ELECTRONIC TOMATO GRADING
Precision Production to Military Requirements

The manufacture of transformers and associated devices for military requirements has been one of the specialties of United Transformer for the past fifteen years. Thousands of military designs are in present production and a few examples are illustrated above.

In this photograph you will find transformers, reactors, filters, high Q coils, and magnetic amplifiers. Types illustrated include units to MIL-T-27, JAN-T-27, and ANE-19.

If you have a tough problem in an Hermetic or Fosterized unit, UTC is your logical production source.

United Transformer Co.

150 VARICK STREET
NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: “ARLAB”
### JANUARY • 1952

#### ELECTRONIC TOMATO GRADING
California inspector B. A. Marchette uses photoelectric equipment to check color of shipment going to the Richmond-Chase canny in San Jose (see p 92)

82

#### AIRCRAFT PLANTS AND ELECTRONIC ENGINEERS, by John Markus
Why they were hired, types of work they do and how they build bigger markets for the electronic industry

86

#### STANDARDS CONVERSION OF TV SIGNALS, by V. K. Zwoykin and E. G. Ramberg
Problems involved in converting from one set of standards to another having a different frame rate

92

#### TOMATO CLASSIFICATION BY SPECTROPHOTOMETRY, by Traver J. Smith and Richard A. Huggins
Accurate grading of tomato color by state inspector using this equipment antiques subjective method previously used

95

#### SINGLE-BAND AUDIO GENERATOR, by Peter G. Sulzer
New circuit that simplifies telemetering control is applicable to video and low radio frequencies

98

#### ACCURATE TIME FOR SCIENTIFIC OBSERVATIONS, by Fred E. Fowler
Synchronous clocks far from power line are kept in step with WWV by selsyn control of crystal standard

101

#### MAGNETIC CENTERING OF ELECTROSTATIC C-R TUBES, by S. L. Reiches and D. P. Ingle
Describes and evaluates three basic types of p-m centering units

104

#### TUNABLE MINIATURE MAGNETRON, by D. A. Wilbur, P. H. Peters and H. W. A. Chalberg
Fits miniature 7-pin tube socket and furnishes up to 0.5 watt from zero to 1,000 mc

110

#### REDUCING OUTAGE AT WNB$ and WNBC-FM, by Lester A. Looney and Frederick A. Everett
Toggle switch on control console puts television program on emergency transmitter within seconds

114

#### NUCLEAR-RESONANCE MAGNETIC FIELD CONTROL, by H. A. Thomas
Field of a 35-ton magnet is controlled by servo system in grid circuit of four parallel 807’s

119

#### JOB EVALUATION CHART, by R. W. Johnson
Permits systematic comparison of employment opportunities

120

#### AUTOMATIC ANTENNA WAVE-FRONT PLOTTER, by Robert M. Barrett and Malcolm H. Barnes
Near-field microwave antenna patterns are plotted automatically and accurately by this device

128

#### SPECIFICATIONS FOR COLOR TV FIELD TESTS
Compatible color signal adopted by NTSC for test purposes in five cities

132

#### SHORT-PULSE AMPLIFIERS, by George F. Myers
Twelve-tube distributed-line amplifier for 0.015-microsecond pulses

UHF RECEIVING ANTENNAS (Reference Sheet), by E. O. Johnson and J. D. Callaghan
Performance data on five types found to be outstanding for 470 to 890-mc uhf television band

132

### BUSINESS BRIEFS

<table>
<thead>
<tr>
<th>Business Briefs</th>
<th>Electrons ABT</th>
<th>NEW BOOKS</th>
<th>BACKTALK</th>
<th>INDEX TO ADVERTISERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>83</td>
<td>136</td>
<td>140</td>
<td>144</td>
</tr>
</tbody>
</table>

### ELECTRONICS

Vol. 25, No. 1


Subscriptions: Address correspondence to Electronics—Subscription service, 99-129 North Broadway, Albany, N. Y., or 530 W. 42nd St., New York 36, N. Y. Allow ten days for change of address. Please indicate position and company connection in all subscription orders.

Sample copies for Editorial Blanks and Overseas, and Canada, $1.00 per copy; $2.00 for Latin America; $6.00 for all other foreign countries. Buyers' Guide $2.00. Subscription rates—United States and Canada, $12.00 for one year; $24.00 for two years, $36.00 for three years. This American edition $30.00 a year for Latin America, $60.00 for one year, $120.00 for two years, $180.00 for three years. All other countries $20.00 a year; $40.00 for two years; $60.00 for three years. Canada, $19.00 a year; $38.00 for two years; $57.00 for three years. All other countries $30.00 a year; $60.00 for two years; $90.00 for three years. Canadian subscription rates by mail for one year, $3.00. All Rights Reserved. BRANCH OFFICES: 309 North Michigan Avenue, Chicago 11, Ill.; 60 Post Street, San Francisco 4; Alden House, Alden House, London, W. 1; Washington, D. C.; Philadelphia, Rf, Cleveland 15; Nashville St., St. Louis 1; Boston 17; Atlanta 3; GZ. 1111 Wilshire Blvd., Los Angeles 17; 138-8 Oliver Building, Pittsburgh 22. ELECTRONS is indexed regularly in The Engineerings Index.
setting new standards for electrical instruments

**MARION RUGGEDIZED METERS**

This amazing new family of Marion ruggedized electrical indicating instruments sets new standards of quality and accuracy in electrical measurement. Marion "Ruggedized" instruments give better performance in *any* application. Use them with confidence even where you never before dared use "delicate instruments." They exceed all JAN-I-6 requirements, are *hermetically sealed* and completely interchangeable with existing JAN 2½" and 3½" types.

Marion Ruggedized instruments perform perfectly under critical conditions of shock, vibration, mechanical stress and strain. Hermetic sealing makes them impervious to weather and climate.

When you want the *best* in meters for any application — from bulldozers to Geiger Counters — insist on Marion, the name that means the most in meters.

Send for our booklet on Marion Ruggedized Instruments. Marion Electrical Instrument Company, 401 Canal Street, Manchester, New Hampshire.

**MARION MEANS THE MOST IN METERS**

Canadian Representative: Astral Electric Company, 44 Danforth Road, Toronto, Ontario, Canada
Export Division: 458 Broadway, New York 13, U.S.A., Cables MORHANEX

**MARION RUGGEDIZED METERS**

Manufacturers of Hermetically Sealed Meters Since 1944
Phonic Motors and Timing Devices

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 10³. 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.

MOTOR TORQUE

The Timing Device Type D-I95-A provides an impulse of 1/10 second duration once every second, whose the motor is supplied with power at a frequency of 100 c/s.

The Timing Device Type O-I95-A provides an impulse of 1/10 second duration 6 times per minute. In addition, an impulse of 1/2 second duration once per minute. A worm and wheel adjustment allows phasing corrections.

Designed for use at frequencies from 50 c/s to 2,000 c/s, Phonic Motors of this type form the nucleus around which are built the timing devices illustrated on this page.

MUIRHEAD & CO. LTD.
PRECISION ELECTRICAL INSTRUMENT MAKERS
BECKENHAM•KENT•ENGLAND

Telegrams and Cables: MUIRHEADS ELMERS-END
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.
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.

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 $-67^\circ F$ to $+275^\circ F$, 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.

SCINTILLA MAGNETO DIVISION
OF
SINDY, NEW YORK

ELECTRONICS

January, 1952 — ELECTRONICS
**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 I²R 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 LSG—**

- **Low-loss**
- **Silicone-impregnated**
- **Glass-encased**

Our specialty is engineering capacitors to exacting requirements. We invite your inquiries.

**MANUFACTURERS**

Glassmike Capacitors
Plasticon Capacitors
HiVolt Power Supplies
Pulse Forming Networks

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

- Radio frequency coupling
- De-spiking networks
- Pulse-coupling
- Radio frequency bypass
- Pulse forming networks
- Audio frequency coupling
- Low and high pass filter networks
- Frequency determining circuits

**All Phones: AMbassador 2-3727**

**Condenser Products Company**

7517 North Clark Street • Chicago 26, Illinois

ELECTRONICS — January, 1952
A New Concept in Precision Potentiometers...

THE MODEL J
Helipot

Precise Mechanical Concentricity
High Electrical Accuracy
Ball Bearing Construction
Independent Phasing

...combined with mass-production economies!

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 % of an inch-ounce (+.25 in.

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

THE Helipot CORPORATION
South Pasadena 2, California


January, 1952 — ELECTRONICS
Brings you all these new features:

**COLOR TV**
More than 100 pages give you one of the most up-to-date treatments of color TV in book form, covering color fundamentals and describing six television systems—the field sequential type and five of the dot-sequential simultaneous type.

**RECENT DEVELOPMENTS**
Among the many new developments covered with understandable explanations are:
- stagger tuning of i-f amplifiers
- intercarrier sound reception
- distributed amplification
- the keyed clamp circuit
- offset carrier reduction of co-channel interference
- tone gradation correction amplifiers
- reaction type power supplies
- u-h-f and s-h-f transmission equipment
- barrowing and supertwinsite transmitting radiators
- new camera tubes and picture tubes

**CIRCUIT DIAGRAMS**
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
1. The Television System
2. Analysis and Synthesis of Images
3. Cameras and Picture Tubes
4. Scanning and Synchronization Methods
5. Transmission of the Video Signal
6. Video Amplification
7. Carrier Transmission of Pictures and Sound Signals
8. Color Fundamentals
9. Color Television Systems
10. Television Broadcasting Equipment
11. Television Receivers
Appendix: Standards of Good Television Practice

10 DAYS’ FREE EXAMINATION
JUST MAIL COUPON

**NOW READY**
The completely revised and rewritten Second Edition of Fink’s great TV book

Here is the volume that gives you working knowledge of the complete television system—prepares you fully for technical work in designing television systems—operating television equipment—or understanding the details of receiving equipment. Much has been done in advancing television technology in the past few years—much more is to come. This book gives you the essential grounding and the knowledge of today’s practice that will equip you to take advantage of the opportunities ahead in this great field.

**TELEVISION ENGINEERING**

THE thoroughness with which Donald Fink presents the great and rapid advances in television technology makes this second edition more than a revision. 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 technology, such as scanning and waveforms 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.

**By Donald G. Fink**
Editor, Electronics; Vice Chairman, National Television System Committee

721 pages 512 illustrations $8.50

**McGraw-Hill Book Co., 330 W. 42nd St., N.Y.C. 36, N.Y.**

Send me Fink’s Television Engineering for 10 days’ examination on approval. In 10 days I will send $8.50, plus few cents for delivery, or return book postpaid. (We pay delivery if you remit with this coupon; same examination and return privilege.)

<table>
<thead>
<tr>
<th>PRINT</th>
<th>Name ____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Address</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>Zone</td>
</tr>
<tr>
<td>Company</td>
<td></td>
</tr>
<tr>
<td>Position</td>
<td></td>
</tr>
</tbody>
</table>

This offer applies to U. S. only.
BUSINESS IN MOTION

To our Colleagues in American Business...

The fact that a Revere Distributor is now celebrating its 125th anniversary year is an indication of the service the company has given its customers through those years. It is also another proof of the essential function performed by distributors for American industry. Most goods, whether industrial materials such as copper and copper alloys, aluminum alloys, iron and steel, or consumer articles such as refrigerators, radio and television receivers, kitchen utensils and ranges, go through the hands of distributors. Generally speaking, only the large buyers are in a position to purchase direct from manufacturers, who do not find it economical to handle the smaller orders. Yet those orders when pooled in the hands of an organization set up to handle them attain sizable totals, and hence a good distributor account is exceedingly attractive to a large manufacturer such as Revere.

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 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.

REVERE COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
Executive Offices: 150TH YEAR OF SERVICE TO AMERICA
230 Park Avenue, New York 17, N. Y.
SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

January, 1952 — ELECTRONICS
we don’t say
you can wave
goodbye to
this

but

we can show you how to use it
less and less and less and less

For more information on how Centralab Printed Electronic Circuits can offer you big savings... See Next Two Pages.
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.

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.

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.

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 13/16" x 3/8" x 13/32". 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 AUDERT, it is designed to couple the diode triode and pentode tubes in the output stage of AC-DC sets. Check coupon for Technical Bulletin 42-149.

**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.

**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.

AMPEC — A full 3-stage speech amplifier. Provides highly efficient performance. Size 1 1/16" x 1 1/6" x 3 4/6" over tube sockets! Used in hearing aids, mike preamps and other applications where small size and outstanding performance counts. Technical Bulletin 42-117.

---

**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.

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 42 mm. Round, rectangular or oval, cut to specified lengths, headed or plain.

SUPERIOR TUBE COMPANY • Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800

January, 1952 — ELECTRONICS
LEADING TV MANUFACTURERS REPORT—

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

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
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.
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.

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-CR-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 1 1/2 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"

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

January, 1952 — ELECTRONICS
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.

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
Announcing

Remember, Sealtrons protect sensitive parts

This is YOUR plant!

SEALTRON'S new plant and general offices in Cincinnati, Ohio utilize the most advanced techniques and manufacturing methods ever conceived for the production of hermetic seals...to give you

IMMEDIATE DELIVERY
HIGHEST QUALITY
REALISTIC PRICES

January, 1952 — ELECTRONICS
sales representatives

for SEALTRON
glass-to-metal
hermetic seals

100 SERIES 27 SIZES AND VARIATIONS

70 SERIES 18 SIZES AND VARIATIONS

90 SERIES 24 SIZES AND VARIATIONS

SEALTRON SUPPLIES COMPLETE SUB-ASSEMBLIES WITH SEALS

THE SEALTRON COMPANY
9701 READING ROAD • CINCINNATI 15, OHIO • TELEPHONE VALLEY 8500

ELECTRONICS — January, 1952
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.

ERIE RESISTOR CORP., ERIE, PA.
LONDON, ENGLAND . . . TORONTO, CANADA
MUST YOUR EQUIPMENT BE RADIO INTERFERENCE FREE?

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, cell 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 Dynamotors
Generators Power Plants
Inverters Actuators
Electronic Gasoline
Controls Engines
And other RF Interference producing equipment

THE FILTRON CO., INC.
FLUSHING, LONG ISLAND, NEW YORK
LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS

ELECTRONICS — January, 1952
Seletron
SELENIUM
RECTIFIERS

May be up your alley, too!

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

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!
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 co-operation 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... MICRO MS SWITCH FREEPORT, ILLINOIS

Honeywell Mercury Switches

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
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 EM9-430(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 Stanton Ave., Phila. 44, Pa.

LEEDS &...
As the tempo and complexity of today's research and engineering activities accelerate, more and more investigators are stepping up efficiency through use of timesaving 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 9" 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. Through 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 µv. 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).
CHASE warehouses from coast to coast offer complete metal cutting services!

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!
±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.

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

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 . . .

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

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

---

Send this convenient coupon now

**Irvington**

VARNISH & INSULATOR COMPANY

Irvington 11, New Jersey

Plants: El Monte, California Hamilton, Ontario, Canada

**Look to IRVINGTON**

for insulation leadership

INSULATING VARNISHES

VARNISHED CAMBRIC

VARNISHED PAPER

VARNISHED FIBERGLAS

INSULATING TUBING

CLASS "H" INSULATION

---

Irvington Varnish & Insulator Company

6E Argyle Terrace Irvington 11, N. J.

Gentlemen:

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

Name........................................Title.....................................

Company........................................Address........................................

City........................................State........................................

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

ELECTRONICS -- January, 1952
IF IT'S SHEET METAL FABRICATION . . . CALL ON

COLE
STEEL EQUIPMENT COMPANY

Tough assignments are part of our day's work. Whatever the product—instrument housings, boxes, chassis—we're geared to design, fabricate, and finish.

Years of experience and a superbly equipped plant give meaning to our statement: "If you have a sheet metal problem, we can solve it".

Inquiries Invited

manufacturers of the famous
Cole steel office equipment

COLE
COLE STEEL EQUIPMENT CO.


January, 1952 — ELECTRONICS
MODEL 24IF
Fixed only
Capacitances up to 60,000 muf.; 1 mc. current ratings: 175, 350, 525 amps.; Safety gap settings: 14, 25, 38, 50, 63 Kv peak.

MODEL 118—Fixed or Variable
MODEL 111—Variable only
MODEL 11F—Fixed only
Capacitances up to 15,000 muf.; 1 mc. current ratings: 120, 240, 360 amps.; Safety gap settings: 6, 14, 25, 38, 50, 63 Kv peak.

MODEL 112—Fixed or Variable
Capacitances up to 8000 muf.; 1 mc. current ratings: 85, 170, 255 amps.; Safety gap settings: 6, 14, 25, 38, 50 Kv peak.

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

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.
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, wide-band, 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.

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.

HEWLETT-PACKARD COMPANY
2371 A PAGE MILL ROAD · PALO ALTO, CALIFORNIA, U.S.A.
FIELD ENGINEERS IN PRINCIPAL AREAS
Export: Frazor & Hansen, Ltd., San Francisco, New York, Los Angeles

Complete Coverage HEWLETT-PACKARD
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 frequency apparatus 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.

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.

Complete Coverage

ELECTRONICS — January, 1952
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 POWER-STAT 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


January, 1952 — Electronics
ELECTRONICS — January, 1952

**NEO-SIL CORPORATION**

**Master Pieces of Hermetic Sealing —Proven to Eliminate Rejects!**

**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. E3-LW terminals are now being used at 1000 psi static oil pressure and under 5000 psi tests."

**FLASHOVER VOLTAGES**

- 6000V 5.00V
- 6500V 5.35V
- 7500V 5.00V
- 10000V 5.45V

**NEO-SIL HERMETIC SEAL**

**INDIVIDUAL TYPE TERMINALS**

**TEST DATA**

The result of the Electrical Testing Laboratories Inc., Report No. 330665B, dated March 18, 1949, on this material shows the following:

- Volume Resistivity at 800 Volts d-c
- Room Temperature 25°C
- R.H. 20 percent
- Megohmeters: 1.4 x 10^9
- 3.5 x 10^9
- Dielectric Constant and Dissipation Factor
  - Diclectric Constant
  - Dissipation Factor

**E-3LW TERMINAL**

- 1/4" SHAFT
- WATERSEAL BUSHING

"Rotary Waterseal Panel Assemblies, with NEO-SIL Packing Gland, have an excellent five year customer history on gas filled pressurized components. They are available for 1/4" shafts and for potentiometers and switch bushings."

"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."

Your special problems are solicited.
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.
NOW YOU CAN MOVE FROM
IDEA TO EQUIPMENT FAST

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 ter-
minal 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
unit cards — components and housings — are all planned in one step.

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

Solder terminal cards and sockets quickly rivet to Alden
terminal card according to layout on Unit Planning
Sheets. Components snap into the special Alden
Miniature Terminals which hold them for solder-
ing. — (No twisting or wrapping of leads neces-
sary). — 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
a tremendous number of circuit variations — to make
next tube and component sub-assemblies with a minimum of wiring.

For Smaller Units Alden
"20" Plug-in Packages

Here is a plug-in package unit using the above
method of converting schematic into finished as-
sembly quickly. Simply mount the completed ter-
minal card sub-assembly on the Alden "20" Non-
Interchangeable base, dip soldering the leads and
adding cover or housing and handle ... In opera-
tion, visual or instrument checks are easily made — if trouble occurs doubtful units are quickly
isolated — these units easily unplug and a compre-
rehensive 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

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 con-
gested 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 panel design of chassis — allows theo-
stats, 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 aldend Tanger Screws.

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

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."

ALDEN PRODUCTS COMPANY
117 North Main Street • Brockton • Massachusetts
A COMPLETE APPROACH TO
SINGLE TRANSIENTS
and PULSES
of low-repetition rate

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.

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.

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.

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 oscillogram 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

ALLEN B. DUMONT LABORATORIES, INC.
Instrument Division
1000 Main Avenue, Clifton, N. J.

January, 1952 — ELECTRONICS
Serving the Nation for 28 Years

Miller
Coils for Industry

R.F. Coils for Military and Civilian Electronic Equipment

Offering expanded production facilities
28 years of specialized experience
Progressive engineering
Modern manufacturing methods
Rigid quality control

Air core and powdered iron core coils - Standard or to Specifications

Inquiries invited

J.W. Miller Company
5917 South Main St., Los Angeles 3, California

In Canada—Atlas Radio Corp., Ltd. 560 King St. West, Toronto 2B
YOUR COPY

of this new book awaits your request

...the technical portrait of an unusual product

G A & F Carbonyl

January, 1952 — ELECTRONICS
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.

ANTARA CHEMICALS
DIVISION OF
GENERAL DYESTUFF CORPORATION
435 HUDSON STREET • NEW YORK 14, N.Y.

Iron Powders...
Designed Right
Built Right

Carboloy Alnico permanent magnets
Delivered Right on Time

and with

Energy-Potential Right

Do you need permanent magnets . . . to improve a meter, motor, instrument or other essential product? To modernize a chuck or holding assembly? Or for one of the many communication applications?

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.

If you need help in a hurry on permanent magnets, contact Carboloy magnet engineers now. Turn your problem over to them. Send specifications, or write for Standard Stock Catalog PM-100.

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

FIRST IN MAN-MADE METALS FOR BETTER PRODUCTS

“Carboloy” is the trade-mark for the products of Carboloy Department of General Electric Company
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\(\frac{1}{4}\)"", 1\(\frac{1}{8}\)", 2\(\frac{1}{4}\)"
Sealed Relay—3\(\frac{1}{4}\)", 1\(\frac{1}{2}\)", 2\(\frac{1}{4}\)"
Overall Mounting Flange—3\(\frac{1}{4}\"
Center to Center Mounting Holes—2\(\frac{1}{4}\)"

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.

Bulletin PK gives complete details. Send for your copy today.

Be sure to send for your copy of Allied's Relay Guide. It gives the engineering data for 2 Allied relays in a concise tabular form for easy reference.

ALLIED CONTROL COMPANY, INC. 2 EAST END AVENUE, NEW YORK 21, N.Y.
Here's what France brings you
Front of technical progress...

SOCIÉTÉ INDUSTRIELLE
S. A. AU CAPITAL DE

DES PROCÉDÉS LOTH
150 006.000 FRANCS

TÉL.: MÉN. 52.94

ALL PROFESSIONAL MATERIAL OF
TELECOMMUNICATIONS

DETAILED LEAFLETS ON REQUEST

RADIO-BEACON 75 M/5

V.H.F. TRANSMITTER
for airport control tower

COMMUNICATIONS RECEIVER

1 KW Standard TRANSMITTER
Simultaneous emissions

500-700 W.
1 KW TRANSMITTER
with several frequencies

26, RUE BOYER PARIS-XX'
ADR. TÉL.: SOCINDLOTH
The manufacture of injection-molded powdered-iron cores, just as in any other high-grade industrial operation, requires carefully designed production machinery that turns out each item exactly the same as the last.

Our equipment, contrived to serve the diverse needs of the European market, is versatile enough to take on the problems of American designers, however complex or in whatever volume.

Our large Research Department stands ready to give immediate technical assistance. Why don't you submit your model specifications to us and let us quote you prices for volume production, based on our study and previous wide experience?

A glance through our descriptive brochure, sent to you without obligation, will show you the characteristics of the hundreds of standard parts we have already turned out for discriminating manufacturers.
High stability Resistors

Very low noise level and temperature coefficient 1/4, 1/2, 1 watt and 2-3 watts models.
Available from ±10% to ±0.5% tolerance.
Noiseless Potentiometers
Available without switch and with multi-pole switch. Every variation curve obtainable.
Ask for free catalog

Name ____________________________
Address __________________________
City ____________________________
State ____________________________

Distributor for U.S.A.:
ARNHOLD CERAMICS INC.
11-54, 44th. Drive
LONG ISLAND CITY-1
N.Y. U.S.A.

RADIAC S. A.
206, Rue Lafayette, PARIS-Xe (FRANCE)
CABLES: SARADIAC-PARIS

MEMBER FEDERATION NATIONALE DES SYNDICATS DES INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES
You **Know** Your Products are PROTECTED . . .

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.

That's why, for 37 years, BUSS has emphasized quality . . . finding new ways to make better fuses . . . and making new test equipment to be sure every fuse is up to standard. Today, every BUSS fuse is electronically tested for correct electrical characteristics . . . for size, straightness of caps and other physical properties.

These important safeguards make sure that you and your customers get the right kind of electrical protection. BUSS fuses are made to protect — not to blow needlessly.

When your problem involves electrical protection, call in a BUSS Sales Engineer. He is at your service — to help you select or design the fuse best suited to your needs.

---

**USE THIS COUPON — Get All The Facts**

Please send me bulletin SFB containing complete facts on BUSS small dimension fuses and fuse holders.

Name __________________________ Title __________________________

Company __________________________

Address __________________________

City & Zone __________________________ State __________________________

Bussmann Mfg. Co.,
University at Jefferson,
St. Louis 7, Mo.
(Division of McGraw Electric Co.)
VERSATILE G-E AMPLISTATS PROVIDE HIGH-GAIN DC AMPLIFICATION

- INSTANT STARTING—No warm-up time
- STATIC OPERATION—No moving parts, no maintenance
- DURABILITY—Unaffected by moderate shock or vibration
- LONG LIFE—Will operate indefinitely without attention

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 1/5 sec or less. Operates directly on 40-volt, 60-cycle a-c. Dimensions, 2 x 2 x 2% 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% x 4½ 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, 3⅔ x 2⅔ x 2½ 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.
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.

Single and multiple deck selector switches by Ucinite

The UCINITE CO.
Newtonville 60, Mass.
Division of United-Carr Fastener Corp.

Specialists in
ELECTRICAL ASSEMBLIES,
RADIO AND AUTOMOTIVE
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.

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.

COMPARATIVE COSTS—

<table>
<thead>
<tr>
<th>WITH COTTER PINS</th>
<th>WITH TRUARC RINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL:</td>
<td>MATERIAL:</td>
</tr>
<tr>
<td>2 washers</td>
<td>2 Truarc E Rings</td>
</tr>
<tr>
<td>2 cotter pins</td>
<td>.0283</td>
</tr>
<tr>
<td>OPERATIONS:</td>
<td>OPERATIONS:</td>
</tr>
<tr>
<td>drilling 2 holes</td>
<td>Cutting 2 grooves</td>
</tr>
<tr>
<td>in shaft</td>
<td>.0000*</td>
</tr>
<tr>
<td>ASSEMBLY TIME</td>
<td>.0268</td>
</tr>
<tr>
<td>Total cost</td>
<td>$.0770</td>
</tr>
<tr>
<td></td>
<td>$0.551</td>
</tr>
</tbody>
</table>

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.

SEND FOR NEW BULLETINS

WALDES TRUARC
REMOVABLE RETAINING RINGS
WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

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.

- 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.

Name
Title
Company
Business Address
City Zone State

ELECTRONICS — January, 1952
... is more fantastic than the patter of the pitchman or the spiel of the barkers that doubled in advertising and sales a generation ago. For example:

- Silicone (Class H) electrical insulation makes motors and other kinds of electrical equipment last 10 times as long as they ever did before.
- These same insulating materials are used to double the power per pound ratio in electric machines.
- 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.

To many engineers and executives, such silicone facts as these still sound too good to be true. That's why we have built and assembled 16,000 pounds of demonstration units and typical applications to prove that our silicone products will do all that we claim for them. This is the first comprehensive Silicone Exposition ever assembled. Previewed in Washington, D. C. during the week of October 22nd, this exhibit will be given private showings in major industrial centers across the country.

---

**DOW CORNING CORPORATION**

ATLANTA  
CHICAGO  
CLEVELAND  
DALLAS  
LOS ANGELES

NEW YORK  
WASHINGTON, D. C.

*In CANADA: Fiberglas Canada, Ltd., Toronto*  
*In GREAT BRITAIN: Midland Silicones, Ltd., London*

---

January, 1952 — ELECTRONICS
A GRADE FOR EVERY NEED!
Available in diameters, wall thicknesses and lengths to meet regular or special adaptations.

CLEVELITE
Grade E ........ Improved post cure fabrication and stapling.
Grade EX ....... Special grade for TV deflection yoke sleeve.
Grade EE ....... Improved general purpose.
Grade EEX .... Superior electrical and moisture absorption properties.
Grade EEE .... Critical electrical and high voltage applications.
Grade XAX .... Special grade for government phenolic specifications.

COSMALITE
Grade SP ....... Post cure fabrication and stapling.
Grade SS ....... General purpose.
Grade SSP ...... General purpose — punching grade.
Grade SLF ...... Thin wall tubing — high dielectric and compression strength.

CLEVELITE* and COSMALITE* LAMINATED PHENOLIC TUBING
... meets the most exacting requirements of the electronic and electrical industries!

Whether to insulate the live electrical parts of a rectifier, a high voltage transformer, or any one of countless other applications ... satisfaction is ensured.

For wherever physical strength, low moisture absorption, high dielectric strength, low loss and good machine-ability are of prime importance ... the combined electrical and physical properties of CLEVELITE and COSMALITE are essential.

DEPENDABLE • ECONOMICAL • LONG LASTING
Why pay more? ... for the best call CLEVELAND

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 | Duco Phenolic-Vacuum Waxed |
| RESISTANCE | Initial 7500 Megohms |
| After Humidity | 1000 Megohms |
| LEADS | #22 Tinned Copper, 1.026 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 | Duco Phenolic-Vacuum Waxed |
| RESISTANCE | Initial 7500 Megohms |
| After Humidity | 1000 Megohms |
| LEADS | #22 Tinned Copper, 1.026 Dia. |
| CAPACITY TOLERANCE | +5%, +10%, +20% |

**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% Max. at 1 KC |
| WORKING VOLTAGE | .200 V.D.C. |
| TEST VOLTAGE | .300 V.D.C. |
| INSULATION | Duco Phenolic-Vacuum Waxed |
| RESISTANCE | Initial 7500 Megohms |
| After Humidity | 1000 Megohms |
| LEADS | #22 Tinned Copper, 1.026 Dia. |
| CAPACITY TOLERANCE | ±20% at +25°C |

**NEW!**

**HI-VOLTAGE DISCAPS**

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

---

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

January, 1952 — ELECTRONICS
STANCOR
OP 827 TRANSFORMERS
manufactured with
CANS & TERMINALS
by Heldor

HELDOR
TRANSFORMER
COMPONENTS
BUILT TO PASS
MIL-T-27
SPECIFICATIONS

Standard Transformer Corporation, one of the nation's leading transformer manufacturers, selected FELDOR 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.

Write for Descriptive Literature!

MAIL COUPON NOW!
HELDOR MFG. CO.
225 Belleville Ave., Bloomfield, N. J.
Please send me prices and specifications on MIL-T-27 cans and bushings.
Name ........................................
Company ....................................
Address .....................................
MEPCO

Precision Resistors

... for Precision Electronics

MEPCO, INC., MORRISTOWN, NEW JERSEY
Faster gunnery for our "flat-tops"—through electronics

Constantly faster and more accurate aerial attack upon aircraft carriers can only be answered in kind. Split-second gunnery is urgently demanded — and met through the miracles of electronics. Working closely with our Armed Forces for 33 years, Arma has developed the wealth of engineering experience and production techniques that plays an outstanding part in the production of these complex, compact, accurate instruments.
LEADING EXPERTS RECOMMEND

Simpson Model 480
GENESCOPE
for TV-FM Servicing

These leading manufacturer's service managers agree—the Simpson Model 480 Genescope is perfectly designed for proper testing, servicing and alignment of all TV and FM receivers!

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.
**Only**

**ELECTRO TEC**

**PRECISION-MINIATURE**

**slip ring assemblies AND COMMUTATORS**

**offer all these advantages:**

**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.

**ELECTRO TEC ASSEMBLIES** are specified by the Nation's leading precision instrument and equipment manufacturers for proven greater dependability, longer life, smoother functioning.

The uniformly superior performance of Electro Tec slip ring and commutator assemblies in thousands of industrial and governmental applications has resulted in wide adoption of these component units by most leading manufacturers of precision instruments and equipment. Although these products provide improved performance and extra dependability, prices are strictly competitive. Write today for fully illustrated literature.

**ELECTRO TEC CORPORATION**

SO. HACKENSACK NEW JERSEY

Products of precision craftsmanship by a new and revolutionary process.
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.

The Arnold Engineering Company
Subsidiary of Allegheny Ludlum Steel Corporation
General Office & Plant: Marengo, Illinois
Bogue Magnetic Amplifiers
for
PRECISION CURRENT
CONTROL WITHOUT
MOVING PARTS

Bogue Power Supplies
for
CONTROLLED CURRENT &
VOLTAGE—OUTPUT REGULATED
TO 1%, LESS THAN 1% RIPPLE

Bogue Control Panels
for
ALL TYPES OF PRECISION
AUTOMATIC PROCESS
AND ELECTRIC CONTROL

Bogue DC Generators
for
LOW RIPPLE
PRACTICALLY PURE
DC CURRENT

High Quality
AC or DC
Current
its production
and control
that's where Bogue's
outstanding engineering
ability is best able
to help you, today!

Full control in one plant
over the design of specialized
equipment, plus extreme pre-
cision in production results
in a quality of equipment
not ordinarily available in an
assembled unit.

The following high quality
is available in Bogue-built
power equipments: Practically
pure DC supplies with voltage
regulation and ripple held to
within a small fraction of a
percent... 1 KW to 150 KW;
AC supplies at frequencies up
to 20 KC with voltage regula-
tion and harmonic content
held to within a small fraction
of a percent... 1 KW to 150
KW.

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.

Bogue 400 Cycle Power
for
LABORATORY • PRODUCTION
TESTING OF
ELECTRONIC EQUIPMENT

Bogue Motor Alternators
for
CONVERTING DC POWER
TO SPECIFIED FREQUENCIES
OF ALTERNATING CURRENT

Bogue Precision Power

Bogue Electric Manufacturing Co.
Paterson 3, New Jersey

ELECTRONICS — January, 1952
Only a complete line answers all your electrical measuring requirements

The case of Mastic Tile Corporation demonstrates how the complete line of Westinghouse Instruments holds answers to your electrical measurement problems.

Mastic's problem was one of predetermining load on a Banbury Mixer motor in order to facilitate the operator's job and speed the mixing cycle. It was answered by the standard Westinghouse GY-40 Recording Wattmeter with proper choice of scale, current and potential transformers, and chart speed. In fact, so well did this standard instrument accomplish its job that final results show—a 15 percent reduction in mixing cycle time along with the elimination of damaging surge shocks which can now be anticipated and prevented by the machine operator.

Westinghouse will continue to give you a wider selection for every need... whether it be a-c or d-c current and voltage, single or polyphase circuits, watts or vars, frequency, power factor, synchroscopes, temperature indicators, ground detectors or synchrotie. You get assurance of quality too, because every applicable instrument...

Meets A.S.A. Performance Requirements!
All Westinghouse Instruments are built to meet the rigid performance requirements of the American Standards Association. No more exacting guarantee of an instrument can be made. And you get...

Competent Application Assistance!
Westinghouse Instrument Application Engineers are available to help you in selecting and applying the proper instruments for your application. Simply call your nearest Westinghouse office.

For complete information about Westinghouse Instruments write for Booklet B-4696, address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.
Where would you go for help on springs with low relaxation at 750°F?

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.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York S, N. Y.
Now in **MASS PRODUCTION**...

**PYRAMID ULTRA-COMPACT**

metallized paper capacitors

**PYRAMID Series M CAPACITORS** use a specially-prepared metallized paper, providing all-important savings in size and weight...Pyramid now produces large quantities of these capacitors in a wide variety of cardboard or hermetically sealed metal containers.

*Your letterhead inquiries are invited*

**PYRAMID ELECTRIC COMPANY** • 1445 HUDSON BLVD., North Bergen, N. J.
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 Countrol.

Now if you, in any of your defense work,* have a counting problem, then you can count on Veeder-Root to help you in every possible way.

VEEDER-ROOT INCORPORATED
"The Name That Counts"
HARTFORD 2, CONN. • GREENVILLE, S.C.
Montreal 2, Canada • Dundee, Scotland
Offices and agents in principal cities

"Counts Everything on Earth"
NOW, Mr. Manufacturer...

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

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.
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.

A BASIC TOOL

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.

3. Unit Construction—Resistors, shunts, rectifier, batteries, are housed in a molded base integral with the switch. Direct connections without cabling. No chance for shorts.

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

ONLY $26.50—at your Distributor

Prices Subject to Change

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

Triplett

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U. S. A.

January, 1952 — ELECTRONICS
ENGINEERS SPECIFY
Burnell TOROIDAL COIL Filters
FOR ALL MILITARY APPLICATIONS
- FACSIMILE
- TELETYPE
- 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.
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.

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!

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.

Sylvania Electric Products Inc.
Advertising Dept. E-2001
Emporium, Pa.
Please send me "40 Uses for Germanium Diodes" Enclosed is $ .25.

Name__________________________
Address________________________
City_______________________Zone______State_______
SHOCK and VIBRATION NEWS

BARRY Mounts for assured control of shock and vibration

ALL-METL BARRY Mounts

for unusual airborne applications

Design Features of ALL-METL BARRY Mounts

1. Outstanding vibration isolation under severe temperature and environmental conditions.
2. High shock protection in accelerated take-offs and arrested landings.
3. Unit mountings are interchangeable with mountings now in use.
4. Complete line of ALL-METL mounting bases to JAN-C-172-A dimensions.
5. Special ALL-METL bases made to customers' requirements.

Free Catalogs

Give dimensions and load ratings of stock BARRY Mounts. Write today for Catalog 509 describing ALL-METL unit mountings and mounting bases. Catalog 502, covering general aircraft applications, and Catalog 504, covering industrial mountings, are also free on request.

See our advertisement in Electronic Buyer's Guide pages 240-241

The BARRY Corp.

707 Pleasant St., Watertown 72, Massachusetts

Sales Representatives in

New York Rochester Philadelphia Washington Cleveland Dayton Detroit
Chicago Minneapolis St. Louis Seattle Los Angeles Dallas Toronto Atlanta

BUSINESS BRIEFS

(continued)

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
4 submarines to anti-submarine 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 corru-
gated 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
- Peas
- 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.

**MILLION-DOLLAR DIALS** ...for pennies!

Self-luminous, fluorescent, phosphorescent, or nonluminescent—etched, lithographed, or screened—whatever type of dial you need, U. S. Radium Corporation can produce it...with "million-dollar" accuracy and finish, at mass-production cost.

Yes, even though they cost less than you'd think, U. S. Radium dials look like a million dollars. That's because, in producing millions of dials for instruments and timepieces, we've learned how to apply precise markings with big-volume methods that are a boon to the budget. We also make high-accuracy dials, in as small quantity as desired, for scientific requirements.

To find out how our dial experience can benefit your instruments — with better dial design, or lower cost, or both — write Dept. E-1, U. S. Radium Corp., 535 Pearl Street, New York 7, N. Y.

**Other Products of U. S. Radium**

- **RADIOACTIVE FOILS** (alpha-ray ionization sources)
- **IONOTRON STATIC ELIMINATORS**
- **RADIUM LOCATORS:** pendants, lenses, buttons, screws, markers
- **LUMINOUS RETICLES** and other specialties
- **POWders:** cathode-ray tube and television tube
- **SILHOUETTE ILLUMINATION** of clocks, watches and instruments

**UNITED STATES RADIUM CORPORATION**
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.
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.
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-

Aircraft Plants
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.
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...
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.

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.
Standards Conversion

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.

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 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 a 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 30-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 synchronized with the received 50-field-per-second signal may be employed to produce a 16¾-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. 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 interface. These employ continuously moving film. Thus, in a modified 'Mechu optical compensation projector' 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. 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.

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 

\[ \frac{57.6}{1} = 50 \] 

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 be...
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 Graflexon*, 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 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 bandpass 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 establishing a large phase difference (for example, a 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 erase (reading) of the picture signals.
The basic period of repetition is 1/10 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 1/10-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 1/10 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.
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 1-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 ½ 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 525/50, 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.

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 writing beam 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

---

**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

---

*January, 1952—ELECTRONICS*
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.

**Proposed System**

In the arrangement proposed by Schröter (Fig. 11) the electron emission is provided by a uniformly illuminated, extending 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 photomission, 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.

**REFERENCES**

(1) D. G. Pins, TV—The International Scene, ELECTRONICS, 22, p 70, Aug. 1950.


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

Tomato Classification

By TRAVER J. SMITH
Magnuson Engineers
San Jose, Calif.

and RICHARD A. HUGGINS
Huggins Laboratories
Menlo Park, Calif.

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

January, 1952 — ELECTRONICS
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. 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.

Selection of light sources dictated 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 vtmv formed by two halves of another 6SN7 with the meter connected across the two cathodes. Various types of d-c amplifiers were

![FIG. 2—Spectral reflectance curves for four grades of tomatoes. Normal visibility curve and spectral energy distribution of sunlight have been superimposed.](image1)

![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.](image2)

![FIG. 4—Circuit of the bridge spectrophotometer includes two stages of amplification and a detector ahead of the measuring bridge.](image3)
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.

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 Agron 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.

References


Bibliography


January, 1952 — ELECTRONICS
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.

By PETER G. SULZER
National Bureau of Standards
Washington, D. C.

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 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, 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 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 and Fig. 1E 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, 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 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-
oposite phase are applied to the series R-C circuit. A constant-out-
put (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 semi-
circle 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 $E_1$ and $E_2$ are the input voltages, $E_3$ and $E_4$ are the voltages across the resistor and capacitor respectively, and $E_o$ is the output voltage. As before, the locus of the junction of $E_3$ and $E_4$ is a semicircle. However, this semicircle passes through the origin, and hence $E_o$ experiences a null.

In a practical network the magnitude of $E_o$, whose phase has been shifted 90 degrees, may vary with frequency. The dashed lines of Fig. 2B show the condition where $E_3 > E_4$. It is apparent from the geometry that the production of a null in $E_o$ is independent of the magnitude of $E_o$. 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 $E_3$ and $E_4$ approximately equal at the middle range of frequencies. In drawing the accompanying vector diagram it was assumed that $R_2$ was much greater than both $R_1$ and the reactance of $C_1$.

It will be noted that a true null is not obtained, since the phase shift of $E_o$ 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 $E_o$, accompanied by two different degrees of attenuation. At point 3, $E_o$ 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 $E_o$ becomes equal to $E_1$ 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 $E_o$. This requires a readjustment of the positive feedback, producing a variation of the oscillator output voltage. Fortunately the magnitude and phase angle of $E_o$ vary with frequency in such a manner that the variation of $E_o$ is partially compensated.

As a final step in the development of the circuit, consider the effect of adding a constant voltage $E_v$ to the output voltage $E_o$. This is easily accomplished by adding a resistor $R_v$ 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 $E_o$ 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 $V_s$ is a single-stage pentode amplifier followed by the cathode follower $V_v$. The frequency-selective circuit is connected in the negative-feedback path from the cathode of $V_s$ to the control grid of $V_v$, while positive feedback is applied between the cathodes of the tubes through an attenuator consisting of a variable resistor $R_v$ 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 $R_v$. 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-quar ter 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 $C_v$ to cover 20 to 20,000 cycles in three decade ranges.

- **Frequency range** Capacitor Capacitor
  - 20-200 cycles... 0.5 10.0
  - 200-2,000 cycles... 0.05 1.0
  - 2 kc-20 kc ... 0.005 0.1

Resistor $R_v$ 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 \( R \).

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 \( R \) is adjusted to its minimum value, and the plate and heater supplies are connected. The plate voltage of \( V \), should be between 110 and 130 volts with the indicated plate-supply voltage. With \( R \) adjusted to one-half its maximum value and \( R \) adjusted to 500 ohms, \( R \) 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, \( R \) is changed, and the test is repeated. This may require the readjustment of \( R \) 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.

**REFERENCES**

8. This circuit has been described in the German and Japanese literature, but a suitable reference is not available.

**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.
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. 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 \( V_{1c} \), 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 \( V_{1a}, V_{1b}, \) and \( V_{1c}, \) 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 \( V_{1a} \) 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...
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 V1a and V1b 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 Vr completes the feedback loop.

The cathode-follower also drives the amplifier Vr. 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 Vr to fire once each second. Tube Vr is a rectifier that furnishes the negative bias for Vr 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 W19-122ae-17.

REFERENCE

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.

By S. L. REICHES and D. P. INGLE

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
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 2\(\frac{1}{2}\) to 2\(\frac{1}{4}\) 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 gauss 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 gauss 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.

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 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 gauss. After exposure to the field from the anastigmatic yoke this dropped to 6 gauss. 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. 3—Rotatable-magnet type centering unit**
magnets are achieved good distribution of magnetic field. In the tube, 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 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 the 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 8th oz) between properly shaped pole pieces to insulate 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
and H. W. A. Chalberg

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 e-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 deliver high frequency range from 0 to 1,000 mc 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-54 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.

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...
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.

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 return 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.

**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.

![FIG. 4—Stable dynamic plate characteristics for 400 to 900-mc turret tuner](image)

![FIG. 5—Negative-conductance characteristic for 600-gauss field](image)
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 voltages 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 percent 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
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 traveling-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

---

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

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Anode Voltage</th>
<th>D-C Input (Watts)</th>
<th>R-F Output (Watts)</th>
<th>Eff (%)</th>
<th>Mode Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 cps</td>
<td>134</td>
<td>3.35</td>
<td>0.252</td>
<td>7.5</td>
<td>Class-A</td>
</tr>
<tr>
<td></td>
<td>(Tank Q too low to start Class-C oscillation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 mc</td>
<td>76</td>
<td>0.80</td>
<td>0.053</td>
<td>6.6</td>
<td>Class-C</td>
</tr>
<tr>
<td>123</td>
<td>0.81</td>
<td>0.020</td>
<td>2.5</td>
<td></td>
<td>Class-A</td>
</tr>
<tr>
<td>38.5 mc</td>
<td>110</td>
<td>2.24</td>
<td>0.125</td>
<td>5.6</td>
<td>Class-A</td>
</tr>
<tr>
<td>(Tank Q too low to start Class-C oscillation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>116 mc</td>
<td>59</td>
<td>0.54</td>
<td>0.080</td>
<td>14.8</td>
<td>T-W</td>
</tr>
<tr>
<td>70</td>
<td>1.79</td>
<td>0.210</td>
<td>11.7</td>
<td></td>
<td>Class-C</td>
</tr>
<tr>
<td>140</td>
<td>2.8</td>
<td>0.125</td>
<td>4.5</td>
<td></td>
<td>Class-A</td>
</tr>
<tr>
<td>225 mc</td>
<td>67</td>
<td>1.34</td>
<td>0.185</td>
<td>13.8</td>
<td>T-W or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Class-C</td>
</tr>
<tr>
<td>110</td>
<td>2.31</td>
<td>0.080</td>
<td>3.5</td>
<td></td>
<td>Class-A</td>
</tr>
</tbody>
</table>

---

**FIG. 7—Equivalent electrical circuit**

**FIG. 8—Tuning element for continuous coverage of frequency range from 515 to 930 mc**
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 ⅛ × ½ 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 μf 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 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 Division in the design and development of this tube.
Reducing Outage

By LESTER A. LOONEY and FREDERICK C. EVERETT
Assistant Manager
Radio and Allocations Engineering
National Broadcasting Co., Inc.
New York, N. Y.

Whether the installation of a new television and frequency-modulation antenna for the National Broadcasting Company, atop the Empire State Building, 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 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...
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. Similar notch filters are used in such applications as part of the tv venti- gial 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 notch- ing 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 feed- through 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...
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 \( \frac{1}{4} \) 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 \( \frac{1}{4} \) 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 at 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, \( \frac{1}{4} \) 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.

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 of the open-end short-circuited stubs that are \( \frac{1}{4} \) 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 \( \frac{1}{4} \) 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.

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.

**References**

(1) Frank G. Kear and O. B. Hanson, Electronics Totem Pole, Electronics, p 20, Feb. 1951.


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.

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 $10^8$ to $10^9$ 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 $\mu$ are established in two energy levels when immersed in a magnetic field $H_0$. These two states differ in energy by an amount

$$\Delta E = \mu H_0 I / I \gamma$$  \hspace{1cm} (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, $H_0$, 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 $T_2^* = 1 / \gamma \Delta f$ where $\Delta f$ is the full line width at half maximum.

Equation 1 can be put in the form

$$\omega_s = \gamma H_0$$  \hspace{1cm} (2)

where $\omega_s = 2\pi \nu, \gamma = 2\pi \nu / I$ 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 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.
Magnetic Field Control

By H. A. THOMAS
National Bureau of Standards
Washington, D. C.

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 \( H \). 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 have shown that the power absorbed per cu cm of sample is given by

\[
P_{\text{abs}} = \frac{\gamma^2 H_1^2 N_a (h \nu)^2 (I + 1) I g(\nu)}{6KT}
\]

erg/sec

and that where the line width is not the natural line width, \( T_0 \), 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 \( T_1^* \) by the relation \( T_1^* = \frac{g(\nu)}{2} \). In Eq. 3, \( K \) is Boltzmann's constant, \( T \) the absolute temperature, \( N \), 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

\[
H_1^2 \gamma^2 T_1 T_2^* = 1
\]

(4)

Substituting these relations into Eq. 3 and introducing the volume of the sample \( V \), where \( V \) is the volume of the coil and \( a \) is a filling factor for the sample, the total absorption is obtained

\[
P_a = \frac{V a N_a (h \nu)^2 I (I + 1) I g(\nu)}{6KT T_1}
\]

erg/sec

**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 \( H^2/2\pi \), the total energy \( E_\nu \) stored in the magnetic field is

\[
E_\nu = \frac{H^2 \nu}{2\pi}
\]

(6)

Recalling that \( P_e = \frac{\omega E_\nu}{Q} \), and using Eq. 4 and 5 there is obtained the power required to maintain the field \( H \).

\[
P_\nu = \frac{\omega V a}{2\pi \gamma^2 T_1 T_2^* Q_1}
\]

(7)

where \( Q_1 \) 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, \( P_e \), from a generator having a resistance many times greater than the equivalent shunt resistance, \( R_\nu \), 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 \( V_n \) and the change in this voltage due to the peak absorption be \( \Delta V \) then since \( i = (P_x/R_x)^{1/2} \) and \( P_x = \Delta V \) we get as a good approximation

\[
\Delta V = P_x (R_x/P_x)^{1/2} \tag{8}
\]

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

\[
\Delta V = \frac{I (L+1) H_y N_x a}{6 K T} (T_x^* - R_x Q_x) \tag{9}
\]

The quantity \( T_x^* \) is a measure of the inverse line width and is dependent only on the area and maximum value of the line shape curve. If \( g(v) \), the line-shape function, is that of a simple singly-tuned circuit it may be shown that \( T_x^* \) is a function of the line width of the line at half maximum point on a power basis is \( 1/\pi T_x^* \). From this relationship, Eq. 7, and the relation that \( \omega = \gamma H \), it may be shown that the power required to maintain the optimum r-f field is

\[
P_x = \frac{H_y H_z v_0}{4 \pi T_z Q_z} \tag{10}
\]

where \( H_y \) is the line width at half maximum in oersteds. The coil voltage required to maintain this field is

\[
V_n = (P_x R_x)^{1/2} = \left( \frac{H_y H_z v_0}{4 \pi T_z Q_z} \right)^{1/2} \tag{11}
\]

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

\[
\Delta V = 7.5 \times 10^{-11} \left( \frac{T_x^* - R_x Q_x}{T_z} \right) \tag{12}
\]

It will be recalled from an earlier discussion that \( T_x^* \) is related to the absorption line width and may be expressed either in terms of frequency \( \Delta v \) or in terms of gaussians \( H_z \) by the relations \( T_x^* = 1/\pi \Delta v = 2/\gamma H_z \). For pure water, the natural line width is of the order of a few milligauss but the measured line widths are usually much greater than this because of inhomogeneities in the field \( H_z \). 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 interac-

[FIG. 2—Signal and noise characteristics of amplitude noise.]

tion between the protons and the lattice (surrounding sample) is increased, decreasing the rate of energy transfer and thus decreasing the value of \( T_x^* \). For pure water \( T_x^* \) 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 \( 10^4 \) to \( 10^5 \) thus increasing the available signal by a factor of at least 1,000.

In most cases, depending on the field inhomogeneity, it is possible to make \( T_x^* \) about equal to \( T_x^* \). 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 line magnitudes. With a \( Q_z \), of 100, \( R_x \), of 4,000 ohms, \( \Delta v = 1.5 \) cm, \( u = 0.4 \) cm, and \( H_z = 7,400 \) gauss, 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 \( T_z \) of about \( 2 \times 10^4 \) sec and substituting this in Eq. 12 indicates that \( \Delta V \) 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, \( \epsilon \), is approximately unity, the output signal should be about 550 \( \mu V \). This can be compared with the actual observed output voltage of 490 \( \mu V \). 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 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 \( R_s \), is fed from a signal generator through an impedance \( R >> R_s \). The change in r-f voltage across the L-C circuit that results when the d-c magnetic field \( H_s \) is varied through the value required for nuclear resonance is detected by the diode circuit.

The value of \( H_s \) may be varied repetitively 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 output voltage 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 \( R_s \), 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 gauss. 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 106.

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 and a bridge-T network 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 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 used7 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 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, 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-µf 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, it is only necessary to measure the frequency required for proton resonance in that field. The value

![FIG. 4—Circuit of the magnetic regulator applied to control of 35-ton magnet](Diagram)
of $\gamma$ is $\gamma = (2.67528 \pm 0.00006) \times 10^4$ sec$^{-1}$ gauss$^{-1}$ 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 $\gamma$ 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 gaussess having a gradient of approximately 5 gaussess 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 gaussess.

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 pip 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. 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.

The complete details of a regulator used to regulate a 35-ton magnet 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.

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.

**References**

(4) Quarterly Progress Report, Research Laboratories of Electronics, MIT, April 15, 1950.
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 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>
<thead>
<tr>
<th>TABLE I—Engineering Job Evaluation Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LIVING:</td>
</tr>
<tr>
<td>Weather</td>
</tr>
<tr>
<td>Housing—cost</td>
</tr>
<tr>
<td>Housing—availability</td>
</tr>
<tr>
<td>Housing—location</td>
</tr>
<tr>
<td>Schools</td>
</tr>
<tr>
<td>Recreation</td>
</tr>
<tr>
<td>Traffic</td>
</tr>
<tr>
<td>Travel to work</td>
</tr>
<tr>
<td>Moving expense and inconvenience</td>
</tr>
<tr>
<td>Medical facilities</td>
</tr>
<tr>
<td>Shopping facilities</td>
</tr>
<tr>
<td>Neighbors</td>
</tr>
<tr>
<td>WORKING:</td>
</tr>
<tr>
<td>Supervisor(s)</td>
</tr>
<tr>
<td>Challenge of job</td>
</tr>
<tr>
<td>Chance for advancement</td>
</tr>
<tr>
<td>Prestige of organization</td>
</tr>
<tr>
<td>Supply and red tape</td>
</tr>
<tr>
<td>Military relationships</td>
</tr>
<tr>
<td>Security of future</td>
</tr>
<tr>
<td>Recognition for work</td>
</tr>
<tr>
<td>Amount of travel</td>
</tr>
<tr>
<td>Other opportunities in area</td>
</tr>
<tr>
<td>Laboratory facilities</td>
</tr>
<tr>
<td>Policies of organization</td>
</tr>
<tr>
<td>Salary</td>
</tr>
<tr>
<td>Value of experience</td>
</tr>
<tr>
<td>Type of work</td>
</tr>
<tr>
<td>Totals</td>
</tr>
<tr>
<td>Percent</td>
</tr>
</tbody>
</table>

By R. W. JOHNSON
Electronics Engineer
U. S. Naval Ordnance Test Station
China Lake, California

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.
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

By ROBERT M. BARRETT and MALCOLM H. BARNES

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...
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-
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 pick-up 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 lams 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-ke 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 1-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 50 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.

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.
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.

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.

REFERENCES
(2) Harley Iams, Phase-Front Plotter for Centimeter Waves, RCA Review, 8, p 270, June 1947.
(3) Winston Koeh, Photographing Sound Waves, Bell Laboratories Record, 28, p 304, July 1950.
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:

**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

\[ E_{c} = E'_{c} + \frac{1}{1.14} \left[ \frac{1}{1.78} (E'_{g} - E'_{b}) \sin \omega t \right. \]

where

\[ E'_{a} = 0.59 E'_{g} + 0.30 E'_{b} + 0.11 E'_{a} \]

in this expression the symbols have the following significance:

- \( E_{c} \) is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture transmitter.
- \( E'_{a} \) 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 \( E'_{a}, E'_{g}, \) 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 \( \omega \) is 2 \( \pi \) 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 \( \cos \omega t \), 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 \( E'_{g}, E'_{r}, \) and \( E'_{b} \) have the following chromaticities in the ICI system of specification:

<table>
<thead>
<tr>
<th>Color</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red (R)</td>
<td>0.67</td>
<td>0.33</td>
</tr>
<tr>
<td>Green (G)</td>
<td>0.21</td>
<td>0.71</td>
</tr>
<tr>
<td>Blue (B)</td>
<td>0.14</td>
<td>0.08</td>
</tr>
</tbody>
</table>

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 \( E'_{g}, E'_{r}, E'_{b} \) and \( E'_{a} \) 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 ½ cps per sec.

15. The horizontal scanning frequency is 2/455 times the color subcarrier frequency. This corresponds to 15,760 cps.

16. The bandwidth assigned to the monochrome signal \( E'_{a} \), is in accordance with the FCC standard for black-and-white transmissions.

17. The bandwidth assigned prior to modulation to the chromatic signals \( E'_{g} - E'_{b} \) and \( E'_{r} - E'_{b} \) 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 \( \pm \) sign in specification 10 is such that the color subcarrier phasor representing \( (E'_{g} - E'_{b}) \) shall lead the phasor representing \( (E'_{r} - E'_{b}) \) 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 \( (E'_{r} - E'_{b}) \) 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.
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

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
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 maximum 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

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.
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 ½-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 ½-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.

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 ⅛-inch polystyrene tubing, 8 turns to the inch, while plate coils are space-wound on ⅛-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-bandaging the 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 enamelled 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 to 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 pur-
poses, 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.

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 com- pensating 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.

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**

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.

<table>
<thead>
<tr>
<th>Type of Transmission Line</th>
<th>100 mc</th>
<th>500 mc</th>
<th>1,000 mc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry</td>
<td>Wet</td>
<td>Dry</td>
<td>Wet</td>
</tr>
<tr>
<td>Standard 300-Ohm Flat Line</td>
<td>1.2</td>
<td>5.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Tubular 300-Ohm Line</td>
<td>1.1</td>
<td>4.6</td>
<td>1.2</td>
</tr>
<tr>
<td>RG 59/U Coaxial Cable</td>
<td>3.7</td>
<td>14.5</td>
<td>9.6</td>
</tr>
<tr>
<td>RG 11/U Coaxial Cable</td>
<td>1.9</td>
<td>7.8</td>
<td>5.2</td>
</tr>
</tbody>
</table>

(Continued on p 134)
Photographs are one-half size, one fourth area of original terminal boards.

TERMINAL BOARDS

... Something of the scope of the Cinch operation in the design and production of electronic components is indicated by these photographs of terminal boards fabricated to meet exacting Armed Forces requirements.

Twenty years ago Cinch Engineers developed an idea... that gave the Radio Industry its first terminal strips for practical production. And so established Cinch strips and boards as standard over the years.

In Cinch components the user gets the utmost in quality, of insulation, tooling, fabrication, plating and printing, vacuum waxing, lug types, materials and workmanship. Cinch facilities and engineering experience and ability, assure the satisfactory fulfillment of any assignment for a terminal board or electronic component. Consult Cinch!

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

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 8-element wide-spaced 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.
In Electrical Contact Assemblies...

MALLORY Assembly Engineering

can mean three-way savings for you

No matter what your contact assembly needs may be, Mallory can do the whole job for you—from design and material selection...to fabrication and finishing of parts...to final assembly.

Mallory assembly engineering is backed by 25 years of research and practical experience and takes pride in...

- Design of more than 5000 different types of contacts.
- Development of many special alloys...and brazing techniques.
- Leadership in the development and practical application of powder metallurgy.
- Design and production of all types of switches.

With this specialized electrical and metallurgical engineering experience working for you, you save three ways—in better performance...in reduced costs...and in relief from the design, handling, scheduling and inventory control problems involved in assembling your own contact units.

EXPECT MORE...GET MORE FROM MALLORY

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.

Mallory engineers produced the right answer at the right price—a contact assembly that is doing an outstanding job. You can expect the same kind of results when you turn your contact assembly work over to Mallory.

In Canada, made and sold by Johnson Matthey & Mallory Ltd., 110 Industry St., Toronto 15, Ontario

Electrical Contacts and Contact Assemblies

Serving Industry with

Electromechanical Products
- Resistors
- Switches
- TV Tuners
- Vibrators

Electrochemical Products
- Capacitors
- Rectifiers
- Mercury Dry Batteries

Metallurgical Products
- Contacts
- Special Metals
- Welding Materials

Mallory
P. R. Mallory & Co., Inc., Indianapolis 6, Indiana
TUBES AT WORK
Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

1,000-Cycle Warning Device ........................................... 136
Ground-Transmitter Klystron for Air Navigation ................. 136
Submerged Repeaters for Telegraph Cables ......................... 164
Automatic Steering for Outboard Motorboats ....................... 172
F-M Performance Measurement Form .................................. 192
Tunable Selector-Rejecter for Audio Amplifiers ................. 196

1,000-Cycle Warning Device

By PHILIP WHITNEY
Chief Engineer
Stations WING 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-f or capacitor or two 0.5-f 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.

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 integrator to give a longer delay time before sounding the warning, if desired, and a wirewound 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...
KESTER FLUX-CORE SOLDER

FAST ... FASTER ... FASTEST

FAST ... Kester Plastic Rosin-Core, the old reliable, always does a fast job.

FASTER ... Step up the tempo with Kester "Resin-Five" and still retain flux stability.

FASTEST ... For high-speed soldering, unbelievable flux mobility. You'll want Kester "44" Resin-Core the newest of all Core Solders.

Free Technical Manual—write for your copy of "SOLDER and Soldering Technique."

KESTER SOLDER COMPANY
4204 Wrightwood Ave., Chicago 39
Newark 5, New Jersey • Brantford, Canada

Over 100,000 types
Kester Flux-Core Solder available
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 re-adjustment. 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 61 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 iris. 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.
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.

...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.

### 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 data.

### COMPARISON—TYPICAL SUPER-JAN VERSUS JAN UNITS

<table>
<thead>
<tr>
<th>Sprague Type</th>
<th>Nearest JAN-C-25 Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967479251</td>
<td>CP25A1EC504K</td>
</tr>
</tbody>
</table>

- **Capacitance (Mfd., ±10%)**: 0.47
- **Voltage, DCW**: 200
- **Insulation Resistance**: 30,000 MΩ at 25°C, 700 MΩ at 175°C
- **Capacitance Change (%)**: 0.02 at 1°C
- **Operating Ambient (°C)**: Max: 125°C
- **Miniature**: No
- **Dielectric Test**: Twice Rated Volts for 1 Min., Twice Rated Volts for 1 Min.
- **Life Test at 85°C**: 250 hrs., 1.5 X rated DCWV
- **Mobility Resistance**: Hermetically Sealed
- **Length**: 1-9/16"
- **Diameter**: 0.39"
- **Volume (cu. in.)**: 0.94

* Ahead of and Beyond JAN ** Above Temperature Limit of JAN-C-25

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT
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 10⁶ 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.

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 (W₁) rise very fast, while the ampere turns in the linear resistance winding (W₂) 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 R₆. 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
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 $\pm 0.25\%$ 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 a precision of about $\pm 0.025\%$ 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.

Write today for complete details!
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.

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 television channels.

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 necessary to have the wires straight and tight so the grid will present a flat uniform control surface to the cathode.

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-watts) 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.

(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.

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.
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 \times 5 \times 8\text{-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 34 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.

Tronic 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, in-
cludes an audible alarm that per-
mits immediate correction of ex-
cess temperatures, and replaces the
cost and use of several instruments
and time-taking logging operations
and maintenance. It is especially
applicable for steam generating sta-
tions and in the manufacture of
synthetic fibers and yarns where the
temperature of feed material
supplying spindles must be main-
tained at specific levels to eliminate
costly defects in the product.
Illustrated is the control unit.

Scanning System
MINNEAPOLIS-HONEYWELL REGULA-
tor Co., Brown Instruments Div.,
Wayne & Windrim Ave., Philadel-
phia 44, Pa., has developed an elec-
tronics R-F Switch
TRANSICO PRODUCTS, INC., 12210 Ne-
braska Ave., Los Angeles, Calif. A new compact single-pole, 4-position coaxial r-f switch for applications
at radar frequencies, has a fre-
quency 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 capa-
bilities are equal to improved type
N connectors. Motor-driven actuator rating is 24 to 28 v d-c. Var-
ious models are available for air-
craft applications.

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 max-
imum 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 \mu f
at 500 volts d-c working and to 110
\mu f at 250 volts. Included in the pho-
toare are also the company’s four
stock sizes of capacitors which are
supplied with \pm 5 percent or
\pm 0.25 \mu f tolerance from 0.5
\mu f through 1,000 \mu f. Operating

Acoustical Lens
JAMES B. LANSING SOUND, INC., Los
Angeles, Calif., is producing model
175DLH full acoustical lens for
loudspeaker use which distributes a

January, 1952 — ELECTRONICS
there are more RAYTHEON SUBMINIATURES in world-wide use than all other makes combined
For Tubes You Can Trust To Meet Your Requirements And More

Specify RAYTHEON RELIABLE Cathode Type SUBMINIATURE TUBES

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.

For complete mechanical and electrical data on these new RAYTHEON types, ask for the new Raytheon RELIABLE Subminiature Tube Catalog E.

RAYTHEON MANUFACTURING COMPANY
RECEIVING TUBE DIVISION · NEWTON 58, MASSACHUSETTS

Reliable Subminiature and Miniature Tubes · Germanium Diodes and Transistors
Radiac Tubes · Receiving and Picture Tubes · Microwave Tubes
Varglas Silicone Electrical Insulating Tubing and Sleevings
Lead Wire and Tying Cord

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.

VARGLAS SILICONE, pioneered by VARFLEX CORPORATION is the first and only Class H insulation with these features:

1. VARGLAS — Continuous filament Fiberglas — a moisture and fungus proof material which will not burn and is chemically inert — strong and flexible at high and low temperatures.
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.

Now, Varflex invites you to test these free samples of Varglas Silicone in your own plant or laboratory.

Just Clip this coupon!

VARFLEX SALES CO., INC.
308 N. JAY ST. ROME, N. Y.

Please send me folder containing free samples of Varglas Silicone products.

Name ____________________________________________
Company _________________________________________
Address __________________________________________
City ___________________________ Zone _______ State __

VARFLEX SALES CO., INC., 308 N. JAY ST., ROME, N. Y.
uniform sound wave over the entire audio spectrum. It smooths 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 Carb-ohm, 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. Carb-ohms 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 x 7 x 8 in. and price is $350.00.

Step-Motor Counter

GENERAL ELECTRIC CO., Schenc-tady 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 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.

Gain Set

THE DAVEN CO., 191 Central Ave., Newark, N. J., has available the
**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.

**audiotape** Wherever professional-quality magnetic recordings are made, the trend is to Audiotape. That's because Audiotape is made by audio engineers for audio engineers — with the right combination of properties for finest performance in any tape recorder. Produced on Audio's highly specialised precision coating machines, Audiotape has achieved unequalled uniformity of output — plus maximum output with minimum distortion at practical bias range. What's more, it's less sensitive to bias changes, has no audible low-frequency modulation noise, and is guaranteed splice-free in both 1250 and 2500 ft. sizes, plastic base. In every respect, Audiotape meets the exacting standards of quality and performance which have characterized Audiodiscs for more than a decade.

**audiofilm** extends the advantages of finest quality magnetic recording to motion picture and TV applications. Available in 16mm, 17½mm and 35mm sizes.

**audiopoints** are precision matched recording and reproducing styli available in types and sizes to meet the precise requirements for every phase of disc recording work.

---

**NEW Free Handbook on The Fundamentals of Magnetic Recording**

This completely new and up-to-the-minute technical manual contains 50 pages of valuable information on basic magnetic principles and tape performance. Professional recordists will find it extremely interesting and helpful — an important addition to their reference files. A request on your business letterhead will bring you a free copy by return mail.

Write to Audio Devices, Dept. C3.
Low-Power CAA Omriranges Tested

The CAA is experimenting with two low-power omriranges—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 omrirange 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 navigational 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 omrirange, 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 omriranges 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.

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.


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...
More and more—engineers, designers, production men and purchasing officials have come to regard Plasticord and Plasticote Wires and Cables by Chester as the standard of comparison. This is because every inch of these dependable insulated conductors is made to conform to exacting quality controls that assure long service life, and performance as specified by the factory. That's the reason electrical men, everywhere, look for the Chester trademark when they're looking for the best!
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 Flighttronic 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 266)

January, 1952 — ELECTRONICS
For Engineers...  
Your Career Opportunity of A LIFETIME... at RCA—NOW!

If you are facing a big question: “What is the best move I can make to further my career?”—we believe you will find the answer on this page.

Today, as never before, RCA is engaged in far-reaching electronic developments that have created a need for career men of talent. This means you have the chance of a lifetime to make a permanent connection with RCA in a position offering you the opportunity of a successful career in the field of your choice. Here is what RCA offers.

Wide Choice of Projects
Unusual opportunities await qualified ELECTRONIC, ELECTRICAL and MECHANICAL ENGINEERS... PHYSICISTS... METALLURGISTS... PHYSICAL CHEMISTS... GLASS TECHNOLOGISTS—in research, development, design and application, also in technical sales. Qualified engineers have the opportunity to choose the area of activity they like best.

POSITIONS OPEN IN THE FOLLOWING FIELDS:

TELEVISION DEVELOPMENT—
Receivers, Transmitters and Studio Equipment

ELECTRON TUBE DEVELOPMENT—
Receiving, Transmitting, Cathode-Ray, Phototubes and Magnets

TRANSFORMER and COIL DESIGN

COMMUNICATIONS—
Microwave, Mobile Aviation, Specialized Military Systems

RADAR—
Circuitry, Mobile Aviation, Specialized Military Systems

COMPUTER DEVELOPMENT and DESIGN
Digital and Analog Computers, Magnetic Recording, Pulse Circuitry, Storage Components, Systems Design

NAVIGATIONAL AIDS

TECHNICAL SALES

ELECTRONIC EQUIPMENT FIELD SERVICE

If you qualify for any of the positions listed above, write us for a personal interview—include a complete resume of your education and experience. Write to:

Mr. Robert E. McQuiston, Specialized Employment Division, Dept. 46A, Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y.

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.

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.

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.
NEW BOOKS

Time Bases


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.

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

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.

You can't shake, pull or rotate a tube out of place when it's secured by a Birtcher Tube Clamp. The tube is there to stay. Made of Stainless Steel, the Birtcher Tube Clamp is impervious to wear and weather.

BIRHTCHER TUBE CLAMPS can be used in the most confined spaces of any compact electronic device. Added stray capacity is kept at a minimum. Weight of tube clamp is negligible.

Millions of Birtcher Tube Clamps are in use in all parts of the world. They're recommended for all types of tubes: glass or metal—chassis or sub-chassis mounted.

THERE'S A BIRHTCHER TUBE CLAMP FOR EVERY STANDARD AND MINIATURE TUBE!

Write for samples, catalogue and price lists.

THE BIRHTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, Calif.

January, 1952 — ELECTRONICS
New rider
for a fast, familiar track

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.

For the first time, DPI offers to makers of large power tubes, high-frequency oscillators, and x-ray tubes this system converted to their use. With the same trouble-free efficiency, capable of producing ultimate vacuums below $1 \times 10^{-6}$ mm Hg, and affording the same fast production pace, it will evacuate your tubes on a continuous instead of a batch basis. And the system is adaptable to running a variety of tubes at once.

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).

High vacuum research and engineering

Also...vitamins A and E...distilled monoglycerides...more than 3500 Eastman Organic Chemicals for science and industry
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)
"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)
PREPAREDNESS PRODUCTION Enlists AMPHENOL

CABLE HARNESSES produced by Amphenol are assembled with the same care and rigid inspection that characterizes all components manufactured by Amphenol. Electrical inspection includes insulation resistance, continuity and high voltage breakdown tests. All assemblies meet and are superior to the rigid Army-Navy specifications. Specifying Amphenol complete cable assemblies cuts costs, saves valuable man hours and insures against losses due to errors and rejects.

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.

American Phenolic Corporation
1830 South 54TH Avenue • Chicago 50, Illinois

NOW AVAILABLE: Catalog B-2—A General Catalog of Amphenol Components—will be sent on request.

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output power (peak)</td>
<td>7.5 kw</td>
</tr>
<tr>
<td>Drive power (peak)</td>
<td>300 w</td>
</tr>
<tr>
<td>Frequency</td>
<td>9,310 mc</td>
</tr>
<tr>
<td>Beam voltage (peak)</td>
<td>17 kv</td>
</tr>
<tr>
<td>Beam current (peak)</td>
<td>2.5 amp</td>
</tr>
<tr>
<td>Duty cycle (max)</td>
<td>2.5 percent</td>
</tr>
<tr>
<td>Pulse length (max)</td>
<td>5 usec</td>
</tr>
<tr>
<td>Bandwidth (optimum drive)</td>
<td>40 mc</td>
</tr>
</tbody>
</table>

January, 1952 — ELECTRONICS
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 nicoloii or mumetal for such specialized applications.

JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY
MALDEN, MASSACHUSETTS, U.S.A.
New 1952 Heathkits

**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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
New CBS-HYTRON 12B4

New 9-pin miniature; high-pervance, 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 155 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-pervance, 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 12827
New high-mu, 9-pin miniature dual triode for high-gain audio amplifiers, gating circuits, synch separators and amplifiers.

Write for Complete Data Today

HYTRON RADIO & ELECTRONICS CO.
Salem, Massachusetts

Please rush me full specifications for the new CBS-Hytron types I have checked:

12B4 12BY7 5Y3WGT
12A4 12B27

Name (please print)
Street
City and State
Model M-2 Oscillator Is Your Answer

The unique SIE oscillator circuit which has no lower limit to its possible frequency of oscillation is responsible for the excellent low frequency performance of the Model M-2 and other SIE oscillators.

**SPECIFICATIONS**

- **Range:** 1 cps to 120,000 cps
- **Calibration:** within 1½% plus 1/10 cycle
- **Output circuits:** 20 volts or 20 mill-amps and 1 volt at 300 ohms constant impedance
- **Amplitude stability:** Plus or minus ½ db
- **UNDESIRED VOLTAGES**
  - **Power Supply Noise:** Less than 1/100% of output signal
  - **Power Line Surge:** Less than 1/10% of output signal
  - **Harmonic Distortion:** Less than 2/10% from 20 cps to 15,000 cps. Less than 1% at all other frequencies
  - **Microphonic Noise:** Less than 1/100% of output signal

**TUBES AT WORK**

... (continued)

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-tone 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
Every pound of idle non-ferrous metal you have is needed to help the non-ferrous smelting and refining industry keep production up to rising demand.

You know that smelters exist by buying scrap metal, refining it scientifically and selling it to you as a raw material fit to fabricate almost any non-ferrous product.

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.

One way we can maintain desired levels of both military and civilian production is for you to survey your plant and turn in your non-ferrous scrap now.

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-usuable 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.
(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^-2 mm. to 10^-4 mm. range. Operates against forepressures as high as 0.300 mm. Blank-off 2 x 10^-3 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.
(L) Narcoil Diffusion Pump Fluids. Three different oils fulfilling industrial and scientific workers' requirements.


with a COMPLETE LINE of HIGH VACUUM EQUIPMENT for the ELECTRONIC INDUSTRY

You may be using one or two of our products without realizing that at this one source you have available such a full line of high vacuum equipment.

You will find a unique quality in most of these products. They were created to "ideal" specifications drawn up by manufacturers who, in many cases, never dreamed we could fulfill their exacting requirements. The products are meeting these requirements day after day on production lines.

Let us supply all your high vacuum equipment needs. You will gain the benefits of a single source of supply plus the high standards of performance designed into National Research products. Write us for further details. National Research Corporation, Memorial Drive, Cambridge, Mass.

National Research Corporation
Seventy Memorial Drive, Cambridge, Massachusetts

ELECTRONICS — January, 1952
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.

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.

A vibrating crystal keeps master time
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.
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.

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.

WHATEVER YOUR FREQUENCY PROBLEMS, OUR ENGINEERS ARE READY TO COOPERATE. PLEASE REQUEST DETAILS BY TYPE NUMBER.

American Time Products, Inc.
580 Fifth Avenue OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY New York 19, N.Y.
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.
MEET EL GATO

El Gato is a wildcat.

He has even more than nine lives. So do LEWIS and KAUFMAN electron tubes.

That’s why the LOS GATOS brand and the cat identify long-lived transmitter, rectifier, and power tubes for JAN-1A and industrial uses.

When you buy electron tubes, look for this brand.

LEWIS AND KAUFMAN, INC.

LOS GATOS CALIFORNIA

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.

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
Year after year, more motor manufacturers use more Cornell-Dubilier A.C. motor capacitors than any other. The reason: a great record of trouble-free service in the field! Filled with C-D’s world-famous Dykanol, and conservatively rated for extra dependability. Dept. K-12, Cornell-Dubilier Electric Corp., South Plainfield, N. J.
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.

MYCALEX TUBE SOCKET CORPORATION
Under Exclusive License of MYCALEX CORPORATION OF AMERICA
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.

MYCALEX CORPORATION OF AMERICA
Owners of 'MYCALEX' Patents and Trade-Marks
Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 — Plant & General Offices: CLIFTON, N.J.
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.
If so, you'll be well repaid by getting the facts on a special group of Pure Ferric Oxides, developed by Williams and manufactured especially for this purpose.

Williams Ferric Oxides analyze better than 99% Fe₂O₃. They contain a minimum of impurities. They are available in a broad range of particle sizes and shapes. Among them, we're certain you'll find one that's "just right" for your requirements. The proper application of Ferric Oxides to the manufacture of Ferrites is our specialty. So write today, stating your requirements. We'll gladly send samples for test. Chances are good that our Ferric Oxide "Know How" can save you considerable time and money. Address Department 25, C. K. Williams & Co., Easton, Pennsylvania.

WILLIAMS
COLORS & PIGMENTS

C. K. WILLIAMS & CO.
Easton, Pa. • East St. Louis, Ill. • Emeryville, Cal.

TUBES AT WORK (continued)

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.
International

Selenium Rectifiers

for unsurpassed performance

STANDARD CELL SIZES

<table>
<thead>
<tr>
<th>B</th>
<th>(1\times\frac{1}{4}\times\frac{1}{8})</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>(1\frac{1}{8}\times\frac{1}{8}\times\frac{1}{8})</td>
</tr>
<tr>
<td>D</td>
<td>(\frac{3}{16}\times\frac{3}{16}\times\frac{1}{16})</td>
</tr>
<tr>
<td>E</td>
<td>(\frac{3}{16}\times\frac{1}{16}\times\frac{1}{16})</td>
</tr>
<tr>
<td>F</td>
<td>(\frac{3}{16}\times\frac{3}{16}\times\frac{3}{16})</td>
</tr>
</tbody>
</table>

Photo-Electric Cells
Self-Generating Type
Output up to 600 microamperes at 100 foot-candles illumination and 100 ohms external resistance.

Hermetically Sealed Rectifiers
Cartridge Type—up to 60 ma., 9,000 volts per cartridge.

High-Voltage Rectifiers
Cartridge Type—up to 60 ma., 9,000 volts per cartridge.

Miniature Rectifiers
From 65 to 1,000 ma.

POWER RECTIFIERS
Ratings up to 250 KW
Efficiency to 87%—Power Factor 95%

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.

GENERAL OFFICES:
1521 E. Grand Ave.
El Segundo, Calif.
Phone El Segundo 1890

CHICAGO BRANCH OFFICE:
205 W. Wacker Dr.
Franklin 2-3889

January, 1952 — ELECTRONICS
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.
DOES WORK OF
25 RESISTORS

saves work—and cost—
of hooking them up

It used to take 25 conventional resistors, 11\(\frac{3}{4}\) x 1\(\frac{1}{4}\) in., spaced on 2\(\frac{1}{2}\) in. centers, to keep the power company happy.

Ward Leonard worked out the problem with a single Edgeohm resistor, 19 in. long—saving all that space, weight, mounting and wiring.

Here’s the application: a 40-kw radio transmitter, operating from a 50 kva transformer, made by a large transmitter manufacturer. Problem: limiting inrush current to avoid a severe voltage drop (objected to by the power company) and a strain on the line contactor.

This single Edgeohm unit is rated for continuous duty at 2200 watts, and when used for a 15-second interval, will dissipate 6400 watts!

Another example of Ward Leonard “Result Engineering”, providing the desired result at a saving! WARD LEONARD ELECTRIC CO., 31 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

TUBES AT WORK (continued)

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!

With military orders urgent, with complex new weapons in the making, time is the key word of our defense program.

But there's one way a manufacturer can get a "priority" on time.

He can ship his parts and products via Air Express—the service that gets top priority of all commercial shipping services!

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.

For more facts, call Air Express Division of Railway Express Agency.

AIR EXPRESS
GETS THERE FIRST
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.

**S P E C I F I C A T I O N S**

**INPUT IMPEDANCE:** High impedance, for bridging 75 ohm coaxial lines.

**OUTPUT IMPEDANCE:** To match 75 ohm lines.

**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.*


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.
RELAYS for
WAR GOODS OR STORE GOODS

IN QUALITY PRODUCTS EVERYWHERE . . .

GUARDIAN Controls

As real as rockets, guided missiles and supersonic jets are the Guardian Controls that set them off and direct their flight. Guardian relays—stepping switches—contactor units—solenoids—multi-contact switches are the basic components of communications, bombing and firing equipment, of control stick switches, control wheels and myriad Guardian developments for the military. Certain basic Guardian control components are still available for peacetime products. Write.

AN-3320-1 D.C.  AN-3324-1 D.C.  Series 595 D.C.  Series 610 A.C.—615 D.C.  Series 695 D.C.

Get Guardian's New HERMETICALLY SEALED RELAY CATALOG Now!

GUARDIAN ELECTRIC
1625-A W. WALNUT STREET  CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY
Tubes at Work (continued)

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
VISIBILITY

...above and beyond the horizon

when EICOR'S "electronamic team" supplies your AC system with electronically controlled power

above the horizon — it's Eicor's electronic team supplying the safe, sure, AC power your nest-glass deicing system needs for perfect flight-vision under all flying conditions.
beyond the horizon — again this dynamic Eicor team provides the ultimate in closely controlled alternating current, the power necessary to give vision to the far-reaching, far-searching eyes of your aircraft's radar and its associate equipment. You can be assured of the flight-reliability of these units. Designed to rigid and exacting AN Specifications, the Eicor 8Kva Alternator and Exciter Regulator have proven their dependability of performance over thousands of operational flying hours.
The Eicor 8Kva Alternator will generate 115/208 volts, three phase, or 115 volts, single phase, at frequencies of 380-1000 cycles and over a speed range of 3800-10,000 rpm. Sensitive voltage regulation and field excitation for the alternator is supplied by its team-mate, the Eicor electronic Exciter Regulator. This Exciter Regulator can also be used in any power circuit, for excitation supply, having a range rating characteristic output of 0.5 to 5.5 amperes DC and 14.0 to 170.0 volts D.C.

EICOR, INC.
1501 west congress street
chicago 7, illinois

Leading the way in electronic controls for aircraft power conversion equipment

ELECTRONICS — January, 1952
NOW THERE ARE 3
They do everything you want!
They make tough jobs easy!

E-V Slim-Trim DYNAMICS
for TV... Broadcasting... Recording... PA

... for wide range high fidelity
response ... for fixed position
or man-in-motion ... for ruggedness
and versatility ... for exclusive
Acoustalloy diaphragm ... for pop-proof
pick-up indoors and outdoors

You see ... and hear ... the E-V Slim-Trim
on network and local telecasts
and broadcasts. You find it in studios
and on remote hook-ups. You find it
on important PA jobs, too. And you
know it's there because it has met the
most exacting tests ... because it serves
so superbly in every way for voice and
music. First in dynamic, it has features
only Electro-Voice can provide. 3
models meet every need!

Ask your E-V Distributor
or Send for Full Facts Now!

FOR TELECASTING-BROADCASTING
"655"—Response 40-15,000 c.p.s.,
±2.5 db. Power rating —53. Omnidirectional.
Changeable low impedance.
Removable swivel. List $200

"654"—Response 50-14,000 c.p.s.,
substantially flat. Power rating —55.
Omnidirectional. 50-250 ohm imped-
ance selector. Swivel head. List $90

FOR PUBLIC ADDRESS
"636"—Response 60-13,000 c.p.s.,
substantially flat. Power rating —55.
Omnidirectional. High or low imped-
ance. Swivel head. List $65

Electro-Voice
401 CARROLL ST. • BUCHANAN, MICHIGAN
Export: 12 E. 40th St., N.Y. 16, U.S.A. Cable: Arlab
MICROPHONES • PHONO PICKUPS • HI-FI SPEAKERS • SELF-TUNING TV BOOSTERS

ENGINEERS
DESIGNERS
PHYSICISTS

THE Aerophysics & Atomic Energy
Research Division of North Ameri-
can Aviation, Inc., offers unparalleled
opportunities in Research, Development,
Design and Test work in the fields of
Long Range Guided Missiles, Automatic
Flight and Fire Control Equipment and
Atomic Energy. Well-qualified engi-
neers, designers and physicists urgently
needed for all phases of work in

Supersonic Aerodynamics,
Preliminary Design & Analysis,
Electronics,
Electro-Mechanical Devices,
Instrumentation,
Flight Test,
Navigation Equipment,
Controls,
Servos,
Rocket Motors,
Propulsion Systems,
Thermodynamics,
Airframe Design,
Stress & Structures.

Salaries Commensurate with
training & experience.
Excellent working conditions.
Finest facilities and equipment.
Outstanding opportunities
for advancement.

Write now—Give complete resume of
education, background and experience

PERSONNEL DEPT.
AEROPHYSICS & ATOMIC ENERGY
RESEARCH DIVISION
NORTH AMERICAN AVIATION
INC.
12214 LAKEWOOD BLVD.
DOWNEY, CALIFORNIA

January, 1952 — ELECTRONICS
BUILD THEM BETTER

WITH

SHAKEPROOF®

Lock Washers

Multiple tapered-twisted teeth bite deeply to resist vibration loosening—lock even tighter as vibration increases!

SEND FOR FREE SAMPLE KIT, TODAY!

Make your own tests... see how every fastening can be positively locked against the hazard of vibration loosening. Ask for Sample Kit No. 21.

SHAKEPROOF inc.

"Fastening Headquarters"

T.M. REG. U.S. PAT. OFF.

DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois
In Canada, Canada Illinois Tools Ltd., Toronto, Ont.

Here SHAKEPROOF Lock Washers are used to lock glove compartment assembly fastenings tight... positive protection against vibration loosening and the abuse of frequent slamming.

This refrigerator door latch mechanism is carefully adjusted for proper closing action. SHAKEPROOF Lock Washers hold the fastenings tight and prevent shifting of the assembly in service.

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.
A New Improved Galvanometer Movement...at Modest Cost

Use of the proven taut-suspension principle assures light weight, minimum size, and low cost for these new Shallcross Type 1951 galvanometer movements. To minimize weight and simplify construction the coil system is suspended on sturdy rod supports instead of a heavy phenolic base. Mounting dimensions are standard and the units are supplied in sensitivities of 0.5-1-2, and 4 microamperes per mm. scale division.

...and Two New Galvanometers

Only 4¼" x 4¼" x 3¾", the new Shallcross Series 315 galvanometer is ideally suited for field, laboratory or production use where low cost and portability are important factors. Where large current variations are encountered, the Shallcross 316 Series with built-in Ayrton shunt switch provides greater versatility. Both types utilize the new Shallcross Type 1951 galvanometer movement. Write for bulletin L-26 to: SHALLCROSS MANUFACTURING COMPANY, Collingdale, Pa.

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
WHY SHOULD YOU BUY ALSIMAG CERAMICS?

When you buy AlSimag Ceramics you get:

- Engineering know-how accumulated during half a century of specialization
- Unexcelled production facilities
- Design assistance which gives you practical suggestions born of experience
- The widest choice of ceramic materials available in the industry
- Equipment of a size and completeness that can handle YOUR job
- Research which has constantly improved known ceramics and has led in the development of new special-purpose ceramics
- Deliveries when and as promised

ASSURED QUALITY starts with analysis of all raw materials plus individual laboratory tests of each batch mixture before it is released for production. Every step in processing is controlled and quality checked—not just guessed at. AlSimag ceramics are checked and double-checked so that you can be SURE they meet specifications.

50TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • PHILADELPHIA, 1649 North Broad St., Stevenson 4-2823
SOUTHWEST: John A. Green Co., 6812 Olive Drive, Dallas P. Drex 9918 • NEW ENGLAND, 1374 Massachusetts Ave., Cambridge, Mass., Kirkland 7-4498
LOS ANGELES, 222 South Hill St., Mutual 9076 • CHICAGO, 228 North LaSalle St., Central 6-1721 • ST. LOUIS, 1123 Washington Ave., Garfield 4959
difficult antenna problems are made easy through Ward's 25 years of Antenna Engineering Experience

Illustrated here is an antenna designed by Ward for Harvey-Wells Electronics.

The problem involved designing a collapsible antenna, for a test-set signal generator, usable in either horizontal or vertical position, without adjusting the equipment. The answer is a Ward-designed antenna—with a swivel mount, permitting the antenna to be quickly swung from horizontal to vertical position. By the use of seven sections, the 33.5" antenna telescopes into 67/8" long with .500" maximum O.D. Full hard brass tubing, chrome plated, is used throughout. A stainless steel ball tops the antenna tip for easy extending or collapsing the unit. With Ward—you get top engineering plus facilities for producing one to thousands of units.

Why don't you save valuable time and expense by having Ward make your hard antenna problems easy!

NOW
a really high-powered RADIO ENGINEERING LIBRARY

Special Offer on This Complete Up-to-Date Set

Save $4.00! These fine engineering books would cost a total of $40.50 at our regular single-copy prices, if you bought them one or two at a time. Under this offer you can have the whole set at once and we'll pay out the saving in handling in a special low Library of only $36.50. In addition you may spread this over several installment payments as shown in the coupon below. Take advantage of these convenient terms to add these helpful books to your working library right away.

5 volumes, 3,921 pages, 2,770 illustrations

Ewing's Fundamentals of Vacuum Tubes, 3rd Ed.
Terman's Radio Engineering, 3rd Ed.
Everitt's Communication Engineering, 2nd Ed.
Hund's High-Frequency Measurements, 2nd Ed.

What this library gives you

These books cover circuit phenomena, tube theory, networks, measurements, and other subjects—give specialized treatment of all fields of practical design and application. They are books of recognized position in the literature—books you will refer to and be referred to often. If you are a practical designer, researcher, or engineer in any field based on radio, you need these books for the help they give in hundreds of problems throughout the whole field of radio engineering.

10 DAYS' FREE EXAMINATION

This offer applies to U.S. only.

[Form for order]
Good ideas for electronic circuitry sometimes run afoul of connector problems. Maybe existing connector units won't hold air pressure gradients, won't stand the heat, aren't rugged enough for the job. Or maybe it's a question of altitude, or under-water application. But if you can sketch the circuit, we'll take it from there. We've engineered so many special connectors, solved so many "impossible" problems, that whatever the requirements are, we can usually provide the answer.

WRITE TODAY for specific information, or send us your sketches. We'll forward recommendations promptly.

BREEZE
Special CONNECTORS

BREEZE CORPORATIONS, INC.
41 South Sixth Street
Newark, New Jersey
TIMERS FOR STANDARD AND SPECIAL APPLICATIONS

TIME DELAY RELAYS
5900 SERIES provides time delay or interval timing ranging up to 10 minutes for applications such as protecting power tubes, or timing portions of a complete cycle of operations.

INTERVAL TIMERS
8006 SERIES provides rugged, heavy-duty interval timers for general, commercial, industrial and appliance applications. Construction is simple providing for long life at low cost.

HAYDON AT TORRINGTON

HEADQUARTERS FOR TIMING

ELAPSED TIME INDICATORS
5700 SERIES motors are made with cyclometer type counters for simple, compact and accurate metering of elapsed time. Applicable either as inexpensive components or with existing equipment.

REPEAT CYCLE TIMERS
5800 SERIES afford flexibility and are adaptable for timing problems requiring continuous complete cycling, or single cycle operation initiated by an external circuit. Also available for D.C. applications.

For complete Design and Engineering Specifications on these and other Timers write for Catalog No. 323.

HAYDON Manufacturing Co., Inc.
SUBSIDIARY OF GENERAL TIME CORPORATION
2425 ELM STREET
TORRINGTON, CONNECTICUT

---

TUBES AT WORK

(continued)
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-
Interoffice Correspondence

To: Assembly Division
From: President's Office

Dear Jim:

I've just been checking over quarterly records. I see unbelievable reduction in cord set rejections. Hope you are maintaining our standard of quality, and that these figures are right. Please double check.

Ed

Dear Ed—Figures are OK. Quality is actually better—we changed to Belden Cords. Jim

CORDITIS-FREE CORDS BY...

Belden WIREMAKER FOR INDUSTRY

1. Low Installation Cost
2. Low Inspection Cost
3. Fewer Rejects
4. Less Returned Goods
5. Less Failures in Service
6. Satisfied Customers

WRITE: Belden Manufacturing Co.
4615 West Van Buren Street
Chicago 44, Illinois
Starting January 1952

NUCLEONICS
takes on new dimensions
to match the
new dimensions of the industry

NUCLEONICS really takes on new dimensions with the January 1952 issue... not only in size, but of far greater importance... in scope. NUCLEONICS pioneered with the industry, has grown with it, and will continue to pace its progress, thus earning by service the right to use the title "first in the field" acquired through early establishment and recognition for the accuracy and excellence of its editorial content.

Beginning with the first issue of '52 NUCLEONICS goes to the regular printed page size of seven by ten inches.

unexplored new markets

The new dimensions of nuclear science mean vast, new and totally unexplored markets. Huge as expenditures are today (7 to 8 billion Gov. dollars) tomorrow promises to be even greater.

While most of the dollars spent come from government, general industry is the prime sub-contractor (of the 75-100 thousand in nuclear work, only 5 thousand work directly for the A.E.C.). As time goes on, it is this industry group with its wisdom and foresight that will take up the industrial, scientific and medical aspects of nuclear science. Therein lies the profitable promise of tomorrow—a market enriched and enlarged—the scope of which no one can rightly gauge. Fantastic though it might sound, its potentials are boundless.

plan NOW to sell those markets

Now is the time to stake your claim in this market. It is rich in prospects, pregnant with possibilities. Alert manufacturers can quickly carve their niche in this industry—and with their name and products established and recognized, they can grow with the industry as it expands.

To reach this market and all its purchasing influences effectively, there is only one accepted advertising medium in which to tell your products story...
EASY TO TAKE...EASY TO READ

with the Fairchild-Polaroid® Oscilloscope Camera

ELECTRONIC CONTROL GIVES INFINITE SPEED VARIATION

with the Fairchild Oscillo-Record Camera

For both still and continuous-motion recording on 35-mm film or paper, the Fairchild Oscillo-Record Camera is ideal. Continuously variable speed control is provided through electronic regulation. There are no belts or pulleys. Film is sprocket-driven so there is no slippage. Top-of-scope mounting eliminates need for tripod and keeps scope controls easily accessible. There is provision for three film lengths—100, 400, or 1000 feet.

Fairchild's adaptation of the Polaroid-Land camera gives you more than just a fast photographic print of an oscilloscope image. The print is exactly half-size for easy measurement of values, especially when a grid is used. And you see the image exactly as it appears on the scope—not reversed. Each 3¼ x 4¼ print records two images.

Moreover, it takes only two minutes (less, if you're fast) to set up the camera, snap the shutter, and pull the tab. Then you wait one minute more and remove the finished print. It's as simple as 1-2-3. No focusing, no special training required.

Full information about the Fairchild-Polaroid and Fairchild Oscillo-Record Cameras is available on request. Write today to Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, New York, Department 120-17A.

FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

ELECTRONICS — January, 1952
MILO RADIO
INDUSTRIAL ELECTRONIC WHOLESALERS

offers FAST, EXPERT ACTION
ON YOUR INQUIRIES and ORDERS!

TREMENDOUS INVENTORY!
MILO's stock of radio-electronic parts, tubes and equipment is enormous! If you have been searching far and wide for some elusive, urgently-needed materials, you are practically sure to find it here at MILO. For MILO stocks everything! Consolidate your purchases with a single, dependable source of supply such as ours and save yourself invaluable time, money and effort.

LARGE TECHNICAL STAFF
— ENABLES WILO TO OFFER "PERSONAL SERVICE" TO EACH ACCOUNT
One of the many reasons for MILO's efficient service to customers is that we assign a highly specialized sales engineer to each account. Thus, each inquiry or order from your firm is cleared through this staff member who becomes personally familiar with your firm's requirements.

STANDARD NATIONAL ADVERTISED BRANDS
MILO stocks the complete lines of products of over 200 of America's leading electronic equipment manufacturers. No matter what your need, MILO has it—or can obtain it with surprising speed.

WHOLESALE PRICES
— Same as "Direct-Factory" Prices
—in most instances
MILO serves the needs of countless hundreds of industrial firms throughout the nation, plus research laboratories, schools, colleges, government agencies, broadcast stations, public utilities, railroads, telephone and telegraph companies, airlines, oil and gas refineries, textile mills, plastic mfrs., etc. Your firm, too, will receive the lowest prevailing wholesale prices.

FAST, SAME-DAY SHIPMENT
Our staff is geared to render fast, efficient service, orders generally being shipped within hours of receipt. MILO ships everywhere—via railway express, parcel post, air express, motor freight, railroad or ocean steamer. Try our service when you are next pressed for time.

NEW 1952 FREE MILO CATALOG
Write today on your company letterhead for your free copy of our massive buying guide—an invaluable aid in your purchasing. Over 1000 pages crammed full with information on the industry's leading products, completely illustrated, including prices and technical specifications. Address Dept. J1K

TUBES AT WORK (continued)

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

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.

On the Kodak Contour Projector, Model 3, you just slip the part into a holding fixture and compare its magnified image with a "chart-gage" over the bright screen. Every detail shown on the drawing is quickly and directly compared against the part itself, to close tolerances and in one operation. Little training or experience is required.

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.

So overwhelmingly has industry turned to optical gaging that production of the Kodak Contour Projector, Model 3, the outstanding instrument for this method, has been greatly accelerated. Deliveries are rapid, and the cost of projector, fixture, chart-gages, and accessories usually comes below corresponding sets of mechanical gages. To get an idea of the large labor savings that the Kodak Contour Projector can bring to your inspection problems, get in touch with Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

If you want to check precision spur and helical gears in action, write for information about Kodak Conju-Gage Instrumentation.
RUNNING TIME METER

- Designed for use on AC lines where successful servicing of electronic or electrical equipment depends upon the regular servicing of such equipment based on actual operating (or idle) time. Unit has a range of 9999.9 hours and resets automatically at 10,000 hours. Can be supplied for either 120 or 240 volts. 60 cycle operation and has operating temperature of -55 to +55° C.

- The Running Time Meter is housed in Burlington's attractive, black bakelite 3" square or 3½" round case.

Write Dept. F 12 for further details.

BURLINGTON INSTRUMENT COMPANY
BURLINGTON, IOWA
Today, in instruments and other devices, more than forty million Telechron synchronous motors are at work... quietly serving the nation's industries, laboratories and homes in a thousand different ways.

As accurate as current itself, the Telechron motor has a rotor so light that it is perfectly synchronized with AC impulses. It responds immediately and reaches full speed in a fraction of a second, giving the accuracy that is so essential to sensitive instruments.

In motion, the rotor virtually floats in its own rotating magnetic field. It's a fact that the rotor shaft bearing of a Telechron motor has never worn out as long as lubrication—which is drawn from a reservoir by capillary action—is constantly maintained. This action furnishes a continuous flow of lubricant to gears, pinions and shafts.

For complete specifications on the full line of Telechron motors, write for booklet 15-120. Telechron Department, General Electric Company, 41 Homer Avenue, Ashland, Mass.

Type B3 Motor — For medium-duty switching, controlling and recording; controlling, such as time switches, business machines, time stamps, system clocks for public buildings, household door chimes and recording instruments.

Type C5 Motor — For heavy-duty timing, switching and controlling such as traffic controls, airfield landing lights, tower clocks and instrumentation. Sturdy gear train construction.
BRING your spring problems to us and be assured of unusual assistance and guaranteed satisfaction . . . for Lewis is geared to design and manufacture springs, coils and wireforms quickly, economically and dependably.

Lewis offers:

- Experienced design and engineering personnel
- Extensive modern facilities
- Unique manufacturing methods
- Skilled production workers
- Veteran sales engineering representatives

Call, wire or write to have a Lewis Spring Engineer help you check your requirements, without obligation.

LEWIS SPRING & MANUFACTURING CO.
2656 W. NORTH AVE., CHICAGO 47, ILL.

Tunable Selector-Rejecter for Audio Amplifiers

BAND-PASS or band-reject selectivity may be added to existing audio amplifiers without having to alter their circuit by the method to be
WE'VE DECIDED NOT TO HIDE OUR LIGHT UNDER A BUSHEL

THE Phaostron COMPANY
ANNOUNCES THE MANUFACTURE
OF THE
"CARB-OHM"
A DEPOSITED CARBON RESISTOR

By license arrangements with Western Electric Company, Incorporated

AVAILABLE HERMETICALLY SEALED

Your inquiries are invited.

ELECTRICAL EQUIPMENT BY

THE PHAOSTRON COMPANY 151 PASADENA AVENUE
SOUTH PASADENA, CALIFORNIA 6-2171
An AGASTAT Time Delay Relay for every requirement
AGASTAT is small and efficient. Furnished to operate in any position although designed for vertical mounting. Time delay range from .1 second to 5 or more minutes. Descriptive literature on request.

AMERICAN GAS ACCUMULATOR COMPANY
1027 NEWARK AVENUE, ELIZABETH 3, NEW JERSEY

Pulse Generator and Calibrator

Model PC-100 R
illustrated here

The Teletronics Model PC-100 Pulse Generator and Calibrator was designed as an accessory for general use with triggered oscilloscopes. However, the variety of waveforms generated and the flexibility of operation provided make it a valuable instrument for many other purposes.

The Pulse Calibrator produces two rectangular pulses of short duration whose amplitudes and polarities can be independently controlled. Their repetition frequency and the time interval between them are also adjustable. Accurate marker pulses and square waves are generated for making both time and amplitude measurements. The unit can be synchronized from an external source or it may be operated self-synchronous in which case a pulse for synchronizing other equipment is generated.

The RAYONIC® Cathode Ray Tubes
by WATERMAN

Since the introduction of Waterman RAYONIC 3MP1 Tube for miniaturized Oscilloscopes, Waterman has developed a rectangular Tube for multi-trace oscillography. Identified as the Waterman RAYONIC 3SP, it is available in P1, P2, P7 and P11 screen phosphors. The face of the Tube is 1 1/2" x 3" and the over-all length is 9 1/2". Its unique design permits two 35P Tubes to occupy the same space as a single 3" round tube, a feature which is utilized in the S-15-A TWIN-TUBE POCKETSCOPE. On a standard 19" relay rack, it is possible to mount up to ten 35P tubes with sufficient clearances for rack requirements. Thus 35P RAYONIC tube is ideal for multi-trace oscillographic work.

Maximum 2nd anode voltage 2750 volts...
...Satisfactory operation can be achieved at 600 volts... Vertical deflection factor 52 to 70 volts DC per inch per kilovolt... Horizontal deflection factor 73 to 99 volts DC per inch per kilovolt... Grid cut-off voltage 2.8 to 6.7% of 2nd anode potential... Focusing voltage 16.5 to 31% of 2nd anode voltage... Heater 6.3V at .6 amp... Twelve pin small shell duodecal base... Tube can be mounted in any position... 3SP1 JAN approved.

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.
CABLE ADDRESS: POCKETSCOPE

WATERMAN PRODUCTS INCLUDE:
3JP1 & 3JP2 JAN RAYONIC CR TUBES
3JP2 & 3JP11 RAYONIC CR TUBES
3MP7, 3MP11 RAYONIC CR TUBES
3RP1, 2, 7, 11 RAYONIC CR TUBES
Also POCKETSCOPES,
PULSESOPES, SAKSCOPES
and other equipment

January, 1952 — ELECTRONICS
Looking for a Material with the RIGHT dielectric constant?

...look to GLASS BY CORNING

In selecting a material for electronic applications, the dielectric constant must not only be exact, it must be the same in every duplicate part. That's why so many manufacturers turn to glass by Corning.

In the hands of Corning technicians, glass can be made with as widely varying dielectric constants as the above figures indicate. And every piece will be exactly the same.

Accurately controlled dielectric constant is just one of the properties Corning can build into your electronic glass components. Whether you need low loss and power factors, controlled transparency, proper sealing characteristics, or corrosion resistance, glass by Corning may well be your answer.

Our research and engineering staffs are ready to help you solve your problems. Just let us know what you have in mind, or write for Bulletin B-88—Glass In The Design Of Electrical Products—Corning Glass Works, Dept. E-1, Corning, N. Y.
TUBES AT WORK (continued)

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 necessity 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.

![Diagram](image)

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".
We call it **mechatronics** as a symbol for Servomechanisms’, Inc., technique for the multiple and interchangeable use of standard, functionally packaged, servo components in varied electronic and electro-mechanical systems. Mechatronics fulfills the urgent need for:

- **Spatial Adaptability**
- **Instant Maintainability**
- **Training Simplicity**
- **Ease of Assembly**

*Trademark*
Before its striking power lie incredibly precise instruments and fire control devices. Here, at the heart of a modern warship's might, you're likely to find Micro precision ground ball bearings — tiny miniatures in sizes as small as ⅜" O.D. and with certain tolerances held to within 25 millionths of an inch.

In America, only Micro makes such bearings. Because they are fully ground they assure trueness of dimensions, higher capacity and lower friction than is possible by other methods. Yet Micro bearings actually cost less.

If extreme refinement in size, weight and efficiency are your objectives, investigate the advantages offered by Micro bearings.

Write today for Technical Bulletin No. 50

New Hampshire
Ball Bearings, Inc.
5 Main Street, Peterborough, N. H.

Somewhere worth thinking about...

Are daily adjustments of your operating costs? There's a big factor showing up in the tape recording world — it's the tragedy of High Maintenance Costs. Many radio stations are confronted with the daily ritual of recorder checking and adjusting. Added to the time cost of such inspections is the cost of frequent parts replacements and loss of program time.

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.

Complete Specifications on Request
Shown is the time-proven Model 300 Console. Throughout the field of professional audio recording this machine is the recognized leader.

Westinghouse offers you SECURITY AND OPPORTUNITY
EE's and ME's with over 3 years experience... a number of excellent positions are now available in our Electronic & X-ray and Air-Arm Divisions for work on:

- Broadcast Transmitters
- Power Line Carrier Communication Equipment
- Railroad Radio
- Radio Frequency Heating
- Medical and Industrial X-ray
- Commercial Radar
- Balancing Equipment
- Military Radar (ship, ground, airborne)
- Military Transmitters
- Specialized Electronic Equipment
- Fire Control Systems
- Automatic Pilots
- Guided Missiles

Check these outstanding benefits: Top pay, ideal working conditions, advancement on merit, graduate study opportunities, employee scholarships, paid re-location expenses, Baltimore location.

Send resume of experience and education to: Manager of Industrial Relations, Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore 3, Md.

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

January, 1952 — ELECTRONICS
Leading the Quality Field for more than 25 Years

Kenyon
TRANSFORMERS
for all ARMY–NAVY specifications

- built for durability
- engineered for trouble-free operation
- designed for standard and special applications

use KENYON TRANSFORMERS for
RADAR • BROADCAST • SPECIAL MACHINERY
JAN APPLICATIONS • ATOMIC ENERGY
EQUIPMENT • AUTOMATIC CONTROLS
EXPERIMENTAL WORK

Write for details  KENYON TRANSFORMER CO., Inc.
840 BARRY STREET • NEW YORK 59, N.Y.
BALLANTINE
STILL THE FINEST
in ELECTRONIC VOLTMETERS

Ballantine pioneered circuitry and manufacturing integrity assures the maximum in SENSITIVITY • ACCURACY • STABILITY

- 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.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>FREQUENCY RANGE</th>
<th>VOLTAGE RANGE</th>
<th>INPUT IMPEDANCE</th>
<th>ACCURACY</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>10 to 150,000 cycles</td>
<td>1 millivolt to 100 volts</td>
<td>1/2 meg. shunted by 20 mmfds.</td>
<td>2% up to 100 KC, 3% above 100 KC</td>
<td>$210.</td>
</tr>
<tr>
<td>302B</td>
<td>2 to 150,000 cycles</td>
<td>100 microvolts to 100 volts</td>
<td>2 meg. shunted by 8 mmfds. on high ranges and 12 mmfds. on low ranges</td>
<td>3% from 5 to 100,000 cycles; 5% elsewhere</td>
<td>$225.</td>
</tr>
<tr>
<td>304</td>
<td>30 cycles to 5.5 megacycles</td>
<td>1 millivolt to 100 volts except below 5 KC; where max. range is 1 volt</td>
<td>1 meg. shunted by 9 mmfds. on high ranges, 4 mmfds. on lowest ranges</td>
<td>3% except 5% for frequencies below 100 cycles and over 3 megacycles and for voltages over 1 volt</td>
<td>$235.</td>
</tr>
<tr>
<td>305</td>
<td>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.</td>
<td>1 millivolt to 1000 volts Peak to Peak</td>
<td>Same as Model 302B</td>
<td>3% on sine waves 5% on pulses</td>
<td>$280.</td>
</tr>
<tr>
<td>310A</td>
<td>10 cycles to 2 megacycles</td>
<td>100 microvolts to 100 volts</td>
<td>Same as Model 302B</td>
<td>3% below 1 MC, 5% above 1 MC</td>
<td>$235.</td>
</tr>
</tbody>
</table>

For further information, write for catalog.

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 that...
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.

Kinney Manufacturing Co.
3565 Washington St., Boston 30, Mass.
Please send me Bulletin VS1-A describing the new Kinney CVM 3153 Midget Vacuum Pump and price information.

Name..................................................................................................................

Company...........................................................................................................

Address...........................................................................................................

City..................................................................................................................... State

ELECTRONICS — January, 1952
PRCISION

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

<table>
<thead>
<tr>
<th>Model</th>
<th>RL-270</th>
<th>RL-271</th>
<th>RL-275</th>
<th>RL-277</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (in.)</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>1/8</td>
</tr>
<tr>
<td>Rating (watts)</td>
<td>1200</td>
<td>2250</td>
<td>1500</td>
<td>1000</td>
</tr>
<tr>
<td>Torque, max. (oz. in.)</td>
<td>40</td>
<td>25</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Weight (oz.)</td>
<td>15</td>
<td>12</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Mounting: 3 holes 1/4&quot; deep</td>
<td>38-32</td>
<td>78-32</td>
<td>160-32</td>
<td>40-32</td>
</tr>
<tr>
<td>Mounting circle diam. (in.)</td>
<td>3.250</td>
<td>1.750</td>
<td>1.250</td>
<td>1.000</td>
</tr>
<tr>
<td>Max. resistance (ohms) ±10%</td>
<td>400,000</td>
<td>275,000</td>
<td>160,000</td>
<td>105,000</td>
</tr>
<tr>
<td>Min. resistance (ohms) ±10%</td>
<td>0.05</td>
<td>0.08</td>
<td>0.15</td>
<td>0.2</td>
</tr>
<tr>
<td>Max. resolution (%)</td>
<td>±0.05</td>
<td>±0.1</td>
<td>±0.15</td>
<td>±0.2</td>
</tr>
<tr>
<td>Min. resolution (%)</td>
<td>0.01</td>
<td>0.015</td>
<td>0.025</td>
<td>0.04</td>
</tr>
<tr>
<td>Linearity (%)</td>
<td>±0.10</td>
<td>±0.10</td>
<td>±0.15</td>
<td>±0.20</td>
</tr>
</tbody>
</table>

Standard Shaft: single end, 3/4" extension; specify if otherwise.
Double ended shaft special; specify diameter and length.
Multiple sections can be ganged, add 5¢ 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

THE GAMEWELL COMPANY
NEWTON UPPER FALLS 64, MASSACHUSETTS

WIDE-BAND • HIGH-GAIN

FIVE INCH

OSCILLOSCOPE

T-601-B

- Y AMPLIFIER
10 mv. rms/in.—3db 2 cy. 12 Mc.
- X AMPLIFIER
250 mv. rms/in.—3db 2 cy. to 250 Mc.
- Z INPUT
1.5V. visible for marking
- RECURRENT SWEET
10 cycles to 100 Kc.
- TRIGGERED SWEET
10 µs. to 100µs.
- INTERNAL CALIBRATOR
Measures 10 mv. to 500 v. P-P
- PROBE
10 mm. 2 megalohms
- Phaseable 60 cy. Sweep & Sync.

$449.50 FOB N. Y. C.

Write for detail sheet E-1-2

TELEVISION EQUIPMENT CORP.
238 WILLIAM ST., NEW YORK 7, N. Y.

IN CANADA THE AHEARN & SOPER CO. LTD OTTAWA

January, 1952 — ELECTRONICS
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.

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.

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.

Illustration shows crystal mixer made from copper base alloy components are silver soldered together
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**

<table>
<thead>
<tr>
<th>6AK5</th>
<th>435A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Current</td>
<td>7.5</td>
</tr>
<tr>
<td>Screen Current</td>
<td>2.5</td>
</tr>
<tr>
<td>Transconductance</td>
<td>5,000</td>
</tr>
<tr>
<td>Input Cap.</td>
<td>3.9</td>
</tr>
<tr>
<td>Output Cap.</td>
<td>2.85</td>
</tr>
<tr>
<td>Center Freq.</td>
<td>60</td>
</tr>
<tr>
<td>Useful F-W</td>
<td>5</td>
</tr>
<tr>
<td>Voltage A-Mp.</td>
<td>15</td>
</tr>
<tr>
<td>Eq. Noise Res.</td>
<td>1,770</td>
</tr>
</tbody>
</table>

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-
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.
The Cannon Electric UA Plug was designed to answer the R. M. A. request for the ideal audio plug. It is the ultimate in a quick disconnect for low level sound and related circuits. Incorporating a wealth of design and construction know-how resulting from Cannon's many years of pioneering in this field, the Type "UA" Series typifies the close attention to important detail that distinguishes every type of Cannon Plug—the world's most complete line. The UA Series is sold through selected franchise distributors. Engineering bulletins sent free on request.

The Cannon UA Series consists of 2 plug types and 5 receptacles, all having 3 gold-plated contacts for 15 amp service. Socket contacts are full-floating. The "G" contact engages first, breaks last for "no noise" grounding or shielding purposes.

CANNON ELECTRIC
Since 1915
CANNON ELECTRIC COMPANY, LOS ANGELES 31, CALIFORNIA
Factories in Los Angeles, Toronto, New Haven. Representatives in principal cities. Address inquiries to Cannon Electric Company, Department A-120, P. O. Box 75, Lincoln Heights Station, Los Angeles 31, California.

Figure 1—Circuit of fm oscillator and amplifier for telemetering respiratory information

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 480 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-

FIG. 1—Circuit of fm oscillator and amplifier for telemetering respiratory information

THE ELECTRON ART (continued)
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.
You'll get it with Corry-Jamestown Housings Too!

The old sailor could tell you that a "perfect fit" is no accident. It's the result of painstaking craftsmanship and the ability to work to close tolerances. Here at Corry-Jamestown we know the value of working with care and precision in electronics equipment, too. You can count on us for large or limited quantity production of housings with apertures that register perfectly every time. It's part of the quality you can rely on when you call on Corry-Jamestown.

We have a large force of highly skilled craftsmen and engineers . . . a completely equipped tool room to make the precise dies and tools we need to meet your specifications . . . a wide variety of shears, presses and brakes . . . automatic welding equipment . . . and modern plating, painting and finishing equipment. Why not let Corry-Jamestown solve your housing problem? Just drop us a line on your needs and we'll give you complete and specific information on how we can help.

CALL, WRITE OR WIRE US TODAY!

CORRY-JAMESTOWN MFG. CORP.
CORRY, PENNSYLVANIA

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...
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.

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

* Trade Mark Registered, U. S. Patent Office

SALES OFFICES: New York, Philadelphia,
Detroit, Chicago, Los Angeles

PLANTS: Olean, N. Y., Franklinville, N. Y.
Jessup, Pa., Myrtle Beach, S. C.
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.

For Rapid, Frequent Changes in COAXIAL CIRCUITS...

- (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.

Write for further information TODAY—

for Uninterrupted Communications across OCEANS and CONTINENTS...

dependable ANDREW Rhombic Antenna Equipment

TRANSMISSION LINES for ANDREW across the convenience Whether your problem

Rapid, dependable

Transmission-Line Tubes

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
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 CORPORATION · COLLEGE POINT, N. Y.
MAGNECORDER
Sound Performance

..from "On The Spot"...to ON YOUR DIAL!*  

"My daddy flies a jet plane over Korea"... Magnetocorders "stationed" in southern Japan perfectly recorded these brave, young words for Americans at home to hear. Easy portability and dependable high fidelity make Magnetocorders known to Americans serving at home and abroad.

At KRLC, Lewiston, Idaho, Magnetocorders bring the same precision and professional quality into the recording room. On an air base or in the studio you can handle "remotes" or delayed programs with complete assurance when you use Magnetocorders, the first choice of radio men everywhere.

MORE FEATURES
PT7 accommodates 10½" reels and offers 3 heads, positive timing and pushbutton control. PT7 shown in console is available for portable or rack mount.

GREATER FLEXIBILITY
In rack or console, or in its really portable cases, the Magnetocorder will suit every purpose. PT6 is available with 3 speeds (3¼", 7½", 15") if preferred.

HIGHER FIDELITY
Lifelike tone quality, low distortion, meet N.A.B. standards — and at a moderate price. PT52 shown in rack mount offers 2 heads to erase, record and play back to monitor from the tape while recording.

WRITE FOR NEW CATALOG
Magnecord, Inc.
360 North Michigan Avenue
Chicago 1, Illinois, Dept. E8-1
Send me latest catalog of Magnecord equipment.

CONSERVE MATERIALS

THE ELECTRON ART (continued)

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
REPLACEMENT:
Tung-Sol Tubes keep service standards up to set manufacturers' specifications.

INITIAL EQUIPMENT:
Tung-Sol Tubes meet the highest performance requirements of set manufacturers.
IF YOU USE powdered-iron cores, one of these popular types will most likely solve your inductor problems. If you use powdered-iron cylindrical cores, toroids, pot-cores, or cup-cores, Lenkurt offers you an economical source of precision-made parts for quick delivery.

POPULAR DIAMETERS are supplied from stock dies. These include: Cylindrical cores with or without inserts from 0.195 to 3.375 inches; toroids from 0.800 to 3.375 inches; pot-cores from 0.930 to 3.375 inches; and cup-cores of 0.590 and 0.937 inches. Lineal dimensions can be made to meet most specifications.

ALL SIZES AND TYPES are available in a wide range of powdered-iron materials to suit your requirements. Write for details or a quotation on your needs.

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
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% 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.

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Mass.

Since 1915—Designers and Manufacturers of Electronic Test Equipment
There's More to a Good Filter Than Meets the Eye!

All of these 66 parts are from a single B&W Toroidal-coil type discriminator only 1 3/4" square by 3 1/2" long exclusive of terminals!

Throughout, the job is one calling for precision components plus a wealth of engineering "know how" in producing and assembling them for maximum performance and effectiveness.

Like all other B & W Special Components, the one illustrated here was designed and produced for a specific application—in this instance a critical military use.

FILTERS
In addition to "tailor-made" discriminators, B & W offers a complete line of performance-proved filters including high-pass, low-pass, band-pass and band suppression types.

TOROIDS
B & W Toroidal Coils of various styles and sizes are available in a wide range of inductance values in open, shielded, potted and hermetically sealed types.

B & W Barker & Williamson, Inc.
237 Fairfield Ave., Upper Darby, Pa.

THE ELECTRON ART
(continued)

New Mullard image converter high-speed photography tube (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 ½ inches so the tube provides image magnification of four times.

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
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.
Berkeley DOUBLE PULSE GENERATOR

DESCRIPTION: The Berkeley Model 903 Double Pulse Generator is a general-purpose laboratory instrument that produces either single or paired pulses. Pulses are individually variable in width, amplitude, and spacing. Pulse polarity is individually selectable. Separate connectors provide impedance levels of 50 or 1,000 ohms for each pulse output.

SPECIFICATIONS

- PULSE DIMENSIONS: Positive or negative as shown below

- REPETITION RATE: Internally or externally controlled, 1 to 1,000 cycles. Push button single cycle.
- CALIBRATION ACCURACY: Separation dial, ±5% over entire range.
- INPUT POWER: 105 to 125 volts, 60 cycles, 90 watt.
- DIMENSIONS: 14¼” x 9¾” x 10¾”; panel, 8” x 13”.
- NET WEIGHT: 18½ lbs.

TYPICAL APPLICATIONS: Checking characteristics of high-resolution electronic circuits, gates, switches, wide-band amplifier, measurement of resolution time of counting circuits, etc.

Complete information is yours for the asking; please request Bulletin 903-E.

January, 1952 — ELECTRONICS
"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 $-67^\circ F$ to $1200^\circ F$, with color retention up to $300^\circ F$. 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.
The value leaders in clock-radios are the brands equipped with Sessions Timers.

Because Sessions Timers are lower-priced than other dependable makes, a growing number of clock-radio manufacturers are offering buyers a better value for their money.

Make any comparison. See for yourself the price-value superiority of Sessions-equipped clock-radios. In today's more competitive market, this important talking point is your greatest assurance of successful sales. Add the quieter operation, unbeatable accuracy, and attractive styling of Sessions Timers, and you have a total number of important features unmatched by any other clock-radio timer. The Sessions Clock Company, Timer Division, Dept. 41, Forestville, Connecticut.

Because Sessions Timers are lower-priced than other dependable makes, a growing number of clock-radio manufacturers are offering buyers a better value for their money.

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.
we’ll work out
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

JEFFERS Electronics INC.
A SPEER CARBON COMPANY SUBSIDIARY
DU BOIS, PENNSYLVANIA
**NEW PRODUCTS**

(continued from p 146)

counter are $13 \times 11 \times 7$ 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 $1\frac{3}{4} \times \frac{3}{4} \times \frac{3}{4}$ 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 7$\frac{1}{2}$ 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.
MITCHELL RAND

electrical insulation headquarters

features...

MIRAGLAS Cords

- to provide maximum insulation
- greatest length of service
- most coverage per pound
- at lowest comparable cost

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:

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>YARDS PER LB.</th>
<th>TENSILE STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC9-1-U</td>
<td>.009&quot;</td>
<td>3,620</td>
</tr>
<tr>
<td>EC9-2-U</td>
<td>.026&quot;</td>
<td>702</td>
</tr>
<tr>
<td>EC9-3-U</td>
<td>.034&quot;</td>
<td>418</td>
</tr>
<tr>
<td>EC9-4-U</td>
<td>.052&quot;</td>
<td>209</td>
</tr>
<tr>
<td>EC9-5-U</td>
<td>.076&quot;</td>
<td>103</td>
</tr>
<tr>
<td>EC9-6-U</td>
<td>.083&quot;</td>
<td>87</td>
</tr>
<tr>
<td>EC9-7-U</td>
<td>.095&quot;</td>
<td>65</td>
</tr>
<tr>
<td>EC9-8-U</td>
<td>.119&quot;</td>
<td>43</td>
</tr>
<tr>
<td>EC9-10-U</td>
<td>.149&quot;</td>
<td>28</td>
</tr>
<tr>
<td>EC9-1-N</td>
<td>.0105&quot;</td>
<td>3,240</td>
</tr>
<tr>
<td>EC9-2-N</td>
<td>.032&quot;</td>
<td>638</td>
</tr>
<tr>
<td>EC9-3-N</td>
<td>.039&quot;</td>
<td>387</td>
</tr>
<tr>
<td>EC9-4-N</td>
<td>.062&quot;</td>
<td>193</td>
</tr>
<tr>
<td>EC9-5-N</td>
<td>.084&quot;</td>
<td>98</td>
</tr>
<tr>
<td>EC9-6-N</td>
<td>.094&quot;</td>
<td>84</td>
</tr>
<tr>
<td>EC9-7-N</td>
<td>.110&quot;</td>
<td>61</td>
</tr>
<tr>
<td>EC9-8-N</td>
<td>.128&quot;</td>
<td>42</td>
</tr>
<tr>
<td>EC9-10-N</td>
<td>.165&quot;</td>
<td>27</td>
</tr>
</tbody>
</table>

MIRAGLAS* CORDS are made by plying fine, strong, flexible fiberglass (filaments of glass). Available either treated or untreated. Treatments: oil, neoprene or wax.

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.

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.

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

Electronics — January, 1952
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 mmfd., in the lower frequency ranges and from 10 to 150 mmfd., 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 mmfd., 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. • 870 MC LAUGHLIN AVE. • P.O. BOX 1278 • SAN JOSE 8, CAL.

NEW PRODUCTS (continued)

Photo shows two Jennings Vacuum Variable Capacitors in position in final amplifier section of transmitter which is housed in the single cubicle.

This Type MW 2 KW Westinghouse Transmitter covers a range of 2 to 30 megacycles for point-to-point communications.

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 ½ 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

Dispalys: 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 frequency 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 ELECTRIC COMPANY
23 Maple Avenue
Phone CAldwell 6-4000
Pine Brook, New Jersey

ELECTRONICS — January, 1952
where PRECISION is of the essence...

makers of the finest sets use MOLDITE IRON CORES

Where it’s a matter of protecting a maker’s reputation for quality performance ... of unquestioned dependability on the battlefield or in the community — engineers don’t gamble. They specify precision-made, performance-tested cores by MOLDITE.

NATIONAL

MOLDITE COMPANY

1410 Chestnut Ave., Hillside 5, N. J.

Samples promptly submitted upon request for design, pre-production, and test purposes

SEND FOR CATALOG 110

Robert T. Murray
614 Central Ave.
East Orange, N. J.

Jerry Gatton Co.
2756 W. North Ave.
Chicago 22, Ill.

Martin P. Andrews
Mott Road
Fayetteville, N. Y.

Perlmuth-Cohen & Assoc.
1335 South Flower
Los Angeles, Cal.

Jose Luis Pontet
Cardoba 1472
Buenos Aires

NEW PRODUCTS (continued)

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, 1\(\frac{3}{4}\) 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

RISETIME — .007 μsec, or less (10%-90%)
SWEEP RANGE — .01 μsec/cm to 20 μsec/cm
SENSITIVITY — .1 V/cm
ACCELERATING POTENTIAL — 24 kv

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 5 cps. 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
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, non-inductive and motor loading.

SYNCHROSCOPE

BROWNING LABORATORIES, INC., 750 Main St., Winchester, Mass. Model
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.
MAXIMUM PROTECTION for Electronic Equipment.
Lord Mountings, of Course!

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—

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 a 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

<table>
<thead>
<tr>
<th>Model 6075</th>
<th>Model 6725</th>
<th>Model 7275</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>5825 to 6175 Mcs.</td>
<td>6525 to 6875 Mcs.</td>
</tr>
<tr>
<td>Reflector Size</td>
<td>48&quot; 72&quot; 96&quot;</td>
<td>48&quot; 72&quot; 96&quot;</td>
</tr>
<tr>
<td>Gain (db, approx., over isotropic radiator)</td>
<td>34.4 37.5 40.4</td>
<td>35.0 38.5 40.8</td>
</tr>
<tr>
<td>Half Power Angles (H plane)</td>
<td>2.86° 1.92° 1.32°</td>
<td>2.56° 1.74° 1.32°</td>
</tr>
<tr>
<td>Half Power Angles (E plane)</td>
<td>3.24° 2.04° 1.47°</td>
<td>2.79° 1.94° 1.47°</td>
</tr>
</tbody>
</table>

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 UHF fitting for RG-50/U (3/4" x 13/4") 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
NEW PRODUCTS (continued)

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 electron magnetic or electrostatic for older 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 DC VOLTS...such as oscillator grid bias. One-megohm resistor in probe prevents circuit leading.

MEASURES AC VOLTS...such as signal voltage on plate of tube.

MEASURES RESISTANCE...such as leakage in coupling capacitor up to 1000 megohms.

Just one probe cable and one slip-on probe handle all measurements.

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 50 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

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.

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 5-ohm input capacitance. Has 1-megohm input, useful for measuring high-resistance circuits such as oscillator, discriminator, and ac.

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 Ohmometer 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 250 Mc.

HERE'S an "on-the-spot" answer to the problem of providing equipment with a combination of push-pull and rotary control. As the illustration shows, with only a single S.S.White flexible shaft, the light can be swung the full 360° arc and tilted up or down simply by turning the control knob or by pushing it in or pulling it out.

The same idea can be used on a wide variety of electronic equipment containing parts which must be regulated from more or less remote points. Not only do S.S.White flexible shafts offer considerable advantages in terms of simplicity and economy, but they also give more freedom in locating the coupled parts where desired.

SEND FOR THIS FREE BULLETIN

Bulletin 5008 has essential facts and data on flexible shafts and shows how to select and apply them.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. E, 10 East 40th St.
NEW YORK 16, N. Y.

Western District Office • Times Building, Long Beach, California

NEW PRODUCTS (continued)

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 meghm. Wattage rating varies from 0.25 to 1 watt. They are available in a variety of resistance wire alloys and impregnation treatments.

Oscillosynchroscopes

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 hermetically
sealed 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.

ELECTRICAL
INDUSTRIES
INC

44 SUMMER AVENUE,
NEWARK 4, NEW JERSEY
Many units, such as timers, transmitters, vending mechanisms, and similar devices require the adoption of small open gear trains for intermittent duty. Beaver Gear Works is equipped to make these trains to any degree of accuracy required. Beaver Gear engineers, knowing what is expected, and qualified to assist in details of fine-pitch gear applications, can advise you as to what will work best under various conditions and can specify the correct design.

Consult us on your gear problems.

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".

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.

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.

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.

For winding coils in quantity accurately . . . automatically use Universal Winding Machines
Many Industrial Products Start Here

Mosinee “fibres that work for industry” depend upon a reforestation program which not only assures trees for the future but protects our forests today. Mosinee Industrial Forests, augmented by aid in planting waste land, make raw material supply secure and ever-growing. From seedlings to technically controlled papers, MOSINEE safeguards every step in the process of making Mosinee Fibres that work for industry.

MOSINEE PAPER MILLS CO., Mosinee, Wis.

NEW PRODUCTS

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 ke 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.

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 \( \mu \) seconds duration for driven sweeps.
- Inputs include a high-impedance input with three attenuator positions; a low-impedance position; and a \( \frac{1}{2} \mu \) 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 \( \mu \) second.
- Weight: less than 30 lbs. Overall dimensions (including eye-shade): 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.
FULL RANGE OF MIL-T-27 TRANSFORMERS

HERMETICALLY SEALED UNITS

NYT hermetically sealed transformers are available in all standard sizes to meet MIL-T-27 specifications, and especially designed constructions for a wide variety of military as well as civilian applications. Designed and built to meet the most exacting specifications. Production facilities for quantity production of all sizes.

the HORNET

HORNET transformers, pioneered by NYT, are of open type construction, utilizing Class H insulating materials. Approximately one-fourth the size and weight of comparable Class A units. Filament and plate supply transformers and chokes. Units can be designed for ambients up to 190 deg. C., altitudes up to 60,000 feet; power ratings from 2VA to 5KVA.

POWER, AUDIO, FILAMENT and PLATE TRANSFORMERS
REACTORS • FILTERS • CHOKES
TV • RADIO • ELECTRONICS

NEW YORK TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

NEW PRODUCTS
(continued)

**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, 4 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.
When you buy for broadcast you want the best... and Altec makes the best microphones for every phase of broadcasting and telecasting. Altec microphones are outstanding for everyday use and will exceed the most exacting requirements when called upon for special jobs. If you are not already familiar with these exceptional microphones, expose yourself to their undeniable advantages.

**NEW PRODUCTS** (continued)

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., 383 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...
Easy comparison tests show G-E rectifier quality

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.
Test, Grade, or Match Resistors

"as fast as you can pick 'em up!"

with the new Clippard PR-5 RESISTANCE COMPARATOR

Just place the "unknown" resistance across the terminals of this precision, production Clippard tester. Even unskilled operators can process up to 17 resistors (of all types) per minute. Working to an accuracy of better than \( \pm 1\% \) through the entire range of 100 ohms to 100 megarms, the PR-5 is a companion instrument to the famous PC-4 Automatic Capacitance Comparator. With it, radio, electrical, resistor manufacturers and large part jobbers save time and money and assure unerring accuracy of inspection.

Completely self-contained, the PR-5 requires no outside attachments other than the Standard Resistor against which unknowns are checked. Operates on 110 Volt—60-Cycle AC. Range: 100 ohms to 100 megarms; reads deviation from standard on any of three scales: \(-5\%\) to \(+5\%\), \(-25\%\) to \(+30\%\) or \(-50\%\) to \(+100\%\). Size: 18" x 12" x 12". Weight: approx. 32 lbs. For complete details, write for Catalog Sheet 1-E.

Clippard

INSTRUMENT LABORATORY INC.

1125 Bank Street • Cincinnati 14, Ohio

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 1/2 in. long \( \times \frac{1}{4} \) in. diameter and are rated 0.25 watt at 250 v. Resistance values up to 0.1, 0.3 or 0.4 megarms 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 \( \pm 1\) deg. Resistance range is 10 to 200,000 ohms.
NEWS FLASH FROM LONDON

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.

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

432 S-D relays help Philadelphia report "Fire!" in 8 seconds

In 8 seconds after the alarm box lever has been pulled, the Quaker City's new fire reporting system receives alarms from 3200 local boxes and dispatches them to the proper fire house and its alternates. Designed by Philadelphia Electrical Bureau engineers, this intricate installation—the most modern of its kind in the world—uses 432 standard Struthers-Dunn relays. Since July 1949, these relays have been in constant service and not one has required adjustment, cleaning or service of any kind.

STRUTHERS-DUNN

5,348 RELAY TYPES

STRUTHERS-DUNN, INC., 150 N. 13th ST., PHILADELPHIA 7, PA.

BAKTLITE * BOSTON * BUFFALO * CHARLOTTE * CHICAGO * CINCINNATI
CLEVELAND * DALLAS * DETROIT * KANSAS CITY * LOS ANGELES
MINNEAPOLIS * MONTREAL * NEW ORLEANS * NEW YORK * PITTSBURGH
ST. LOUIS * SAN FRANCISCO * SEATTLE * SYRACUSE * TORONTO

NEW PRODUCTS (continued)

up to \( \pm 1 \) percent. Linearity accuracy is up to \( \pm 0.25 \) 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
**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.

<table>
<thead>
<tr>
<th>VOLTS</th>
<th>CURRENT</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-325</td>
<td>0-150 Ma.</td>
<td>131</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td></td>
</tr>
<tr>
<td>6.3 AC.CT.*</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>200-500</td>
<td>0-200 Ma.</td>
<td>245</td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>6 Amp.</td>
<td></td>
</tr>
<tr>
<td>0-300</td>
<td>0-150 Ma.</td>
<td>315</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td></td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>5 Amp.</td>
<td></td>
</tr>
<tr>
<td>0-500</td>
<td>0-300 Ma.</td>
<td>500R</td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>#1 200-500</td>
<td>0-200 Ma.</td>
<td>510</td>
</tr>
<tr>
<td>#2 200-500</td>
<td>0-200 Ma.</td>
<td></td>
</tr>
<tr>
<td>#3 6.3 AC.CT.</td>
<td>6 Amp.</td>
<td></td>
</tr>
<tr>
<td>#4 6.3 AC.CT.</td>
<td>6 Amp.</td>
<td></td>
</tr>
<tr>
<td>0-500</td>
<td>0-200 Ma.</td>
<td>515</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td></td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>#1 0-500</td>
<td>0-200 Ma.</td>
<td>600</td>
</tr>
<tr>
<td>#2 0-500</td>
<td>0-200 Ma.</td>
<td></td>
</tr>
<tr>
<td>#3 6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>#4 6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VOLTS</th>
<th>CURRENT</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-500</td>
<td>0-300 Ma.</td>
<td>615</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td></td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>#1 0-600</td>
<td>0-200 Ma.</td>
<td>800</td>
</tr>
<tr>
<td>#2 0-600</td>
<td>0-200 Ma.</td>
<td></td>
</tr>
<tr>
<td>#3 6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>#4 6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>0-600</td>
<td>0-200 Ma.</td>
<td>815</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td></td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>0-1000-Ripple 10 mv.</td>
<td>0-50 Ma.</td>
<td>1020</td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>0-1200-Ripple 10 mv.</td>
<td>0-20 Ma.</td>
<td>1220</td>
</tr>
<tr>
<td>6.3 AC.CT.</td>
<td>10 Amp.</td>
<td></td>
</tr>
<tr>
<td>200-1000-Ripple 20 mv.</td>
<td>0-500 Ma.</td>
<td>1250</td>
</tr>
<tr>
<td>0-1000-Ripple 20 mv.</td>
<td>0-500 Ma.</td>
<td>1350</td>
</tr>
</tbody>
</table>

Specify your voltage and current requirements. Regulation available .5%, .1%, .01%.

*All AC Voltages are unregulated. All units are metered except Models 131 and 315.

---

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.
We're sorry, but we think it's only fair to tell possible new customers our Standing Room Only sign must be changed to Sold Right Out!

The design and production facilities of our microwave department are now taken over by the increasing requirements of our present customers. Because of our responsibility to them, this situation may continue quite a while.

We are sorry to say this because we enjoy making new friends. But we feel that we should tell those who might be interested in our engineering and manufacturing facilities, that for some time we may not be able to serve them.

Any change in the situation will be announced in this publication.

**NEW PRODUCTS**

(continued)

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 a 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 designed for use in making laboratory measurements.
The BNC 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 BNC series is used successfully in the region of microwave frequencies.

Whether your connector requirements call for the BNC 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.
MORE POWER

GH-368 HYSTERESIS SYNCHRONOUS MOTOR

MOST POWERFUL MOTOR MADE IN THIS FRAME

FULL 1 1/8 HP AT 1800 RPM
SIZE 4-9/8" x 5-7/8"
- 115V 60 CY SINGLE-PHASE
- CAP. START AND RUN, 5 MFD.
- TEMP. RISE 40° CONTINUOUS DUTY
- RATED LOAD 1.2 AMP.
- REVERSIBLE
- PULL-OUT TORQUE 2.5 IN. LB.
- PULL-IN TORQUE 2.55 IN. LB.
- STARTING TORQUE 2.65 IN. LB.

OTHER UNITS AVAILABLE IN VARIETY OF SIZE, VOLTAGES, AND FREQUENCIES . . . ONE, TWO, AND THREE PHASE.

ELECTRIC INDICATOR CO.
CAMP AVE., SPRINGDALE, Conn.

DESIGNERS AND MANUFACTURERS OF GOVERNOR-CONTROLLED, SELF-SYNCHRONOUS, DRAG-CUP, DC AND AC TACHOMETER, SHUNT, SERIES, COMPOUND, PERMANENT-MAGNET, SPLIT-FIELD, SEPARATELY EXCITED, UNIVERSAL, INDUCTION, RELUCTANCE, HYSTERESIS, DC & AC SERVO, REELMOTOR, TOTALLY-ENCLOSED, AC DYNAMICALLY BRAKED, STABILIZED HYSTERESIS, MULTIPLE-SPEED, PRECISION FRACTIONAL HORSE-POWER MOTORS AND GENERATORS.

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 Offers its Outstanding Engineering and Manufacturing Facilities to GOVERNMENT CONTRACTORS

Consult us for your Aircraft, Ground and Naval Requirements

Federal has years of experience in meeting military specifications

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.

Federal knows selenium rectifiers. Federal has unmatched power conversion experience...an experience backed by years of successfully meeting the rigid requirements of contracts for military equipments. And Federal has the capacity to deliver your orders—when you want them!

Mail us your specifications today! Write to Dept. E-813.

"America's Oldest and Largest Manufacturer of Selenium Rectifiers"

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD — CLIFTON, NEW JERSEY

(973) 471-7474

Export Distributors: International Standard Electric Corp., 67 Broad St., N.Y.

ELECTRONICS — January, 1952
A Big Step Forward
In Ceramic
Coil Forms!

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.


---

**NEW PRODUCTS**

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 current. 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 14-v range for both a-c and d-c volts, the instrument is housed in a molded Bakelite case that measures...
NEW PRODUCTS (continued)

7¼ × 5½ × 2½ 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-
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.

LESA manufacture potentiometers for all requirements. With 20 years research and experience behind us, our products are known and recognised for their quality throughout the world. Write for complete information and catalog.
NEW PRODUCTS (continued)
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 con-
trol, using the new type R-6 crys-
tals, 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 cover-
age of 150 kc to 220 mc. This is
accomplished in 8 ranges, 6 being

In Electronic Design...

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 require-
ments, 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 require-
ment. Rome’s manufacturing facilities are sufficiently diversi-
fied 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 litera-
ture, mail the coupon below today!

Rome Cable Corporation
ROME CABLE CORPORATION
ROME, NEW YORK and TORRANCE, CALIFORNIA

Copper wire mill products are a Controlled Material under N.P.A.
Controlled Materials Plan . . . USE YOUR CMP ALLOTMENT.

--- IT COSTS LESS TO BUY THE BEST ---

Name
Company
Address
City State
Of particular interest to all who need resistors with inherent low noise level and good stability in all climates.

**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.

**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.

**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!

**STEVENS ARNOLD INCORPORATED**

22 ELKINS STREET
SOUTH BOSTON 27, MASS.

January, 1952 — ELECTRONICS
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
The model 12GLX-M, 1KW Beacon Transmitter illustrated, operates on a single frequency in the range 200-415 Kcs. Oscillator coil can be supplied crystalline-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 kios.
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 x 2 x 4 in. to 12 x 11 x 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 $1 \times 10^{-4}$ liter-microns of hydrogen per second. It measures 13½ in. high, 15 in. wide.
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.

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.
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 1, 1 1/2, 2, and 5-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-Steele 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

2200 per cubic foot 41 weigh just a pound

Requiring a panel area just 3/8" wide by 3/4" 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 screwdriver 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 Condensers.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Nominal Capacity</th>
<th>Number</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>5M11</td>
<td>5.0</td>
<td>1.5</td>
<td>5</td>
</tr>
<tr>
<td>9M11</td>
<td>8.7</td>
<td>1.8</td>
<td>9</td>
</tr>
<tr>
<td>15M11</td>
<td>14.2</td>
<td>2.3</td>
<td>15</td>
</tr>
<tr>
<td>20M11</td>
<td>19.6</td>
<td>2.7</td>
<td>21</td>
</tr>
<tr>
<td>DIFFERENTIAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6MA11</td>
<td>5.0</td>
<td>1.5</td>
<td>7</td>
</tr>
<tr>
<td>9MA11</td>
<td>8.7</td>
<td>1.8</td>
<td>13</td>
</tr>
<tr>
<td>15MA11</td>
<td>14.2</td>
<td>2.3</td>
<td>22</td>
</tr>
<tr>
<td>19MA11</td>
<td>19.6</td>
<td>2.7</td>
<td>31</td>
</tr>
<tr>
<td>BUTTERFLY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3MB11</td>
<td>3.1</td>
<td>1.5</td>
<td>7</td>
</tr>
<tr>
<td>5MB11</td>
<td>5.1</td>
<td>1.8</td>
<td>13</td>
</tr>
<tr>
<td>9MB11</td>
<td>8.0</td>
<td>2.2</td>
<td>22</td>
</tr>
<tr>
<td>11MB11</td>
<td>10.8</td>
<td>2.7</td>
<td>31</td>
</tr>
</tbody>
</table>
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.

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.

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.
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 miniature tubular ceramic capacitors, the GP3 Ceramics. They employ a high dielectric constant ceramic material with which capacitance values as high as 0.002 μF are available on a basic 1/4 × 1/8 in. long tube, and 0.005 μF on a 1/4 × 5/16 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 24-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-
HERE'S A QUALITY RELAY
That Meets Exacting Requirements

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.

WRITE FOR CATALOG R-10

American Relay & Controls, Inc.
4911 W. Flournoy St., Chicago 44, Ill.

HEAT RESISTANT WIRES FOR EVERY APPLICATION...

HEATING UNITS
HEATING ELEMENT
RESISTANCE LINE CORD
THERMOCOUPLE WIRE
ASBESTOS LEAD & FIXTURE WIRE
INSULATED RESISTANCE WIRE
FIBERGLAS INSULATED WIRE
WIRE TO ANY SPECIFICATIONS

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

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.

FOR A TRIAL ORDER OR A CARLOAD consult

THE LEWIS ENGINEERING CO.
Wire Division
NAUGATUCK CONNECTICUT

PHYSICISTS
And
SENIOR RESEARCH ENGINEERS

POSITIONS NOW OPEN

Senior Engineers and Physicists having outstanding academic background and experience in the fields of:

- Microwave Techniques
- Moving Target Indication
- Servomechanisms
- Applied Physics
- Gyroscopic Equipment
- Optical Equipment
- Computers
- Pulse Techniques
- Radar
- Fire Control
- Circuit Analysis
- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
- Electronic Design
- Flight Test Instrumentation

are offered excellent working conditions and opportunities for advancement in our Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:

NORTH AMERICAN AVIATION, INC.
Aerophysics Laboratory
Box No. K-4, 12214 S. Lakewood Blvd.
DOWNEY, CALIFORNIA

January, 1952—ELECTRONICS
cally shielded; has a zero corrector in the base, or rear; and the accuracy rating on d-c is 2 percent.

Moisture Meter
TAGLIABUE INSTRUMENTS DIV.,
Weston Electrical Instrument Corp., 614 Frelighuyse 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-
PROBLEM
Regardless of the intricacies of an application, you can depend on prompt and thorough evaluation by experienced engineers of The A. W. Haydon Company.

SOLUTION
From problem statement through quantity production, the specialized know-how of The A. W. Haydon Company is devoted to expeditiously fulfilling your requirements.

WRITE FOR CATALOG

IT'S ALLIED FOR RCA
Electron Tubes for Industry

Quick, Expert Service on RCA Tubes
ALLIED maintains in stock for quick shipment, the world's largest distributor inventory of RCA special-purpose tubes—of all types. We specialize in supplying the needs of industrial, broadcast, governmental and other users. To save time, effort and money—phone, wire or write to ALLIED. Fill all your needs quickly from the complete, dependable electronic supply source.

See Your 1952 ALLIED Catalog
Refer to your ALLIED Catalog for all electronic supplies—parts, tubes, test instruments, tools, audio amplifiers, accessories—available from the world's largest stocks. Write today for your FREE copy of the complete 212-page ALLIED Catalog.

FREE! Send for it now

ALLIED RADIO
833 W. Jackson Blvd., Dept. 11-A-2, Chicago 7, Ill.

WESGO
CRACK-PROOF CERAMIC SHAPES FOR Furnace Brazing

Withstand any amount of thermal shock without cracking. Proven superior to carbon or metal brazing fixtures in positioning vacuum tube components for furnace brazing.

WESGO
CRACK-PROOF CERAMIC SHAPES FOR Furnace Brazing

WESTERN GOLD & PLATINUM WORKS
589 Bryant Street • San Francisco, Calif.

January, 1952 — ELECTRONICS
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, event-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.


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

OUTSTANDING CARRIER FREQUENCY STABILITY

Bendix-Pacific has developed a new subminiature airborne telemetering transmitter offering outstanding carrier frequency stability under extremes of temperature, vibration and acceleration. This new unit is a crystal-controlled, phase-modulated, VHF transmitter.

The Bendix TXV-11 VHF Telemetering Transmitter, now in production, meets the following specifications:

- **Temperature Stability**: Carrier drift less than ±0.02% from -40°C to +70°C.
- **Vibration**: Maximum noise is less than an equivalent carrier deviation of ±0.25 kc when subject to a sinusoidal vibration 20 to 300 cps at 10 g in any plane.
- **Acceleration Error**: Negligible to 75 g along 3 major axes.
- **Power Output**: 2 watts (nominal)
- **Output Impedance**: 52 ohms (nominal)
- **Modulator Input Impedance**: 470 K ohms and 60 mmf.
- **Modulation Index (b)**: 1.8 at .3 v rms.
- **Distortion**: Less than 1.5% total harmonic distortion for any frequency between 2300 cps and 70 kc at a modulation index of 1.8.
- **Heater Supply**: 6.3 v ± 10% of 1.2 A
- **Plate Supply**: 200 v at 60 ma
- **Screen Supply**: 150 v at 15 ma.
- **Size**: 2 1/2 x 3 1/4 x 1 1/8
- **Weight**: 0.9 lb.

Write the factory for complete engineering data.
Plastic Metals has long been a supplier of special property metal powders for a wide variety of applications in the field of electronics. Among these applications have been powders for permanent magnets, permeability tuning cores, fly-back transformer cores, cathode-ray tube deflection yokes, radar and sonar items, and silicon steel lamination substitutes.

With 17 years of experience in metal powder development and production, Plastic Metals is prepared to cooperate in any problem requiring special selection or combining for unusual characteristics.

Our Research staff is ready to consult with you on problems relating to:

1. the development and production of cores, magnets and other electronic parts requiring metal powder having special, designed-for-the-job properties.

2. the use of metal powder parts for structural or mechanical applications.

3. the substitution of iron powder parts for items difficult or impossible to obtain because of current material shortages or restrictions.

We stand ready to serve you now, or later when such problems may occur.

**NEW PRODUCTS (continued)**

Illustrating the type 13I6 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., Seaard, 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 in...
**TYPE H-14** 108-132 MEGACYCLES

Standard signal source for complete testing of VHF airborne omnirange and localizer receivers in aircraft or on the bench is ARC's Type H-14 Signal Generator. It checks up to 24 omni courses, omni course sensitivity, to-from and flag-alarm operation, left-center-right on 90/150 cycle and phase-localizers, and all necessary quantitative bench tests. Permits quick, accurate, check-out of aircraft just before take-off. For ramp checks RF output 1 volt into 52 ohm line; for bench checks, 0-10,000 microvolts. AF output available for bench maintenance and trouble shooting.

Price $885.00 net, f.o.b. Boonton, N.J.

**Type H-12** VHF Signal Generator

900 - 2100 mc - source of cw or pulse amplitude-modulated RF. Power level 0 to -120 dbm. Internal pulse circuits with controls for width, delay, and rate, and provision for external puling. Frequency calibration better than 1%. Built to Navy specs for research, production testing. Equal to Military TS-419/U.

Price $1,950.00 net f.o.b. Boonton, N.J.
NEW PRODUCTS (continued)

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 wire-wound 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-
ELECTRONIC ENGINEERS

WHO WE ARE:
As a result of our recent affiliation with the Westinghouse Airbrake Co., we are entering a new and accelerated expansion program directed toward permanent growth in the industrial electronics field.

WHAT WE OFFER:
To qualified, competent engineers, we offer truly permanent positions at salaries that rank among the highest in the industry. Additional compensation is paid for the extended work week.

WHERE WE ARE:
We are located just outside Washington, D.C.—away from the hustle and bustle, yet close enough for you to enjoy all the advantages the nation’s capital offers. Suburban housing in northern Virginia is available only a few minutes away from where we are located.

HERE’S ALL YOU DO:
If you have experience in any of the fields listed below, you owe it to yourself to investigate career opportunities here. Of course, all replies will be strictly confidential.

- Computers
- Radar Beacons
- Telemetry
- Sub-Miniaturization
- Microwave Receivers
- Microwave Transmitters
- Millimicrosecond Pulse Circuits
- Research in Underwater Sound Systems

Send resumes to: PERSONNEL DIRECTOR
MELPAR, INC.

---

steatite, ceramic & lava insulators

M. KIRCHBERGER & COMPANY, INC.
Established 1890
1423 37th St., Brooklyn 18, New York 6-1144
West Coast Representative:
S. Siegel, 1145 So. La Cienega Blvd., Los Angeles 35, Calif.

Independent Research Proves:
2 out of 3 Engineers Prefer BURGESS BATTERIES!

NOT TO WONDER Burgess is the first source for industrial dry batteries. Burgess long-life dependability and uniform high-level performance are backed by more years of engineering “know-how” than any other batteries. The maintenance of highest quality always is the reason why 2 out of 3 engineers prefer Burgess... by independent survey. Check for your local source of supply or write now!

WRITE FOR ENGINEERING MANUAL AND CHECK SHEET—No obligation. By return mail you will receive the FREE Engineering Manual listing the complete line of Burgess Batteries together with detailed specifications; also the Burgess “Check Sheet” on which you may outline your battery requirements in the event that the battery you need has not already been developed. Address:

BURGESS BATTERY COMPANY
(DEPT. E-6) FREEPORT, ILLINOIS
Military Tube Sockets

In addition to meeting applicable JAN specifications, METHODE sockets and accessories for military applications are manufactured with all the EX-RA quality, precision and care which can go into a compact heavy duty wiring device.

The J-54B is a miniature, lightweight, plastic molded socket with a choice of two pin designs. The socket is applicable for standard type electrical components including transistors, electronic tubes, rectifiers, batteries and various types of wires and cables.

Following are standard JAN specifications to which METHODE is currently producing:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>JAN 5.28A</th>
<th>JAN 5.28A</th>
<th>KEY DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miniature 7 Pin Plastic Socket</td>
<td>TS102P01</td>
<td>TSF7T1101</td>
<td>S010M S011M</td>
</tr>
<tr>
<td>Miniature 7 Pin Ceramic Socket</td>
<td>TS102C01</td>
<td>TSF7T1102</td>
<td>S010C S011C</td>
</tr>
<tr>
<td>Naval 9 Pin Plastic Socket</td>
<td>TS103P01</td>
<td>TSF9T1101</td>
<td>S015C S016C</td>
</tr>
<tr>
<td>Naval 9 Pin Ceramic Socket</td>
<td>TS103C01</td>
<td>TSF9T1102</td>
<td>S015C S016C</td>
</tr>
<tr>
<td>Miniature 9 Pin Tube Shield</td>
<td>TS103U01</td>
<td>TSF0T1101</td>
<td>S015M S016M</td>
</tr>
<tr>
<td>Miniature 9 Pin Tube Shield</td>
<td>TS103U02</td>
<td>TSF0T1102</td>
<td>S015M S016M</td>
</tr>
<tr>
<td>Miniature 9 Pin Tube Shield</td>
<td>TS103U03</td>
<td>TSF0T1103</td>
<td>S015M S016M</td>
</tr>
<tr>
<td>Miniature 9 Pin Tube Shield</td>
<td>TS103U04</td>
<td>TSF0T1104</td>
<td>S015M S016M</td>
</tr>
<tr>
<td>Miniature 9 Pin Tube Shield</td>
<td>TS103U05</td>
<td>TSF0T1105</td>
<td>S015M S016M</td>
</tr>
<tr>
<td>Miniature 9 Pin Tube Shield</td>
<td>TS103U06</td>
<td>TSF0T1106</td>
<td>S015M S016M</td>
</tr>
</tbody>
</table>

Plastic insulators in above sockets are Type MFE, phenolic, per MIL P-14A. Ceramic insulators are sintered, Grade L-48 or bepper JAN 1-10. Contacts are silver plated copper base alloy (phosphor bronze and beryllium bronze) specified material with terminals hot tin dipped. Shields and bases on JAN 5-28 units are steel cadmium plated. S-28A and S-5005 units are stainless steel; 1-10 parts use brass, nickel plated.

Crystal Socket

A number of METHODE products not as yet covered by JAN specifications are finding application in military equipment, 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.

Inquiries are invited.

METHODE Manufacturing Corp.
2265 West St. Paul Avenue • Chicago 47, Illinois

NEW PRODUCTS

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 2000 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 thermostat.

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...
This new material packs 1000 ohms cm²—48% more than the widely-used nickel-chromium alloys.

And what's more, there's no loss of other important physical and electrical properties. High tensile strength—excellent solderability—TC of Resistance is 20—EMF vs Copper + 7 micro-volts—Coefficient of Expansion 13.9—remarkable Surface-Corrosion Resistance—and many more vital characteristics make ALLOY 1000 a money-making prestige-building component of compact, precision resistors. For complete data, get Bulletin 17.
STANDARD
Radio Interference
and Field Intensity
MEASURING EQUIPMENT
Complete Frequency Coverage -- 14kc to 1000mc!

**NM - 10A** *VLF*
14kc to 250kc
Commercial Equivalent of AN/URM-6.
Very low frequencies.

**HF NM - 20A**
150kc to 25mc
Commercial Equivalent of AN/PRM-1.
Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies.

**NMA - 5A** *VHF*
15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.

**UHF NM - 50A**
375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as JAN-I-225a, ASA C63.2, 16E4(Ships), AN-I-24a, AN-I-42, AN-I-27a MIL-I-6722 and others.

STODDART AIRCRAFT RADIO CO.
6644 SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA
Hillside 9-294

NEW PRODUCTS (continued)

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 Quadruple thickness, NEMA STANDARDS

We invite inquiries where requirements call for:
small SPACE FACTOR
HIGHEST ABRASION RESISTANCE
FLEXIBILITY AND ADHERENCE
DIELECTRIC STRENGTH
RESISTANCE TO CHEMICALS

and it will withstand temperatures of 250 centigrade.

WARREN WIRE COMPANY,
POWNAL VERMONT

SCOPE DOLLY
Model 1
Convenient Height and Viewing Angle
Adjustable to Hold Portable Scopes
Ball Bearing Swivel Rubber Tired Casters
Lightweight Aluminum Construction
Recommended by Laboratories Wherever Used

$35.00 FOR LOUISVILLE, KY.
Formerly manufactured by UNIQUE DEVICES
Now manufactured and sold by
TECHNICAL SERVICE CORPORATION
3116 Michigan Drive Louisville 5, Kentucky

HIGH VOLTAGE
RF POWER SUPPLIES
Voltage Ranges to 60,000 Volts

INQUIRIES INVITED REGARDING YOUR REQUIREMENTS

EMBASSY ENGINEERING CO.
224 East 204th St. New York 58, N. Y.
ECLIPSE-PIONEER Announces the New Line of PYGMY SYNCHROS

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 1 3/4 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

Typical Performance Characteristics

<table>
<thead>
<tr>
<th></th>
<th>One AY-201-3 Driving</th>
<th>Two AY-500-3 Driving</th>
<th>One AY-500-3 Driving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Transformer</td>
<td>Control Transformer</td>
<td>Control Transformer</td>
</tr>
<tr>
<td>INPUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>26-volts, single-phase</td>
<td>26-volts, single-phase</td>
<td>26-volts, single-phase</td>
</tr>
<tr>
<td>Frequency</td>
<td>400 cycles</td>
<td>400 cycles</td>
<td>400 cycles</td>
</tr>
<tr>
<td>Current</td>
<td>88 milliamperes</td>
<td>110 milliamperes</td>
<td>55 milliamperes</td>
</tr>
<tr>
<td>Power</td>
<td>0.8 watts</td>
<td>1.2 watts</td>
<td>0.9 watts</td>
</tr>
<tr>
<td>Impedance</td>
<td>105+/-280 ohms</td>
<td>100+/-280 ohms</td>
<td>290+/-370 ohms</td>
</tr>
<tr>
<td>OUTPUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage Max.</td>
<td>17.9 volts</td>
<td>16.2 volts</td>
<td>14.1 volts</td>
</tr>
<tr>
<td>(roto output)</td>
<td>40 millivolts</td>
<td>40 millivolts</td>
<td>40 millivolts</td>
</tr>
<tr>
<td>Voltage at null</td>
<td>31.0 millivolts/degree</td>
<td>280 millivolts/degree</td>
<td>245 millivolts/degree</td>
</tr>
<tr>
<td>Sensity</td>
<td>23 degrees</td>
<td>26 degrees</td>
<td>44 degrees</td>
</tr>
<tr>
<td>Voltage phase shift</td>
<td>6 degrees</td>
<td>6 degrees</td>
<td>75 degrees</td>
</tr>
<tr>
<td>System accuracy</td>
<td>(max. possible spread)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.6 degrees</td>
<td>0.6 degrees</td>
<td>0.75 degrees</td>
</tr>
</tbody>
</table>

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.

NEW PRODUCTS (continued)

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 tinfoil.
WINCHESTER ELECTRONICS, INCORPORATED

NEW MINIATURE CONNECTORS

...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:

2. Light Weight — Total for plug and receptacle 1.5 oz.
3. Small Size — Maximum diameter 1". Total length O.A. 1 1/4".
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.

Other contact arrangements and shell designs will be available soon — Write our Engineering Department for complete details.

WINCHESTER
ELECTRONICS
INCORPORATED

GLENBROOK, CONN., U.S.A.

FOR YOUR
STAINLESS STEEL FASTENERS

IT'S ALLMETAL

for quality and delivery

ALLMETAL, Specialists in Stainless, Produce Stainless Products Exclusively


WRITE FOR CATALOG C

M A N U F A C T U R E R S   S I N C E   1 9 2 9

ALLMETAL SCREW PRODUCTS COMPANY, INC.
33 GREENE STREET NEW YORK 13, N. Y.

33-26 LIEBRECHT AVE., BROOKLYN 4, N. Y.

ELECTRONICS — January, 1952

281
EXTRUDED

TEFLON®

INSULATED

COAXIAL CABLE

BY

ROCKBESTOS

FOR

HIGH-FREQUENCY

CIRCUITS

Because of Teflon's very stable electrical and chemical properties over a wide range of temperatures (−320°F to +550°F), it is widely used in UHF transmission lines in jet planes and in various airborne communications systems, radar and radio equipment.

Extruded Teflon coaxial cable — extruded Teflon rod now available from Rockbestos. Get in touch with your nearest Rockbestos representative or write direct for information.

Teflon Coaxial Cable
RG 87A/U
RG 116A/U
RG 117A/U
RG 118A/U
RG 119A/U
RG 120A/U

Extruded Teflon Rod

ROCKBESTOS

PRODUCTS CORPORATION

NEW HAVEN 4, CONN.

Specialists in High Temperature Wires and Cables Since 1918

New York • Cleveland • Detroit • Chicago • Pittsburgh • St. Louis
Los Angeles • Oakland, California • New Orleans • Seattle

NEW PRODUCTS (continued)

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.

MICO INSTRUMENT CO.
76E Trowbridge St., Cambridge, Mass.

NEWCOMB
THE SOUND CHOICE OF ENGINEERS

The flawless workmanship, superb operational features and the unsurpassed performance of the distinguished Newcomb amplifiers, excite the admiration of even the most case-hardened engineer. Judged by the most critical standards they more than measure up to your fondest expectations. The brand you can most confidently recommend, or use in your own installations... the industry's most complete sound line.

Write for information

The sound line that quality built

NEWCOMB AUDIO PRODUCTS CO.
AMPLIFIERS, SYSTEMS, RACK EQUIPMENT, TRANSCRIPTION PLAYERS, PHONOGRAPHES

NOTHELFER
Special TRANSFORMERS

Proven by Past Performance

Over 25 years' experience in the manufacture of special transformers to meet individual requirements. Built in quality proved by years of actual use.

From 10 VA to 300 KVA Dry-Type only. Both Open and Encased. 1, 2, and 3 Phase. 15 to 400 cycles.

Send for 8 Page Bulletin, and Price List

NOTHELFER WINDING LABORATORIES
9 ALBEMARLE AVE., TRENTON 3, N. J.

Use "IMPROVED" Silver-facing for speed, quality, durability!

We are equipped to render rapid, dependable service in brazing silver to your pre-shaped contact parts.

Consult us also for any problem concerning wire, sheet or tubing where a composite material, i.e. silver-copper, gold-nickel, copper-iron, etc., is desired.

Your inquiries will be appreciated and replied to promptly.

We invite you to send for a free copy of our brochure, "The Story of laminated Metals."

The Home of IMPROVED Service

The IMPROVED SEAMLESS WIRE COMPANY
INCORPORATED 1898
Dept. 1-A 775 Eddy Street, Providence 5, Rhode Island
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; intercommunication 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:
M. SWIFT & SONS
Engineering Department
10 Love Lane
Hartford 1, Conn.

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 colored 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 occa-
sionally necessary, the dependable G-E car-
tidge 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.

*Registered Trademark

GENERAL ELECTRIC

INSULATION
FORMVAR • FORMEX • ENAMEL

STRIPPED CLEAN IN SECONDS
with X-VAR

IN
OUT
WIPE

1. DIP WIRE in
X-VAR for 3
seconds.
2. WITHDRAW
and watch coat-
ing disintegrate.
3. WIPE CLEAN.
Operation com-
pleted 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.

FIDELITY CHEMICAL PRODUCTS CORP.
472 Frelinghuysen Avenue, Newark 5, New Jersey

ELECTRONICS — January, 1952
The largest commercially available equipment for shake testing according to military specifications is now in service at Sperry Gyroscope Company. Developed by Calidyne to deliver a force output of 2500 pounds at frequencies up to 500 cycles per second, this electro-dynamic shaker, with its associated power supply and control system, is the latest addition to Calidyne’s complete line of equipment for vibration studies.

Further original Calidyne developments in the field of vibration investigation include other electro-dynamic shakers, vibration pick-ups, couplers, vibration standards, vibration meters, and calibrators for accelerometers and vibration pick-ups. Each of these was produced to satisfy a recognized need in vibration research and the advanced thinking they demonstrate has earned their extensive use in diverse fields of engineering.

When you need sure knowledge of vibration and its effects, you need Calidyne apparatus. Write for your free copy of data sheet EBG-521.

**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
- 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.

Write for fully detailed bulletin
10 SOUTH SECOND AVENUE, MOUNT VERNON, N. Y.

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.

76 STAGE STREET
MANSON LABORATORIES
STAMFORD, CONN.

Quartz Crystals

Made to your specific specifications.
Accurate to the minutest tolerance. Exacting in performance—with thorough dependability.

Whether one or a million, you get prompt shipment. Made by craftsmen with a quarter century experience.

Send us detailed description and quantity for prices.

MICHAEL STAHL, Inc.
215 Fulton Street
New York 7, N. Y.
There's a TIC Potentiometer for every application

Miniaturization of precision potentiometers is keeping pace with the increased demand for smaller assemblies and compact design. Now you can minimize wasted space with TIC's outstanding, new RV 3/8" and RV 1-1/4" Miniature Potentiometers.

In spite of their thumbnail size the RV 3/8" and the RV 1-1/4" are precision, high linearity variable resistors, (adjustable trimmers) of high stability achieving a standard of performance hitherto unavailable in such miniature potentiometers.

Construction features include: precision machined aluminum base. low torque...extended connections except sliding contacts...palmkey contacts can be sealed to withstand all humidity, salt spray and altitude specifications. Ganging if desired with TIC adjustable clamp ring.

RV 3/8" 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 3/8 with threaded bushing...servo mounting available if desired.

RV 1-1/4" available with linear or non-linear resistance elements—nine standard resistance values from 100 to 50,000 ohms. Illustration shows RV 1-1/4 with 3 tapped hole mounting...servo mounting or threaded bushing if desired.

Type RV1/32" 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 ranging. Ball bearing models available.

*Numbers refer to diameter of base.

Tapped mounting inserts
Bronze bushing
Totally enclosed with cover
"Constrict-O-Grip" clamping to shaft
(No set screws)
Precious metal contacts
Silver overlay on rotor take-off slip ring

Sine and cosine potentiometers available in RV1/32" and RV2" bases.

Type RV3" Bakelite Base 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 ±0.25%)—see TIC Bulletin RV3-250. Special models available for high humidity applications.

Type RV3/4" 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 RV1 Translatory Potentiometers...accurated by longitudinal instead of rotary motion providing linear electrical output proportional to shaft displacement. Used as a position indicator, high amplitude displacement pickup and for studying low frequency motion or vibration. Features exceptionally high linearity and resolution. Available in various lengths and resistance values.

TECHNOLOGY INSTRUMENT CORP.
531 Main Street, Acton, Mass.

Engineering Representatives

Cleveland, Ohio — Progress 1-6171
Chicago, Ill. — Uptown B-1111
Rochester, N. Y. — Monroe 3143
Cambridge, Mass. — Eliot 41751
Hollywood, Cal. — Hollywood 9-6309
Dallas, Texas — Dixon 3918

Manhasset, N. Y. — Manhasset 3-3424
Boonton, N. J. — Boonton 3-3097
Cambridge, Mass. — Eliot 41751
Hollywood, Cal. — Hollywood 9-6309
Dallas, Texas — Dixon 3918

NEWS OF THE INDUSTRY (continued)

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:


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:

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.


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 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 thickness 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
Vickers educational magnetic amplifier

Permits study of all three basic single phase self-saturating circuits

- For Industrial Laboratories—Schools.
- Can actually be used in operating controls circuits.
- Gives d-c or a-c output... uses d-c or a-c control power.

Designed by Vickers Electric Division to help industrial personnel and students obtain a wider knowledge of the characteristics and applications of high-performance self-saturating magnetic amplifiers.

Complete with Magnetic Amplifier Laboratory Manuals and Magnetic Amplifier Design Handbooks.

Write for literature and price.

Vickers Electric Division
1801 Locust Street • St. Louis 3, Missouri

sub-miniature AND moisture-proof

IN-RES-CO S-15 & S-30 WIRE WOUND RESISTORS

THE ECONOMICAL SOLUTION where moisture proof resistive elements of comparatively small size are required for commercial applications. Type S-15 is ⅜" long by ⅞" diameter. Type S-30 measures ⅜" by ½" diameter. Both types are moisture proof and capable of high performance over long periods of continuous service. IN-RES-CO Resistors for every ordnance or civilian requirement are available at a cost that solves circuit design problems both performance-wise and cost-wise. Check up now on the complete line of IN-RES-CO quality wire wound resistors.

INSTRUMENT RESISTORS CO.
Commerce Avenue • In-res-co
Union New Jersey
Application-Designed Resistors for Electronics and Instrumentation

ANNOUNCING
New 16th Edition

ELECTRONICS

Get your copy of RADIO'S literature it will
send you... will complete
and sell you cash

1ST -1 quotation-

Send

Complete

HADDON & ST.

1100 pages.

Over 75,000 items.

Over 7,000 illustrations.

Fully indexed.

Hard Covers.

Size 8½" x 10½".

Over 75,000 items. Fully indexed and cross indexed. It contains about 90 per cent of the industry's products offering you the widest assortment possible... Yes... it's really an education just to have RADIO'S MASTER.

Furthermore, you will like RADIO'S MASTER because it will save you time and trouble in collecting loose literature and small catalogues. From its pages you can specify, buy and sell with confidence. Get your copy of RADIO'S MASTER at the special low price of...

$1.95

10% CASH WITH ORDERS

ALMO RADIO CO.
509 ARCH ST. & 6205 MARKET ST.
6th & ORANGE STS • Wilmington, Del.
4401 VENTNOR AVE • Atlantic City, N. J.
1133 HADDON AVE. • Camden, N. J.

Hundreds of standard
JONES TERMINAL PANELS
Complete equipment for SPECIALS

Send your specifications for prompt quotation.

Several pages of Jones Catalog No. 17 illustrate standard and special panels we are constantly producing. Latest special equipment enables us promptly to produce practically any panel required. Send print or description for prices, without obligation. Hundreds of standard terminal strips also listed. Send for Catalog with engineering drawings data.

JONES MEANS Proven QUALITY

HOWARD B. JONES DIVISION
CINCINNATI MANUFACTURING CORPORATION
ELECTROLUX DIVISION
SUBSIDIARY OF UNITED CAR FABRICATORS CORP.

ELECTRONICS - January, 1952

289
For your MIL-T-27 requirements specify

For your MIL-T-27 requirements specify

General Transformer

We offer our proved ability to produce hermetically-sealed transformers to JAN-T-27 or MIL-T-27 government specifications. Prompt delivery, efficient engineering techniques and modern production facilities which include conveyorized assembly lines make "GTC" worthy of your consideration.

Our new plant is self-contained with complete metal-working and tool-making facilities. We invite inquiries from prime and sub-contractors. There is a "GTC" representative in your territory.

GENERAL TRANSFORMER COMPANY
serving industry since 1928
18240 Harwood Avenue, Homewood, Illinois
(Suburb of Chicago)

NEWS OF THE INDUSTRY
(continued)

adjustments and electrical circuits continued through the summer under the direction of engineers from Armaen Co., designers and engineers for Tadenz Sendorimir, 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. Henyant of Saheycryad, 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 MANUFACTURERS... LABORATORIES UNIVERSITIES... BROADCASTERS

We don't sell surplus, but we can offer equal values with new merchandise. Send for list of our lines. Let us place your name on our mailing list and place our name on your mailing list to receive your requests for bids.

Address: Industrial Dept.

DeMAMBRO Radio Supply Co., Inc.
“New England’s Largest Electronics Distributor”
1111 COMMONWEALTH AVE.
BOSTON 15, MASS.
Telephone STadium 2-1342

BRANCH OFFICES
Providence, R. I., 98 Broadway Worcester, Mass., 222 Summer St. Manchester, N. H., 1308 Elm St.

Kahle SPECIALISTS IN HIGH-SPEED electron tube machinery

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!

Machinery for all types of electron tubes and related glass products.

Consultations invited. Write today for our new catalog with complete details.

Kahle ENGINEERING CO.
1309 Seventh St., North Bergen, N. J.

GREEN INSTRUMENT COMPANY
363 PUTNAM AVENUE
CAMBRIDGE, MASS.

LOW HARMONIC CONTENT PERMANENT MAGNET ALTERNATOR

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.

EASTERN AIR DEVICES, INC.
585 DEAN STREET • BROOKLYN 17, N. Y.
Hairline Leakers Are Eliminated in these cathode-ray tube parts and crystal cartridge components for glass-to-metal sealing. Standard Volkert items, formed to close tolerances from Allegheny HC-4 Sealmet and Kovar.

Volkert can offer you
Precision...Volume...Low Cost in your Stamped Metals

A pioneer in the application of stamping and forming techniques to electronic components, Volkert is well equipped to help you solve unusual parts problems when difficult-to-form materials are involved.

For other difficult glass-sealing applications, Volkert can furnish you with engineering help...design necessary dies, no matter how complex...mass produce high-quality parts.

Write today for your copy of the 16-page brochure, "3-Way Facilities for Precision Stampings." It tells how Volkert can serve you with facilities for design engineering, tooling and production—all combined under a single roof.

JOHN VOLKERT METAL STAMPINGS, INC. 222-34 96th Avenue, Queens Village 8, New York

NEWS OF THE INDUSTRY (continued)

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
fine wire made finer

Custom drawn custom insulated custom spooled... to your most exacting requirements

Specify the electrical properties, flexibility, tensile strength, laying speed, uniformity and other characteristics you must have. Our Hudson and Winsted Divisions will meet and maintain your specifications.

Yes, "Fine Wire Made Finer!" That's why Hudson-Winsted fine wires are the first choice of electrical, radio-TV and electronic manufacturers whose products are noted for reliability and long life.

hudson wire company

TUNGSTEN LEADS BASES AND CAPS SPOT WELDERS COMPLETE ASSEMBLIES

Manufacturing Component Parts for Electronic Tubes Since 1923.

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 specifications.

Quality tubes depends on quality bases and caps. We make all types including also on all glazed ceramic base.

Our engineers will be happy to help you with any of your problems.

THE ENGINEERING CO.
27 WRIGHT STREET • NEWARK 5, N. J.

Little thought-of facts about capacitors

The short time breakdown voltage of a well-made D.C. capacitor is not less than 5 to 6 times the actual working voltage at 20°C—

\[ E = 5 \times e \min \]

\[ E = \text{Breakdown voltage} \]
\[ e = \text{Rated d.c. working voltage} \]

INDUSTRIAL CAPACITORS are unvaryingly held to this formula.

Designed for maximum safety and the smallest possible volume, INDUSTRIAL CAPACITORS are the most widely used capacitor in industrial applications.

WRITE TODAY FOR DETAILED CATALOG

INDUSTRIAL CONDENSER CORP.
Reduces Inspection Time Up to 75%  
—Semi-Skilled Personnel Can Operate

This instrument is used to compare a fully assembled chassis, no matter how complex the circuitry, against an identical chassis that has been found satisfactory by the usual testing methods and thus is standard. The deviation, in percent, of the circuit under test as compared to the standard circuit is indicated on a calibrated dial.

In the hands of semi-skilled personnel, the RXZ Comparator becomes a valuable instrument for fast troubleshooting as well as test and inspection — reduces inspection time to one-fourth of your present time.

--- PINPOINTS CIRCUIT TROUBLE ---

A switching system is incorporated in the RXZ Comparator by which abnormal deviations are pinpointed in the chassis under test. Besides means for sequential checking of a multiplicity of directly compared circuits in rapid order, means is incorporated for specific troubleshooting by point-to-point impedance measurement. A wide range ohmmeter is included for individual component analysis.

NEWS OF THE INDUSTRY (continued)

Beach, S. C., about 250 miles away, is programmed exclusively by signals from WMIT since the quality is superior to that obtained from existing telephone lines in the region.

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 3048 W. El Segundo Blvd., Hawthorne, Calif., increasing available plant space approximately eight times.

Bendix Aviation Corp. has purchased the Utica, N. Y., plant of the Continental Can Co., Inc., to facil-
The shield that fits all Miniature Tubes

A flexible shield that snugly fits all miniature tubes because it compensates for all variations in tube dimensions. Mini-Shields are made for both T5½ and T6½ bulb tubes. Send for catalog sheet.

THE STAVER COMPANY
INCORPORATED

91 PEARL ST. • BROOKLYN 1, N. Y.
ULSTER 5-6303

ONLY WITH CO-AX

AIR SPACED ARTICULATED R.F. CABLES

4 mmf/ft.

THE LOWEST EVER CAPACITANCE OR ATTENUATION
We are specially organized to handle direct inquiries from overseas and any immediate deliveries for U.S.A. Bill in dollars. Settlement by your check.

TRANSRadio LTD
CONTRACTORS TO H.M. GOVERNMENT.
138A CROMWELL ROAD LONDON SW.7 ENGLAND
CABLES: TRANSRAD LONDON.

LOW IMPED. ATTEN. LOAD. 200 OHM. OD,
CAPAC. IMPED. ATTEN. LOAD. 200 OHM. OD

C1 7.3 150 2.5 0.36
C2 6.3 171 2.15 0.44
C3 5.5 184 2.8 0.44
C4 4.1 252 2.1 1.03

POLARAD

TELEVISION MONOSCOPE SIGNAL SOURCE

Model PT-102

Used in transmitting stations, laboratories and in receiver factories where a reliable standard video signal in the form of a test pattern is a prime requisite for testing overall video performance.

- Composite Video Signal.
- Wide Band Video Amplifier, 3 db down at 7 mc.
- Dual outputs for feeding two 75 or 100 ohm lines.
- Black positive or Black negative output.
- Resolution greater than 500 lines.


OUTPUT: Composite Video Signal, 2 Volts peak to peak.

Complete with tubes, high and low voltage power units, cabinet rack.

100 Metropolitan Ave. • Brooklyn 11, N. Y.
CONVANT RESISTANCE
HIGH POWER RATING
TERMAINE
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

<table>
<thead>
<tr>
<th>Model</th>
<th>Cont. Power Rating</th>
<th>Input Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-5</td>
<td>5 watts</td>
<td>UG-218/U</td>
</tr>
<tr>
<td>100-5M</td>
<td>5 watts</td>
<td>UG-218/U</td>
</tr>
<tr>
<td>50A</td>
<td>50 watts</td>
<td>UG-218/U</td>
</tr>
<tr>
<td>R1</td>
<td>500 watts</td>
<td>Mole, 218/U</td>
</tr>
<tr>
<td>R2</td>
<td>500 watts</td>
<td>Mole, 218/U</td>
</tr>
<tr>
<td>82C</td>
<td>2500 watts</td>
<td>218/U supplied</td>
</tr>
</tbody>
</table>

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

BIRD
ELECTRONIC CORP.
TERMAINE
COAXIAL LINE INSTRUMENTS

1800 EAST 38TH ST.
CLEVELAND 14, OHIO
West Coast:
NEELY ENTERPRISES
Hollywood 46, CAL.

BIGGEST PERFORMANCE—Smallest Size

Four exclusives are yours with the Northern Radio FREQUENCY SHIFT CONVERTER—almost 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.

NORTHERN RADIO COMPANY, INC.
143-145 West 22nd Street
New York 11, N. Y.

NEWS OF THE INDUSTRY

(continued)

state 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, tele-metering 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 post offices 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 capacitor 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-
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 rooftop 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.

PREMAX PRODUCTS
DIVISION CHISHOLM-RYDER CO., INC.
5201 Highland Ave. Niagara Falls, N. Y.

SPECIALTY LAB-BILT DRY BATTERIES

Write for New FREE CATALOG

Here are complete descriptions of 78 Lab-Bilt Batteries of industrial and hard-to-get types. Specification Sheet enables you to order batteries especially designed to your own requirements. No order is too small. Specialty makes and ships FRESH Lab-Bilt Batteries without delay. Get this new catalog today.

Write for bulletin and prices.
POPULAR NATIONAL DIALS

For years, National dials have been the popular choice of amateurs, experimenters and commercial users because of their smooth, velvety action, easily-read scales, and quality construction.

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.

Address export inquiries to Export Div., Dept. E-152

NEW! FREQUENCY AND TIME MEASUREMENTS ACCURATELY . . . CONVENIENTLY!

Using \( f = \frac{N}{T} \)

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.

Please address inquiries to Dept. 6-H

PROVEN DEPENDABLE QUALITY components

NEWS OF THE INDUSTRY (continued)

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 government 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.

Amplex 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
NEWS OF THE INDUSTRY  

(continued)

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.

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 Tele-

F I R S T  
COMMERCIAL  
100  
VACUUM TUBE  

*AGING RACK  
TYPE 242  

Any Standard VOLTAGE  
with  
Any Standard LOAD  
on  
Any TUBE ELEMENT

* Complies with Service aging requirements for reliability testing vacuum tubes.

* Power supplies regulated and continuously variable.

* 500 to 1000 watts for both filament and plate power.

* Bias voltage 0 to 75 volts at 0 to 50 mils.

* Flexible patching permits changing tube types in banks of ten in less than 2 minutes per bank.

* Safe for continuous operation. Furnished with reliable production type sockets.

PENNSYLVANIA TESTING LABORATORY  
Doylestown, Pa.
ELECTRONIC GLASS WORKING EQUIPMENT for RADIO, TELEVISION TUBES, INCANDESCENT LAMPS, GLASS LATHES for TELEVISION TUBE REPAIR. We make Transformers, Spot and Wire Butt Welders, Wire Cutting Machines and 500 other items, indispensable in your production. Eisler Engineers are constantly developing New Equipment. If you prefer your own designs, let us build them for you. Write to Charles Eisler who has served The Industry over 30 years.

EISLER ENGINEERING CO., Inc. 751 So. 13th St. Newark 3, N. J.

GET THE COMPLETE STORY ON
SUPERIOR STEATITE AND CERAMIC INSULATORS FOR THE ELECTRONICS INDUSTRY.
SEND PRINTS FOR QUOTATIONS TODAY.

Custom-made to your specifications. Low-loss factor; dense, high mechanical strength. We are equipped to serve you quickly and efficiently.

STEATITE & CERAMIC CORP.
32-49 GALE AVENUE, LONG ISLAND CITY 1, N. Y.
West Coast Representative: S. Siegel, 1145 So. La Gienaga Blvd., Los Angeles 35, Calif.

NEWS OF THE INDUSTRY (continued)

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.
SOLVE YOUR WIRING PROBLEMS

In almost endless variety of colors, sizes and specifications to your order, Runzel products will assist you in your wiring problems. Shielded wire and cords ... popular hook-up and lead-in wire ... speaker cords and all types of insulated wire products.

Geared for fast production ... Centrally located ... our facilities for service are unexcelled.

Write for samples.

RUNZEL CORD & WIRE CO.
4723 Montrose Avenue
Chicago 41, Illinois

SEALING
DIPPING
POTTING
IMPREGNATING
INSULATING
FUNGUSPROOFING
MOISTUREPROOFING
HEAT CONDUCTING

WAXES BIWAX COMPOUNDS

Developed and produced for manufacturers of electronic components and other electrical units.

Specifications and samples available on request.

Information relative to your problem or application will enable us to make suggestions and recommendations.

BIWAX CORPORATION
3445 Howard Street
Skokie, Illinois

FSC MICROMETER HEAD
for the Electronics Industry

Electronic engineers praise FSC Micrometer Heads for their precise accuracy even after long hard usage. This accuracy is made possible by a patented thread form with radially-loaded nut for elimination of backlash, and automatic wear compensation. Other features and specifications are described in our new bulletin, obtainable on request.

FREQUENCY STANDARDS CORPORATION
P. O. BOX 66, EATONTOWN, N. J. • TELEPHONE ASBURY PARK 1-1018
Try Remler for Service-Tested "Hard-to-Get" Components

Custom Components
Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

Remler Company Ltd. 2101 Bryant St. San Francisco 10, Calif.

PLUGS & CONNECTORS
BANANA PIN TYPES...JAN SPECIFICATIONS
Multi-contact connectors and mating chassia counterparts. Melamine or alkyd insulation; steel or brass nickel-plated shells. Banana springs are heat treated beryllium copper. Unexcelled low resistance contact. Highest quality... good for thousands of connects and disconnects.

Special Connectors to Order—Miniatures: water tight and pressure proof types to JAN specifications.

Remler
Since 1918 PIONEERS IN ELECTRONICS AND PLASTICS

Off-the-Shelf Service from
ELECTRO-TECH

ELECTRICAL MEASURING INSTRUMENTS and INDUSTRIAL CONTROL EQUIPMENT

Laboratory and portable test instruments, panel and switchboard instruments, pyrometers and associated equipment, transformer, rectifiers, controls, timers, counters, thermostats, solenoids, etc.

Thousands of standard and special items by Simpson, Sensitive Research, Biddle, Superior Electric, Struthers Dunn, Weston, Micro-Switch and others.

Complete laboratory service to solve your special instrument problems.

KEEP UP-TO-DATE
Write today for the ELECTRO-TECH CATALOG and the ELECTRO-TECH MONTHLY PURCHASING GUIDE

ELECTRO-TECH EQUIPMENT COMPANY, Dept. E
308 Canal Street, New York 13, N. Y.

NEW BOOKS
(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 R.
Du Mont Laboratories, Inc.

Television Principles

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. LOUGHERN,
Director of Research, Hazeltine Corp.

The Earth's Magnetism


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
6 OUTSTANDING FEATURES of the ROBINSON Metering Pump

- Forcibly ejects fluid compounds...not a gravity dispenser.
- Thermostatically controlled heat...maximum temperature 450° F.
- 1/2 Second per ejection...motor driven, clutch actuated.
- Variable discharge...speed of ejection changed in 2 seconds without tools.
- Reduces unit costs...saves material, reduces rejects...no skilled operator required.
- Adaptable to any production technique...easily installed.

The Robinson Metering Pump has a wide variety of applications and, therefore, may be instrumental in solving some of your problems. Write us for further information.

Edward F. Robinson

95 PARK AVENUE - NOTLEY 10 N. J.

DEPARTMENT 2

Our facilities are organized for design, development and production of delay lines in any quantities.

Your standards are observed in the design stage, prototype development and throughout the entire production run. We meet all JAN specifications when required. Our design assures you maximum engineering efficiency in a minimum space.

Our delay lines are made to special order only. Write for brochure DL-181.

Electronic Systems Co.

578 EAST 161st STREET - NEW YORK 56, N. Y.

NEW BOOKS (continued)

The High Pressure Mercury Vapor Discharge

By W. Elenbaas, North-Holland Publishing Company, Amsterdam; Inter-

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 ultra-violet 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 sec-

304

January, 1952 — ELECTRONICS
TRIED and PROVEN THE WORLD OVER

LETTINE MODEL 240 TRANSMITTER WITH MOBILE CONNECTIONS AND A.C. POWER SUPPLY

This outstanding transmitter has been acclaimed a great performer throughout the world. It is excellent for fixed station, portable or mobile operation.

The 240 is a 40 watt transmitter for CW and plate modulated Phone operation, operating on any frequency from 1.8 to 30 mc; complete with self contained 115 volt A.C. power supply, mobile connections, meter, (8 x 14 x 8) cabinet and tubes: 6V6 osc., 807 final, 6SJ7 crystal mike amp., 6L6 phase inverter, 2 6L6's mod., 5U4G rect. Weight 30 lbs. 90 day guarantee. Also used on 160 to 10 meter Amateur bands.

PRICE: less coils and crystal 576.55 Coils for any one freq. from 1.8 to 3.5 mc.. 53.60 Coils for any one freq. from 3.5 to 30 mc.. 52.91

Send order to:
LETTINE RADIO MFG. CO.
62 Berkley St. Valley Stream, N.Y.

NEW HERMES, Inc. • 13-19 University Place, New York 3, N.Y.

ELECTRONICS • January, 1952
Oscillographs and Amplifiers unsurpassed for
- Amplitude Linearity
- Wide Band Frequency Response
- Rugged and Practical Construction for Field and Mobile Operation
- Heat Sensitive Recording Medium of wide dynamic range

Recorder and Amplifier Combinations
- 1, 2, 4, or 6 channel recorders driven by a selection of DC, high gain AC or combination AC/DC amplifiers
- Rack mounted, mobile units are available

Shielding Problems effectively and economically solved with Metex electronic "Weather Strips"

Resilient...Conductive...Compressible...Cohesive

From closures for cabinets to gaskets for waveguide couplings, Metex Electronic Shielding assures lasting metal-to-metal contact to prevent leakage, without the need for costly machining to secure precise surface-to-surface contacts. Metal wire — knitted, not woven or braided — gives Metex Electronic Strips and Gaskets that combination of conductivity and resiliency which makes them so effective and economical for shielding.

For a more detailed picture of the scope of utility of Metex Electronic Products, write for free copy of "Metex Electronic Weather Strips." Or outline your specific shielding problem—it will receive immediate attention.

Electronics


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 said 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


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-
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
PHASE ANGLE PROBLEMS?

Acme is producing filters with less than 5° total phase shift variation over a temperature range of −55 to +125 °C. These filters solved a problem in a computer system and also affected a substantial reduction in size and weight. They exemplify the exceedingly close phase shift tolerances. Acme can hold when required. Variation between individual filters can be held to less than one degree.

Do you have a phase angle problem that may be solved with an Acme filter?

Acme ELECTRONICS INC.
300 N. Lake Ave., Pasadena 4, Calif.
Formerly Acme Metal Die, Inc.
Wave Filters • Daley Lines • Magnetic Amplifiers • Special Transformers & Chokes • Toroidal, Universal & Solenoid Wound Inductors

SYNCROMOUNT POTENTIOMETER

- SMALL SIZE (1/4"
- LOW TORQUE
- LONG LIFE
- SYMNOL TYPE MOUNT
- GROUND SHAFT
- LINEAR OUTPUT
- FUNCTIONAL OUTPUT

Giannini, standard with the leaders, develops this small ballbearing potentiometer with a variety of unique features to meet the latest computer requirements. Runout and concentricity within .001 in. Total resistance up to 100,000 ohms, torque less than 0.2 inch ounces.

For details on this and other instruments write:
G. M. GIANNINI & CO., INC.
PASADENA 1, CALIFORNIA

MICRODIAL
TEN TURN-COUNTING DIAL

Microdial is composed of two concentrically mounted dials... one for counting increments of each turn and the other for counting turns. The incremental dial has 100 equal divisions and is attached rigidly to the shaft so there is no backlash. Thus the contact position is indicated to an indexed accuracy of 1 part in 1000. Rotation is continuous in either direction. There are no stops on the Microdial assembly.

COMPACT... Microdial has some O.D. as Micropot... requires no more panel space.

CLEAR READING... Forced fast-reading tests showed only 1/10th as many errors with Microdial open window as with next most legible dial. Turn counter distinguishes between 0 and 10 turn readings, and accelerates to avoid confusion on readings near integral turns. Precise readings are made from larger dial with maximum separation of graduations and wide angle visibility.

CONVENIENT... delivered completely assembled with dials synchronized. Easily mounted in a few seconds. All dials may be locked.

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
JANESVILLE * WISCONSIN

PIX WIRE FORMING SPECIALISTS

Precision Parts to meet your Production and Engineering needs. From .002" dia. to .125" dia. Radio tube parts—Stampings—Drawings Modern facilities, high-production equipment.

Metal Crystal Holder Parts
Send sketch or print for quotation.
PIX MANUFACTURING CO., Inc.
24 Bedford St., Newark 3, N. J.

WHAT MAKES A MAILING CLICK?

Advertising men agree... the list is more than half the story. McGraw-Hill Mailing Lists, used by leading manufacturers and industrial service organizations, direct your advertising and sales promotional efforts to key purchasing power.

In view of present day difficulties in maintaining your own mailing lists, this efficient personalized service is particularly important in securing the comprehensive market coverage you need and want. Investigate today.

DIRECT MAIL DIVISION
330 West 42nd Street New York, 18, New York
ZOPHAR WAXES

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types: radio, television, etc. Cold flows from 100°F to 285°F. Special waxes non-cracking at -76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N.Y.

GRANT Electronic Slides

Note simple unit removal possible when unit is mounted on Grant Electronic Slides. Chassis can be easily re-inserted.

CAT. No. 375

Three section slide, progressive action type. Can lock in closed and extended positions or any other combination of positions. Tripping mechanism controls unlocking.

Grant's Engineering and Research Departments are available for consultation on individual requirements.

NEW BOOKS (continued)

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


THE PREPARATION OF PROGRAMS FOR AN ELECTRONIC DIGITAL COMPUTER. By Maurice Noll. University of California Press, 1952, 228 pages, $6.00. Step by step 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 subroutines, order codes, binary- decimal conversions, checking facilities, types of subroutines, proof-reading of programs, tape punching, examples and specifications.


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.

PAUL M. ERLANDSON
Southwest Research Institute
San Antonio, Texas

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 uninstructed 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...
YOUR'S for the asking ... 

75 Years' Experience in MOLDED PLASTICS

... and the Trained Minds that go with it!

AUBURN offers you a background of 75 years' continuous operation in the molded plastic field, plus the experience, skill and specialized talents that go with it — for the asking.

AUBURN salesmen are an example of what experience teaches. They are sales engineers, not agents, experienced in both design and production ... qualified for technical discussion with your design and engineering personnel.

Every Modern Molding Method

AUBURN molds any plastic material by every modern method — Compression, Injection, Transfer, Extrusion, Automatic Rotary, and Reinforced (Fiberglass) Plastic molding.

Dependable Subcontractor

Approved for production of classified material, AUBURN is a dependable subcontractor. Complete tool and die making facilities are maintained, with a highly skilled staff long experienced in the problems of mold design and volume production methods.

For the complete story of AUBURN, write for illustrated booklet.

Auburn Button Works, Inc.
550 McMaster Street, Auburn, New York
Founded in 1876 Telephone 3-5320

BACKTALK (continued)

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 # defined as

\[ \phi = \frac{R_L + R_E}{R_L} \]

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.
EXAMPLE: Working with the North Electric Manufacturing Co., Galion, Ohio, we developed a new miniature hermetically sealed relay to meet exacting military requirements. Features include an 8-terminal sealed header .600" O.D. and a new design balanced armature relay, sealed in a \( \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \) drawn aluminum can. The entire unit may be panel mounted from either the top or bottom. The unit can be furnished either with a dry air fill or vacuum-pumped and pressure filled with dry nitrogen.

HAVING HEADER TROUBLES? We make all types of Sealed Headers, ranging from simple 2- and 3-electrode, crystal holder bases, and standard octal headers, to 14- and 16-terminal headers for sealed Transformer and Relay applications. (Also a variety of special-design headers and terminals.) Write for catalog and quotes.

**THE HERMASEAL COMPANY, Inc.**
Elkhart 9, Indiana

**HIGH VACUUM -- FASTER PUMPING -- QUIET OPERATION**

**are the outstanding characteristics of the LARGE CAPACITY**

**TWO-STAGE DUO-SEAL VACUUM PUMP**

**FREE AIR CAPACITY**
300 Liters Per Minute

**HIGH VACUUM — 0.1 MICRON GUARANTEED**

**FAST PUMPING at all Pressures**

**QUIET RUNNING**

**COMPACT**
Size 26 x 14\(\frac{1}{2}\) x 18\(\frac{1}{2}\) inches

Complete
$515.00

**WELCH, LARGE CAPACITY, TWO-STAGE DUO-SEAL PUMP.**

Although the guaranteed vacuum is stated as 1/10 Micron, most of the tests produced a vacuum of 3/100 Micron. Free Air capacity 300 liters per minute (5 liters per second). It operates quietly with a minimum of vibration. A built-in trap prevents the oil from backing up into the system. It has been designed to prevent oil from being thrown out of discharge side of pump. Oil level shown in convenient indicator window at all times. Convenient oil drain permits oil change without dismantling system.

**WRITE FOR COMPLETE CIRCULAR GIVING RESULTS OF TEST**

---

BACKTALK (continued)

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 (el).

Note that for both cases the electrical damping is provided by \( R_e \) in series with \( R_s \). As \( R_s \) is reduced by feedback or other means, the total electrical damping resistance approaches \( R_e \) as an asymptote. Unless a means could be devised of making \( R_e \) negative, the damping resistance can never become less than \( R_s \). This is why reduction of the amplifier output impedance beyond the point where it is small compared to \( R_s \) (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.

In Fig. 2, Mitchell's Fig. 5 has been translated to the one of gain reduction factor versus electrical damping factor of merit. Compar-
Here's a direct writing, high speed oscillograph with microvolt d-c sensitivity—made completely drift-free through an exclusive chopper type amplifier. Now you can obtain a precise record of transient variables—some formerly recorded only by photographic means—at about 100 times the speed of other recorders with comparable sensitivity.

Remember—only the Offner Dynograph gives you all of these features:

- Pen Deflection Linearity of 1% with pen response of 1/120th second.
- Sensitivity of 150 microvolts d-c per centimeter of pen deflection.
- No extra equipment needed with reluctance type pick-ups.
- True differential input obtained through special transformer coupling.
- Yes, if your need is for accurate, high speed, simultaneous recording of transients in the operation of various equipment—Investigate the Offner Dynograph—write today for Bulletin L-311—see the complete specifications and construction details of the Dynograph.

OFFNER ELECTRONICS INC.
5320 N. Kedzie Avenue
Chicago 25, Illinois

NEW PULSE GENERATOR
FEATURES
- Pulse Height: 0-50 v. continuously variable, positive or negative polarity.
- Pulse Width: 0.07 to 7µs continuously variable.
- Repetition Frequency: 50-5000 cycles, controlled from an internal or external oscillator.
- Output Impedance: 75 ohms or less.
- Output Distortion: 5% or less.
- Pulse Shape: 0.02 µs rise and fall times. Top flat within 2%. Synch Out: 50 v. into 200 ohms, 1 µs wide, 0.1 µs rise time.
- Pulse Phasing: Output pulse can be delayed 100 µs or advanced 10 µs with respect to the synch output.

Other laboratory pulse generators also available. For full details write for Bulletin PG-50

MANSO LAOBORATORIES
76 STAGE STREET
STAMFOI ORIGON

SPECIFICATION
AN-P-89
PANELS-DIALS-ETC.
BODNAR INDUSTRIES, INC.
19 RAILROAD AVE., NEW ROCHELLE, N.Y.

BACKTALK (continued)

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".

CYRUS J. CREVELING
WILLIAM A. WHITE
Washington, D. C.

Proper Credit
DEAR SIRS:

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 |\(e_n|/|e_m|\)?

A payment of five dollars is made for each problem published in this department. Readers are encouraged to send in their pet brain teasers for consideration. Correct answers must accompany problems.

January, 1952 — ELECTRONICS
A CHALLENGE to Outstanding ENGINEERS, PHYSICISTS, DESIGNERS

POSITIONS with SCOPE and IMAGINATION NOW OPEN

Minimum Requirements for ENGINEERS and PHYSICISTS
Four years experience in advanced research and development on Radar Systems, Computers, Wave Guides and Antennas, Fire Control, Moving Target Indicators, Servomechanisms, Pulse Techniques, Gyroscopic Equipment and Related Fields.

Minimum Requirements for DESIGN ENGINEERS
Background—experience in design of Light Machinery, Radar Systems, Computers, Moving Target, Indicators, Servomechanisms, Gyroscopic Equipment and related fields.

Please send resume and salary requirements to:

The W. L. MAXSON CORPORATION
460 W. 34th St., NEW YORK 1, N. Y.

POSITIONS VACANT

PRODUCTION MANAGER familiar with design and production techniques for assembling and wiring on precision electronic test equipment. A steady growing manufacturer located in Northern New Jersey about thirty miles from New York. Salary commensurate with ability and experience. P-5723, Engineering News Record.

EMPLOYMENT SERVICE

SALARIED PERSONNEL 15,400-325,000. This confidential service established 1926, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jiri Thayer Jennings, Dept. 1, 341 Orange St., New Haven, Conn.

POSITIONS WANTED


PATENTS


CONSULT: Z. H. POLACHEK.

P.O. Box 172, Attorney, Broadway, New York 1, N. Y.

ENGINERS
Special opportunities for YOU in SAN DIEGO that sunshiny, smog-free city on the coast of CALIFORNIA

Convair (Consolidated Vultee Aircraft Corporation) is now accepting applications for these following positions in its modern, progressive Engineering Department.

Microwave Engineers Servomechanism Engineers Electronics System Engineers Electronic Circuit Designers

Unusual opportunities for those experienced in the design and analysis of Radar and Missile Guidance Systems.

WORKING FACTS: You get two holidays a week at Convair — overtime accomplished in 5-day week. Attractive salary ranges. An "engineer's" engineering department... with stimulating, competent associates... and interesting, challenging, essential, long-range projects of a wide variety including — commercial aircraft, military aircraft, missiles, engineering research and electronic development. Excellent patent royalty arrangements. Top-notch retirement plan — better than-average life and health insurance. Complete progress—salary review for each person twice yearly. Opportunity for continuing engineering education.

LIVING FACTS: San Diego, with its wonderful residential areas, offers you and your family incomparable living. Ideal climate — cool, clean, dry. Mountains, desert, Mexico, Hollywood, Los Angeles, Pacific Ocean, beaches and bay — only hours or minutes away. It offers you a new way of life... pleasant, refreshing, happy.

If you qualify, you will receive generous travel allowances. SEND COUPON for free booklets and complete information.

THANK YOU

Mr. H. T. Brooks, Engineering Department 900
Convair, 3302 Pacific Hiway, San Diego, California

Please send me FREE booklets describing the Convair Opportunity for me and my Convair Application Form.

My name _____________________________

Occupation ___________________________

Address _____________________________________________________________________________

City _____________________________ State _____________________________

SEND COUPON for free booklets and complete information.
MAKE THIS YOUR HOME FOR IMPORTANT WORK UNDER IDEAL CONDITIONS

- TV RECEIVER DESIGN ENGINEERS
- ELECTRONICS ENGINEERS
- FIELD ENGINEERS
- TEST & INSPECTION ENGINEERS
- LAB. TECHNICIANS


YOU BENEFIT AT BENDIX RADIO:
from high wages, a modern, air-conditioned plant, paid vacations and holidays, group insurance and a good chance for advancement.
Housing immediately available in the beautiful suburban and country areas that surround the Bendix Radio plant.

Write, Wire or phone
MR. E. O. COLE, DEPT. J.
Bendix Radio
DIVISION OF BENDIX AVIATION CORPORATION
BALTIMORE-4, MD. Phone: TOWSON 2200

Engineers
choose your area of specialization at
Minneapolis-Honeywell

Minneapolis-Honeywell Regulator Company, the leader in the field of automatic controls and instrumentation, is presently engaged in research and design work in the areas listed below in both the aeronautical and general engineering divisions. Much of this work borders closely on so-called “pure” or “basic” research.

If you as an engineer are primarily concerned with any of these fields of work; if you have the proper background; and if you are interested in becoming associated with a progressive firm, please let us hear from you.

- electronics
- servo-mechanisms
- hydraulics
- electro-magnetics
- heat transfer
- vacuum tubes
- gyros
- relays
- computers
- electro-mechanical devices
- semi-conductors
- bearings
- electrical contact phenomena

Excellent opportunities for advancement in an expanding organization. Promotions granted on basis of merit. Salaries commensurate with background. Address reply to:

R. WAGNER
Minneapolis-Honeywell Regulator Company
2753 Fourth Avenue South
Minneapolis, Minnesota

PHYSICISTS
and
ELECTRONIC ENGINEERS

Both junior and senior engineers as well as administrative personnel with technical background are needed for employment with expanding research and development organization specializing in Instrumentation, Radio Telemetering, Missle Guidance, Telemetering Data Treatment and special electro-mechanical devices. New laboratory facilities located in research center. Corporation has five year history and is operating on pre-Korean contracts.

Replies held in strictest confidence.

Please send complete resumes to:
APPLIED SCIENCE CORPORATION OF PRINCETON
Post Office Box 44
Princeton, New Jersey

WANTED ENGINEERS AND SCIENTISTS

Unusual opportunities for outstanding and experienced men.
These top positions involve preliminary and production design in advanced military aircraft and special weapons, including guided missiles.
Immediate positions include:
- Weight-control engineers
- Electronic project engineers
- Electronic instrumentation engineers
- Radar engineers
- Flight test engineers
- Stress engineers
- Aero- and thermodynamics
- Servo-mechanists
- Power plant installation designers
- Structural designers
- Electro-mechanical designers
- Electrical installation designers
- Excellent location in Southern California.
- Generous allowance for travel expenses.
- Write today for complete information on these essential, long-term positions.
- Please include resume of your experience & training. Address inquiry to Director of Engineering.

NORTHROP AIRCRAFT, INC.
1009 E. Broadway
Hawthorne (Los Angeles County) California

318 JANUARY, 1952
ATOMIC WEAPONS INSTALLATION NEEDS ELECTRONIC ENGINEERS

Two to ten years' experience in research, design, development or test. Patent history desirable but not necessary. A variety of positions open for men with Bachelor's or advanced degree qualified in one or more of the following fields:

- RELAYS
- TELEMETRY
- PULSE CIRCUITS
- UHF TECHNIQUES
- SERVO-MECHANISMS
- INSTRUMENTATION
- QUALITY CONTROL
- LOW POWER APPLICATION
- TEST EQUIPMENT RELATING TO ABOVE FIELDS

- TECHNICAL WRITERS

- JOB ANALYSTS
  Mechanical & electrical engineers experienced in job evaluation & other wage administration activities.

- PHYSICISTS
  With pure physics background.

- STANDARDS ENGINEERS
  Experienced in writing specifications, in liaison work, and in correlating design information to accepted standards. Aircraft industry experience desirable.

These are PERMANENT POSITIONS with Sandia Corporation in Albuquerque, New Mexico. The Laboratory is operated by Sandia Corporation, a subsidiary of Western Electric Company, under contract with the ATOMIC ENERGY COMMISSION. This laboratory offers good working conditions and liberal employee benefits, including paid vacations, sick leave, and a retirement plan.

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment," Albuquerque lies at the foot of the Sandia Mountains, which rise to 11,000 feet. Climate is sunny, mild and dry the year 'round. No housing shortage in Albuquerque.

MAKE APPLICATION TO
Professional Employment
SANDIA CORPORATION
SANDIA BASE
ALBUQUERQUE, N. M.

ENGINEERING WITH A FUTURE

RESEARCH • DEVELOPMENT • DESIGN

The continued and steady growth of established research and development projects has opened a number of unusual opportunities for outstanding and experienced men.

ENGINEERS • SCIENTISTS • PHYSICISTS

Positions are available in our organization for qualified personnel in the following fields:

Circuit Analysis
Microwaves
Analog Computers
Servomechanisms
Dynamics

Aerodynamics
Applied Mathematics
Physics
Flight Test
Design

Openings exist at several levels, and inquiries from recent graduates are also invited. Salaries are based on education, ability, and experience. Liberal salary, vacation, insurance, and retirement plans are yours if you qualify.

If you are interested in a secure future in these experimental fields, write and give full details to Mr. C. G. Jones, Salary Personnel Department.

ENGINEERS

WANTED

SALES REPRESENTATION

Reputable established high grade test instrument manufacturer wants sales representation in all sections of country. Prefer offices now handling high grade non-conflicting lines. Must be technically informed.

RW-5010, Electronics
230 W. 45 St., New York 16, N. Y.

ELECTRONIC ENGINEERS

Degree in Electrical Engineering
Plus Maintenance or Repair Experience on SCR-584 Radar

ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA
180 S. ALVARADO STREET
LOS ANGELES, CALIFORNIA
Capehart needs outstanding
RESEARCH PHYSICISTS
SR. ELECTRONIC ENGINEERS
SR. MECHANICAL ENGINEERS
ENGINEERING PHYSICISTS
CIRCUIT ENGINEERS
MICROWAVE ENGINEERS
TELEVISION ENGINEERS
VACUUM TUBE ENGINEERS
TEST EQUIPMENT ENGINEERS
FIELD ENGINEERS
ELECTRONIC TECHNICIANS

with advanced academic training and several years' experience
for
RESEARCH AND DEVELOPMENT

Our Long Range Programs and Steady Growth Assure Permanent Employment at Excellent Salaries for Competent and Qualified Personnel.

Interested Persons are Invited to Submit Detailed Resumes of Experience and Education with Salary Requirements and Availability Date to:

The Employment Department
CAPEHART-FARNSWORTH CORPORATION
FORT WAYNE, INDIANA

Engrs...Physicists...Chemists...Metallurgists...

A Reminder from GENERAL ELECTRIC
Tremendous material resources...the stimulation of highly creative work...long-range security and professional recognition...these are but a few of the assets General Electric offers you in unusual positions now available in:

Advanced Development, Design, Field Service and Technical Writing.

If you have a Bachelor's or Advanced Degree in Electrical or Mechanical Engineering, Physics, Metallurgy or Physical Chemistry and experience in the Electronics Industry, you can expand your training and experience to the fullest in openings in connection with:

MILITARY RADIO & RADAR MOBILE COMMUNICATION MULTIPLEX MICROWAVE COMMUNICATIONS ELECTRONIC COMPONENTS...TELEVISION, TUBES and ANTENNAS.

Please send resume to:
TECHNICAL PERSONNEL ELECTRONICS PARK

GENERAL ELECTRIC
Syracuse, New York

TECHNICAL WRITERS
The Signal Corps Center at Fort Monmouth, New Jersey, has a need for technical writers and editors in communications, electronics and associated fields.

Current needs are at several professional levels, ranging from trainee positions, grade GS-5 to senior writer, grade GS-11. Attractive salaries ranging from $3410 to $5960 and good promotional opportunities are offered.

These technical writers and editors will write, edit, and review technical and scientific manuscripts, hand books, pamphlets, circuits, instruction books, etc. on radio, radar, electronics, communications, sound ranging and position finding equipment, and associated equipment, as used by combat units of the United States Army.

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.

ENGINEERS and PHYSICISTS
Work in Challenging Design and Development Fields Combining the Benefits of Essential Work with Security and Rapid Professional Advancement. Enjoy, among other Benefits:

- Overtime (5-day week)
- Company-Paid Insurance
- Periodic Merit Reviews
- Excellent Compensation

IMMEDIATE OPENINGS EXIST FOR MEN EXPERIENCED IN THE FIELDS OF

- GYROSCOPICS
- ANALOG COMPUTERS
- FIRE CONTROL SYSTEMS
- SERVO MECHANISMS
- INSTRUMENT DESIGN
- CONTROL CIRCUITS

Reply by sending complete resume to TECHNICAL PERSONNEL OFFICE

ARMAR CORP.
254 36th St.
Brooklyn 32, N. Y.

FIELD REPRESENTATIVE for WEST COAST NUCLEAR INSTRUMENT MANUFACTURER

We want a Sales Engineer to contact principal users of nuclear instruments. This man will spend approximately 85% of his time traveling throughout the United States and Canada. He will receive a straight salary plus all traveling expenses and an opportunity to grow with a progressive organization in a new industry.

A strong background in nuclear instrumentation is required, plus an ability to organize your own time and activities. A keen interest in people and challenging situations is essential. Sales experience is desirable, but not necessary. This is not a war baby. If you are building for the future and have the necessary qualifications, please send your complete work history, along with a resume of your formal education, plus a recent photograph to:

PERSONNEL MANAGER
BERKELEY SCIENTIFIC CORP.
2500 Wright Ave., Richmond, Calif.

January, 1952 — ELECTRONICS
ENGINEERS - DESIGN DRAFTSMEN

There is a future for you at Workshop!

We are building a new antenna laboratory—the finest in the world and need people who are interested in a company that has a commercial future. Permanent openings are available now for research and development in these interesting fields: television—mobile communications—broadcasting—aircraft—microwave—radar—and other high frequency antenna fields.

If you have
- experience with antenna, RF, antenna rotator or servo-mechanism designs
- a degree in physics, mathematics, electrical or mechanical engineering

WRITE TODAY TO:

Paul Hines, Director of Engineering
THE WORKSHOP ASSOCIATES
135 CRESCENT ROAD
Division of The Gabriel Company
NEEDHAM HEIGHTS, MASS.

LOUD SPEAKER ENGINEER
WANTED

With several years’ development and acoustic measurement experience. Position now open with large Eastern Manufacturer. All replies will be held confidential.

P.2653, Electronics
330 W. 42nd St., New York 36, N. Y.

LABORATORY INSTRUMENTATION MAN

Responsible position for instrumentation man, preferably a chemical engineer with strong leaning toward instrumentation involving maintenance, design, and selection of electronic and other instruments required by chemical research groups. Position requires a more practical than theoretical man having good gadgeteering sense. Practical knowledge of high and low voltage electrical circuits is desirable. Location Anchorage, Alaska. Please state qualifications and salary requirements in letter addressed to: R. F. McGoone, Technical Personnel Manager.

Monsanto Chemical Company
St. Louis 4, Missouri

PHYSICISTS - MATHEMATICIANS

ELECTRONICS ENGINEERS - DESIGN DRAFTSMEN

There is a future for you at Workshop!

We are building a new antenna laboratory—the finest in the world and need people who are interested in a company that has a commercial future. Permanent openings are available now for research and development in these interesting fields: television—mobile communications—broadcasting—aircraft—microwave—radar—and other high frequency antenna fields.

If you have
- experience with antenna, RF, antenna rotator or servo-mechanism designs
- a degree in physics, mathematics, electrical or mechanical engineering

WRITE TODAY TO:

Paul Hines, Director of Engineering
THE WORKSHOP ASSOCIATES
135 CRESCENT ROAD
Division of The Gabriel Company
NEEDHAM HEIGHTS, MASS.

PHYSICISTS

ELECTRONIC ENGINEERS

ELECTRONIC SCIENTISTS

MECHANICAL ENGINEERS

The Signal Corps Engineering Laboratories located at Fort Monmouth, New Jersey, have a number of attractive openings for physicists, electronic scientists, electronic engineers, and mechanical engineers in the research and development, design, modification and testing of electronic equipment in the fields of radio and wire communications, radiological detection, meteorological instruments, facsimile, televisi- on, photography, and communications systems.

Current vacancies are at nearly all professional levels ranging from trainee positions for engineers and physicists just out of college to project and staff positions requiring considerable background of accomplishment in the technical field. The Signal Corps Engineering Laboratories offer attractive salaries ranging from $240 to $3200 an unusual latitude in choice of research or developmental work, and a good opportunity to develop individual ideas.

Signal Corps Engineers and scientists have at their command the most complete and finest laboratory equipment and facilities available anywhere, and opportunities to progress professionally are virtually unlimited.

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.

SALES ENGINEER

Manufacturer's representative required salesman with engineering knowledge of electronic parts to sell to manufacturers and jobbers in metropolitan New York, New Jersey, Connecticut. Must be experienced in electronics business experience and starting salary desired.

RW-2590, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED

COMPETENT ELECTRONIC TUBE DESIGN ENGINEER

with knowledge of radio tube design and production. Excellent position for qualified man.

P.2583, Electronics
330 W. 42nd St., New York 36, N. Y.

LOCKHEED AIRCRAFT CORPORATION, Burbank, California

There's a great future waiting for you in Southern California—helping create the planes of the future in Lockheed's long-range development program. Lockheed is building planes for defense, planes for the world's airlines. You are needed to help carry on this program—a program that offers you not just a job, but a future!

Lockheed also offers you: Increased salary rates, generous travel allowances, a chance to live in Southern California, and many other benefits only a company like Lockheed can provide.

REQUIREMENTS:

Design experience in aircraft electrical installation, circuit layout and systems analysis; experience in radio and radar circuit design and installations, as applied to aircraft.

NOTE TO ENGINEERS WITH FAMILIES:
Housing conditions are excellent in the Los Angeles area. More than 35,000 rental units are available. Thousands of homes have been built since the war, huge tracts are under construction now. You will find the school system as good—from kindergarten to college.

Send today for free, illustrated brochure describing life and work at Lockheed in Southern California. Use handy coupon below.

M. V. Mattson, Employment Manager Dept. EL-12

LOCKHEED

Please send me your brochure describing life and work at Lockheed.

My name: ____________________________

My occupation: _______________________

My address: _________________________

My city and state: ____________________

ELECTRONICS — January, 1952
SEARCHLIGHT SECTION

LOOKING AHEAD?

If you’re a top performer in the field of physics, electronic engineering or design, and you’re looking for a career as well as a well-paid position, it will pay you to investigate the excellent opportunity we offer.

**BASIC QUALIFICATIONS:** Minimum of four year’s experience in advanced research or development related to:
- Pulse Circuits
- Computers
- Nuclear Instruments
- Miniaturization

ILLUSTRATED BROCHURE on request. Please write (giving summary of your education and experience, plus salary requirements) to:

THE BERKELEY SCIENTIFIC CORP.
2200 Wright Avenue
RICHMOND, CALIFORNIA

---

**ELECTRONIC ENGINEERS**

Opportunities with Tracerlab, Inc. are available for Electronic Engineers, qualified by design experience on DC and wide band amplifiers, low power pulse circuitry, computers, telemetering or allied fields.

Tracerlab, Inc. manufactures instruments of all types for the fast growing field of radioactivity. Tracerlab, as one of the foremost leaders in this field, has much to offer its employees concerning security and opportunity for advancement.

Men who have had complete responsibility for design of complex electronic instruments in a manufacturing organization with supervision of Junior Engineers and Technicians are invited to write, giving a detailed outline of training and experience. Correspondence will be confidential. Selected applicants will be asked to come to Boston at our expense for an interview.

Industrial Relations Department
TRACERLAB, INC.
130 High Street Boston 10, Mass.

---

**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 progressive in its field. Our employees know of this advertisement. If you think you qualify, please telephone our advertising agency, Hancock B-3855, 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 cooperating with manufacturers and laboratories to sell $5" bandwidth high-gain oscilloscopes in the $400 class. Please write full details of lines now handled, area covered and other pertinent facts.

BW 2621 ELECTRONICS
330 W. 42nd St., New York 36, N. Y.

---

**ENGINEER**

**MECHANICAL OR ELECTRICAL**

SYLVANIA

Needs in Its
PRODUCT DEVELOPMENT LABORATORIES

In KEW GARDENS, L. I.

... a mechanical or electrical engineer to work on problems relating to shock and vibrations in the field of vacuum tubes and electronic devices. BS in EE or ME and a minimum of 5 years experience, some of it on vacuum tubes, essential.

This opening offers opportunity to contribute to the growth of a steady expanding company. Please send complete resume to:

Manager of Personnel
DEPT. K-1
SYLVANIA
ELECTRIC PRODUCTS, INC.
40-22 Lawrence St.
Flushing, New York

---

**POSITIONS OPEN**

Location
KANSAS CITY, MO.

Electronic & Mechanical Engineers

**ELECTRONIC ENGINEERS**

Electronic Engineers: Must have considerable development experience in radio transmitting and receiving equipment. Ability to fill position of Senior Project Engineer a plus.

Mechanical Engineers: Must have development experience in mechanical design of electronic or similar precision equipment. Practical and theoretical knowledge of materials, finishes, sheet metal, and machine shop design are basic requirements. Position is one of considerable responsibility.

SALARY: Open.

These positions are permanent.

Write stating educational and professional history directly to:

Jay V. Wilson, President
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut St. Kansas City, Mo.

---

**ELECTRONICS**

**PROJECT MGR.—Special Devices and Instrumentation Research** Salary: $12,000

**PROJECT ENGRS.—Sonar, Serres, Propulsion, Guided Missiles, Fire Control, Radar, Sonar,**

**Thermonuclear**, etc.

**HIGH PATENT ATTORNEY—Electronic**

**HIGH GROUP LEADERS—Electro-Mechanical device**

Circuit Research, Gold Cathode Tubes, Instrumentation, Computers, etc.

**RESEARCH ENGRS.—Magnetic Devices, Chlortype**

**TRANSISTORS DESIGN & LABS**

**HIGH MATH—LOGICANS**

**SEND DUPLICATE RESUMES**

FRANKLIN

225 S. 15th St.
Philco, 2 Pa.

---

**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-8. Attractive salaries ranging from $3410 to $5060 and good promotional opportunities are offered.

These civilian instructors will train officer and enlisted military personnel in the theory, installation, repair, maintenance and operation of communications, electronic and associated equipment, as indicated above.

Applicants hired as trainees will be given an accelerated training course in teaching techniques. Those instructors to 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 Office. Mail to:

Civilians Personnel Division
SIGNAL CORPS CENTER AND
d FORT MONMOUTH
Fort Monmouth, N. J.

---

January, 1952 — ELECTRONICS
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:

ELECTRONICS ENGINEERS
PHYSICISTS
MECHANICAL ENGINEERS
AERODYNAMISTS
AERONAUTICAL ENGINEERS
CHEMICAL ENGINEERS

In such fields as:
GUIDED MISSILES
RADAR RESEARCH
BASIC AND APPLIED PHYSICS
ELECTRONIC COMPUTERS
SYSTEMS ANALYSIS
AIRCRAFT PRECISION INSTRUMENTATION
WIND TUNNEL RESEARCH
FLIGHT RESEARCH
DEVELOPMENT ENGINEERING
HEAT TRANSFER
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.

CORNELL AERONAUTICAL LABORATORY, INC.
P. O. Box 235
Buffalo 21, New York

AG 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

DEVELOPMENT ENGINEERS
With Several Years Design Experience or Advanced Degrees for Permanent Positions with IBM

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, 1725 North Street, Endicott, N. Y.

INTERVIEWS ARRANGED IN YOUR CITY

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. Mayrhoaser.

THE TURNER COMPANY
909 17th St. N. E.
Cedar Rapids, Iowa

ELECTRONICS — January, 1952
### Meters

<table>
<thead>
<tr>
<th>Name</th>
<th>Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2MA DC 25&quot; R</td>
<td>$3.50</td>
<td></td>
</tr>
<tr>
<td>500 Microamp</td>
<td>DC-3/5&quot;</td>
<td>$1.00</td>
</tr>
<tr>
<td>DM 125A Dc and</td>
<td>$0.50</td>
<td></td>
</tr>
<tr>
<td>500 mA DC 25&quot;</td>
<td>$1.05</td>
<td></td>
</tr>
<tr>
<td>General Electric</td>
<td>$1.00</td>
<td></td>
</tr>
<tr>
<td>3% 3V DC 25&quot; R</td>
<td>$0.50</td>
<td></td>
</tr>
<tr>
<td>General Electric</td>
<td>$0.50</td>
<td></td>
</tr>
<tr>
<td>2 amp NF 3/5&quot; R</td>
<td>$0.50</td>
<td></td>
</tr>
<tr>
<td>Weston</td>
<td>$0.50</td>
<td></td>
</tr>
</tbody>
</table>

### Oil-Filled 35 KV and 50 KV Isolator Transformers

- Type: 35KV-120 1.09
- Type: 35KV-230 4.50
- Type: 50KV-230 5.25

### Voltage Dividers

- Type: 50KV-230 5.25
- Type: 60KV-230 6.25

### Oil Filled Condensers

<table>
<thead>
<tr>
<th>Mfd</th>
<th>VDC</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>660</td>
<td>$4.00</td>
</tr>
<tr>
<td>6-5</td>
<td>660</td>
<td>$4.50</td>
</tr>
<tr>
<td>2</td>
<td>1000</td>
<td>$4.00</td>
</tr>
<tr>
<td>2</td>
<td>1060</td>
<td>$4.50</td>
</tr>
<tr>
<td>2</td>
<td>1100</td>
<td>$4.00</td>
</tr>
<tr>
<td>2</td>
<td>1200</td>
<td>$5.00</td>
</tr>
<tr>
<td>2</td>
<td>1500</td>
<td>$5.00</td>
</tr>
<tr>
<td>2</td>
<td>1800</td>
<td>$5.00</td>
</tr>
</tbody>
</table>

### High Voltage Transformers

- Type: 50KV-230 5.25
- Type: 60KV-230 6.25

### Crystal Diodes

<table>
<thead>
<tr>
<th>Type</th>
<th>Qty</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N21</td>
<td>1</td>
<td>$1.19</td>
</tr>
<tr>
<td>1N23</td>
<td>1</td>
<td>$1.95</td>
</tr>
<tr>
<td>1N34</td>
<td>1</td>
<td>$0.79</td>
</tr>
<tr>
<td>1N21A</td>
<td>1</td>
<td>$1.95</td>
</tr>
<tr>
<td>1N21B</td>
<td>1</td>
<td>$1.95</td>
</tr>
<tr>
<td>1N25</td>
<td>1</td>
<td>$1.25</td>
</tr>
</tbody>
</table>

### Antennas

<table>
<thead>
<tr>
<th>Name</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlas</td>
<td>$10.70</td>
</tr>
<tr>
<td>Antenna</td>
<td>$15.00</td>
</tr>
<tr>
<td>AN-746</td>
<td>$3.00</td>
</tr>
<tr>
<td>AN-53A</td>
<td>$2.50</td>
</tr>
<tr>
<td>AN-56A (P/o SC-123)</td>
<td>$1.75</td>
</tr>
<tr>
<td>AN-120H optical condensers</td>
<td>$1.00</td>
</tr>
<tr>
<td>ASA yeast</td>
<td>$1.25</td>
</tr>
</tbody>
</table>

### WESTINGHOUSE HYPERLIS TRANSFORMER

- PRR-115V. 900V 1/4 KVA
- SEG 2 - 240V 1/50A
- SEG 3 - 240V 1/50A
- WT. 3 LBS.

### Generators

- Eiffel-Pioneer type 718-3A (Navy Model N-2A-3)
- Output-650 (110-360) 400 to 1000A
- $19.50 each
- DC 15 Amps. Brand New-General Packing. $28.50

### 3-Phase Inverters

- Type: 31212A
- DC Input: 24 Volts
- AC Output: 115-120 Volts

### Test Equipment

- 1-122A Signal Generator
- 1-123A Signal Generator
- C-Quat Groove Filter Type 1B-110-137295

### Electronic Research Laboratories

715-19 ARCH ST.
PHILA. 6, PA.
Telephones - MARKET 7-6771 - 2-3
SUPERIOR VALUES FROM AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

Continental Motor Generator Sets, Type
DN-44AX, available at 220 Volts DC, 1800
R.P.M., 20, 25, 30, 40, 50, and 60 cycles.
Complete with automatic controller and
push button Start. Brand New. Special.
Price $95.

G. E. ROTARY CONVERTERS

Type: 45, 46, 310 Series A, B, & C. 110
Volts, 60 cycles, 1 phase, 600 watts. Com-
plete with controller, Mounts built in stock.
Rebuilt. Special Price $12.00.

CENTURY GENERATOR SETS

Continental HP, B.B., 7.5 KW, 120/240-
VAC, 1500 R.P.M. $1250.00. Complete with
controller, Mount built in stock, Rebuilt.
Special Price $800.00.

KATO ROTARY CONVERTERS

Type: 45, 46, 310 series A, B, & C. 110
Volts, 60 cycles, 1 phase, 600 watts. Com-
plete with controller, Mounts built in stock.
Rebuilt. Special Price $12.00.

NEW 1 HP GAS ENGINE

Air cooled Light weight aluminum construc-
tion. 10 HP, 1800 R.P.M., 0.5 HP. Preci-
sion built, covered by manufacturer’s war-
ranty. $250.00. Marathon Generators can be used with above engines, have outputs of 115 Volts Altern-
cy, 300 Volts, rebuilt, self-exc. Price $250.00.

CENTRAL ELECTRIC DC/AC MG SETS

Four Bearing Marine Unils: 25 HP, 300 Volts, DC, connected to alternator, 28.5 KVA, 60 CY. 1800 R.P.M. Output: 115 Volts, AC. Special Price $1450.00.

PINCOR CONVERTERS

300 VA. Price 145.00. 2 HP. Special Price 110.00.

MARATHON GENERATORS

Input: 110 Volts, 60 CY. 50 CY. 3000 R.P.M.,
60 cy, 500 VA. Marine Type. Voltage regula-
tion 3% Output: 115 Volts, 60 CY, 1 phase.
Price $75.00.

WESTINGHOUSE M-10 G M G SET

110 Volts DC, 1 phase, 3600 watts. Re-

WESTINGHOUSE M-10 G M G SETS

Compact two bearing unit consisting of a re-
verse induction motor, type MG, 115/230
Volts, 60 cycles, 1 phase, 5.6/2.2 T.F. An-
swers. Complete device for application requiring constant voltage output for all load variations. Price $150.00.

WESTINGHOUSE M-G UNITS

Compact two bearing unit consisting of a re-
verse induction motor, type MG, 115/230
Volts, 60 cycles, 1 phase, 5.6/2.2 T.F. An-
swers. Complete device for application requiring constant voltage output for all load variations. Price $150.00.

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
Tel. Hancock 6-2450
BOSTON 10, MASSACHUSETTS

January, 1952 — ELECTRONICS
HIGH FREQUENCY M-G SETS AND AMPLIDYNES FROM AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

HIGH FREQUENCY CONVERSION EQUIPMENT

ELECTRICAL GENERATOR M-G SETS. Motor 120 VAC Connection; 110-120 VAC, 50/60 cycle, 5 hp, 2500 RPM. Base, 1.5 kW, 5 amp. New, 1.05. Price...

BENDIX POWER MG SET. Contains of G.E. 3 HP Rep-laid Motor. 115 volts, single phase, 60 c.p.s. directly connected to output of 175 c.p.s., 200 watts and DC output of 14.5 volts. Price...

WINGRASER P11-7/AP. Built-in...

BRITISH ELECTRIC SPECIALTY FREQUENCY CHANGERS Tamper & Equipment...

75-180 New operative at 220/440-3-60, Self-exc. Belted generators. VAC, control. Specially Priced...

BALL 800 Price 75...

17.5 1200 CYCLE V.A. Output: 115 volts, 1.5 amp. Brand new...

HOLZER-CABOT 251. Connect 3-phase units to single phase generators...

LELAND INVERTER TYPE MG 4A. DC Input: 25.00, 2500 cycles. DC Output: 6.6 volts, 500 cycle. Price...

EMCO DUAL FREQUENCY MOTOR. Motor operating at 120/240 VAC. 110 volts at 120 cycle. 240 volt at 240 cycle. Price...

ECLIPSE 500 CYCLE GENERATOR. Phases mounted on steel base. Of 500 cycles. 120 VAC. 5 amp. Price...

BRITISH ADE 500 CYCLE MG SETS. Motor 180 VAC, 5 cycle, 1500 RPM. Price...

150 AMP-3850 CYCLE. Frequency variation is 3.0...

100 AMP-3850 CYCLE. Frequency variation is 3.0...

115 AMP-3850 CYCLE. Frequency variation is 3.0...

220/440 VAC, 5 cycle. Price...

220/440 CYCLE. Price...

INVERTER UNIT PZ117. Input: 57.5 VAC. Output: 120 VAC, 500 cycles. Price...

RLX DUAL GENERATORS. Price...

HIGH FREQUENCY CYCLE AERO UNIT. Priced...

BRITISH ALTERNATORS. 1.5 KVA, 230 volts, 1.5 amp. Price...

DONAN 400 CYCLE MG SET. Motor: 5 HP, 220/60 cycle. 115 volts, single phase, 60 cycle. Price...

DONAN 400 CYCLE MG SET. Motor: 5 HP, 220/60 cycle. 115 volts, single phase, 60 cycle. Price...

G.E. MG SET MODEL 2512. Alternator: 1 HP, 220 volt, 50 cycle. Price...

CROCKER-WHEELER 500 CYCLE MG SET. Connected to 2 hearing cycle alternator. Output: 220 volts, 5 amp. 500 cycles. Rebuilt Price...
<table>
<thead>
<tr>
<th>Insert</th>
<th>Shell and 1947 List Price</th>
<th>3105</th>
<th>3106</th>
<th>3107</th>
<th>3108</th>
<th>3109</th>
<th>3110</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-16</td>
<td>4.00 3.99 3.98 3.97 3.96 3.95 3.94 3.93 3.92 3.91 3.90 3.89 3.88 3.87 3.86 3.85 3.84 3.83 3.82 3.81 3.80 3.79 3.78 3.77 3.76 3.75 3.74 3.73 3.72 3.71 3.70 3.69 3.68 3.67 3.66 3.65 3.64 3.63 3.62 3.61 3.60 3.59 3.58 3.57 3.56 3.55 3.54 3.53 3.52 3.51 3.50 3.49 3.48 3.47 3.46 3.45 3.44 3.43 3.42 3.41 3.40 3.39 3.38 3.37 3.36 3.35 3.34 3.33 3.32 3.31 3.30 3.29 3.28 3.27 3.26 3.25 3.24 3.23 3.22 3.21 3.20 3.19 3.18 3.17 3.16 3.15 3.14 3.13 3.12 3.11 3.10 3.09 3.08 3.07 3.06 3.05 3.04 3.03 3.02 3.01 3.00 2.99 2.98 2.97 2.96 2.95 2.94 2.93 2.92 2.91 2.90 2.89 2.88 2.87 2.86 2.85 2.84 2.83 2.82 2.81 2.80 2.79 2.78 2.77 2.76 2.75 2.74 2.73 2.72 2.71 2.70 2.69 2.68 2.67 2.66 2.65 2.64 2.63 2.62 2.61 2.60 2.59 2.58 2.57 2.56 2.55 2.54 2.53 2.52 2.51 2.50 2.49 2.48 2.47 2.46 2.45 2.44 2.43 2.42 2.41 2.40 2.39 2.38 2.37 2.36 2.35 2.34 2.33 2.32 2.31 2.30 2.29 2.28 2.27 2.26 2.25 2.24 2.23 2.22 2.21 2.20 2.19 2.18 2.17 2.16 2.15 2.14 2.13 2.12 2.11 2.10 2.09 2.08 2.07 2.06 2.05 2.04 2.03 2.02 2.01 2.00 1.99 1.98 1.97 1.96 1.95 1.94 1.93 1.92 1.91 1.90 1.89 1.88 1.87 1.86 1.85 1.84 1.83 1.82 1.81 1.80 1.79 1.78 1.77 1.76 1.75 1.74 1.73 1.72 1.71 1.70 1.69 1.68 1.67 1.66 1.65 1.64 1.63 1.62 1.61 1.60 1.59 1.58 1.57 1.56 1.55 1.54 1.53 1.52 1.51 1.50 1.49 1.48 1.47 1.46 1.45 1.44 1.43 1.42 1.41 1.40 1.39 1.38 1.37 1.36 1.35 1.34 1.33 1.32 1.31 1.30 1.29 1.28 1.27 1.26 1.25 1.24 1.23 1.22 1.21 1.20 1.19 1.18 1.17 1.16 1.15 1.14 1.13 1.12 1.11 1.10 1.09 1.08 1.07 1.06 1.05 1.04 1.03 1.02 1.01 1.00 0.99 0.98 0.97 0.96 0.95 0.94 0.93 0.92 0.91 0.90 0.89 0.88 0.87 0.86 0.85 0.84 0.83 0.82 0.81 0.80 0.79 0.78 0.77 0.76 0.75 0.74 0.73 0.72 0.71 0.70 0.69 0.68 0.67 0.66 0.65 0.64 0.63 0.62 0.61 0.60 0.59 0.58 0.57 0.56 0.55 0.54 0.53 0.52 0.51 0.50 0.49 0.48 0.47 0.46 0.45 0.44 0.43 0.42 0.41 0.40 0.39 0.38 0.37 0.36 0.35 0.34 0.33 0.32 0.31 0.30 0.29 0.28 0.27 0.26 0.25 0.24 0.23 0.22 0.21 0.20 0.19 0.18 0.17 0.16 0.15 0.14 0.13 0.12 0.11 0.10 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.02 0.01 0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SEARCHLIGHT SECTION
111111111111111lull111111111111111111111111111111111111111111111luuIIIIIIIIIIIlull'

TEST EQUIPMENT

MOTOR GENERATORS
2.5 KVA Diehl Elec. Co. 120 V.D.C. to 120V A.C.
60 cy. ills., .4PF. Complete with Magnetic Controller, 2 Field Rheos and Full Bet of Spare Parts
including Spare Armatures for Generator and
$285.00
Motor. Full apeo. on request. New
2 KVA O'Keefe and Merritt. 115V DC to 120V AC.
50 cy. Idles at 3 Ph. tones motor on 208V. 50 cy.
5165.00
New. Export crated
1.25 KVA Allis-Chalmers. 230 DC to 120 AC. 60
BearBall
Splashproof.
cy. 1 Ph. Fully enclosed.
ings. centrifugal starter. New, complete with Mt
$175.00
of Spare parts
M.G. 164, Holtzer-Cabot Motor: 440V 3Ph, 60 cy.
90A. 1/3HP, 1750 RPM. Generator: I0V, 3Ph 146
Cy., .14OKVA. Exciter: 115DC, lA. New...$57.50
Type CG -21302. 440V AC. 60 cy., 3Ph., 1500 VA to
$69.50
875 DC and 300V DC. New

INVERTERS
Onan MG -215H. Navy type PU/13. Input 115/230,
60 cy, 1 Ph. Output 115, 480 a 1 Ph. 1200W and
$295.00
28V DC at 4 amps. New
G.E. Model 5D-21N13A. Input: 24V. DC, Output:
$29.50
115V, 400 cy., 985 Va. New
38 Amps. Output, 80V.. 800 cv, 485 VA. New $22.50
G.E. 18169172. Input: 28V, DC, Output: 115 400
S32.50
cycles at 1.5 KVA

400 CYCLE TRANSFORMERS

TB -127/U Lavoie Freq. Meter -375 to 725 MC.
TS-47APR Test Oso. 40-500MC.
TB -487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets lesa tuning units.
lt111A/APR-5A Receiver -1000 to 6000 MC.

AN/APR-4 Tuning Units TN -17
AN/APR-4 Tuning Unita TN -18
AN/APR-4 Tuning Units TN -19
TU -58 Range ' A' Tuning Units
BC1203 APN-4 Test Sets.
AN/APA-10 Panoramic Adapters

(76300 MC).
(300-1000 MC).

(950-2200 MC).
(110-370 MC).

115V/60 cycles.

RADAR

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 -20A11.111.
SO Modulation Generators CRP-35AAH.
SG Radar Receivers CHP-46ABD-1.
SG Complete trans. ale Coupling Assemblies.
SO Power Control Chassis.

SG Driver Modulator Assemblies.
SO Complete seta equipment spares.
SG Load Divider Modernization kits.

AMPLIDYNES
5AM2IJ17. 4600 R.P.M. Motor Compound wound. 150 Watts. Input: 27V DC. Output:
60V DC, Sig. Corps. U. S. Army MG-27-B.
G. E. Model

New

$34.50

CRYSTALS-W.E. TYPE CR-1A/AR
6610 - 6670 5910 - 6350 - 6370 - 6470 - 6510
6690 - 6940 - 7270 - 7350 - 7380 - 7390 - 7480 -

Available In quantity

Kilocycles.

9720
ce

$1.25 each

REPLACEMENT PARTS FOR BC348 MODELS
H, K, L, R AND BC 224 F, K
We can supply for above models only:
All coils for Ant., RF., Det. and Osa bands.
All LF. trans., Including C. W. One, and xtal

New

FILAMENT. Raytheon Hypersil Core, Pri: 115V.
Sec: 6.3V22Á/6.3V2.4A/6.3V2.25A/6.3VO., 6A Ins.
$5.95
for 1700V
Voltage 11200-135. Inductance H.V. Winding 135
Cat.
Henries. Output: Peak Voltage 22.811V.
$89.50
831806501. New
High Voltage Trans. Westinghouse Pri: 115 60 cy.
Seo: 15,000 C.T., 60 MA. Good for Hi -Pot test set
$29.50
up. C. T. ungrounded

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
$5.00
ohms. L of Wdg. 1.3=.08211 at 100 cps
PULSE. WECO KS -161310. 50 KC to 4MC, 1K"
$I.95
Dia. x 11/6" high, 120 to 2350 ohms. New

RAYTHEON VOLTAGE REGULATOR
Adj. Input taps 95-130V., 60 cy. 1 Ph.
Reg.
of
Watts,4%'
W. Overload otected.
z18ß4" L
constructed. Tropicalized. Special

gang condensers, engraved front panels, complete
dial mechanism assemblies. etc.
Write for complete listing.

GE Servo type 2CV1C1 400 cycle
Constant Output Line BC -730C
Synchro Amplifiers for Radar
Intercommunication type BC -605

$27.50

Electrolux Corp. of Canada. P/O vent fan assembly for SCR -602-T6. 1/3511P. 28.5V, 2.15 amps..
2200 RPM. Price
$16.50
Oster type E-7.5, 27.5V, 1/2011P, 3650 RPM.
Shunt wound. Prim
$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 5ßD0. Brand New
522.50
Electrolux Torque Motor
$16.50

$1.75

60 CYCLE TRANSFORMERS

Output:
Stu d ly
$14.75

4

AMPLIFIERS
G.E. Model 56A50L12A. Armature 27V D.C. at
8.3A. Field 60V DC at 2.3A. RPM 4000. H.P. 0.5

95

rl
400/2400 cps. WECO KS9553.
FILLAMENT.
I
115V. Seo: 8.2V1.25A/6.35V1.5A Elecstat shdld.
$1.95
Wt. 0.5 lbs. New
PLATE & FIL. 400/2600 cy. Pri: 0/80/115V Seo:
51=1200VDC at 1.5MA. Sec. 52=400VDC at
Secs: 6.4V4.3A/6.35V0.8A (Ins
130MA. Fil.
$4.95
1500V) /5V 2A/5V2Á
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA.

filters.

Edison type 5AM3INJIBA. Input: 27 volts. 44
Amps., 8300 RPM. Output: 60V DC at 8.8 amps.
$22.50
530 Watts. New

SMALL D.C. MOTORS

FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/
115/125V. Output: 5V3A/.5V3A/5V3A/5V3A 5V6A/
$2.95
5V6A/6.3V8A/6.35A. New
THRYRATRON POWER. 400/1800 cy. Raytheon
UX-8876. 400/1600 cv. Prl: 115, Sec: 50-0-50V at
New
1780.
52.75
Test
r.m.s.
1.511 6.3V at 1.2A.
PLATE WECO K99560. 400/800 cy: Prl: 115V Sec:
1350-0-1350 at 057A (2700 V Total). Elecatat
$2.95
abided. Wt. 2.3 lbs. New
Plate. Thordarson ST46889. 1650 VA. Prl: 105120V. 500 oy. 1 PH. Sec: 5600V. Center tapped.
$49.50
1.5KV insulation Brand new
PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V.
Sec #2: Three 6.3V windSec #1: 930-0-930.

P

Antenna-Trans-Rec Unit ASO -I.
Radar Set SA complete with spares.
Modulator type SO -11.
Pulse Timers CITZ-50AGD (SD -5 Radar)
Radar Crystal Units 98.35kc, Raytheon.

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
Elev. 64V DC to 110V AC, 60 cy. 1 Ph. 2.04
Amps. New
$24.50
32V DC to 110V AC. 60 cil 1 Ph, 0.43 Amps.
Never
í2 5
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

AUTO. 400 W. G.E. Cat No. 800184.
KVA .945S -520P Volts 460/345/200/115. New $4.95

RELAYS
Struthers -Dunn 1RXX129, 110 D.C.
Advance type 455C, SPDT, 115 A.C.
Leach type 1154.4. SPDT, 115 A.C.
Leach type 1054. BSN 20-28V D.C.
Clare Plug-in base No. 301rMX 115 A.C.
G.F. Plug-in base Sensitive K27J853
Allied Control type BJ 452-1128
Western Electric D-163781 Plug-in
Delay
Guardian
Time Delay 17717 110V/60

ANTENNAS
Coast Guard MR-162 Whips 2334 ft.
Microwave types AT-49. AT-38, AS-125
APT -2 Dipole Antennae
TDY Radar Jammer Horns
Paraboloids, Magnesium Dishes 1794" dia.
SCR 634-A (Part of RC -153-B Antenna).

POTENTIOMETERS
W.E. KS -15138 Linear Sawtooth
W.E. KS -8732 for SC[L547 Radar
W.E. KS -8801 Motor Driven

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: 927 lbs.,
42.0 cu.

FL BLOWER

RECTIFIERS

MISCELLANEOUS

SYNCHROS

G.E. No. ItC89F16 for 54 cells 10 amps.
O.E. No. 6 RC133F2-In: 110/220/60/1. Out:
15/30V -75-150A
Mallory APS-20-In: 115/230/60/3. Out: 12/24V6.1 -130A
In: 220/60/3. Out:
Turret Trainer Supply.
28V -130A
RA20 Vibrator Power Supply
Complete specs on request

$3.75
Cathode Ray Shields for 3" tube
$13.50
Variac type Motor Controls 600 watt
$20.00
10 CM Waveguide 90 elbow
for
samples
Adel Clamps assorted types -write
$ 40
Shock Mounts Lord #20
$ 30
Shook Mounts U. S. Rubber #5150C
$1.00
Commando Pole Jacks (Cook Elec. Co.)
25
Fusetron (Bus FRN 50 Ampere 250V)
40
Switchboard Lamp Receptacles & Jewels

Westinghouse 115v. 400 cy.

17

(t

c.f.m.

Includes

capacitor. Price

$12.50

MISCELLANEOUS
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, 51140, 2x2 and 6AK5 DC re Has controls for intensity, focus
Inserter tube.
..$29.50
aux. focus. Brand New less tubes

HI-VOLT CAPACITORS
.25 Mfd., 20KV
.25 Mfd., 15KV
.5 Mfd.. 255V

Mid.. 15KV
1.Mfd.. 7.5KV
2 Mfd.. 6.OKVA
1

525.50
$22.50
$34.50
$34.50
$12.50
$14.50

X1VIIIVIIIVIIIi 11,111IIIIII11111IIIII11111
330

SCR522 Transmitter Receivers Brand New
Wit Transmitters 125 watt Ship to Shore
RC966A Transponders
11T7-AN/APN-1 Receivers
BC -423B Modulators

BC -1308M Jack Boxes-Large quantity
Sweep Generator Capacitors 5/10 rntd.

TERMS: Rated Concerns Net 30, FOB Bronx
ville, New York. All Merchandise Guaranteed
Prices Subject to Change

SOUND POWERED PHONES
Western Electric No. D173312. Type O. Combination headset and chest microphone. Brand new in$17.50
cluding 20 ft. of rubber covered cable
Automatlo Elec. Co. No. GL843A0. Similar to
above but including Throat microphone In addition
rubber
20
ft.
new
with
to chest microphone. Brand
$16.00
covered cable
17.50
20' cable and plug. Brand new
$16.50
W. E. type TS -IOM Handset. New

ELECTRONICRAFT
27 MILBURN

ST

PHONE

:

.

INC.
BRONXVILLE 8, N. Y.
BRONXVILLE 2-0044

INDICATORS
ID.24/ARN-9
ID-14/APN.1
1-82A

$12.50
$14.50
$9.75

Panoramic
ID-60/APA-10
Adapter converted for 00 cycle
operation-complete with tubes
and 80 page Tech. Manual
5245110

January,

1952- ELECTRONICS


### SHORT TELEPHONE RELAYS

<table>
<thead>
<tr>
<th>STK. NO.</th>
<th>VOLTAGE</th>
<th>OHMAGE</th>
<th>CONTACTS</th>
<th>UNIT PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-635</td>
<td>12 VDC</td>
<td>100</td>
<td>1C81B</td>
<td>$1.35</td>
</tr>
<tr>
<td>R-688</td>
<td>12 VDC</td>
<td>100</td>
<td>2C @ 4 Amps</td>
<td>1.85</td>
</tr>
<tr>
<td>R-343</td>
<td>12 VDC</td>
<td>100</td>
<td>1C</td>
<td>2.00</td>
</tr>
<tr>
<td>R-623</td>
<td>12 VDC</td>
<td>150</td>
<td>2C, 1B</td>
<td>1.55</td>
</tr>
<tr>
<td>R-770</td>
<td>24 VDC</td>
<td>150</td>
<td>1A/10 Amps</td>
<td>1.45</td>
</tr>
<tr>
<td>R-388</td>
<td>8/12 VDC</td>
<td>200</td>
<td>1B</td>
<td>2.50</td>
</tr>
<tr>
<td>R-771</td>
<td>24 VDC</td>
<td>200</td>
<td>1A/10 Amps</td>
<td>1.45</td>
</tr>
<tr>
<td>R-603</td>
<td>18/24 VDC</td>
<td>400</td>
<td>2A</td>
<td>2.50</td>
</tr>
<tr>
<td>R-875</td>
<td>24 VDC</td>
<td>500</td>
<td>2C</td>
<td>2.40</td>
</tr>
<tr>
<td>R-764</td>
<td>48 VDC</td>
<td>1000</td>
<td>1C2A</td>
<td>2.00</td>
</tr>
<tr>
<td>R-437</td>
<td>5.5 ma</td>
<td>4800</td>
<td>2C</td>
<td>2.50</td>
</tr>
<tr>
<td>R-563</td>
<td>60/120 VDC</td>
<td>7500</td>
<td>1A</td>
<td>2.15</td>
</tr>
<tr>
<td>R-213</td>
<td>5/8 VAC 80 Cy.</td>
<td>1A</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td>R-601</td>
<td>11 VAC</td>
<td>150</td>
<td>NONE</td>
<td>1.45</td>
</tr>
<tr>
<td>R-589</td>
<td>12 VDC</td>
<td>125</td>
<td>2A</td>
<td>1.30</td>
</tr>
<tr>
<td>R-713</td>
<td>12 VDC</td>
<td>150</td>
<td>4A</td>
<td>1.55</td>
</tr>
<tr>
<td>R-589</td>
<td>12/24 VDC</td>
<td>255</td>
<td>1C</td>
<td>1.55</td>
</tr>
<tr>
<td>R-799</td>
<td>24 VDC</td>
<td>500</td>
<td>1C</td>
<td>1.70</td>
</tr>
<tr>
<td>R-110</td>
<td>26/32 VDC</td>
<td>3500</td>
<td>1C</td>
<td>2/3.10</td>
</tr>
</tbody>
</table>

### TELEPHONE TYPE RELAYS

<table>
<thead>
<tr>
<th>STK. NO.</th>
<th>VOLTAGE</th>
<th>OHMAGE</th>
<th>CONTACTS</th>
<th>UNIT PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-565</td>
<td>120/250 VDC</td>
<td>7500</td>
<td>1C</td>
<td>2.40</td>
</tr>
<tr>
<td>R-124</td>
<td>300 VDC</td>
<td>12,000</td>
<td>1A</td>
<td>1.55</td>
</tr>
<tr>
<td>R-531</td>
<td>24 VDC</td>
<td>290</td>
<td>W/MICRO N.O.</td>
<td>3.05</td>
</tr>
<tr>
<td>R-160</td>
<td>6 VDC</td>
<td>12</td>
<td>1C2A</td>
<td>3.00</td>
</tr>
<tr>
<td>R-581</td>
<td>52/228 VDC</td>
<td>600</td>
<td>1C, 1A</td>
<td>3.00</td>
</tr>
<tr>
<td>R-691</td>
<td>6 VDC</td>
<td>40</td>
<td>1B1C</td>
<td>1.35</td>
</tr>
<tr>
<td>R-160</td>
<td>12 VDC</td>
<td>100</td>
<td>1A64B</td>
<td>1.90</td>
</tr>
<tr>
<td>R-520</td>
<td>200/300 VDC</td>
<td>14,000</td>
<td>1C</td>
<td>1.90</td>
</tr>
<tr>
<td>R-599</td>
<td>6 VDC</td>
<td>50</td>
<td>2A</td>
<td>1.35</td>
</tr>
<tr>
<td>R-154</td>
<td>6 VDC</td>
<td>12</td>
<td>5A1C</td>
<td>1.25</td>
</tr>
<tr>
<td>R-182</td>
<td>6/12 VDC</td>
<td>200</td>
<td>1B1C</td>
<td>2.50</td>
</tr>
<tr>
<td>R-153</td>
<td>12 VDC</td>
<td>200</td>
<td>1C21A</td>
<td>1.57</td>
</tr>
<tr>
<td>R-304</td>
<td>12 VDC</td>
<td>270</td>
<td>4A Split Cerm.</td>
<td>2.50</td>
</tr>
<tr>
<td>R-338</td>
<td>6/12 VDC</td>
<td>560</td>
<td>1A Split</td>
<td>2.50</td>
</tr>
<tr>
<td>R-385</td>
<td>6/12 VDC</td>
<td>560</td>
<td>1B1C Split</td>
<td>2.50</td>
</tr>
<tr>
<td>R-384</td>
<td>6/12 VDC</td>
<td>560</td>
<td>3A Split</td>
<td>2.50</td>
</tr>
<tr>
<td>R-386</td>
<td>6/12 VDC</td>
<td>290</td>
<td>2A</td>
<td>2.50</td>
</tr>
<tr>
<td>R-316</td>
<td>24 VDC</td>
<td>290</td>
<td>1C</td>
<td>1.50</td>
</tr>
</tbody>
</table>

### TELEPHONE TYPE RELAYS

<table>
<thead>
<tr>
<th>STK. NO.</th>
<th>VOLTAGE</th>
<th>OHMAGE</th>
<th>CONTACTS</th>
<th>UNIT PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-366</td>
<td>30/120 VDC</td>
<td>4850</td>
<td>1C</td>
<td>2.50</td>
</tr>
</tbody>
</table>

### OTHER RELAY TYPES IN STOCK

- Keying Relays
- Rotary Relays
- Contactors
- Sealed Relays
- Midget Relays
- Special Relays

Telephone

Seely 8-4146
GOT A PROBLEM?
We'll Bet HARMAR
Can Help You!

Honestly, we don't claim that we can solve every problem facing you. But—many Purchasing Agents found that a call to Harmar has licked some of their toughest procurement headaches—whether for civilian or military requirements.

Our engineers have had production and purchasing experience—and their only responsibility is to help you get the parts you need.

We can furnish from stock, production quantities of the materials listed below.

Remember... when you deal with Harmar, you deal with principals—

**LISTED ARE FEW OF MANY ITEMS AVAILABLE!**

- ANTENNAS
- RESISTORS
- TRANSFORMERS
- DYNAMOTORS
- CONDENSERS
- CABLES AND CORDS
- SOCKETS
- INSULATORS
- TUBES
- METERS
- CONTROLS
- SWITCHES
- JACKS
- COILS
- RECEIVERS
- KEYS
- HEADSETS
- BREAKERS
- RADAR
- TRANSCEIVERS

write, wire or phone:
242-A Territorial Rd.,
Benton Harbor, Mich.
• Phone: 5-7271
1003-A Union Trust Bldg.,
Cincinnati 2, Ohio
• Phone: Main 3155

NOTE: We have developed special facilities for keying our stock to manufacturers part numbers or Armed forces stock number. For quickest possible service, please request quotations by these numbers.
2.5 AMP H.D. FILTER REACTOR

Amertek Type PBN 0.5 Hy. at 2.5 A. 23 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. $3.95

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 202100. Shielded. #T287. $2.25

Input Line to Single or P.P. Grids, 500-ohm C.T. Primary. Overall Ratio 1:137, Kenyon 213089-1. Shielded. #T288. $2.25

Multiple Line or Mike to Single Grid. 500-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 1:12. Hi-Fidelity. Stancon 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. 12S Ma, 200 Ohm, S.C. Stock #4G1668C/R1. 2000V Test, Shielded. #T111 $4.40

5 to 20 Hys, 300 Ma, 90 Ohm, 2000V Test, Shielded. #T290. $3.95

GLASS TO METAL SEALS

Many types and sizes. Send us your blue print or sample for our quote. Our prices are a fraction of our original cost.

TERMS

WRITE US YOUR NEEDS FOR IMMEDIATE QUOTE. ALL PRICES F.O.B. OUR PLANT. MIN. ORDER $5.00.

January, 1955 — ELECTRONICS
## TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N912</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N913</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N914</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N915</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N916</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N917</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N918</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N919</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N920</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N921</td>
<td>100</td>
<td>$0.30</td>
</tr>
</tbody>
</table>

**FLEXIBLE SHARING AVAILABLE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N912</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N913</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N914</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N915</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N916</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N917</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N918</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N919</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N920</td>
<td>100</td>
<td>$0.30</td>
</tr>
<tr>
<td>1N921</td>
<td>100</td>
<td>$0.30</td>
</tr>
</tbody>
</table>

**AN/ARR-2X RECEIVER**

The AN/ARR-2X receiver, for reception of reception of double modulated carrier, is ideal for mobile or fixed installations. Full-voltage automatic gain control is featured. When either is based on a standard receiver, no modifications are necessary. The receiver is available in either RF or IF output, being furnished, 12V DC input. Excellent condition.

**SO-13 S-BAND MARINE RADAR**

Compact S-Band Radar for small vessels, P.P.I. indicates 300 miles, King of the seas with complete set of spares. Excellent condition.

**AN/ARC-1 TRANS/REC.**

Provides maximum, as well as minimum, coupling between Aircraft or Aircraft & Ground. Complete with Block Mount Air Data Computer, complete with crystal oscillator, 100-190 MHz, checked out.

**AN/TPS-3 PORTABLE RADAR**

Lightweight Portable Search Radar for detection of all types of targets. Complete installation. Excellent condition.

**Coastal Radar E-101 STDT—24" IN.$**

**RHS SPECIALS OF THE MONTH**

**Searchlight Section**
**Synergy Section**

**Immediate Delivery**

**Servo-Tek**

**Synchronous Motor**

| W.B.E. 1298325 | For 2 phase 240 cycle 55 volts. Stock #5A-21T. $9.75 each. |

**Bodine Nshg-12 Motor**

| Constant speed 37.5 v. D-C Governor controlled 3600 rpm. 1/30th hp. Stock #5A-59. $17.50 each. |

**Selsyn Specials**

General Electric types 2J1F1, 2J1G1, 2J1H1 and type 2J1F3 aircraft units and 466 cycle units designed for use with turret control systems. Prices on Request.

**Subfractional Horsepower AC Motors**

- **Eastern Air Devices-J-2211-115 v. 400 cy. 1/50th Cont. duty 4700 rpm.**
- **E.A. D. J-408-115 v. 400 cy. 1/80th hp.**
- **E.A. D. J-408-115 v. 400 cy. 1/80th hp. Synchroneous.**
- **Diahi FFB-24-1-115 v. 400 cy. 1/100th hp. Synchroneous-506-115 v. 600 cy.**
- **Haydon 30838-115 v. 60cy. 1 rpm.**

**Fm Motor**

| Sampwell 27 v. DC PM motor. Type S-51573. One in. J. torque at 7000 rpm. 1/2" x 1/2" x 1/4" in. Stock #5A-281. Price $17.75 each. Quantity available. |

**Revere Camera Motor**

| 57 v. D-C Split field series Approx. 2½ mo. 1½ in. Stock #5A-31T. Price $6.75 each. |

**Jai Motor (D-C)**


**Permanent Magnet Gearhead Motors**

- **Delco Type 5084650-275.5 VDC 255 rpm.**
- **Delco Type 5084208-275.5 VDC.**

**C1B Thyratrons**

| Special offer - Large quantity C1B Thyratrons available. New, original packing. Write for quantity quotation. |

**Dc Motor Special**

| 1½ hp. 28 v. DC motor. Magnetic brake Electric Specialty Cotype H1A3.0B. Large Qty. Available. |

**Inverters**

- **Wincharger Pu-7-AP Input 28 VDC at 160 amps. Output 115 v. 60 cy. 1/5 d. at 1500 VA. Voltage and frequency regulated. Cont. duty. Stock #5A-141. Price $48.50 each.**

| G.E. 5A8131N3 (P.E.-118) Input 28 VDC at 160 amps. Output 115 v. 60 cy. 1/5 d. at 1500 VA. PP 0.8 W. Spec. NR-56111. Stock #5A-316. Price $29.50 ea. |

**Pe-218 Inverters**


**Airframe Generator**

- **Eclipse Nea-3 Output 115 VAC 10. 6 amps 800 cycles.**
- **286 rpm. Also 29 VDC 4.45 amp. Stock #5A-306. Price $29.50 each.**

**Radio Compass Indicator**

- **K.Z.F. Compass Indicator 5-33-5-6 in. dial. 26 v. 400 cy. B Reeves 60 cy. Ideal position indicator. Stock #5A-284. Price $6.50 each.**

**Magnetics**

- **PIioneer Type CL-3, 6 power. Pioneer 1066-2E-B3 reduction. Output 240 BMC blowers.**
- **400 cy. AC blowers.**

**Synchros-Selsyns**

- **18S, 1G, 5G, 7G, 10G, 396T, 5EDG, 5DG, 5SG, 8B, 5HSP, 3G, 6D9, 7G, 571F, 2J1G, 12J1N, 134PB1, 52J4, 271- F3, XXI, X, XV, VII, II, V, etc.**

**Write for Listing**

Prices F.O.B. Paterson Airmore 4-3366

**January, 1952 - ELECTRONICS**

**Servo-Tek**

Specialists in fractional horse power motor speed control.
A C. MOTORS

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, Synchro-

nous, 115 V., 400 Cy., 3 d., 800 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. PRICE $3.75 EA.

TYPE 1600, 2.1 W., 1/60 RPM. PRICE $3.00 EA.

SERVO MOTORS

CK1, PIONEER, 2 d 400 Cy. PRICE $10.00 EA.

CK2, PIONEER, 2 d 400 Cy. PRICE $12.00 EA.

CK2, PIONEER, 2 d 400 Cy. With 40:1 reduction

gear. PRICE $15.50 EA.

10047-2-A, PIONEER, 2 d 400 Cy. With 10:1 reduction

gear. PRICE $10.00 EA.

MINNEAPOLIS HONEYWELL Type B, Part No.

G3036, 115 V., 400 Cy. 2 d. 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 AN730-2 Indicator and

AN730-3 Transmitter. PRICE $40.00 PER SET.

KOLLMSAN TYPE 680k-03 Indicator and 679-

01 Transmitter. PRICE $15.00 PER SET.

D C MOTORS

JAEGER WATCH CO. TYPE 44K-2 Contacto

Motor, 3 to 4.5 V. Makes one contact per

second. PRICE $3.50 EA.

GENERAL ELECTRIC TYPE 5B3A1A37, 27 V.

0.5 amps. 8 oz. In torque, 250 RPM. PRICE $10.00 EA.

BARBER-COLMAN CONTROL MOTOR, Type

AYLC 5097, 27 V., 0.7 Amps, 1 RPM. Con-

tains 2 adj. limit switches, 500 In. In

torque. PRICE $9.50 EA.

WHITE RODGERS ELECTRIC CO. TYPE 690S

No. 3, 12 V., 1.3 Amps, 115 RPM, 70 in.

lbs. PRICE $10.50 EA.

ENGINE HOUR METER

John W. Hobbs Model M-277. Records run-

ning time up 1000 hours. 20 to 36 volts D.C.

PRICE $15.50 EA.

INSTRUMENT ASSOCIATES

WRITE FOR CATALOG NE100

363 GREAT NECK ROAD, GREAT NECK, N. Y.

Telephone Great Neck 4-1147

IMMEDIATE -- FULLY GUARANTEED

SYNCHROS

1F SPECIAL REPEATER, 115 V., 400 Cy.

PRICE $20.00 EA.

2J1F3 GENERATOR, 115 V., 400 Cy.

PRICE $10.00 EA.

2J1G1 CONTROL TRANSFORMER, 57/57.5 V.,

400 Cy. PRICE $15.00 EA.

2J1F1 GENERATOR, 115 V., 400 Cy.

PRICE $10.00 EA.

2J1H1 DIFFERENTIAL GENERATOR, 57/57.5 V.,

400 Cy. PRICE $10.00 EA.

35DG DIFFERENTIAL GENERATOR, 90/90 V.,

400 Cy. PRICE $20.00 EA.

5G GENERATOR, 115 V., 60 Cy.

PRICE $50.00 EA.


PRICE $10.00 EA.

D C ALNICO FIELD MOTORS

DIEHL TYPE S5. FD6-23, 27 V., 10,000 RPM.

PRICE $10.00 EA.

DELCO TYPE 5069464, 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 MX315/APG. 24 V. D.C.

2,000 RPM, 1/100 H.P. PRICE $10.00 EA.

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 As-

sembly, R.P.M. Motor, 27 V., 10,000 RPM.

PRICE $15.00 EA.

GENERAL ELECTRIC D C SELSYNS

8T3P-PAB, TRANSMITTER, 24 V.

PRICE $4.50 EA.

8D1J-1, PCY, INDICATOR, 24 V, Dial marked

from 0 to 165 in. PRICE $7.50 EA.

8D1J-1, PCY, INDICATOR, 24 V, Dial marked

from 0 to 360. PRICE $7.50 EA.

RECTIFIER POWER SUPPLY

Hummmert Electric Mfg. Co., Model SPS-330, Input Voltage AC, 208 or 230, 60 cycle, 3

phase, 21 amps. Output 28 Volts, 130 amps.

Continuous duty, 37" high, 221/2" wide, 21" deep. Contains DC Volt meter, DC ammeter and 8 point tap switch for variable output voltage. Brand new. PRICE $350.00.

MISCELLANEOUS

SPERRY AS CONTROL UNIT, Part No. 644830.

PRICE $7.50 EA.

SPERRY AS AZIMUTH FOLLOW-UP AMPLI-

IFIER, Part No. 656030, with tube. PRICE $5.50 EA.

SPERRY AS DIRECTIONAL GyRO, Part No.

656029, 115 V., 400 Cy., 3. PRICE $25.00 EA.

PIONEER TYPE 1280-1 GYRO SERVO UNIT

115 V., 400 Cy., 3. PRICE $20.00 EA.

ALLEN CALCULATOR TYPE CT TURN & BANK

INDICATOR, Part No. 21500, 28 V. D.C.

PRICE $25.00 EA.

TYPE CT AUTO-PILOT FORMATION STICK,

Part No. G1105435, 115 V., 400 Cy., 3. PRICE $15.00 EA.

PIONEER GYRO FLUX GATE AMPLIFIER TYPE

12076-1-A, 115 V., 400 Cy. PRICE $40.00 EA.
# New York’s Radio Tube Exchange

## Test Equipment

### Microwave K Band 24,000 MC
TSK-SE Spectrum Analyzer

### X Band 10,000 MC

- **TS 12** Unit 1 USWR Measuring Amplifier, 2 channel
- **TS 12** Unit 2 Preamplifier for above
- **TS 33** X Band Power and Frequency Meter
- **TS 35** X Band Pulsed Signal Generator
- **TS 36** X Band Power Meter

### S Band 3000 MC

- **TS 102, TS 270**
- **TS 125, TS 155, TS 127**
- RF 4 Electrically Tuned S Band Echo Box
- **BC-1770/60ABQ** S Band Pulsed Signal Generator
- **PE 102** High Power S Band Signal Generator

### L Band

Hazeltine 1030 Signa, Generator 145 to 235 Megacycles

### Broadcast Wave Bands

162C Rider Chanolyst
Short Wave Adapter for 162C
TS 174 Signal Generator

### Oscilloscopes

- **BC-1287A** used
- **APA 10, APA 28** in LZ sets
- **Supreme 564**
- **TS 34 Oscil-Isocopes WE**

### Other Test Equipment and Meters

- **TS 15/A Magnet Flux Meter**
- General Radio V T Voltmeter 728A
- **Calibrator WE 1-147**
- **General Radio 1000 cycles type 213**
- **Limit Bridges**
- **Boonton Standard instructions**
- **Model 40 Pyrometer**
- **Barnes, meters 0-10 Microampe 0-2**
- **Millivolts**

### RADAR Sets & Parts

- **APS-1-AFS 4-R-111/APS 13**
- **Prices Subject to Change**

---

### THIS MONTH'S SPECIAL 4C28

- **$55.00**

### OTHERS

- **Minimum Order $25.00**

---

### ATTENTION PURCHASING AGENTS AND BUSINESS MANAGERS

We purchase complete inventories and electronic parts and tubes for cash. Can we help you to obtain urgently needed electronic materials? Our organization is dedicated to serve the electronic field. You can reach us on TWX NYI—3235.

---

### PHONE WORTH 4-8262

135 Liberty St., New York 6, N.Y.
COMMUNICATIONS EQUIPMENT CO.

10 CM RESEARCH EQUIPMENT

COAXIAL WAVEVETER, W, R. Transmission type, using type "N" fittings.


BEACON LIGHTS, LIGHTHOUND Assemblies. New.

MAGNETRON, WAVEGUIDE Coupler with T12A Duplexer Card, and T50A Tees Card, 60 watts 1.5 A 125 microsec. New.

RIGID WAVEGUIDE, WAVEGUIDE Coupler with T12A Duplexer Card, and T50A Tees Card, 60 watts 1.5 A 125 microsec. New.

MAGNETRON COUPLER complete with T12A Duplexer Card, and T50A Tees Card, 60 watts 1.5 A 125 microsec. New.

3 CM Research Equipment

1" 1/2 WAVEGUIDE.

RIGHT ANGLE BEND, with flexible coax output pickup loop. $3.00

RIGHT ANGLE BEND, with pressurizing nipples. $4.50

RIGID COAX, to 100 kv. $16.00

STUB KLYSTROM COUPLER, with 50 kv. $11.00

ANGULAR COUPLING, for 100 kv. $15.00

DIRECTIONAL COUPLER, 10", Male to female. $15.00

3/8" RIGID COAX, BULKHEAD THRU. $1.00

3/4" 1/2" WAVEGUIDE.

WAVEGUIDE, 3/4" 1/2" in length. $12.00

FLEXIBLE COUPLING, for 3/4" 1/2" WAVEGUIDE. $1.00

MAGNETRON COUPLER, complete with attenuator, W, Y. $3.50

MICROWAVE TEST EQUIPMENT.

X BAND POWER METER. Constitute of characteristic mount and broken meter, magnetic ring, rough attenuator. XBand, Waveguide through. For power measurements anywhere in the 5000 MC band. New.

BROADBAND TEST OSCILLATOR. First, coverage 50-3000 MC. By direct calibration and interpretation arc-a-sphere, key, bridge, center, and pressurizing nipple battery source. New, with all tubes. $425.00

RADAR INDICATORS.

10-11/AP-12.

MICROWAVES, 10-11, WAVEGUIDE. 10-11, WAVEGUIDE. 10-11, WAVEGUIDE. 10-11, WAVEGUIDE. $1.50

SO-7 RADAR.

SO-7 RADAR.

All merchandise guaranteed. All prices F.O.R. N.Y.C., Send M.O. or Check. Only shipping charges sent C.O.D. Rated concerns send P. O. 

ELECTRONICS — January, 1952

339
OIL CONDENSER SPECIAL
10 mfd. — 600 V ............... $ .89

Three term. bat. mnt. 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 deg. "C". Ideal
for filter or power factor application where ruggedness and
durability are paramount. Carton of 24, weight 42 lbs. ........ $ .79

CHANNEL CONDENSORS

<table>
<thead>
<tr>
<th>MFD Volts</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 600 V</td>
<td>.45</td>
</tr>
<tr>
<td>1 600 V</td>
<td>.45</td>
</tr>
<tr>
<td>1 600 V</td>
<td>.45</td>
</tr>
</tbody>
</table>

MICA CONDENSORS

<table>
<thead>
<tr>
<th>Type</th>
<th>Jan Style</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPST</td>
<td>ST/35K</td>
<td>.45</td>
</tr>
<tr>
<td>DPDT</td>
<td>ST/35P</td>
<td>.45</td>
</tr>
<tr>
<td>DPDT</td>
<td>ST/35R</td>
<td>.60</td>
</tr>
</tbody>
</table>

MICA CONDENSORS

<table>
<thead>
<tr>
<th>Price SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 750 mfd.</td>
</tr>
</tbody>
</table>

SILVER MICA CONDENSORS

| Special Mica Kit—100 @ $ .350 |

GERAMICON CONDENSORS

<table>
<thead>
<tr>
<th>Price SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 56 &amp; 100 mfd.</td>
</tr>
</tbody>
</table>

MOLDED PAPER CONDENSORS

<table>
<thead>
<tr>
<th>Price SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 600 VTYP C .50 ea.</td>
</tr>
</tbody>
</table>

GOAX CONNECTORS

<table>
<thead>
<tr>
<th>Type &quot;AB&quot; POTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>.15 @ 15 $ .35</td>
</tr>
</tbody>
</table>

BATHTUB CONDENSORS

<table>
<thead>
<tr>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>.15 @ 1 $ .01</td>
</tr>
</tbody>
</table>

MONMOUTH RADIO LABORATORIES

BOX 159 Long Branch 6-5192

OAKHURST, N. J.

January, 1952 — ELECTRONICS
SEARCHLIGHT

Niagara • ONE OF AMERICA'S GREAT RADIO STORES

"An" Connectors, Large Variety in Stock at Tremendous Savings Requested Invited.

HEART OF THE BC-221 FREQ. METER
This VFO Sub-assembly, used in BC-221 Freq. Meter, FULLY WIRED and mounted on study aluminum sub-assembly, ready for installation, end to end-in original packing. Very special.

Each $4.50

BRAND NEW HEINEMANN CIRCUIT BREAKERS

<table>
<thead>
<tr>
<th>Amps</th>
<th>Volts</th>
<th>Part No.</th>
<th>Each</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>24 D.C.</td>
<td>AM1550M-7</td>
<td>1.49</td>
</tr>
<tr>
<td>10</td>
<td>40 D.C.</td>
<td>P-0392</td>
<td>1.78</td>
</tr>
<tr>
<td>150</td>
<td>350 D.C.</td>
<td>AM-1510</td>
<td>1.10</td>
</tr>
<tr>
<td>350</td>
<td>500 D.C.</td>
<td>AM-1510</td>
<td>1.35</td>
</tr>
<tr>
<td>500</td>
<td>750 D.C.</td>
<td>AM-1510</td>
<td>1.50</td>
</tr>
<tr>
<td>750</td>
<td>1000 D.C.</td>
<td>AM-1510</td>
<td>1.75</td>
</tr>
<tr>
<td>1000</td>
<td>1500 D.C.</td>
<td>AM-1510</td>
<td>1.97</td>
</tr>
<tr>
<td>1500</td>
<td>2000 D.C.</td>
<td>AM-1510</td>
<td>2.40</td>
</tr>
<tr>
<td>2000</td>
<td>2500 D.C.</td>
<td>AM-1510</td>
<td>2.65</td>
</tr>
<tr>
<td>2500</td>
<td>3000 D.C.</td>
<td>AM-1510</td>
<td>2.80</td>
</tr>
<tr>
<td>3000</td>
<td>4000 D.C.</td>
<td>AM-1510</td>
<td>3.00</td>
</tr>
<tr>
<td>4000</td>
<td>5000 D.C.</td>
<td>AM-1510</td>
<td>3.20</td>
</tr>
<tr>
<td>5000</td>
<td>6000 D.C.</td>
<td>AM-1510</td>
<td>3.50</td>
</tr>
</tbody>
</table>

FAMOUS MAKE SELENIUM RECTIFIERS

All first quality, guaranteed brand new fresh factory stock. Buy now while still available. All 130 V.

SINGLY | LOTS OF
| Each |
|-------|-------|
| 65    | .66   |
| 75    | .75   |
| 100   | .90   |
| 150   | 1.10  |
| 200   | 1.35  |
| 250   | 1.50  |
| 300   | 1.65  |
| 350   | 1.79  |
| 400   | 2.01  |
| 450   | 2.34  |
| 500   | 2.64  |
| 550   | 2.99  |

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.

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 $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.

Niagara
160 Greenwich Street, New York 6, N.Y.

ARCH-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—1257—1st and 2nd I.F. (16.9 mc.), 1257—Det., AVC, Squelch, 1257—1st audio and squelch amplifier, 12A6—2nd audio, 1257—R.F. Osc. and 4th harmonic gen., 717a—trip. 12th Harmonic gen., 717a —Dbir. 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 calls 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 Col. 11280 Synchro Differential 100 V. 60 Cycle. Price .......... $3.75
C-78473 Col. 13920 Repeater type XX 50 V. 50 Cycle. Price .......... 3.75
C-78411 Col. 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 Co-4460A-4 Repeater type II-5 110 V. 50 Cycle. Price .... $7.50

January, 1952 — ELECTRONICS
ELECTRONICS — January, 1952

343
BUY TOP Radio-Electronic Values!

Select your requirements of:

**AIR TRIMMER CONDENSERS**

From one of the largest sources of supply in the country. APC's, Butterfly's & other types. All available in large quantities. Write quantity prices.

**BUTTERFLY CONDENSERS**

<table>
<thead>
<tr>
<th>Fig. A</th>
<th>Fig. B</th>
<th>Fig. C</th>
<th>Fig. D</th>
<th>Fig. E</th>
<th>Fig. F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TRANSMITTING MICA CAPACITORS**

**TOGGLE SWITCHES**

<table>
<thead>
<tr>
<th>Fig. 1</th>
<th>Fig. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OIL FILLED CONDENSERS**

<table>
<thead>
<tr>
<th>Stock No.</th>
<th>MFR.</th>
<th>Name on Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>5675-A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**6.3 VOLT FILAMENT TRANSFORMERS**

Primary 115 Volt 60 Cycle 1600 Insulation Three 6.3 Volt Secondaries

- 6.3 Volts @ 4.9 Amps. Horizontal Half Shell Mounting. 2 1/4" x 2" x 13/16" Mounting Centers. 2 13/16" x 2 1/4" Core Size. 2 1/4" above Chassis. Solder Lug Terminals—All Terminals Marked. Price $2.65 Each

**Terms:**

Open Account to rated or acceptable reference accounts. Others Pre-payment or 25% deposit with order, balance D.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject prior sale.
GERMANIUM DIODES
We carry a complete line of diodes available for immediate delivery:

<table>
<thead>
<tr>
<th>DIODE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N48</td>
<td>$0.75</td>
</tr>
<tr>
<td>1N48</td>
<td>2.49</td>
</tr>
<tr>
<td>1N51</td>
<td>0.48</td>
</tr>
<tr>
<td>1N52</td>
<td>1.53</td>
</tr>
<tr>
<td>1N52</td>
<td>4.05</td>
</tr>
<tr>
<td>1N63</td>
<td>3.30</td>
</tr>
<tr>
<td>1N63</td>
<td>7.65</td>
</tr>
<tr>
<td>1N75</td>
<td>2.85</td>
</tr>
<tr>
<td>1N75</td>
<td>6.66</td>
</tr>
<tr>
<td>1N64</td>
<td>0.66</td>
</tr>
</tbody>
</table>

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.

A Few of Our Many Specials.

SHIELDED SCOPE TRANSFORMER

Pri—115V
Sec—2400—6MA

@ $1.95

Amphenol 80 C connectors . . . . . . S12 ea.

MICA CONDENSORS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>TOL.</th>
<th>CASE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMF</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
<tr>
<td>150</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
<tr>
<td>250</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
<tr>
<td>350</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
<tr>
<td>470</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
<tr>
<td>670</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
<tr>
<td>800</td>
<td>85%</td>
<td>CM19</td>
<td>$1.10</td>
</tr>
</tbody>
</table>

Hermetically sealed—low power audio transformer
Primary 600 ohms at zero MADC
Secondary 8 ohms at same

Westinghouse NA-35 3" round zero—150 V A.C. $5.95

.01—100V
molded paper waxed
diffed capacitors

$.05

Hi-Q Induct. choke
½ mil. rating
$.99

Jan 832 A
$.95
We Invite Inspection of Our Complete Line of:

<table>
<thead>
<tr>
<th>CONNECTORS</th>
<th>RELAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN • UG • UHF • PL • SO</td>
<td>LEACH • ADVANCE • ALLIED</td>
</tr>
<tr>
<td>ARC • NAF • K • BRITISH</td>
<td>CLARE • POTTER &amp; other JAN types</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANJC 48 • ANJC 76 • RG COAX</td>
</tr>
<tr>
<td>Shielded • Twisted • Multi-Conductor</td>
</tr>
<tr>
<td>Bare Tinned Copper • Shield Braid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HARDWARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screws • Nuts • Self Locking Nuts</td>
</tr>
<tr>
<td>Washers • Solder &amp; Solderless Lugs</td>
</tr>
<tr>
<td>Rivets • AN Clamps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN Toggles • Micro • Push Button</td>
</tr>
<tr>
<td>Switchboard • Rotary Selector</td>
</tr>
<tr>
<td>Circuit Breakers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAPACITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mica • Oil Filled</td>
</tr>
<tr>
<td>Ceramic, Fixed &amp; Variable</td>
</tr>
<tr>
<td>Bypass &amp; Electrolytic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESISTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN • CARBON all Wattages</td>
</tr>
<tr>
<td>Wire Wound, Fixed &amp; Variable</td>
</tr>
<tr>
<td>Potentiometers • Rheostats</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TUBE SOCKETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molded &amp; Wafer 4 to 11 Prong</td>
</tr>
<tr>
<td>Miniature 7 &amp; 9 Prong</td>
</tr>
<tr>
<td>Commercial and JAN Types</td>
</tr>
</tbody>
</table>

WRITE, PHONE or WIRE Your Needs AT ONCE

Prices quoted on request; simply state type and quantities required. All inquiries receive PROMPT ATTENTION. Industrial needs served ACCURATELY and EFFICIENTLY.

SEND for our CATALOGS

- TELEPHONE: BEEkman 3-5780

Avnet Electronic Supply Co.
6 West Broadway N.Y.7, N.Y.

Electronic, Television & Radio Components

January, 1952 — Electronics
**SEARCHLIGHT SECTION**

**FILAMENT TRANSFORMERS**

L2132 Prt: 115V, 50 cycles

10G 6V $2.65

Hermetically sealed in metal case with porcelain insulated stud terminals $0.95

L2133 Prt: 115V, 60 cycles

10G 6V $2.65

Hermetically sealed in metal case with porcelain insulated stud terminals $0.95

L2134 Heavy duty Filament transformer

#511

115V, 50 cycles

Sec: 10G, 2A, 1000V Foot Test

2A, 250V Test $0.95

Unshielded type

L2132 Filament transformer with high voltage insulation

Prt: 115V, 60 cycles

Sec: 5V, 7A, 1000V Test

6V, 250V Test $0.25

5.6V, 1A, 1000V Test $0.25

Housed in hermetically sealed case with solderless terminals $2.25

10 STATION INTERCOMMUNICATING SYSTEM

6G

An unusual offering in a 10 station intercommunicating system for factory and interoffice communications.

Built for the U.S. Navy Type 1-A for 115 volt 60 cycle operations with the following outstanding features:

- Operates independently and, separately, by push button control, 10 sub-stations.
- Pilot light identification of each substation, on master unit.
- Transformer coupled 60's in push pull to provide up to 180 watt output.
- Amplification provided by 2-6SL7 transformers.
- Rectification by 2-5V2 tubes.
- A high voltage step, power transformer providing filament and plate voltage to all six tubes.
- Hayden 34 R.P.M. Motor, 10 V.A. rectifies the switch which silences all lights when each substation is used.
- Jensen type NF 101 614 high fidelity speaker.
- Tubes and audio transformers mounted, on a shock proof base.
- Entire unit mounted in a sturdy gray finished steel cabinet 15" X 10" X 6.
- Weight 48 lbs. net. Each packed in wooden crate.

This unit is priced at a fraction of original government equipment cost.

**Price $59.50 each**

Substations for above consisting of a 4" x 2.725" magnet, Goodman, (British) make in high fidelity enclosed 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.

To obtain a copy please write to:

**EDLIE ELECTRONICS, Inc.**

154 GREENWICH ST.

New York, N.Y.

Telephone DI 9-3143
### BRAND NEW GUARANTEED U.S. GOVT. SUPPLIES

#### POWER RHEOSTATS

<table>
<thead>
<tr>
<th>Ohms watt ea.</th>
<th>Ohms watt ea.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>2.51</td>
</tr>
<tr>
<td>1/4</td>
<td>5.01</td>
</tr>
<tr>
<td>1</td>
<td>10.00</td>
</tr>
<tr>
<td>2</td>
<td>20.00</td>
</tr>
<tr>
<td>3</td>
<td>30.00</td>
</tr>
<tr>
<td>5</td>
<td>50.00</td>
</tr>
<tr>
<td>10</td>
<td>100.00</td>
</tr>
<tr>
<td>15</td>
<td>150.00</td>
</tr>
<tr>
<td>25</td>
<td>250.00</td>
</tr>
<tr>
<td>50</td>
<td>500.00</td>
</tr>
<tr>
<td>75</td>
<td>750.00</td>
</tr>
<tr>
<td>100</td>
<td>1000.00</td>
</tr>
</tbody>
</table>

#### OIL CONDENSERS

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5-25</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>7.5</td>
<td>7.5</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
</tbody>
</table>

#### HIGH POWER TR. MICA

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-1</td>
<td>1000</td>
<td>1.0</td>
<td>400-1250</td>
<td>50</td>
</tr>
<tr>
<td>G-2</td>
<td>10000</td>
<td>1.0</td>
<td>400-1250</td>
<td>50</td>
</tr>
</tbody>
</table>

#### TRANSMITTING MICAS

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>50</td>
<td>0.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>0.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>0.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>150</td>
<td>150</td>
<td>0.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>250</td>
<td>250</td>
<td>0.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>500</td>
<td>500</td>
<td>0.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
</tbody>
</table>

### OIL MICROSWITCHES

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5-25</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>7.5</td>
<td>7.5</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
</tbody>
</table>

### BATHTUBS

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5-25</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>7.5</td>
<td>7.5</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>600-1250</td>
<td>50</td>
</tr>
</tbody>
</table>

### "UG" and "UHF" CONNECTORS

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5-25</td>
<td>2.5</td>
<td>600-1250</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

### POTENTIOMETERS

<table>
<thead>
<tr>
<th>Type</th>
<th>&quot;JJ&quot;</th>
<th>Type</th>
<th>&quot;JL&quot;</th>
<th>Type</th>
<th>&quot;J&quot;</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1.5</td>
<td>5</td>
<td>1.5</td>
<td>5</td>
<td>1.5</td>
<td>$2.95</td>
</tr>
</tbody>
</table>

### MICROSWITCHES

<table>
<thead>
<tr>
<th>Mfd.</th>
<th>Values Available</th>
<th>OHMS</th>
<th>Voltage</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5-25</td>
<td>2.5</td>
<td>600-1250</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

### TERMINAL BOARDS

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 terminal</td>
<td>$1.67</td>
</tr>
<tr>
<td>2</td>
<td>5 terminal</td>
<td>$2.60</td>
</tr>
</tbody>
</table>

### SHOCKMOUNTS

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 terminal</td>
<td>$1.67</td>
</tr>
<tr>
<td>2</td>
<td>5 terminal</td>
<td>$2.60</td>
</tr>
</tbody>
</table>

---

**SEARCHLIGHT SECTION**

**French-van Breems Inc.**

375 Fairfield Avenue
Stamford, Connecticut

Telephone 48-9231

**January, 1952 — ELECTRONICS**
COLUMBIA ELECTRONICS LTD.

SCR 300
WALKIE-TALKIE normal range 3 miles or more depending on operating conditions. Frequency range: 40.0 to 48.0 mcs. Band new. Complete.

R-4/ARR-2 RECEIVER
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 21/2 W. on 500 kc and 2 W. on 8280. BRAND NEW COMPLETE WITH PARACHUTE, KITES, LAMP, BALLOON and GENERATOR.

TEST EQUIPMENT
Complete Line!
Signal Generator 804-C
DuMont 224-A Oscilloscope
1-77 Hickok Tube Checker
1-208 FM Signal Generator
RFC Model 644 Multimeter
Ferris Microvolter Mod. 18-C
IE-36 (New) TS-100/AP
1-122 TS-102A/AP
1-139 METER TS-111/CP
1-212 TS-126
1-22 TS-127/U
TS-3/AP TS-170/ARN-5
TS-5/AP TS-175/UP
TS-108/APN TS-182/UP
TS-19/APQ-5 TS-184A/AP
TS-24A/APR-2 TS-204/AP
TS-34/AP TS-250/APN
TS-36/AP UFM-1
TS-61 (Complete)
TS-62/AP WE 1 193
SL-1 Slotted Line Calibrator
-Line Test Set tor 1-146

MODULATOR UNIT BC-1203-A
With Coupling Heads BC-1201 & BC-1202
RC-184 IFF EQUIPMENT
Complete. Brand new.
APS-4 Complete Radar
Mark 16 Complete Radar
APS-6 Complete

RECEIVERS
APR-4 APR-5

SCR-720 Equipment MG-19A New

HEADSETS
MS-36 & HS-33 Brand new.
MK-20A/UP Brand new. Individually boxed.

TELEVISION CAMERA
350 line resolution. Easily converted to present RMA standards. Receivers available with camera. Complete, like new.

SEE COLUMBIA ELECTRONICS AD ON PAGE 364

COLUMBIA ELECTRONICS LTD.
324 S. San Pedro St., Los Angeles 13, Calif.
Cable Address COELECT
ALL ITEMS SUBJECT TO PRIOR SALE

SEARCHLIGHT SECTION

TEST EQUIPMENT

HI-POWER DUMMY LOADS

X Band. 1¼" x 1¼" 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. 7/8" 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 3/16" 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 3/16" guide, plain flange, dissipates 150 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band. 7/8" x 3/16" guide dissipates 1,200 watts average power in still air. VSWR less than 1.15 between 2.6 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 5/8" x 1¼" wave guide.—$205.00.

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 5/8" 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-220 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/AF (Unit 2) X Band slotted line with adapters and probes.—$175.00.

TS-100 Synchroscope

Amplifier Strip AM-SS/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 18 300-1,000 megacycles
TN 17 80-300 megacycles
TN 19 1,000-2,200 megacycles
TN 54 2,200-4,000 megacycles

ELECTRO IMPULSE LABORATORY
62 White Street Red Bank 6-0404 Red Bank, N. J.
CALL CREDDA MU 6-4164
Accredited WESTINGHOUSE Distributor and Clearing House Extraordinary—FOR THE BIG THINGS and the
*VITAL LITTLE THINGS* in ELECTRONIC COMPONENTS & EQUIPMENT

We Buy! We Sell! We Serve!

Solves your production problems
Solves your distribution problems
Send for our bulletins

GO RIGHT TO THE SOURCE...
Your answer in a matter of minutes!

CREDDA, INC.
THE ONE-CALL CLEARING HOUSE

MU 6-4164

19 WEST 26th STREET • NEW YORK 10, N. Y.
ELECTRONICS NEW

WANTED—WE PAY TOP DOLLAR FOR:

All Types Aircrāft, RaDiO, RaDiO SETS, COMMUNICATIONS, TEST EQUIPMENT, Etc. Includes
- Radio-Controlled Aircraft
- Electronic Motor Control Equipment
- Associated Equipment such as ART-13 B-C-611'S, Test Equipment, Etc. Prompt Replies to Do It Yourselfers.

NEW STANDARD BRAND CHOKES

SWINGING CHOKES

Hy Mils Ohms Price (

2-10 200 50 8.55 100
2-20 200 80 5.36 195
2-30 200 90 4.80 215
2-40 200 120 3.55 235
2-50 200 80 4.80 215
2-60 200 120 3.55 235
2-70 200 80 4.80 215

SMOOTHING CHOKES

5 200 4.35 100
5-30 200 30 5.25 195
5-30 200 60 5.25 195
5-60 200 120 3.55 235
5-80 200 80 4.80 215
5-100 200 120 3.55 235
5-120 200 80 4.80 215
5-140 200 120 3.55 235
5-160 200 80 4.80 215
5-180 200 120 3.55 235

TEST EQPT.

RaDAR S-545-A. Complete in Trailcr Trkr, with one, out 25 KVA trans./radio Generator Unit.
Mark V. Tracing Radar, for schools, training.

Radio, 100-150 MC, with crystal cali.

Hundreds of Tuba components, plumbing, magnets, tubes, trans.

NEW STANDARD BRANDS

TEST EQPT.

RaDAR S-545-A. Complete in Trailcr Trkr, with one, out 25 KVA trans./radio Generator Unit.
Mark V. Tracing Radar, for schools, training.

Radio, 100-150 MC, with crystal cali.

Hundreds of Tuba components, plumbing, magnets, tubes, trans.

RECEIVERS


30 KB, 200 MC, Crystal sets, DZ-1600, to 1000 MC, part of DZ-80/40, transistor assembly, w/insulator.

90-AR-5A Gide-Path Receiver.

RT-3-AR-1 Radio Receivers, New.

NEW STANDARD CHOKES

ATTENTION PURCHASERS AGENTS: We have thousands of items to stock not listed in your requirements and we will reply promptly.

PHONE: 260-276-2127

THE BEST IN ELECTRONIC SURPLUS
AVAILABLE FROM OUR STOCK FOR IMMEDIATE DELIVERY

TELEMARINE COMMUNICATIONS COMPANY

Cable Address: TELEMARINE, N. Y.

540 W. 27th St., N. Y. 1, N. Y.

EXTRA-SPARES!!! GR 872-A Rectifier Tubes, packed 25 to each carton. NEW, original cartons. Or for $72.99, we will trade.

WRITE FOR PRICES. ALL MATERIAL SUBJECT TO PRIOR SALE.
DYNAMOTERS & INVERTERS

**Descriptions and Specifications**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>INPUT VOLTS</th>
<th>OUTPUT VOLTS</th>
<th>MILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM-21</td>
<td>14</td>
<td>235</td>
<td>90</td>
</tr>
<tr>
<td>AE-320</td>
<td>14</td>
<td>235</td>
<td>62</td>
</tr>
<tr>
<td>2415</td>
<td>14</td>
<td>220</td>
<td>100</td>
</tr>
<tr>
<td>2414</td>
<td>14</td>
<td>240</td>
<td>80</td>
</tr>
</tbody>
</table>

**MOTOR-ALTERNATOR**

- **BARI212W**
  - Input: 27V DC
  - Output: 125V 800 Cycles 1 Phase

**MOTOR GENERATOR**

- **PU-7**
  - Input: 28V DC
  - Output: 115V AC 21.6 Amps

**BLOWERS**

- 24V DC 1/100 hp - 7000 RPM

**POWER SUPPLIES**

- All with Cut Cords
- Complete with tubes and 97A

**400 CYCLE TRANSFORMERS**

- CAT # 06606X
- B09050
- BM5556

**NOISE SUPPRESSOR CAPACITORS**

- 1 MFD, 200 Volt

**OIL FILLED CAPACITORS**

- MFD, VOLTS:
  - 0.06-0.01, 10,000
  - 0.01-0.03, 10,000
  - 0.05-0.001, 10,000
  - 0.05-0.01, 10,000
  - 0.05-0.03, 10,000
  - 0.05-0.05, 10,000
  - 0.05-0.10, 10,000
  - 0.05-0.20, 10,000
  - 0.1-0.6, 90V 60 CY
  - 10-10, 90V 60 CY
  - 15-15, 90V 60 CY
  - 20-20, 90V 60 CY
  - 25-25, 300V 60 CY
  - 25-25, 250V 60 CY
  - 90-90, 50V 60 CY
  - 175-175, 300V 60 CY
  - 175-175, 250V 60 CY
  - 250-250, 300V 60 CY

**CIRCUIT BREAKERS**

- 24 Volts DC 300 AMPS
- 115 Volts AC 15 AMPs
- 24 Volts DC 150 AMPs

**T. V. HIGH VOLTAGE CONDENSER**

- 500 MAX.-10,000 Volts

**POWDERFED IRON TUNING SLUGS**

- ALL SIZES

**CONTROL BOXES**

- CAY-23215
- J-27-A101
- JD 212
- CM5556
- J-22-1/2C

**FERRULE TYPE RESISTORS**

<table>
<thead>
<tr>
<th>OHMS</th>
<th>DIAM.</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>3/16</td>
<td>1/2</td>
</tr>
<tr>
<td>360</td>
<td>3/16</td>
<td>1/2</td>
</tr>
<tr>
<td>1500</td>
<td>3/16</td>
<td>1/2</td>
</tr>
</tbody>
</table>

**ALTITUDE GAIN CONTROLS #55586**

- Contains 100K ohm 1/2 watt. Type J Pot. Control is coupled to a sealed chamber, setting automatically with altitude.

**GYRO CONTROL**

- Contains a motor driven gyroscope friction plate paralleled and resistors. The gyro motor is a 115 V 210 cycle 3 phase 1400 RPM induction motor.

**GYRO MOTOR GENERATOR**

- Is a 115 Volt 60 cycle 3 phase, 5400 RPM motor driving a DC generator with 3 fields. The output of the generator is from 8 to 25 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**

- BRUSHWOUND

**Gear box for above equipment**


**BUD MIDGET CONDENSERS**

- Capacitor Per Sect. Air
- No. Max. Min. Gap
- 915 6.0 .004
- 329 5.5 .006

- 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**

<table>
<thead>
<tr>
<th>Watts</th>
<th>Volts</th>
<th>Dia.</th>
<th>Length</th>
<th>Mfd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>110</td>
<td>3/16</td>
<td>7/8</td>
<td>V</td>
</tr>
<tr>
<td>250</td>
<td>120</td>
<td>3/16</td>
<td>7/8</td>
<td>V</td>
</tr>
<tr>
<td>150</td>
<td>150</td>
<td>3/16</td>
<td>7/8</td>
<td>V</td>
</tr>
<tr>
<td>80</td>
<td>120</td>
<td>3/16</td>
<td>7/8</td>
<td>V</td>
</tr>
</tbody>
</table>

**ADEL CLAMPS—ALL SIZES**

**SEARCHLIGHT SECTION**

**HARD TO GET ITEMS! WE HAVE THEM!**

**Genuine TELECHRON Motors**

- 2 RPM $2.90
- 3 RPM $3.90
- 5.8 RPM $3.90
- 1 RPM $3.95
- 60 RPM $4.30

- One of each $18.00

**ZINN 1951 TV Remote Control Motor Units**


- Can be used for door opener, window raiser, model RR turntable. Complete with transformer, 6 for $70.00

**MARKTIME 3 HOUR SWITCH**

- A 10 amp. timing device, circuit and switch enclosed in steel case. Ideal for shutting off radio and other equipment after time elapsed. Ideal for 40 volt A.C. and 6 volt D.C. Switches assorted 4 for $3.90

- Also available in 15 min., 20 min., 1 hr. at $5.00

**ALNICO 9 LUCKY MAGNETS**

- 39c EACH

**Westingham**

- ELAPSED TIME METERS

- $15.50

- EST. 1923
- BLAN
- EST. 1923
- 64 Day St., New York 7, N. Y.

**FOR SALE (NEW) HEAT CONTROL AND RECORDERS**

- 3 Wheelco Capacitors—Model 2702
- 1—Range 0-600 C
- 1—Range 0-1000 C
- 1—Range 0-1100 C
- New in original crates

- Spot Delivery—No Priority

**KINGS COUNTY MACHINERY EXCHANGE**

- 408 Atlantic Ave., Brooklyn 17, N. Y.

- Phone-Tr 5-5327

**January, 1952 — ELECTRONICS**
TELEPHONE RELAYS
Large Stock of

CLARE TYPES B, C, D & F
Contact ringing, maintained
ALL TYPES OF COILS and PILE-UPS

Qualify For Your Quote

CLARE TYPE C SENSITIVE TELEPHONE RELAYS

1) 6500 ohms 1C 2.8 mA 57.75 ea.
2) 6500 ohms 1A-1C 3.2 mA 27.75 ea.
3) 6500 ohms 1B-1C 4.0 mA 38.00 ea.

CLARE TYPE G SENSITIVE HALF-TELEPHONE RELAYS

1) 6500 ohms 2A 5 mA 52.50 ea.
2) 5500 ohms 3A 5 mA 52.50 ea.
3) 3500 ohms 1B-1C 5 mA 52.50 ea.
4) 4800 ohms 1A-7C 6 mA 52.50 ea.
5) 3600 ohms 1C 6 mA 2.00 ea.

All above Relays may be used for continuous duty except those marked (Legend)

(At) Normally open contact of sets.
(Anda) Normally closed contact of sets.
(C) Single pole double throw set of contacts.

Silica Type 5F Low Voltage Sensitive Relays.
250 ma. 2,500 volts. DPDT contact.
Enclosed in Dust Cover. Contacts may be
connected in series or parallel or independently. Contacts are normally closed, but can
be easily changed to S.P.D.T. Contact.

385 Jackson St., Hempstead, N. Y.

SCARCE BUYS!

ELECTRONIC SUPPLY CO.
222 Fulton St.
New York 7, N. Y.

Radiocraft & Electronics

SPECIAL! $49.56

3845.83

$3.00 ea.

$90.00 ea.

$4.95 ea.

$27.50 ea.

$12.50 ea.

$25.00 ea.

$875.00 ea.

$13.00 ea.

$70.00 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$90.00 ea.

$25.00 ea.

$875.00 ea.

$13.00 ea.

$70.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.

$50.00 ea.

$6.95 ea.

$6.95 ea.

$19.90 ea.

$25.00 ea.
# COMPASS COMMUNICATIONS COMPANY

393 GREENWICH STREET

NEW YORK 13, N. Y.

B6ckman 3-6510

CABLE ADDRESS: COMPRAID

---

## SEARCHLIGHT SECTION

- **RADAR**
  - MARYNE, GROUND & AIRBORNE
    - AN/APG-2: $950.00
    - AN/PSD-3: $950.00
    - AN/PLS-4: $950.00
    - AN/PLS-5: $950.00

- **BEACONS**
  - AN/CPS-6: 3 em.
  - AN/CPS-10: 30 em.

- **LORAN**
  - AN/APN-4 and AN/APN-9

- **TELEPHONE EQUIPMENT**
  - Portable and Stationary Switchboards and Supplies
  - BD-32-1: 72-line portable switchboard
  - BD-72: twelve-line portable switchboard

- **CONVERSION EQUIPMENT**
  - MOTOR GENERATORS
  - CONVERTORS
  - INVERTORS
  - POWER SUPPLIES
  - RECTIFIERS

- **TEST EQUIPMENT**

---

## WE GUARANTEE EVERYTHING WE SELL

---

## COMPASS ELECTRONIC PRODUCTS

- **SELECTED EQUIPMENT**
  - TCB-Coilless slides. Navy radiotelephone for shipboard and mobile use, complete with all accessories for operation from 12, 24, 110, 220 volts d.c. and 110 or 220 volts a.c.
  - TKR—Navy high frequency transmitter, 2-30 megacycles output. Supplied complete with m/g and starter for d.c. or a.c. operation.
  - TBL—Navy all-wave transmitter; 550 watts output. CW and phone. Supplied complete with m/g and starter for d.c. or a.c. operation.

- **TRANSMITTING STATIONS**
  - KW—600-5600 kw complete, 600 volt, 3 ph.
  - 500-600 kw, power supply—Price $2,500.
  - 1000 watts power plant, Eastern Electro 10-channel automatic dial station, 2-200 watts output, 200-500 kw power plant, complete.

- **TUBES**
  - New, Standard Brands Only
    - MAGNETRONS
    - KLYSTORS
    - TRANSMITTING
    - and other Special Purpose Tubes

---

## BRAND NEW STANDARD BRAND TUBES

<table>
<thead>
<tr>
<th>OAB...</th>
<th>1.45</th>
<th>1JA7...</th>
<th>.69</th>
</tr>
</thead>
<tbody>
<tr>
<td>OAR/957</td>
<td>1.47</td>
<td>1LG7...</td>
<td>.65</td>
</tr>
<tr>
<td>OBJ/V950</td>
<td>1.19</td>
<td>1PSG...</td>
<td>.69</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>1RG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OBJ/V950</td>
<td>1.19</td>
<td>1SG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>1TG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OGC/1054</td>
<td>1.05</td>
<td>1UG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OBJ/V950</td>
<td>1.19</td>
<td>1VG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OGC/1054</td>
<td>1.05</td>
<td>1WG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OGC/1054</td>
<td>1.05</td>
<td>1XG7...</td>
<td>.69</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2A5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/1054</td>
<td>1.05</td>
<td>2A6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2A7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2A8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2A9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2B5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2B6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2B7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2B8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2B9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2C5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2C6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2C7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2C8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2C9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2D5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2D6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2D7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2D8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2D9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2E5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2E6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2E7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2E8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2E9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2F5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2F6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2F7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2F8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2F9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2G5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2G6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2G7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2G8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2G9...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2H5...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2H6...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2H7...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2H8...</td>
<td>.65</td>
</tr>
<tr>
<td>OGC/957</td>
<td>1.05</td>
<td>2H9...</td>
<td>.65</td>
</tr>
</tbody>
</table>

---

## MARITIME INTERNATIONAL COMPANY

11 State Street, New York 4, N. Y.

Cable Address "Foxcroft"

Phones: Digby 4-3192-3

---

WE MAINTAIN OUR OWN FULLY EQUIPPED TESTING LABORATORY IN THE SAME BUILDING AS OUR MAIN WAREHOUSE TO TEST ANY ITEM WE SELL

---

## CATHODE-RAY TUBES

- **SR5**
- **SR6**
- **SR7**
- **SR8**
- **SR10**

---

WE GUARANTEE EVERYTHING WE SELL
WEATHER INSTRUMENTS
I—First Recording Microbarograph Cat. f 792, metal 2, 467-40. Signal Circuit type M.D-S-4, 4 day clock chart in 6 1/2 inches high.
II—First Psychrometer, (Thermidry) Cat. # 673, complete with 50 volt 50 cycle motor and table
III—Thermograph, 50 due to blips 125 deg Fahrenheit, complete set of four different chart agings. Chart 4 1/2, high.

Specialty Instruments
A—Anemometer, Velocity in feet, 4" diameter, calibrated 1500 Feet per hour, Aluminum Dial Register, 0-10 in hundreds, 0-100 in thousands, and 0-1000 in ten thousands, with complete cases, and correction table.
B—Altimeter, 0-30000 feet, also 0-2 inches of water. Type 6002 complete with 3 sets for above ranges in a carrying case.

These Instruments have been used but are in good condition. Subject to your inspection in the store. All the Instruments, as a lot, with list price over $1450. Your net cost $690.00.

We specialize in electrical instruments. Over 75,000 meters in stock. Send for our latest circular showing our complete list of surplus-New-Guaranteed meters.

TUBES
6B8 .60
6B8G .55
6J8G .65
6L7G .65
6S7G .60
6U7 .50
12A6 .50

IN STOCK
12F5GT .48
12K8GT .50

IMMEDIATE SHIPMENT
807 .85
1619 .40

PLUGS
TELEPHONE PLUGS. Equivalent to PL-55, with Screw Terminals inserted. Samples furnished to quantity users...New...$3.50

TRANSFORMERS
PLATE TRANSFORMER
5000 volt AC, center tapped, 350 MA. Primary 115 volt, 60 cycle. Unmounted and not potted, overall dimension 6 1/4 inches x 6 inches x 7 inches, weight 37 lbs.

New. $25.00

BUTTERFLY CONDENSER
(A-PR-4TN-17) Antenna Tuning Unit Condenser (C-302) for TN-17, 74-320 MC, in original package
All items subject to price sales. Ships, BEST WAY C.O.D. or freight prepaid. For orders {

MARITIME SWITCHBOARD INSTRUMENTS—ACCESSORIES
338 Canal St.. N. Y. 13, N. Y. Worth 4-8217

STEAM TRANSPORT AT T "100" roof 7.50

ELECTRONIC COMPONENTS

T. R. LOWENTHAL CO.

RADIO

TECHNICAL RADIO SINCE 1919

1205 WEST SHERWIN AVENUE, CHICAGO 26, ILLINOIS

PHONE: ROGERS PARK 4-0784
American & Canadian enquiries to our Agents:

POLAS MERCANTILE
115 Broadway
New York, 6
Telephone: Rector 2-8595

ALL OTHER ENQUIRIES TO LONDON


HALL ELECTRIC LTD
89, CHARLOTTE ST., LONDON, W.1.

GENERAL PURPOSE
GERMANIUM CRYSTAL DIODES
Size 3/4" x 1/4"
Length of each Pigtail 2 1/4"
Price $ .63 each

<table>
<thead>
<tr>
<th>Type</th>
<th>Mounting &amp; Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation Bell Housing</td>
<td>115AC 60 cycle</td>
<td>$1.95</td>
</tr>
<tr>
<td>Isolation Fully Enclosed</td>
<td>115V 35 Watts</td>
<td>$1.95</td>
</tr>
<tr>
<td>Navy Modulation</td>
<td>Pri. Imp. Sec. Tertiary Imp.</td>
<td>$5.95</td>
</tr>
</tbody>
</table>

TRANSFORMERS—Special Purpose

<table>
<thead>
<tr>
<th>Type</th>
<th>Characteristics</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1632</td>
<td>10,000 MMF</td>
<td>1.30</td>
</tr>
<tr>
<td>1633</td>
<td>8500 MMF</td>
<td>1.30</td>
</tr>
<tr>
<td>1635</td>
<td>6000 MMF</td>
<td>1.30</td>
</tr>
</tbody>
</table>

CONDENSERS

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBA</td>
<td>40/40/40</td>
<td>1.25</td>
</tr>
</tbody>
</table>

PI ELECTRONICS COMPANY
MINIMUM ORDER $5.00 NET CASH FOB N. Y.
120 Cedar St.
DIGBY 9-3832 New York City


AT DEALERS' COST! WHILE THEY LAST!
New! (Minimum Order $25.00 Guaranteed!)

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N4</td>
<td>$1.95</td>
</tr>
<tr>
<td>1N5</td>
<td>$2.95</td>
</tr>
<tr>
<td>1N6</td>
<td>$3.95</td>
</tr>
<tr>
<td>1N7</td>
<td>$4.95</td>
</tr>
<tr>
<td>1N8</td>
<td>$5.95</td>
</tr>
<tr>
<td>1N9</td>
<td>$6.95</td>
</tr>
</tbody>
</table>

TRANSMITTING UNITS

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>12N1</td>
<td>$8.95</td>
</tr>
<tr>
<td>12N2</td>
<td>$9.95</td>
</tr>
<tr>
<td>12N3</td>
<td>$10.95</td>
</tr>
</tbody>
</table>

FOREST SALES CO., INC.
701 Madison Street
Encino 6-1883 Oak Park, Ill.

January, 1952 — ELECTRONICS
RADAR SEARCH RECEIVER ARD-2
Will measure RF signals from 80 to 3000 MHz and pulse rates from 50 to 8000 cycles. It can also locate transmitted signal sources by visual and aural indicators.

EQUIPMENT: Consists of the following: A. ANTENNA-DETECTOR (GMD-GAFM) has variable length antenna (G), detector, and rf amplifier which is controlled by a calibrated scale: B. AMPLIFIER (GMD-200A) has three stage amplifier which is controlled by a calibrated scale: C. FILTERS (GMD-200) have variable frequency and aural indicators, and detent mounted which is controlled by a calibrated scale: D. AFTER DETAIL (GMD-100) has variable frequency and aural indicators, and detent mounted which is controlled by a calibrated scale.

Price each	...	$225.00

AVT/R/A OR 110/220 AC
M/RE/MT by RCA, 6-19 Waves and CW and Radio frequencies from 5 to 100 MHz. Complete. Brand New.

Price each	...	$125.00

TCS .. Collins
18 Q Transmitter and Receiver
Freq. 1.5 to 12.0 MHz with all cables, tubes, key, microphone, antenna loading box, remote control unit optional. Input 15 or 110/220 a.c. models with appropriate power supply.

Price each	...	$295.00

5 WATT, Model JT-52
by Jefferson Electronics 1-channel, single crystal controlled receiver-transmitter, built-in speaker, microphone, and 115 V.D.C. or 110/220V.A.C. This unit is complete from 24-28 MHz. New.

Price each	...	$99.00

COMMUNICATION DEVICES CO.
N. Y. 27, N. Y.
SEARCHLIGHT SECTION

Specialists in Test Equipment

This month we feature the 3CM favorites, TS-12 and 15. The TS-12 being a complete SWVR set in two parts including a slotted line detector and amplifier, while the TS-15 as its companion signal generator provides both a wave meter and power monitor. This device permits either peaked or CW power over the range of 0.0001-99.9999. Hence, it can be used in automatic operation while direct reading of power may be had from a temperature compensated thermistor bridge. The calibrated audio and volume regulated power source make this an outstanding piece of laboratory equipment.

Other pieces available include:

TS-1ARR
TS-3A/AP
TS-8A/US
TS-10A/AP-1
TS-11/AP
TS-12
TS-13
TS-14
TS-15B/4P
TS+16/APM
TS-19
TS-23/AP
TS-27/T5
TS-32A/URC-1
TS-33/4P
TS-34/AP
TS-35/AP
TS-36/TP
TS-37/TP/1M-3
TS-46/TP/1M-3
TS-47/AP
TS-50/6Q-4
TS-54/AP
TS-61/AP
TS-62/AP
TS-65/TP
TS-76/TPM-3
TS-81/TP/49
TS-92/TP/1W-1
TS-98/4P
TS-100/AP
TS-102/AP
TS-108/AP
TS-110/AP
TS-113/AP
TS-117/TP
TS-118/TP
TS-122/TP
TS-123/TP
TS-124/U

Cable: WESLAB Tel. Boston: WE 5-4500

Weston Laboratories
Weston 95, Mass.

SAVING ON TUBES BRAND NEW TUBES GUARANTEED TUBES

O2A 5.10 2243 $26.50 427/2CV 5.95
O2A/VH 3.95 2231 4.65 421 5.00
O4J 1.25 2670 1.55 422B 12.00
O6 2.65 2670 1.95 427C 15.00
OBI/V890 1.25 2275 1.35 422C 14.50
PC1/V195 1.35 2277 1.35 422B 14.50
ODY/V195 1.35 2275 1.35 422C 14.50
RB-2R 3.00 2228 2.85 426S 9.50
RB-3R 3.00 2228 2.85 426S 9.50
RB-5R 3.00 2228 2.85 426S 9.50
RB-5/4 2.25 2228 1.95 426S 9.50
RB-7R 2.00 2226 1.95 426S 9.50
RB-8R 3.50 2228 2.85 426S 9.50
RB-11R 2.75 2226 1.95 426S 9.50
RB-15R 2.50 2226 1.85 426S 9.50
RB-15/2R 2.75 2226 1.95 426S 9.50
RB-17 17.50 2246 1.75 426S 9.50
RB-17B 17.50 2246 1.75 426S 9.50
RB-32 12.50 2226 1.95 426S 9.50
RB-32B 12.50 2226 1.95 426S 9.50
RB-32C 12.50 2226 1.95 426S 9.50
RB-32D 12.50 2226 1.95 426S 9.50
RB-32E 12.50 2226 1.95 426S 9.50
RB-43A 12.50 2226 1.95 426S 9.50
IN1L 1.45 2496 1.25 4X100A 35.00
IN1L/5 1.75 2496 1.25 4X100A 35.00
IN1L/5B 4.50 23P3 4.30 44PPS 9.50
IN2L 1.45 2496 1.25 4X100A 35.00
IN2L/5 1.75 2496 1.25 4X100A 35.00
IN2L/5B 4.50 23P3 4.30 44PPS 9.50
IN5 1.65 2301 1.55 424T 9.50
IN5B 1.65 2301 1.55 424T 9.50
IN69 0.60 2C74 1.55 54PP 4.95
IN69A 0.60 2C74 1.55 54PP 4.95
JAP 6.95 2C45 6.50 5GP(4) 4.95
JAP 5.95 2C45 6.50 5GP(4) 4.95
JAP 3.00 2C45 6.50 5GP(4) 4.95
JAP 2.60 2C45 6.50 5GP(4) 4.95
JAP 2.00 2C45 6.50 5GP(4) 4.95
JAP 1.60 2C45 6.50 5GP(4) 4.95
JAP 1.30 2C45 6.50 5GP(4) 4.95
JAP 0.90 2C45 6.50 5GP(4) 4.95
JAP 0.30 2C45 6.50 5GP(4) 4.95
JAP 0.00 2C45 6.50 5GP(4) 4.95

YOUR SURPLUS WANTED

We Pay Highest Prices!

J. S. H. SALES CO.
Dept. 8-R, 7552 Melrose Ave.
Los Angeles 46, California

Specialist! RCA Audio Analyser

Type 170-A - $195.00

January, 1952 - ELECTRONICS
WIRE-CABLE

CORDAGE
CO 22 3 conductor each #22 AWG neoprene coated 500' length or #28 AWG braid and tinned copper braided shield. CO 22 twisted pair #16 AWG shielded type SJ 500' length.

MULTI-CONDUCTOR
7 conductor AWG 14 2 conductor AWG 18
19 conductor AWG 18 14 conductor AWG 18
7 conductor AWG 18 7 conductor AWG 12

ARMOUR
DRHA-23 FYIA-4 OLLA-56

SINGLE CONDUCTOR AWG 10
Shielded cable with terminal lug each end 100' and 150' length.

WIRE
AWG 18 copper braid AWG 22 tinned copper
AWG 12 bare copper
AWG 22 with nylon core plastic insulation

CRYSTAL HOLDERS—ELECTRODES
Holders CR-1 CR-1A/AR with chasis
Plain electrodes #24 #25 #26 #28 blanks

ENTERING INSULATOR
Porcelain flared bowl with glass rod and fittings aluminum shield Dimensions: 4'' High X 3/4'' OD at base. Non-c. $4.30 each. Bowl Bowl $1.50 each.

EQUIPMENT
10-Tube Tuning 2 2-1/2 MCs
MN-265 Resistor Compass Receiver
HC-225 Transmitter
TLM-15 Transmitter with masts
High Frequency Equipment. 200-500 KC Fixed Tuned

TUBES

TUBE LIST
TUBES 1.50 2.35 3.50 5.50 8.50
URI 1.00 1.75 2.75 4.25 6.50
URI 1.00 1.75 2.75 4.25 6.50
URI 1.00 1.75 2.75 4.25 6.50

HI-VOLTAGE CHOKES
1-3 Amp DC 5 Ohms 1250 RMS to ground
25 Amp 5 Ohm 20,000 Test.
1-3 Amp DC 2.5 Ohm GU 064595. New

DE-ION LINE STARTER
DPF-113 Volt 60 Cycle 15 Amp 1 Horse Power
Holding Westinghouse with interlock Switch.

Pulse Network
1 Micro Second 15 KVA 450 Cycle 50 Ohm. Brand New

400 CYCLE VOLTAGE REGULATOR
115 Volt 400 Cycle GR Type GRAC.

TIME DELAY SWITCHES
1 Minute 115 Vac 60 Cycle. In Waterproof Metal Case. New. $2.50 each.
3 Micro Switches Contact at 40-41-43 Second Time Delay. 110 Vac Meter. New. $4.50 each.
Thermistor Switch 50° to 100° F. 115 Vac @ 5 A. 500 Volt & 5 A Breaks Contact with Increase of Thermistor. New. $1.75 each.

Relays
21 Vac DPD7 5 Amp $3.50 each.
110 Vac DPDT 1 Amp Contacts Struthers Dunn CXA 1916 $3.50 each.
110 Vac DPDT 5 Amp Contacts Ward Leonard $7.50 each.
115 Vac DPDT 25 Amp Contacts Ward Leonard $3.95 each.
115 Vac DPDT Struthers Dunn CXA 2078 $3.65 each.
120 Vac DPDT Struthers Dunn CXA 2125 $4.50 each.

SWITCHES
TERMS: Minimum order $5.00—Mail orders Promptly filled—All prices F.O.B. Boston, Mass. Send M. D. or check. Shipping charges paid C.O.D. 25% deposit required with all C.O.D. orders.

ATTENTION INDUSTRIAL USERS ! ! !
We have large stocks of the following items and we invite your inquiries.

Amphenol Connectors
Allen-Bradley Potentiometers
A M P Terminals
Bunya Hylugs
T & B "Ste-Kon" Terminals
Dialco Panel Light Assemblies
Superior Powerstats
Ferrule Type Resistors
Relays, Transformers and Chokes
Synchros
Tube Sockets
Contactors
Magnet Wire & Hook-up Wire
Vacuum Condensers
Gas-filled Condensers

Oil-filled Capacitors
High-voltage Mica Capacitors
High-voltage Oil-filled Capacitors
Mica & Silver Mica Capacitors
Tubes
Switchboard Meters
Crystal Diodes
Interlock Switches
Key Switches
Type FP Capacitors
Type G Capacitors
Fiberglass Yarn
Contactors & Contactor Coils
T & B "Wedge-On" Terminals
Glass-enclosed Relays
Welding Rod; including Type 347
Tube Cocks

We invite inquiries regarding items not listed above.

Replies will be made to your inquiries within twenty-four hours after they are received by us.

Key Electronics Division
1801 North Longwood Street
Baltimore 16, Maryland

Eastern Air Device J50 Centrifugal Blower, 115 volt 60 cycles 0.1 amp. 1 P.F. 10 C.P.M. Continuous duty 1.0 M.F.D. Capacitor start with Capacitor $10.78; without Capacitor $11.86.

Eastern Air Device J50E Dual Centrifugal Blower, 115 volt 60 cycles 0.1 amp. 1 P.F. 20 C.P.M. Continuous duty 1.0 M.F.D. Capacitor start with Capacitor $18.76; without Capacitor $19.86.

Miniature lamp T14, 1 volt .15 amp. Adirane Indicator, Amb. Qty. 10 for $1.80. 100 for $8.20.

A5 Automatic pilot Directional Gyro made by SPERRY'S Part # 55652B.

AMMETERS, 100/200 dual range Triplet 341A 3 1/2" rectangular flush bakelite 6 amp Movement @ 4.55 with external current transformer for 160 amp. Uni Stock $7.00.

Square D Circuit Breakers Push Type AN3161-35 16 amp @ 30 volt D.C. $1.25 each.

Square D Bus Handle Circuit Breaker Type AN3160-15 30 volt @ 10 amp. $1.25 each.

SEND FOR FREE BULLETIN Digby 9-5186-1

A. Cottone & Company

Electronic Mechanical & Optical Components
336-340 Canal St., New York 13, N. Y. ALL PRICES F.O.B. N. Y. CITY

COMMERCIAL BUYERS

HANDSETS and HEADSETS

AVAILBLE FROM STOCK:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>300 mm</td>
</tr>
<tr>
<td>B</td>
<td>300 mm</td>
</tr>
<tr>
<td>C</td>
<td>55 mm</td>
</tr>
</tbody>
</table>

ELECTRO IMPULSE LABORATORY

62 White St. Red Bank, N. J.

ELECTRONIC TUBE-MAKING MACHINERY


AMERICAN ELECTRICAL SALES CO.

67 E. 8th St.

Commerical Buyers

Surplus Sales Catalog


WRITE FOR PRICES.

APY4, APYA, TS-24, 8N422, BC-348, ART-13, TS-12, ARC-1, AP6-9, BC-810, TCB, 304TL, 809R.

Western 769 Electronic Analyzer

WRITE FOR PRICES.

WRITE FOR PRICES.

Priced Right—Immediate Delivery

100,000 RELAYS

50 TYPES

A. Cottone & Company

Electronic Mechanical & Optical Components
336-340 Canal St., New York 13, N. Y. ALL PRICES F.O.B. N. Y. CITY

COMMERCIAL BUYERS

HANDSETS and HEADSETS

AVAILBLE FROM STOCK:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>300 mm</td>
</tr>
<tr>
<td>B</td>
<td>300 mm</td>
</tr>
<tr>
<td>C</td>
<td>55 mm</td>
</tr>
</tbody>
</table>

ELECTRO IMPULSE LABORATORY

62 White St. Red Bank, N. J.

ELECTRONIC TUBE-MAKING MACHINERY


AMERICAN ELECTRICAL SALES CO.

67 E. 8th St.

Commerical Buyers

Surplus Sales Catalog


WRITE FOR PRICES.

APY4, APYA, TS-24, 8N422, BC-348, ART-13, TS-12, ARC-1, AP6-9, BC-810, TCB, 304TL, 809R.

Western 769 Electronic Analyzer

WRITE FOR PRICES.

WRITE FOR PRICES.

Priced Right—Immediate Delivery

100,000 RELAYS

50 TYPES

A. Cottone & Company

Electronic Mechanical & Optical Components
336-340 Canal St., New York 13, N. Y. ALL PRICES F.O.B. N. Y. CITY
**REAL VALUES!**

**CATHODE RAY TUBES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3FP7</td>
<td>$1.95</td>
</tr>
<tr>
<td>5CF1</td>
<td>$4.95</td>
</tr>
<tr>
<td>4AP10</td>
<td>$2.95</td>
</tr>
<tr>
<td>5CF2</td>
<td>$3.95</td>
</tr>
<tr>
<td>16D6-6</td>
<td>$19.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>T58/A7</td>
<td>$1.95</td>
</tr>
<tr>
<td>B56</td>
<td>$2.95</td>
</tr>
<tr>
<td>B107</td>
<td>$3.95</td>
</tr>
<tr>
<td>B192</td>
<td>$3.95</td>
</tr>
<tr>
<td>B18A</td>
<td>$5.95</td>
</tr>
<tr>
<td>B116</td>
<td>$7.95</td>
</tr>
<tr>
<td>B118</td>
<td>$9.95</td>
</tr>
<tr>
<td>B196</td>
<td>$11.95</td>
</tr>
<tr>
<td>B189</td>
<td>$15.95</td>
</tr>
</tbody>
</table>

**PRICES UPON REQUEST**

All kinds of dynamos and inverters in stock—write Today!

We carry a complete stock of electronic equipment.

A copy of our new bulletin is available upon request.

Shipment FOB warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance. Prices subject to change without notice.

---

**SCF 625**

**FAMOUS ARMY MINE DETECTORS**

for prospectors—miners—oil companies—plumbers—etc.—etc.

This unit is being offered now as a considerable reduction in price. Recently advertised at $275.00. It is now available in the same high grade form as before.

**SCF 625**

Immediate delivery from our stock of over 250,000.

- Wide assortment from 0.2 to 300,000 ohms.
- **ENAMEL-GLASS FIXED-ADJUSTABLE**
- **New and in perfect condition.**
- Nearly all made to JAN specification.

For Catalog.

Universal Marine & Mfg. Corp.

127 Alexander St.

Yonkers 2, N. Y.

---

**SEARCHLIGHT SECTION**

- **SELENIUM RECTIFIERS**
  - Full-Wave Bridge Types
  - Current (cont.)
  - Volts
  - Volts
  - Volts
  - 1 Amps.
    - 5.00
    - 7.50
  - 2 Amps.
    - 5.25
    - 7.75
  - 5 Amps.
    - 5.50
    - 8.00
  - 10 Amps.
    - 6.00
    - 9.50
  - 15 Amps.
    - 6.50
    - 10.00
  - 20 Amps.
    - 7.00
    - 12.50
  - 30 Amps.
    - 7.50
    - 15.00
  - 40 Amps.
    - 8.00
    - 20.00

- **NEW, SELENIUM RECTIFIERS, TRANSFORMERS**
  - Pri: 110 V, 60 cycle in
    - 1 amp. 46 V
    - 1.50 V
    - 3.00 V
    - 150 V

- **DESIGNED**
  - for bridge or center-tap use
  - These transformers are not surplus, but are made to our specification by a leading mfr.

**QUALITY, TESTED TUBES**

- **NEW & GUARANTEED**
  - Complete listing of all 10,000 Stocks.
  - Write for price quotation.

**ARROW SALES, INC.**

Dept. 66

1712-14 S. Michigan Ave., Chicago 16, Ill.

PHONE: Harrison 7-9374

---

**Small Lot Sale**

**ARMY & AIR FORCE**

Surplus Radio & Electronic’s

**JANUARY 15, 1952**

Due to our inability to procure sufficient merchandise for continued operation, we are liquidating our entire stock of surplus consisting of approximately

300 tons of equipment!

**Inspection dates January 12th to January 15th at 1 PM—when bids will be opened.**

**FURTHER PARTICULARS may be had by calling Mr. Strickland, Jacksonville, Fla. Phone 3-0410 or Mr. Stephens at Jacksonville Beach, Fla. Phone 5-4893. Call either at Jacksonville 3-8686.**

**EAST COAST RADIO CO.**

IMESON AIRPORT, JACKSONVILLE, Fla.
commercial buyers' tubes
available from stock:

1A3  6AK5  6SH7
1L4  6AQ5  6DJ7
1R4  6C5  6SK7
1R5  6F6  6SL7GT
155  6H6  6SN7GT
174  6JS  6V6GT
354  6J6  6X5GT
5U4G  6K7  6Y6G
5Y3GT  1.65  12AX7
5Z3  6L6GA  12SG7
6A7  6L7  81
6AC7  6Q7  42
6AG5  6SC7  450TH
6AG7  6SF5  80

western engineers ltd.
box 5

ELK GROVE, CALIF. TEL: 129 J

Look! Been Searching for Any of These?
New and Used Electronics Equipment

receivers
BC-453 Range Band  $22.50
BC-454 3-6 MC  ......  8.50
BC-455 6.9 MC  ......  8.50
BC-433G Compass  ......  22.50
BC-357 Marker Beacon  ......  9.75
BC-733D Localizer  ......  24.50

Dynamotors—All New
DM-32A .850 PE-86 .500
DM-33A .850 PE-94C .500

BC-347 Interphone Amplifier—
New  .... $2.95
BC-212 Interphone Amplifier—
New  .... 3.50
BC-442 Antenna Relay  ......  3.75
BC-929 Scope Indicator—New  ......  18.00
BC-450 3 Rec. Control Box—
New  ......  4.50
CD-307 Extension Cord—New  ......  1.25
AT-2A/AN-2 Antenna—
New  ......  4.50
AN-104A Antenna—New  ......  1.50
LC-98 Type Cert. Jack Box  ......  25.00
LC-99 Type Cert. Intercom.
Box  ......  12.50
AM-5A/APS-4 Control Box
Less Tubes  ......  3.50
AS-69/APT Antenna—New  ......  6.25
AT-39A/ANTENNA Antenna—
New  ......  6.25

dave rumph co.
PO. BOX 4178
FORT WORTH, TEXAS

panel meters
large stocks—guaranteed accuracy
complete conversion facilities,
special scales, special design,
calibration, maintenance, complete standard
special offerings—panel meters

sun
2'RD 0-300 V.D.C. 1000
G.E. 2'RD 0-30 amp D.C. 4.95
DEJUR 2'RD 0-500 Microamp D.C. 3.95
G.E. 2'RD 0-300 Milliamp D.C. 4.95
SIMPSON 2'RD 0-1000 Milliamp D.C. 6.95
WESTON Ltd. 3'RD 0-500 Milliamp F.C. 4.45
G.E. 3'RD 0-15 Milliamp F.C. 6.95
WESTHS 3'RD 0-3000 Milliamp D.C. 9.95
special offering—lab test equip.
gen. rdio b.f.o. no. 716 150.00
leeds northrup—hoops conductivity
bridge 500.00

special offering—portable lab
new standards
weston 280 1% Manuals & Ranges
3 A, 35 A, 70 A, 300 A
3'V. 15 V, 150 V D.C.
large selection of weston
sensitive research, g. e.
westinghouse lab. standards
inquiries promptly answered
american electrics
29 so. park ave., rockville center, l. i., n. y.
gu-6-2007

January, 1952—electronics
STEVE-EL IS your RELIABLE source for SPECIAL PURPOSE & TRANSMITTING TUBES

All tubes are standard brands and fully guaranteed!

STEVE-EL ELECTRONICS CORP.
Dept. EL-1
61 Reade St., N. Y. 7, N. Y.

Visit our NEW store

For sale
1 REL Model 600 FM Broadcast Modulation and Frequency Monitor
Like new, Frequency of monitor: 100.3 mc. Cost $795. With service for $550. Contact: L. C. Barnes, Los Angeles 28

WESTINGHOUSE HIPERSIL CORES

Strip Build Window Window Quantity Gauge Width Up Width Height
11,365 .003 1 1/2 7/16 3
3,740 .003 1 1/8 7/16 3

Available for immediate delivery

Portable Instruments
Molded Bakelite case 7" x 4 1/2" x 3" D.C. MICROAMMETERS
3. 5 . 10 microamperes
THERMOCOUPLE MILLIAMMETERS
1.5 .5 .10 milliamperes
THERMOCOUPLE VOLTMETERS
4 to 500 volts

Available in multiple range combinations

Berlin Electric Instrument Co.
146 Grand Street
New York 13, N. Y.

DEPENDABILITY IN ELECTRONICS.
WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.

STEVE-EL ELECTRONICS CORP.
Dept. EL-1
61 Reade St., N. Y. 7, N. Y.

Visit our NEW store

For sale
1 REL Model 600 FM Broadcast Modulation and Frequency Monitor
Like new, Frequency of monitor: 100.3 mc. Cost $795. With service for $550. Contact: L. C. Barnes, Los Angeles 28

WESTINGHOUSE HIPERSIL CORES

Strip Build Window Window Quantity Gauge Width Up Width Height
11,365 .003 1 1/2 7/16 3
3,740 .003 1 1/8 7/16 3

Available for immediate delivery

Portable Instruments
Molded Bakelite case 7" x 4 1/2" x 3" D.C. MICROAMMETERS
3. 5 . 10 microamperes
THERMOCOUPLE MILLIAMMETERS
1.5 .5 .10 milliamperes
THERMOCOUPLE VOLTMETERS
4 to 500 volts

Available in multiple range combinations

Berlin Electric Instrument Co.
146 Grand Street
New York 13, N. Y.

DEPENDABILITY IN ELECTRONICS.
WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.

STEVE-EL ELECTRONICS CORP.
Dept. EL-1
61 Reade St., N. Y. 7, N. Y.

Visit our NEW store

For sale
1 REL Model 600 FM Broadcast Modulation and Frequency Monitor
Like new, Frequency of monitor: 100.3 mc. Cost $795. With service for $550. Contact: L. C. Barnes, Los Angeles 28

WESTINGHOUSE HIPERSIL CORES

Strip Build Window Window Quantity Gauge Width Up Width Height
11,365 .003 1 1/2 7/16 3
3,740 .003 1 1/8 7/16 3

Available for immediate delivery

Portable Instruments
Molded Bakelite case 7" x 4 1/2" x 3" D.C. MICROAMMETERS
3. 5 . 10 microamperes
THERMOCOUPLE MILLIAMMETERS
1.5 .5 .10 milliamperes
THERMOCOUPLE VOLTMETERS
4 to 500 volts

Available in multiple range combinations

Berlin Electric Instrument Co.
146 Grand Street
New York 13, N. Y.

DEPENDABILITY IN ELECTRONICS.
WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.

STEVE-EL ELECTRONICS CORP.
Dept. EL-1
61 Reade St., N. Y. 7, N. Y.

Visit our NEW store

For sale
1 REL Model 600 FM Broadcast Modulation and Frequency Monitor
Like new, Frequency of monitor: 100.3 mc. Cost $795. With service for $550. Contact: L. C. Barnes, Los Angeles 28

WESTINGHOUSE HIPERSIL CORES

Strip Build Window Window Quantity Gauge Width Up Width Height
11,365 .003 1 1/2 7/16 3
3,740 .003 1 1/8 7/16 3

Available for immediate delivery

Portable Instruments
Molded Bakelite case 7" x 4 1/2" x 3" D.C. MICROAMMETERS
3. 5 . 10 microamperes
THERMOCOUPLE MILLIAMMETERS
1.5 .5 .10 milliamperes
THERMOCOUPLE VOLTMETERS
4 to 500 volts

Available in multiple range combinations

Berlin Electric Instrument Co.
146 Grand Street
New York 13, N. Y.

DEPENDABILITY IN ELECTRONICS.
WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.

STEVE-EL ELECTRONICS CORP.
Dept. EL-1
61 Reade St., N. Y. 7, N. Y.

Visit our NEW store

For sale
1 REL Model 600 FM Broadcast Modulation and Frequency Monitor
Like new, Frequency of monitor: 100.3 mc. Cost $795. With service for $550. Contact: L. C. Barnes, Los Angeles 28

WESTINGHOUSE HIPERSIL CORES

Strip Build Window Window Quantity Gauge Width Up Width Height
11,365 .003 1 1/2 7/16 3
3,740 .003 1 1/8 7/16 3

Available for immediate delivery

Portable Instruments
Molded Bakelite case 7" x 4 1/2" x 3" D.C. MICROAMMETERS
3. 5 . 10 microamperes
THERMOCOUPLE MILLIAMMETERS
1.5 .5 .10 milliamperes
THERMOCOUPLE VOLTMETERS
4 to 500 volts

Available in multiple range combinations

Berlin Electric Instrument Co.
146 Grand Street
New York 13, N. Y.

DEPENDABILITY IN ELECTRONICS.
WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.
**WANTED**

**Your Surplus Laboratory Equipment, Tubes and Parts**

Particularly items of good quality—Boonton, Ferris, L&N, G-R, etc.

Also MILITARY SURPLUS items, such as ARC-1, ARC-3, ART-13, APR-1, APR-4, APR-5A, BC-646, etc. Transmitters, Receivers and components; TS-24 and other "TS"; "EE" and other Test Equipment needed, particularly for the Microwave region; also all kinds of quantity stocks of tubes, meters, spares parts and wire. SEND NOW during this period of temporary shortage, obtain top price and aid the defense effort.

**EDUCATIONAL INSTITUTIONS**

We buy for cash, or will trade for equipment you need.

We specialize in reconditioning and assembling complete sets of equipment for use in the nation's laboratories and factories. We can, for instance, supply complete APR-4 RECEIVING EQUIPMENT, with continuous coverage of the frequency range 38-4,000 Mc; technical details and quotations furnished upon request.

**ENGINEERING ASSOCIATES**

434 Patterson Road Dayton 9, Ohio

**GET OUR PRICE for your**

**RADIO & AIRCRAFT EQUIPMENT**

We'll do our best to buy your parts or equipment. Send us a description of the type and condition of the equipment you wish to sell, what you think it's worth, and we'll make you a firm offer. We will explain the conditions under which we would buy and be pleasantly surprised at the first action you'll get.

**HARJO SALES CO., Suite 312**

341 S. Vermont Ave., Los Angeles 5, Calif.

**WANTED**

**WE NEED YOUR SURPLUS ELECTRONIC COMPONENTS OR EQUIPMENT**

**WE PAY TOP$$$$$$ FOR:**

- Radio Components: Wire & Cable
- Instruments: Selsyns or Relays
- Tubes: Synchros and Special Purpose
- Signal Corps: Autoprops
- Equipment: Motors or Generators
- Receivers: Transformers
- Test Equipment: Air Cooled

**TECHNICAL MATERIALS COMPANY**

104 Pearl Street Boston 10, Mass.

**WANTED**

**YOUR SPARE SURPLUS EQUIPMENT**

**DYNAMOTORS • SELSYN • AUTOSYN • INVERTERS • TRANSMITTERS • RECEIVERS • TEST EQUIPMENT**

Please send list stating condition and lowest price. No Quantity Too Small or Too Large!

**C & H SALES COMPANY**

BOX 356-SE EAST PASADENA STATION • PASADENA 6, CALIFORNIA

**WANTED**

**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:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>CONDITION</th>
<th>PRICE WANTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To: COLUMBIA ELECTRONICS LTD., 524 S. San Pedro St., Los Angeles 13, Calif.

Name

Address

SEE COLUMBIA ELECTRONICS AD ON PAGE 349

**WANTED**

**PARTS**

**HEADSET **

**HANDSET **

**BANDS **

**UNITS **

**CAPS **

**CORDS **

**UNITS**

**WESTERN ENGINEERS LTD.**

Box 5 Elk Grove, Calif.

**AARON**

**ELECTRONIC SALES**

moved to new quarters:

6025 MT. ELLIOTT

DETROIT, MICH.

Tel: WA Inut 1-8481

Try us for hard-to-get electronic test equipment, transmitters, receivers, etc.

We BUY and SELL all types of electronics.

**WANTED**

**QUARTZ CRYSTAL UNITS**


**WE BUY**, Electronics

330 W. 43 St., New York 18, N. Y.

**WANTED**

**MICROWAVE**

**ATTN: JOE ANZINO**

642 East 230 St., Bronx 66, New York

**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**

4949 Washington Ave. Little Ferry, N. J.
FOR QUICK ACTION

Any Kind of Electronic Equipment

WE BUY FROM YOU

FOR YOU

WE SELL TO YOU

 spill your Surplus to Green

We buy and sell every type of electronic material,
including war surplus. Let us submit our bid for
your surplus today. You will not be disappointed.

SOLDIERS 40-45 surplus base, 1217 Kester Ave.,
Yellow Kester, 532-2423.

SOLDERS 40-45 surplus base, 1281 Kester Ave.,
1291 Kester, 532-2423.

RESISTORS: precision wire-wound, standard Brand
(1000), vacuum, 1000, 10,000, 100,000 ohms;
plastic, bakelite, metalized. Select at standard
prices and save. Write for complete list of
capacitors, resistors, etc. Write today.

RESISTANCE WIRE: 250 ohm units for lots of
5000 units each. Write for details. No. 250-
ohm bulk. Write for details. No. 250-
ohm bulk.

CABLES: rubber, insulated, 200 ohm, all sizes.
Write for complete list.

INVESTMENT: we have surplus lots of capacitors,
standard, vacuum, bakelite, metalized, with
value. Prices, by lot or by piece.

TUBULAR CONDENSERS, STANDARD BRAND.
Q1, 400V, 1200, 2000, 2250, 2200, 8000, 2000, 1000
per 125 VAC, 250 VAC, 250 VAC, 250 VAC,
2000 VAC, 125 VAC, 125 VAC, 125 VAC.

SPLIT-TUBE CAPACITORS: have same style &
values, vacuum, standard value. Write for
details, prices, etc. By piece or by lots.

SALT HAVES: bulk packs - new or used.

SOLIDS: B2, C2, N, Tap-ex. Prices: $15.00 per
Doz.

DRIED MILLS: 250, 3600, 3200, 2000, 1900,
5000, 2000, 8000, 5000, 2000, 8000, 5000,
2000, 8000, prices vary by size.

SOLDER: 500, 1000, 2000, 2200, 2250, 2200,
2000, 8000, 2000, 8000, prices vary by size.

SALTS: B2, C2, N, Tap-ex: $15.00 per
Doz.

SPLIT-TUBE CAPACITORS: have same style &
values, vacuum, standard value. Write for
details, prices, etc. By piece or by lots.

SALT HAVES: bulk packs - new or used.

SOLIDS: B2, C2, N, Tap-ex. Prices: $15.00 per
Doz.

DRIED MILLS: 250, 3600, 3200, 2000, 1900,
5000, 2000, 8000, 5000, 2000, 8000, 5000,
2000, 8000, prices vary by size.

SOLDER: 500, 1000, 2000, 2200, 2250, 2200,
2000, 8000, 2000, 8000, prices vary by size.

SALTS: B2, C2, N, Tap-ex: $15.00 per
Doz.

WANTED

Any quantity of C6L or C6L Electron Tubes
as manufactured by Electronics, Inc., also Jesse
Hughes C6L, C6L, C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L, 3C6L,
ELECTRO—THE BEST FOR ELECTRONIC SURPLUS

WIRE-WOUND RESISTORS

<table>
<thead>
<tr>
<th>Type</th>
<th>Watts</th>
<th>Resistance</th>
<th>Choice</th>
<th>Voltage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-111</td>
<td>5</td>
<td>5000, 50K</td>
<td>Choice</td>
<td></td>
<td>SPST-NO</td>
</tr>
<tr>
<td>2000-83</td>
<td>5</td>
<td>5000, 10K</td>
<td>Choice</td>
<td>60VDC</td>
<td>SPDT</td>
</tr>
<tr>
<td>2000-101</td>
<td>5</td>
<td>5000, 20K</td>
<td>Choice</td>
<td>60VDC</td>
<td>SPDT</td>
</tr>
<tr>
<td>2000-112</td>
<td>5</td>
<td>5000, 50K</td>
<td>Choice</td>
<td>60VDC</td>
<td>SPDT</td>
</tr>
<tr>
<td>2000-113</td>
<td>5</td>
<td>5000, 100K</td>
<td>Choice</td>
<td>60VDC</td>
<td>SPDT</td>
</tr>
</tbody>
</table>

EQUIPMENT SPECIALS

- Converters: Choose from a variety of types and values.
- Transformers: Suitable for use in various applications.
- Inductors: Available in a range of sizes.
- Reactors: Perfect for specific electronic needs.

RELAYS

- Auto Look, R3HJ, 6500 Ohms. DIA, SPDT 1NO, 1NC, 3A, 125VAC, $1.95
- Guardian 120VAC-DC, SPDT, 5A, $1.35

INSULATED TUBING

- Size I.D. Color Type Per 100* For 100* *
- 1/4" Clear Green $0.25 $1.50
- 1/4" Clear Blue $0.25 $1.50
- 1/4" Black $0.25 $1.50
- 3/8" Clear Green $0.30 $1.80
- 3/8" Clear Blue $0.30 $1.80
- 3/8" Black $0.30 $1.80

*Prices subject to change without notice.

**Insulated tubing is available in various colors and sizes.**
SOLDERING IRON GUN
SENSATIONAL VALUE, LIGHTWEIGHT, POWERFUL, with removable all-metal tipped gun. Fully automatic...ideal for reversing sw. Ideal for heavy work. Special...

SOLDERING LUGS

METER SPECIALS

NEW THRIFT-LITE LIFETIME PHOTO-FLASH

NEW "TAB" TESTED & GUARANTEED

"TAB" THOUGH NOT A BUY

DEPT. 16, SIX CHURCH ST., NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS.

January, 1952 — ELECTRONICS
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambda Electronics Corporation</td>
<td>277</td>
</tr>
<tr>
<td>Lampkin Laboratories, Inc.</td>
<td>278</td>
</tr>
<tr>
<td>Lampkin-Plastics Corp. (Vee-D-X)</td>
<td>279</td>
</tr>
<tr>
<td>Lapp Insulator Co., Inc.</td>
<td>280</td>
</tr>
<tr>
<td>Lewis &amp; Northrup Co.</td>
<td>281</td>
</tr>
<tr>
<td>Lenski Electric Sales Company</td>
<td>282</td>
</tr>
<tr>
<td>Less</td>
<td>283</td>
</tr>
<tr>
<td>Lettine Radio Mfg. Co.</td>
<td>284</td>
</tr>
<tr>
<td>Lewis Engineering Co.</td>
<td>285</td>
</tr>
<tr>
<td>Lewis &amp; Kaufman, Inc.</td>
<td>286</td>
</tr>
<tr>
<td>Lewis Spring &amp; Manufacturing Co.</td>
<td>287</td>
</tr>
<tr>
<td>Lord Manufacturing Company</td>
<td>288</td>
</tr>
<tr>
<td>Magnecord, Inc.</td>
<td>289</td>
</tr>
<tr>
<td>Mallory and Company, Inc., P. R.</td>
<td>290</td>
</tr>
<tr>
<td>Manson Laboratories</td>
<td>291</td>
</tr>
<tr>
<td>Markem Machine Company</td>
<td>292</td>
</tr>
<tr>
<td>Mils Manufacturing Company</td>
<td>293</td>
</tr>
<tr>
<td>Murbon Electrical Instrument Co.</td>
<td>294</td>
</tr>
<tr>
<td>Nabco Mill Book Co.</td>
<td>295</td>
</tr>
<tr>
<td>Mergel, Inc.</td>
<td>296</td>
</tr>
<tr>
<td>Metal</td>
<td>297</td>
</tr>
<tr>
<td>Metal Textile Corporation</td>
<td>298</td>
</tr>
<tr>
<td>Metals &amp; Control Corp., General Plate</td>
<td>299</td>
</tr>
<tr>
<td>Div.</td>
<td>300</td>
</tr>
<tr>
<td>Methylene Manufacturing Corp.</td>
<td>301</td>
</tr>
<tr>
<td>Mics Insulator Company</td>
<td>302</td>
</tr>
<tr>
<td>Micro Instrument Co.</td>
<td>303</td>
</tr>
<tr>
<td>Miron Switch, Div. of Minneapolis-Honeywell Regulator Co.</td>
<td>304</td>
</tr>
<tr>
<td>Miles Reproducer Co.</td>
<td>305</td>
</tr>
<tr>
<td>Milten Mfg. Co., Inc., James</td>
<td>306</td>
</tr>
<tr>
<td>Miller Company, J. W.</td>
<td>307</td>
</tr>
<tr>
<td>Miller Radio &amp; Electronics Corp.</td>
<td>308</td>
</tr>
<tr>
<td>Minneapolis-Honeywell Regulator Co.</td>
<td>309</td>
</tr>
<tr>
<td>Industrial Division</td>
<td>310</td>
</tr>
<tr>
<td>Mitchell-Hamood Insulation Co., Inc.</td>
<td>311</td>
</tr>
<tr>
<td>Modern Paper Mills Company</td>
<td>312</td>
</tr>
<tr>
<td>National Manufacturing Co.</td>
<td>313</td>
</tr>
<tr>
<td>National Manufacturing Co., Ltd</td>
<td>314</td>
</tr>
<tr>
<td>National Research Corporation</td>
<td>315</td>
</tr>
<tr>
<td>Neeley Enterprises</td>
<td>316</td>
</tr>
<tr>
<td>Neo-Sil Corporation</td>
<td>317</td>
</tr>
<tr>
<td>Neumann Audio Products Co.</td>
<td>318</td>
</tr>
<tr>
<td>New Hampshire Rail Haulings, Inc.</td>
<td>319</td>
</tr>
<tr>
<td>New Hermes, Inc.</td>
<td>320</td>
</tr>
<tr>
<td>New York Transformer Co., Inc.</td>
<td>321</td>
</tr>
<tr>
<td>Ney Company, J. M.</td>
<td>322</td>
</tr>
<tr>
<td>North American Aviation, Inc.</td>
<td>323</td>
</tr>
<tr>
<td>Northern Radio Co., Inc.</td>
<td>324</td>
</tr>
<tr>
<td>Nomex Winding Laboratories</td>
<td>325</td>
</tr>
<tr>
<td>Nuclear Research Corporation</td>
<td>326</td>
</tr>
<tr>
<td>Numatex</td>
<td>327</td>
</tr>
<tr>
<td>Numberall Stamp &amp; Tool Co.</td>
<td>328</td>
</tr>
<tr>
<td>Offer Electronics, Inc.</td>
<td>329</td>
</tr>
<tr>
<td>Panoramic Radio Products, Inc.</td>
<td>330</td>
</tr>
<tr>
<td>Panoramic Testing Laboratory</td>
<td>331</td>
</tr>
<tr>
<td>Phalo Plastics Corp.</td>
<td>332</td>
</tr>
<tr>
<td>Philco Corporation</td>
<td>333</td>
</tr>
<tr>
<td>Pickering &amp; Co., Inc.</td>
<td>334</td>
</tr>
<tr>
<td>Pit Manufacturing Co. Inc.</td>
<td>335</td>
</tr>
<tr>
<td>Polaroid Electronics Corp.</td>
<td>336</td>
</tr>
<tr>
<td>Potter Instrument Co., Inc.</td>
<td>337</td>
</tr>
<tr>
<td>Precision Apparatus Co., Inc.</td>
<td>338</td>
</tr>
<tr>
<td>Precision Paper Tape Co.</td>
<td>339</td>
</tr>
<tr>
<td>Precision Products, Div. Chelium.</td>
<td>340</td>
</tr>
<tr>
<td>Premax Products, Inc.</td>
<td>341</td>
</tr>
<tr>
<td>Pyramid Electric Co.</td>
<td>342</td>
</tr>
<tr>
<td>Radiation Co.</td>
<td>343</td>
</tr>
<tr>
<td>Radio Corp. of America</td>
<td>344</td>
</tr>
<tr>
<td>Radio Materials Corporation</td>
<td>345</td>
</tr>
<tr>
<td>Radio Receiving Company, Inc.</td>
<td>346</td>
</tr>
<tr>
<td>Radio Shack Corporation</td>
<td>347</td>
</tr>
<tr>
<td>Radio Wire Television Incorporated</td>
<td>348</td>
</tr>
<tr>
<td>Rahm Instruments, Inc.</td>
<td>349</td>
</tr>
<tr>
<td>Rahm Manufacturing Co., Air Express Division</td>
<td>350</td>
</tr>
<tr>
<td>Rand McNally</td>
<td>351</td>
</tr>
<tr>
<td>Railway Division, of &quot;S&quot; Copper Products Co.</td>
<td>352</td>
</tr>
<tr>
<td>Robinson Company</td>
<td>353</td>
</tr>
<tr>
<td>Robinson Engineering Co.</td>
<td>354</td>
</tr>
<tr>
<td>Resistance Products Co.</td>
<td>355</td>
</tr>
<tr>
<td>Revere Copper &amp; Brass, Inc.</td>
<td>356</td>
</tr>
<tr>
<td>Rex Corporation</td>
<td>357</td>
</tr>
<tr>
<td>Richter Inc., Edward E</td>
<td>358</td>
</tr>
<tr>
<td>Ruckers Products Corporation</td>
<td>359</td>
</tr>
<tr>
<td>Railroad Station Corporation</td>
<td>360</td>
</tr>
<tr>
<td>Rome Cable Corporation</td>
<td>361</td>
</tr>
<tr>
<td>Ruhnke &amp; Co.</td>
<td>362</td>
</tr>
<tr>
<td>Sanborn Company</td>
<td>363</td>
</tr>
<tr>
<td>Scientific Electrical Div. of &quot;S&quot; Corrugated</td>
<td>364</td>
</tr>
<tr>
<td>Quenched Gap Co.</td>
<td>365</td>
</tr>
<tr>
<td>Scientific Materials Division of Bendix Aviation Corp.</td>
<td>366</td>
</tr>
<tr>
<td>Scotch Tape, Inc.</td>
<td>367</td>
</tr>
<tr>
<td>Secon Metals Corporation</td>
<td>368</td>
</tr>
<tr>
<td>Seely-Whitehouse, Inc.</td>
<td>369</td>
</tr>
<tr>
<td>Sessions Clock Company, Timer Div</td>
<td>370</td>
</tr>
<tr>
<td>Snap-proof</td>
<td>371</td>
</tr>
<tr>
<td>UNITED STATES GASKET COMPANY</td>
<td>372</td>
</tr>
<tr>
<td>FLUOROCARBON PRODUCTS DIVISION</td>
<td>373</td>
</tr>
<tr>
<td>600 N. 10TH STREET, CAMDEN, N.J.</td>
<td>374</td>
</tr>
<tr>
<td>FOREMOST FABRICATORS OF &quot;TEFLON&quot; AND OTHER FLUOROCARBON PLASTICS</td>
<td>375</td>
</tr>
</tbody>
</table>

---

**Metal Faced TEFiT**

- Here is the answer to the bonding and hermetic sealing of dielectric materials to metal components.

Chemelec Multi-Bond is metal faced pure or filled TEFoton, produced by an exclusive (patents pending) method of uniting fluorocarbon resins and metals with an interlocking bond unaffected by severe mechanical shock, vibration and unequal rates of thermal expansion.

The bond is micro-crystalline in structure and gradually changes from dielectric to metal, the conducting metal surface being applied by electro-deposition or other conventional means.

Facing metals include practically all the ferrous and non-ferrous metals, the ferro magnetic group and the precious metals.

Sheets are available, metal faced one on both sides, in thickness from .034 to 1.75 in. and in sizes up to 36 in. square.

Write for Bulletin MI-424.

*The trademark for its tetrafluoroethylene resin.
THE NEW "PRECISION" CR-30 CATHODE RAY TUBE TESTER

A complete and self-contained Electronic Instrument, incorporates a TRUE BEAM CURRENT Test Circuit. Checks overall electron-guns performance for proportionate picture brightness. Additional tests for accelerating anodes and deflection plate elements.

The CR-30 should not be confused with more 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 set.
★ 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 a cathode emission) which is the pattern on the face of the CR tube. The significance of the above is that the fact that Beam Cathode (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 superior tube quality indications and positive check of low current anodes and deflection plates.
★ Micro-Line Voltage Adjustment Meter-monitored at filament.
★ Accuracy of test circuits closely maintained by use of factory adjusted internal carefully controlled calibration, plastic insulated, telephone type cables using highest quality, conservatively rated components.
★ Built in, High Speed, Roll-Gain Tube Chart.
★ Test Circuits Transformer Isolated from Power Line.
★ 4¾" Full Vision Meter with scale-plate especially designed for CR tube testing requirements.
★
★ SERIES CR-30—In hardworn, taped portable case, 17¾" x 13¾" x 6¼". Complete with standard 12 pin tube cable and universal CR Tube Test Cable.

Shipping Weight: 22 lbs. 
Not Price: $99.75

See the new CR-10 on display at leading electronics equipment distributors. Place your orders now to assure earliest possible delivery.

Precision Apparatus Co., Inc.
97-27 HORECE HABING BLVD.
ELMWOOD PARK, N. J.

Export: 145 W. WY., N.Y., U.S.A. Cabin: MOHAN
In Canada: Atlas Radio Corp. Ltd., Toronto, Ontario

ADVERTISERS INDEX

Bendix Aviation Corp.
318
Berkley Scientific Laboratories
232
Beverly, Inc.
322
Burke, Hubert J.
364
Carpenter-Parnsworth Corp.
353
C. E. S. Sales Co.
353
Chase Electronics Supply Co.
353
Columbia Electronics Co.
353
Comet Electric Sales Co.
359
Company Communications
317
Communications Devices
317
Components Supply Co.
358
Convar
317
Coral Aircraft Electronics Co.
317
Cottone & Co., A.
356
Crewe, Inc.
317
East Coast Radio Co.
361
Edie Electronics, Inc.
361
Electric Impulse Laboratory
349, 360
Electro Sales Co.
356
Electro Engineering Co. of Calif.
319
Electro Experimenter
332
Electronic Spec. Supply Co.
232
Electronic Surplus Brokers
365
Electronics Inc.
365
Emmons Radio Supply Co.
317
Empire Electronics Co.
317
Leveray Manufacturing Co.
364
Forest Sales Co., Inc.
356
Franklin Employment Testing, Inc.
317
General Electric Company
320
General Motors Corp., AC Spark Plug Div.
362, 365
General Surplus Trading
362, 365
Globe Trading Co., Ltd.
362, 365
Goodyear Aircraft Corp.
362, 365
Green, Gould
362, 365
Green, Leonard
362, 365
Hall Electric, Ltd.
356
Harjo Sales
312
Harwood Co., W.
345
Hatty & Young
345
Hurt, Inc.
345
I. B. M.
317
Instruments Associates
358
J.S.H. Sales Co.
358
Key Electronics Div.
358
Kings County Machinery Exchange
352, 364, 365
K M P.
356
Laron Products
324, 365
Larc Electronics Supply
360
Liberty Electronics, Inc.
318
Lincoln Aircraft Co.
332
Lowenthal, Co. T. R.
355
Lowenthal, International Co.
355
Maritime Switchboard
355
Mason Corp., The W. L.
355
Metropolitan Overseas Supply Co.
361
Microwave Equipment Supply Co.
364
Miniature Honeycomb Co.
318
Mogull, Co., Inc.
348
Monmouth Radio Laboratories
317
Monsanto Chemical Co.
321
Niagara Radio Supply Co.
321
Nokia Electronic Corp.
350
Norman Radio Distributors, Inc.
363
Norblin Aircraft, Inc.
363
Oceanside Sales
360
Photonic Sales
360
P. & D. Electro Electronics
360
Poeuling, Harold H.
328, 329
Price Electrical Instrument Co.
320
Radio Development
360
Radio Development
360
Radio & Electronic Supply
360
Radio Shack
360
Radio Supply Corp
364
Raychem Mfg. Co.
364
Relay Sales
364
Rep. Merchandise Co.
364
Rump Co., David
362
Sandia Corp.
362
Service Parts Div., Inc.
360
Signal Corps Center & Fort Monmouth
362
Steve El Electronics Corp.
363
Steve El Electric...
363
Tab Electronics Co.
361
THERMO MACH II
361
Technical Radio Parts Co.
365
Teledural Communications Co.
360
Tecumseh Inc.
361
Turner Co.
367
Union Carbide
367
Universal Marine & Mfg. Corp.
361
University of Iowa, Shop Supply
361
V & H Radio Supply Co.
351
Western Distributing Co., The
360
Western Engineers Ltd.
360, 362, 364
Wescon Laboratories
362
Wescott Electric Co.
362
Wildwood Industries
333
Wilkerson, Edward
317
Workshop Associates
317
Zied, Julius
360

This index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

January, 1952 — ELECTRONICS
For many years Daven has been 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.

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 ±2% 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.

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.
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 400 V, 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.