap. 20 K.W.

Hi-Frequency Induction Model 4F20 for 3/60/220 Like New (1948) with work Table 2 positions.

Price . . . . $7,500—F.O.B. Bklyn.

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ELECTRICAL STEEL

We can offer about 26,000# of Hi-Grade Strip—.005 x 12⅜" "Hipersil" 3¼% Transformer grade — In Coils weighing about 900# each—Material new and prime but outside wrap weather discolored.

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Wholesale Dealers
IN GOVERNMENT SURPLUS

- electronic components,
- units, wire, etc.

LAPIROW BROS.
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Kirby 1285

WANTED

Any quantity of C6J or C16J Electronic Tubes as manufactured by Electronics, Inc., also Jones plugs Cat. Nos. P-506-SB, S-506-SB, P 2402-SB, S 2402-SB.

State quantities available and best price for each size. Reply to Box Number

W-2731, Electronics
330 W. 42 St., New York 18, N. Y.

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RBF-3
U.H.F. RECEIVER

Physics Department
STATE UNIVERSITY OF IOWA
Iowa City, Iowa

LAST CALL! *Surplus New*
DIVERSITY
Receiving Equipment
ALSO BC 223AX TRANSMITTERS

FS-2693, Electronics
330 W. 42 St., New York 18, N. Y.

Sell Your Surplus to Gould Green

We buy and sell every type of electronic materiel, including war surplus. Let us submit our bids for your surplus inventory; large or small quantities. When you buy from us you save plenty — here are a few of our bargains:—

SOLDER 40/60, solid .030" dia., Yellow Kester Label; 5 lb. spools @ ....**$1.00 lb.**

SOLDER 40/60, rosin core, Red Kester Label, .030" dia. 5 lb. spools @ ....**$1.25 lb.**

RESISTORS; precsion wire-wound. Standard Brand (surplus) accuracy within 1%; small, compact (size of one and two watt carbon types), 2" pigtails, bakelite enclosed; excellent as standards; combined in series or parallel you get any ohmage wanted; 100 diff. sizes; 100 ohms to 10 megs; wonderful value at $10.00 per kit of 100 resistors (all diff. sizes — think of it).

RESISTANCE WIRE; 2500 ohms per inch (30,000 ohms per ft.) Mfr. W. E., a fine enamelled wire (#50 approx.) spirally wound on a flexible insulated core. Sold as they come in fractional lb. spools. Write for sample. Price.....**$10 per lb.**

RESISTORS; (Standard Brands) type AB 40 ohm-10 watt; type DJ 24 ohm-20 watt; price 15.00 per C; also, flat sand type 3500 ohm-10 watt; price, 12.00 per C. 500 ohm-20 watt. Flex. leads; price $5.00 per C.

CARBON (COMPOSITION) RESISTORS; we have surplus sizes & tolerances; new, standard brands; we may have the sizes & wattages you need; price, ½w. @ $24.75 per M for 10%. ONE watt, price, $35.50 per M for 10% tolerance. 5% is approx. $10.00 additional.

TUBULAR CONDENSORS STANDARD BRANDS; .01, 400 V., 100 for $3.85. .03 @ 400 V., $3.85 per C; .05 @ 200 V. $3.65 per C. Many other sizes—write for prices.

CONTROLS; quantities always available; inquiries solicited.

SPAGHETTI; many sizes & some colors in stock; we'll match your samples; price, $10 per M.

DRIVE SHAFTS for table radios; price, $21.50 per M; write for free sample.

TUBULAR COND. STANDARD BRAND; .0005 @ 600 V. pigtail; price, $22.50 per M. Also, type TTR, .005 @ 100 V. @ $5.25 per M.

SOCKETS; sub-miniature type (hearing aid), 5-prong, moulded (free sample); price $40.00 per M. Miniature 7-prong sockets, $38.00 per M. 9-prong @ $38.75 per M.

SWITCH; a wafer type mounted on "edge" with lever (rubber handle) reversing control; DPDT X three; price, $8.50 per C. Sample free.

BLINKER LIGHT; army surplus; a neon light operated by two 67½ V. portable-type batteries; blinking as a warning signal intermittently. A resistance-condenser circuit (RC) controls the rate of blink. These lights, with fresh batteries, have been known to operate continuously (24 hrs. daily) for two years. Size, 5" x 5" x 4½" with 3" carrying handle; made of wood, army-green finish; Price, less batts., 4 for $1.00

STORAGE BATTERY; Willard, 4 volt—40 amp.; transparent plastic case, 6" x 6" x 4½" high; comes ready-charged, dry—you add the water; built-in hydrometers; two cells. Ideal for burglar-fire alarms; automatic switching relays; intercom or private telephone and telegraph systems, etc. Wt. 8½ lbs.; packed 4 to carton. Price, 4 for $9.80.

CATHODE-RAY TUBES; 9LP7; 5CP1; 4AP10; 5BP4; limited qty; price, $3.00 ea.

TOGGLE Sw.; C*H, aircraft type; #B-5A; 5 amp @ 125 V.AC—35 amp @ 24 V. $19.00 per C.

SCREWS, EYELETS, RIVETS, WASHERS, SHAKEPROOF WASHERS & TERMINALS are available in surplus lots; also, special screws and terminals. Inquiries solicited.

DYNAMOTOR; Elcor, large, wt. abt. 50 lbs. Brand new. Most D.C. input voltages available from 24 v. to 95 v.; output 6.6 v. at 15 amp.; 300 v. at 350 mils. Packed in wood cases (new), orig. cost $140.00; Special price **$25.50**

Klixon circuit breakers; 10 amp 2; #C-6363; other sizes also; ea. ....**$19.00 per C**

DYNAMOTOR; Input 14 v. at 3 amp.; output 220 v. at .08 amp. ea. **$3.75**

JAN TUBES; bulk packed; war surplus;

12SN7, Sylvania	70¢	7N7 Sylvania	78¢
6SN7 KenRad	74¢	7C5 Sylvania	65¢
6SL7 Sylvania	58¢	954 Tungstol	20¢
12A6 RCA boxed	41¢	221-A amperex	45¢
6J5 RCA metal	54¢	371-B Nat. U.	41¢
6SG7 RCA metal	77¢	371-A amperex	45¢
6AC7 RCA	$1.00	800 RCA boxed	72¢
6AC7 KenRad	95¢	1630 RCA boxed	38¢
7Y4 Sylvania	65¢	559 RCA boxed	69¢

RADIO AND TV TUBES; bulk and orig. boxes (see our terms:)

6BG6 Syl. bulk	$1.60
35Z5 Nat. Un. blk.	52¢
6W4 Syl. & Tung.	61¢
6AT6 Syl. Blk.	72¢
50L6 Syl. Blk.	73¢

Sylvania, Tungsol Boxed tubes, current dating at 50% off. Expired dating 50 and 5 off.

TUBE CARTONS; white, folding with flap.

Small or large peanut @	$1.00 per C.
GT @	1.10 per C.
Small G @	1.45
Large G @	1.60 per C.
Extra large (6½") @	2.85 per C.

Bathtub Cond.; .35 x .35 MFD. @ 400 VDC. Standard makes @ 18¢ ea. Free sample.

Bulbs (Jap 4 v.) 100 to the box. Very cheap at $8.25 per M. Free Sample.

LAMP; 15 candle pr.; 6-8 V.; single contact; Mazda GE #1617; 1" dia., 2" long; free sample; cartons of 400; price 400 for $5.00

BULB; screw base (pilot); 6 V.; round bulb ⅝" dia., 1" long Jap; price $20.00 per M.

Terms:—Net cash, o/a to est. firms; MINIMUM ORDER $25.00; FOB/NYC. If you would like to see the mdse. before paying for it, specify "Privilege of Inspection" (Express only).

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OIL FILLED & TRANSMITTING MICA TYPES
All Values and Voltage Ratings
We Invite Your Inquiries

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Any Kind of Electronic Equipment
Bought or Sold

We BUY FROM YOU FOR YOU
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NOW IN STOCK

WESTON SENSITROL RELAYS Model 705, KS-7996. Calibrated 13-19 V....................$12.50

RUNNING TIME METERS Sangamo Model 17, in hours and 1/10th hours to 9999.9, 440 V AC 60 Cycles $4.95

Variable **RESET TIMERS** Sangamo Model 21, open circuit from 0 to 3 minutes, calibrated in 5 second intervals. Will handle 10 amps or more 110/230 V AC 60 cycles..........................$4.95

CALCULOGRAPHS. These units compute elapsed time to 30 minutes in minutes and seconds, and print this elapsed time as well as time of day on a card (For example a card may show "start 9:55 AM" "Elapsed time 18 minutes, 51 seconds"). Any number of jobs may be run at the same time. Originally used to log long distance telephone calls. Dial type printing. Reconditioned. With 8 day "windup" movement $85.00
With 20V AC 60 cycle Movement........$70.00

PIONEER TORQUE UNITS 12604-3-A......$70.00
PIONEER AUTOSYNS AY-30-D...........$35.00
BENDIX AMPLIFIER 12077-1-A..........$29.50
SELSYNS, IF, 1CT, 1SF, 5F, 5G, 5SF, 5SG. Write for prices.

BEACHMASTER 250 Watt Audio Amplifier with bank of 9 35 watt speakers, cables, mike, tubes. Operates on 110 V AC 60 cycles. Like new $395.0

BEACHMASTER AMPLIFIERS are available as originally delivered to the Navy, with 1500 Watt gas engine driven generator & complete spares, all packed in 6 waterproof cases, all new ....$695.

SUPERSONIC MODULATOR Mfgd by Doolittle for Navy Air Drawing # 68326-1, contains 11 tubes, 10 relays etc. for operation on 12 V Cases dirty, very clean inside............................$14.95

SUPERSONIC SELECTOR Mfgd by Doolittle for Navy air. Drawing # 69245-1 Contains 11 tubes, 10 relays etc. for operation on 12 V Cases dirty, dirty, very clean inside......................$14.95

Laboratory **PRECISION REGULATED RECTIFIER** Type CZC-20AAQ. Input 110 V AC 60 cycle, output adjustable from 250 to 500 VDC at 250 Mills. Contains 2-5U4G, 2-6SQ7 1-VR150-30, 1-VR-105-30, 4-6L6G. A steal at $98.50

DYNAMOTORS

Type	Input Volts	Output Volts	Mils	Price
DM-34........	12	220	80	$9.95
DM-35........	12	625	225	
DM-36........	28	220	80	5.95
DM-37........	28	625	225	11.50
DM-64........	12	275	150	11.50
DM-65........	12	400	440	22.50
BD-77........	12	1000	350	25.00
TCS-Rcvr......	12	225	100	11.50
TCS-Xmtr......	12	440	200	22.50
TCS-Complete power supply, 110 VDC input				68.50

ET-8012-D-230/MG24

BEARING DEVIATION INDICATOR Type CBM-55105. Mfgd by Sub Signal....................$60.00

QBG-1 DRIVER RECEIVER type CFF 43058. $125.00

BC-348, RECEIVERS, Reconditioned......$150.00

RBL RECEIVERS Operate on 110v AC 60 Cycles Frequency range 15 Kc to 600 Kc. Reconditioned. $90.00

RMCA AR-8600X AUTO ALARM RECEIVER Complete, like new..........................$295.00

SN PORTABLE RADAR with all tubes, antenna rotor cases, less antenna screen & tripod...$300.00

SF-1 RADAR Brand new with complete spares, waveguide, fittings, etc. 19 boxes.........$3000.00

SO-1 or SO-8 RADAR, Fully reconditioned, overseas packed $2750.00

ANTENNA SLEWING MOTORS For SO-8 radar 24 VDC $15.00—32 VDC $15.00—110 VDC $42.50—110 VDC for SO-1........$19.95

ALLEN-BRADLEY Type B-200 starting relay DPST 440V AC 60 cycle. Excellent condition $3.00

TRANSFORMER 230-460 V 60 Cy in, 7.5 V 27A out, weight 7 lbs. $3.00 ea. Special 100 for $125.00

SOUND POWERED CHEST & HEADSETS, used operating RCA & Automatic Electric (large Headset) per pair...............................$12.50

SOUND POWERED HANDSETS. New per pair $19.95

CD-149 High voltage cable for BC-191 **10 for $27.50**

CD-152 ....**10 for $17.50**

TDE PRIMARY SHIP TRANSMITTERS. If band 300-1500 Kcs. H.F. band 1500-18100 Kcs, CW MCW & Phone. With Internal M.G. for 115 VDC or 230 VDC. Fully reconditioned. $600.00

MARINE TRANSMITTERS

Mackay 108-C 5.5 to 17 Mcs
Mackay 128-A 5.5 to 17 Mcs
Mackay 147-M 375 to 500 Kcs
RMCA-8010 325 to 500 Kcs
RMCA-8019 with 110 VAC power supply
TCP, TCS, TAY, and many others
Write for quotations on your requirements

TCP-2 Line Filter unit, CRM 53086 for use on 115 VDC, New..............................$15.00

All prices FOB Oakland, Calif., subject to change without notice. Terms 20% cash with order, balance COD.

EMMONS RADIO SUPPLY CO.
405 10th St. Oakland, Calif.
Phone TWinoaks 3-9103

ELECTRO—THE BEST FOR ELECTRONIC SURPLUS

Amertran "TRANSTATS"

Voltage Regulator

11.5 KVA 50/60 cy. Commutator range 0-115 V. Max. Amps. 100. Reconnection diagram available for 230 V. 50 A operation $225.00

SUPERIOR POWERSTATS

Type 1156, Output 0-135V, 60 cy, 45A, 6.1 KVA $100.00

Type 1256, Output 0-270V, 60 cy, 28A, 7.5 KVA $100.00

Type 1256-2P, Output 0-270V, 60 cy, 56A, 15.1 KVA $225.00

Type 1126-3Y, Output 0-270V, 15A, 60 cy, 7.0 KVA $100.00

Type A2-LF Voltstats, Output 0-230V, 60 cy, 25A (LN) $75.00

Transtat .25 KVA. Fixed winding 115/1/60. Commutator range 103-126 V. Max AMPS. 2.17.......$9.45

.5 KVA Fixed Winding 115/1/400 Commutator range 92-115 V Max Amps. 5.5..........$4.50

MOTORS AND GENERATORS

Elec Spec Type 1A1, Spec 32159D, 24VDC, 15A, ¼ HP, 3800RPM $22.50

Pump Eng Type 1454ME, 24VDC 95A, 4000RPM, 2.25HP $37.50

Holtzer Cabot Type RBD220, 24VDC, 8A, 1/5HP, 6000RPM $14.95

G. E. Mod #5BC21MJ6A, 24VDC, 60A, 3800RPM, 1¼HP $32.50

Oster Type D-4-2, 24VDC, 116HP, 1800RPM....$9.95

Eicor ML2310-52, 24VDC, 0.32A, 1800RPM....$4.95

Oster Type ES-2-1, motor for 7G selysen........$7.95

Universal Model 523, 115VDC, 1-2A, 5000RPM.$5.95

Westinghouse Style 171391, 27VDC, ⅛HP, 6.5A, 5800RPM $14.95

Holtzer Cabot Type 2505, 115VAC, 60 cy, 3ph 9W, 1725RPM (LN) $9.95

Oster Motor, 6VDC, 1.8A, 5000RPM..........$8.95

W.E. #KS5603L01, 24-28VDC, 0.6A. 5000RPM, 1/100HP $4.50

Alliance Type 2207, 27.5VDC, 7500RPM, 1/100HP $8.95

Oster Type C-2BP-1A, 27.5VDC, 7000RPM, 1/100HP $8.95

Lear Type C004, 24VDC, 1.5A, 8W, 7500RPM..$6.95

EAD Type J31, 115VAC, 400Cy, 1/50HP.......$9.95

Lear Type 133A, 24VDC, 5.5A, 72W, 9000RPM $15.75

Barber Coleman #BYLC2190, 24VDC, 1A, Torque 100 in/lbs. 60 strokes, 6-7 sec..........$14.95

W.E. Mod 28944, S type SD, 45/52V, 3.5A, 1765 RPM $15.25

W.E. Mod 24517, 230/200V 60cy or 45/52VDC 1/16 HP, 1725RPM $17.50

G.E. Mod 5BA10AJ22, 24VDC, 100 oz/in torque, 140RPM $14.95

G.E. Mod 5BA10AJ40, 24VDC, 10 oz/in torque, 140RPM $15.95

Emerson Style 161-0212, 24VDC, 160 oz/ft torque, 100RPM $17.50

Westinghouse Type GN-WL33 Alternator, 12VDC @ 0.6A and 1.5VAC 0.1A 375-870 cycles..........$14.95

G.E. Generators Type BY, Model 5BY9E8, 140VDC, 0.025A 1800RPM, Perm Mag Wound..........$8.95

G.E. #2J1F1 Selysen Generator..........$12.95

G.E. #2J1G1 Control Trans..........$9.95

G.E. #2J1H1 Selysen Generator..........$12.95

G.E. #2J1D1 Selysen Generator..........$12.95

G.E. #2J1F3 Selysen Generator..........$12.95

Bendix Mkl Mod. 3 Step by Step Motor........$14.95

Pioneer Magnesyn PR-51505-1-2320-1A.........$9.95

Pioneer Autosyn AY-20 ....$14.95

Pioneer Autosyn AY-14G $14.95

Pioneer Motor, 10047-2AG..........$14.95

Holtzer Cabot PM Mtr #B3-RBD0808, 24VDC.$14.95

Pioneer Autosyn AY-27DW..........$14.95

Pioneer Autosyn AY-59D1 ....$12.95

Bendix Synchro Generator 1G..........$49.95

G. E. Selysen 2JD55JB1, 60 cy..........$19.95

Diehl Control Mtr, FPE-49-6..........$52.50

Diehl Control Mtr. FPE-25-11..........$39.50

Diehl Resolver, FPE-43-1 (used)..........$24.50

Modulator MD-7/ARC5 w/tubes & dyna......$12.50

Rogers Switching Motor, Type 25, Ref #110FB/81, 24VDC $8.95

American Blower w/G.E. mtr, 230VAC 50/60cy 1/3HP $49.50

EAD Blower & Mtr, 115VAC 400cy 110CFM..$14.95

Redmond Blower & Mtr, 115VAC, 60cy 85CFM.$14.95

Redmond Blower & Mtr, 24VDC. 1.35A 4750RPM, Dual Output 100CFM (LN)..........$12.50

Dynamic Axial Flow Fan & Mtr, Mod 586-SCB4. 24-28VDC, ½ HP, 8000RPM, 225CFM @ 5"H20 (LN) $24.95

Westinghouse Blower & Mtr, Type FL, 115VAC 400cy, 6700RPM, 50CFM $8.95

F. A. Smith Model 69C Blower & Mtr. 115VAC, 60cy 50CFM $9.95

Oster Blower & Mtr, Type C-2P-1L, 28VDC, 1/100HP 0.8A $12.50

Delco Motor, A-7155, 27VDC @2.4A 1/30HP, 3600RPM $12.95

Elec Ind Mtr, Type 203, 115VAC, 60cy 1ph, 0.45A 1800RPM 1/75HP $14.50

Ohio Elec Type CP35220, 115VAC, 60 cy 1ph, 3400 RPM, 1/40HP $15.95

Diehl Mtr, C78291 & Delco C76889, 115VAC, 50/60cy, 3ph, 1/40HP (LN) $3.95

Delco Model A7501B Mtr, 24VDC, ¼HP 11A, 6000 RPM $17.50

Eicor, ML4620-43, 24VDC, 17A, 1/3HP 3000 RPM $22.50

Pioneer Type CK-2 Servo Motor, 26V 400cy fixed phase, var. phase 49V, 40:1 gear reduction....$10.95

Pioneer 10047-2A Servo Motor, 2ph, 400cy, w/40:1 reduction gear $14.95

W. E. Sine Wave Motor Generator, KS-5913L02. Mtr 115V 60cy 1 ph 1/50hp 1725 RPM; Generator 16V 2ph 1725 RPM..........$17.95

Pioneer Gen-E-Motor, Input 18VDC; Output 450 VDC @ 150MA $4.95

D. C. Generator #CBF-21263A, Input 12.6V 0.86A; Output 500VDC @ 0.065A. Power drive speed 2100 RPM, Hand drive 50-70 RPM..........$14.95

PE-103A Dynamotors; Input 6-12VDC @ 21/11A; Output 500V @ 0.15A, filtered w/cables......$29.95

PE-103 Dynal motors: Same as above only w/o filter and cables $19.95

Bendix Generator Model 3975-1; Input 28VDC @ 0.175A, Output 300VDC @ 0.040A..........$3.95

PU-16/AP Inverters, Input 28VDC 60A; Output 115V 400cy 6.5A 8000 RPM 750VA..........$89.50

PU-7/AP Inverters, Input 28VDC 160A; Output 115V 21.6A 400cy 8000 RPM 2500VA..........$89.50

PE218 Inverters, Input 28VDC 100A; Output 115V 400cy 1500VA $29.95

PE109 Inverters, Input 13.5VDC 29A; Output 115V 400cy 1.53A 8000 RPM..........$59.95

MG149F Inverters, Input 28VDC; Output 500VA @ 115V 400cy 1ph & 250VA @ 26V 400cy 1ph...$89.95

HIGH VOLTAGE CAPACITORS

#18F269 rated dual 60 Mfd @ 3000 VDC.....$65.00

#PFD-40244G Paper rated 7.0 Mfd @ 4000 VDC $37.50

#19F210 rated 0.1 Mfd @ 6000 VDC, max amps 204 ....$37.50

#TK-60020 Paper rated 2.0 Mfd @ 6000 VDC.$27.50

Inerteen Type FL rated Dual 0.275 Mfd @ 7500 VDC/section $16.50

#7520, Oil, rated Dual 1.0 Mfd 7500 VDC....$27.50

#14F338 rated 4.5 Mfd @ 7500 VDC..........$69.50

#2C-21B1 Paper rated Dual 0.5 Mfd @ 9000 VDC $32.50

Inerteen type FL rated 1.0 Mfd @ 10,000 VDC $37.50

#14F13 rated 5.0 Mfd. @ 10,000 VDC..........$85.00

#26F68 rated 0.1 Mfd @ 12,000 VDC..........$9.95

#A7548, oil filled, rated Dual 0.25 Mfd @ 6000 VDC $14.50

#TK120065-1 Paper rated 0.65 Mfd @ 12,500 VDC $19.95

#15020, rated 0.25 Mfd @ 15,000 VDC......$19.50

#14F63 rated 1.0 Mfd @ 15,000 VDC..........$45.00

#20020 rated 0.25 Mfd @ 20,000 VDC..........$27.50

#TK20002-2 Paper rated 0.25 Mfd @ 20,000 VDC $27.50

#14F64 rated 0.25 Mfd @ 20,000 VDC..........$29.95

#TK20005 Paper rated 0.5 Mfd @ 20,000 VDC $45.00

#14F22 rated 1.0 Mfd @ 20,000 VDC..........$69.50

#14F103 rated 0.5 Mfd @ 25,000 VDC..........$57.50

#TK25050 Paper rated 0.5 Mfd @ 25,000 VDC $57.50

Inerteen type FP rated 0.5 Mfd @ 25,000 VDC $57.50

#14F88 rated 0.75 Mfd @ 25,000 VDC..........$72.50

#14F59 rated 1.0 Mfd @ 25,000 VDC..........$82.50

#A6734 rated 1.0 Mfd @ 25,000 VDC..........$82.50

#14F72 rated 0.15 Mfd @ 65,000 VDC......$57.50

TRANSFORMERS

G. E. #69G500. Pri: 6V 60cy; Sec: 450V, 3VA..$1.25

Raytheon UX8486A. Pri: 115V 400cy Sec: 5V @ 5A, 13.5KV ins. $3.95

Raytheon UX7358, Pri: 115V 400cy; Sec: 1-6500 @ 0.005ADC 2XIND. $4.25

G. E. #68G450. Pri: 500/250V; Sec: 72.5V 52.5W. 1KV ins. $2.45

Raytheon UX7489A. Output. Pri: 3600 Ohms 70 MADC, Sec: 720 Ohms O MADC 1780TV.......$1.75

Stancor A3871 Modulation, for use w/6L6 (Class) A1. Pri: 4500 Ohms, Sec: 8500 Ohms..........$1.65

Stancor D12A3551. Pri: 120V 60 cy; Sec. #1:220V @ 50MA, Sec. #2; 5V @ 6.5A, #3: 6.3V @ 2A, Sec. #4: 6.3V @ 1A..........$3.25

Stancor Type C-1 Current Trans. Pri: 100V 25/600A, Sec: 5V @ 50VA, 5KV ins..........$17.50

G. E. #68G449. Pri: 200V 60 cy, Sec: 260VCT @ 150W. Pri Ind: 14H @ 0.022ADC; Sec Ind: 26.5H $2.50

W. E. #KS8606. Pri: 115V 60cy; Sec. #1: 1080VCT @ 177MA, Sec. #2: 6.5V @ 1A, Sec. #3: 5.3V @ 4A, Sec. #4: 2.5VCT @ 7.5A..........$7.25

G. E. #68G457. Pri: 1/1.5/3.6/8/10V; Sec: 50-50 Volts 100 Watts $1.65

G. E. #K54J111 Output. Pri: 990 Ohms, Sec: 3650 Ohms. Pri Ind: 20H @ 0.01ADC 10V 60cy....$2.50

HEAVY DUTY TRANSFORMERS

Moloney Elec. #REL10383. Pri: 115/230V, 50/60cy; Sec: 21000 Volts @ 200MA. Oil Filled. 16½"W. 16"D, 20-⅛"H exc. of ins..........$225.00

G. E. Cat. #79G365. Pri: 203.5V; Sec: 6.5VCT @ 250A, 50/60cy, 2.46KVA. Wt: 130 lbs. 9¼"x7¼" x9-¾" $39.50

G. E. Cat. #7479972. Pri: 230/208V, 50/60cy; Sec: 2450/2320/2210V @ 1.162/1.222/1.29A. 2.85KVA $49.50

G. E. Cat. #7471997. Pri: 215/430V, 50/60cy; Sec: 5VCT @ 30A, 8KV ins..........$22.50

G. E. Cat. #7479971. Pri: 230/208V, 50/60cy; Sec: 1365/1300/1235V @ 0.539/0.555/0.595A. 0.735KVA $29.50

G. E. Cat. #7479965. Pri: 230V, 50/60cy, 3 ph; Sec: 16.4/8.2V @ 60A 1KVA..........$27.50

G. E. Cat. #7475695. Pri: 115V, 50/60cy; Sec: 3530/3720/3910V 1.31KVA, 2.5KV ins......$47.50

MINE DETECTOR SCR 625

Detects metallic objects (ferrous or non-ferrous) to a depth of approx. 6 ft. Find outboard motors on the bottom of lakes, locate underground piping, treasure, metallic fragments in lumber, etc. New, complete with inst. book. $65.00. Used but like new..........$45.00

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Mfd. by R. W. Cramer Co. Type RT-2H. 0-10,000 hours by tenths. 115 Volts 60 cy..........$9.75

Mfd. by G.E. Model 8KTYD33, 0-10,000 hrs. by tenths. 115V., 60 cy, 3" sq..........$14.95

Mfd. by G.E. Model 8KT8Y60. 0-10,000 hrs. by tenths. 115 V., 60 cy..........$14.50

GP-7 Radio Xmtr, Complete w/6 Tuning Units & all accessories. Freq. Range: 350-9050 Kcs. Tube Complement: (1) 803, (1) 801, (1) 843, (1) 5Z3. (2) 1616 and a full set of spares. 100W output. Brand New export boxed. Gross Wt. 450 Lbs.$149.50

GIBSON GIRL POWER SUPPLY

Complete power plant, with automatic distress signal gear train. Model 3975-1 Dynamotor rated 28VDC @ .175A. Output 300VDC @ 0.04A. Sockets, plugs. the relay, capacitors, etc., worth the money....$1.95

G.E. Cooper Hewitt Lamps, Type HTS..........$3.95

G.E. Cooper Hewitt Lamps, Type ATS..........$3.95

G.E. Cooper Hewitt Lamps, Type TU..........$3.95

Murdock Elec. KE-Switch, Cat. #A394. Double Throw, No Fuse, 100A, 250V..........$3.95

Test Panel, Mfd. by Pelham Elec. 24"W 6'8"H, 1" bakelite on channel uprights. Complete w/3 test meters 4" sq. (1) 0-15ADC, (1) 0-30/300VDC, (1) 0-30/150ADC. Three knife switches DPST for test of 20/115 or 230V supply. Each line fused. Receptacles for lamp test and fuse test, continuity test. Lamp bank $49.95

Resistor Bank #CR-9133-7117910. Consists of 3 ribbon-wound resistors 2.3 Ohms 1500W each. Can be used in series or parallel. 10½"W x 18½"L x 4¼"H $9.50

Sola Constant Voltage Trans. Cat. #30531, Type CVH. Pri: 190-250 Volts, 60cy 1 ph; Sec: 230 Volts 2.07A 477VA $49.50

Sola Constant Voltage Trans. Type 4. Pri: 95-135V 60cy; Sec: 115V 2000VA (LN)..........$125.00

Thordarson Modulation Trans. Type T47420A. Pri: 1500-750 Ohm. D.B. level 250W. Ratio: 1 to 2.33-3.27. Cycles per sec: 90 to 20,000. 13-⅜"L, 9½"H. 7½"W $19.95

CHOKES AND REACTORS

G.E. #7475694 rated 10H @ 0.65ADC, 2KV test $22.50

Raytheon UX-9114A rated 0.100H @ 1.4ADC, 1780 VT $3.00

Raytheon UX-9116 rated 0.030H @ 2.0ADC, 1780 VT $4.95

G.E. #7479973 rated 2.5H @ 3.5ADC, 7KV test $49.95

G.E. #7479964 rated dual 50H @ 0.025ADC each sec., 58 Ohms D.C. res, 15-30,000cys..........$27.50

G.E. #7469170 rated 6H @ 3.2ADC $22.50

Raytheon #CRP-30509 dual. Sec. #1 rated 1.8H @ 0.384ADC, Sec. #2 rated 0.7H @ 0.384ADC, 1780 TV $4.25

Raytheon #WX-5148 Dual. Each section rated 1.75H @ 0.25ADC, 42 Ohms DC res. each sec., 1780TV $3.50

G.E. Type K, Form FR. Rated 175.8H @ 0.0672ADC 7KV ins. $39.95

G.E. Type K, Form HIR. Rated 37H @ 0.10ADC. 14KV ins. $27.50

Amertran Type ELS. Class: Swing, 7.5KV ins. 6H @ .145ADC; 24H @ 0.145ADC, 120cy ripple..$29.95

Raytheon U11010 Rated 10H @ 1.2ADC 5KV.$49.95

Industrial #CK3016 Rated 20H @ 60MADC...$2.95

Amertran Type W. Class: Audio. Rated 1H @ 0.800ADC 15KV ins..........$27.50

PULSE NETWORKS AND TRANSFORMERS

Sprague #7.5-E4-16-60-67-P. 7.5KV, "E" Circuit, 4 sections, 16 Microsec. 60 PPS, 67 Ohms Imped. $7.95

Sprague #7.5-E3-3-200-67-P. 7.5KV, "E" Circuit, 3 Microsec. 200 PPS, 67 Ohms Imped. 3 sections $6.75

Sprague #8-E5-1-1000-50P. 8KV, "E" Circuit, 1 Microsec. 1000 PPS, 50 Ohms Imped. 5 sections $22.50

Sprague #10-E3-0.5-2000-50P. 10KV, "E" Circuit, 3 sections, 0.5 Microsec. 2000 PPS, 50 Ohms Imped $29.95

Sprague #15-A-1-400-50P. 15KV, "A" Circuit, 1 section, 1 Microsec. 400 PPS, 50 Ohms Imped. $37.50

Sprague #15-E4-0.91-400-50P. 15KV, "E" Circuit, 4 sections, 0.91 Microsec. 400 PPS, 50 Ohms Imped. $19.95

Fast #15-E5-1.33-700-50P2T. 15KV, "E" Circuit, 5 sections, 1.33 Microsec. 700 PPS, 50 Ohms Imped. $29.50

W.E. #D-163330 Network Assy, 3 retard coils & 3 cond in oil filled rect. case, 330 Ohms, 1 Microsec. $22.50

Raytheon Pulse Trans. Type WX-5137. Pri: 4KV, 1 Mu. Sec., Sec: 16KV 16A..........$9.75

Raytheon Pulse Inversion Trans. Type UX-8442 −40V +40V $6.75

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10 Watts, Fixed, Your Choice: 4000, 6000, 85000 Ohms....29¢
10 Watts, Adjustable. Your Choice: 1, 15, 20, 50 Ohms....29¢
10 Watts, Multi-Tapped. Choice: 80CT, 90CT, 50 and 67 Ohms....15¢
12 Watts, Fixed Bracket, 5, 11K Ohms....23¢
15 Watts, Fixed Bracket, 45 Ohms....23¢
16 Watts, Fixed Bracket, 12K Ohms....23¢
20 Watts, Fixed. Choice: 0.3, 2, 3.53, 5, 10, 12, 15, 75, 500, 5000, 7000, 15K, 20K Ohms....25¢
20 Watts, Adjustable. Choice: 6 or 25 Ohms....32¢
20 Watts, Multi-Tapped. Choice: 3 & 25, 2.5 & 5 Ohms....20¢
25 Watts, Fixed. Choice: 4, 10, 15, 36, 45, 50, 440, 640, 750, 1000, 1600, 2900, 9000, 40K, 100K Ohms 29¢
25 Watts, Fixed, 500 Ohms....39¢
25 Watts, Adjustable. Choice: 15, 115, 1350 Ohms 35¢
25 Watts, Multi-Tapped. Choice: 0.5CT, 4000 & 11K Ohms....25¢
40 Watts, Fixed. Choice: 20, 5000, 100K Ohms..40¢
50 Watts, Fixed. Choice: 100, 300, 800, 2000, 3000, 5000, 24K Ohms....50¢
50 Watts, Adjustable. Choice: 25, 50, 125, 300, 1250, 5500 Ohms....69¢
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90 Watts, Fixed, Center-Tapped. Choice: 0.6CT, 0.9CT, 2000CT Ohms....90¢
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Heavy Duty Air-Cooled Resistors, Leading Mfd. 1500 Watts. Your Choice of Following Resistance: 1.3 Ohms, 3.5 Ohms, 1.6 Ohms, 25 Ohms, 0.5 Ohms, 0.16 Ohms....$6.75 ea

BF Precision Sealed-Ohm Resistors, Your Choice of Type @ 95¢ ea
Type 2000-24: A to B—283 Ohms, B to C—567 Ohms ± 0.1%.
Type 2003-29: A to B—12.8 Ohms, D to M—1.67 Ohms, C to M—300 Ohms.
Type 2000-36: A to B—71123 Ohms, B to O—0 Ohms, C to D—71123 Ohms, ± 0.1%
Type 2000-40: A to B—14300 Ohms, C to D—14300 Ohms ± 0.5%
Type 2000-58: A to M—100K Ohms ± 0.2%, A to M—100K Ohms ± 0.2%, D to M—22670 Ohms ± 0.1%
Type 2000-70: A to B—4600 Ohms, C to D—4600 Ohms ± 2%
Type 2000-71: A to B—798300 Ohms, C to D—850000 Ohms ± 1%
Type 2000-72: A to B—0.32 Ohms, C to D—1.20 Ohms ± 5%
Type 2000-76: A to B—8333 Ohms, B to C—667 Ohms, C to D—417 Ohms ± 0.2%
Type 2000-82: A to B—817K Ohms, B to C—36600 Ohms, C to D—81700 Ohms ± 0.1%
Type 2000-84: A to B—800K Ohms ± 0.5%
Type 2000-85: A to B—786K Ohms, B to C—831500 Ohms ± 0.5%
Type 2000-111: A to B—54711 Ohms, C to D—27400 Ohms ± 0.3%
Type 2000-148: A to B—133440 Ohms, C to D—118336 Ohms ± 0.1%
Type 2000-150: A to B—731708 Ohms, C to D—850K Ohms ± 0.1%
Type 2000-155: A to B—223580 Ohms, B to C—223580 Ohms, B to D—4144 Ohms ± 0.2%
Type 2000-156: A to B—133440 Ohms, B to C—100K Ohms, C to D—70974 Ohms ± 0.1%
Type 2000-160: A to B—58464 Ohms ± 0.1%, B to C—4.29-1 Ohms ± 0.2%
Type 2000-169: A to B—341200 Ohms, B to M—107019 Ohms, C to M—75606 Ohms, D to M—181770 Ohms ± 0.1%
Type 2000-170: A to B—13344 Ohms, B to C—46777 Ohms ± 0.1%
Type 2000-175: A to B—216960 Ohms, B to C—216960 Ohms, B to D—11704 Ohms ± 0.2%
Type 2000-176: A to B—133440 Ohms, B to C—100K Ohms, C to D—64354 Ohms ± 0.1%
Type 2000-179: A to B—500K Ohms, B to M—6218 Ohms, C to M—24790 Ohms, D to M—15240 Ohms ± 0.5%
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YOUR CHOICE OF ANY OF THE ABOVE 95¢ ea.

EQUIPMENT SPECIALS

Converter & Range Plan Position Indicator Type CBM-55ACW. P/o SF Radar equip. Complete with tubes and parts. (LN)....$125.00
AS-5/APS-2 Antenna Unit. Complete with motor $59.95
R-31/APS-2E Indicator Unit. Complete with meters, tubes, motors, etc....$125.00
TCE-1 Radio Transmitter Equip. Xmtr-Rectifier Unit Type CAY-52151 w/plug-in tuning units. 350 to 9050KCS. Output 125 Watts. (LN)....$69.95
Spare Plug-in Units for above Xmtrs. (LN)....$3.95
Radar Transmitter-Converter Type CBM-43ABT. p/o SF Radar equip. Complete (LN)....$69.50
NF2-14 Noise Filters. Mallory, 25 Amps 35 Volts $1.75
M300 Inserts for HS3OU Headsets....$4.00/c
W.E. Type 716E Headphones, Magnetic, 275 Ohm imped. 1000 cycles....$3.95
EE8 Field Telephones, complete (LN) per pr..$34.95
T17 Shure Microphones w/plug. (LN)....$4.95
HS30 Headsets w/transformer & plug....$2.35
HS30 Headsets w/o transformer....$1.75
T45 Lip-Microphones....85¢
T26 Chest Sets with headphones (LN)....$2.35
EE70 Headsets....$4.95
TBY Transmitter-Receiver. 28-80MC. Complete w/ 5000KC Xtal & tubes....$39.95
Transmitter BC-AB200. Less tuning units & tubes $3.95
PE112A Power Rectifier with dynamotor....$7.95
BC-AN-430 Xmtr w/tubes less tuning units (LN) $4.95
BC-AN-429 Receiver w/tubes less tuning units (LN) $3.95
BC-AS-229 Receiver w/tubes less tuning units (L.N) $3.95
Westinghouse Negative Sequence Filter Style N636586 for type HQS relay. 3 phase output, 5 amps 50/60cy. Westghse Ground Fault Phase Selector Relay Type HQS.Style N636585. Westinghouse TS Relay Style N636664. These 3 units make up the type HQS Phase Selector Relay Sets used for Selective-Pole Carrier Relaying. Complete....$95.00
G11A Solenoid. Mfd. by Magnavox Co. 24VDC...95¢
G.E. Voltage Regulator Model 3GVD11B6, 115V 60cy supply, 23-35KV. Complete with 10 tubes. 18¼" x 12½" x 8¾"....$49.95
J17/ARC-5 Junction Boxes, 28VDC (LN)....$1.25
RT-7/APN1 Radio Xmtr & Receiver w/tubes (LN) $39.95
Raytheon Line Voltage Regulator type CRP301407. Pri: 92-138 Volts 57-63 cycles, 15 Amps. 1ph; Sec: 115 Volts 7.15 Amps. 0.82 KVA, 96% PF, 31"H, 11"D, 19½"W....$97.50
TP-890D McElroy Tape Puller w/115V 60cy motor, speed regulator....$29.95
BC604D Xmtr w/meter, tubes, and crystals (LN) $34.50
AM-6/APA-1 Video Test Set....$14.95
I-115 Western Electric Test Set....$9.50
Ohmite R. F. Choke, Z-O 2 Millihen, 1000MA....60¢
Hammarlund R. F. Choke, RFC-250....95¢
BC-375E Xmtr, Comp. w/tuning units....$50.00
Jack Box BC-1366....39¢
MT/ARC5 Mounting Base f/ATA or ARC5 equip $1.00
Daven Sound Attenuators, Type 350A, ladder network, linear, 30/30 Ohms imped. 2DB attenuation, 10W....$3.95
Westinghouse Watthour Meters Type CS, 120V 60cy 1ph 15A, 2 wire....$9.50

RELAYS

Auto Elec, R45H, 6500 Ohm, 2MA, SPST, NO..$1.45
Auto Elec, R45, 6500 Ohm, 2MA, SPST, NC & SPST, NO Simul....$1.95
Guardian G39327, 6VAC, SPDT & SPST — NO, Simul....$1.95
Struthers-Dunn ADBT8, 6VAC, DPST, 30A...$2.95
Edison Thermal 18480S, 6V AC-DC, SPST-NC..$1.95
Allied FX-31A, 6VDC, SPDT, 2A....$2.25
Allied POX-86, 6VDC, 4PDT, 15A....$4.95
RBM #59B84712, 6VDC, SPST-NO, 5A....$1.95
RBM #5608-10, 6VDC, SPST, double break..$1.45
Allied BO9D29, 6VDC, 3PDT, 15A....$3.95
G.M. #12700, 6VDC, SPST-NO, 200MA....$1.95
Struthers-Dunn 8XAX100, 18VAC, SPDT, 8A..$2.95
Auto Elec, R45P, 24VAC, SPST-NC & SPST-NO $1.95
Auto Elec, R-30, 20-30VDC, 3PST-NO & DPDT $2.95
Clare #35EC, 12-24VDC, DPST-NO & SPST-NC $1.75
G.E. CR2791-B108C20, 12-24VDC, DPDT, 10A..$1.75
G.M. #13020, 18-24VDC, DPST-NO & SPST-NC $1.75
Leach 1054ARW, 22-30VDC, DPDT & SPST-NO, 15A....$2.25
Henry #1010 Min., 24VDC, SPST-NC....$1.35
Allied BO13D35, 24VDC, SPST-NO, double break, 15A....$2.35
Allied ES691526, Min. 24VDC, DPDT, 3A....$1.35
Allied 452-11272, 24VDC, SPDT, 3A....$1.65
G.E. CR2791-G110F2, 24VDC, DPDT, 5A....$1.95
G.E. 55836, 24VDC, DPST, 6A, Min....$1.95
G.M. #13013, 24VDC, SPDT, double break, 15A $1.95
G.E. 3GTR72F4, 24VDC, SPST, double break, 300A $4.95
G.E. CR2791-D101F3, 24VDC, DPDT, 10A....$2.25
Allied BO14D35, 24VDC, SPST-NC, double break, 15A....$2.95
G.E. E55837, 24VDC, SPST-NO, double break, 2A $1.95
Sperry E1A20248, 24VDC, DPST-NO, 2A....$1.75
Leach 1222DED, 24VDC, SPDT, 8A....$1.95
G.E. CR2791-B100F3, 24VDC, DPDT, 15A....$2.25
G.E. #55251, 24VDC, SPST-NO, 6A, Min....$1.75
Leach #1074, 24VDC, DPST-NO, 15A, Ceramic $3.25
Allied BO15D35, 24VDC, SPDT, double break, 15A $2.95
Allied BO6D35, 24VDC, DPDT, 10A....$2.25
Allied BN18D33, 24VDC, 6PDT, 10A....$5.25
Allen Bradley X95545, Type B6B, 24VDC, SPST-NO double break, 200A....$2.95
Allen Bradley X89309, Type B6B, 24VDC, SPST-NO double make/break, 200A....$3.95
Allied BOX48, 24VDC, SPST, double break....$2.95
Price Bros. #311, 28-32VDC, DPDT, rotary....$2.95
Square D, Class 8990, ARO-30, 110VAC 60cy, 3PST, double make NO double break, 15A....$9.95
Cramer Type TEC, Adjustable timer, 115VAC, 0-5 min....$12.50
W-L Type N83, 115VAC, 60cy., 3PST-NO & SPST-NC, 15A....$9.95
Westinghouse #1162956, 115V, 60cy, DPDT, 10A $9.95
Struthers-Dunn 1BXX54, 115VAC, 60cy, DPST-NO, 3A....$3.95
W-L #4566297, 115VAC 60cy, DPST-NO, 25A..$7.50
Allied BOHX-P4, 115VAC 60cy, DPDT, 10A....$5.25
Edison Type 501, 115VAC-DC, SPST-NO, Thermal, 5 sec....$1.95
Edison Type 501, 115VAC-DC, SPST-NO, Thermal, 45 sec....$1.95
Struthers-Dunn TD474A, Thermal, 115V, 60cy, SPDT, 30 sec....$2.95
Struthers-Dunn Thermal, PVA3, 115V, 60cy, SPST-NO, 1 min....$2.95

CIRCUIT BREAKERS

Heineman Type AN744, Cat. #PAM151ORWM, 24 VDC, 0.220 Amperes, SPST....$1.25
Heineman Type CB-193B, 110V 60cy, 1.25 Amperes, Curve 3, DPST....$2.25
Heineman #CB193BC20C3534, 115VAC 60cy, 4 Amperes, Curve 1, DPST....$2.95
Westinghouse, 115VAC 60cy, 15 Amperes DPST (LN) $3.95
Heineman Type 0711, 110V 60cy, 15 Amperes Curve UN-2000, SPST....$4.95
Westinghouse #WEP-3901C, 125VAC 60cy, 15 Amperes, SPDT (LN)....$3.95
Heineman Type 0322-M15, 24VDC, 15 Amperes Curve D, DPDT....$3.95
G.E. Type AF1, 125VAC 60cy, 15 Amperes SPST $4.95
Adams Electric Thermag, 120VAC 60cy, 15 Amperes, SPST....$4.95
Adams Electric Thermag, 120VAC 60cy, 20 Amperes, SPST....$5.25
Westinghouse #4127F, 125VAC 60cy, 20 Amperes, SPST (LN)....$4.95
Adams Electric Thermag, 120VAC 60cy, 25 Amperes, SPST....$5.95
Heineman #0322, 230VAC 60cy, 25 Amperes Curve A, DPST....$8.75
Heineman #0111, 115VAC 60cy, 30 Amperes Curve 2, SPST....$7.75
G.E. Type AF-1, 230VAC 60cy, 35 Amperes DPST $9.95
G.E. Type AF-1, 230VAC 60cy, 50 Amperes DPST $12.50
Heineman #0322, 115VAC 60cy, 50 Amperes Curve UN-2000, SPST....$12.50
G.E. Type AF-1, 125-250VDC, 70 Amperes 3PST $17.95

INSULATED TUBING

Size	I.D.	Color	Type	Per 100′	Per M′
	.0156″	Greent	Var. Cam.	$1.75	$11.00
	.0156	Black	Extr. Plas.	.75	5.40
20	.034	Black	Var. Cam.	1.75	13.50
20	.034	Yellow	Tri. Sat. Glass	3.75	32.50
20	.034	Brown	Tri. Sat. Glass	3.75	32.50
14	.072	Black	Var. Cam.	2.10	17.50
12	.089	Black	Sat. Glass	1.10	7.00
12	.089	Orange	Extr. Glass	4.75	42.50
12	.089	Orange	Var. Cam.	2.20	18.00
12	.089	Black	Var. Cam.	2.20	18.00
11	.101	Black	Extr. Plas.	1.10	7.00
11	.101	Black	Var. Cam.	2.55	21.50
11	.101	Black	Sat. Glass	5.00	46.00
11	.101	Yellow	Sat. Glass	5.00	46.00
11	.101	Yellow	Dbl. Sat. Glass	7.50	60.00
10	.112	Black	Var. Cam.	2.75	23.50
9	.124	Black	Var. Cam.	3.00	26.00
8	.141	Black	Var. Cam.	3.15	27.50
8	.141	Black	Extr. Plas.	1.40	10.00
8	.141	Clear	Extr. Plas.	1.40	10.00
8	.141	Yellow	Cel. Extr.	3.15	27.50
7	.158	Black	Var. Cam.	3.45	30.50
6	.178	Black	Sat. Glass	6.15	57.50
6	.178	Clear	Extr. Plas.	1.65	12.50
6	.178	Orange	Var. Cam.	3.80	34.00
6	.178	White	Extr. Plas.	1.65	12.50
6	.178	Black	Var. Cam.	3.80	34.00
5	.198	Black	Var. Cam.	4.10	37.00
5	.198	Black	Extr. Plas.	1.85	14.50
5	.198	White	Extr. Plas.	1.85	14.50
4	.224	Clear	Extr. Plas.	2.00	16.00
4	.224	Black	Sat. Glass	7.00	64.00
3	.249	Black	Extr. Plas.	2.25	18.50
3	.249	Black	Tri. Sat. V. C.	5.25	48.50
3	.249	White	Extr. Plas.	2.25	18.50
3	.249	Black	Sat. Glass	6.55	61.50
2	.278	Clear	Extr. Plas.	2.65	22.50
2	.278	Black	Var. Cam.	5.15	47.50
1	.299	Clear	Extr. Plas.	3.00	26.00
5/16″	.3125	Clear	Extr. Plas.	3.10	27.08
5/16″	.3125	Black	Neo. Hose	10.00	......
0	.347	Yellow	Var. Cam.	6.60	62.00
0	.347	Black	Var. Cam.	6.60	62 00
3/8″	.375	Black	Dbl. Sat. V. C.	8.90	81.00
3/8″	.375	Black	Extr. Plas.	3.60	32·00
3/8″	.375	Yellow	Var. Cam.	8.00	76.00
3/8″	.375	Black	Sat. Glass	8.90	85.00
3/8″	.375	Black	Var. Cam.	3.60	32.00
7/16″	.438	Black	Extr. Plas.	4.00	36.00
7/16″	.438	White	Extr. Plas.	4.00	36.00
15/32″	.469	Clear	Extr. Plas.	4.50	41.00
1/2″	.500	Black	Extr. Plas.	5.00	46.00
5/3″	.625	Clear	Extr. Plas.	6.85	64.00
11/16″	.688	Black	Extr. Plas.	8.75	Quot. on req.
3/4″	.750	Clear	Extr. Plas.	9.50	
13/16″	.813	Clear	Extr. Plas.	10.00	
7/8″	.875	Black	Extr. Plas.	12.50	
7/8″	.875	Clear	Extr. Plas.	12.50	
1″	1.000	Clear	Extr. Plas.	15.00	
1″	1.000	Black	Extr. Plas.	15.00	
1-1/8″	1.125	Black	Extr. Plas.	17.50	
1-1/8″	1.125	Clear	Extr. Plas.	17.50	
1-1/4″	1.250	Black	Extr. Plas.	20.00	

ALL MDSE. BRAND NEW UNLESS OTHERWISE NOTATED; ALL MDSE. GUARANTEED. IMPOSSIBLE TO LIST ALL OF OUR ITEMS AND COMPONENTS. TELL US YOUR NEEDS.

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PRECISION RESISTORS

Over 2½ Million In Stock

"TAB"—Specialists in Precision Resistors
No Mfrs Choice—We Ship Types in Stock

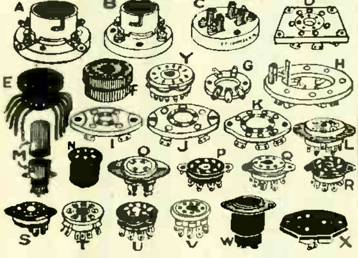
0.116	275	1250	3509	17977	130000
0.42	280	1260	3600	18000	135000
0.425	286	1300	3700	18300	140000
0.607	289	1350	3730	18380	141000
0.7	299	1355	3760	18500	145000
1.03	300	1400	3900	18800	147000
1.3	310	1488	4000	19000	150000
1.75	311.5	1495	4030	19500	155000
2.5	320	1500	4200	20000	160000
3	325	1510	4220	20441	165000
3.83	330	1518	4280	20500	166750
4	340	1600	4300	21000	167000
4.38	350	1640	4314	21500	169200
5	360	1646	4440	22000	
5.025	366.6	1650	4444	22500	175000
6.25	370	1670	4500	22990	180000
6.5	375	1680	4700	23000	180600
7	380	1710	4720	23150	185000
7.8	389	1712	4750	23325	186600
7.9	390	1740	4850	23400	190000
8	400	1770	4885	23500	198000
10.38	410	1800	4900	24000	200000
11.25	414.3	1818	5000	24600	201000
12	418.8	1830	5100	25000	205000
13.52	425	1850	5210	25200	210000
14.2	426.9	1865	5235	25400	215000
14.25	427	1892	5270	25833	220000
14.5	430	1894	5300	26000	225000
15	440	1895	5500	26500	229000
16	450	1896	5600	26600	230000
17	452	1897	5730	27000	235500
19	460	1898	5770	27500	238000
19.2	470	1899	5910	28000	240000
20	475	1900	6000	28430	345000
22	478	1901	6100	28500	250000
23	470	1902	6125	29000	265000
24	487	1903	6140	29500	268000
25	500	1904	6200	29990	270000
26	510	1905	6300	30000	275000
28	520	1906	6495	31000	294000
30	525	1907	6500	31500	300000
31.5	540	1908	6800	32000	307500
37	550	1909	6840	33000	311000
48	560	1910	6990	35000	314000
49	575	1911	7000	36000	316000
50	580	1912	7320	37000	325000
51.78	588	1913	7500	38140	330000
55	600	1914	7700	38500	333500
56.7	612	1915	7717	39000	350000
60	620	1916	7900	39500	353500
63	625	1917	7930	40000	375000
68	633	1918	7950	41400	380000
74	640	1919	8000	42000	390000
75	641	1922	8094	43000	400000
80	645	1924	8200	45000	402000
81.4	649	1926	8250	47000	420000
88	650	1960	8500	47500	422000
89.8	657	1980	8700	48000	425000
95	665	2000	8770	48660	430000
100	668	2045	9000	49000	450000
101	670	2080	9100	50000	458000
103.2	673	2095	9445	51000	470000
105	675	2141	9500	52000	472000
105.7	680	2142	9710	55000	478000
107	681	2145	9800	56000	500000
110	684	2150	9900	57065	510000
120	689	2160	9902	58333	520000
121.2	697	2180	10000	60000	521000
125	699	2187	10430	61430	525000
130	700	2195	10500	62000	543000
135	711	2200	10600	64000	550000
147.5	733	2250	10900	65000	560000
150	740	2300	10936	66600	570000
160	750	2400	11000	66650	575000
165	800	2450	11400	67500	600000
170	806	2463	11500	68000	620000
175	820	2485	11690	70000	650000
179	850	2490	12000	72000	654000
180	854	2500	12500	73500	660000
182	899	2525	12800	75000	680000
182.4	900	2600	13000	80000	690000
200	910	2625	13100	82000	700000
209.4	917	2635	13500	84000	750000
210	948	2700	13550	85000	761300
216	978	2750	13600	85750	800000
220	1000	2850	14000	88000	813000
220.4	1030	2860	14250	90000	820000
225	1056	2870	14400	91000	850000
230	1059	2900	14500	93000	860000
235	1067	3000	14550	93300	900000
240	1100	3100	14600	95000	910000
245	1110	3163	15000	100000	930000
245.4	1150	3259	16000	110000	950000
250	1155	3290	16500	115000	
260	1162	3333	16800	116667	
270	1200	3384	17000	120000	
271	1225	3500	17500		

Any size Above, Each 35¢; Ten for $3.29

MEGOHMS

1	1.57	2.25	3.673	6	8.02
1.1	1.579	2.5	3.75	6.5	8.5
1.2	1.65	2.7	3.9	6.6	9.05
1.25	1.75	2.75	4	6.7	9.5
1.3	1.8	2.8	4.23	7	10
1.35	1.9	2.855	4.25	7.5	11.55
1.39	2	3	4.5	7.62	12
1.4	2.11	3.3	5	7.74	12.83
1.5	2.2	3.5	5.5	8	13

Any Size Above, Each 70¢; Ten for $6.49



TUBE SOCKETS, ALL TYPES

A.	RCA 5-pin GIANT, 803, etc.	$1.49
B.	Johnson 4-pin Bayon. 866, etc.	.85
C.	304TL Socket	1.15
D.	Johnson 7-pin Steatite, 829B	.69
D.	Johnson 122-237, HK257, 813	.63
E.	Small Shell DUODECAL, 2BP1	.75
F.	Med Shell DIHEPTAL Cinch MICA bklt	.89
G.	5-pin ACORN 1-9/16" dia HAML'D	.39
H.	Johnson 122-234, w/tube Lock.	.98
I.	4-prong STEATITE Johnson, 866	.30
J.	5-prong STEATITE Johnson, 807	.30
K.	7-pr STEAT Johnson, 1625	.36
L.	7-pin NATIONAL CIR7L Steatite	.30
M.	MINI 7-pin Mica 'B-HF & Shield	.30
M.	MINI 7-pin Mica 'B Top Mtg & ½ Shld B	.23
M.	MINI 7-pin Bot Mtg Blkt Sim Amph 147-500	.13
M.	NOVAL Shld. 1½"	.12
N.	AMPH fem 78F Pin 4,5,6,8	.17
O.	4-pin AMPH49RSS4 & mtg	.27
P.	OCTAL 8-pin & plate Bklte	.10
Q.	OCTAL 8-pin & plate Steatite	.25
Q.	OCTAL 8-pin & plate Mica 'B	.11
R.	LOKTAL 8-pin & lock Mica 'B HF	.10
S.	KLYSTRON socket Cinch	.35
T.	LOKTAL Amph 49SSL Steatite	.30
U.	OCTAL Amph 78S8 mica Bklte	.09
U.	11-pin 78S11/931 Amph.	.16
V.	OCTAL Amph 49SS8 steatite	.25
W.	HIV Safety 4-pin Amph 77A4	.39
Y.	MAGNAL 49SS11L ceramic	.69

"TAB" THAT'S A BUY

END EQUIPMENT BUYS

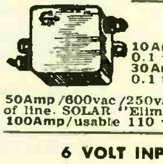
US Navy Version BC645 Ideal Citizens Band Conversion, NEW, less tubes, connector & Dyn	$12.95
As Is	5.98
EE8 Ringing Gen Assy, Like New, Less Handsect (TS-9)	7.98
R9/APN4 Receiver, Less Tubes, AsIs	14.98
TG10 Code Unit, Less Tubes & Cabinet, as is	19.95
ART13 Spch Amp. New, Less Tubes	9.95
W/CLPR Kit	10.98
RM29 Control Unit, BRAND NEW	11.98
RT34/APS13 30 Mc IF Less Tubes, As Is. Good Condition	7.98
R59/TP53 Good, As Is, Less Tubes	29.98
EE65 Telephone Test Set, Fine Cond	24.98
EE65 Time Interval Signal, Used	3.98
R74/CRW Rcvr, Less Tubes, As Is.	2.49
I-81 Compass Indicator, Like New	7.95
I-82 Compass Indicator, Like New	4.95
PE97 Plate Supply Unit, Less Tubes	9.98
I-108 Range Calibrator, Metal Case	29.98
PE120 Pwr Sup'y, Less Tubes, Used	9.98
Mackay 168BRadioXmitter, w/Metal Case, Less Vibrapack & Tubes, AsIs	2.98
I-198 Sig. Gen. GoodCond. LessTubes	14.95
BC456 Mod. Less Tubes, Dyn, As Is	1.98
SCR595 IFF, Less Tubes, As Is	3.98
BC602 Cont Box for 522, As Is	1.29
BC605 Amp. Less Tubes, As Is	3.98
BC906 Freq. Mtr. exc. cond. Less Tubes	29.95

ALIGNMENT TOOLS

Ideal NO-LOSS Alignment Screwdriver TL150, long Insulated Shaft. Sure-Grip Knurled Knob. Only ....49¢
RELAY Spring Adjuster & Switch-Bd Tool Slot takes up to .022". WEC No. 293 .98¢
Feeler Gauge for Relay, Telephone & Teletype contact, 8 Detachable sizes.....98¢

MERCURY THERMO REGULATOR

Dual Ckt. 32°&105°F. Extremely Sensitive & Accurate—FIRE PREV, FREEZE Pt or MAX-MIN TEMP CONTROL, RESEARCH. Brand New, Individ Boxed. List over $20. SPECIAL..............98¢; 12 for $10



LINE FILTERS

10Amp/130vacdc Csd USN 0.1 to 1000 Mc's..$1.29
30Amp/250vacdc Csd USN 0.1 to 1000 Mc's..$3.98
2 for $6.00
50Amp/600vac/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat". New $9.98;
100Amp/usable 110 vacdc GE 2 for $1.98

6 VOLT INPUT CARTER GENEMOTORS

Brand New
Way Below List Price!

Output			Model
400V/375Ma	Int	Each $29.95	4037AS
590V/150Ma	Int	Each $29.95	5919AS
590V/250Ma	Int	Each $34.95	5925AS

All CARTER GENEMOTORS supplied with General-Electric Input Filter FREE!

SELENIUM RECTIFIERS

We Specialize in Rectifiers and Power Supplies to Your Specifications.

IMMEDIATE DELIVERIES

FULL WAVE

Volts In	Volts Out	Amps	Each
18	14	2	$2.40
18	14	4	3.85
18	14	6	5.49
18	14	8	5.65
18	14	12	7.50
18	14	24	14.00
36	28	1.2	2.75
36	28	2	3.75
36	28	4	7.00
36	28	8	9.95
36	28	12	14.00
36	28	24	27.00

Full Wave Selen Rect & Trans. with Ageing Taps, in Kit form, at Fraction of usual price. All 115V/60cy inputs
up to 16VDC at 12 amps.........$29.95
up to 32VDC at 12 amps......... 36.50
up to 32VDC at 48 amps.........149.50
up to *20VDC at 6 amps......... 12.98
*This 6amp supply has no ageing taps.
Full Wave Bridge Selen for relays or Pwr. Inpt 115 to 130 vac: Outpt 115vdc/40ma Ea. 69¢; 10 for $5.98

RHEOSTATS

2 ohm 50W Model J	$2.59
6 ohm 25W Model LH	1.98
15 ohm 25W w/knob	1.98
15 ohm 75W Model G	3.74
20 ohm 50W Model J	2.35
60 ohm 50W w/knob	2.69
100 ohm 50W Model K	2.25
200 ohm 50W Model D	2.40
250 ohm 25W .....ea. 1.39; 4 for	5.00
300 ohm 200W Model P	5.49
350, 500, 1500, 5000 ohm Slotted shaft, 25 watt 79¢: 3 for	2.00
1000 ohm 25W Model J	2.19
7500 ohm 50W Model J	2.59
10000 ohm 50W Model J	2.89

ATTENUATORS

DUAL 5000 ohm 20 step Bridged "T"	$4.98
7470 & 1063 ohm 12 step W.W.	3.98
DUAL 25000 ohm 20 step	3.98
DUAL 13000 ohm 20 step	3.98
100,000 ohm 20 step 3DB/Step	4.98

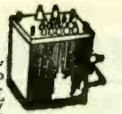
POTENTIOMETERS TYPE "J"

5 ohm Type J ¾" Flatted Shaft	$1.45
200 ohm Type J ⅛" Slotted Shaft	1.25
1000 ohm Type J ¼" Flatted Shaft	1.45
3500 ohm Type J ¾" Shaft	1.45
7K ohm Type J ⅛" Slotted Shaft	1.25
25K ohm Type J ⅛" Slotted Shaft	1.25
50K ohm Type J ⅜" Flatted Shaft	1.45
100K ohm Type J ⅜" Flatted Shaft	1.45
1 meg Type J ⅛" Slotted Shaft	1.25
1 meg Type JJJ (Triple) 1 ⅜" Shaft	4.69

CIRCUIT BREAKERS

Heinmann Magn Bkrs, Amps; 0.22, 2, 3, 5, 7, 9, 12, 15, 20, 25, 30, 35, 40, 50, 80, 100, 180. Each..............$1.69
Sq.D & CH Toggle Sw Brkrs, Amps; 5, 10, 15, 20, 25, 30. Each..............98¢
Klixon Thermal Push Button Brkrs Amps; 5 10 15 20 25 30 Each 89¢

TRANSFORMERS



115 V 60 Cyc Input
TV & CR Pwr Xfmr for 7" to 20" Tubes, HI VOLTS to 20 KV (w/quardupter ckt). ALL Tubes, PL & FIL wndgs dlvrng; 300 VDC/275Ma Full-Wave, 6.4V/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core, Oil Impreg..$7.98
2500V for CRT 6.3V/.6A 2.5V/1.75A KENYON Csd HVins, 4/BC412.....$7.98
1100VCT/200ma.6.3VCT/4A,5V/3A.$5.98
700VCT/120ma,2x6.3V/3A,6.3V/1A $3.98
1000 VCT/200ma, 18V/.55A, 6.3V/5A, 5V/6A $6.98
650VCT/150ma, 5V/3A, 6.3V/2.1A.$2.98
1400VCT/90ma 6.3V/3A/5V/3A..$5.98
1320V & 375VCT/110ma, 5V/3A 2.5V/2.25A, 6.3V/2.75A H'Sld HVins...$9.98
1000VCT/150ma 300V Bias 6.3V/5A 5V/3A 2x6.3V/.65A, 6.3V/1.25A..$4.98
1000 VCT/125ma, 500 VCT/100ma, 2x5V/3A 18V/1A, 6.3V/8A UTC...$5.98
1000VCT/45ma, 795VCT/80ma & 360 VCT/ 55ma, 3X5V/3A, 6.3VCT/1A 6.3VCT/.3A Csd HVins can be used 2X rating Raytheon U.S.N. rated Hipersil Core $4.98
900V/35ma, 2X2.5V/2A. Excellent 1800V/DBLR Two 2X2 Fil. Wndgs..$3.49
840VCT/110ma & 530VCT/21ma 2X5V/3A 6.3V/1A, 6.3V/.3A Csd Hvins Rayth. $4.98
770V/2.5ma, 2.5V/3A, HVins H'Sld incld Fltr Parts $3.69
700 VCT/125ma, 6.3VCT/4A, 5V/3A $3.98
570V/150ma, 5V/3A, 12V/4A, H'Sld $4.49
500VCT/60ma, 6.3V/4A H'Sld.....$2.98
420VCT/90ma, 6.3V/1.9A, w/inpts 6-12-24 115 VDC & 115 230 VAC $1.98; Vib Trans ....2 for $3.49

FILAMENT TYPE

2.5V/2A @ .79 2 for $1.49 10 for 6.98
2.5VCT/20A/12KV Insul Csd H'Sld $7.98
5VCT/10A/4KV Insul Csd H'Sld...$5.95
2.5VCT/10A 10KVins ....$ 4.98
5V/115A Csd KENYON HVinsul..$16.95
6.3VCT/.6A/1KV insl Csd........$1.98
6.3VCT/.7A Navy H'Sld Hvinsl....$1.98
6.3VCT/1A Thordason HV Csd.....$1.98
6.3V/2A @ $1.39 ....2 for $2.69
7.5VCT/12A 15KVins KENYON....$10.98
6.3VCT/4A USN Usable 6.5A Hvins $2.69
12.6VCT/1.25A Csd H'Sld........$1.98
24V/2A Csd @ $1.98.......2 for $3.49
24V/6A Csd @ $4.98.......2 for $9.49
Bridge Rectifier UTC CSD/12KVins 2.5V/6, 2.5V/6A, 2.5V/12A..........$8.49
6.3V/.6A, 2x2.5V/1.75A H'Sld....$3.49
2X6.3V/.3A 2X5V/3A.6A, 7V/14A .147 KVA G.E. $4.98

PLATE TRANSFORMER

2X330VCT/25ma or, 660VCT Csd..$1.29
355VCT/325ma 490V Tap Hvins...$4.98
1100VCT/212ma Pri-115 or 230V Csd $6.50
3000V/10ma W.E. D161913 HVins.$8.95
5500VCT/650ma USN Wstghs Csd.$69.95
15000 V as V'Dblr W.E. Sig. 3H5629/7500V $19.95

STEP UP OR STEP DOWN

220V to 110V/100W Ametran......$3.98
440/220V/200W @ $4.98; 220/110V/200W $4.98
Isolation 115 to 115V/185 Watts...$3.98
90, 95, 100, 105, 110, 115, 120 & 220V/2KW $9.95
220/110V/250W G.E. $5.98

CHOKES

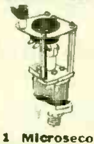
Dual 30Hy/60ma Csd $.98
3Hy/40ma/Hi & Csd UTC 2 for .98
15Hy/40 ma AC/DC sets 3 for .98
12Hy/80ma/Csd/H'Sld/3KVins USN $2.25
10Hy/85ma @ .98; ....2 for $1.79
8Hy/100ma/160∼/Csd/H'Sld / 2KVins / USN $1.49
10Hy/125ma/UTC/Csd/1KVins $1.69
12Hy/200ma Tapped UTC $3.65
59Hy/100ma/Csd 3KVins./H'Sld ..$1.98
50Hy/125ma/Csd/H'Sld $2.25
Dual/12Hy/150ma/Csd/2KVins/H'Sld $2.98
12Hy/300ma/Csd/3KVins/H'Sld ...$3.95
20Hy/300ma or 15Hy/400ma/12KVins $7.95
8hH/225ma Thordason $3.65
10Hy/135ma $1.35

MODULATION and AUDIO XFMRS

MODUL/240 Watts Peak PP Par 807's to PP807's RF/2000 ohm Load STANCOR/USN H'Sld $6.95
UNIV OUTPUT/12 Watts Any Tube Any Voice Coil UTAH 5999.$1.29; 2 for $1.98
Line Auto Former/30W UTC LVM-11.$3.49
Mike or Line to Grid "ouncer" UTC 0.14 50:1/200 ohms to ½ meg $13 List.$2.38
OUTPUT/300 Watts Hi-Fi PP805 to 9 ohm VC, Weco H'Sld HiVins..........$12.98

PULSE TRANSFORMERS

7.5 KV Pulse, Pri 4KV, 50-1000 ohm imped. Permalloy Core, WEco $14.98
Pulse Blocking Osc. 3 wndgs. Video Interstage, 1:1 ratio, 32 mh wndgs, H'Sld, HiVins, GE. $1.98
Pulse Blocking Osc, 3 wndgs, 1:1:1 ratio, 1 mh wndgs, GE. H'Sld, HiVins....$2.98
Pulse Blocking Osc. Video Interstage, 3 wndgs, 1:1:1 ratio, 4.3 mh wndgs, GE. H'Sld, HiVins, 1, s rise time $2.98



MICROWAVE

Klystron Mtg Assy (723 AB) & Coupling to 2 Type "N" Co-Ax Fittings $9.98
3 cm T-Sect. Waveguide & Atten Outpt.
Thermal Comp & Pwr Meas Thermistors Xtal Diode Detector Mtg & Coupling $18.95
Less Xtal Mtg & Thermistor $13.95
1 Microsecond Delay Line. Millen $2.95
Microwave Lighthouse Assy—P/O RT39 Apg & 15. osc & Tr Cavities. Type N Coupling. Uses 2C43, 2C40, 1B27. Tunes 24-2700 MC Less Tubes $29.95

CONNECTORS

UG9/U	$1.90	UG58/U	$0.75
UG19/U	2.20	UG106/U	.10
UG21/U	1.30	UG254/AU	3.40
UG22/U	1.60	CW123U	.55
UG24/U	1.50	M359A	.75
UG27/U	.70	UG30/U	2.45

831R/SO239 Receptacle $0.50
831SPN/PL259A Plug .... .65
831SP/PL259 Plug .... .50
83-1J/PL258 Junction .... .95

METER SPECIALS

5ma Tuning Mtr G.E. 2½" Dia.....$1.29
0-50 UA Weston 3" Sq. 16.98
0-300 Ma Weston 3" Sq. 5.98
0-10 ADC Triplett 3" Sq. 3.98
0-30 ADC 2½" Shunt Weco Wstghs 2.98
0-60 ADC 2½" Int. Shunt Weco... 3.49
0-1A R.F. 2½" G.E. USN Bklt Csd 3.95

OIL CAPACITORS

Mfd	Each
25wvdc	
50	$6.98
50wvdc	
4	.49
150wvdc	
1-1-3-5	.69
250wvdc	
2x.25	.35
300wvdc	
1.2	.39
400wvdc	
.1	.49
.25	.55
.5	.59
1	.69
4	1.69
6	2.29
8	2.49
10	2.89
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.034	.49
.1	.64
.2	.69
.25	.71
.5	.75
1	.85
2	.99
3	1.08
4	1.89
5	2.29
6	2.69
7	2.89
10	3.29
2x.1	..79
2x.25	.85
2x.5	.98
2x1	1.19
2x2	1.39
2x8	3.49
3x.05	.89
3x.22	.98
3x.25	1.09
700wvdc	
4	1.98
800wvdc	
.1	.69

Mfd	Each
1000wvdc	
.1	.73
.45	.79
1	.90
2	1.69
4	2.29
5	2.98
10	3.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.56
.75	1.69
1	1.79
2	2.29
4	2.98
5	3.49
6	3.98
2000wvdc	
.1	1.49
2x.1	1.75
1	1.98
2	2.49
3	3.98
4	4.40
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
.5	2.98
2	4.49
3	5.39
4	6.49
4000 wvdc	
2	8.98
5000wvdc	
.2	4.49
2	10.98
4	19.98
5500wvdc	
2	12.98
7000wvdc	
.002	.1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49

Mfd	Each
10000wvdc	
.03	3.49
12000wvdc	
.02	4.98
12500wvdc	
.65	16.98
2	95.00
15000wvdc	
.0016	9.98
25000wvdc	
.00025	7.49
1	95.00
AC RATED	
220vac/600dc	
2	.69
4	.89
5	1.29
225vac/630dc	
3.3	.79
230vac/630dc	
5	1.29
330vac/1000dc	
1.25	.79
1.5	.89
1.75	.98
2	1.03
2.5	1.09
2.8	1.15
3	1.19
4	1.29
5	1.49
12	3.49
15	3.98
25	6.49
40	9.98
405vac/1200dc	
.15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98

MICA CAPACITORS

Brand NEW Made to Rigid Gov't Specs.

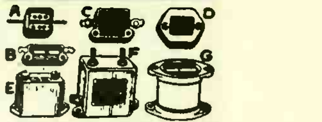


Fig. A. Postage & ½ Postage (*Silver Mica)

Mfd.	Each	Mfd.	Each
.00002	$0.09	.0011*	$0.17
.000022	.09	.0012*	.23
.000024*	.17	.002	.15
.000025*	.17	.00224*	.27
.00004	.09	.0025	.15
.00005*	.17	.003/1KV	.29
.000082	.09	.0033*	.35
.0001	.09	.004	.22
.0003	.09	.004*	.43
.0011	.09	.005	.22
		.006	.23
		.01	.29

Fig. B. .0001 mf, 10c; .006 mf, 23c; .01 mf, 35c.

Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Each	Mfd.	Each
600 WV		600 WV	
.0001	$0.29	.02	$0.76
.001	.42	.03	1.19
.002	.45	1200 WV	
.004	.53	.002	.66
.005	.55	.004	.68
.006	.59	.005	.71
.008	.63	.01	.78
.01	.66	2500 WV	
		.00047	.59

Fig. D. Screw Term & Mtg

Mfd.	Each	Mfd.	Each
600 WV		1200 WV	
.0001	$0.29	.01	$0.78
.00055	.37	.013	.89
.00085	.42	.03	1.89
.0012	.44	.033	2.39
.003	.49	2500 WV	
.005	.54	.0004	.59
.015	.71	.002	1.09
.02	.78	.0022	1.09
.03	1.19	.0024	1.13
.033	1.29	.0035	1.19
.039	1.98	.0036	1.19
.04	2.09	.0043	1.29
.05	2.39	.005	1.45
1200 WV		.006	1.55
.001	.61	.01	1.89
.002	.66	.015	2.19
.0051	.71	3000 WV	
.0068	.75	.005	1.65
		.008	1.79

Fig. E. Upright Xmtg Micas

Mfd.	Each	Mfd.	Each
250 VDC		3000 VDC	
.05	$0.47	.0001	1.08
.2	2.59	.0003	1.15
1500 VDC		.0007	1.19
.04	.89	.005	1.65
.05	1.08	.0055	1.35
2000 VDC		.008	1.79
		3500 VDC	
.003	1.08	.000033	.78
.005	1.19	5000 VDC	
.006	1.25	.000082	1.65
.01	1.39	.0001	1.79
.015	1.68	.00015	2.29
.02	1.98	.00018	2.39
.03	2.35	.0002	2.49
2500 VDC		.0003	2.75
.0025	1.08	.00043	2.85
.006	1.65	.0006	3.59
3000 VDC		.001	3.89
.00005	.78	.01	4.79

Fig. F. Heavy Duty, Upright, Bklte Csd

Mfd.	KV	Each	Mfd.	KV	Each
.003	6KV	$5.59	.01	8KV	$10.95
.0003	8KV	4.98	.0025	8	7.98

HIGH CURRENT MICA CNDSRS

CYLINDRICAL SIMILAR TYPE "G"

MFD	KV	AMPS	MC	EACH
.09	1.5	35	1	$14.98
2X.003	1.5	7	1	2.98
.0002	6	5	3	5.98
.01	10	30	3	49.50
.00005	20	4.5	3	6.98
.0005	35	13	3	39.95
.004	20	22	3	45.00
.0025	20	22	3	45.00
.005	15	30	1	48.00
.0025	12	20	3	28.95
.0015	5	3.3	.3	3.98

ELECTROLYTIC CNDSR SPECIALS!

50 mf/350vdc FP............3 for 98¢
30-15-10mf/250vdc ....3 for 98¢
40-20mf/250-25vdc ....4 for 98¢
30-2x20mf/450-25vdc FP.....2 for 98¢
10-2x20mf/450-25vdc FP.....3 for 98¢
4mf/450vdc "Tynee-Dry"......2 for 98¢
8000mf/15vac SPECIAL..........$3.29

THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 1E SIX CHURCH ST. NEW YORK 6, N.Y. U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

Money Back Guarantee (Cost of Mdse Only) $5 Min. Order FOB NYC. Add Shpg. Charges & 25% Dep. Tubes Gtd via R-Exp. only. Prices Subject to Change Without Notice. Phone: WOrth 2-7230.

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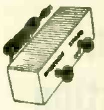
INDEX TO ADVERTISERS



Selenium Power Supply

0 to 12VDC/2 Amp. Variable DC supply, cased and completely built — inpt. 115v/60 cy. Useable LAB supply, filament D.C., plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives.
Special $10.95 Two for $20.00

SOLDERING IRON GUN

SENSATIONAL VALUE, lightweight heavy duty soldering gun, with removable alloy tip — will not corrode, tip is flat, can be used for soldering small and large parts "TAB" Special $9.95

SOLDERING LUGS

TYPE	LGTH	HOLE	PER 1000
A	5/8	8	$2.98
A	1"	3/16	6.98
B	3/4	8	2.98
B	10/16	6	2.98
C	1/2	10	3.06
C	13/16	1/4	2.98
D	9/16	Rivet	2.85
E	1/2	4	2.98
E	1 5/16	6/16	5.95
F	14/16	10	1.58
F	10/16	4	1.28
G	14/16	6	9.98

MFGS, TELL US YOUR HARDWARE NEEDS

SHAKEPROOF SOLDER LUGS

C	5/8	4	500 for $3.44
C	14/16	10	500 for 3.89
DUAL	1 3/8	8	500 for 8.75

Assortment of 60 for 50¢

EYELETS

LGTH	DIA.	PER 1000
3/16	1/8	$2.98
3/8	3/32	4.08
5/8	5/32	5.74
7/32	9/32	7.65

"TAB" THAT'S A BUY

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10 to 20000 cycles with Easel Internationally Famous; For HiFi enthusiasts. Incl Pwr supply, selected parts; Balanced resists $29.95
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SUPER-Wide-Range HIFI TRIODE LOW KIT. 10to20000 cycles, 6B4G's, Max Harmonic Distortion 1¾% at full outpt & only ½% at 5W outpt. Includes Bass & Treble tube boost & Tone ckts 4PreAmp G.E. pickup 5 dual & 2 outpt (7) tubes, Parts, RCA chassis & Info., less output xformer $29.95
UTC Hi-Fi Outpt Xfrm for P.P. 2A3, 6B4, 6A5 & 6L6. Csd cap 30W; Sec 5 taps 2½ to 250 ohms $6.98
GE Reluc Cartridge perm needle....$1.38
GE Dual Reluc Cartridge RPX 050..$7.29
GE Reluc Cartridge RPX040 or 041.$7.29
GE 51201D Hi-Fi Hvy dty 12" PM Spkr $18.98
Sensational 10" HiFiSpkr Ideal 10 Watt Home Size, Concentric, Separate Driver Woofer & Horn **Driver Tweeter—30 to 16000 cps Range** $18.98
Electro Voice EV16H dual twilt Cart.$3.98
"LP" Anti-Static fluid GUD 1000 plays.69¢
Hi Gain Dynamic Mike & Xfrm.....$1.98
XFMR Hmt-sld UTC/Super Elect 3 wdg. 600 ⏜ ct & 400 tapped 250 & 150 ⏜ can be used Mike to Grid, Line to Grid & Line to Line. Csd & Hmt Sld **SPECIAL 49; Ten for** $4.49

Infrared Snooperscope

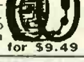

Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 lines/in. Complete data & tube. each.......$4.98; 2 for $9.49

METER SPECIALS

5Ma Tuning Mtr GE 2½" dia......$1.29

DC MICROAMMETERS

0-50 ua Weston 3" sq. 16.98
0-500 ua, 2½" DeJur.......... 6.98

DE MILLIAMETERS

0-1 Ma (Reads 5KV. Less Mult) 3"sq. Weston 7.50
0-10 Ma & 0-5KV (Basic 1 Ma). 3½" 4.98
0-10 Ma & 0-1KW (Basic 1 Ma), 3½" 4.98
0-25 Ma, Weston 3" sq.......... 6.98
0-300 Ma, Weston 3" sq. 5.98

DC AMMETERS

0-1A, 3½ Wstghs 4.98
0-5A, 2½" Triplett 3.49
0-10A, 3" sq Triplett 3.98
0-15A, 2½" Triplett 3.49
0-30A, 2½" Shunt WECo. Wstghs.. 2.98
0-60A, 2½" Int. Shunt. WECo 3.49
0-240A, 2½", Less Shunt 3.98
0-300A, 3" Less Shunt, WECo 4.49
30-0-30A, 2⅜", Weston 203 P & Wstg 4.98
60-0-60A, 2½", W/Shunt. WE/Wstg 4.98
120-0-120A, 2½" Shunt. WE/Wstg 3.98
240-0-240A, 2½", Less Shunt. GE. 3.69

RF METERS

0-1A, 2½" G-E. USN—B'Csd 3.95
0-8A, 3" Triplett Hi-Freq.;Int. Couple 4.98
0-9A, 2½" Wstghs USN 2.49

DC & AC VOLTMETERS

0-8V, 3¼". Weston 3.49
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50 Draw Hvy Steel 34½"H/18"W/9"L/65 lbs. Draws 3"W/2½"H/8"L.. @ $38.
100 Draws as above .... @ $63.
27 Draw Hvy Steel 37"H/30¾"W/14¼"L/120 lbs. Draws 3"H/9"W/12"L @ $39.95

Write for Quantity Price "EXTEND DO"

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2J1G1 GE As Is No Returns...2 for .49¢
2J1H1 GE Selsyns ....2 for $6.98
2J1F3 GE Brand New115V/400cy.ea.$9.75
C78248 Sync.Trans115V/60cy.2for$18.00
C78249 Sync.Diff. 115V/60cy. @ $9.95; 2 for $18.00
Sync Trans. C-69405-2 Type I-I Brand New $27.50 ....2 for $50.
Sync Repeator 115V/60cy Type 11-4 Indv. Cart. New $13.95;.......... 2 for $25.

NEW THRIFT-LITE LIFETIME PHOTO-FLASH

Not a kit. Incl Pwr pck, Life gtd Lamp, Rflctr & 15' cord 1/1000 Sec flash every 7 sec. Truedaylitecolor.Usable all cameras oper 115VAC w/lite Type AC40..$41.98
Complete Outfit for AC & Battery opr. Incl AC40&BP25 portopak & all accssrs for KODAK&COMPUR shutters. Complete $69.95
Write for Complete "THRIFTLITE" Data Boosterpacks. Ext lites, Units for Focal plane shutters & accessories. WE BUY SELL & SWAP.

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U10	GE FT114	100	$ 9.98
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT210	200	10.98
53GT	GE FT403	500	16.98
VA	SYLV. 4330	200	11.98
23MT	FT214	250	10.98
22ST	FT110	200	10.98
353GTQ	FT503	5000	54.98

R4340 FLASH TUBE — Nationally Advtsd @ $57. NEW $36.00
X400 Air Corps Lamp 14.98

866A KIT AND XFORMER

2 Tubes. Sckts, xmfr 115v 60cyc Inpt. outpt 2.5vct/10A/10Kvins $6.98

DIODE PROBE TUBE

Unexcelled for **No-Loss VHF** testing. Ultra-sensitive subminiature-envelope. App. 1¼ x⅜". Element and probt at tip. Low pwr. htr. **Brand New, w/data VR92 25¢; 5 for $1.**

MERCURY THERMO REGULATOR

DUAL CKT. 105°F & 32° F. Extremely sensitive & accurate for most exacting requirements—Research, Fire Prev., Freeze, Pt Control, or Max-Min Temp Control. Brand New. Individ. Boxed w/data & ckt. SPECIAL........**Ea. 98¢; 12 for $10.00**
Ball Pens Gtd Red or Blue...5 for $1.00
Ball Pens Draftsman Black....2 for 1.00

OA2	$1.29
OA3/VR75	1.42
OA4G	1.45
OB2	1.45
OB3/VR90	1.23
OC3/VR105	1.43
OD3/VR150	.98
OY4	2.53
OZ4	.79
VS-1	12.49
C1A	9.75
O1A	.69
1A3	1.10
1A4P	.79
1A5GT	.79
1A6	1.49
1A7GT	1.32
1AE4	1.80
1B3/8016	.98
1B4P	.89
1B5/255	.99
1B7GT	.99
1B21/471A	2.85
1B22	3.23
1B23	9.90
1B24	17.49
1B26	2.65
1B27	24.00
1B32/532A	3.90
1B35	11.98
1B37	18.00
1B38	29.95
1B40	4.95
1B41	49.95
1B42	18.00
1B46	1.98
1B53	49.95
1B56	38.50
1B58	350.00
1B60	69.75
ELIC	2.70
1C5GT	.89
1C6	.79
1C7G	.89
1D5GP	.99
1D7G	.89
1D8GT	.89
1E5	.99
1E7G	.99
1F4	.69
1F5G	.79
1F6	.89
1F7G	.89
1G4GT	.89
1G5G	.89
1G6GT	.79
1H4G	.89
1H5GT	.89
1H6GT	.79
1J5G	1.20
1J6GT	.79
1L4	.69
1L6	.98
1LA4	1.19
1LA6	.99
1LB4	1.29
1LC5	.79
1LC6	1.39
1LD5	.99
1LE3	.99
1LH4	.89
1LN5	.79
1N5GT	.99
1P5GT	.79
1P42	4.75
1Q5GT	.89
1026	69.00
1R4/1294	1.29
1R5	.79
1S4	1.19
1S5	.79
1S21	6.90
1T4	.79
1T5GT	.99
1U4/5910	.69
1U5	.79
1V	.79
1V2	.70
1X2	.99
1Y2	6.98
1Z2	3.98
2A3	1.78
2A4G	1.19
2A5	.69
2A6	.69
2A7	.69
2AC15	4.98
2A515	4.98
2B7	.89
2B22	3.90
2C21/1642	.67
2C22/7193	.33
2C26	.19
2C26A	.47
2C33/RX233A	3.49
2C34/RK34	.69
2C39	33.98
2C40	9.98
2C40 JAN	19.90
2C43	26.75
2C43/464A	9.49
2C44	1.20
2C51	7.98
2C52	5.98
2D21	1.49
2E5	1.19
2E22	1.25
2E24	4.85
2E25/HY65	5.15
2E26	3.49
2E30	2.19
2J21	10.69
2J21A	9.25
2J22	7.90
2J31	29.75
2J31A	79.95
2J32	59.95
2J33	39.39
2J34	38.50
2J36	120.00
2J37	12.70
2J38	17.75
2J39	49.50
2J42	250.00
2J48	28.50
2J49	39.45
2J50	27.50
2J52	249.50
2J56	199.50
2J62	49.45
2K25	31.95
2K25/723AB	29.45
2K29	23.95
2V3G	1.29
2W3GT	.98
2X2	.69
2X2A	1.89
3A4	.99
3A5	1.69
3A8GT	1.59
3B4	2.69
3B5	.98
3B7/1291	.69
3B23/RK22	4.95
3B24	5.40
3B25	4.50
3B26	3.70
3B28	8.80
3C6/XXB	1.49
3C22	125.00
3C23	10.98
3C31/C1B	3.45
3C33	14.98
3C45	19.90
3C34/HK24	5.49
3D6/1299	.69
3D21A	1.95
3D23	4.90
3E29	14.95
3LF4	1.29
3Q4	.79
3Q5GT	1.29
3S4	.79
3V4	.79
4-125A	29.95
4-250A	40.95
4-1000A	108.50
4B27	4.98
4C25/HK54	5.98
4C33	59.00
4C36	15.98
4E27/257	14.98
4J22	148.50
4J31	95.00
4J34	194.00
4J42/700	27.00
4J47	260.00
4J47CY	198.00
4J52	350.00
4T4/2	5.95
4X150A	45.00
4X-500F	85.00
5AX4GT	.54
5AZ4	1.35
5C30/C5B	3.95
5D21	24.30
5D23/RK65	24.95
5J29	12.40
5R4G Spec.	1.49
5R4WGY	2.98
5T4	2.49
5U4G	.77
5V4G	1.39
5W4	.89
5X4G	.79
5Y3GT	.49
5Y4G	.79
5Z3	.99
5Z4	1.29
C6A	6.75
6A3	1.59
6A4	1.89
6A5G	2.39
6A6	.89
6A7	1.32
6A8GT	1.09
6AB4	.79
6AB5/6N5	1.33
6AB7/1853	1.39
6AC5GT	1.09
6AC6G	1.49
6AC7	.99
6AD6G	.98
6AD7G	1.49
6AF6G	1.33
6AG5	.89
6AG7	1.99
6AH5G	1.49
6AH6	1.99
6AJ5	2.16
6AK5	1.39
6AK5W	2.98
6AK6	1.49
6AL5	.69
6AL7GT	1.29
6AN5	5.35
6AQ5	.59
6AQ5W	5.98
6AQ6	1.25
6AQ7GT	1.19
6AR5	.79
6AR6	2.98
6AS5	.79
6AS6	2.79
6AS7G	4.98
6AT6	.82
6AU5GT	1.49
6AU6	.69
6AV5GT	1.29
6AV6	.59
6AW6	1.89
6AX5GT	.79
6B4G	1.78
6B5	1.19
6B6G	.89
6B7	1.19
6B8G	1.09
6BA6	.79
6BA7	1.19
6BC5	.69
6BC7	1.23
6BD5GT	1.65
6BD6	.89
6BE6	.79
6BF5	1.06
6BF6	1.49
6BF7	2.55
6BG6G	1.65
6BG7	1.98
6BH6	.89
6BJ6	.99
6BK7	2.15
6BL7GT	1.45
6BN6	1.49
6BN7	1.69
6BQ6GT	1.29
6BQ7	2.15
6BY5G	1.45
6C4	.69
6C5GT	.79
6C6	.79
6C7	1.26
6C8G	.89
6C21	29.45
6CB6	.89
6CD6G	2.49
6D4	2.85
6D6	.89
6D7G	.89
6D8G	.89
6E5	.89
6E7	1.39
6F4	6.35
6F5	.79
6F6	.99
6F6GT	.79
6F7	1.39
6F8G	1.29
6G6G	1.39
6H4GT	.98
6H6	.89
C6J	6.95
6J4	7.65
6J5GT	.59
6J6	1.29
6J7	1.09
6J8G	1.19
6K4	3.39
6K5GT	1.09
6K6GT	.79
6K7	.85
6K8	.99
6L5G	.79
6L6	2.43
6L6G	1.69
6L6GA	1.69
6L6GAY	2.29
6L7	1.19
6N4	2.39
6N6G	1.69
6N7GT	1.29
6P5GT	.89
6Q7	.89
6R7	.99
6R8	1.39
6S4	.98
6S7G	.89
6S8GT	.99
6SA7GT	.89
6SA7GTY	3.37
6SB7Y	1.19
6SC7	1.39
6SD7GT	.99
6SF5	.89
6SF7	.89
6SG7	1.39
6SH7	.99
6SJ7	.89
6SK7GT	.89
6SL7GT	.89
6SN7GT	.79
6SN7WGT	2.25
6SQ7GT	.79
6SR7	.69
6SS7	1.09
6ST7	1.33
6SU7GTY	3.37
6SZ7	1.05
6T7G	.89
6T8	1.09
6U4/6AX4	.79
6U5/6G5	.99
6U6GT	1.09
6U7G	.69
6V6	2.25
6V6GT	.69
6V8	1.99
6W4GT	.69
6W6GT	.89
6W7G	1.33
6X4	.69

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

6X5GT	.75
6Y6G	1.27
6Y7G	.89
6Z7G	.89
6ZY5G	.89
7A4/XXL	.89
7A5	.99
7A6	.79
7A7	.99
7A8	.89
7AD7	1.49
7AF7	.89
7AG7	1.99
7AH7	1.19
7B4	.79
7B5	.79
7B6	.79
7B7	.89
7B8	.89
7C4/1203A	.79
7C5	.98
7C6	.99
12SQ7GT	.79
12SR7	.98
12X3	.90
12Z3	.89
14A4	1.09
14A7/12B7	.99
14AF7/XXD	1.19
14B6	.99
14B8	.89
14C5	1.09
14C7	1.09
14E6	.99
14E7	1.09
14F7	1.09
14F8	1.29
14H7	.99
14J7	1.19
14N7	1.49
14Q7	1.09
14R7	1.19
14S7	1.09
14W7	1.09
14X7	1.23
45Z3	.69
45Z5GT	.89
46	.89
47	.99
48	1.99
RK48A	14.85
RK49	7.50
49	.83
50	1.19
EF50	.98
50A5	1.19
50B5	.79
50C5	.69
50C6	1.49
50L6GT	.69
50X6	.89
50Y6GT	.79
50Z7G	.98
52	.99
53	.69
T55	8.79
55	1.06
56	.85
CE215	8.98
RX215	9.95
WE215A	.18
217C	8.75
227A	4.98
231	1.20
242C	8.49
244A	4.15
247A	9.95
250R	9.90
250TH	22.25
250TL	19.40
HK254	14.49
262B	3.98
274B/5R4	1.90
276A	9.89
T300	26.98
304TH	11.25
304TL	11.25
307A/RK75	4.85
310A	6.75
725A	7.45
726A	6.90
726B	59.95
726C	69.95
801A	.45
802	3.98
803	3.89
804	8.95
805	3.90
807	1.67
808	2.98
809	2.43
810	10.98
811	2.90
812	2.90
813	8.65
814	3.85
815	2.90
816/866Jr.	1.09
826	.95
828	11.29
829	11.49

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

7C7	1.49
7C23	72.00
7C29	69.95
7E5/1201	1.29
7E6	.89
7E7	.89
7F7	1.25
7F8	2.19
7G7/1232	1.29
7H7	.89
7J7	1.09
7K7	1.29
7L7	1.19
7N7	1.19
7Q7	.79
7R7	.99
7S7	1.09
7T7	1.03
7V7	1.39
7W7	1.19
7X7/XXFM	1.19
7Y4	.69
7Z4	.69
8DC-15	4.98
10Y	.49
12A	.89
12A5	1.39
12A6	.89
12A7	1.29
12A8GT	.79
12AC7	1.45
12AH7GT	1.99
12AK5	1.98
15E	1.47
15R	.89
FG17	4.95
18	.98
19	.69
19BG6G	1.79
19T8	1.09
19V8	1.62
T20/1623	3.79
TUF20	5.19
TZ20	3.79
20	1.17
RK20A	8.95
RX21	3.75
22	.99
24	.85
24A	1.10
24G/3C24	1.90
25A6	1.09
25A7	3.17
25AC5GT	1.59
25AV5GT	1.29
25BQ6GT	1.19
25C6	1.18
25L6GT	.69
25W4GT	.89
25Y6	.79
25Z5	.79
25Z6GT	.99
26	.79
27	.69
FG27A	8.70
RK28A	4.89
57	.79
58	.79
RK59	1.45
59	1.78
T60	10.49
HY69	4.98
70A7	1.59
70L7GT	1.59
71A	.79
72	.95
CRP72	1.37
CRP73	1.49
73	1.67
NR74	.29
HY75	4.59
75	.98
75TL	6.89
76	.79
77	.69
78	1.05
79	.89
80	.69
81	1.69
FG81A	3.90
82	1.19
82V	1.5[illegible]
83	1.45
83V	1.79
84/6Z4	.99
85	.79
89	.75
VR92	.25
311A	7.90
313C	2.98
316A	1.49
323A	24.25
327A	4.95
350B	5.90
353A	4.65
HK354	24.98
355A	14.15
368AS	7.75
371B	.90
380A	.79
388A	1.49
393A	8.90
394A	4.90
FP400	15.98
X400	14.98
417A	8.95
GL434A	29.95
446/2C40	1.19
446B	3.89
450TH	39.00
450TL	44.00
460/HF200	15.95
WL468	13.95
GL471A	2.69
GL502A	1.79
RH507	9.98
GL530	22.00
531	6.98
WL532	3.89
829B	13.45
830B	3.49
832	9.75
832A	9.75
833A	48.90
834	5.95
836	4.75
837	1.55
838	3.98
843	.39
845	4.90
849	29.45
852	19.98
860	4.90
861	23.9[illegible]
864	.39
865	1.29
866A	1.69
868/CEIC	3.49
869	36.95
872A	3.69
GE872A	5.49
874	1.39
878	1.95
884/6Q5G	1.80
885	1.45
893A	250.00
922	1.79
923	1.00
927/CE25	1.49

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

12AK5W	2.98
12AL5	1.11
12AT6	.59
12AT7	1.49
12AU6	.89
12AU7	.95
12AV6	.69
12AW6	1.79
12AX4GT	1.20
12AX7	.99
12AY7	2.95
12BA6	.79
12BA7	.79
12BQ6	1.75
12BE6	.89
12BF6	.85
12BH7	1.29
12BY7	1.35
12BZ7	1.25
12C8	1.39
12F5GT	.79
12H6	.89
12J5GT	.69
12J7GT	.99
12K7GT	.89
12K8	.99
12Q7GT	.79
12S8GT	.98
12SA7GT	.89
12SC7	1.39
12SF5GT	.79
12SF7GT	.59
12SG7	.89
12SH7	1.10
12SJ7GT	.79
12SK7	.89
12SL7GT	.79
12SN7GT	.89
28D7	1.39
30	.79
31	.59
HY31Z	2.75
32	.49
FG32/5558	13.85
32L7GT	1.49
33	.59
34	.69
35/51	.89
35A5	.79
35B5	.79
35C5	.69
35L6GT	.79
35T	4.89
35TG	3.45
35W4	.59
35Y4	.69
35Z3	.79
35Z4GT	.69
35Z5GT	.59
REL36/6J4	.49
36	.65
37	.69
38	.59
RK39	2.89
39/44	.59
CRC40	.59
T40	4.29
TZ40	3.98
40	1.09
HY40Z	3.75
41	.79
42	.69
43	.85
45	.69
45S/VT52	.34
FG95/5560	24.85
FG98	19.95
100TH	8.89
102D	2.98
102G	2.98
FG104	37.98
FG105	18.38
VU111	1.45
HY114B	.75
HY115/145	.79
117L/M7GT	1.59
117N7GT	1.79
117P7GT	1.39
117Z3	.59
117Z4GT	1.39
117Z6GT	1.19
117Z7GT	1.49
F123A	8.49
T125	12.49
F127A	19.98
VT127A	3.90
CV148	4.98
150T	14.50
VT158	14.49
FG166	49.00
FG172	42.50
182B	1.20
FG190	12.80
T200	22.98
201A/CX301A	.98
203A	5.98
205B/VT2	1.69
CE206	3.15
211/VT4C	1.89
550P1	19.95
575A/975	13.75
WL579	10.49
WL579B	12.98
601B	.19
HY615	.25
616	37.00
KU627	18.00
WL670A	11.98
701A	5.89
702A	3.29
702B	5.98
703A	5.98
704A	.98
705A/8021	2.79
707A	10.49
707B	17.49
710A/8011	.95
713A	1.00
NL714	5.95
714AY	5.90
715A	6.45
715B	9.65
715C	24.25
717A	1.49
718BY	48.45
718CY	48.45
719A	49.95
721A	2.49
722A/287	2.45
723A	9.75
723A/B	14.49
724A	3.95
724B	3.45
929	1.33
930	1.2[illegible]
931A	6.90
954	.29
955	.40
956	.39
957	.45
958A	.67
991	.39
SM1000	1.50
CK1005	.85
CK1006	3.49
CK1007	.89
CK1090	2.69
R1100	5.00
R1130	12.00
E1148	1.3[illegible]
HY1231Z	5.[illegible]
1612	1.98
1613/6F6X	.98
1616	.90
1619	.29
1620	5.75
1622	2.69
1624	1.90
1625	.42
1626	.42
1629	.35
1630	.97
1631	1.2[illegible]
1632	.77
1633	.73
1634	.73
1635	1.49
1636	3.19
1644	.95
2000T	149.50

5516	5.98
5517	3.39
5594	6.65
5608A	5.95
5651	3.05
5638	4.79
5654	4.79
5656	19.98
5663	1.85
5670	6.98
5684	14.98
5686	4.25
5687	5.75
5692	7.69
5693	7.69
5694	3.65
5726	4.39
5744/CK619CX	6.49
5749	4.39
5751	5.45
5763	1.70
5812	2.99
5814	5.49
5881	3.29
X6030	4.49
UX6653	.69
8002R	99.50
8005	5.85
8008	6.40
8012	2.89
8013	2.75
8013A	6.45
8014A	28.95
8020	1.25
8025	5.79
9001	1.65
9002	1.29
9003	1.69
9004	.59
9006	.29
Sub-Miniatures	
1AD4	2.95
2E31	1.49
2E36	1.49
2E41	2.39
2E43	1.39
2G21	2.39
CX501X	1.26
CK501AX	1.26
CK502AX	1.79
CK503AX	1.79
CK505AX	1.79
CK506AX	1.79
CK509AX	1.26
CK512AX	1.79
CK522AX	1.79
CK525AX	1.79
CK526AX	2.98
CK528AX	2.39
CK529AX	2.98
CK531DX	.98
CK532DX	.98
CK533AX	1.39
CK534AX	.89
CK536AX	.89
CK537AX	4.98
CK538DX	.89
CK539DX	.98
CK541DK	1.98
CK542DX	.98
CK543DX	.98
CK544DX	.98
CK546DX	1.98
CK547DX	1.98
CK571AX/5886	6.98
CK573AX	2.98
SD828	.98
CK1027	3.35
CK1028	9.98
CK1089	4.69
CK1090	4.69
CK5672	3.15
CK5676	2.98
CK5678	2.45
CK5697	5.98
CK5702	5.98
CK5704	5.79
CK5783	6.69
CK5784	4.49
5829	5.98
CK5851	4.98
CK5875	1.98
C'Ray Tubes	
2AP1	11.90
3AP1	12.95
3AP1	14.25
3BP1	7.95
3BP1A	14.98
3CP1	2.20
3DP1	4.85
3EP1	4.98
3GP1	4.70
3FP7	1.89
3FP7A	14.98
3HP7	3.85
3HP14	14.98
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.69
2050	1.79
2051	1.19
R4340	36.00
5AP1	5.98
5BP1	4.59
5BP1A	14.98
5BP4	4.75
5CP1	4.89
5CP7	4.95
5CP7A	9.98
5FP7	2.95
5FP14	18.98
5HP1	9.75
5HP4	9.75
5JP2	24.40
5LP1	29.95
5MP1	9.75
5NP1	5.85
7BP1	4.95
7BP7	6.75
7JP4	18.39
9GP7	14.89
9LP7	10.95
10BP4	18.29
10FP4	24.50
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	16.89
12HP7	16.89
12JP4	27.00
12KP4	47.00
902	10.65
905	3.49
912	89.98
913	11.98
914A	45.00

Vacuum Capacitors

MMF	5KV	Each
25	5	3.49
100	7.5	6.95
12	20	9.98
50	20	9.98
50	5	1.29
55	20	9.98
100	20	12.98
150	20	14.98
12	32	12.98
25	32	14.98

Tungar Bulbs

16x897	3.49
20x672	2.95
199698	4.49
195528	2.49
206501	3.59
217283	6.75
289881	2.50
859483	2.95

Mazda Pilots

49, box 10	.60
51, box 10	.55
55, box 10	.50
64 each	.07
56/T4/3W	.18
100W/20V	.25
291, box 10	.36
311/28V	.15
313/28V	.15
323/3V	.23

Xtal Diodes

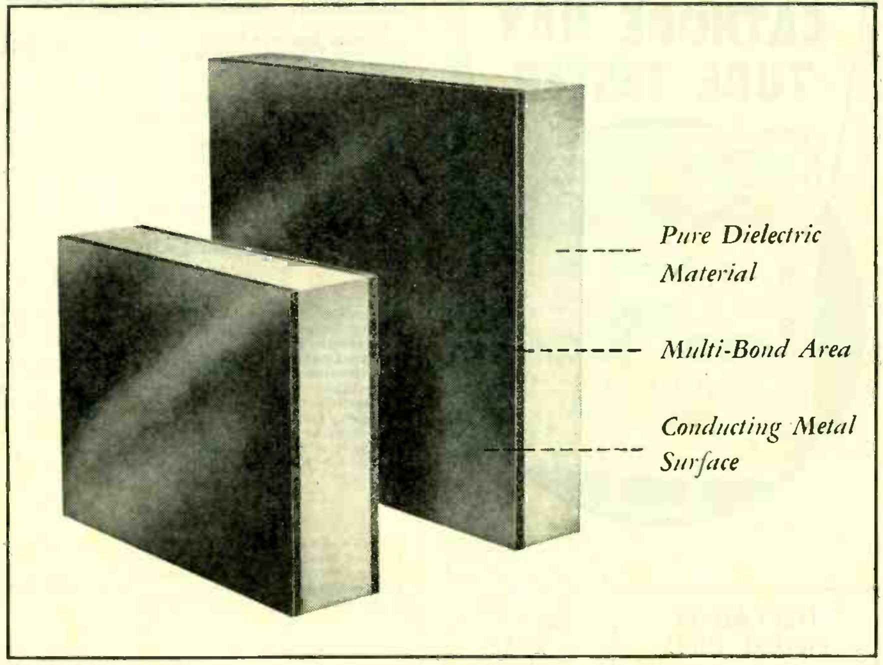
Many Late Dates Latest JAN Specs

1N21	.89
1N21A	1.65
1N21B	3.98
1N21C	27.45
1N22	1.25
1N23	1.49
1N23A	2.98
1N23B	4.98
1N25	7.45
1N26	9.15
1N27	1.65
1N29	3.50
1N32	24.50
1N34	.69
1N34A	.98
1N35	1.95
1N38	1.65
1N39	5.98
1N40	9.98
1N43	1.69
1N45	1.39
1N44	1.21
1N46	.98
1N47	9.50
1N48	.70
1N51	.52
1N52	1.85
1N54	.89
1N55	2.99
1N56	.89
1N57	.89
1N58	1.19
1N60	.60
1N61	1.98
1N63/K63	2.49
1N64	.75
1N67	1.95
1N69	1.98
K34	1.39

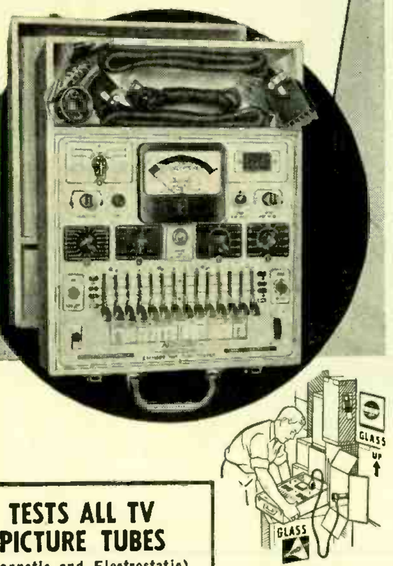
THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 1E SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

Money Back Guarantee (Cost of Mdse Only) $5 Min. Order FOB NYC. Add Shpg. Charges & 25% Dep. Tubes Gtd. via R-Exp. only. Prices Subject to Change Without Notice. Phone: WOrth 2-7230.


Pure Dielectric Material
Multi-Bond Area
Conducting Metal Surface

THE NEW
"PRECISION" CR-30
CATHODE RAY
TUBE TESTER



TESTS ALL TV PICTURE TUBES
(Magnetic and Electrostatic)
'SCOPE TUBES AND INDUSTRIAL CR TYPES

IN FIELD, LAB & WAREHOUSE
Tests CR Tubes without removal from chassis or carton!

A complete and self-contained Electronic Instrument. Incorporates a TRUE BEAM CURRENT Test Circuit. Checks overall electron-gun performance for proportionate picture brightness. Additional tests for accelerating anodes and deflection plate elements.

The Precision CR-30 should not be confused with mere adapters connecting to ordinary receiving tube testers which were never designed to meet the very specialized needs of CR tube checking. Similarly, it is not to be confused with neon-lamp units or similar devices of limited technical merit and which do not check all CR tubes or all tube elements.

GENERAL AND TECHNICAL SPECIFICATIONS

★ **Tests All Modern Cathode Ray Tubes. Tests All CR Tube Elements:** Not just a limited few.

★ **Free-Point 14 Lever Element Selection System,** independent of multiple base pin and floating element terminations, for Short, Leakage and Quality Tests.

★ **True Beam Current Test Circuit** checks all CR Tubes with Electron-gun in operation. It is the **Electron Beam** (and NOT total cathode emission) which traces the pattern on the face of the CR tube. The significance of the above rests in the fact that Beam Current (and picture brightness) is primarily associated with the condition of the center of the cathode surface and not the overall cathode area.

★ **Voltage Regulated, Bridge Type VTVM** affords super-sensitive tube quality indications and positive check of low current anodes and deflection plates.

★ **Micro-Line Voltage Adjustment Meter-monitored at** filament supply.

★ **Accuracy** of test circuits closely maintained by use of factory adjusted internal calibrating controls; plastic insulated, telephone type cabled wiring; highest quality, conservatively rated components.

★ **Built In, High Speed, Roller Tube Chart.**

★ **Test Circuits** Transformer Isolated from Power Line.

★ 4⅝" **Full Vision Meter** with scale-plate especially designed for CR tube testing requirements.

★ ★ ★

SERIES CR-30—In hardwood, tapered portable case. 17¼" x 13¾" x 6¾". Complete with standard 12 pin tube cable and universal CR Tube Test Cable.

Shipping Weight: 22 lbs....................Net Price: $99.75

See the new CR-30 on display at leading electronic equipment distributors. Place your orders now to assure earliest possible delivery.

Precision Apparatus Co., Inc.
92-27 HORACE HARDING BLVD.
ELMHURST 10, N. Y.

Export: 458 B'way, N.Y.C., U.S.A. Cables: MORHANEX
In Canada: Atlas Radio Corp. Ltd., Toronto, Ontario

SEARCHLIGHT SECTION
(Classified Advertising)

ADVERTISERS INDEX

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You Can Depend on DAVEN for Accuracy in Attenuators

For many years Daven has beeen known for the quality of its attenuators. And, although Daven production has grown to include a wide variety of instruments for the electronics industry, the development of its attenuators has grown apace. Much of the testing equipment used by Daven to guide them in the manufacturing of attenuators has been developed by Daven's own engineering specialists. As a result, Daven attenuators have become the standard of the industry, by which all other similar equipment is measured. Shown and described here are two of the newest units that are typical of the vast Daven line of attenuators. Your inquiry for specific information to apply to your own particular problems is invited. Let Daven furnish you with completely detailed catalog data.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, N. J.

RF Attenuation Network

This equipment is an exclusive Daven development. It is a moderately priced attenuator incorporated in an RF Attenuation Box to insert accurate losses from D.C. to 225 MC. The unit has many applications where attenuation of UHF is desired, since it can be utilized as an all-purpose laboratory and test instrument.

SPECIFICATIONS:

ZERO INSERTION LOSS OVER ENTIRE FREQUENCY RANGE.
FREQUENCY RANGE: Zero to 225 MC.
IMPEDANCE ACCURACY: Within ±5% over frequency range.
ATTENUATION ACCURACY: ±5% over frequency range.
CONNECTORS: Receptacles are supplied. Cable plugs, if required, will be supplied at a slight additional cost. When ordering, specify which type connector is desired—either Series "BNC" (UG-185/U) or Series "N" (UG-58/U).
CIRCUIT: Constant input and output impedance (unbalanced). Zero initial loss.
RESISTOR ACCURACY: ±2% at D.C.

Carrier Frequency Decade Attenuator

This equipment is particularly applicable to extremely accurate measurements from D.C. to 200 kc. and can be used up to the lower radio frequencies. The Decade type switches make the box convenient to use. In addition, there are switch stops which prevent return from full to zero attenuation when making adjustments. A total of 110 Db. is available in 1.0 Db. steps, or 111 Db. is available in 0.1 Db. steps. Both of these types may be obtained in either a balanced H or an unbalanced T network.

SPECIFICATIONS:

ACCURACY: Each individual resistor is adjusted within ±0.25% of its correct value. The error in attenuation is less than ±1% of the indicated value, provided the output is matched by a pure resistance.
FREQUENCY ERROR: At frequencies below 200 kc., the total error in attenuation will not be greater than ±1% of the indicated value.

TYPICAL ICAS* OPERATING CONDITIONS
Class C Telegraphy and FM Telephony

Heater Voltage			6.3 volts
Heater Current			1.25 amps
	Below 60 Mc.		At 175 Mc.
DC Plate Voltage	600	750	400 volts
DC Grid-No. 2 Voltage	180	160	200 volts
DC Grid-No. 1 Voltage	−85	−85	−54 volts
DC Plate Current	150	120	150 ma
Power Output (Approx.)	69	69	35 watts

*Intermittent Commercial and Amateur Service.

Another RCA First... the RCA-6146

New beam power tube for VHF transmitters

Specifically designed for VHF transmitter applications, the new RCA-6146 features low-cost, small size, unusual ruggedness, and high power sensitivity. It can deliver an output of 35 watts at 175 Mc under ICAS conditions, with a plate voltage of 400V., and a plate current of 150 ma. Adequate driving power can be obtained from a 5763, 2E26, or another 6146, depending upon the circuit design requirements.

The RCA-6146 employs a rugged button-stem construction with short internal leads, and an octal base with short metal sleeve which shields the input to the tube so completely that no other external shielding is required. Input and output circuits are well separated by bringing the plate lead out at the top of the bulb. Base pin connections permit three connections to the cathode, to provide good rf grounding.

For complete technical data on the RCA-6146 and RCA-6159, write RCA, Commercial Engineering, Section 42AR, Harrison, N. J., or your nearest RCA field office.

FIELD OFFICES: (East) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J. (Midwest) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill. (West) Madison 9-3671, 420 S. San Pedro St., Los Angeles, Calif.

Another **new RCA tube**

The *RCA 6159*, identical with the 6146 except for its heater rating of 26.5 volts, 0.3 amperes, is designed for VHF service in aircraft application.

The Fountainhead of Modern Tube Development is RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES ***HARRISON, N. J.***