for MINIATURIZED COMPONENTS

The constant miniaturization of military and portable civilian gear has required audio components of smaller and smaller dimension. This is particularly exaggerated in the case of transformers for use in transistor circuits. The "H" series of miniature and sub-miniature transformers described below are hermetic military types to cover virtually all audio applications. For even smaller structures our ultra-miniature types are available against quantity orders.

from STOCK

MINIATURE AUDIO UNITS...RCOF CASE

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Application</th>
<th>MIL Type</th>
<th>Pri. Imp. Ohms</th>
<th>Sec. Imp. Ohms</th>
<th>DC in Pri., MA ± 50b. (Cyc.)</th>
<th>Response 300-10,000</th>
<th>Max. level dBm</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Mike, pickup, line to grid</td>
<td>TFA100Y</td>
<td>50,000</td>
<td>0</td>
<td>50-10,000</td>
<td>+5</td>
<td>$16.50</td>
<td></td>
</tr>
<tr>
<td>H-2</td>
<td>Mike to grid</td>
<td>TFA110Y</td>
<td>82</td>
<td>0</td>
<td>250-8,000</td>
<td>+21</td>
<td>16.00</td>
<td></td>
</tr>
<tr>
<td>H-3</td>
<td>Single plate to single grid</td>
<td>TFA130Y</td>
<td>15,000</td>
<td>0</td>
<td>50-10,000</td>
<td>+6</td>
<td>13.50</td>
<td></td>
</tr>
<tr>
<td>H-4</td>
<td>Single plate to single grid, DC in Pri.</td>
<td>TFA150Y</td>
<td>15,000</td>
<td>4</td>
<td>200-10,000</td>
<td>+14</td>
<td>13.50</td>
<td></td>
</tr>
<tr>
<td>H-5</td>
<td>Single plate to P.P. grids</td>
<td>TFA150Y</td>
<td>15,000</td>
<td>50</td>
<td>50-10,000</td>
<td>+11</td>
<td>16.00</td>
<td></td>
</tr>
<tr>
<td>H-7</td>
<td>Single plate to P.P. grids</td>
<td>TFA130Y</td>
<td>20,000</td>
<td>4</td>
<td>200-10,000</td>
<td>+21</td>
<td>16.50</td>
<td></td>
</tr>
<tr>
<td>H-8</td>
<td>Single plate to line</td>
<td>TFA150Y</td>
<td>150</td>
<td>0</td>
<td>50-10,000</td>
<td>+8</td>
<td>15.50</td>
<td></td>
</tr>
<tr>
<td>H-9</td>
<td>Single plate to line</td>
<td>TFA150Y</td>
<td>600</td>
<td>1</td>
<td>200-3,000 (4db.)</td>
<td>+10</td>
<td>16.50</td>
<td></td>
</tr>
<tr>
<td>H-10</td>
<td>Single plate to line</td>
<td>TFA150Y</td>
<td>15,000</td>
<td>1</td>
<td>200-3,000 (4db.)</td>
<td>+10</td>
<td>15.50</td>
<td></td>
</tr>
</tbody>
</table>

SUBMINIATURE AUDIO UNITS...SM CASE

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Application</th>
<th>MIL Type</th>
<th>Pri. Imp. Ohms</th>
<th>Sec. Imp. Ohms</th>
<th>DC in Pri., MA ± 50b. (Cyc.)</th>
<th>Response 300-10,000</th>
<th>Max. level dBm</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-30</td>
<td>Input to grid</td>
<td>TFA100Y</td>
<td>50**</td>
<td>60</td>
<td>0</td>
<td>150-10,000</td>
<td>+13</td>
<td>$13.00</td>
</tr>
<tr>
<td>H-31</td>
<td>Single plate to grid, DC in Pri.</td>
<td>TFA150Y</td>
<td>10,000</td>
<td>90,000</td>
<td>0</td>
<td>300-10,000</td>
<td>+13</td>
<td>13.00</td>
</tr>
<tr>
<td>H-32</td>
<td>Single plate to line</td>
<td>TFA130Y</td>
<td>10,000***</td>
<td>200</td>
<td>3</td>
<td>300-10,000</td>
<td>+13</td>
<td>13.00</td>
</tr>
<tr>
<td>H-33</td>
<td>Single plate to low impedance</td>
<td>TFA130Y</td>
<td>30,000</td>
<td>50</td>
<td>1</td>
<td>300-10,000</td>
<td>+15</td>
<td>13.00</td>
</tr>
<tr>
<td>H-34</td>
<td>Single plate to low impedance</td>
<td>TFA130Y</td>
<td>100,000</td>
<td>60</td>
<td>.5</td>
<td>300-10,000</td>
<td>+6</td>
<td>13.00</td>
</tr>
<tr>
<td>H-35</td>
<td>Reactor</td>
<td>TFA200Y</td>
<td>100 Henries-0 DC</td>
<td>100 Henries-1 Ma, DC</td>
<td>4,400 ohms.</td>
<td>11.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ULTRA-MINIATURE UNITS TO SPECIFICATIONS ONLY

UTC ultra-miniature units are uncased types of extremely small size. They are made to customers' specifications only, and represent the smallest production transformers in the world. The overall dimensions are 1/2 x 1/4 x 1/4. Weight approximately 1/2 ounces. Special units of this size are noted below:

- Type K-16949 100,000 ohms to 100 ohms . . 6 MW . . 100 to 5,000 cycles.
- Type M-14878 20,000 ohms (1 Ma. DC) to 35 ohms . . 6 MW . . 300 to 5,000 cycles.
- Type M-14879 6 ohms to 10,000 ohms . . 6 MW . . 300 to 5,000 cycles.
- Type M-14880 30,000 ohms (1 Ma. DC) to 3,000 ohms . . 6 MW . . 300 to 5,000 cycles.
- Type M-14881 25,000 ohms (1 Ma. DC) to 1,000 ohms . . 6 MW . . 300 to 5,000 cycles.

* 200 ohm termination can be used for 150 ohms or 250 ohms. 500 ohm termination can be used for 600 ohms.
** can be used with higher source impedances, with corresponding reduction in frequency range. With 200 ohm source, secondary impedance becomes 250,000 ohms . . loaded response is +6 db. at 300 cycles.
*** can be used for 500 ohm load . . 25,000 ohm primary impedance . . 1.5 Ma. DC.

United Transformer Corp.
150 VARICK STREET * NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40TH STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"
MAGNETIC-CORE MEMORY—New coincident-current memory, developed in Digital Computer Laboratory at MIT, uses 256 Ferramic toroids made by General Ceramics & Steatite Corp. For details, see p 146

COVER

FIGURES OF THE MONTH
Includes Electronics Output Index, a business barometer for management

INDUSTRY REPORT
Brings you news, trends and market interpretations

SPIRAL-BEAM TUBE MODULATES 1 KW AT UHF, by C. L. Cuccia
Improved electron coupler may find use in uhf television

PUNCHED TAPE GUIDES MILLING MACHINE CUTTERS, by J. O. McDonough
Costly setup chores are eliminated electrorically

ENERGY LEVELS IN TRANSISTOR ELECTRONICS, by Abraham Koblenz and Harry L. Owens
Second in a series of articles on transistor theory and application

X-RAY ABSORPTION GAGE CHECKS ARTILLERY SHELLS, by George M. Ettinger
Used to find voids in projectile filler, instrument is fast and automatic

FERRITE SPEED DIGITAL COMPUTERS, by David R. Brown and Ernest Albers-Shonberg
New material increases computer speed and reliability

VIDEO INSET SYSTEM, by J. L. Hathaway and F. L. Hatke
Scenery costs can be cut by using miniatures with human actors electronically superimposed

TRANSISTORIZED HEARING AIDS, by James D. Fahnstock
Discusses typical circuits from standpoint of performance and economy

TESTING UHF-TV MIXER CRYSTALS, by Nicholas DeWolf
Laboratory and factory production test methods use standard equipment

R-F IRRADIATION OF SEEDS, by Herbert Jonas
Higher percentage of seeds germinate when properly treated using high power oscillator

HOW TO DESIGN BISTABLE MULTIVIBRATORS, by Ralph Pressman
Flip-flops that work despite voltage and resistance variations

CATHODE-INTERFACE EFFECTS IN TV RECEIVER DESIGN, by F. M. Dukat and I. E. Levy
Careful design can stretch tube life

BIOELECTRIC INTEGRATOR GAGES STRAIN AND EFFORT, by Adelbert Ford
R-C circuit sums complex potential waveforms from human tissue

UHF GRID-DIP METER, by A. E. Hylas and W. V. Tyminski
Unit uses 6F4 mounted on movable carriage to cover band between 390 and 1,000 mc

PRODUCTION-LINE GAS TEST FOR PICTURE TUBES, by R. E. Ostrowski
Semiautomatic circuit checks degree of vacuum while finished tubes move on conveyor line

MINIATURIZATION OF AIRBORNE FILTER CHOKES, by Walter E. Tanner
New calculation chart gives optimum design, reducing space and weight 30 percent

NUCLEAR RESONANCE SPECTROMETER, by Leonard Mailing

HIGH-IMPEDANCE ARTIFICIAL DELAY LINES, by William S. Carley and Edward F. Seymour
Distributed-constant delay lines have characteristic impedances as high as 10,000 ohms

CROSSTALK 139 ELECTRONS AT WORK 196 PRODUCTION TECHNIQUES 300 NEW PRODUCTS 312 PLANTS AND PEOPLE 384 NEW BOOKS 410 BACKTALK 420 INDEX TO ADVERTISERS 481


KEITH HENNEY, Editorial Director

H. W. MATEER, Publisher; WALLACE B. BLOOD, Manager; R. S. Quint, Buyers' Guide Manager; N. F. Cullinan, Promotion & Research Assistant; H. E. Hilty, Classified Manager; D. H. Miller, James Girdwood, New York; Wm. S. Hodgkinson, New England; Warren W. Shew, Philadelphia; C. D. Wardner, Chicago; J. L. Phillips, Cleveland; T. H. Carmody, R. C. Alcorn, San Francisco; Carl W. Dysinger, Los Angeles; Ralph C. Maultsby, Atlanta

April, 1953

ELECTRONICS
Member AIEE and ABI

Published numerically with an additional issue in June by McGraw-Hill Publishing Company, Inc., Jason H. McGraw (1860-1918), Founder. Publication Office, 52-129 North Broadway, Albany 1, N. Y. Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 46 St., New York 36, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice President; Nelson A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publication Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bird, Vice-President and Director of Advertising; J. E. Buckingham, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to Electronics—Subscription Service, 52-129 North Broadway, Albany 1, N. Y., or 330 W. 46 St., New York 36, N. Y. Allow one month for change of address. Subscription orders are solicited only from persons engaged in industry, research, design, production, maintenance and use of electronic and industrial control components, parts and end products. Position and company connection must be indicated on subscription orders.

Single copies 75¢ for United States and possessions, and Canada; $1.00 for Latin America; $2.00 for all other foreign countries. Buyers' Guide $2.00. Subscription rates United States and possessions, $5.00 a year; $9.00 for two years. Canada, $10.00 a year; $16.00 for two years. Other Western Hemisphere countries, $15.00 a year; $25.00 for two years. Other foreign countries, $25.00 a year; $45.00 for two years. Printed in U.S.A. Copyright 1953 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved. BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 600 Fifth Avenue, New York 20, N. Y.; 1136 Century Building, London, E.C. 4; Philadelphia 21, Pennsylvania, 520 Sansom Street; Detroit 26, Mich.; Los Angeles 14; 300 South Grand Avenue; Boston 10, 1521 Farnsley-Harding House, Atlanta 4, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 725-9 Oliver Building, Pittsburgh 12. ELECTRONICS is indexed regularly in The Engineering Index.

www.americanradiohistory.com
NEW small size marion 2½"
ELAPSED TIME INDICATOR

small panel size – standard 2½" JAN dimensions
reduced weight and cube
wide operating temperature range -55°C to +85°C
low temperature (-55°C) starting and operation
hermetically sealed – true glass-to-metal tamperproof
easy to read – standard size counter

SPECIFICATIONS
Registers: 1/10 hour steps to 9999.9
Registers: 1 hour steps to 99999
Drawn steel case – magnetically shielded
Self-starting Synchronous Motor 110-125 or 220-250 volt 50 or 60 cycle A.C.

Write for further information
Marion Electrical Instrument Company, 401 Canal St., Manchester, N.H., U.S.A.

MANUFACTURERS OF RUGGEDIZED AND "REGULAR" METERS AND RELATED PRODUCTS

Want more information? Use post card on last page.
April, 1953 — ELECTRONICS
The D-649 18" Mufax Chart Recorder offers the most convenient method yet devised of receiving facsimile weather maps transmitted by radio or landline. It can be used side by side with American equipment on existing systems; alternatively, a private network can be set up by using it in conjunction with the D-658 18" Mufax Chart Transmitter.

Recording is on inexpensive Mufax paper supplied in 100-foot rolls, which enables the recorder to operate unattended for days at a time. The transmitted map, measuring 18" x 22", is received full size, and can be examined while recording is still taking place.

The record, which is black on white, is instantly visible and requires no processing. Picture quality is better than that obtainable by any other direct recording system, even when using the double speed facility which is exclusive to Mufax equipment.

No other system can offer these advantages—write now for full descriptive literature.
### FIGURES OF THE MONTH

#### RECEIVER PRODUCTION
(Source: RTMA)  
<table>
<thead>
<tr>
<th>Year Ago</th>
<th>Previous Month</th>
<th>Latest Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. '52</td>
<td>Dec. '52</td>
<td>Jan. '53</td>
</tr>
<tr>
<td>404,932</td>
<td>921,086</td>
<td>719,234</td>
</tr>
<tr>
<td>288,724</td>
<td>452,556</td>
<td>361,921</td>
</tr>
<tr>
<td>80,151</td>
<td>271,507</td>
<td>189,592</td>
</tr>
<tr>
<td>68,433</td>
<td>194,837</td>
<td>93,962</td>
</tr>
<tr>
<td>198,147</td>
<td>406,528</td>
<td>447,667</td>
</tr>
</tbody>
</table>

#### RECEIVER SALES
(Source: RTMA)  
<table>
<thead>
<tr>
<th>Year Ago</th>
<th>Previous Month</th>
<th>Latest Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. '52</td>
<td>1,049,770</td>
<td>640,073</td>
</tr>
<tr>
<td>1,548,648</td>
<td>414,726</td>
<td></td>
</tr>
</tbody>
</table>

#### RECEIVING TUBE SALES
(Source: RTMA)  
<table>
<thead>
<tr>
<th>Year Ago</th>
<th>Previous Month</th>
<th>Latest Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. '52</td>
<td>Dec. '52</td>
<td>Jan. '53</td>
</tr>
<tr>
<td>26,736,645</td>
<td>43,220,363</td>
<td>37,343,081</td>
</tr>
<tr>
<td>15,763,221</td>
<td>31,061,892</td>
<td>25,409,671</td>
</tr>
<tr>
<td>6,338,157</td>
<td>8,771,935</td>
<td>9,367,420</td>
</tr>
<tr>
<td>3,208,025</td>
<td>1,745,491</td>
<td>1,576,298</td>
</tr>
<tr>
<td>1,426,262</td>
<td>1,641,975</td>
<td>1,189,672</td>
</tr>
<tr>
<td>340,192</td>
<td>852,501</td>
<td>625,209</td>
</tr>
</tbody>
</table>

#### SEMICONDUCTOR SALES
(Source: RTMA)  
<table>
<thead>
<tr>
<th>Year Ago</th>
<th>Previous Month</th>
<th>Latest Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. '52</td>
<td></td>
<td>Jan. '53</td>
</tr>
<tr>
<td>1,568,334</td>
<td></td>
<td>1,470,472</td>
</tr>
</tbody>
</table>

#### BROADCAST STATIONS
(Source: FCC)  
<table>
<thead>
<tr>
<th>Year Ago</th>
<th>Previous Month</th>
<th>Latest Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb. '52</td>
<td></td>
<td>Feb. '53</td>
</tr>
<tr>
<td>108</td>
<td>137</td>
<td>147</td>
</tr>
<tr>
<td>0</td>
<td>177</td>
<td>221</td>
</tr>
<tr>
<td>506</td>
<td>791</td>
<td>815</td>
</tr>
<tr>
<td>2,336</td>
<td>2,399</td>
<td>2,409</td>
</tr>
<tr>
<td>74</td>
<td>130</td>
<td>131</td>
</tr>
<tr>
<td>313</td>
<td>246</td>
<td>252</td>
</tr>
<tr>
<td>636</td>
<td>612</td>
<td>611</td>
</tr>
<tr>
<td>14</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

#### COMMUNICATION AUTHORIZATIONS
(Source: FCC)  
<table>
<thead>
<tr>
<th>Year Ago</th>
<th>Previous Month</th>
<th>Latest Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. '53</td>
<td>Dec. '52</td>
<td>Jan. '53</td>
</tr>
<tr>
<td>31,076</td>
<td>34,600</td>
<td>35,323</td>
</tr>
<tr>
<td>34,310</td>
<td>38,422</td>
<td>38,631</td>
</tr>
<tr>
<td>10,292</td>
<td>12,096</td>
<td>12,234</td>
</tr>
<tr>
<td>11,859</td>
<td>15,653</td>
<td>15,761</td>
</tr>
<tr>
<td>4,700</td>
<td>5,536</td>
<td>5,533</td>
</tr>
<tr>
<td>103,570</td>
<td>117,800</td>
<td>117,106</td>
</tr>
<tr>
<td>792</td>
<td>1,858</td>
<td>1,892</td>
</tr>
<tr>
<td>26</td>
<td>88</td>
<td>90</td>
</tr>
<tr>
<td>425</td>
<td>500</td>
<td>507</td>
</tr>
<tr>
<td>877</td>
<td>1,023</td>
<td>1,037</td>
</tr>
</tbody>
</table>

### TV AUDIENCE
(Source: NBC Research Dept.)  
- Sets in Use—total: 16,129,300  
- Sets in Use—New York: 3,290,000  
- Sets in Use—Los Angeles: 1,375,002  
- Sets in Use—Chicago: 1,360,000

### NETWORK BILLINGS
(Source: Pub. Info. Bureau)  
- Jan. '53: $2,669,327  
- Dec. '52: $2,669,327

### EMPLOYMENT AND PAYROLLS
(Source: Bur. Labor Statistics)  
- Dec. '51: $31,200-p  
- Nov. '52: $31,200-p  
- Dec. '53: $31,200-p

### STOCK PRICE AVERAGES
(Source: Standard and Poor's)  
- Radio-TV & Electronics: $268.8  
- Radio Broadcasters: $300.4  
- 285.1

### INDUSTRIAL EQUIPMENT ORDERS
(Source: NEMA)  
- Q3 '51: $920,000  
- Q4 '52: $920,000

### INDUSTRIAL TUBE SALES
(Source: NEMA)  
- Q3 '51: $8,420,000  
- Q4 '52: $8,420,000

---

*Month: Jan., Feb., Dec.*
Congress Starts Probe Of Color TV

Senator cries ‘holdup’, industry says ‘not true’, as investigation starts

CHARGING that “powerful interests have used every legal maneuver and technical roadblock” to delay the development of color TV until the monochrome market has been exhausted, Senator Johnson of Colorado has asked for a full Congressional investigation.

Senator Tobey, chairman of the Senate Committee on Interstate and Foreign Commerce, has promised a thorough probing.

(The House Commerce Committee under its chairman Rep. Wolverson, R., N. J., began its own tv color hearings March 24.)

► First Step—In a letter to W. R. G. Baker, chairman of the National Television Systems Committee, Tobey says, in part, “As a preliminary step before embarking on a full study of this problem, the following information is requested:

(a) Does any member of your group propose to manufacture receivers capable of receiving the color signals under the Commission’s present standards? If not, why not?

(b) Does any member of your group propose to manufacture receivers capable of receiving color signals under any other standards? For example, under the signals specifically approved by NTSC. If so, when do they expect to start production? If not, why not?

(c) Do you know if anyone is going to request the Commission to adopt new standards for color broadcasts? If so, when and who?”

► Industry’s Answer—In reply to Tobey’s request, Baker lists experimental compatible NTSC receiver availability reported at a January, 1953 meeting of his Committee and announces he is sending Tobey complete minutes of NTSC meetings. Baker then says that “Our Committee has concerned itself solely with a significant and highly challenging technical problem: how best to achieve the optimum in terms of a color television system. The only persons on the Committee and associated with its work are scientists and engineers of special technical qualifications. This has been the only limiting factor with respect to participation, since any interested scientist or engineer has been welcome. The Committee has not concerned itself with any phase of production equipment, nor with considerations involving the proprietary interests of members or companies in the industry.”

► Prime Objective—Baker further states that “a primary objective of this Committee was to attempt to create a practical color transmission which would utilize as a foundation the existing monochrome transmission standards... Then this important improvement in this service can be realized without reducing the value of a single one of the millions of television receivers owned by the American public.”

Reviewing the TV background, Baker says the NTSC monochrome standards established in 1941, adopted by the FCC, have proved to be “soundly engineered” and he intimates that the government freeze on color set construction has been mostly responsible for slowing up market development.

A compatible color system is now practicable, Baker feels, and “the completion of extensive field tests scheduled to begin within the next month, should permit a definitive judgment.”

► RCA—David Sarnoff announced, in the midst of all this, that RCA has spent $20 million for research and development of color television, $5 million of it in 1952 and that “these large expenditures are continuing during the present year.”

Germanium Diode Sales To Double Again

UHF-TV mixers and video detectors will account for half of expected 20 million in 1953

GERMANIUM diode sales doubled in 1952, and present indications are that they will double again in 1953.

RTMA statistics show that sales in 1952 totaled 9.5 million, as compared to 4.5 million in 1951 and
about 3.7 million in 1950. Sales in 1953 are expected to approach 20 million, with half of this figure being divided between uhf-tv mixers (5 million) and video detectors (5 million) in vhf and vhf-uhf combination sets.

Most impressive jump in sales came in latter part of 1952 when uhf tv became a reality and manufacturers rushed to meet demands of new areas. As shown in accompanying plot of sales by months, figures rose from 350,000 in July to over 1.5 million in December. 

**Setmakers Watchful As UHF Gains**

Sales battle shapes up over r-f tuning methods; consumer reaction awaited.

With 15 stations on the air and a score or more rapidly approaching completion, uhf television has receiver manufacturers watchful. Biggest question mark is front-end design.

Sets currently available generally feature either of two r-f tuning methods: One uses uhf-converter strips with from 13 to 16 positions. (An 82-channel detent-type tuner was recently announced.) The other method requires a separate tuner or converter that tunes continuously through all 70 uhf channels.

**Enter the Viewer**—Big question is whether the average consumer will readily shell out the extra dollars that all-channel uhf reception might cost.

Manufacturers are divided in their answer. Some have come out four square for strip tuning. Others, particularly those whose vhf sets do not use turret tuners, offer continuous tuning. Still others are riding both ends of the goat and supply both. For the most part, a wait-and-see attitude pervades the industry. Even the staunchest partisans are not producing sets in overwhelming quantity.

**A Look at the Field**—Twenty-four receiver manufacturers were asked about their plans: 11 said they were making uhf sets, 5 said sets would soon be forthcoming, 6 gave no information and 2 disclaimed interest in uhf.

**Business Machine Firms Active**

Top manufacturers prepare to hasten computers' move from laboratory to office.

Building electronic brains for business is the most recent goal of the nation's leading business-machine firms.

Electronic computing techniques, developed during the latter part of World War II, were first applied largely to warlike chores like compiling ballistics tables and meteorological data. The big brains were built chiefly for government labs and universities. Electronic computing captured the popular imagination and names like SEAC, ENIAC, UNIVAC and even MANIAC began to enrich the language.

**Out of the Lab**—After the war, several small firms, long on hair but short on capital, attempted to exploit the new devices commercially. Their machines were still, however, intended for use in laboratories. But, the big brains' aptitude for solving other problems was not lost to canny business-machine company executives. They foresaw use of electronic business machines to keep ledger accounts, make up payrolls, keep running sales records, compute and mail bills and premiums, control industrial production and maintain perpetual inventories.

**Engineers Wanted**—You don't throw an electronic computer together solely by the model-shop pilot-plant approach; high-powered research is prerequisite. Competent engineers are rare birds, however, and how to acquire red-hot electronic research staffs plagued the business-machine people not a little.

Following P. T. Barnum's advice, "If you can't beat them, make 'em part of your act," business-machine firms with sales and application experience and smaller firms with technical know-how began to make sweet music together.

**Many Mergers**—Remington Rand recently acquired Engineering Research Associates of St. Paul, Minn. and Arlington, Va., a well-seasoned electronics firm whose stock in trade heretofore has been custom-building super-secret computing equipment for government labs. ERA joins Eckert-Mauchly, makers of UNIVAC, as a division of Remington Rand.

Underwood has taken over the Electronic Computer Corp. of New York; National Cash Register has teamed up with Computer Research Corp. of Hawthorne, Calif., and Physical Research Co. has said "I do" to Marchand Calculating Machine.

Burroughs Adding Machine is in the electronics business via both their rapidly-expanding Philadelphia research lab and their Brooklyn subsidiary, Control Instrument.
Here's how to get GOOD USABLE POWER AT UHF

Sylvania Rocket Tube Type 2C37 supplies 450 MW at 3300 Mc.

Because of their high power throughout the UHF spectrum, Sylvania rocket tubes are especially recommended for service as pulsed oscillators, cw oscillators, rf amplifiers and frequency multipliers... this is one more reason why it will pay you to specify SYLVANIA.

Compare Sylvania Rocket Tube's Performance

Typical UHF Triode Performance
Power Vs Frequency (For Sylvania Rocket Tube Type 2C37)

POWER OUTPUT (MILLIWATTS)

900 800 700 600 500 400 300 200 100

FREQUENCY (MEGACYCLES)

1000 1500 2000 2500 3000 3500

TUBE "A" SYLVANIA 2C37 ROCKET TUBE 4.8 WATTS INPUT
TUBE "B" UHF TRIODE
TUBE "C" UHF TRIODE 6 WATTS INPUT
TUBE "C" UHF TRIODE 6 WATTS INPUT

SYLVANIA ROCKET TUBE TYPE 2C37

Sylvania Electric Products Inc.
Dept. 3E1084, 1740 Broadway, N.Y. 19, N.Y.
Please send me latest data sheets concerning Sylvania Rocket Tubes

Name _____________________________________________
Street ____________________________________________
City _____________________________________________
Zone State _______________________________________

Want more information? Use post card on last page.

ELECTRONICS — April, 1953
INDUSTRY REPORT—Continued

Co. Friden has bought the rights to the Benson-Lehner Computerper and is planning to market a low-cost printing calculator. Victor Adding Machine is energetically casting about for electronics engineers.

►Self-Made Staffs—In the electronic computer business since 1944, IBM will soon supplant their SSEC in the big-brain bracket with their new model 701. Production is scheduled to be one a month. The 604 printing calculator will remain IBM’s entry in the medium price range.

Monroe has been building up its staff since the last war and recently launched the MONRO-BOT, a medium-priced business type calculator. No mass production plans have been announced.

New Process Cuts Cost of Germanium

Rare transistor material is extracted from waste coal-gas liquid at half of present costs

ADDITION of processing facilities to the Omori plant of Tokyo Gas Co. will make possible the production of 100 grams of pure germanium a day from waste liquid, at about half the cost of present U.S. production methods. This and other Japanese pilot-plant installations now under way are expected to produce over 200 pounds of the precious metal this year. Present world output is only about 3 tons a year.

►Process Details—Black sediments are filtered out of the waste liquid, heated and burned with tar to get a reddish powder. Chloric acid is added and the powder is distilled to get germanium tetrachloride vapor at 85 deg C. Running this through water gives white germanium oxide which, when mixed with hydrogen gas at 900 deg C, gives 99.99 percent pure germanium.

The rare metal gallium, also essential to the electronics industry, can be obtained by extracting gallium tetrachloride from the sediments of germanium tetrachloride vapor with a solvent and electrolyzing the extract.

Patents on the process have been applied for in 12 countries, including U.S., by inventor Masaru Inagaki, who is an engineer with the Coal Research Institute in Tokyo. The new process eliminates the problems of removing impurities such as arsenic and antimony, encountered in the present method which uses coal soot or coal ash.

New Eye and Brain for AA Guns

BIGGEST peacetime military contract ever received by Sperry Gyroscope is for ‘Skysweeper’, the Army’s largest-caliber automatic antiaircraft gun with radar, target computer and weapon on a single mount.

The weapon spots and tracks an enemy plane flying at near-sonic speed, aims and fires at a rate of 45 rounds per minute. It finds and tracks at 15 miles and provides effective shoot-down range of 4 miles.

►Dollars per Gun—Cost of the fire-control system is about 75-per cent of the gun unit which costs $240,000. Spares, tools and test equipment cost $60,000, and the prime mover, a cargo tractor, $85,000, to a total of $385,000.

A complete Skysweeper has 317 electron tubes, 12,000 parts and 4,500 items in tools, test equipment and spare parts. A total of 18 harnesses connect the chassis. One of these contains 600 wires and three have 400.

Feasibility of an automatic on-mount radar fire control combined with a rapid fire antiaircraft gun was studied by Army Ordnance and Sperry in 1943.

Development work on the gun during the next few years resulted in the first complete experimental weapon being delivered to Ordnance in 1948.

This and the second system delivered one month later were given extensive evaluation tests at Aberdeen Proving Ground, Md., and Fort Bliss, Texas.

►Speed Up—A closely coordinated package subcontracting plan was

(Continued on page 10)
NEW processing developments now make it possible for every Prokar miniature molded capacitor to be used at temperatures up to 125°C without voltage derating!
An exclusive Sprague solid dielectric and a mineral-filled phenolic jacket assure stable performance from −55°C to +125°C.
Ten mold sizes—ranging upwards from the .175" dia. x 5/8" long unit pictured actual size at left—give you maximum space economy in miniaturized equipments. Originally developed for military uses, the moderate prices of these miniature capacitors make them well worth your investigation also for use in dependable commercial electronic equipment. Write today for Engineering Bulletin 205F to the Sprague Electric Company, 35 Marshall St., North Adams, Massachusetts.
evolved, whereby other manufacturers could produce complete sub-assemblies of the system. This spreading of the work reduced lead time by one year and utilized surplus capacity of other manufacturing facilities.

Army Ordnance awarded Sperry a multi-million dollar contract to produce the fire-control systems at a high rate in December 1949. By February 1950, more than 20 subcontractors had started work on package units, while numerous parts designs were released to hundreds of small businesses.

A second-source prime contract was awarded to AC Spark Plug Division of General Motors, for additional production of Skysweeper fire control systems. Under an assistance agreement, Sperry provided AC Spark Plug with technical aid.

Radio-TV Industry Holds Price Line

Full price decontrol has not yet brought general price increases on parts or receivers

MANY industry observers thought that radio-tv parts and receiver manufacturers would take quick advantage of the recent decontrol of prices in the industry to up profits via price hikes. But so far, the industry in general has pretty well held price lines.

Parts Manufacturers—Component makers themselves were of the opinion that most parts companies would raise prices as much as 10 percent as soon as the lid came off and that in a short time the industry as a whole would climb to a higher price structure. No such concerted movement has yet taken place. As a result of rising copper costs some parts manufacturers have upped prices on yokes, transformers and hook-up wire but the number of companies doing so is still small.

Parts makers and buyers generally laud an announcement by Motorola. Even before full decontrol had taken place, Paul V. Galvin, president of the company, announced a 2-point policy: “(1) No increases will be allowed on any of our radio and television prices this year. Our basic policy will be to lower prices, if possible. (2) Because of the criticalness of our own cost-price relationship, all requests for price increases from our suppliers during the next few months will be examined by a committee of top management, including myself. This committee intends to follow the materials market in detail and to know whether companies among our suppliers look upon their relationship with Motorola with the long view in mind or only for the immediate gain.”

Set Manufacturers—Before the first of the decontrol actions had been taken, the beginning of an upward trend in tv receiver prices had begun. Admiral had raised prices on 8 tv models from $10 to $60 each. Emerson followed with an increase in list prices on 4 tv models of from $20 to $30 due to increased cost of cabinets and components. CBS-Columbia also raised prices on some models. However, none of these increases were made as a result of decontrol.

Guided-Missile Plans Make Progress Slowly

Three-billion dollars buys much research but little production

When a rocket blasts off, it rises slowly in a cloud of dust and flame. Then it hovers precariously and for a sickening, dizzy second seems about to topple over. However, it begins to rise, gather speed and disappear from view, only to reappear seconds later as a wispy, silver trail spiraling in the stratosphere.

The entire guided-missile program seems to be at the second crucial point.

Cost—Since June 1950, the guided-missile program has cost about 4 billion. The level of spending is rising steadily. The Air Force will spend $300 million this year as against $130 million in 1952 and $150 million in 1951. The
This New Centralab Printed Electronic Circuit

replaces these 9 parts...

but that's not all!

SEE NEXT TWO PAGES FOR COMPLETE DETAILS
Centralab Printed Electronic step up production,

1. 25% to 80% fewer soldered connections — speeds assembly
2. Fewer pieces to buy or inventory — saves money, saves time
3. Fewer connections minimize wiring errors — speeds production

Another Centralab first!

New Pendet
— a complete pentode detector and audio coupler circuit that replaces 9 parts...
... eliminates 9 soldered connections

For scores of electronic applications — Centralab PECs give you 6 tremendous SAVINGS

Any way you look at them, Centralab Printed Electronic Circuits mean more money in your pockets. No other modern electronic development offers you six such tremendous time and cost-saving advantages for low-power applications.

Pioneered and completely developed by Centralab, these resistor-capacitor combinations in complete or partial circuits are extremely economical to use. Many times, the first cost of PEC's is less than the components they replace.

As for versatility — there are more than 30 standard

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.
Circuits simplify design, improve performance

4 Lower installation cost — compared with separate components

5 Less weight, less space — “opens-up” tight chassis

6 Improved circuit stability due to uniformity of PEC plates

circuits already tooled for you. Those illustrated here can only suggest the wide range of sizes and capacities available.

If you have a special circuit problem, we’ll even design custom plates at nominal cost where volume warrants. No wonder 25,000,000 PECs are in use today! No wonder scores of manufacturers say it’s good business to specify and use Centralab Printed Electronic Circuits. Send coupon for full details.

Centralab

A DIVISION OF GLOBE-UNION INC. • Milwaukee 1, Wisconsin

In Canada, 635 Queen Street, East, Toronto, Ontario


Navy will shell out about $242 million. About half the money will go for electronic equipment for missile guidance and control. Other expenditures, not included in the guided-missile figures, will be made for vital ground equipment such as radar.

What Did It Buy?—The money has been spread thinly. Research projects have ranged from developing new rocket fuels to compiling exhaustive meteorological statistics. Engineering staffs have had to be hired and trained. Aircraft manufacturers like Hughes and Martin found themselves connected with the guided missile operating real estate.

A list of companies in the field reads like a Who's Who of Industry and includes such firms as: Aeronautical and Electric, Boeing, Consolidated Vultee, Douglas, Fairchild, General Electric, Northrup, Reaction Motors, Ryan Aeronautical and Western Electric.

Much of the money has gone for real estate. The armed services are operating 51 major facilities connected with the guided missile program.

Progress—Two new Army missiles near the production stage are the Corporal E and the Niki. The Corporal E is a long-range missile for use against ground targets that the Army hopes will take over some of the chores heretofore done by big guns.

Already in use training Army GM battalions is the Niki, supersonic ground-to-air missile that the Army hopes will supply the antidote to swift high-flying bombers.

The Corporal E will be produced by the Firestone Tire and Rubber Co. The Niki is a joint development of Douglas and Western Electric.

The Navy will soon get its guided missiles ships, the Boston and the Canberra. Four other ships are already listed as part of the program. These include the battleship Mississippi, the sea-plane tender Norton Sound and the submarines Cusk and Carbonero.

Components—Battling the twin enemies of missile electronics, heat and size, engineers have worked up a host of new components. These include carbon and boron-carbon film resistors, tantalum-foil and barium-titanate capacitors, tiny magnetic amplifiers and silicon transistors.

The ceramic vacuum tube may provide an answer to operation of tubes at high ambient temperatures. New tubes, using ceramics bases instead of glass are said to operate at several hundred degrees centigrade.

Road Telephones Employ Transistors

WIDESPREAD use of transistors in the railroad field may result from an improved telephone subset developed by Baltimore and Ohio engineers. Used on heavily-loaded train-dispatching circuits, the device employs a single npn junction transistor connected in a base-input amplifier circuit.

Power—Direct-current supply is no problem since, in railroad practice, a local 41-volt battery is normally used to power the telephone's carbon microphone. The subset provides 20 db gain, which exceeds that normally obtained from a telephone repeater on a dispatching line.

Fifteen transistor-amplifier subsets are in use in the B&O's fire-line plant.

Time Compressor Does An Hour In 45 Minutes

Invention speeds up words or music without changing tone or ease of understanding

INVENTED by Grant Fairbanks, W. L. Everitt and R. P. Jaeger at the University of Illinois, an interesting new machine trades time against frequency, eliminates 'temporal redundancies' and proves that the ear is quicker than the tongue.

Speech and music compressions up to 10 percent go unnoticed by listeners, and more than 50 percent of the time can be thrown away without destroying understandability. This allows programs, for example, to be fitted exactly to allotted time.

How?—Heart of the device is a revolving drum carrying four magnetic-tape pickup heads. An endless loop of tape passes around the drum and over erasing and record-
HERE'S THE SECRET

... of a NEW wire-mesh isolator that won't change on the job!

The new Type 7630 and Type 7640 ALL-METL Barrymounts have been specifically designed to eliminate loss of efficiency due to damper packing. Previous wire-mesh unit vibration isolators exhibited a definite loss of damping efficiency after a period in actual service, because the wire-mesh damper tended to pack. These new unit Barrymounts have eliminated this difficulty, because load-bearing spring returns damper to normal position on every cycle.

- Very light weight — helps you reduce the weight of mounted equipment.
- Hex top — simplifies your installation problems.
- High isolation efficiency — meets latest government specifications (JAN-C-172A, etc.) — gives your equipment maximum protection.
- Ruggedized — to meet the shock-test requirements of military specifications.
- Operates over a wide range of temperatures — ideal for guided-missile or jet installations.

Compare these unit isolators with any others — by making your own tests, or on the basis of full details contained in Barry Product Bulletin 531. Your free copy will be mailed on request.

Free samples for your prototypes are available through your nearest Barry representative.

THE BARRY CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN
Atlanta Baltimore Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York
Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington
ing heads. The speed of drum and tape can be adjusted independently to vary the amount of time compression.

Based on physical sound research, the electro-mechanical tape scanner samples the recording so as to eliminate redundant parts of the sound, without altering the original pitch, allowing the recording to be tailored to a desired length. Used on popular recordings, the device plays songs compressed 30 percent, which some listeners insist sound better than the original.

 мн Stretches, Too—Time can be expanded by maintaining sounds longer than originally recorded. Also, by holding time constant, the frequencies can be compressed to a narrow band, so that more signals can be sent on a wire or radio channel. At the receiving end, the sound can be reshaped to its original pitch.

Flying Lab Services Radar Sights

Jet fighters are readied for action at front-line airfields by electronic test trailer

COMBAT ZONE maintenance and repair of complicated radar-controlled gun sights is routine work for the flying repair shop shown in the photograph. The seven-ton van and its crew of specialists can be loaded aboard a plane in 30 minutes and flown to advanced airfields for service jobs that once required shipment of equipment back to the United States.

This new approach to servicing will permit a saving of about $18,000 for every hundred items repaired. It also reduces the total number of gun sights needed by the Air Force.

The Works—The van carries a complete line of electronic test equipment including provisions for accurate calibration work. Also included are all necessary tools, spare parts, modification kits, work benches, cabinets, and complete air conditioning and power plants.

The first fully-equipped van was outfitted and ready to go just 30 days after the empty van was acquired. Parts were flown from all parts of the country to the assembly point at Gentile Air Force Depot at Dayton, Ohio.
This instrument — the first UHF Monitor — is another example of the pioneering in engineering, design and workmanship which has characterized G-R monitoring equipment since the beginning of broadcasting.

**FEATURES**

- Continuous indication of percentage modulation and frequency deviation of aural and visual transmitters — large illuminated meter scales permit reading at a glance.
- High Stability
  - Visual Monitor — 100 cycles
  - Aural Monitor — 1000 cycles
- On all VHF channels, the above accuracy is guaranteed for at least thirty days — at the lower VHF frequencies (channel 14), the period is over six months.
- *High-fidelity audio output for distortion and noise-level measurements, and for audio monitoring — residual noise level is down 65 db or better for 25 kc deviation*
- Overmodulation alarm for aural transmitter — lamp flashes when modulation exceeds predetermined level set by dial.
- Sensitivity for both Aural and Visual inputs
  - High Impedance Input (VHF) — 1 volt or better
  - Low Impedance Input (UHF) — 500 mV or less
- Excellent signal-to-noise ratio through channel 83.
- Separate heater inputs also direct connection of crystal oven to station standby power.
- Pilot lamp indicates adequate r-f input level.
- Terminals are provided for connecting remote center-frequency and modulation meters and overmodulation indicators.
- Counter-type discriminator linear to better than 0.1% for ±20 kc range, permitting accurate distortion measurements and center-frequency indications reliable even with heavy modulation.
- New cabinet arranged for maximum heat dissipation and easy installation or removal for servicing.

The G-R Type 1183-T T-V Monitor meets all requirements of the FCC, including those established for offset operation. It not only provides complete monitoring facilities for VHF and UHF stations in accordance with FCC specifications, it assures the quality of everyday transmissions as well. Monitoring of distortion, noise, modulation level, and video and audio carrier frequencies, with the aid of this instrument, results in the rapid detection of substandard operation.

Conveniences for operating personnel are a major feature. The relatively high stability of the VHF Monitor makes frequency checks necessary only once a month. Stability, accuracy, ease of maintenance and operation, dependability and long life are optimum. The G-R trademark guarantees trouble-free operation with a minimum of maintenance.

**Visual transmitter frequency deviation** is continuously indicated by this large scale meter, in terms of the same master crystal.

**Modulation in both percentage and db** is indicated continuously on this meter. Panel switch selects either peak, or indicates both peaks simultaneously. Meter ballistics meet FCC requirements.

**Type 1183-T T-V Station Monitor**

- From $2850.00 to $2905.00 depending on frequency bands.

---

Large-scale illuminated meter continuously indicates frequency deviation of aural transmitter in terms of highly stable crystal oscillator. Zero correction for crystal oscillator easily accessible from panel, to compensate for long-time drift.

Visual transmitter frequency deviation is continuously indicated by this large scale meter, in terms of the same master crystal.

Admittance Meters & Coupling Elements • Decade Capacitors
- Decade Inductors • Decade Resistors • Distortion Meters
- Frequency Meters & Frequency Standards • Geiger Counters
- Impedance Bridges • Modulation Meters • Oscillators
- Varies • Light Meters & Megohmmeters • Motor Controls
- Voice Meters • Null Detectors • Precision Capacitors
- Pulse Generators & Signal Generators • Vibration Meters & Stroboscopes • Wave Filters
- U-H-F Measuring Equipment • V-T Voltmeters • Wave Analyzers • Polarimeters
A strong protest, to Senator Charles W. Tobey, chairman of the potent Senate Interstate Commerce Committee.

Strong pitch by the unions may be the fact that FCC held no oral hearing to discuss the problem. Government action was based upon a consideration of 2,000 written comments from individuals (most of them operators), unions and trade schools as well as station managers, networks and associations of broadcasters.

Radio Controlled Light May Save Half Million

Awaiting FCC approval is a plan for turning New York City's street lights on or off at will by means of a coded signal superimposed upon the program from the city's municipally owned broadcast station WNYC.

Developed by Broadway Maintenance Corp., the control unit comprises a radio receiver complete with a short whip antenna. This receiver, the size of a soup can, is fastened directly above the lighting fixture. From the electronic circuit imbedded within, four wires lead from the base of the can. Two wires are attached to the lighting power line. The other two are connected in series with the lamp bulb.

Remote Control—Each tiny receiver is designed to actuate the light switch when it receives a coded break in the carrier signal from station WNYC. In addition, the power of the broadcast station would be increased momentarily during this coded period. A listener would presumably be unable to detect this very momentary signal, but, since a-m stations are not licensed for such purposes, a special grant is necessary from Federal Communications Commission.

The Dollar Angle—At present, some street lighting is controlled by so-called astronomical time clocks that automatically take into account the changing seasons. It has been estimated that eventual replacement of 189,000 of these clocks and elimination of their attendant maintenance could save New York City $500,000 a year.

How Soon?—Those familiar with the workings of FCC predict that New York City will not get a quick decision. Still pending is Chicago's petition for radio control of 3,000 traffic signals, although use of a broadcast transmitter is not contemplated there. Greeley, Colorado, is currently operating a similar network under a developmental grant, but uses a frequency 500 times higher than that proposed for New York.

Electronic Eye Invades Kitchen

Surface heating unit of one model Westinghouse electric range cooks food without burning, even if all water is boiled away. Secret is the 'Electronic Eye' shown in illustration, a thermistor which senses excessive temperature and unbalances a bridge circuit feeding an amplifier and relay in the power line.

Front of range has dial marked in three cooking zones and additional intermediate points. Boiling of potatoes calls for setting at low boil for 25 minutes. Even if the cook neglects them for 50 minutes or longer there is no danger of food scorching because of the controlled surface unit, which was ten years in development.

Financial Roundup

Year-end profit reports, stock filings and registrations and security transactions were made on the financial front of the electronic industry during the past month:

Net profits for 1952 of 5 important companies were up compared to 1951 profits:

<table>
<thead>
<tr>
<th>Company</th>
<th>1952 Net Profit</th>
<th>1951 Net Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garrett*</td>
<td>$1,582,000</td>
<td>$1,127,000</td>
</tr>
<tr>
<td>GE</td>
<td>131,710,905</td>
<td>128,114,227</td>
</tr>
<tr>
<td>Philco</td>
<td>11,491,297</td>
<td>10,165,046</td>
</tr>
<tr>
<td>RCA</td>
<td>32,125,389</td>
<td>31,192,759</td>
</tr>
<tr>
<td>Stewart-Warner</td>
<td>4,533,000</td>
<td>4,165,000</td>
</tr>
<tr>
<td>Westinghouse</td>
<td>68,581,000</td>
<td>64,919,000</td>
</tr>
</tbody>
</table>

Stocks Filed—Audio and Video Products filed with SEC covering 138,000 shares of common stock (par 1 cent) to be offered at market (about 35 cents a share) for the account of certain selling stockholders.

Radar-Electronics filed with SEC covering 5,996,000 shares of common stock (par 1 cent) to be offered at 5 cents per share. Proceeds are to be used for working capital.

Western Electric filed with SEC covering 2,007 shares of common stock (no par) at $10 per share on the basis of one new share for each 10 shares held. Proceeds will be

(Continued on page 20)
NEW

5 KW at 900 MC
GL-6182

- "Custom-tailored" for military communications and medium-power TV transmitters!
- Compact. Only 8 5/16" high!
- One tube handles all military and TV frequencies, 200 to 900 mc.
- Tetrode design assures low drive requirement.
- Modern ceramic construction and ring-seal design.
- Quickly installed or removed. Spring-finger electrical contacts; convenient firm-grip handle. Tube weighs only 2 pounds!

U-H-F DESIGNERS: this 5-kw tetrode is the power tube you've been waiting for! Provides ample r-f for your new medium-power transmitter, efficiently, with economy—takes up minimum space, is lightweight and easy to plug in. A tube that maintenance-conscious operators will welcome! ... Military communications and radar—industrial dielectric heating—u-h-f TV—these are leading applications. Get ratings and the full tube story in special G-E Bulletin ETD-726. Write Tube Department, General Electric Company, Schenectady 5, N. Y.
used for expansion and general corporate purposes.

**Registrations**—Cinerama registered with SEC covering $2 million of 4 percent convertible debentures due 1958 to be offered as a speculation at 100 percent of their principal amount. Proceeds to be used for assembly and supply of equipment for use in producing and exhibiting Cinerama productions.

P. R. Mallory registered with SEC covering 150,000 shares of cumulative convertible preferred stock, $50 par. Proceeds to be used for general funds and general corporate purposes.

Westinghouse registered with SEC covering (1) 200,000 shares of common stock, $12.50 par, to be offered under employee Stock Plan; (2) 598,735 shares of common stock, $12.50 par to be offered under Restricted Stock Option Plan to executive employees.

**Other Actions**—Avco sold all holdings of New York Shipbuilding Corp. It marks the final step in the transition of the organization from a holding company into a integrated manufacturing corporation.

Cornell-Dubilier increased its authorized common shares from 0.5 million to 1 million shares to have them available for further acquisitions and possible stock dividends.

**Color Selector for Paint Reduces Obsolescence**

AUTOMATIC color "carousel" developed by Standard-Toch Chemicals takes less than 90 seconds to squirt a desired color paste into an open can containing only the vehicle. A selective mechanical and electronic control system measures out the kind and amount necessary to attain the shade previously chosen from a code-numbered color chip.

The can is magnetically held against the dispenser and the size of the can is automatically indi-

**Educational TV Goes Grass-Roots**

June deadline for reserved channels will produce many applicants below state level

MINIMUM COSTS of plant at $300,000 and yearly operations at $200,000 (Joint Committee on Educational Television figures) make the average taxpayer snort at the idea of educational tv. But educators never seem to tire of patient explanations that school video isn't merely a matter of multiplying the little red schoolhouse by the number of receiving antennas. They speak persuasively of "increased productivity" in education and try to show that in a complex world, education must, of necessity, become more complex and efficient.

**Kick in the Teeth**—Because television finances are big business, it was natural that New York State's Board of Regents should obtain construction permits for seven stations, plan for three more and then go to the legislature for money to build them.

A special commission appointed by Gov. Dewey voted 10-to-5 to located to the right of the color-tank turntable. If the receiving can is jostled out of position, all power in the color selector is immediately shut off.

**Color Selector for Paint Reduces Obsolescence**

AUTOMATIC color "carousel" developed by Standard-Toch Chemicals takes less than 90 seconds to squirt a desired color paste into an open can containing only the vehicle. A selective mechanical and electronic control system measures out the kind and amount necessary to attain the shade previously chosen from a code-numbered color chip.

The can is magnetically held against the dispenser and the size of the can is automatically indi-

**Educational TV Goes Grass-Roots**

June deadline for reserved channels will produce many applicants below state level

MINIMUM COSTS of plant at $300,000 and yearly operations at $200,000 (Joint Committee on Educational Television figures) make the average taxpayer snort at the idea of educational tv. But educators never seem to tire of patient explanations that school video isn't merely a matter of multiplying the little red schoolhouse by the number of receiving antennas. They speak persuasively of "increased productivity" in education and try to show that in a complex world, education must, of necessity, become more complex and efficient.

**Kick in the Teeth**—Because television finances are big business, it was natural that New York State's Board of Regents should obtain construction permits for seven stations, plan for three more and then go to the legislature for money to build them.

A special commission appointed by Gov. Dewey voted 10-to-5 to turn down the plan. Nothing daunted, smaller groups in New York City and Rochester are working locally to obtain educational stations for their cities. In this regard, they are like other groups in other parts of the country operating below the state level.

Outstanding as a pattern of local activity is that of Detroit. Here, seventeen educational and cultural institutions in three counties are working out plans for a joint educational-tv venture. Emphasis, so far, has been upon studio locations (three scattered throughout the city) and programming. Application for a transmitter construction permit will come later.

**Coming Deadline**—FCC will hold reserved channels until June 2. After this date, the earmarked bands may be thrown open for commercial use. By mid-March only 20 applications had been filed for the 242 educational channels. Of these, 14 construction permits have been granted (including those requested by the New York

(Continued on page 22)
are Adlake Mercury Relays particularly fitted to function?

In any installation that requires both sensitivity and lasting dependability... from traffic control systems to long-range navigation equipment... Adlake Mercury Relays will give superior service!

Here are just a few of Adlake's many applications:

- Radio transmission
- Standard telephone circuits
- Precision control instruments
- X-ray control
- Air-conditioning and refrigeration controls
- Voltage regulators
- Incubators
- Production time controls
- Animated displays
- Duplicator controls
- Communication equipment
- Remote controls
- Alarms

The same engineering skill... the same high-quality control standards... that have insured dependability in these installations are available for your relay problems. If you don't find the relay you need in the Adlake catalog, it will be custom-built for you. Write for full information today—The Adams & Westlake Company, 1171 N. Michigan, Elkhart, Indiana. In Canada write: Powerlite Devices, Limited, of Toronto.

Every Adlake relay gives you these plus features:

- Hermetically sealed—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation.
- Silent and chatterless—requires no maintenance.
- Absolutely safe—mercury-to-mercury contact prevents burning, pitting and sticking.

And every Adlake is tested—and guaranteed—to meet specifications!

The Adams & Westlake Company

Established 1857 • Elkhart, Indiana • New York • Chicago
Manufacturers of Adlake hermetically sealed mercury relays

Want more information? Use post card on last page.
State Regents). In addition, educational institutions have filed for 8 non-reserved (commercial) frequencies and 4 CP's have been awarded.

Along with Detroit, some 20 or 30 more schools and colleges are expected to make application before deadline.

British TV Sales Spurred by Coronation

TV set production rises to new high despite tax as 1952 radio sales show sharp drop-off

EXPECTED purchase-tax reduction has caused some British subjects to postpone buying new TV sets—but not many. Last year's U.K. tv production topped 800,000, an increase of more than 90,000 over 1951. Radio sales dropped 44 percent in the same two-year period.

Pre-coronation sales are expected to set new high for TV purchases regardless of tax. Retailers with large inventories are anxiously awaiting Parliament committee report that will clarify position of traders holding unsold goods on which customs and excise duties have already been paid at higher rates.

FCC Cracks Down On Diathermy

BY LOWERING THE BOOM on interference-radiating medical diathermy equipment, Federal Communications Commission may create a market for new machines that conform to modern specifications. Chief objection to older equipment is that it has no control of frequency and sends out strong signals that wander among television, aircraft and other bands as the patient moves during treatment.

Crackdown—Last June, FCC realized that a hardship would be worked on doctors and hospitals if new rules were clamped down too hard too fast. It agreed to consider individual requests for continued temporary use of old equipment until it became possible to obtain better machines.

But reports of interference keep coming in. With few exceptions the troubles are traced to equipment manufactured prior to July 1947. Information available to the Commission indicates that type-approved, nonradiating machines are now available for early delivery. Accordingly, says FCC, there is no present intention to hold off full enforcement of modern standards beyond June 30, 1953.

Electronic Fuel Gage Extends Flight Range

OPERATING RANGE or load carried by planes on long flights can be increased by the use of a new electronic system for accurately measuring the weight of fuel being consumed. The increase is gained by a reduction in the fuel-supply safety factor required in flight calculations.

In the usual method of measurement, by a flowmeter indicating consumption in gallons per hour, variations in fuel volume caused by temperature and altitude changes make a large safety factor necessary. The new system uses a weight-measuring device to continuously measure the density of the fuel and correct the output of the flowmeter for any variations. Consumption is indicated in pounds per hour with an accuracy of 1 per cent.

Other Applications—The measuring system, made by Gavco Division of General Aviation Corp., can also be applied to guided missile research, where the density and flowmeter outputs can be used for frequency modulation in a telemetering system.

For industrial use, particularly in the chemical industry, the weight-corrected output on the flowmeter can be used to control the flow of liquid ingredients.

Heating Equipment Orders Rising

Total induction and dielectric heating equipment orders for 1952 were lower than the 1951 high of $17 million but the trend for the industry is moving upward, as shown in the chart. Rotating induction equipment still constitutes the bulk of the business but the proportion of both radio-frequency induction and dielectric equipment is increasing

Resistor Industry Helps Its Own

SMOKE had hardly cleared away from the $300,000 fire at Shallcross Manufacturing's plant in Collingdale, Pa. before competing resistor manufacturers were offering a helping hand. Several nearby companies, such as International Resistance and Mepco, offered use of their facilities and even supplied needed materials. Vendors wasted no time in replacing damaged supplies and equipment and customers cooperated in readjusting delivery schedules.

In expressing the company's appreciation for these neighborly actions, president John Shallcross said: "It makes me proud to be associated with an industry where folks are willing to go so far out of their way to help a fellow mem-

(Continued on page 24)
FROM V.H.F. TO S.H.F.

* RADAR TEST SET S AND X BAND

LABORATOIRES R. DERVEAUX
S. A. R. L. AU CAPITAL DE 20,000,000 DE FRANCS

BUREAUX ET USINES
6, RUE JULES-SIMON — BOULOGNE-SUR-SEINE
TEL: MOLITOR 37-00

LABORATOIRES
64, RUE DU CHATEAU — BOULOGNE-SUR-SEINE
TEL: MOLITOR 73-90 ET 91


Ag. PUB. EDITE-DOMENACH

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
U. S. Electronics Firms Enter Japan

INDICATION of activity of U.S. manufacturers in Japan's electronic industry is given in the recently released official Japanese record of foreign entry into the industry of the country since 1950. A total of 6 U.S. companies have entered into Japanese electronic manufacturing through a total of 13 technical assistance contracts with Japanese companies. The six firms and the number of contracts each have is as follows: Bendix Aviation, 1 contract; Hogen Laboratories and Faximile, 1 contract; International Standard Electric, 2 contracts; RCA, 5 contracts; Sperry, 2 contracts and Westinghouse, 2 contracts.

Three U.S. manufacturers acquired stocks in Japanese electronic companies. Westinghouse acquired a 4-percent interest in the Mitsubishi Electric Co.; International Standard Electric acquired a 6-percent interest in Sumitomo Electric Ind., Ltd. and Sperry acquired a 25-percent interest in Tokyo Keiki Seizosho., Ltd.

Contracts—The number of technical assistance contracts for electronics entered into by U.S. firms has grown steadily since 1950. In that year only one such contract was signed but in 1951 5 were set and last year 8 agreements were made.

The type of equipment on which technical assistance was given by U.S. companies broke down as follows: 4 contracts were for electron tube manufacture, and transistors; 4 were for radar and marine electronic equipment; 3 for radio and communications equipment; 1 for tv receivers and 1 contract for facsimile equipment.

The Siemens and Halske A. G. company from Germany was the only other outside firm to enter Japanese electronics since 1950, according to the report.

Transparent Airframes May Baffle Radar

AT THE RECENT annual session of the Society of Plastics Industry in New York, Wm. E. Braham of Zenith Plastic announced it is possible to produce complete airframes made of a plastic that is not only strong, easily molded and temperature stable, but is also nearly electronically transparent.

Carrying this development into the aircraft power plant, Braham said it might also be possible to produce engines which use plastic for all but the hot working surfaces—turbine blades, combustion chambers, and so on.

Small Target—The problem for some electronics men is to figure out radar's potential limits. How much can transmitter power be increased to compensate for reduced target size? What is the smallest target an ideal radar can recognize? How well could an enemy missile whose only electronically reflecting surfaces were the bomb warheads be spotted high in the sky?

Canadian TV Expansion Sought

PRIVATE BROADCASTERS in Canada (as contrasted with government-controlled Canadian Broadcasting Corporation) have complained long and loud about their lot in Canadian radio. Now that many of them are losing listeners to the television programs from south of the border, they have set up a clamor for their own television stations.

But CBC was anxious to get its own television network going before allowing competition from private initiative. So far, it is transmitting programs from Montreal and Toronto, plans an Ottawa outlet for May. It has also blueprinted stations for Vancouver, Winnipeg and Halifax.

What’s Left—Canada’s equivalent of FCC is the Department of

(CA A Uses Radar Simulator

Pilots seated at a multiple console fly in accordance with traffic controller's telephoned instructions from desk at center rear. White dots on chart at right represent the craft. Simulated radar presentation on common screen is electronically controlled and viewed in mirrors above each position.

April, 1953 — ELECTRONICS
We haven't cut corners on **QUALITY CONTROL** to speed deliveries for

**CHESTER**

**plasticord-plasticote**

**WIRES & CABLES**

Extra shifts, not speed-ups are the way Chester catches up on production to meet your delivery dates. Chester Wires and Cables are never rushed through...every foot is quality controlled according to the highest standards known to the industry. This is the reason Chester Wires and Cables are of uniform quality, always dependable, whether you use a foot or a spool. For an extra measure of reliability, specify Chester, for your next electrical or electronic requirements.

**WIRE AND CABLE DATA SHEETS**
Contains complete information on Chester Quality Conductors. Call or write for yours, today!

**CHESTER CABLE CORP**

**CHESTER • NEW YORK**

---

ELECTRONICS — April, 1953
Transport, but broadcasters must have their applications approved by CBC in addition. For the present, at least, CBC will accept tv applications only for cities in which it has no stations planned. First applications with a ghost of a chance are: Hamilton, London, Sudbury and Windsor, Ont.; Quebec City, Que.; Saint John, New Brunswick; and Sydney, Nova Scotia.

Next Year's IRE Show Location?

When the Government Tax Bureau announced it was taking over Grand Central Palace in 1954, IRE made arrangements to hold next year's show in the Kingsbridge Armory in the Bronx (New York City). Then the newspapers announced that the Tax Bureau had changed its mind and now considers the Palace 'not desirable'.

▶ Who Says?—Tracking the story to the General Service Administration, the agency that hires office space for all Uncle Sam's agencies, ELECTRONICS learned from Walter T. Downey, Regional Director, that the policy reversal was not yet official. Yes, the Treasury Department had changed its mind, but they are still awaiting permission from Washington to stop Palace negotiations.

Meanwhile, IRE says "No comment".

Business Briefs

▶ Bathtubs and home telephones are outnumbered by tv sets in Chicago, according to Admiral Corp. There are 1,360,000 tv sets in use while bathtubs number 1,260,000 and home telephones 1,320,000.

▶ Costing more than $600,000, New York Fire Department's new two-way f-m communications system uses 8 adjacent radio channels. Over 500 pieces of fire apparatus are now equipped; there are 10 marine installations and a batch of walkie-talkies. Motorola's share of the contract came to $586,000.

▶ India plans to spend $2.1 million on an expanded network of radio transmitters including three high-power shortwave transmitters, seven high-power medium-wave, five medium-power medium-wave and five low-power medium-wave transmitters.

▶ Nuisance Tax of $2.50 yearly on Canadian broadcast receivers has been abolished. Henceforth government-controlled Canadian Broadcasting Corp. operations will be supported by 15-percent excise tax on radio and tv sets, tubes and components. Yield of $12 million yearly is expected.

▶ Ship-to-shore tv trials in England resulted in clear tv reception from a point 16 miles distant and 100 feet under the sea. Experimental Pye transmitter used had an output of 250 watts.

▶ Experimental radar station will be constructed at Rensselaer Polytechnic Institute in Troy, N. Y. Three airborne units may be in operation by June for the study of the effects of weather conditions on range and clarity of image.

MEETINGS

APRIL 8-10: AMA Spring Manufacturing Conference, Hotel Statler, New York, N. Y.


APRIL 11: Seventh Annual Spring Technical Conference, Cincinnati IRE, Cincinnati, Ohio.


APRIL 21: Symposium on Ceramic-Metal Seals sponsored by the Panel on Electron Tubes of the Research and Development Board, Rutgers University School of Ceramics, New Brunswick, N. J.


APRIL 28, 30, MAY 7, 14: Lecture Series on the general theory of semiconductors by H. K. Henisch of the University of Reading, England, Brooklyn Polytechnic Institute, Brooklyn, N. Y.


APRIL 28-MAY 1: Seventh Annual NARTB Broadcast Engineering Conference, Burnett Hall, Philharmonic Auditorium, Los Angeles.


MAY 11-13: IRE National Conference on Airborne Electronics, Dayton, Ohio.

MAY 18-21: 1953 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.


MAY 24-29: NAFED, 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.


JUNE 9-11: International Aviation Trade Show, Hotel Statler, New York, N. Y.


JUNE 20-22: German Communication and Transportation Exhibition, Munich, Germany.


JUNE 29-SEP. 6: West German Radio and Television Exhibition, Dusseldorf, Germany.

SEPT. 1-3: International Sight and Sound Exposition, Palmer House, Chicago, Ill.

Rugged local oscillator for mobile radar. Highly non-microphonic. Shaft tuner; no chatter or backlash; excellent for motor-tuned systems. Reflex, 8.5-10.0 kmc, replacing Varian V-50.

For radar, beacon or low-power transmitter operation under severe mechanical punishment. Lock-nut tuner holds the tube on frequency even under shocks of several hundred g. Reflex, 8.5-10.0 kmc, replacing Varian V-51.

For high altitude or high humidity applications. Silicone-rubber-potted base and reflector connections instead of conventional base and reflector cap. Electrically identical with V-260 and V-280.

Reflex tube for test and measurement work at x-band. Integral tuner covers the full frequency range, 8.2-12.4 kmc. Typical power output is 150 mw over the band, 500 mw at center frequency.

Detailed data sheets available. Write Varian Associates, Section AA2AX, 990 Varian Street, San Carlos, California
Why PHELPS DODGE ROUND THE YARDSTICK FOR

- Up-to-the-Minute Research
- Quality Controlled for Maximum Performance
- Leader in Application Engineering
- Experience Over Complete Range— #4 to #44, AWG—All Grades and Colors

"It takes the best"

PHELPS DODGE COPPER PRODUCTS CORPORATION

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
FORMVAR has become

FILM WIRE QUALITY!

PHILIPS DODGE, recognizing the advantages of round Formvar magnet wire, became the leader in replacing enamel, fabric and paper-covered wires. Today, round Formvar is used extensively in motors, transformers and coils, with resultant overall cost reductions and quality improvements in the insulation system.

Where greater spacing or additional safety factors are indicated, fabrics such as cotton or paper can be added. For higher temperature operation Phelps Dodge Formvar, with a wrap of fiberglass, has been widely used.

For some applications a thin sheath of Nylon has been applied over the Formvar and identified as Phelps Dodge Nyform magnet wire.

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

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

www.americanradiohistory.com
Facts behind the S-1 TIMER'S extraordinary .005 SEC. accuracy...

Formula S-1: Expensive high torque, ball bearing motor, low inertia of moving parts, high proportion of precision and ground parts, no thrust bearings as found in ordinary clutches.

- High torque (2 inch-ounce at 100 RPM) industrial grade motor (#1) with no internal gear train so small changes in load due to binds or hand acceleration cause no phase shift between rotor and rotating field... runs continuously to eliminate starting error.
- Precision cut gears (#2, #3). Any eccentricity or inaccuracies in gearing reflect directly in timer reading.
- Slip clutch composed of hardened steel spring (#4) riding a V-grooved graphited (for long wear) collet, applies .6 inch-ounces of torque to aluminum (for low inertia) control disc (#5) with over 314 tiny teeth in its periphery.
- To hold control disc (#5) at rest, 2 hardened steel brake shoes (#6), ground to square knife edges, grip periphery of control disc in 4 places... control disc position to under 1/2 of a degree (1.720 second).
- Electro magnet (#8) pulls brake shoes away from control disc through armatures (#7). Air gaps kept to minimum for speed. Precision made fulcrums prevent stickiness or unequal movement of armatures.
- Adjusting screw (#11) adjusts tension of armature spring (#10) so that time between energizing magnet coil and starting of control disc is same as time between de-energizing magnet coil and stopping of control disc. This compensates for starting and stopping errors.
- Second friction clutch (#2) transfers control disc motion to center shaft (#13); allows hands to be reset when control disc is held stationary.

"Gentlemen... Let me give you the formula for our astounding final accuracy of .005 sec. obtained with our D-C clutch S-1 Timer."

To Split the Split Second with ACCURACY, Take a Minute Now and Write Us for Engineering Data

The STANDARD ELECTRIC TIME COMPANY
97 LOGAN STREET - SPRINGFIELD 2, MASSACHUSETTS

SINCE 1884

PRECISION TIMERS • CHRONO-TACHOMETERS • LABORATORY PANELS • PIPELINE NETWORK ANALYZERS

want more information? Use post card on last page.

April, 1953 — ELECTRONICS
### General Electric Interchangeability Chart for Germanium Diodes

<table>
<thead>
<tr>
<th>Type &amp; Mfr.</th>
<th>G.E. Replacement</th>
<th>Minimum Forward Cur. @ +15V (Ma)</th>
<th>Peak Inverse Voltage (Volts)</th>
<th>Cont. Inverse Voltage (Volts)</th>
<th>Maximum Reverse Cur. (Amp)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N424 (S)</td>
<td>1N410</td>
<td>1.0</td>
<td>200</td>
<td>50</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>1N410</td>
<td></td>
<td>1.0</td>
<td>200</td>
<td>50</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>1N522</td>
<td>2.0</td>
<td>400</td>
<td>150</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>1N35 (S,G)</td>
<td>1N48</td>
<td>4.0</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1N330 (S)</td>
<td></td>
<td>4.0</td>
<td>100</td>
<td>50</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>KB152</td>
<td>1.0</td>
<td>200</td>
<td>50</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>KB160</td>
<td>2.0</td>
<td>200</td>
<td>50</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>KB110</td>
<td>3.0</td>
<td>300</td>
<td>150</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>KB115</td>
<td>4.0</td>
<td>400</td>
<td>200</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>KB120</td>
<td>5.0</td>
<td>500</td>
<td>300</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>1N340 (S)</td>
<td>KB125</td>
<td>6.0</td>
<td>600</td>
<td>400</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** For more information, visit www.americanradiohistory.com.

---

**General Electric**
It's VERSATILITY that sells SANBORN in the field of Industrial Recording

As indicated by references at the right, you may have a choice of five different instruments (A) for quick and convenient standard rack mounting in the system or PLUS a choice of up to four of any of the three different type amplifiers (B) or any combination of these amplifiers with the

SANBORN FOUR-CHANNEL OSCILLOGRAPH RECORDING SYSTEM

(MODEL 67)

As shown in the diagram, removing or interchanging any of the amplifiers or other instruments is simply a matter of sliding the unit in or out of the mounting rack where contact is made automatically by plug-in connectors. Screws at the four corners of the panel hold the instrument in place.

Other features of this system which add to Sanborn VERSATILITY are the choice of eight paper speeds — 50, 25, 10, 5, 2.5, 1.0, 0.5 and 0.25 mm/sec, and the use of either 4-, 2-, or 1-channel recording paper.

And, of course there are these popular Sanborn advantages: a high torque movement (200,000 dyne cms per cm deflection), direct inkless recording in true rectangular coordinates, and provision for code and time markings.

Sanborn Recording Systems may be used to record any one or more of a wide variety of phenomena whose characteristics range from static to 100 cycles per second. If your recording problem is not one which can be solved by standard Sanborn equipment, our engineers will be glad to suggest ways in which modifications of it may suit your requirements.

A complete catalog of Sanborn Industrial Recording Equipment will be sent gladly on your request.

SANBORN COMPANY
CAMBRIDGE 39, MASS.

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
G.E. ANNOUNCES a new line of subminiature metal-clad capacitors with silicone end seals and a solid dielectric for operation from -55 C to +125 C without derating

This new line of General Electric subminiature metal-clad capacitors offers the designer and user of electronic equipment the utmost reliability under the severe operating conditions required of military equipment. G-E metal-clad capacitors are rugged units that provide the essential advantages of small size, no liquid leakage, and high insulation resistance. They also will withstand extreme temperature and humidity conditions.

While these capacitors have been designed for application in the temperature range from -55 C to +125 C without derating, they can, with proper derating, be operated up to +150 C.

G-E subminiature metal-clad capacitors meet all requirements of JAN-C-25 and the proposed MIL-C-25. They can be supplied in both tab and exposed foil designs depending upon your application requirements.

- **Silicone end seal** for high shock resistance—both thermal and physical.

G-E subminiature metal-clad capacitors offer two important, exclusive features that insure outstanding performance:

- **Solid dielectric**—G.E.’s Permafil—to provide excellent electrical characteristics and to eliminate the possibility of leakage.

Need Wax Replacement? If you are caught in the squeeze because of the recent elimination of characteristic J (wax) from the proposed MIL-C-25 specifications, you need not go to a larger capacitor (or continue to use an unacceptable product). See back page of this advertisement for information about a new line of G-E liquid-filled metal-clad capacitors. They’re as small as the wax units, yet have superior life characteristics which make them a “natural” for military equipment.

See next page for informative data on these new G-E capacitors.
ANNOUNCING also... a new line of G-E Pyranol liquid-filled metal-clad capacitors

subminiature in size—ineffective—for operation to +85 C

This new line of G-E subminiature metal-clad capacitors with Pyranol dielectric equals its 125 C Permafil cousin for reliability and ruggedness. It is designed for operation from -55 C to +85 C without derating.

Pyranol, long noted for its high dielectric strength and exceptional stability, has been used in G-E capacitors for more than 20 years with excellent success. Now recently improved, Pyranol makes possible a small-size capacitor with extremely good life characteristics.

This G-E metal-clad line also incorporates the silicone end seal for maximum resistance to shocks—both thermal and physical—and thus permits soldering right up to the bushing without danger of damaging the seal.

G-E Pyranol metal-clad capacitors can be supplied in either tab or exposed foil designs in ratings from .001 to 10.0 muf in voltages of 100, 200, 400, and 600 volts d-c working.

Delivery of G-E Subminiature Capacitors. While many sizes and voltage ratings of both the 125 C Permafil and the 85 C Pyranol metal-clad capacitors are available for immediate shipment, not all muf and voltage ratings are in stock. However, the full line of each type of G-E metal-clad capacitor will be in "stock shipment" shortly. If your requirements demand the highest performance standards for subminiature capacitors, check with your nearest G-E Apparatus Sales Office for exact delivery information. Or write to Section 442-4, General Electric Company, Schenectady 5, New York.

*Reg. trademark of General Electric Company.
POWERSTAT
Variable Transformer

TYPE 10

... with a rheostat or other resistance type controls. You will find POWERSTAT type 10 the ideal source of variable a-c voltage control of 50-100-150 watt loads.

- **EFFICIENCY** of type 10 is high ... does not control by dissipating power in the wasteful form of heat as does a resistance type control.
- **SPACE REQUIREMENT** of type 10 is only 2½ by 3½ inches. Not only is it compact but since it does not produce heat there is no ventilation problem.
- **CONSTRUCTION** of type 10 is rugged for long life and dependable service.
- **ADAPTABILITY** of type 10 to any load within its rating is possible without tailoring as is necessary with a resistance type control.
- **RATING** of type 10 is conservative with the rated output current available at any brush setting.
- **MOUNTING** of type 10 is simple by means of a single hole in the panel. It is locked in position by a keying arrangement.
- **OPERATION** of type 10 is smooth, stepless and silent.
- **PRICE** of type 10 is low ... comparable to any other type of a-c voltage control apparatus of equal capacity and characteristics.

A comparison of POWERSTAT type 10 with a rheostat or other resistance type controls reveals that it is the logical answer to any variable a-c voltage control problem involving loads up to 150 watts.

Additional information on POWERSTAT type 10 is available by writing 204 Mae Avenue, Bristol, Conn.

POWERSTAT type 10 is a small, compact autotransformer of toroidal core design with a movable brush-tap. Rotation of the tap delivers any output voltage from zero to, or above, line voltage. It is tapped to allow compensation for a 10 per cent drop in line voltage.

**THE SUPERIOR ELECTRIC CO.**
BRISTOL, CONNECTICUT

Want more information? Use post card on last page.
This "mighty midget" SX motor provides the power for a wide variety of timing devices, recording instruments, signal systems, traffic controls, and other similar control devices that require dependable performance at constant speed. Available in many output speeds ranging from one revolution per second to one revolution per day, the SX provides up to five times the power of most hysteresis clock motors of equivalent size.

Write for Cramer Timing Device Catalog or specify Bulletin No. 10A for complete information on the Model SX Motor.
18,000 VOLTS OF ELECTROSTATICALLY FOCUSED PICTURE BRIGHTNESS

electrostatically focused Picture Tubes take the full design center max. rating of 18,000 volts with adequate "high line" reserve.

Tested At 22,000 Volts
No Voltage Breakdown

Long Life Guns
Long Life Screens
Superior 100% Area Focusing

RAYTHEON MANUFACTURING COMPANY

RAYTHEON MAKES ALL THESE:

RELIABLE, SUBMINIATURE AND MINIATURE TUBES - GERMANIUM DIODES AND TRANSISTORS - NUCLEONIC TUBES - MICROWAVE TUBES - RECEIVING AND PICTURE TUBES

Raytheon Manufacturing Company


RAYTHEON MAKES ALL THESE:

ELECTRONICS - April, 1953
Which Pilot Light Do You Need?

The Big One

This Pilot Light Assembly was first made to accommodate the S-11 lamp and was intended for use in the cabs of great diesel locomotives.

Dialco Has the Complete Line of Indicator and Panel Lights

The Little One

The miniaturization program on defense products required the development of this sub-miniature light. It is used on communication equipment and aircraft. Midget flanged base bulbs to fit are rated 1.3, 6, 12, and 28 volts.

To suit your own special conditions and requirements will be sent promptly and without cost. Just outline your needs. Let our engineering department assist in selecting the right lamp and the best pilot light for YOU.

Write for the Dialco Handbook of Pilot Lights

Foremost Manufacturer of Pilot Lights

Dialight Corporation

60 Stewart Ave., Brooklyn 37, N. Y.

April, 1953 — Electronics
Formed pieces of tough, National Vulcanized Fibre, with exceptionally high dielectric strength, are used to make this universal coil form. It is expandable to conform to cores of various sizes.

NATIONAL VULCANIZED FIBRE contributes to an improved product—in universal coil forms for Cutler-Hammer, Inc.

This practical use of National Vulcanized Fibre by Cutler-Hammer, Inc. in their wire spools is typical of the countless contributions National Vulcanized Fibre—the material of a million uses—makes to business and industry.

In the electrical field National Vulcanized Fibre has been the standard insulation for years. It has high dielectric strength and, when subjected to hot electrical arcing, it evolves neutral gas which extinguishes arcs without "tracking." Many electric appliances find National Vulcanized Fibre to be the one best material for one or more of their parts.

National Vulcanized Fibre applications, both mechanical and electrical, are varied and extensive. In mechanical applications it is desirable because it possesses exceptional tensile and crushing strength, toughness, density and resistance to wear—coupled with ease of fabrication. It actually improves with age; for many mechanical purposes it is better, more durable than metal.

Available in various grades and colors; and in sheets, rods, tubes and special shapes. Write for detailed literature and engineering service information—

NATIONAL VULCANIZED FIBRE CO.

Wilmington Delaware

Offices in Principal Cities
Since 1873

National Laminated Plastics nationally known—nationally accepted

PHENOLITE Laminated PLASTIC

NATIONAL VULCANIZED FIBRE
Here is Plug-in Unit Construction

Everything you need to mount, house, fasten, connect, monitor your equipment.

1st START WITH
ALDEN MINIATURE TERMINALS

Here's a beautiful new Terminal that really puts soldering on a production basis; taking a minimum of space and material. Ratchet holds leads firmly for soldering, no wrap-around or pliering necessary. Unique punch press configuration gives rapid heat transfer, taking less time and solder. Designed for Govt. Miniaturization contracts. Staked in Alden Pre-punched Terminal Cards, allow patterns for any exactfit.

2nd Take Pre-punched Terminal Mounting Card ready-to-cut to size you require. Stake in Alden Miniature Terminals to mount your circuitry.

3rd Attach Miniature Terminals, Alden Card-mounting Tube Sockets and Mounting Brackets, which mount in the pre-punched holes.

FOR YOUR SMALLER UNITS .

FOR YOUR LARGER UNITS .

TO OBTAIN COMPLETE DETAILS .

Tiny Sensing Elements specifically designed to spot trouble instantly in any unit.

Here are tiny components to isolate trouble instantly by providing visual tell-tales for each unit.

"PAN-i-LITE" MIN. INDICATOR LIGHT

So compact you can use it in places never before possible. Glows like a red-hot poker, Push-mounts in 3/4" drill hole. Bulls replace from front. Tiny spares are unbreakable, easily kept available, taped in recess of equipment. Alden #86L, ruby, sapphire, pearl, emerald.

MINIATURE TEST POINT JACK

Here are tiny insulated Test Point Jacks that make possible checking critical plate or circuit voltages from the front of your equipment panel—without pulling out equipment or digging into the chassis. Takes a minimum of space, has low capacitance to ground, long life beryllium copper contacts. Available in black, red, blue, green, tan and brown phenolic conforming to MIL-P 145. GFF; also yellow in black, red, orange, blue, yellow, white, green. Alden #110BCS.

ALDEN "FUSE-LITE"

Fuse Blows - Lite Glows.

Signals immediately blown fuse. Lite visible from any angle. To replace fuse simply unscrew the 1-pc. Lite-ten unit. Mounts easily by standard production techniques, in absolute minimum of space. 110V Alden #440-4FH. 20V #440-6FH.

Free Samples Sent Upon Request

ALDEN PRODUCTS COMPANY

www.americanradiohistory.com
READY-MADE for your Electronic Equipment

All designed — all tooled — production immediately available — no procurement problems. Apply ALDEN Standards wholly or in part.

ALDEN PLUG-IN PACKAGES

4th After mounting your circuits on Terminal Cards, use Alden Standard Plug-in Bases, Housings, Bails for packaging.

Min. 7 & 9-pin BASES available, also 11-pin & 20-pin BAILS & HOUSINGS or LIDS to match.

ALDEN BASIC CHASSIS

4th Fit Prepunched Cards carrying completed circuitry into Standard Alden Basic Chassis Body.

Prepunched to your specs. Easy accessibility at sides, front for completing wiring.

SERV-A-UNIT LOCK
pulls in or ejects chassis.

ALDEN PLUG-IN PACKAGES —

Using standard Alden Plug-in Packaging Components you can mount a tremendous variety of circuits on chassis or in racks.

HOUSE PLUG-IN UNITS IN ALDEN BASIC UNI-RACKS

STACKED Mounting all equipment in Alden Uni-Racks provides a uniform system easy to handle and ship. Can be installed and interconnected as fast as unloaded.

ALDEN UNIT CABLE
interconnects between Uni-racks or other major circuitry divisions. Quick, sure, coded means of initiating and restoring (with spare) inter-division circuits.

SEND FOR FREE "ALDEN HANDBOOK"

Your design and production men have always wanted these advantages:

1. Experimental circuitry can be set up with production components, cutting down debugging time.
2. Allows technicians, rather than engineers, to debug, by taking out unit.
3. Given the circuitry, nothing further to design—make up from standard Alden components.
5. Absolute minimum requirements of labor, materials, space.
6. The various sub-assemblies can be built concurrently on separate assembly lines.
7. No tooling costs—no delays—no procurement headaches.
8. Fewer prints—smaller parts inventory.

Your customers and sales force will welcome these advantages:

The big objection to electronic equipment—from the user's point of view—is that if it goes out of order he feels helpless. But you have a perfect answer when your equipment is made to Alden Standards of Plug-in Unit Construction because they assure DEPENDABLE OPERATION, as follows—

30-SECOND REPLACEMENT OF INOPERATIVE UNITS by plugging in available coded spares.

TROUBLE INSTANTLY INDICATED AND LOCATED by monitoring elements assigned to each functional unit.

TECHNICAL PERSONNEL NOT REQUIRED to maintain in operation, due to obvious color coding and fool-proof non-interchangeability of mating components.

TOOLESS MAINTENANCE made possible by patented Alden fasteners and plug-in locking and ejecting devices.

MAIL SERVICE—
Compact functional units practical to send air mail to factory for needed overhaul.

UNIT-RACK FIELD HANDLING UNIT—groups functional units into stacking cabinets not exceeding one- or two-man handling capacity—go easily through windows, doors.

CONNECT AS FAST AS UNLOADED, by coded non-interchangeable unit cables plugged in between Uni-racks.

SEND FOR FREE 226-PAGE HANDBOOK

This 226-page Handbook describes fully the Alden System of Plug-in Unit Construction and the hundreds of components ready-made and completely tooled to meet your every requirement. It's a gold-mine for those designing electronic control equipment that is practical in manufacture; dependable in operation.

REQUEST YOUR COPY TODAY — SENT FREE!

127 North Main Street • Brockton 64 • Massachusetts
COMPLETE CIVILIAN LINE

Exceptionally good delivery cycle on civilian orders due to tremendous mass production facilities.

NEW HIGH QUALITY MINIATURIZED "DIME-SIZE" CIVILIAN CONTROL—Performance Fully Equals Larger Types.

TYPE 70, 3/4" diameter variable composition resistor. Wattage rating: .3 watt for resistances through 10,000 ohms, .2 watt with 350 volts maximum across and terminals for resistances over 10,000 ohms. Also available in concentric shaft tandem construction C45-70 as shown above.

TYPE C2-45

Exceptionally good delivery cycle on civilian orders due to tremendous mass production facilities.

TYPE C2-35

TYPE C2-252

TYPE C2-25

TYPE GC-45, 15/16" diameter variable composition resistor. Wattage ratings: 1/2 watt for resistances through 10,000 ohms, 1/3 watt for resistances over 10,000 ohms through 106,000 ohms, 1/4 watt with 500 volts maximum across and terminals for resistances over 100,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-45 as shown above.

TYPE GC-35, 1 1/8" diameter variable composition resistor. Wattage rating: 3/4 watt for resistances through 10,000 ohms, 2/3 watt for resistances over 10,000 ohms through 25,000 ohms, 1/2 watt with 500 volts maximum across and terminals for resistances over 25,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-35 as shown above.

TYPE GC-252, 2 watt, 1 17/32" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-252 as shown above.

TYPE GC-25, 4 watt, 1 17/32" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-25 as shown above.

Typical concentric shaft tandem with panel and rear sections operating separately from concentric shafts (TYPE C45-70 ILLUSTRATED). Similar construction available for all military resistors.

REPRESENTATIVES:

IN CANADA

C. C. Meredith & Co.
Streetville, Ontario

SOUTH AMERICA

John A. Green Company
8318 Olive Drive
Dallas 9, Texas

OTHER EXPORT

Sylven Ginsbury
8 West 40th Street
New York 18, N. Y.

IN CANADA

McClatchy Bldg.
69th 8th
Market Sr.
Upper Darby,
Pennsylvania
Phone: Flanders 2-4423

W. S. Harmon Company
1638 South La Cienega
Hilve.
Los Angeles 35,
California
Phone: Bradshaw 2-332

John A. Green Company
6815 Oriole Drive
Dallas 9,
Texas
NEW 38-PAGE ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. Write today for your copy.

TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

TYPE 35, (JAN-R-94, Type RV5)
1/2 watt, 11/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

TYPE 252, (JAN-R-19, Type RA30)
2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.

TYPE 25, (JAN-R-19, Type RA50) (May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.

TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.

TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.

TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 11/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

CHICAGO TELEPHONE SUPPLY Corporation
ELKHART • NDIANA

PRECEDENTED PERFORMANCE CHARACTERISTICS
Specially designed for military communications equipment subject to extreme temperature and humidity ranges, −55°C to +150°C...ardidity to saturation.
MEPCO'S NEW SEALED Precision Resistors STOP Humidity Failures

Over 2 years of laboratory development and testing were required to achieve a sealed resistor design up to Mepco's standard of quality. No sacrifice of our standard time-proven features have been made in order to perfect this sealed resistor.

SPECIFICATIONS: Meets all requirements of MIL-R-93A and JAN-R-93.

SEALING: Completely encapsulated and bonded.

OPERATING TEMPERATURE: -65°C to +125°C.

WINDINGS: Reversed and balanced Pi-windings for low inductance with use of only the finest "certified" resistance alloys.

EXCLUSIVE INTERNAL FEATURES: Internal section's cross-over wire insulated from winding by 2000 v. insulation (patented). Special metal molded connecting feature, which bonds end of winding and terminal in a non-corrosive and mechanically secure manner — no solder or flux used.

TERMINALS: Rigid hot solder coated brass terminals for easier and more secure soldering.

---

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NOMINAL WATTAGE RATING</th>
<th>RESISTANCE</th>
<th>SECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB15</td>
<td>.25</td>
<td>0.1 ohm</td>
<td>2</td>
</tr>
<tr>
<td>(M15)</td>
<td></td>
<td>.185 meg.</td>
<td></td>
</tr>
<tr>
<td>RB16</td>
<td>.35</td>
<td>0.1 ohm</td>
<td>2</td>
</tr>
<tr>
<td>(M16)</td>
<td></td>
<td>15 meq.</td>
<td></td>
</tr>
<tr>
<td>RB17</td>
<td>1.00</td>
<td>0.1 ohm</td>
<td>4</td>
</tr>
<tr>
<td>(M17)</td>
<td></td>
<td>3 meq.</td>
<td></td>
</tr>
<tr>
<td>RB18</td>
<td>.50</td>
<td>0.1 ohm</td>
<td>4</td>
</tr>
<tr>
<td>(M18)</td>
<td></td>
<td>1.5 meq.</td>
<td></td>
</tr>
<tr>
<td>RB19</td>
<td>2.00</td>
<td>0.1 ohm</td>
<td>8</td>
</tr>
<tr>
<td>(M19)</td>
<td></td>
<td>15 meq.</td>
<td></td>
</tr>
<tr>
<td>RB52</td>
<td>.25</td>
<td>0.1 ohm</td>
<td>2</td>
</tr>
<tr>
<td>(M52)</td>
<td></td>
<td>.5 meq.</td>
<td></td>
</tr>
</tbody>
</table>

MIL - R - 93A

<table>
<thead>
<tr>
<th>TOLERANCE SYMBOL</th>
<th>WATTAGE &amp; RESISTANCE TOLERANCE</th>
<th>PERCENT OF NOMINAL WATTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>0.10 %</td>
<td>50 %</td>
</tr>
<tr>
<td>C</td>
<td>0.25 %</td>
<td>50 %</td>
</tr>
<tr>
<td>D</td>
<td>0.50 %</td>
<td>75 %</td>
</tr>
<tr>
<td>F</td>
<td>1.00 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>

MIL - R - 93A

<table>
<thead>
<tr>
<th>TEMPERATURE COEFFICIENT</th>
<th>EXPRESSED IN PERCENT PER DEGREE C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(REFERRED TO 25°C)</td>
<td>NEGETIVE, MAX.</td>
</tr>
<tr>
<td>E</td>
<td>0.0022</td>
</tr>
<tr>
<td>J</td>
<td>0.0040</td>
</tr>
<tr>
<td>K</td>
<td>0.0050</td>
</tr>
</tbody>
</table>

SPECIAL REQUIREMENTS

Variations of the above ratings, tolerances, temperature coefficient, etc. can be supplied to special order.

MEPCO, INC.
MORRISTOWN, NEW JERSEY

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
...by winding a paper strip into tubular form...

These words by Marvin C. Stone were contained in this artificial drinking straw patent granted him January 3, 1888, a patent which marked the entry of Stone into the spiral wound paper tube field.

During the next forty years, the use of Stone's Drinking Straws became worldwide and the products of the Tube Division of Stone Straw Corporation were finding an important place in industry.

To better serve the expanding needs of the electrical and electronics industries, the Stone Paper Tube Company was organized early in 1928 and since that time has become one of the largest manufacturers of small diameter paper tubes in the country.

Today, millions of Stone custom-made items pour from batteries of Stone designed and manufactured machines... machines whose unique construction features are a closely guarded trade secret.

Magnetic switch insulation for automotive accessories, armature shaft insulation for fractional HP electric motors, coil winding bobbins for time control motors, and Stonized spiral phenolic coil forms for radio and television are just a few of the many uses hundreds of America's leading manufacturers make of our product.

Made-to-order quality items can be furnished in diameters as small as 3/64" ID, various wall thicknesses and lengths, and of many materials including high-dielectric kraft, fish paper, and plastic film. They are, of course, made to extremely close tolerances... are low in cost... and your order is handled with unsurpassed service.

Chances are there are many applications in which you could put Stone products to profitable and practical use in your business. Write us for a more complete story of what we have to offer you.

Sales representatives are located in principal cities for your convenience.

Stone Paper Tube Co. Incorporated
Washington 17, D.C.
You know he'll never lose you...

YOUR GUIDE...you know he'll take you where you want to go, by the quickest, easiest route. That's exactly what Bristol Brass aims to do... to get your order to you the same way. And that takes experience and character... both in the company and in its product.

Matter of fact, that's why so many people keep standing orders with Bristol Brass... because they know those orders will never get lost.

They'll be where they're supposed to be, right on time, and right according to specifications... be it sheet, rod or wire.

The BRISTOL BRASS CORPORATION, makers of Brass since 1850 in Bristol, Conn. Offices or warehouses in Boston, Chicago, Cleveland, Dayton, Detroit, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, Providence, Rochester.
SORENSEN REGULATES AND CONTROLS

SORENSEN'S EXPANDED LINE OF B-SUPPLYS NOW INCLUDES THIS NEW MULTI-RANGE DUAL SUPPLY.

Many users of Sorensen Nobatrons* and AC Regulators are unaware that the standard Sorensen line includes a wide range of "B-Nobatrons" — high voltage, low-current DC sources.

Are you familiar with the number of units in the line? Two of them — models 360BB and 520BB — are low-cost units for those not requiring outputs adjustable down to zero, but which can be paralleled for higher current requirements. The other models are highly flexible, all-purpose laboratory instruments. All of them provide voltage and current well in excess of the specifications given below (these "plus values" are shown graphically in the new Sorensen DC catalog).

You owe it to yourself to get acquainted with these Sorensen B-NOBATRONS. You'll find they are reasonably priced — surprisingly so — yet in all ways live up to the Sorensen reputation for sound engineering, quality construction, dependable operation. Write for information.


MODEL 350-B SPECIFICATIONS

<table>
<thead>
<tr>
<th>INPUT</th>
<th>105 - 125 VAC, 50 - 60 Hz, 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT</td>
<td>1. 175-350 VDC @ 0-60 Ma simultaneously from two independently adjustable outlets.</td>
</tr>
<tr>
<td></td>
<td>2. 175-350 VDC @ 0-120 Ma from one outlet.</td>
</tr>
<tr>
<td></td>
<td>3. 0-175 VDC @ 0-60 Ma from one outlet.</td>
</tr>
<tr>
<td></td>
<td>4. 6.3 VAC @ 3.5 amps., C.T., unregulated.</td>
</tr>
</tbody>
</table>

| OUTPUT REGULATION | ±1.0% |
| RIPPLE | 10 mv |
| SIZE | 13" x 7 1/2" x 8" |

For Complete Information Write
SORENSEN & COMPANY, INC.
375 Fairfield Avenue Stamford, 1 Conn.

www.americanradiohistory.com
ANOTHER milestone in production techniques

ANOTHER instance of “built-in know-how”

This is not just another stem machine. It is a completely automatic stem machine with 24 heads and precision high speed index. The machine illustrated embodies all the improved techniques and mechanisms that Kahle engineers could find from their own and their customers’ experience.

This problem involved glass tubulated stems for radio tubes. However, Kahle has solved many other problems neither associated with glass or connected with electronics.

If your problem requires special techniques or processes; if you need custom machinery; or, if you need relief from expansion projects, Kahle engineers will work with you to achieve “customer satisfaction” from “Built-In Know-How.”

AUTOMATIC BUTTON STEM MACHINE

- Kahle Engineering Company has added one more outstanding piece of equipment to their constantly growing list of production equipment.
- A new 24 head Button Stem Machine No. 2179 for making one inch button stems with 8 wires and tubulation for T-9 tube sizes.
- Machine incorporates automatic lead wire feed, automatic tubulation feed, automatic glass bead feed, automatic unload. These, combined with automatic rejection and head cleanout in case any component fails to feed, make this machine unique.
- Such a machine is ideal for other similar stems such as cathode ray stems with 6, 8 or 10 wires.
The FIRST and still the only ALL-BAND DIRECT READING SPECTRUM ANALYZER

10 MCS TO 21,000 MCS

Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.

- Continuous tuning.
- One tuning control.
- Resolution is 5KC when dispersion is 5MC per inch per sec.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1%.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment from 1 to 12 KMC.
- Frequency marker for measuring frequency differences 0-25 MCS.
- Only four tuning units required to cover entire range.
- Microwave components use latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Where Used:
Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency of distribution of energy in an r.f. signal in the range 10 to 21,000 MCS.

Other uses are:
1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measure noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.

Write for Complete Details

100 METROPOLITAN AVE.
BROOKLYN 11, N. Y.

Export Dept.: 13 East 40 Street, New York 16, N. Y.
Cable Address: "ARLAB"
For multiple contact connectors, Ucinite offers its molded miniaturized connector in low-loss material and banana plugs and jacks for adaptability to special requirements.

Molded assemblies are available in standard 12 and 14 pin connectors. Banana plugs and jacks can readily be made in assemblies for specific application.

Ucinite banana pins have one-piece beryllium copper springs to insure proper alignment and firm contact under the most adverse conditions. Mounting ends can be made up in practically unlimited variety for staked or threaded mounting. Springs and mating jacks are available in several sizes.

Ucinite engineers are ready to design and manufacture single and multiple contact connectors to solve your special problems.

The Ucinite Co.
Newtonville 60, Mass.
Division of United-Carr Fastener Corp.

Specialists in
ELECTRICAL ASSEMBLIES,
RADIO AND AUTOMOTIVE
Turn your special fastening problems over to United-Carr and free your own design staff for full-time work on finished-product engineering.

United-Carr's engineering department is constantly at work, improving current DOT fasteners and designing entirely new fasteners to meet the changing needs of industry.

Experience gained through working with the leading manufacturers of automobiles, aircraft, appliances and furniture as well as electronic apparatus ... enables us to bring an unusually wide variety of abilities and techniques to bear on your particular fastening problems. And, with complete facilities for volume production of metal fasteners and the assembly of metal to plastic and ceramic components, we are in a position to supply practically any fastening need.

The fasteners and assemblies illustrated here are typical of thousands of special devices designed and manufactured by United-Carr and its subsidiaries.

We urge you to call in your nearest United-Carr field engineer before your new designs crystallize. It is at this all-important planning stage that you can make most effective use of our special services.

UNITED-CARR

MAKERS OF DOT FASTENERS

UNITED-CARR FASTENER CORPORATION, CAMBRIDGE 42, MASSACHUSETTS

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
AMP CAPITRON® Capacitors and Pulse Forming Networks are particularly suited for radar and guided systems not only because of their remarkable size and weight characteristics, but also because of their outstanding stability and reliability in operation. AMP Pulse Forming Networks are fabricated with AMPLIFILM®, a startling new synthetic dielectric, chemically similar to mica, which imparts its unique combination of extremely high dielectric strength, stability over wide temperature ranges, low power factor, and good dielectric constant to these products.

For this reason CAPITRON® High Voltage Capacitors and Pulse Forming Networks are designed and fabricated for either A-C or D-C use in applications where the mechanical, electrical or thermal requirements are such that standard or catalog capacitors made with mica, paper or plastic dielectrics would be inadequate. These Capacitors and Networks are not made in a standard line of types or models.

They are designed in each instance for the specific requirements as to size, shape, working or test voltage, capacitance, life or other operating conditions of the equipment in which they are to be used. Inquiries are invited.

AMP is also nationally recognized leader in the field of solderless terminals, simplified wiring devices and, automatic wire termination.

Write for our "Quality Control" brochure.
AMP CAPITRON Trademark
HIGH VOLTAGE CAPACITORS AND PULSE FORMING NETWORKS

up to 70% size and weight reduction
wide temperature range
close capacity tolerance
no derating
no drift
highest known leakage resistance
low absorption
meets JAN-C-25 (3) specs.
dimensional flexibility

AMP

AIRCRAFT-MARINE PRODUCTS, INC.
CHEMICALS AND DIELECTRICS DIVISION
2100 Paxton Street, Harrisburg, Pa.
5 sure ways to improve equipment—
all spelled F-I-B-E-R-G-L-A-S*!

There’s no substitute for proven performance—and for more than 15 years Owens-Corning Fiberglas materials have been helping to make good electrical equipment perform even better. Five such materials are shown below and on the facing page. All are proven...all are universally available...most are priced no higher than ordinary organic products...and all are spelled F-I-B-E-R-G-L-A-S...as in Owens-Corning Fiberglas, originators of glass in fiber form! For further details on any of these five sure ways to improve equipment—and names of suppliers nearest you—be sure to send in the coupon today.

*Fiberglas is the trade mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with fibers of glass.

"if it's Fiberglas, it's Owens-Corning!"

OWENS-CORNING FIBERGLAS CORPORATION • TEXTILE PRODUCTS DIVISION • 16 EAST 56TH STREET, NEW YORK 22, NEW YORK

electrical laminates

Fiberglas yarns absorb energy without permanent set—give Fiberglas glass-base laminates maximum impact resistance. Retain their shape—can’t shrink or swell—and punch clean, handle well. Available impregnated with phenolic, polyester, melamine, silicone resins.

sleeving and tubing

Sleeving and tubing made with Fiberglas yarns offer unsurpassed strength, flexibility and resistance to moisture, oils, most acids. Won’t burn during soldering work and is easier to slip over conductors because it is round and smooth inside.
**varnished cloth**

Glass can't burn; cloth woven of Fiberglas yarns thus offer unparalleled fire safety. Permit operation of equipment at higher ambient temperatures for longer time with fewer breakdowns. Dissipate heat faster, too—provide greater overload insurance.

**magnet wire**

Fiberglas yarns used in magnet wire are thinner than organic textiles, yet withstand higher temperatures. Makes possible the design of smaller, lighter, higher-rated equipment—with corresponding savings in metals and other expensive materials.

**electrical tapes**

Exceptional tensile strength and smaller diameter of Fiberglas yarns means thinner, stronger tapes—less bulky wrappings, savings in space. Fewer equipment breakdowns, too, because Fiberglas yarns cannot stretch or shrink...won't burn...and are resistant to moisture and most acids.

---

**Clip the coupon below and mail today for your copies of these booklets!**

Owens-Corning Fiberglas Corporation
Electrical Sales Division, Dept. 860
16 E. 56th Street, New York 22, N. Y.

Please send me the following booklets:

- [ ] Sleevng & Tubing  
- [ ] Magnet Wire  
- [ ] Electrical Laminates  
- [ ] Electrical Tape  
- [ ] Varnished Cloth  
- [ ] Sources of Supply

**NAME**

**TITLE**

**COMPANY**

**ADDRESS**

**CITY**

**ZONE**

**STATE**

---

Want more information? Use post card on last page.
VOLTAGE REGULATED POWER SUPPLIES
For Industrial and Research Use

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 complete specifications.

Workmanship is of a quality with the highest existing production standards and best instrument electronic practices consistent with the intended use of the item as a continuous duty voltage regulated power supply. Oil filled paper condensers and resistor-board construction are included in the design.

<table>
<thead>
<tr>
<th>VOLTS</th>
<th>CURRENT</th>
<th>REGULATION</th>
<th>RIPPLE</th>
<th>6.3 V.± AC. CT.</th>
<th>MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1500</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>20 Mv.</td>
<td>10 Amp.</td>
<td>1520</td>
</tr>
<tr>
<td>0-1200</td>
<td>0-20 Ma.</td>
<td>0.1%</td>
<td>10 Mv.</td>
<td>10 Amp.</td>
<td>1220</td>
</tr>
<tr>
<td>0-1000</td>
<td>0-500 Ma.</td>
<td>0.5%</td>
<td>20 Mv.</td>
<td></td>
<td>1350</td>
</tr>
<tr>
<td>200-1000</td>
<td>0-500 Ma.</td>
<td>0.5%</td>
<td>20 Mv.</td>
<td></td>
<td>1250</td>
</tr>
<tr>
<td>1-1000</td>
<td>0-50 Ma.</td>
<td>0.1%</td>
<td>10 Mv.</td>
<td>10 Amp.</td>
<td>1020</td>
</tr>
<tr>
<td>0-600</td>
<td>0-3 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>780</td>
</tr>
<tr>
<td>0-600</td>
<td>0-2.25 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>770</td>
</tr>
<tr>
<td>0-600</td>
<td>0-1.5 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>760</td>
</tr>
<tr>
<td>0-600</td>
<td>0-750 Ma.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>750</td>
</tr>
<tr>
<td>0-600</td>
<td>0-300 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>615</td>
</tr>
<tr>
<td>0-600</td>
<td>0-5 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 0-600</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>500R</td>
</tr>
<tr>
<td>#2 0-600</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>500R</td>
</tr>
<tr>
<td>0-600</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>800</td>
</tr>
<tr>
<td>0-600</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>815</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>141</td>
</tr>
<tr>
<td>#1 200-500</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>800</td>
</tr>
<tr>
<td>#2 200-500</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>815</td>
</tr>
<tr>
<td>200-500</td>
<td>0-200 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>6 Amp.</td>
<td>510</td>
</tr>
<tr>
<td>0-400</td>
<td>0-150 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>6 Amp.</td>
<td>245</td>
</tr>
<tr>
<td>0-150</td>
<td>0-150 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>400</td>
</tr>
<tr>
<td>100-400</td>
<td>0-150 Ma.</td>
<td>0.01%</td>
<td>1 Mv.</td>
<td>10 Amp.</td>
<td>141</td>
</tr>
<tr>
<td>100-100</td>
<td>0-150 Ma.</td>
<td>0.01%</td>
<td>1 Mv.</td>
<td>10 Amp.</td>
<td>2000</td>
</tr>
<tr>
<td>0-350</td>
<td>0-3 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>730</td>
</tr>
<tr>
<td>0-350</td>
<td>0-2.25 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>720</td>
</tr>
<tr>
<td>0-350</td>
<td>0-1.5 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>710</td>
</tr>
<tr>
<td>0-350</td>
<td>0-750 Ma.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>700</td>
</tr>
<tr>
<td>100-325</td>
<td>0-150 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>10 Amp.</td>
<td>131</td>
</tr>
<tr>
<td>0-150 Bias</td>
<td>0-5 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>5 Amp.</td>
<td>315</td>
</tr>
<tr>
<td>0-300</td>
<td>0-150 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td>5 Amp.</td>
<td>315</td>
</tr>
<tr>
<td>0-150</td>
<td>0-50 Ma.</td>
<td>0.5%</td>
<td>5 Mv.</td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>3-30</td>
<td>0-30 Amp.</td>
<td>0.5%</td>
<td>0.1%</td>
<td></td>
<td>3030</td>
</tr>
<tr>
<td>1-13</td>
<td>0-10 Amp.</td>
<td>0.5%</td>
<td>10 Mv.</td>
<td></td>
<td>3200</td>
</tr>
<tr>
<td>0-3-3</td>
<td>0-100 Ma.</td>
<td>5 Mv.</td>
<td>1 Mv.</td>
<td></td>
<td>3100</td>
</tr>
</tbody>
</table>

DC POWER SUPPLY SPECIFICATIONS

REGULATION: As shown in table for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

*Regulation Bias Supplies: 10 millivolts for line 105-125 volts. 1/2% for load at 150 volts.
†All AC Voltages are unregulated.

All units are metered except Models 131, 315 and 3100. All units are designed for relay rack mounting or bench use.

WORKMANSHIP

MANUFACTURERS OF ELECTRONIC EQUIPMENT • RESEARCH • DEVELOPMENT

KEPCO LABORATORIES
131-38 SANFORD AVENUE • FLUSHING 55, NEW YORK

Want more Information? Use post card on last page.

April, 1953 — ELECTRONICS

www.americanradiohistory.com
No ordinary relay...This! New CLARE Type T High Frequency Impulse Relay will follow 2500 cycles per second with life measured in billions of operations!

specifications . . . .

MECHANICAL

SIZE: 1-15/16 in. diameter x 2-3/16 in. overall.
WEIGHT: 5 ounces.
MOUNTING: Equipped with mica-filled bakelite plug, to fit a standard B-pin actuator socket.
COVER: Removable dust-tight cover.
CONTACTS: Type: Form A (s.p.s.t., normally open)
Material: Platinum-iridium
Gap: 0.005 inch
Pressure: 30 grams, min. (Coil energized with 50 ampere-turns)
COIL: Type: Single winding, bobbin-wound
Wire: Heavy formex

ELECTRICAL

COIL DISSIPATION: 0.5 watt (estimated max.)
CONTACT RATING: 0.05 amp., max. 50 volts ac, non-inductive (estimated)
CONTACT BOUNCE: None
OPERATION:
- Pull-in: 15 ampere-turns
- Drop-out: 12 ampere-turns
- Pull-in time: 120 microseconds
- Drop-out time: 100 microseconds
RATE: Will follow 2500 cycles per second, aperiodic to 1000 cycles per second.
LIFE EXPECTANCY: 5 x 10⁶ operations with zero contact current.
DIELECTRIC STRENGTH: 500 volts rms.

TYPICAL APPLICATIONS

- Coil inductance: 0.3 hy (contacts open)
- Normal coil current: 135 ohms
- Pull-in current: 10 to 12 ma.
- Drop-out current: 8 to 10 ma.
- Contact current: 0.075 ma.

LIFE EXPECTANCY: Following a 1 x 10⁶ operation run-in period, a life of 5 x 10⁶ operations with a .075 ma contact load over a 6-month period without readjustment.

- Originally designed for use in an analog computer, the new CLARE Type T High Frequency Impulse Relay is now available for other applications which require a highly sensitive relay completely free from contact bounce and capable of a prodigious number of operations at extremely high speeds.

Its pull-in time of 120 microseconds and drop-out time of 100 microseconds enable this relay to follow up to 2500 cycles per second; aperiodic to 1000 cycles per second.

In a typical application, it has a life expectancy, following a run-in period of 1 x 10⁶ operations, of 5 x 10⁹ operations with a 0.75 ma contact load over a 6-month period without readjustment.

To achieve its high-speed, no-bounce, and other unusual characteristics, this relay is built to extremely close tolerances, with a high degree of precision, under conditions of utmost cleanliness. This necessitated the development of techniques never before employed in the manufacture of relays.

Even before this first public announcement of the availability of this truly remarkable relay, its fame has spread. Already dozens of inquiries and sample orders have been received from laboratories and development organizations which had learned of its existence through the manufacturer who first applied it in a well-known computer. It may provide the answer to one of your problems.

For full information on this new relay or for consultation on any relay problem, we invite you to contact your nearest CLARE sales engineer or write to C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13, Ontario. Cable address: CLARELAY.

WRITE FOR BULLETIN 117

CLARE RELAYS
FIRST IN THE INDUSTRIAL FIELD

www.americanradiohistory.com
To meet the strictest requirements of both Government and Industry, specify **JAN TYPE**

**Germanium Diodes**

Precision made, easy to handle, easy to assemble — the tapered shape shows polarity at a glance! Make **Radio Receptor** Germanium Diodes your first choice in the large variety of electronic circuits where JAN types are a must.

**Typical Uses**

- Computer Circuits
- Clamping Circuits
- RF Detectors
- Control Circuits
- Discriminators
- Modulators
- Noise Eliminators
- Clippers
- Level Setters
- Restorer Circuits

**JAN Types - All Values Measured at 25°C.**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1N69</td>
<td>5.0</td>
<td>50 @-10V 850 @-50V</td>
<td>40</td>
<td>75</td>
<td>60</td>
</tr>
</tbody>
</table>

Rectification efficiency: 35% minimum in 100 MC test circuit.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1N70</td>
<td>3.0</td>
<td>25 @-10V 300 @-50V</td>
<td>30</td>
<td>125</td>
<td>100</td>
</tr>
<tr>
<td>1N81</td>
<td>3.0</td>
<td>10 @-10V</td>
<td>30</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

*Average half wave rectified current at 60 CPS and 25°C. Consult us for ratings at other conditions.
†For zero dynamic resistance.

Radio Receptor Germanium Diodes may hold the answer to many of your problems. Our engineers will be glad to study your requirements and submit their recommendations. Many other types, both standard and special, are available . . . Write us!
Du Pont "TEFLON" provides high-temperature insulation

Dielectric properties remain constant over wide temperature range

Standoff and feed-thru insulator terminals often fail in service due to high-temperature breakdown. Cracking frequently occurs during degreasing operations. And breakage may occur during manufacture. Today's equipment and operating conditions require terminals that eliminate these failures and provide improved, lasting performance.

In designing such improved terminals, Sealectro Corporation sought an insulating material that had good dielectric properties, resistance to high operating temperatures and chemical attack, and the toughness and resiliency to eliminate breakage and cracking. And it had to provide for simple, positive installations.

They chose Du Pont "Teflon" tetrafluoroethylene resin. "Teflon" is an excellent insulator. Its dielectric constant (2.0) and loss factor (0.0005) are unaffected in temperatures from -80°F to 400°F. Du Pont "Teflon" is inert to all chemicals except molten alkali metals and fluorine. It is tough, durable . . . will not crack or arc. And the one-piece terminals assure simple, tight, lasting installations.

Du Pont "Teflon" serves many uses in electrical equipment—coaxial spacers, insulation for wire, cables and motor windings, and other parts where high temperatures, service, dielectric strength and durability are required. Perhaps it can help you improve or develop a product. For full information, write E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 224T, Du Pont Bldg., Wilmington 98, Delaware.

---

Terminals made by
Sealectro Corp.,
New Rochelle, N. Y.

---

Want more information? Use post card on last page.
TO KEEP GUNS STABILIZED
over rough terrain

keep the gun aimed

...and FORD
was asked to find
the answer

Over open area a tank pitches and heaves like a rocking chair...but regardless of the humps...ditches...hills...the guns keep pointing at the target while the tank is moving. Ford Instrument Company played a vital role in designing and manufacturing a stabilizer unit for the tank’s gun fire control system.

This is typical of the problems that Ford has solved since 1915. From the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electro-mechanical, magnetic and electronic instruments that bring us our “tomorrow” today. Control problems of both Industry and the Military are Ford specialties.

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N.Y.

You can see why a job with Ford Instrument Company offers a challenge to young engineers. If you qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
A NEW IRVINGTON CLASS "B" INSULATION...

IRV-O-BESTOS®

QUINTERRA asbestos sheet
bonded to. ...... MYLAR
4000 vpm polyester film

By bonding a range of thicknesses of Quinterra asbestos to various thicknesses of Mylar—a tough, strong polyester film with the highest dielectric strength known—Irvington now brings you a line of Class "B" insulation that balances cost and properties to meet your needs. The Mylar gives IRV-O-BESTOS its high tensile, tear and dielectric strength. The Quinterra makes for ease of gripping—gives added heat stability and added thickness at moderate cost.

Since Quinterra is available in thicknesses from .003” to .015”, and Mylar from .0005” to .007”, a very large number of combinations are available—in duplex constructions or in triplex, with either the Quinterra or the Mylar on the outside. Whether your requirements are for high dielectric strength, or for added thickness at low cost, IRV-O-BESTOS will fill your needs.

Mail the coupon for technical data and samples of this outstanding new Class "B" insulation.

Send this convenient coupon now

Irvington
VARNISH & INSULATOR COMPANY
10 Argyle Terrace, Irvington 11, New Jersey

Plants: Irvington, N. J.; Monrovia, Calif.; Hamilton, Ontario, Canada

Look to
IRVINGTON for Insulation Leadership

INSULATING VARNISHES
VARNISHED CAMBRIC
VARNISHED PAPER
VARNISHED FIBERGLAS
INSULATING TUBING
CLASS "N" INSULATION

Irvington Varnish & Insulator Company
11 Argyle Terrace, Irvington 11, N. J.

Gentlemen:
Please send me technical data sheet and samples of your new IRV-O-BESTOS Class "B" insulation.

Name........................................Title..............
Company........................................
Street..............................................
City..............................................Zone....State
The illustrated S-Band Rotary Joint is a waveguide to coaxial to waveguide structure employing doorknob transitions. The use of choke terminations for the inner conductor of the coaxial section, as well as doorknob transitions, ensures satisfactory operation at high powers without breakdown. This joint is characterized by a low VSWR (less than 1.04 over a 2% bandwidth) and freedom from resonances throughout its rotation of 360°. Similar rotary joints for elevation and cross-level purposes are available in various sizes of waveguide.

Inquiries are cordially invited write to DEPT. R1
Bradley Rectifiers are doing many different types of jobs

HERE IS A PARTIAL CHECKLIST OF HOW THEY ARE HELPING TO IMPROVE CIRCUIT PERFORMANCE

- MAGNETIC AMPLIFIERS
- MODULATORS
- CURRENT LIMITERS
- INSTRUMENT PROTECTION
- TEMPERATURE COMPENSATORS
- VOLTAGE REGULATORS
- D. C. VALVES
- BIAS SUPPLIES
- BATTERY CHARGERS
- ARC SUPPRESSORS

CHECK THIS LIST to see if you might be overlooking a simplified way to solve a circuit problem or better circuit operation. New developments have widened rectifier application. Bradley engineers can help you realize these new possibilities for your product.

In either conventional or special applications, Bradley rectifiers offer maximum stability and long life under usual or unusual temperature conditions. Laboratory conditions of manufacture, engineer inspection, and our exclusive vacuum process assure top quality, prompt delivery and lowest unit cost.

Write or call us for further information.

COPPER OXIDE MODULATOR
Bradley copper oxide modulator for this very low voltage threshold application features low noise level, good temperature characteristics, and long-term stability. No moving parts to get out of order as in mechanical modulator; much longer life than vacuum tube.

Selenium and Copper Oxide Rectifiers
Vacuum Processed for Performance as Rated
Self-Generating Photovoltaic Cells

The complete selenium rectifier line — from microamperes to thousands of amperes

Bradley Laboratories, Inc.
168 Columbus Avenue, New Haven 11, Conn.
C Series Connectors are a greatly improved mechanical and electrical type of co-axial connector. They are constant impedance and are designed for use with 50 ohm, middle size RF cables.

The C Series like every co-axial connector made by Kings is the result of constant research and development. Engineering ingenuity and precision manufacture have put "Connectors by Kings" in the front-line of communications equipment for industry and the armed services.

If you have a connector problem consult Kings. You'll be glad you called on Kings first.

KINGS Electronics Co., Inc.
40 MARBLEDALE ROAD, TUCKAHOE, N. Y.
Have you heard the latest...

IN BACKGROUND MUSIC?

An atmosphere to relax and enjoy—or the stimulation to work, to think, to play or buy—these are the benefits of background music. And background music is now practical anywhere, even beyond the reach of present wired services.

With the announcement of the new AMPEX 450, magnetic tape, musical wonder of a coming era, has become the ideal medium for background music. Hourly cost drops to a new low; quality rises to an all-time high. A wide variety of music for every purpose is now available on pre-recorded tape (see your Ampex distributor). Tape recordings eliminate needle scratch and their fidelity is permanent. They last for any conceivable number of plays.

On the AMPEX 450, up to eight hours of unrepeated music is available from one 14-inch reel of tape, and fully automatic repetition is available. The troubles and complexities of record changers are eliminated. And the AMPEX requires no standby attention from an operator.

AMPEX background music has a place in your business.

THE NEW AMPEX 450

- 8 hours of uninterrupted music (rest periods as desired)
- Usable on land, sea or air
- No standby operator required
- Lowest cost per hour

For further information, write to Dept. E

AMPEX MAGNETIC RECORDERS

AMPEX ELECTRIC CORPORATION
934 CHARTER STREET • REDWOOD CITY, CALIF.
Keeping communications ON THE BEAM

JK PRODUCTS

FREQUENCY AND MONITOR MODULATION

Monitors any four frequencies any where between 25 mc and 175 mc; checking both frequency deviation and amount of modulation. Keeps the "Beam" on allocations; guarantees more solid coverage, too.

JK STABILIZED H-17 CRYSTAL

CRYSTALS FOR THE CRITICAL

The JK H-17 Crystal meets rigid airline requirements for compactness, light weight, rugged dependability. A Military type, it is hermetically sealed—dust and moisture proof—plated, quartz plate is shock mounted. One of many JK Crystals made to serve every need.

Ceiling Zero...Communications 100%...

"P ea soup" over the field...and still the giants of air travel come "on the beam". When visibility is poor, commercial pilots must rely on radio-radar equipment to bring their ship in safely. JK Crystals play an important role in this every day drama of keeping airlines communications "on the beam" in the air and on the ground.

THE JAMES KNIGHTS COMPANY

SANDWICH ILLINOIS

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Miniature Tube Socket Eliminates Ambient Temperature Interference

This new socket, overcomes two important obstacles to dependable tube performance—interference from high and low ambient temperatures, and erratic output at high frequencies due to insulation leaks—through the use of Kel-F trifluorochochloroethylene polymers as the insulation. The precision molded insulation resists buckling, cracking or chipping due to sudden rises in temperature. The unique properties of the plastic allows the injection molded part to remain tough but resilient at temperatures of from below zero to well above 300°F. The high dielectric strength and low dissipation factor of Kel-F assures consistent, reproducible output even at high frequencies.

United States Gasket Company of Camden, N. J., produces this injection molded tube socket for a major electronic component manufacturer. Designating it as the "Chemelec"** series socket, U.S. Gasket is currently producing 7- and 9-pin types for a variety of military and industrial applications.

The resistance of Kel-F to embrittlement under constant vibration, or mechanical failure due to physical abuse, make it particularly suited to military uses. Its broad range of application also includes installations where high humidity is encountered—the zero water absorption, non-wetting characteristics of Kel-F allow it to maintain a high level of dielectricity through diminution of surface leakage due to moisture or longsulfins. Additional flexibility in specifying this tube socket is possible because Kel-F is also resistant to attack or degradation by chemicals, oils and most organic solvents.

**Trade mark of the United States Gasket Co.  
Refer to Report E-107

Terminals with KEL-F* Plastic Insulation Feature  
10° Megohm Insulation Resistance...and  
Minus 94°F. to 390°F. Range!

With true hermetic seal characteristics these terminals will bear rough production handling and still pass a 7 pound terminal pull test and a 10 inch torque test on the central conductor. Combine this with the high insulation resistance, broad temperature utility and mechanical strength of Kel-F in the body, and you have a solder-seal type terminal that stands out among all others.

Manufactured by the International Resistance Company of Philadelphia, Pa., this "Type HS-1" terminal (picture at right) achieves its high rating through the use of insulation injection molded of Kel-F and a special process developed by this company to obtain a plastic-to-metal bond of remarkable strength. Employing highly dielectric and inert Kel-F polymers as the insulation in this terminal, International has overcome limitations associated with similar type terminals; low corona breakdown voltage, electrolysis under high DC voltage, failure under thermal shock.

The molded Kel-F is inert to acids, alkalies, oils, vapors and most organic solvents—thereby extending its usefulness to many processes and industries. Consistent, dependable, performance is assured in humid installations—insulation molded of Kel-F has zero water absorption. Sells, weather, precludes formation of fungus.

International Resistance Company molds and extrudes Kel-F polymer in many forms to serve many phases of the electrical and electronic industry. The main illustration includes several of the current applications, as well as others in the testing stage, among them press-fit insulated terminals...resistors with bodies molded of Kel-F...similar items in which the Kel-F is loaded with mica and silica...miniature insulated feed-through terminals...injection molded multiple header for hermetic seal use...selenium rectifier employing parts of Kel-F. Work is also continuing on development of unusual types of electrical materials which take advantage of the unique electrical and physical properties of Kel-F alone, or in combination with other materials.

Refer to Report E-104  
(SEE REVERSE SIDE)
“Spaghetti”, Flexible in Sub-sub-zero Temp.,
Protects Against Oils, Chemicals and Moisture!

This smooth extruded “spaghetti” sleeving for aircraft wiring made of Kel-F polymer, is in a class by itself. Not only does it have a high dielectric strength of from 2500 to 5000 volts per mil, and excellent are resistance, but it will stay pliable and resist cracking and splitting even after prolonged use at temperatures from minus 90° to 300° F. The unique physical and chemical properties of this fluoro-chloro-carbon plastic permits the lightweight properties and characteristics of Kel-F polymers withstands nuclear radiations without significant effects on its electrical or mechanical properties.

New Technical Bulletin on Properties Issued...

Kel-F Technical Bulletin #1-12-49, has just been revised and resued as #1-3-53. The new edition of the bulletin contains expanded data on physical properties including a table of Chemical Resistance to more than 100 specific chemical substances...two new tables on Permeability....also new data on Light Transmission in both the visible and ultra-violet spectrums.

If you have not received your copy, just drop a card or note to Technical Service.

Significant advantages are gained in using this sleeving to protect aircraft wiring. The high heat resistance of Kel-F and its non-flammability make it particularly valuable in enclosed or tight installations—also lighter sleeving can be used while still maintaining superior protection. The overall result is a significant reduction in the weight and bulk of an assembly.

Preliminary investigations also show that sleeving, made from unplasticized grades of Kel-F polymers withstands nuclear radiations without significant effects on its electrical or mechanical properties.

Resistoflex Corporation of Belleville, N. J., manufactures several grades of “spaghetti” and rigid sleeving, made from Kel-F polymers, under the name Fluoroflex “C***. Flexible spaghetti, ranging in size from #22 wire up to 1/4" I.D. is extruded in continuous lengths from Kel-F polymer. Larger sizes, up to 1/2" I.D., are available in 12’ lengths.

The activities of this company in applying Kel-F to corrosion, temperature and electrical problems are widespread. It has developed extruded (reinforced steel braid) aircraft hose for handling corrosive oxidants, sheets for gaskets and pump diaphragms, precision machined fittings and instrument parts of Kel-F to close tolerances.

** Trade mark of Resistoflex Corporation

Refer to Report E-105

* Registered trademark for The M. W. Kellogg Company's trifluoro(chloro)ethylene polymers
A Great First in Automatic Controls

- Zero Maintenance
- No warm-up time
- Absolute reliability
- Fast response
- Miniaturized and Hermetically Sealed.

Illustrated at the left is the 434-B Servo Amplifier, designed to drive the MK14, MK7 and MK8 BuOrd Servo Motors from synchro data. No power supply or stabilization tachometers are required. There are only six connections to the unit: 2 inputs, 2 outputs, and 2 for 117 volts, 400 cps.

TRANSPORT - MAGNETIC SERVO AMPLIFIERS

With the transistor as a preamplifier, there results a combination with the power output capacity of the magnetic amplifier and the sensitivity and speed of response of the transistor. Hermetic sealing is feasible because of the practically unlimited life and the low internal temperature rise. This radically new amplifier, developed and manufactured by the Industrial Control Company, will revolutionize the application of automatic control systems and servo-mechanisms in:

- Industrial Controls
- Military Equipment
- Atomic Energy Installations.

The Engineering Staff of the Industrial Control Company is continually engaged in long range development, designed to bring to our customers a variety of new techniques and equipments in this field.

INDUSTRIAL CONTROL COMPANY
Wyandanch Long Island, New York
PHONE: MIDLAND 3-7548
TRANSISTOR AMPLIFIER in LUCITE equipped with Bradleyunit Fixed Resistors

Bradleyunit Fixed Resistors—1/2, 1, and 2 watt units

BUILD SUPERIOR PERFORMANCE INTO YOUR ELECTRONIC EQUIPMENT WITH ALLEN-BRADLEY QUALITY COMPONENTS

If you want to be sure of getting consistently fine and dependable performance from your electronic circuits over a long period of time, just follow the example of leading laboratories... and use Allen-Bradley solid molded resistors.

Bradleyunit resistors have permanent characteristics, because they are rated to operate continuously at 70°C ambient temperature... not 40°C.

Bradleyunits withstand extremes of temperature, pressure, and humidity without deterioration. They are solid-molded with high mechanical strength.

The A-B honeycomb carton prevents tangling of leads and saves time in production. Leads are differentially tempered to prevent sharp bends near the resistor body.

Let us send you an A-B resistor chart.

Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.

ALLEN-BRADLEY RESISTORS & CAPACITORS

Sold exclusively to manufacturers of radio and electronic equipment

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Waldes Truarc Rings Replace 19 Parts

...Save $6.75 Per Unit...Cut Weight by Nearly 16%

OLD WAY 2 Threaded nuts locked bearings in place. 8 screws and washers positioned bearing and shaft assemblies. This fastening method required expensive tapping and threading. Assembly was slow and costly.

TRUARC WAY Two Truarc inverted rings (Series 500B) provide uniform shoulder to lock bearings in place, position bearing and shaft assemblies. Additional Truarc Ring (Series 5100) locates ball bearing...eliminates 1 sleeve type spacer.

Airborne Accessories Corporation, Hillside, New Jersey, uses Waldes Truarc Retaining Rings to take all thrust load from right angle bevel gears in their ANGLgear*. Truarc Rings make ANGLgear* more compact—save approximately 1/8" at each end of housing. By providing a choice of 3 mounting possibilities — instead of 1 — Truarc Rings make ANGLgear* adaptable to many different assemblies. New design increases load capacity...eliminates machining of threads.

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.

Waldes Truarc Rings are precision-engineered...quick and easy to assemble and disassemble. Always 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.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send me the new Waldes Truarc Retaining Ring catalog, (Please print)

Name
Title
Company
Business Address
City Zone State
Permanent magnets last forever... a reliable source of permanent potential energy. Indiana Permanent Magnets supply a constant, uniform magnetic field, indefinitely.

Research Leadership — Constant research at INDIANA has produced new and better permanent magnets. In countless different products, this versatile "packaged energy" improves performance, permits new uses or applications, saves space and money. INDIANA engineers, backed by years of experience gained in the development of over 30,000 magnet applications, are exceptionally well qualified to help you. They will properly design the magnet and select the best permanent magnet material for your product.

Quality in Mass-produced Magnets—
Look to INDIANA for quality permanent magnets—for unsurpassed skill in manufacture—for cost-cutting engineering aid. Rigid supervision in every step of production is your guarantee of magnets with precise electrical characteristics and exact physical dimensions.

To meet your mass production needs, INDIANA gives you the advantages of the largest facilities in the world for the manufacture of permanent magnets and complete permanent magnet subassemblies. Furthermore, INDIANA makes no end products, has no subsidiaries; therefore, you can discuss your confidential problems freely with us. Take advantage of this wealth of extensive experience; "know-how"; top engineering; and prompt, reliable delivery of magnets on a regular production schedule. To help you in your design and production problems, consult The Indiana Steel Products Company, today.

The Indiana Steel Products Co.
VALPARAISO
INDIANA

World's Largest
MANUFACTURER

SALES OFFICES FROM COAST TO COAST—BOSTON • CHICAGO • CLEVELAND
PERMANENT MAGNETS
CUNICO • CHROME, COBALT and TUNGSTEN STEEL

Write for This Permanent Magnet Design Hanbook
Complete, authoritative reference manual on theory of magnetism, permanent magnet design principles, energy curves, formulae, design steps, and constructive data. Write for Manual No. 4-A4, today.

OF PERMANENT MAGNETS
NEW YORK • PHILADELPHIA • ROCHESTER • LOS ANGELES
M Molded Tube Sockets for High Production Applications

Recent addition to METHODE line of TUBE SOCKET ACCESSORIES is this new "Twist-On" type of tube shield and base, mounted in combination with molded sockets, as illustrated. Projecting lugs on shields provide direct ground to chassis under screw pressure and a reliable shock and vibration proof mount.

Other METHODE PRODUCTS include:
- Laminated wafer tube sockets
- Military tube and crystal sockets
- Panel Connectors
- Printed circuit sockets
- Tube shields

METHODE Manufacturing Corp.
2021 West Churchill Street • Chicago 47, Illinois
Geared to produce Plastic and Metal Electronic Components

Top and Sub-mount Octal Sockets, G. P. or Mica Phenolic, 1 1/4" or 1 1/2" mounting centers.

"J Lock" Type Miniature and Naval Socket and Shield Base Combination, G. P., Mica Phenolic or Ceramic Insulators.

Top and Sub-Mount Miniature and Naval Sockets, G. P., Mica Phenolic, Ceramic Insulators.

"Snap-in" Type Miniature and Naval Sockets and Shield Base Combination, G. P. or Mica Phenolic.


Subminiature Tube Sockets, 4, 5, 6, 7 and 8 pin sizes, Mica Phenolic.

We invite your inquiries

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
For Excellence in Performance...

PYRAMID subminiature "GLASSEAL" CAPACITORS

For the most demanding applications, where top-quality and minimum-size considerations are the most vital factors, Pyramid "Glasseal" capacitors are the popular choice.

This attractive new catalog PG3, incorporating complete engineering data, styles, sizes, and capacitance and voltage ranges is now available.

% Capacitance Change vs. Temperature

These graphs show typical performance characteristics of the Pyramid "Glasseal X" type, which is designed for 125°C operation. Full information on all "Glasseal" capacitors is provided in new catalog PG-3.

Visit Booth 2 - 310 I.R.E. Convention

For your free copy, please address letterhead request to Department T1

PYRAMID ELECTRIC COMPANY
1445 HUDSON BOULEVARD * NORTH BERGEN, N. J.
New convenience for laboratory, field or production measurements in sub-audio, audio, telephony, carrier current, super-sonic, telemetrying and rf applications.

New! Completely redesigned!
Highest quality throughout
Lighter weight, smaller size
New wider frequency range
Time-tested RC circuits
No zero set. High stability
Constant output, low distortion

COMPACT, EASY TO USE BASIC INSTRUMENTS FOR LABORATORY OR PRODUCTION TESTS

Hewlett-Packard RC oscillators have long been basic tools for making electrical and electronic measurements of precise accuracy. Now these world-famous test instruments are redesigned to give you the most compact, dependable, accurate and easy-to-use commercial oscillators available.

New -hp- 200 series oscillators have highest stability and precisely accurate, easily resettable tuning circuits. Low impedance operating levels together with superior insulation guarantee peak performance throughout years of trouble-free service. New models have wider frequency range. Operation is simplified—just three front panel controls. Size is different, too—the instruments are more compact, lighter in weight and enclosed in an easy-to-handle aluminum case with carrying strap. Minimum bench space is required. (Rack mounting available on request.)

Complete Coverage! HEWLETT-PACKARD
-hp- 202A

Low Frequency Function Generator

This instrument is a compact, convenient and versatile source of transient-free test voltages between 1,000 and 0.01 cps. It provides virtually distortion-free signals for vibration studies, servo application, medical and geophysical work and other subsonic and audio problems. The equipment generates 3 wave forms—sine, square and triangular. Output is 30 volts peak-to-peak for all wave forms. The output system is fully floating with respect to ground and may be used balanced or single-ended. The instrument will deliver 10 volts RMS to a 2,500 ohm load; internal impedance, however, is only 40 ohms. There are no coupling capacitors in the output system, and a high degree of balance is achieved by a special circuit. Price, $450.

BRIEF SPECIFICATIONS—200 SERIES OSCILLATORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range</th>
<th>Bands</th>
<th>Frequency Response</th>
<th>Power Output</th>
<th>Load Impedance</th>
<th>Distortion</th>
<th>Power Consumption</th>
<th>Principal Applications</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>200AB</td>
<td>20 cps to 40 kc</td>
<td>d</td>
<td>1 dB @ 1 kHz</td>
<td>1 watt or 24.5 V</td>
<td>600 ohms</td>
<td>1%</td>
<td>60 watts</td>
<td>Audio Tests</td>
<td>$120 00</td>
</tr>
<tr>
<td>200CD</td>
<td>5 cps to 600 kc</td>
<td>s</td>
<td>1 dB @ 1 kHz</td>
<td>100 mw or 600 ohms or 20 volts open circuit*</td>
<td>1%</td>
<td>75 watts</td>
<td>Audio, Ultrasonic, Tests</td>
<td>$150 00</td>
<td></td>
</tr>
<tr>
<td>200H</td>
<td>60 cps to 600 kc</td>
<td>d</td>
<td>1 dB @ 1 kHz</td>
<td>10 mw or 1 v</td>
<td>100 ohms</td>
<td>1%</td>
<td>115 watts</td>
<td>Carrier, Current &amp; Telephone Tests</td>
<td>$350 00</td>
</tr>
<tr>
<td>202D</td>
<td>2 cps to 70 kc</td>
<td>s</td>
<td>1 dB @ 1 kHz</td>
<td>100 mw or 10 v</td>
<td>1,000 ohms</td>
<td>1%</td>
<td>80 watts</td>
<td>Low Frequency Measurement</td>
<td>$275 00</td>
</tr>
<tr>
<td>200E</td>
<td>6 cps to 6 kc</td>
<td>s</td>
<td>1 dB @ 1 kHz</td>
<td>100 mw or 10 v</td>
<td>1,000 ohms</td>
<td>1%</td>
<td>115 watts</td>
<td>Interpolation and Frequency Measurement</td>
<td>$225 00</td>
</tr>
</tbody>
</table>

*Internal impedance 600 ohms.

Data subject to change without notice.

Prices f.o.b. factory.

HEWLETT-PACKARD COMPANY
Field Engineers in Principal Cities
2523A PAGE MILL ROAD • PALO ALTO, CALIFORNIA

INSTRUMENTS—Complete Coverage!

ELECTRONICS—April, 1953

Want more information? Use post card on last page
Western Electric installer in an aircraft plant connecting telephone equipment with a G-E soldering iron.

Western Electric Uses G-E Soldering Irons to Speed Vital Telephone Installations

For efficient soldering of millions of connections during the installation of telephone equipment, Western Electric uses G-E industrial soldering irons. Repeat orders testify to this company's satisfaction with G-E irons.

No matter what your soldering operation—intermittent or high-speed repetitive work—General Electric has the iron to meet your particular requirements. You'll find that G-E irons, equipped with the famous long-life Calrod* heating element, give you lower maintenance costs. You can choose durable, interchangeable calorized copper tips or, for even longer maintenance-free tip life, sturdy Ironclad copper tips. Ratings range from 25 to 1250 watts, tip sizes from ½-inch to two inches.

Give G-E industrial soldering irons a chance to prove their lower over-all costs to you. Buy a few through your nearest G-E Sales Office or Apparatus Distributor, and keep cost comparison records on their performance. You will see for yourself that these irons will save you money, General Electric Company, Schenectady 5, N. Y.

*Reg. Trade-mark of General Electric Company

You can put your confidence in... GENERAL ELECTRIC

Want more information? Use post card on last page. April, 1953—ELECTRONICS
VOLUME PRODUCTION is available for your extruded ceramics at AMERICAN LAVA CORPORATION. Several batteries of presses from 10-ton to 100-ton capacity assure the right press for the job. Ceramics of uniform cross section up to 8½” diameter can be extruded, sawed and machined to intricate shapes. These pictures show part of our extrusion equipment and typical AlSiMag ceramics made from extruded material. Send us your blue prints or sample; let us show you what we can do for you.

51ST YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA, 671 Broad St., Newark, N. J., Mitchell 2-9159 • SYRACUSE, N. Y., Philadelphia 1, 449 N. Broad St., Stevenson 2-2833 • CLEVELAND, 501 Euclid Ave., Express 1-6665 • CHICAGO, 228 N. LaSalle St., Central 6-1721 • ST. LOUIS, 1123 Washington Ave., Garfield 4959 • SOUTHWEST, John A. Green Co., 6815 Circle Dr., Dallas 6, Dixon 9918 • NEW ENGLAND, 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • LOS ANGELES, 5601 N. Huntington Dr., Central 1-9114
PROBLEM:
Obtain higher electrical conductivity without increasing the cross-sectional area of spring blades

SOLUTION:
General Plate provided the solution with BRONCO . . . a composite metal

Increased conductivity of spring blades in a time switch was recently required by a manufacturer of demand meters. Operating requisites were high conductivity, excellent spring properties and small cross-sectional area.

General Plate provided the solution with BRONCO, phosphor bronze double-clad on copper. The phosphor bronze makes an excellent spring member; the copper gives increased conductivity. BRONCO 25/50/25 provides an electrical conductivity of 55% compared with solid copper.

BRONCO permits miniaturization. It permits you to make smaller units because you can reduce spring size without sacrificing conductivity.

No matter what your problem, it will pay you to consult with General Plate. Their vast experience in bonding any combination of malleable metals can overcome your problems . . . often reduce costs.

General Plate products include . . . precious metals clad to base metals, base metals clad to base metals, thin-gauge rolling, composite contacts, buttons and rivets, Truflex® thermostat metals, Alcuplate®, platinum fabrication and refining, #720 manganese age-hardenable alloy. Write for complete information and Catalog PR700 today.
No tapping!
THEY CUT THEIR OWN THREADS!

SHAKEPROOF® THREAD-CUTTING SCREWS

Save time ... Save tools ... Give you a tighter, stronger fastening!

The shank slot does it! Type 1 is designed for the harder metals.
Type 23 with a wider slot works well in die castings.
Type 25 with a spaced thread is ideal for plastics.

SHAKEPROOF
"Fastening Headquaters"®
DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois • Offices in principal cities
In Canada: Canada Illinois Tools Limited, Toronto, Ontario

America's Great Resources Plus A Free Economy Made This Business Possible!

FREE TESTING SAMPLE KIT
... contains SHAKEPROOF Thread-Cutting Screws in a variety of sizes and head styles. Try them on your product now ... ask for Kit No. 22 for metals or Kit No. 10 for die castings or plastics.

www.americanradiohistory.com
**It will serve on any Panel...**

**Everyone Can Count on**

**VEEDER-ROOT**

REPORTER AT LARGE . . . that's what you might call this new Veeder-Root Reset Magnetic Counter . . . adaptable to remote counting from machines or processes to central boards or instrument-clusters, wherever you want to put them. NOW . . . what can your imagination do with these few facts? For the full facts, write:

**VEEDER-ROOT INCORPORATED**

*The Name That Counts*

HARFORD, CONNECTICUT

Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.

Montreal 2, Canada • Dundee, Scotland

Offices and Agents in Principal Cities

"Counts Everything on Earth"

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
4 FINE RHEOSTATS

Announcing 3 new sizes now in production

We have added to our new H-50 rheostat, announced a few months ago—the new H-75, H-100 and H-150 models. These higher wattage rheostats incorporate all the new improved features that have made the H-50 so successful.

- Unequaled perfection in brush control, which automatically adjusts tension to complete, continuous contact.

- Positive, smoothly-controlled spring action which eliminates all strains tending to bind shaft in the bushing.

- Greater flexibility—no risk of backlash.

All models are of course completely bonded with our new high-temperature-enamel; thermo-shock-proof; more resistant to heat; increased safety factor; higher terminal strength.

And all are designed to comply with current standards of:
  (a) Military Specifications JAN-R-22.
  (b) Underwriters’ Laboratories.
  (c) R.T.M.A.
  (d) N.E.M.A.

Send today for our new bulletin, containing additional information.

HARDWICK, HINDLE, INC.
Rheostats and Resistors
Subsidiary of
THE NATIONAL LOCK WASHER COMPANY
Established 1886
Newark 5, N. J., U. S. A.

The mark of quality for more than a quarter of a century

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
New line of G-E voltage stabilizers features flexibility

Now, to help you iron out voltage ups and downs, General Electric offers a new line of standard automatic voltage stabilizers that offers greater design flexibility at no extra cost. These compact, lightweight units can be a key feature in your design of sensitive electronic equipment where precision performance depends on accurate voltage stabilization.

Output ratings of 1000, 2000, 3000 and 5000 volt-amperes are available, with 115 and 230 volts on both input and output, to give you a wide variety of operating combinations. Fluctuations between 95 and 130, or 190 and 260 volts are corrected to a stable 115 or 230 volts within ±1 per cent—in less than two cycles. Single-core construction completely isolates input circuit from output circuit. For more information see Bulletin GEA-5754.

Miniature selenium rectifiers resist severe operating conditions

Two types of totally enclosed casings are available: Textolite* tubes for normal operating conditions; hermetically sealed, metal-clad casings to meet severe government specifications.

These small-size selenium cell assemblies have long life, high reverse resistance, good regulation and low heat rise. Their ambient temperature range is broad—from −55°C to +100°C. Lead mounting is standard, but they may also be bracket-mounted.

This new G-E line of rectifiers may be used for blocking, electronic computer, signal, magnetic amplifier, communication or control circuits; for operating small relays, solenoids, precipitators. Cell sizes range from 3/32 in. to 15/32 in. diameter, d-c current ratings 0.050 milliamperes to 25 milliamperes. For further information, write for Bulletin GEA-5935.

Switchettes are versatile, have high current rating
A wide range of design problems can be solved by G-E general-purpose switchettes. They are corrosion-proof, vibration-resistant, small, lightweight. Efficient at sea level or at 50,000 feet, in ambient temperatures from 200°F to -70°F. Ratings up to 230 volts, 25 amp. a-c; 250 volts, 25 amp. d-c. See Bulletin GEC-796.

Inductors—for automatic or manual voltage regulation
Compact design of G-E inductors lets you fit them into any location. They offer micrometer-fine control, autotransformer efficiency. Hand-operated and automatically operated models are available for indoor service 600 v and below on circuits 3 to 520 kva. Bulletin GEC-795 covers single-phase inductors; GEA-5824, 3-phase models.

New iron weighs only 8½ oz.
The new 120-v, 60-w G-E lightweight iron is designed for high-speed, production-line soldering on electronic, instrument, and communications equipment. Thin, 5/16-inch diameter shank gets the ½-inch tip into places a regular iron can’t reach. Balanced design allows the soldering of more joints per minute. Long-lasting Iron-clad tip needs no filing or dressing. See Bulletin GED-1583.

G-E cast-permafil* transformers designed to meet MIL-T-27 specs
The small, light design of General Electric’s new line of cast-permafil transformers makes possible greater flexibility in many electronic designs. Sealing these solventless-resin-type transformers for life has eliminated the need for metal enclosures and fungus-proof coatings. Construction is simple—terminals are anchored directly in the tough, solid, shutter-resistant permafil mixture to cut size and weight by 20 per cent. Machined and punched parts have been kept at a minimum for lower cost.

Cast-permafil transformers have an expected life of 1000 hours or more at 130°C ultimate. The complete line of 11 sizes is available in various terminal arrangements, and is designed to meet MIL-T-27 (Grade 1) performance requirements. For more information, write General Electric Co., Sect. 667-25, Schenectady 5, N. Y.
ONLY THE LFE 401 OSCILLOSCOPE

Offers all these Important Features

HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER

The vertical amplifier of the 401 has been designed to provide uniform response and high sensitivity from D-C. The accompanying amplifier response curve shows the output down 3 db. at 10 Mc. and 12 db. at 20 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time. Coupled with this wide band characteristic is a high deflection sensitivity of 15 Mv./cm. peak to peak at both D-C and A-C.

LINEARITY OF VERTICAL DEFLECTION

The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection without serious compression; at 3 inches, the compression is approximately 15%. The accompanying photographs illustrate transient response and linearity of deflection.

SWEEP DELAY

The accurately calibrated delay of the 401 provides means for measuring pulse widths, time intervals between pulses, accurately calibrating sweeps and other useful applications wherein accurate time measurements are required. The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

SPECIFICATIONS

**Y-Axis**
- Deflection Sens. - 15 Mv./cm. p-p
- Frequency Response - DC to 10 Mc
- Transient Response - Rise Time (10% - 90%) 0.035 µ sec
- Signal Delay - 0.25 µ sec
- Input line terminations - 52, 72 or 93 ohms, or no termination
- Input Imp. - Direct - 1 megohm,
  - 30 µ µ f
  - Probe - 10 megohms,
  - 10 µ µ f

**X-Axis**
- Sweep Range - 0.01 sec/cm to 0.1 µ sec/cm
- Delay Sweep Range - 5-5000 µ sec in three adjustable ranges.
- Triggers - Internal or External, + and - trigger generator, or 60 cycles, undelayed or delayed triggers may be used.
- Built-in trigger generator with repetition rate from 500-5000 cps.

General
- Low Capacity probe
- Functionally colored control knobs
- Folding stand for better viewing
- Adjustable scale lighting
- Facilities for mounting cameras

PRICE: $895.00

Write for Complete Information

LIFE for ELECTRONICS, INC.
75 PITTS STREET • BOSTON 14, MASS.

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • MICROWAVE OSCILLATORS • MERCURY DELAY LINES

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS

[Image of oscilloscope diagram]

[Graph showing frequency response]

[Text: TRIGGER GENERATOR with variable repetition rate from 500 to 5000 cps.
POSITIVE & NEGATIVE UNDELAYED TRIGGERS and a POSITIVE DELAYED TRIGGER are externally available.]

[Text: Additional Features:]

**Input Termination Switch** for terminating transmission lines at the oscilloscope.
- A FOLDING STAND for convenient viewing.
- FUNCTIONALLY COLORED KNOBS for easier location of controls.

Designed and built for electronic engineers, the 401, with its high gain and wide band characteristics, and its versatility, satisfies the ever-increasing requirements of the rapidly growing electronics industry for the ideal medium priced oscilloscope.
puts other tape recorders in the SHADE...the PRESTO RC-11

PRESTO introduces a precision-engineered tape recorder with a radical new type of construction!

Featuring a self-contained capstan drive unit, the PRESTO RC-11 provides durability, flexibility and rapid maintenance heretofore unheard of in tape equipment. Motor, fly wheel, capstan shaft, pressure pulley and solenoid are all pre-mounted on a cast aluminum sub-assembly...a complete working unit quickly removable for service or replacement.

A heavy, ribbed, cast aluminum panel designed for rack or case mounting supports all other components. Overall durable construction gives additional reinforcement and protection during shipping and adds years to the life of the machine.

In terms of performance and operational ease, the RC-11 also steps out front. This new recorder, with complete push button operation, automatic microswitch in case of tape breakage and a reel capacity of 10½ inches, is an engineer's delight.

The combination of advanced design and engineering in the RC-11 puts ordinary tape recorders in the shade...makes this instrument an investment, not an expenditure. Ask your PRESTO distributor for full information on this important development in tape recorder design...the all new RC-11.

The "unitized" construction of the Presto RC-11...allows a complete flexibility in the manufacture of various types of instruments. By the simple rearrangement of components the RC-11 becomes a high fidelity recorder, a dual track, bi-directional recorder or reproducer or a long-playing reproducer with automatic tape reversal.
Money-Saver Switches that Boost Product Efficiency

The right type—at the right price—
FOR INSTRUMENTS, RADIOS, APPLIANCES, TOYS, SMALL MOTORS and dozens of other uses.
**NEW! G-E FREQUENCY AND MODULATION METER**

Measures both carrier frequency displacement and square wave modulation with direct reading on 2-range 3½" meter

Here is a quality FM Communications instrument with features that are unmatched in the industry! The ST-13A is engineered to give you hairline accuracy ... lowest possible cost ... plus full provision with oven accessories for future split-channel adjustments. This unit meets today's demand for accuracy and economy and provides for tomorrow's more stringent needs. Two RF outputs for receiver testing and alignment. New case design is durable and good looking.

**G-E OSCILLOSCOPE—MODEL ST-2A**

Here's the ideal scope for shop and general laboratory use. Size and weight have been held to a minimum yet you are assured of quality G-E construction and materials. Features high sensitivity ... exceptional stability. Special features include a DC vertical amplifier to adapt the equipment to a wide range of applications. Deflection pattern expands to several times tube diameter.

---

**SPECIFICATIONS—MODEL ST-13A**

**FREQUENCY RANGES**
One or two specified frequencies in the following ranges:
- 25 MC to 50 MC
- 72 MC to 76 MC
- 138 MC to 174 MC

Quantum crystal operating range: 4 MC to 6 MC

**REFERENCE OSCILLATOR ACCURACY**
0.01%, from 32°F to 122°F

Greater accuracy will be obtained over a more limited temperature range. External connections and brackets are provided for 6 V oven operation where wider temperature range with greater accuracy is available.

**MODULATION ACCURACY**
- 5% ± 200 cycles

On sinusoidal or square wave modulation (complete limiting).

**METER RANGES**
0 to 10 MC and 0 to 20 MC. These scales are calibrated in terms of carrier frequency displacement from the internal reference oscillator and deviation due to square wave modulation. Sinusoidal modulation is 1.57 times this value. A conversion curve appears in the cover.

**INPUTS**
- Eighteen-inch collapsible whip antenna
- Fifty-ohm BNC connectors

This input can handle only limited power as it is followed by a molded carbon potentiometer attenuator.

**OUTPUTS**
- Low RF output—adjustable around 1 microvolt
- High RF output—adjustable from about 100 to several thousand microvolts, depending on frequency

Both outputs come out on 50-ohm BNC connectors.

**POWER—INTERNAL BATTERIES**
- 2—45 volt batteries
- 2—1.5 volt flash light cells
- 2—1.5 volt pen light cells

**TUBE COMPLEMENT**
- 2—E14, 2—104

---

**Accessories include:** External antenna mount (above), adapter cable, and crystal ovens.
ERIE Disc Ceramicons have proven to be an ideal adaptation for high voltage application. Inherent construction simplicity means greatest economy yet for comparable voltage and capacitance values.

They are amazingly easy to install in small spaces . . . they simplify soldering and wiring operations, and speed up the assembly line. Erie Disc Ceramicons consist of round flat dielectrics with fired on silver plates and leads of No. 22 tinned copper wire firmly soldered to silver electrodes.

The Ceramicons are phenolic dipped and vacuum wax impregnated for moisture seal. They are identified by the Erie trademark and are marked with nominal capacitance and rated voltage.

Write for Bulletin 440. Erie Standard 500 volt By-pass and Coupling Disc Ceramicons are described in Bulletin 438. For Temperature Compensating Disc Ceramicons see Erie Bulletin 439.

ERIE components are stocked by leading electronic distributors everywhere.

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices: ERIE, PA.
Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill. • Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.
Factories: ERIE, PA. • LONDON, ENGLAND • TORONTO, CANADA

Want more information? Use post card on last page.
Case History: Hastings needed accessibility

1. Mobile relay stations are a part of this nation's defense network. Hastings Instrument Co., Inc., manufactures much of the equipment installed in these rugged trailers.

2. A lot of equipment has to go into a very small space. Yet the very nature of the problem requires that the operating components be accessible for maintenance and servicing.

3. Grant Industrial Slides were used. With them, units may be withdrawn and locked in a fully extended position in a matter of seconds, with no more effort than opening a filing cabinet.

4. A full 90° tilt brings the wiring under the chassis into full view for repair. Unit locks at this and other angles, and may continue to operate in any of these positions.

5. Grant No. 363 Slide is just one of an unlimited variety available. Load requirements from 25 to 500 lbs. Locking in closed, open or pivoted positions, angles up to 180°.

Grant Industrial Slides provide built-in accessibility, without effort, without costly loss of operating time. Bring your equipment mechanically up to your high electronics standards. Whatever the problem, call upon Grant, the foremost name in sliding devices.

grants industrial slides

a product of the engineering design department of Grant Pulley and Hardware Company
31-75 Whitestone Parkway, Flushing, New York.
Write for information... consult on any problem

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
For duty at high voltage and high current, Lapp Gas-filled Condensers offer the advantages of extreme compactness... low loss... high safety factors... puncture-proof design... constant capacitance under temperature variation... grounded tuning shaft... complete reliability—electrically and mechanically. Models for capacitances up to 60,000 mmf; current ratings to 525 amps at 1 mc; voltages to 100 kv peak.

Write for description and specifications. Radio Specialties Division, Lapp Insulator Co., Inc., Le Roy, N.Y.
this is your product

but

does it look the part?

In other words, do you get the same perfection in your cabinets as your engineers build inside?

Karp customers do—and they know that this painstaking sheet metal fabrication doesn’t mean high prices.

They know that our vast assortment of available dies eliminates the need for much costly tooling. They know that our plant—the length of three city blocks—with its modern facilities, offers custom production at prices that are surprisingly low.

You’ll find, as others have, that we can produce to exacting tolerances precisely the type of cabinet you require.

In large quantity or small. Steel or aluminum. Any type of welding. Painstaking hand finishing. Prompt shipment.

Visit our plant and see these things for yourself if you wish. We welcome your visit. Write for our bulletin.

KARP METAL PRODUCTS CO., INC.
215 63rd ST., BROOKLYN 20, N. Y.

MOST COMPLETE FACILITIES FOR LARGE AND SMALL RUNS OF ENGINEERED SHEET METAL FABRICATION

ENGINEERING + TOOLING + PRODUCTION + FINISHING = KARP
Motorola uses Eimac 2C39A's

In the First 460 Mc Type-Approved Equipment For Operation in the Class-A, "Citizen's Band"

Motorola's new 460 mc equipment—the first 460 mc equipment type-approved for operation in the Class-A, "Citizen's Band" employs Eimac 2C39A's as tripler-drivers and power amplifiers in its mobile and base station transmitters. In the Eimac 2C39A, Motorola utilizes a highly efficient, domestically available tube that has been JAN accepted and proved in rugged and exacting military service. Motorola, through the use of Eimac 2C39A's and other late electronic developments, makes available a UHF two-way radio system designed to meet the demands of individuals, industry and emergency services.

FOR INFORMATION ABOUT THE 2C39A WRITE EIMAC'S APPLICATION ENGINEERING DEPARTMENT

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

Export Agents: Frazier & Hansen, 301 Clay St., San Francisco, California

Want more information? Use post card on last page.
"Crash-worthy?"

Pre-check with Consolidated Instrumentation

What happens to structural members and car-body components when freight cars are subjected to the shock impacts and buffeting of hump-yard switching?

To determine stress distribution and to evaluate the effectiveness of shock protection devices, the Pullman-Standard Car Manufacturing Company selected a Consolidated 5-114 Recording Oscillograph, System D Amplifiers, and Bridge Balance as basic recording instruments.

Freight cars, loaded with sand and steel blocks at gross weights ranging from 46,400 pounds (empty) to 164,000 pounds (fully loaded) crashed together 185 times at speeds up to 10 miles per hour.

In this way the dynamics of simultaneous shocks, some as brief as one five-thousandth of a second, were permanently recorded in visual form. From such data will come design changes, giving protection against shock and vibration damage. Thus an improved product is achieved.

Consolidated Engineering

Dynamic Recording Systems

such as the one shown here are designed and manufactured by Consolidated. Variations in the arrangement of the equipment are infinite. Applications are widely varied throughout industry and the sciences. A typical recording system includes pickups, amplifiers or bridge balances, and a recording oscillograph. Write for Bulletin CEC 1500B-X7
FREE BOOK on specialty transformers

This fully illustrated book on Westinghouse Specialty Transformers contains full details on design, construction and operation of each type in entire line.

Find the answer to your problems in these types!

"Off-The-Shelf" Standard Models . . . includes electrical and electronic designs for both commercial and military applications.

"Built-To-Order" Special Designs . . . reviews wide range of custom-built types. Shows how Westinghouse adapts basic transformer components to meet your exact specifications economically.

SEND FOR YOUR COPY TODAY! Write on your letterhead for Booklet B-5806, or use coupon below. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-70689-A

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

Westinghouse Electric Corporation
Application Data and Training Dept.
P. O. Box 868
Pittsburgh 30, Pennsylvania

Gentlemen:
Please send me Booklet B-5806,
Westinghouse Specialty Transformers

NAME
TITLE

FIRM

STREET

CITY ZONE STATE
Now you can get rid of troublesome, costly seal-assembly operations. Sealtron will solder seals into your assemblies, will guarantee hermetic perfection. Not "standardized" designs, these assemblies are built to your specifications by our specialists — delivered to you on time, at low cost.

Take the seal assembly shown above, for example. We produced the mounting inserts and tuning device, installed them in our stamped lid, and soldered in the seals. Result? Reduced costs, elimination of soldering-in troubles for our customer — and a unit that's guaranteed free of hermetic "leaks."

Here's how you'll save:
- You use every seal you purchase.
- Eliminate throw-aways, "shrinkage" of seal supplies.
- No more losses due to oxidation of seals in storage.
- End delays due to short seal supply or limited selection — Sealtron has over 1600 types of seals always available.

Let our specialists take over your seal assembly problems. Write us today — you can depend on our prompt service.

Want more information? Use post card on last page.
Selected stock. Always free from defects and surface blemishes.

Moisture and fungus proof coatings, varnish or lacquer smoothly applied. No wrinkles or unsightly heavy deposits.

C.T.C. standard terminals. Types for all applications. Silver-plated, cadmium plated, electro tinned, hot tinned or gold plated as required.

Precisely located, clearly defined imprinting: rubber stamped, silk-screened, engraved or hot stamped.

Riveting or staking of terminals, brackets and other components accomplished without radial cracks or splitting of rivet shanks, and without damaging the finish.

Cleanly cut or punched edges and holes. No signs of delamination.

Little details on terminal boards ...make the big difference in quality

C.T.C. is constantly supplying special terminal boards to the top names in electronics. These boards are built to strict government specifications, are fabricated of certified materials to fit the job. Among the specifications involved are: MIL-P-3115A, MIL-P-15037, MIL-P-15035, MIL-P-15047, MIL-P-997A.

Our Custom Engineering Service is well-equipped to fill these specifications for you. We are thoroughly familiar with the JAN and MIL-approved materials and finishes in accepted usage by government agencies and the armed forces. This, combined with assembly know-how developed over many years of supplying electronic components and equipment to the government, enables us to meet your needs for quality above and beyond the basic government standards.

Boards can be made of cloth, paper, nylon or glass laminates (phenolic, melamine or silicone resin), and can be lacquered or varnished to specifications: JAN-C-173, MIL-V-173 and JAN-T-152. Lettering and numbering is done by rubber stamping, silk screening, hot stamping, engraving. Inks used in rubber stamping contain anti-fungus and fluorescent additives.


CAMBRIDGE THERMIonic CORPOration

custom or standard...the guaranteed components

See our listing in Electronics Buyers' Guide

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Immediate Service
Will Solve Your Inventory Problems

Everything in Electrical-Insulating Materials

**INSULATION & WIRES INCORPORATED**

A Complete Line of Electrical Insulating Materials...Ready for Delivery!

- Varnished Cambric Products
- Insulating Paper
- Varnished Tubing
- Saturn ed Sleev ing
- Insulated Varnish
- Vulcan zed Fibre
- Phen ole
- Fibre Wedges
- Wood Wedges
- Built up Mica Products
- Asbestos Insulation
- Woven Glass Insulation
- Pressure Sensitive Tape
- Cotton Tape
- Cotton Sleev ing
- Contractors Built To Specifications
- Teflon
- Silicone Resins
- Silicone Insulations

- Guard Against Production Slowdowns caused by delayed factory shipments of insulation materials. IWI gives you fast delivery from ample stocks.

- Keep Inventories At A Minimum by getting seldom-used items and small production lots of essential materials quickly from your nearest IWI Warehouse.

- Only Nationally Advertised Quality Products are sold by IWI. All are approved and used by leading electrical manufacturers.

- Expert Technical Assistance on any problem involving electrical insulating materials is offered without obligation by IWI's staff of experienced Field Service Representatives.

A National Network of Warehouses Serving Electrical Manufacturers

**INSULATION AND WIRES INCORPORATED**

3435 Chouteau Avenue • St. Louis 3, Missouri

Write For The Address Of The Warehouse Nearest Your Plant

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
CONTROLLED QUALITY PRODUCTION

HiperCore

ELECTRONIC CORES

PERMIT SUPERIOR PERFORMANCE
IN MANY ELECTRONIC PRODUCTS

The superior performance of Moloney HiperCore Electronic Cores is immediately discernable when incorporated in various electronic products. This is the result of rigid quality control during manufacture.

To begin with... every mill shipment of cold-rolled, oriented grain, high permeability steel for HiperCore Cores must pass rigid Epstein Tests. Then, during manufacture... care and precision in the winding on Moloney's patented winding mandrels... absolute control of tension... exact overall dimensions. Care... in annealing to relieve stresses by maintaining accurate temperature and atmospheric control. Care... in cutting, to obtain a minimum gap followed by an etching process to insure interlaminar insulation.

Production, in quantity, is available to you if you need superior performance, smaller size, less weight in your electronic cores.

Write today for Bulletin SR-205 containing specifications, performance data and prices on over 300 standard sizes. Over 1000 sizes available for special applications.

Bulletin GF-531... "A Trip Through the Moloney Plant"... 48 pages in full color picturing the facilities of the Moloney Electric Company... will be sent free upon request.

Moloney Electric Co.

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations

SALES OFFICES IN ALL PRINCIPAL CITIES

FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA,

April, 1953 — ELECTRONICS
A MESSAGE TO AMERICAN INDUSTRY • ONE OF A SERIES

PROSPERITY IN THE USA:
How Deeply in Debt Are We?

How prosperous are the people of the United States? Previous messages in this special series have answered this question in part by recording the progress—relatively slow progress—we have made in increasing both the income and the wealth per person in the USA.

This fourth and concluding piece of the special series deals with the extent to which our prosperity should be discounted because it has been accompanied by an increasing volume of debt. Many correspondents have suggested to us that an individual or a nation can temporarily increase prosperity by borrowing, but in so doing lives on both borrowed goods and borrowed time. Our purpose here is solely to throw light on the question of whether or not we are now in that unenviable position.

On January 1, 1953, the total debt of the United States government and of its citizens was $627 billion, as shown in the table below. On its face, a debt of this magnitude, which represents about $3,900 of debt for each person, suggests that we are heavily debt-ridden.

The burden of our debts, however, does not depend simply on their size. It depends in much more decisive degree on our capacity to carry the load successfully. This capacity, in turn, is partly a matter of attitude, and attitudes defy objective measurement. A community that gets very jittery about its debts has less capacity to carry its burden successfully than one that does not. But the accurate measurement of jitters, present or prospective, still remains to be mastered.

**Capacity to Carry the Debt Load**

Nonetheless, it is possible to throw some light on our capacity to carry the debt burden by studying key economic elements that can be measured with some degree of accuracy. The following paragraphs indicate how some of these key economic elements stand.

Compared with our national income, the total volume of our debts, public and private, is still well below the level of 1929, when it proved to be too big for the good of the country. Our total debt is now 113% greater than the national income whereas in 1929 it was 146% greater.

There are several other cheering facts about our debts. One is a sharp decline in interest rates which makes the cost of carrying our debts relatively much less than it was in 1929. It took 8% of our total national income to carry our debts in 1929; it takes only about 5% of the income today.

---

**TOTAL DEBT — PUBLIC AND PRIVATE**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal government</td>
<td>$267 billion</td>
</tr>
<tr>
<td>State and local debt</td>
<td>30 &quot;</td>
</tr>
<tr>
<td>Private debt</td>
<td></td>
</tr>
<tr>
<td>Corporations</td>
<td>195 &quot;</td>
</tr>
<tr>
<td>Individuals</td>
<td>135 &quot;</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$627 billion</strong></td>
</tr>
</tbody>
</table>

www.americanradiohistory.com
More Cheering Facts

We also have much more ready cash now than in 1929. Today individuals and corporations hold a total of $269 billion in cash or its equivalent which is almost twice as much as the portion of private short-term debt (about $140 billion) that is subject to sudden demand for payment.

Many students of the subject cite the relatively low cost of carrying our debts and the large volume of cash on hand, and reach the comfortable conclusion that our debt burden is nothing to worry about. In further support of this view they emphasize the fact that no important part of our debt is owed abroad. Hence, they reason there is not the danger, so conspicuous in Britain since the end of World War II, that our economy will be upset by the necessity of making heavy debt payments to other countries.

Some Dangers of Present Debt

However, the nature of our debts presents dangers that it would be foolish to ignore. This is true of both the debt of $267 billion owed by the federal government to its citizens and the $330 billion in private debts owed by some citizens and corporations to others.

Public debt can be a dangerous kind of debt because government has the power to print money or to create its equivalent by expanding bank credit. Of the $215 billion that the federal government borrowed during World War II, over $90 billion was borrowed from banks. This was the largest single contributor to the inflation of prices that since the war has robbed the dollar of about half of its purchasing power, and thereby robbed the buyers of government bonds of about half the purchasing power these bonds were supposed to represent.

If, as is quite possible, a new emergency should again require the federal government to borrow heavily while its debt remains so high, it is doubtful that the public would be avid to buy its bonds. Hence, the government might again be forced to resort to the inflationary process of relying on bank credit.

Private debts can be dangerous if the people take on new debts more rapidly than is justified by the growth of business or by their ability to repay. Last year bank loans were increased by the imposing sum of about $61/2 billion, which represents an increase of about 11% in total loans outstanding. This is almost twice as much as the increase in the volume of business over the same period. Installment credit for consumers increased by $3 billion last year, again an increase in debt about twice as great as the increase in business volume in the fields where the credit was used. It is also the fastest rate of such growth in our history.

Constructive Use of Credit

So long as the expansion of credit does no more than keep pace with expansion in the volume of business, the expansion is constructive. Also, when credit is expanded to acquire resources and equipment that will enlarge the volume of business a little later, that use is clearly constructive. But when private credit expansion begins to run ahead of business growth, it is time for us to be heads up. Such credit expansion courts price inflation. It also creates a forced draft under business so that, if credit is cut off, there may be a painful drop.

To give a summary answer to the question: Is the level of debt in the United States a danger to our prosperity?—the answer seems to be, “Not at the moment.” We owe nothing abroad. The interest burden on present debt is relatively small, and we appear to have the resources to handle the short-term debt. Yet both the total amount of debt and the recent rapid increase in total private debt, especially the latter, are enough to signal for caution. We need restraint on the part of business and consumers to avoid expanding private borrowing at an excessive rate. The federal debt needs to be reduced and put in more manageable form. If these things are done, we can proceed to build a sound prosperity.

FILTERED BY FILTRON

GUARANTEES CONFORMANCE TO RADIO INTERFERENCE SPECIFICATION

MIL-I-6181

(0.15 to 1000 MEGACYCLES)

FILTERS BY FILTRON

Filtron’s Engineering division, with its completely equipped screen room facilities, is always available to measure and recommend RF Interference Filters for your equipment, to meet and exceed the Radio Interference requirements of MIL-I-6181.

Filtron’s production facilities are supplying more RF Interference Filters for use in military electronic equipment than ever before, to meet the nation’s requirements.

Filtron... the LEADER IN RF INTERFERENCE FILTERS... has pioneered:

- Sub-miniature Filters
- High-temperature Filters
- RF Filters to withstand shock and vibration

Wide band Multi-section Units
RF Filters “Custom Designed”

to meet YOUR requirements

An inquiry on your Company letterhead will receive prompt attention.

Largest Exclusive Manufacturers of RF Interference Filters

www.americanradiohistory.com
Here's how L&N engineers verify Speedomax resistance to stray electrical fields. The ring is a Helmholtz coil, adjustable for a wide variety of field effects.

Speedomax is engineered for field service

- Built into every Speedomax recorder and controller is a high degree of indifference to stray electrical fields. And this is one of its most useful characteristics in almost any job. It means that you can install a Speedomax near a big motor, power line or X-Ray machine—any electrical equipment in fact—and you'll probably see no effect at all from surrounding electronic noise and "junk".

The reason for this indifference to stray fields goes back through the adjustment, building and design of the instrument, to its basic engineering. Speedomax has an electronically-clean measuring circuit, as well as clean signal and amplifier circuits.

This clean design includes a bifilar-effect slidewire, to eliminate any objectionable inductance at that point. It includes our "no-moving parts" trolley contact on the slidewire, which eliminates pigtails and their variable inductances. It includes use of a Mumetal slidewire shield where desirable, instead of less expensive but lower-permeability aluminum. And it includes a lot of just downright meticulous detailing, such as carefully engineered wiring and input filtering, plus ingenious shielding where required.

These and other precautions eliminate out-of-phase components in the supply to the amplifier. The latter therefore doesn't "load"; hence sends the correct amount of correct-phase power to the balancing motor. With ample power, the motor's recording and control action is snappy and accurate.

Our Catalog ND46(1) and Technical Publication ND46(1) tell the story. Write our nearest office or 4979 Stenton Avenue, Philadelphia 44, Pa.

Scientists find that Speedomax instrument operation is not affected by the stray fields created by motors, electric heaters, x-ray equipment and other laboratory gear.

LEEDS NORTHRUP
instruments automatic controls + furnaces

PHOTO COURTESY COLUMBIA UNIVERSITY.

PHOTO COURTESY GENERAL ELECTRIC CO.

Jr Ad ND46(10d)

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
C-D probably has the answer to your electrolytic problem! Is it for a motor? TV circuit? Photoflash? Micro-wave communications? If anybody has the answer to your electrolytic problem, it's likely to be Cornell-Dubilier, the greatest name in capacitors. Write for the complete catalog to: Dept. K43, Cornell-Dubilier Electric Corp., General Offices, South Plainfield, New Jersey.

CORNELL-DUBILIER
world's largest manufacturers of capacitors

SOUTH PLAINFIELD, N. J. • NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS • PROVIDENCE, R. I. • INDIANAPOLIS, IND. • FUQUAY SPRINGS, N. C. • SUBSIDIARY, THE RADIANT CORP., CLEVELAND, O.
"This Cat will never be an orphan!"

"Construction men work against deadlines. If machinery can't be serviced—regardless of age—with genuine manufacturer's parts, they don't want it. It's an 'orphan'!

"This can't happen when it's Caterpillar-built.

"If the Caterpillar dealer is temporarily out of stock, he can get any part practically overnight—by Air Express! Air Express speed, closely coordinated with our Special Order department, gives all domestic Caterpillar dealers—over 375 stores—complete parts service for every model ever built. It gives them an 'inventory' of some 80,000 different parts!

"'Down time' is cut to the minimum... machine life extended to the maximum... with the help of Air Express speed and dependability.

"That's why Caterpillar dealers frequently tell us 'Ship it Air Express'—averaging more than 18 times a day!"

Air Express gets there first—and often saves money, too! In many weights and distances, rates are lowest of all commercial air carriers!

It pays to express yourself clearly. Say Air Express! Division of Railway Express Agency.

Want more information? Use post card on last page.

E. J. (Eph) Davis, Manager of Traffic and Order Dept., with new Caterpillar DW20 Tractor
This is MINIATURIZATION!

TRANSISTOR MOUNTS

Actual Size of Single and Triple Transistor Mounts
Fused Metal to Glass Vacuum Seal, Nickel-Silver Covers, Any Pin Configuration Furnished

Now for the first time, transistor mounts you can depend upon. The knowledge and skill of the foremost manufacturer of crystal holders went into the engineering of these units. By drawing on this great amount of experience gained in overcoming similar problems, transistor mounts have been designed allowing the germanium block to be permanently sealed in either a vacuum or inert gas atmosphere. This gives you the assurance against variations due to moisture, dirt, changing atmospheric or light conditions.

Constantin transistor mounts, as well as other Constantin component parts are manufactured to withstand heavy usage while maintaining complete effectiveness.

By submitting your requirements ... you can see for yourself how our special design engineers can really help in planning your product.

L.L. Constantin & Co.
MANUFACTURING ENGINEERS
RT. 6 AND FRANKLIN AVENUE & LODI, NEW JERSEY

also manufacturers of
- Crystal Holders
- Multi-Pin Headers
- Single Terminals
- Single End Seals
- Multi-Pin Con Plugs
- Vacuum Coating Equipment
Model 622 — Ultra-Sensitive Instruments
Portable d-c and a-c thermo instruments for precision measurement of potentials and minute currents in electronics or laboratory research.

Model 901 Portable Test Instruments
Available in d-c, Model 901 — and a-c, Model 904, single and multiple ranges of wide coverage. Excellent scale readability and shielding. Accuracy within 1/2 of 1%. A.C. Clamp Volt-Ammeter
(Model 633, Type VA-1) For convenient and rapid measurement of a-c voltage and current without breaking the circuit. Jaws take insulated or non-insulated conductors up to 2" diameter. Safe, rugged, versatile. Also available as a-c clamp ammeter, without voltage ranges.

Sensitive Relays
A line of sensitive relays including the Model 705 which provides positive operation at levels as low as 1/2 microampere. Non-chattering magnetic contacts handle up to 10 watts at 120 volts.

Panel and Switchboard Instruments
A complete line of instruments in all types, sizes and ranges required for switchboard and panel needs . . . including d-c, a-c power frequencies and radio frequency, rectifier types and D.B. meters.

Model 697 Volt-Ohm-Milliammeter
One of a line of pocket-size meters, Model 697 combines a selection of a-c and d-c current, and resistance ranges. Ideal for maintenance testing and many inspection requirements.

Model 1411 Inductronic D-C Amplifier
Stable amplifier provides high degree of resolution even at fractional loads. Reached steady full scale deflection in a fraction of a second. Interchangeable plug-in range standards for either microamperes or millivolts.

Industrial Circuit Tester — Model 785
A multi-range, multi-purpose, ultra-sensitive analyzer, for laboratory and industrial checking of electrical and electronic circuits. Has 28 practical scale ranges; measures d-c and a-c voltage, d-c and a-c current, and resistance. Accessories available to extend ranges. Compact and portable; furnished in either oak or steel case.

Model 665 Electronic Tube Analyzer
Tests tubes under exact operating potentials. Accurately determines true mutual conductance of all tubes, in accordance with manufacturers' rated operating conditions, or under special operating conditions.

High Frequency Electronic Analyzer Model 769

WESTON Instruments

Instruments for
• Research
• Production
• Maintenance

For complex, or just routine measurement jobs, these and other specialized WESTON Instruments save time and assure dependable measurements. For information on the complete line, see your local Weston representative, or write . . . WESTON Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Leagues Ahead in Lug Seals

HERMETIC SEALS with Attached Lugs

...embodying the newest, most advanced features for every application

HERMETIC has designed a complete series of hermetic seals with attached lugs as an associated line of the self-lug tubing seals. This series is characterized by innovations of particular interest to design engineers:

- Lugs are affixed by HERMETIC's new positive method and are guaranteed to be secure.
- Lugs are available for every tubular seal and bathtub condenser seal currently used in industry.
- Lugs are available flat or bent through any angle desired; with pierced holes, or notched for wrap around connection.
- Solder-Lug Feed-Throughs, parts 1503-04-05-06, are also available in this series.

WRITE detailing your problem for immediate attention, and ask for FREE copy of HERMETIC's informative 32-page brochure, the most complete presentation ever offered on hermetic seals.
IT'S MADE OF BERYLCO BERYLLIUM COPPER

The safety of a plane, the effectiveness of a battalion, or the success of a bombing mission may depend on this tiny beryllium copper part, which measures only 1/8 inch in length— one-twelfth the size shown here.

Contacts like this are used in miniature tube sockets for radar, communications and other electronics equipment. Everyday thousands of these contacts are stamped out at high speeds on progressive dies.*

The men who design our military equipment are well aware of the old saying "For want of a nail, the shoe was lost"... and consequently the battle. The specifications, the load and test requirements, are exacting. Contacts must excel in spring properties, in resistance to both corrosion and relaxation, in electrical conductivity. They must not be subject to vibrational fatigue and must withstand wide variations in temperature. There is one metal which possesses all these essential characteristics to a high degree— Berylco beryllium copper.

Unique properties, such as combination of great strength and electrical conductivity, make this versatile alloy as important in the manufacture of peacetime products as of those for defense. We invite you to take advantage, in your plans for the future, of the technical knowledge acquired by the world's largest producer of beryllium copper. Write or telephone any of the offices listed below.

VALUABLE ENGINEERING INFORMATION on Berylco beryllium copper is contained in a series of technical bulletins, published monthly. To receive your copy regularly, write on your business letterhead.

TOMORROW'S PRODUCTS ARE PLANNED TODAY WITH BERYLCO BERYLLIUM COPPER

Sample material available for testing purposes

*Data supplied by John Volkert Metal Stampings, Inc., Queens Village, L. I., N. Y.

BERYLCO
THE BERYLLIUM CORPORATION
DEPT. 3D, READING 21, PENNSYLVANIA
New York • Springfield, Mass. • Rochester, N.Y. • Philadelphia • Cleveland • Dayton • Detroit • Chicago • Minneapolis • Seattle • San Francisco • Los Angeles
 Representatives in principal world-trade centers

Want more information? Use post card on last page.

April, 1953— ELECTRONICS
OUTMODES ALL OTHERS

PICTURE TUBE

*With Internal Magnetic Focus

YEARS OF ELECTRICAL PROGRESS

• Saves parts, circuitry, labor in set manufacture!
• Gives needle-sharp over-all image!
• Permanently pre-focused for best viewing!

COMPARE (left) the bulky parts needed for a standard tube with (right) the clean simplicity of an i-m-f tube ready to install!

The external ion-trap magnet on this standard tube, is an extra cost item for the TV manufacturer and requires special adjustment. The focus coil and complicated mounting also mean extra cost. They take up space, add weight, consume assembly and adjustment time. Get rid of all three parts with G. E.'s new i-m-f tube!

Now, no hard-to-adjust external ion-trap magnet! No focus coil, or external focus magnet, with cumbersome bracket! Instead, an i-m-f tube calls for just two parts when installed, both of them compact: (1) a close-fitting steel shunt band that is easily slipped on and (2) a small centering device to position the picture.

On this 75th anniversary year, General Electric takes pride in announcing its i-m-f picture tube as the latest in a long series of significant G-E "firsts". To the many advantages given by internal, factory-adjusted ion-trap and focus magnets, can be added radically improved design in important tube details. One example of this is the new, precision-made metal "lens" that greatly narrows the electron beam, assuring clean, sharp picture definition over the entire TV screen area. Now 90°-sweep tubes can have good detail across the whole face! You can expect production soon in 21" size. Other i-m-f types will be added rapidly. Television manufacturers and television designers will be sent full information on request. Tube Department, General Electric Company, Schenectady 5, New York.
How to use **GLOBAR**

**TYPE BNR RESISTORS to advantage**

- The unusual characteristics of GLOBAR type BNR ceramic resistors make them practical for a diverse number of advantageous uses. Charted here are five typical applications where these resistors are being used to advantage at present.

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil burner ignition transformer</td>
<td>High voltage feed back into line is prevented.</td>
</tr>
<tr>
<td>Small motors</td>
<td>Arcing of governor contact points is greatly decreased.</td>
</tr>
<tr>
<td>Rectifier circuits</td>
<td>Peak voltages are limited thus stabilizing circuits.</td>
</tr>
<tr>
<td>Electronic devices</td>
<td>Successful use in voltage control circuits.</td>
</tr>
<tr>
<td>DC Circuits</td>
<td>Solenoid valve coils are protected.</td>
</tr>
</tbody>
</table>

Our Bulletin GR-2 contains detailed engineering data which may well suggest applications in your own products. It will give you facts that will help you decide how these ceramic resistors can be of value to you. Let us send you a copy. Write Dept. E L 87-101,
Are you using this "Servo" principle?

This Avien "feedback" system has important advantages for plane-makers and engineers.

Avien was among the first to use the servo principle in the design of aircraft gages.

But there's another servo principle that Avien offers to every aircraft manufacturer.

It's a "feedback" system that has provided a lot of effective answers to aviation's most complex problems.

This scheme is basically simple. Once handed the problem, Avien tailor-makes gages for the aircraft. Avien engineers follow through all the way, from drawing board inspiration to instrument panel installation.

But after installation is completed, Avien's job continues. Avien field engineers constantly check and test the gages in service—and feed back information to design headquarters.

This "closed-loop" operation has aided Avien in the perfection of some remarkable products.

We've designed Cylinder Head Temperature Indicators and Jet Tailpipe Thermometers that use the servo principle. Result: longer scale gages, unaffected by lead characteristics.

We've designed a Jet Engine Thrustmeter that computes gross thrust from measurement of tailpipe pressures and ambient pressures.

We've made over fifty fuel gages that measure fuel quantity by weight, eliminating moving parts in the fuel tank.

Every month, Avien produces over 10,000 major instrument components for the aviation industry.

Right now, we have two goals.

First, we're going to keep on solving the toughest instrumentation problems in the industry. If you think you've got them, call us.

Second, we're going to keep on adding the best engineers in the business. If you think you're one of them, send your detailed resume to Department E.
WHEN THEY DESIGN
WHEN THEY SPECIFY
WHEN THEY BUY . . .

they look for
PRODUCTS
FIRST in the
GUIDE

Engineers, designers, specifiers, purchasing agents — everyone who has anything to do with the design or use of electronic gear, components or allied products have, for years, learned to use the ELECTRONICS BUYERS’ GUIDE for essential product data and sources. The reason? Because they have found it thoroughly up-to-date, the most accurate and the only complete source available. Tailored as it is to the critical needs of the electronic industry, it is the only book upon which the industry’s technicians rely.

FOR THE REASONS WHY IT’S THE ADVERTISER’S BEST BUY
THE 3 ESSENTIALS THAT MAKE THE

electronics BUYERS’ GUIDE

The ONE reliable source of product information

1. ACCURACY
2. NEW PRODUCTS
3. COMPLETENESS

1. ACCURACY...
The year-round staff of the ELECTRONICS BUYERS’ GUIDE has had years of experience in compiling and verifying products. Fully aware of the rapid changes that are taking place in the electronic field, the staff starts from scratch each year. Questionnaires are sent to every manufacturer. When they are returned, they are checked — and double checked. Nothing is taken for granted in relation to products, terminologies and new classifications. A manufacturer’s product will not be included in the “GUIDE” until evidence is supplied that they are manufactured and available. It is this careful research in which no detail is overlooked, that provides users with a GUIDE that is the only accurate and reliable product source available in the electronic field.

2. NEW PRODUCTS...
Electronics is a fast moving science-industry. The experiments of yesterday become the realities of today. Thus it becomes vitally important that all new products are included to keep listings ... not only up-to-date, but up-to-the-minute. A continuing search is made of all sources for new products and new terminologies. This search is a year-round job. Every possible method is employed, including direct contact with industry through our sales and field representatives. The result of this painstaking search makes the “GUIDE” the only book that provides complete up-to-the-minute information.

3. COMPLETENESS...
By completeness is meant that ALL essential product information is provided. This includes: Complete listing of all manufacturers and their products — not just a token listing. Correctness and completeness of addresses. Sufficient cross indexing to locate any product regardless of terminology. And, most important, the format of the “GUIDE” provides, in one complete listing, a simple method of locating products. In addition to these important details, the “GUIDE” has trade name and distributor listings. These are the factors of completeness — these are the essential things that have made the “GUIDE” the “breadboard blue book” for every technician or purchaser in the field.

THE “GUIDE” IS THE ADVERTISERS BEST BUY!
Precision Tuning Accomplished by Using Bronze and Brass Parts

An important feature which receives careful consideration when designing a communications receiver is the mechanical tuning system. A military receiver must be able to accurately separate and hold the signal it is receiving even under adverse conditions when the receiver may be constantly jolted or vibrated.

Mechanical Bandspread

The R-366/TRR5 radio receiver specially designed for the United States Marine Corps as a communications and morale receiver is equipped with a geared tuning drive and special dial locking device. By using a series of accurately machined brass gears (alloy 63, 66% copper, 1.1% lead, remainder zinc), a reduction ratio of 10:1 is obtained, assuring smooth tuning and easy separation of signals. Spring loading the split gear sections eliminates back lash when tuning. The gear mechanism also drives the main tuning condenser shaft (free-machining brass rod) which in turn rotates the four gang set of rotor plates. An automatic stop at each end of the dial travel protects the condenser plates from damage. These plates are blanked from high brass (approx. 66% copper, balance zinc) annealed and then silver-plated to increase resistance to corrosion.

Dial Lock Assembly

When the desired station is located, the condenser can be held in place with a special dial lock.

Many different types of dial locks have been designed but most all have one fault in common. As they are tightened, they exert pressure against one side of the dial or knob, causing a slight movement and consequent detuning of the receiver.

The illustrated dial lock prevents this movement by simultaneously exerting pressure on four sides of the tuning knob. When the dial lock knob is rotated, four heat treated beryllium copper springs mounted on a brass plate tighten against the edges of a braking plate fastened to the main tuning knob.

The disassembled illustration of the dial lock shows the various brass and bronze parts used in the assembly. All high brass parts are nickel plated to increase resistance to corrosion. The dial lock knob is a machined bronze casting. The beryllium copper springs insure high resistance to fatigue and a strong grip to prevent slipping.

Bridgeport Service

The use of the correct alloy and temper is most important in precision fabrication. For help on your metal problems, contact the nearest Bridgeport office.

April, 1953 — ELECTRONICS
YOUR FILTER NETWORK PROBLEMS ... Solved in Jigtime

Selecting the proper filter network component for a critical electronic application is not exactly comparable to fitting a piece to a puzzle. In filter networks the criteria are not quite as superficial as proper size, shape, etc. Even compliance with attenuation requirements is not usually sufficient. There are a multitude of hidden factors in the manufacture of an audio filter that go much deeper than these qualifications.

Here in Burnell & Co. we concern ourselves with all the phases in the design of a filter of superior quality. To maintain our high standard we manufacture our toroids with the most modern facilities and quality controlled methods. The capacitor components employed are either the finest silver mica type or are wound with plastic dielectric material employing no impregnants that may affect the life or long term stability. All other components are just as carefully selected and controlled.

This policy of incorporating only the best ingredients coupled with our advanced design method insure our customers that not only will our filters meet the basic requirements but that they will also maintain all of their characteristics under all the service conditions of equipment in which they are used.
16 years of experience

...and know-how goes into your purchase of a Cinema resistor.

Accurate wire wound resistors in the new Cinema CE type are hermetically sealed to surpass the requirements of MIL R-93A. Investigate the use of the new CE resistor in your applications. Contact your local Cinema Engineering Company factory representative, or write direct today for literature.

IN NEW YORK
Audio & Video Products Corp.
730 Fifth Ave. - Plaza 7-3091

EXPORT AGENTS
Frazier & Hansen, Limited
301 Clay Street
San Francisco, Calif., U.S.A.

CINEMA ENGINEERING CO.
1510 W. VERDUGO AVE, BURBANK, CALIF.
New line of G-E Amplistats now available for high-gain DC amplification circuits

40-VOLT-AMPERE INDUSTRIAL AMPLISTAT operates directly from 115-volt, 60-cycle power supply.

400-CYCLE PLUG-IN AMPLISTAT is a push-pull output DC linear amplifier with three separate input windings. Tube-type base simplifies mounting.

ONE-VOLT-AMPERE AMPLISTAT is compact (two-inch cube), mounts in standard octal socket for convenient connection and easy circuit testing.

EDUCATIONAL-LABORATORY AMPLISTAT (10-volt-amperes) has multiple input for flexibility. Diagram molded into panel allows easy demonstration.

The Amplistats (self-saturating magnetic amplifiers) illustrated here are typical of the units General Electric is now producing. Ten ratings have been designed to extend application to a wide variety of circuits. There are two models in the 1-volt-ampere range, one model in the 40-volt-ampere range, and two models for use with 400-cycle input current.

An Educational-Laboratory unit (40-volt-ampere) and a 400-cycle hermetically sealed unit are also available. New ratings of 25-volt-amperes, 125-volt-amperes, and 600-volt-amperes will go into production in the near future.

General Electric's expanded line of Amplistats offers you many advantages in the design of control and instrumentation systems which require high-gain DC amplification of small signal sources. Combining amplifying and rectifying elements in a packaged unit, G-E Amplistats give you instant starting, low power consumption, long life, electrical signal isolation, and rugged durability where moderate shock or vibration might occur. They are simple and convenient to mount, and are often lighter in weight than other types of amplifiers.

G-E engineers are ready to assist you in developing complete amplification systems around these units or in designing units for specific applications. Mail coupon below for more information on G.E.'s new Amplistat line. General Electric Co., Schenectady 5, N. Y.

---

Please send without charge bulletin GEA-5950 on G.E.’s new Amplistat line.

☐ For immediate project. ☐ For reference only.

NAME ___________________________ TITLE ___________________________

COMPANY ________________________

ADDRESS _________________________ CITY ________ STATE ________

---

GENERAL ELECTRIC

Want more information? Use post card on last page.

ELECTRONICS — April, 1953
"Miniature" I.T.E precision wire-wound resistor—
1 3/4" long x 1/16" OD.

SIZE
FORM
and
FUNCTION

"Meter multiplier" — 9 3/4"
long, ferrule type—houses
four I.T.E precision resistors
wound on bobbins of the same
material as the encapsula-
tion. This assures uniform
low coefficient of expansion
throughout the resistor resulting in a true hermetic seal.

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
I-T-E precision wire-wound resistors can be specially engineered to your requirements

New electronic equipment designs often require special types of precision wire-wound resistors. A wide range of special types and ratings, built to exact customer specifications, is being produced by I-T-E in quantity.

Expanded I-T-E design and engineering facilities, and advanced production and testing techniques, are all combined to provide individually tested units guaranteed to perform within narrowly defined limits.

Here's what I-T-E offers you:

**SIZE**
Resistance values up to 500,000 ohms can be produced in a body as small as 13/4" long x 3/16" OD—with emphasis on close accuracy, low temperature-coefficient, and high stability.

I-T-E also produces *multiple-tapped* units in cylindrical and card forms—or in any required special form. Number and spacing of taps are available to specification.

**RESISTANCE**
Special resistors are obtainable in tolerances down to ± 0.05%. I-T-E units surpass MIL-R-93A specifications.

Tiny plastic bobbins are used to obtain higher resistance values than ceramic-core resistors in the same size body.

_Matched pairs_ can be supplied in any ratio—with ratio tolerance to within ± 0.05%. (Unity ratio to within ± 0.005%.)

**FREQUENCY**
Proper selection of wire and balanced winding techniques limit reactance within narrow ranges.

**TEMPERATURE COEFFICIENT**
I-T-E selects low temperature-coefficient resistance wire. Test procedures determine temperature coefficient of a precision wire-wound resistor to within ± 2 parts/million/degree C. In matched pairs, TC of one resistor can be matched to TC of the other within ± 5 parts/million/degree C.

Rigid testing of each resistor makes it possible to guarantee TC of an entire lot.

**STABILITY**
Accelerated aging of finished resistors obtains stability as low as 0.005%. Hermetic sealing protects against the destructive effects of salt water immersion and high humidity.

**WHAT ARE YOUR REQUIREMENTS?**
I-T-E engineering and production facilities offer you much more than a standard line of precision wire-wound resistors and other wire-wound components.

If your problem is *special*, write us outlining your requirements. Resistor Division, I-T-E Circuit Breaker Co., 1924 Hamilton St., Philadelphia 30, Pa.
How Carboloy permanent magnets

Products work better, weigh less, cost less to build

Throw away that electro-magnetic source of energy! Replace it with a Carboloy permanent magnet!

Hundreds of manufacturers in the field of communications equipment have taken this sound advice . . . and make better performing products for less money as a result.

Here’s why: A Carboloy permanent magnet is a simple package of stored energy that will never fail. When it replaces a wound coil in a circuit, it is usually a smaller assembly, with current losses eliminated. For unlike a coil, a magnet generates no current-wasting heat; its field strength always remains steady.

Fabrication costs go down because the magnet eliminates the coil, wires and operating parts. Even in small sizes, it is powerful. That means product design is simplified . . . size and weight substantially reduced. A Carboloy permanent magnet costs nothing to operate, never needs maintenance. Result? More savings, more product dependability.

Why not call a Carboloy magnet engineer soon? Find out just where and how a magnet assembly can help you . . . and get an expert, helpful assist in magnet design and application.

High-quality, low cost Carboloy Permanent magnets are available in all sizes, all shapes—cast or sintered to your specifications. Mail coupon for free Magnet Design Manual and Standard Stock Catalog.

HEARING AIDS—Here is an outstanding advance in hearing aids—a new all-transistor, all-magnetic “Radioear” developed by E. A. Myers & Sons, Inc., Pittsburgh. Carboloy permanent magnets are used in the magnetic receiver and magnetic microphone—both newly designed, high-efficiency, high-output units made especially for use in the all-transistor “Radioear.”

Magnets have eliminated hearing aid failure caused by severe conditions of heat and humidity encountered in use, and make it possible to match the impedance of the transistor amplifier without the use of an input transformer as required for crystal-type microphones.

Want more information? Use post card on last page.

April, 1953—ELECTRONICS
improve communication devices

WALKIE-TALKIES — Size and weight are highly vital here. Carboloy permanent magnets in these speakers help to reduce both considerably.

TRANSMITTER RECEIVERS — Huge communication links like these rely on Carboloy permanent magnets for trouble-free performance.

FIELD TELEPHONES — In receivers, Carboloy magnets help step up clarity, cut down size and weight, and reduce power requirements.

16 OUTSTANDING ADVANTAGES OF CARBOLOY PERMANENT MAGNETS

- Cool — generate no heat
- Require no electrical energy
- Cost nothing to operate
- Eliminate coils, windings, wiring, etc.
- Need no maintenance — no coils to burn out, no slip rings to clean or replace, etc.
- Simplify mechanical assemblies — exert strong tractive force for holding, lifting and separating devices that eliminates component parts, makes product design and fabrication simple
- Save space — great magnetic strength in small sizes
- Powerful — and power is constant
- Combine electrical and mechanical features — transform electrical energy into mechanical motion; mechanical motion into electrical energy
- No power failures
- Resist moisture — no coils to collect dampness
- Give uninterrupted operation
- Create savings — often eliminate costly, power-supplying parts
- Simple — no operating parts
- Reduce weight, product size
- Supply a permanent source of energy

CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

11139 E. 8 Mile Street, Detroit 32, Michigan

Plants at Detroit, Michigan; Edmore, Michigan; and Schenectady, New York

"Carboloy" is the registered trademark of the Carboloy Department of General Electric Company

FREE CATALOG AND MANUAL

Carboloy Department of General Electric Company
11139 E. 8 Mile Street, Detroit 32, Michigan

Send me, at no cost or obligation, copies of Permanent Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

NAME

POSITION

COMPANY

ADDRESS

CITY    ZONE    STATE

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
Flaw finder switches to AXIOHM RESISTORS

The Sperry ultrasonic Reflectoscope, a compact, portable unit designed for on-the-job inspection, "listens" for defects through as much as thirty solid feet of aluminum and even greater thicknesses in steel and other materials.

Many of the circuits in this highly sensitive electronic instrument now include Ward Leonard Axiohm Resistors. Sperry's design engineers gave three reasons for specifying this ruggedly built, self-mounting, miniature resistor.

- stronger anchorage of the axial lead
- smaller size
- full watt rating at high resistance values

AXIOHM RESISTORS of the vitreous enamel wire-wound power type are designed for use by the electronic and allied industries. These newly developed miniature resistors are self-supporting by their own wire leads which are hot tin-dipped for ease of soldering. They are available in conservatively rated 5 and 10 watt sizes. Write for Axiohm resistor bulletin.

WARD LEONARD ELECTRIC COMPANY
MOUNT VERNON, NEW YORK
Result-Engineered Controls Since 1842
WARD LEONARD
makes
19 distinct inspections and tests on every Vitrohm resistor

Measurement of outer diameter and concentricity of ceramic cores are but two of the 19 checks made on every Axiohm resistor.

In the Axiohm, as in every stock and made-to-order resistor, Ward Leonard gives this same careful attention to the details that result in long-life service even under the most adverse conditions.

Every resistor component is matched with respect to thermal expansion. Ward Leonard resistor cores, Vitrohm enamel, terminals, junctions, even resistance wire, are result-engineered for accuracy and uniformity.

Whether your product is a delicate electronic device like the Reflectoscope or a heavy-duty industrial machine, you need an electrical control you can count on. Ward Leonard has the productive facilities and the technical know-how to meet your every resistor need. Let Ward Leonard’s engineering department help you select the right one. Ward Leonard Electric Company, 31 South Street, Mt. Vernon, New York.

Want more information? Use post card on last page.

ELECTRONICS — April, 1953
Manufacturers are assured of tightly-closed doors and panels, with gaskets tightly compressed, by using Southco Adjustable Pawl Fasteners. Variations in thickness at point of fastener contact, whether in heavy castings or light metal frames, do not affect either the fit or the simple fastener installation procedure.

Adjustment is made automatically every time the knob of a Southco Fastener is turned. Only one size is stocked for use on various panel thicknesses, but every fastener fits.


*Important for military contractors! Prompt deliveries now possible.*

*SO*UTHCO

**FASTENERS**

**OFFICES IN PRINCIPAL CITIES**

WHEREVER TWO OR MORE PARTS ARE FASTENED TOGETHER; STANDARD AND SPECIAL DESIGNS FOR IMPROVED PERFORMANCE AND LOWER PRODUCTION COSTS

Want more information? Use post card on last page.

April, 1953 -- ELECTRONICS
Specifically designed and built to performance standards far beyond present concepts of potentiometer design, GANGPOT Instrument-Quality potentiometers are ready to solve multiple potentiometer problems. Rugged, aluminum-housed units with low torque, high performance, and long-life accuracy, GANGPOTS are presented in two sizes to fill all requirements. GANGPOT EXTRAS include solid, stainless steel shafts, toroidally wound coils for up to 360° windings, shielded ball bearings, synchro or screw type mounting, and adaptability to non-linear functional windings. Built without any bulky external bolts, clamps or rings, the GANGPOTs lend themselves to an unsurpassed versatility of design applications.

For catalog and engineering data on these and other fine instruments write:

G. M. GIANNINI & CO., INC., PASADENA 1, CALIFORNIA—EAST ORANGE, NEW JERSEY

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
Increase Tube Reliability with

VACUUM-CAST METALS

Vacuum-melting removes gases and oxide inclusions from metals ... makes them less porous, so they won't absorb or emit gases.

Used in tubes, vacuum-cast metals won't leak or continue to out-gas to spoil vacuums. They are being used to reduce pump-down time ... increase tube reliability ... and shelf life.

Commercial quantities of ferrous and non-ferrous metals and alloys are now being vacuum-cast at pressures as low as one millionth part of atmospheric by Vacuum Metals Corporation. Available in either billet or fabricated forms. Write for more information.
A High VACUUM FURNACE for the ELECTRONIC INDUSTRY

For Producing:
Germanium · Silicon
Degassed Tube Parts
Vacuum melted tube materials
A versatile and valuable production tool.

For Research and Development:
Complete flexibility for almost any purpose.

There is now available a single furnace that does away with the need to purchase equipment for each phase of your high-vacuum, high-temperature work. Because of its modest price, it will fall within the budget of most laboratories.

With this new furnace you can melt and solidify — melt and pour — add to the melt — stir — look into the hot zone — measure hot zone temperatures — introduce controlled atmospheres — degas — heat treat. It's a complete, versatile unit, capable of handling the widest variety of metallurgical research work. Write today.

FEATURES
- Ultimate vacuum of less than $5 \times 10^{-2}$ mm. Hg.
- Working temperatures up to 2000°C.
- Temperature controllable within $\pm 5$° C.
- Hot zone reaches temperature within two minutes.
- No refractories used in hot zone.
- 4" purifying type diffusion pump insures high capacity for out-gassing.

- Utilizes single turn low voltage resistance element of tungsten 2½" dia. x 3" high.
- Optional heating elements of larger size are available.
- Integral power supply for furnace.
- Manual temperature control. (Automatic control optional.)
- Thermocouple vacuum gage is standard equipment. Other gages are available.

National Research Corporation
EQUIPMENT DIVISION
Seventy Memorial Drive, Cambridge, Massachusetts
Moisture Proof
PLASTIC COATED TOROIDs

In addition to standard windings, we offer toroids encased in tough thermosetting plastic. Plastic encasement provides extra protection from humidity, mechanical shock. Available in all sizes of coils.

Steel Cased
TOROIDS AND FILTERS

Existing designs cover a wide range of types and frequencies. Filters meet military specifications and can be offered in miniaturized versions. A typical filter is shown. C. A. C. filter design engineers will convert your specifications to production deliveries with minimum delay.

Why is it?...

From a modest beginning five years ago, Communication Accessories Company has grown to one of the largest exclusive toroid coil winding producers in the U. S. today. Why?

We like to think that this growth is due to the thorough, careful handling we apply to each coil ... and because of the particular skill of our people. Whatever the reason, we'll continue—doing the best we know how—thankful for the trust that important companies have placed in us.

write for this catalog
**TAYLOR Commercial Grade Vulcanized Fibre**
is tough, lightweight, abrasion resistant ... excellent for bending, punching, stamping and forming ... resistant to organic solvents, oil and gasoline ... has excellent electrical characteristics.

**Want to make something of it?**

*Make it* into insulating plates, upset washers, arc barriers, terminal blocks, switch and appliance insulation, cases, face plates for golf clubs ... or any other electrical or mechanical component that can benefit from the unique properties of this versatile material.

*Make it* in red, gray, black, or special colors.

*Make it* from sheets or rolls with these specifications:

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Thickness Range:</th>
<th>.005&quot; to 1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish:</td>
<td>Pressed and calendered</td>
</tr>
<tr>
<td>Punching:</td>
<td>To 3/16&quot; thick</td>
</tr>
<tr>
<td>Sheet Size:</td>
<td>56&quot; x 90&quot;</td>
</tr>
<tr>
<td>Roll Width:</td>
<td>56&quot; for thicknesses of .005&quot; through .060&quot;, Coils to 3/16&quot; for thicknesses of .005&quot; through .090&quot;</td>
</tr>
</tbody>
</table>

**PROPERTIES**

**Mechanical**

- **Flexural Strength**
  - (Lengthwise): 14000 psi min.
  - (Crosswise): 12000 psi min.

- **Tensile Strength**
  - (Lengthwise): 7500 psi min.
  - (Crosswise): 5500 psi min.

- **Compressive Strength**
  - (Flatwise): 20000 psi min.

- **Izod Impact Strength**
  - (Lengthwise): 3.5 Ft.-Lbs./inch
  - (Crosswise): 2.9 Ft.-Lbs./inch

**Electrical**

- **Dielectric Strength**
  - (1/32" thick): 250 min.

- **Short Time Test**
  - (1/8" thick): 175 min.

- **Arc resistance, seconds**: 100

*Make it* from turned rods. Diameters from 1/8" to 1" with ground or buffed finish.

*Make it* easy for yourself when you're buying vulcanized fibre. Call your Taylor engineer ... he will be glad to work with you ... help select the correct grades to fit your needs — Commercial, Bone, Super White, Abrasive and Built-up. Also ask him for samples of Taylor Laminated Plastics ... Phenol, Silicone and Melamine Laminates ... suited for a variety of your product requirements.

Taylor Fibre Company, Norristown, Pennsylvania — La Verne, Calif.

---

**ELECTRONICS — April, 1953**

Want more information? Use post card on last page.
TRU-OHM RHEOSTATS and RESISTORS are approved by the foremost manufacturers for civilian and government applications.

TRU-OHM PRODUCTS Division of Model Engineering & Mfg., Inc.

General Sales Office: 2800 N. Milwaukee Avenue, Chicago 18, Ill.
Factory: Huntington, Indiana

MANUFACTURERS: Power Rheostats, Fixed Resistors, Adjustable Resistors, "Econohm" Resistors, "Tru-rib" Resistors

April, 1953 — ELECTRONICS
electrical insulation made with

**DOW CORNING SILICONE RESINS**
give you unequalled freedom in design, still more power per pound, even longer life and greater reliability

**COATING VARNISH**
Dow Corning Silicone Varnish 994
has over 100 times the thermal life of the best organic varnishes; over 3 times the life of earlier silicone varnishes.

**IMPELLATING VARNISH**
Dow Corning Silicone Varnish 997
bakes without bubbling at 300° to 400°F; cuts processing time to 1/4 to 1/7 the time required for earlier silicone impregnating varnishes.

**BONDING RESIN**
Dow Corning Silicone Resin 2105
Makes it possible to produce silicone-glass laminates with over 100 times the dielectric life of the best silicone laminates previously available.

Electric machines built with Class H insulation bonded and impregnated with the original Dow Corning Silicone resins have 10 to 100 times the life, or half again as much power per pound as comparable equipment built with the next best class of insulating materials. That has been proved time and again during the past eight years by functional tests and by performance of thousands of industrial motors.

**New Silicone Resins** invented for you by our scientists and engineers have several times the dielectric life of the original silicone resins at high temperatures. That means that electrical equipment insulated with the new silicones will last even longer; give you still greater reliability; reduce motor maintenance and down time to the vanishing point; deliver more power per pound than ever before.

**KEEP PACE WITH PROGRESS**

Mail coupon today

Dow Corning Corporation, Dept. No. BE-4, Midland, Michigan

Please send me complete data on

<table>
<thead>
<tr>
<th><strong>BONDING RESIN</strong></th>
<th><strong>COATING VARNISH</strong></th>
<th><strong>IMPELLATING VARNISH</strong></th>
</tr>
</thead>
</table>

Name ____________________________
Company ________________________
Street __________________________
City ____________ State ____________

Dow Corning Corporation, Midland, Michigan

Dow Corning Silicates

Atlanta  Chicago  Cleveland  Dallas  Los Angeles New York  Washington, D.C.
For use in military electronic equipment, Mallory manufactures a line of electrolytic capacitors which will meet the requirements of Specification JAN C-62. Included in the Mallory line is the full selection of standard case styles, ratings and characteristics required under the specification.

Into these military-type capacitors go the same engineering know-how and production craftsmanship which have made Mallory capacitors the standard of quality in the radio and television industry.

Look to Mallory for all your capacitor needs... whether for military or for civilian applications.

New Folder Outlines JAN Capacitor Types
A new folder, available on request, condenses the information on type designations of all electrolytic capacitors covered by JAN C-62, to convenient, easy-to-read chart form. It's an ideal reference for everyone who specifies or uses electrolytic capacitors. Write to Mallory for your copy today.

SERVING INDUSTRY WITH THESE PRODUCTS:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Dry Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

MALLORY electrolytic capacitors
JAN C-62 types

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

Want more information? Use post card on last page.
April, 1953 — ELECTRONICS
TRIO ... Long-range prospects for electronics are excellent. We are living in an age of almost unlimited power (atomic energy), and unlimited speed (jets). To utilize these two things we need unlimited control, and control is where electronics shines.

SPACE ... There are two schools of thought among reputable scientists relative to space travel. One believes that man will contrive practical space stations, eventually reaching distant celestial bodies, and the other does not. One thing, at least, is certain. If and when man does leave his natural habitat the vehicle he uses will depend heavily upon the science of electronics for navigation, communication and many other things not yet fully visible. Man may, in effect, ride electronics to the moon.

TIMETABLE ... Several experimental television receivers of different makes have just been tested on NTSC color signals at a Long Island laboratory. The results were good.

Early in April these same receivers, augmented by several more obtained from still other manufacturers, are scheduled to be put through their paces in Syracuse. Then they will be tried out again, in Philadelphia.

The timetable is subject to change without notice but it does seem that the system could be ready for demonstration before the FCC this summer, and perhaps as early as June.

WORKMANSHIP ... Modern design plus mass production can provide low-cost electronic equipment capable of giving good service. Much still depends, however, upon personal care during assembly and, particularly, the conscience of inspectors at the end of the line.

Somehow, we've gotten the impression that an unusual number of casually-put-together items are currently being sold. Two ceramic trimmer capacitors were picked up at retail; one entirely lacked threads for the adjustment screw. Of three simultaneously purchased toggle switches one was defective. Two trips were necessary to buy one good transformer. A microphone fresh from the shipping carton proved intermittent due to soldering flux under riveted lugs.

Maybe we're just unlucky. Or maybe pride in good workmanship has momentarily declined to a point where not even the fanciest test procedures can catch all the bugs.

DETOIT ... Car manufacturers tell us it is only a question of time when most American automobiles will be equipped with 12-volt electrical systems; increasing load is almost more than 6-volt batteries of reasonable size can stand despite numerous improvements.

It may take several years, but the market for 12-volt mobile electronic equipment and accessories is destined for expansion. Use of raised voltage and lowered amperage has many virtues. Smaller, lighter high-voltage power supplies handle a given load faster and easier, are much less critical with respect to input-circuit wire size. There could be some new troubles with regulation, but car makers say that they are aware of this and are working on it.

SHOPTALK ... Since 1944, all ELECTRONICS' feature articles have been published on sequential full pages. There is no "turnover", no "continued" line, no interleaved extraneous material to complicate reference to illustrations.

We wonder how many of our readers realize that this policy, which involves considerable editing trouble and substantial cost, is by no means common in commercial publications.

CONSERVATION ... It is said that one manufacturer of envelopes for television picture tubes has contributed substantially to the defense program by taking the lead out of its glass.
Electron coupler is 18 in. long by 5½ in. in diameter. Details shown in cutaway include the two coupling-beam electron guns and three of the five modulating beams. Coupling loops are not shown.

Spiral-Beam Tube

Multibeam electron coupler may be useful in ultrahigh-frequency television transmitters. Tube has excellent linearity, 5-mc bandwidth and 50-percent transfer efficiency. Five parasitic electron beams in output circuit control power transfer to load.

By C. L. CUCCIA
Radio Corporation of America
RCA Laboratories Division
Princeton, N. J.

Designed to operate at the 1-kw level in the 800-mc range, the multibeam electron coupler is an improved spiral-beam modulation tube suitable for use in uhf television. When placed between generator and load, the electron coupler presents a constant impedance while permitting control of power to the load. The tube uses coaxial-line cavities and has five modulating electron beams in the output circuit. It possesses excellent linearity characteristics, a bandwidth in excess of 5 mc and a 50-percent transfer efficiency.

Use of auxiliary electron beams in the output cavity of the tube provides a modulation method whereby a 50-volt modulator grid swing can control power output over a range of 98 percent of maximum. This is seen as a great improvement over the performance of single-beam electron couplers. A single-beam tube operated at 775 mc with a beam current of 50 milliamperes and an input-cavity po...

April, 1953 — ELECTRONICS
Modulates 1 KW at UHF

tential of 650 volts, using transit-time control, required a voltage swing of nearly 1,000 volts to achieve the same depth of modulation.

In the multibeam electron coupler, the auxiliary beams work both to absorb power and to create a mismatch between the tube and its output load, thereby making the amount of power transferred to the load a function of the auxiliary beam current.

Coaxial Cavity

Auxiliary-beam modulation is capable of producing high-level amplitude modulation. This can be accomplished in the tube to be described only by auxiliary-beam currents of from one-half to one ampere. To accommodate these currents, it is convenient to utilize resonant coaxial cavities. The use of coaxial cavities in an electron coupler also yields advantages in header construction and suitability for use with electromagnets.

Consider the case of an electron beam sent through a coaxial cavity whose center conductor (Fig. 1B) is shaped to produce a transverse, alternating, electric field of suitable rectilinearity in the path of the electron beam. Such a cavity is illustrated in Fig. 1A. In this cavity the transverse electric field varies sinusoidally along the path of the electron beam.

Let a magnetic field be placed parallel to the path of the electron beam and let the operating frequency be adjusted to the cyclotron frequency

\[ f_c = 2.794H \times 10^6 \]

where \( H \) is magnetic field intensity in gauss and \( f_c \) is frequency in cycles per second.

If the length of the cavity is \( L/2 \), then the deflection, \( X \), of the directrix beam at some distance \( l \) through the cavity is

\[ X = \frac{2.36}{\pi} \frac{E}{V_p f_c} \frac{L}{2} \left( 1 - \cos \frac{2\pi l}{L} \right) \times 10^6 \]

where \( E \) is the peak value of the transverse electric field in volts per...
centimeter, $V_b$ is the beam voltage in volts, $f$, is frequency in cycles and $l$ and $L$ are in centimeters.

**Coupling-Beam Shape**

Because the cyclotron frequency is used as the operating frequency, the electrons all have the same azimuthal angle at any instant, thereby causing the electrons to form a directrix beam. However, unlike the cone-directrix beam formed in vane-cavity electron couplers, the directrix beam in a coaxial cavity will have a milk-bottle shape as shown in Fig. 1A. This shape is described mathematically by Eq. 2.

The reason for the milk-bottle shape is readily understood. As the electrons enter the coaxial cavity, the transverse field intensity is initially zero. As the electrons pass through the cavity, encountering the sinusoidally varying field, the greatest contribution to the spiral radii is obtained near the center of the cavity where the peak transverse electric field is maximum. This causes the rapid increase in $X$ in this region as illustrated in Fig. 1C.

Power into a rotating directrix beam in a coaxial cavity of length $L/2$ is expressible in either of two forms

$$P = \frac{1}{8\pi} \frac{I_e}{V_b} \frac{E^2}{L} \left( \frac{L}{2} \right)^3 \quad (3A)$$

$$P = 1.768 \times 10^{-2} \times f^2 \times I_e \times X^2 \quad (3B)$$

where $I_e$ is the beam current in amperes and $V_b$ is the d-c beam voltage. Equation 3 shows that if peak alternating electric field strengths are equal, the power absorbed by a directrix beam in a coaxial cavity is $2/\pi$ times that absorbed in a cavity with an axially uniform field. The resistance in ohms presented by such a beam in a coaxial cavity is

$$R = \frac{d_1^2 E^2}{2P} = 16\pi \frac{V_b}{I_e} \left( \frac{d_1}{L} \right)^2 \quad (4)$$

where $d_1$ is separation between pole faces in centimeters.

Once the power given by Eq. 3 has been absorbed by the rotating beam, it can be utilized for electron coupling. Were the cavity to be closed as shown in Fig. 1A, this power would be dissipated at the end of the cavity in the form of heat. However, if the rotating beam is passed into a second cavity, the rotational energy contained in the beam can be used to excite the second cavity.

This principle is used in the spiral-beam tube. Two coaxial cavities, each with a suitably shaped center conductor, are placed end to end. Two round apertures are installed between the cavities to allow two electron beams to enter and pass through the second or output cavity after traversing the input cavity.

**Secondary-Cavity Modulation**

As the electrons pass through the intercavity space after emerging from the input cavity, no energy is imparted to or extracted from them since no transverse electric fields are present. Each electron pursues a helical path through the intercavity space at a transit velocity prescribed by the beam potential. Therefore, the electrons enter the output cavity with the same spiral radius with which they emerged from the input cavity.

As the rotating electron beam passes through the output cavity, a current is induced in the load of the output system because the electrons represent an oscillating space charge with periodicity, $f$, between the pole faces. The product of this induced current and the load resistance will yield the r-f voltage across the pole faces.

If the load, $R_r$, exists across the output cavity boundaries, it can be shown that all of the rotational power in the beam can be extracted when

$$R_r = 16\pi \frac{V_b}{I_e} \left( \frac{d_1}{L_0} \right)^2 \quad (5)$$

$I_e$ is the optimum value of coupling-beam current that will accomplish the matching suitable for complete transfer of input power to the output load. $V_b$ is the beam voltage in the output cavity and $d_1$ and $L_0/2$ are respectively the pole-face width and length in the output cavity. For this particular value of coupling beam load and current, the beam-transmission in the output cavity will be an exact image of the beam-transmission in the input cavity, that is, the milk-bottle directrix having maximum radius at the entrance to the cavity and zero radius at the exit or collector.

When an auxiliary beam of magnitude $I_m$ is injected only through the output cavity, the beam will present the resistance

![FIG. 2—Voltage output is function of optimum coupling-beam current, modulating beam current and operating parameters of tube.](image)
\[ R_M = 16\pi V_{SM}/I_M (d_e/L_e)^2 \]  \hspace{1cm} (6)

where \( V_{SM} \) is the difference in potential between the output cavity and the auxiliary-beam cathode. Resistance \( R_M \) will be in shunt with load resistance \( R_L \) forming a combined load \( R_c \) where

\[ R_c = R_L R_W/R_L + R_W \]  \hspace{1cm} (7)

Consider now the power transfer efficiency, \( \eta \), where

\[ \eta = \frac{\text{r-f power into } R_w}{\text{r-f power into input cavity}} \times 100 \]

If the coupling beam is matched to the output cavity when the auxiliary-beam current is zero,

\[ \eta = 4\gamma/(1 + \gamma)^2 \times 100 \]  \hspace{1cm} (8)

where

\[ \gamma = R_c/R_w \]  \hspace{1cm} (9)

**Mismatch**

As the auxiliary beam current is turned on and increased in value from zero, the output cavity experiences a mismatch between the coupling beam and the combined load presented by the combination of the output load and the shunting resistance due to the auxiliary beam. This mismatch results in a decrease in transfer efficiency. The power goes to three sinks—output load, auxiliary beam, and collector, rather than to the output load alone. To illustrate load mismatch and output cavity-auxiliary beam modulation, consider the following cases that follow from Eq. 8:

Case A—When the auxiliary beam is off, \( R_w = \infty \), \( \gamma = 100 \) percent.

Case B—When the auxiliary beam is turned on such that \( R_w = R_w \), the transfer efficiency is reduced to 88 percent leaving 12 percent of the power available to the output load.

Twelve percent goes to the collector and 44 percent to the auxiliary beam.

Case C—When the auxiliary beam is adjusted such that \( R_w = 1/10 R_w \), transfer efficiency is 30 percent. Seventy percent of the total power goes to the collector; 27.28 percent goes to the auxiliary beam and only 2.72 percent reaches the output load. This corresponds to 97.18 percent power modulation and demonstrates the capabilities of the output cavity-auxiliary beam modulation method.

The preceding discussion presupposes the coupling-beam current at optimum value, \( I_a \), which is related to the load \( R_w \), by Eq. 5. However, it is expedient to increase the depth of modulation for certain ranges of performance by operating with a coupling-beam current differing in value from \( I_a \). This is illustrated in the general case when some arbitrary value of coupling-beam current, \( I_a \), is related to the optimum coupling-beam current by

\[ I_a/I_a = \alpha \]  \hspace{1cm} (10)

Using Eqs. 5 and 6 the ratio \( R_a/R_w \) can be expressed in terms of the optimum coupling-beam current and the auxiliary-beam current as

\[ R_a/R_w = I_a/I_a \cdot V_b/V_b \]  \hspace{1cm} (11)

It follows that the relationship between percent voltage output \( \sqrt{\gamma} \cdot \alpha \), \( I_a \) and \( I_a \) is that shown in Fig. 2. The ratio \( V_b/V_b \) will be a constant depending upon the operating parameters of the tube.

**Depth of Modulation**

Modern practice in commercial transmission requires a depth of voltage-modulation of 85 percent, which corresponds to 97.75 percent power modulation. With a source of auxiliary-beam current capable of yielding twelve times the magnitude of the optimum coupling-beam current, this depth of modulation can be achieved for \( \alpha = 1 \). However, as seen from Fig. 2, if values of \( \alpha \) down to 0.5 are chosen, it is possible to achieve this depth of modulation with less auxiliary-beam current without too great a sacrifice of power-transfer efficiency at the peak power. However, the auxiliary-beam voltage must be sufficient to yield the required modulating current.

**Mechanical Design**

The developmental multibeam electron coupler operates at 800 mc. It is a seven electron-beam tube using output cavity-auxiliary beam modulation and coaxial cavity construction.

Two of the seven beams are coupling beams passing the entire length of the tube. Each coupling-beam gun is capable of 200 milliamperes, produces a cylindrical beam 3 in. in diameter and traverses an electric field region having boundaries 1 in. apart. The power-handling capabilities of such a tube at 800 mc using all 400 milliamperes of coupling-beam current, with a practical grazing limit set at 1.25 centimeters, may be calculated using Eq. 3

\[ P = 1.78 \times 10^{-5} \times 500 \times 4.000 \times 1.25 \times 7,072 \text{ watts} \]  \hspace{1cm} (12)

Actually, considerations arising from the method of modulation place severe restrictions on this magnitude.

**Auxiliary-Beam Guns**

Five electron-beam guns are installed in such a way that the electrons from these guns traverse only the output cavity. Each gun is a screen-grid-beam type similar in cathode and grid construction to the design used in the 6L6. Each output-cavity gun yields a rectangular beam, \( \phi \times \phi \) in., capable of producing, at several hundred volts effective plate potential, a beam current of 120 ma at zero grid bias. Beam current can be reduced to zero by approximately minus 50 volts on the control grid. All five auxiliary beam guns acting simultaneously are capable of yielding up to 650 ma.

The multibeam electron coupler based on the coaxial design is pictured in the photograph. The tube is cylindrical, using header construction which leaves the sides of the tube free of protuberances. Design is such that the tube is suitable for use with solenoidal magnets and water-cool-
ing rings. Only the output cavity is tuned, the input cavity frequency being fixed at 800 mc. The tube is approximately 18 in. long and 5½ in. in diameter. The main body of the tube is copper, with monel end rings atomic-hydrogen welded to monel rings on the headers.

**Experimental Performance**

The input cavity should present a matched or mismatched load to the driving magnetron depending upon what operating point is desired. It is important that this match or mismatch be constant. The match will be a function of four system parameters that provided that the frequency involved is the cyclotron frequency. These parameters are:

1. The coefficient of coupling of the coupling loop and the associated parameters that transform the impedance of the beam in the beam space to that of the termination of the transmission line to the electron coupler.
2. The coupling-beam current.
3. The coupling-beam voltage in the input cavity.
4. The peak-power input, which should be substantially under the value that would cause electrons to graze on the pole faces and be lost to the output cavity.

By making suitable choices of parameters, the input-cavity system presented a match to the driving transmission line during operation over the ranges of coupling-beam currents and voltages described in Fig. 3. Match was obtained over a wide range of usable current values up to 200 milliamperes at 1,250 volts. Included in Fig. 3 are calculated values of maximum power that can be handled by the coupling beam having the values of I and V prescribed by the experimentally observed curve.

The transfer efficiency of the multibeam electron coupler was found to be about 50 percent, as contrasted with the transfer efficiency of 70 percent obtained with the single-beam electron coupler. This decrease in transfer efficiency is attributable to the length of the beam path and to the lack of exact parallelism of magnetic field lines over the entire beam path as a result of the use of solenoidal magnets rather than an electromagnet.

**Input**

The tube was operated with a top power input of one kilowatt. Up to 650 milliamperes was available from the five auxiliary beam guns with Vₓ = 750 volts and a grid swing of 0 < εₓ < -50 was required to swing the auxiliary beam current from maximum to zero. In a typical d-c operating run, the multibeam electron coupler was first adjusted to Iₓ = 165 milliamperes and Vₓ = 1,150 volts, corresponding to a maximum power of 3,410 watts, achieving thereby a match for the 50-ohm line (Fig. 3). Since this would have required a total auxiliary beam current of almost two amperes for 85 percent depth of voltage modulation it was found expedient to mismatch the coupling beam and the output load.

The coupling-beam current was reduced to 60 milliamperes, corresponding to a maximum power into the beam of

\[ P = 1.768 \times 10^{-3} \times 809 \times 0.060 \times 1.25 \]

= 1,062 watts \((13)\)

The parameters yielding the depth of modulation are

\[ \alpha = \frac{60}{185} = 0.364 \]

\( \alpha \) (14)

\[ \frac{V_b}{V_{ab}} = \frac{1,150}{750} = 1.532 \]

\( V_b/V_{ab} \) (15)

\[ \frac{I_{sh}}{I_{sh}} = \frac{650}{185} = 3.64 \]

\( I_{sh}/I_{sh} \) (16)

\[ \frac{I_{sh}}{I_{sh}} = \frac{1,532}{3.64} = 0.406 \]

These values substituted into the curves of Fig. 2 give 15.5 percent. In the actual experimental test, this depth of voltage modulation was almost exactly corroborated.

**Output**

The actual power output and voltage runs for a peak output of 300 watts is shown in Fig. 4. This power corresponds to a beam voltage of 750 volts. It is evident from Fig. 4B that the linearity of the output voltage as a function of modulating-grid voltage is excellent.

The bandwidth of the modulation system was examined by impressing on the control grids of the auxiliary-beam guns a signal of known amplitude whose frequency was continuously variable from 100 kc to 5 mc. The output of a diode detector inserted into the transmission line at the output load was detected and viewed on an oscilloscope. The response of the system was found to be substantially independent of frequency up to and beyond 5 mc. This result was independent of the depth of modulation of the auxiliary-beam modulation system.

**References**


(2) C. L. Cucia and J. S. Donal, Jr., The Electron Coupler—A Spiral-Beam UHF Modulator, Electronics, p. 80, March 1950.
Cincinnati Hydro-Tol, automatic 28-inch vertical milling machine, is controlled by 250-tube electronic director

Punched Tape Guides
Milling Machine Cutters

Modern information handling and feedback control techniques may eliminate costly and time-consuming setup procedures in metal-trades industry. Automatic vertical milling machine cuts out each piece in response to instructions punched in paper tape.

In certain metal-trades industries, notably aircraft manufacturing, automatic production of machined parts may be relatively costly and inefficient. Many different parts are required and production runs are characteristically short. A skilled machinist is needed to set up the machine each time a new part is manufactured. Often expensive jigs and fixtures and specially-designed cutting tools are required for a particular part.

Numerical control can eliminate these costly change-overs by providing prearranged machine setups that can be changed much as a phonograph record is changed. Machining information is reduced to a series of numerical specifications appropriate to the machine tool. Milling machine work is described as a series of cuts in Cartesian coordinates; lathe work is specified in cylindrical coordinates. The numerical specifications are then tabulated and transferred to some permanent information-storage medium such as punched cards.

By J. O. McDonough
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Mass.

Electronics — April, 1953

135
punched tape or magnetic tape. A machine tool equipped to read and act upon the stored information may then machine the piece. All that is required for a different part is a new tape.

**Control System**

Operation of the numerically-controlled milling machine shown in the photograph may be explained with the aid of the functional block diagram in Fig. 1. The data input system reads the punched paper tape containing the machining information and arranges the information appropriately in storage. The input system consists of a tape reader, stepping-switch data distributors, a set of relay storage registers, and appropriate control systems.

The data-interpreting system interpolates between the points on the work that are specified explicitly on the tape. It comprises a pulse generator and an electronic pulse distributor.

The decoding servomechanisms convert the numerical information to an equivalent analog form, while the power servomechanisms control the motions of the machine tool itself.

There are three power servomechanisms to control the motions of the head, table, and cross slide. The power servomechanism controlling the table is shown schematically in Fig. 2. The system consists of a hydraulic rotary transmission driving a lead screw and controlled by synchro signals. Identical units drive the head and cross slide. The power servomechanisms are designed for high stiffness of output and as low a bandwidth as possible to prevent chattering under machining loads. Approximately 1 horsepower is required.

**Interpolation**

Choice of an interpolation function determines in great measure the cost, complexity, and convenience of the machine. The simpler the machine's interpolation function, the more input data is required for any job. In the extreme case, if the machine has no systematic interpolation function, data must be provided for every point on the finished work. For a machine capable of handling workpieces 60 inches long and 30 inches wide, some form of interpolation appeared to be highly desirable. While curvilinear interpolation might have allowed a great saving on input data, it could be built into the machine only at the cost of highly complex special circuitry. A linear interpolation function was adopted as a compromise.

Operation of the interpolator in response to each command on the tape results in a constant feed rate at the milling machine in each machine axis. The vector summation of the three constant feed rates causes the tool to move over the work in a straight line. To achieve this result, the interpolator transmits to each axis a counted number of pulses at a repetition rate proportional to the desired feed rate.

Each pulse indicates that the machine should move 0.0005 inch. The number of pulses thereby controls the distance through which the machine should move, while the repetition rate controls the feed rate.

The interpolator also synchronizes the three pulse trains so that the three machine axes start and stop together. Thus the output of the interpolator is a series of sets of three pulse trains, each set directing the machine tool along some straight line in space. The number of pulses in each train and the time interval during which each set of trains should run are determined by the information in storage.

**Digital-to-Analog Converter**

Since the power servomechanisms use a synchro data system, the converter must be capable of driving a synchro; it must have an output in the form of a shaft rotation. The interpolator produces a series of pulses each representing a unit of desired motion. The converter must accept as its input a pulse train on either of two lines. Since the machine tool must always be accurately located in space and the pulses form the only converter input, the converter itself must maintain an accurate count of the total number of pulses received and ensure that its output shaft position, except for transient disturbances, always indicates the correct total number, regardless of how long the run is.

A schematic block diagram of the digital-to-analog converter is shown.
in Fig. 3. It contains an instrument servomechanism whose output shaft, driven conventionally by a 60-cycle, two-phase induction motor, carries a commutator-type coder wheel upon which three brushes ride. These brushes allow an electronic unit with which they are associated to generate and transmit a pulse whenever the wheel rotates through an angle of one degree. The pulse is transmitted on one line whenever the rotation is clockwise and on another whenever the rotation is counterclockwise. Exactly 360 pulses are generated for every complete revolution of the wheel. Thus the total rotation of the wheel is always given by the total number of pulses. The system is designed so that these feedback pulses are never coincident with possible output pulses from the interpolator. Hence it is possible to feed both sets of pulses into a reversible counter that will then maintain a running count of the total number of interpolator pulses, less the total number of feedback pulses. This count, which measures the degree to which the converter output differs from its total input, is used to generate the error voltage for the servomechanism. The polarities and connections are such that the servomechanism always tries to rotate the coder wheel in whichever direction will bring the error count to zero.

Use of this type of servomechanism for numerical-to-analog conversion provides several features of importance. In the first place, it permits the actual direct decoding of a numerical signal into an analog signal to take place in the error channel of a servomechanism where the magnitude of the signal is always a small fraction of the total signal handled by the servomechanism. In the second place, inaccuracies in this conversion affect only the gain, not the positional accuracy of the servomechanism. Lastly, the dynamic characteristics of a servomechanism may easily be adjusted to provide whatever smoothing or filtering may be required in the interpolator output.

**Operation**

A summary of the components of the entire machine indicates the nature of the input information required for the operation of the machine. Each of the three motions of the machine is driven by an independent hydraulic power servomechanism in response to rotations of a control synchro. Any machine motion in space may be achieved by simultaneously rotating a combination of the three control synchros. Each of the three synchros is rotated by a decoding servomechanism in response to a pulse train from the interpolator. The desired combination of three rotations is achieved by separately controlling the pulse repetition rate of each pulse train so that the desired total number of pulses is transmitted to each axis in the specified time interval. Eight different time intervals from 2 seconds to 41 minutes are available. Thus, during each time interval the machine's cutting tool moves in some straight line with respect to the work. The interpolator receives from the data system numbers specifying the time interval and the three distances, which are, therefore, merely the three orthogonal components of the straight line along which the tool is to pass. These numbers come from the tape.

To prepare the tape, the programmer need merely describe numerically the desired tool path over the work in a series of straight-line increments, and punch the three components of each straight line in order on the tape. Preliminary operation on actual machined pieces indicates that in some cases the production of a single piece by numerical control shows savings when compared to previous toolroom methods. In almost all of the cases studied to date, the cost of tape preparation is recovered after fewer than five pieces have been run.

**Acknowledgment**

This article reports the results of a group effort made possible through the support extended the Servomechanisms Laboratory of the Massachusetts Institute of Technology by the Air Materiel Command, USAF under contract No. AF 33(038)-24007.
In the first article of this series an approximate explanation of transistor action was given. This introductory treatment of transistor theory demonstrated that the field of transistors is intimately connected with the study of solid materials in general, and with semiconductors in particular. The principles governing the behavior of solid materials are collectively referred to as solid-state theory.

Semiconductors

Like any other specialized branch of the sciences, the field of semiconductors uses its own terms and definitions. This nomenclature cannot be explained in all cases by using the concepts normally encountered in electronics. New and very general concepts which describe the basic behavior of matter and energy must be introduced to aid in explaining clearly the terms commonly used in semiconductor and transistor work.

As an illustration, in the study of transistors it is difficult to avoid the use of such terms as energy levels, forbidden bands and quantum states. The explanation of these terms may be more readily understood if the reader is first introduced to the fundamental principles of quantum mechanics.

Black Bodies

Consider an air-tight box whose inside walls are lined with a thick layer of felt. Over the felt has been deposited a heavy, uniform layer of lampblack to provide a smooth, flat inside surface. Such an enclosure absorbs all the frequencies in the light or visible range and reflects none and is called a black body. It is significant in the field of physics because of all the absorbers known, a black body is the most perfect.

If energy in the form of radiation (heat or light) were introduced into this box through a tiny hole in one end, it would bounce back and forth from wall to wall ultimately being almost totally absorbed. The energy would merely raise the temperature of the black body. It can be shown that this simple structure is an ideal absorber and an ideal radiator.

Physicists have found that the behavior of the black body can be described in relatively simple mathematical terms.

By means of bolometers, physicists are able to measure minute amounts of heat or radiant energy. With single-color or single-frequency filters it is possible with the aid of the bolometer to determine the amount of energy contained in each frequency component of the radiation being studied.

The black body is the most perfect radiator known. Of all possible radiators, not only will the black body give off the maximum amount of radiant energy, but that radiant energy will contain the widest range of frequencies. A bolometer inserted in a tiny hole in the black body, for a given temperature of the black body, will show a variation or distribution of the energy with frequency as shown in Fig. 1.

Much can be said about these curves but it is actually not important for future applications in the study of transistors. The reader need merely note that these curves are obtained by a straightforward process from a simple and fundamental experiment.

The bolometer is capable of measuring temperature very accurately. The experiment described above can be made under careful control and with almost no special equipment. The distribution of black-body radiation was known to physicists as far back as the 1890’s. The data was so accurate and fundamental that it was felt that if the physicists could explain the curves obtained, whatever theory of matter was proposed as a basis for the explanation stood an excellent chance of being the ultimately correct theory of the structure of matter.

Some of the outstanding physicists who lived about the year 1900 tried their hand at proposing a theory of matter on the basis of which an equation could be obtained involving the energies, the wavelength and the temperature which when plotted would give a curve...
Fundamental principles of quantum mechanics, as they apply to transistors, are described in easy-to-read language for electronics engineers and technicians with limited backgrounds in physics. Pertinent theories of Planck and Einstein are discussed that would fit Fig. 1. These efforts were to no avail.

**Planck's Theory**

One of the physicists interested in this mathematical and physical problem was an obscure professor of thermodynamics named Max Planck. He came to the conclusion that one or more of the fundamental assumptions being made by these eminent physicists must be inadequate or entirely incorrect. Planck asked himself what assumption must be made, regardless of whether it was reasonable or not, in order that the theory of matter based on this assumption would lead to a mathematical expression to fit the curve.

Generally speaking, this kind of thinking is both unscientific and unwise. It is called an ad hoc theory, that is, it is a theory compounded to fit a specific set of facts and these facts only. While an ad hoc theory usually fits the facts, it is frowned upon by the scientific world. In nearly all such cases, it is not long before additional data are uncovered which the ad hoc theory, made to fit only a specific set of facts, fails to explain. For this reason, the physicists of the day paid little attention to Planck's hypothesis.

Planck found that he could write a mathematical expression to fit the curve of black-body radiation if he assumed that the molecules of the material of which the black body was made, namely the molecules of the lampblack, would oscillate or vibrate under the action of the heat energy supplied. Each molecule thus became a generator of high-frequency energy or an oscillator.

Thus far his assumption was not different from that made by the other physicists. But Planck broke sharply from the assumptions made by the others when he said that these microscopic oscillators can generate energy only in integral multiples of a unit amount of energy which we shall call simply \( E \) (the least amount of energy that any oscillator could have would be \( E \) ergs or joules or any other unit of energy). Oscillators may generate \( 2E, 3E, 10E, 72E, \) and so on, but never, say, 2.5312\(E \) ergs or units of energy, or 3.5\( E \) units, or 7.7\( E \) units. In short, the basic unit of energy \( E \) can be multiplied by an integer, or a whole number only. When describing the energy of any other oscillator, all intermediate values of energy were arbitrarily omitted from further consideration in Planck's theory. This hypothesis received little immediate attention.

**Photoelectricity**

When light strikes certain surfaces, such as zinc, electrons are knocked out from the metal surface. If a metal plate is then placed near the metal surface in a vacuum and made positive with respect to the zinc plate, electrons will flow to the positive plate and an electric current can be detected. Phototubes are made that employ this principle.

It might seem perfectly reasonable that if the intensity of the light shining on the zinc plate is increased, the energy with which the light strikes the zinc atoms would be increased and the electrons knocked out from the zinc plate would have greater energy. This is entirely wrong.

The intensity of the light has no effect on the energy of electrons knocked out—it determines only the number of the electrons liberated from the zinc plate. To get higher-energy electrons out, the frequency of the light must be increased.

The fact that the higher energy electrons are freed by the higher frequencies of light was well known.
around 1905. As in the case of black-body radiation, physicists were unable to establish the mathematical relationship between energy and frequency. When quite a young man, Einstein tried to find this mathematical relationship. He found that if he applied Planck’s idea about the energy imparted to the zinc plate by the light occurring only in integral multiples of a fixed unit of energy $E$, there was a possibility that he could supply a suitable equation. Planck, for this basic unit of energy, had written simply $E$ is proportional to $f$, the frequency, or $E = \text{constant} \times f$.

This constant, which is now known as Planck’s constant, is given by $6.6 \times 10^{-27}$ erg sec, and is usually designated by the letter $h$. So the equation that Planck wrote for this basic unit of energy is

$$E = hf$$

The unit of Planck’s constant is erg seconds and that of $f$ is cycles per second. In physics “cycle” is not a bona-fide unit and the units of frequency will usually be found to be given by “per second” or “time”. Dimensionally

$$h f = E$$

$$\text{erg sec} \times \text{cycles per sec} = \text{ergs}$$

Starting with Planck’s assumption and applying it to the photoelectric effect described above, Einstein wrote an equation which stated that the kinetic energy of an electron emitted from the photosensitive surface, $\frac{1}{2}mv^2$, is this Planck energy $hf$ minus a constant $w$, which depends on the nature of the photosensitive metal and is called a work function. Thus Einstein wrote

$$\frac{1}{2}mv^2 = hf - w$$

This equation has been experimentally established as correct and accurate and provides a quantitative formula to explain adequately the photoelectric effect. However, a single application like this one does not prove a theory and the physicists of the time were not greatly impressed by an isolated success of so radical a theory.

**Application of Theory**

The reader is probably acquainted with the dispersion of light by a glass prism. White light focused as a beam on a prism is broken up into its component colors or frequencies, violet, indigo, blue, green, yellow, orange and red.

Consider two vertical carbon electrodes with the lower one scooped out to form a hollow in the top of it where it faces the upper one. Pour a small quantity of fine chips of some element like copper or aluminum into this hollow. Near the space between the two carbon electrodes place a suitable prism. When an electric arc is struck between the carbon electrodes, the characteristics of the arc are affected by the element placed in the hollow. The element vaporized by the heat of the arc radiates a large number of frequencies and these are dispersed or separated by the prism. Focusing the radiation on a suitable photographic plate constitutes an exposure. When the plate is developed, regularly spaced lines are observed on the negative. This negative is called a spectrogram. The lines in the spectrogram are unique for each element and correspond to the frequencies into which the radiation is dispersed by the prism. For a long time scientists tried to understand why the frequencies were related in specific ways and to predict new lines in certain elements. As they did not understand the fundamental laws which produced the spectrograms, they were mostly content to derive empirical laws on the basis of which they could account for the observed lines. They could not derive these formulas from considerations of the structure of matter.

A number of series, or groups of lines, were known for the element hydrogen. From chemical findings it was known that hydrogen had only one electron associated with its nucleus. To explain the observed series, a physicist named Bohr tried to apply the Planck concepts about the energy occurring in discrete jumps to the orbit of the hydrogen electron. Not only did Bohr’s theory fit the observed facts about the hydrogen atom and electron, but also he was able to propose a simple formula which explained the frequencies of the lines in the hydrogen and helium atom spectrograms.

His formula went further—it predicted where to look for new lines beyond the range of equipment then available. When improved apparatus had been developed the lines were found as Bohr had predicted. Thus, by application of Planck’s rather radical innovation, Bohr was able to provide a satisfactory formula for the frequencies of the lines in the hydrogen series. Previous attempts to provide a formula based on classical concepts had failed.

**Energy Levels**

To the physicist, mechanics means the body of laws, all the mathematics and formulas, all the theorems and axioms, in short, all the rules that govern the description and explanation of a given science.

Quantum mechanics is the body of rules and laws and mathematics which determines our description of the phenomena of nature in terms of quanta, or discrete amounts of something, such as energy or momentum. The ideas about the laws of nature as conceived prior to the advent of the quantum hypothesis are known as classical mechanics.

Consider a molecule d inches above the ground. The reader can imagine an experiment in which he raises the molecule an infinitesimally small amount, $\Delta d$. Potential energy may be defined as the weight of a body times the distance through which it is raised. If the change in height of the molecule is given by...
the change in its potential
energy is given by WM. If we can
make Ad extremely small, we can
also make WM quite small and
thus change the energy by as
small an amount as we please. But
Planck's hypothesis hays we cannot
do this-the least amount by which
energy may be changed is given by
E = hf, where h is Planck's constant, and f is a frequency associated with the molecule.
The concept of energy varying in
jumps or quanta does not appeal to
the common sense as much as
energy varying smoothly or having
a continuous distribution. As we
will see later many of our ideas on
logic are rudely disturbed by the
mandates of quantum mechanics.
The success of quantum mechanics
lies in its ability to explain experimental data and to indicate new
avenues of experimental investigations.
The discreteness in the distribution of energy of electrons when
within the field of influence of the
nucleus makes it necessary to consider energy levels. An energy
level means a specific value of energy which is some whole number
multiplied by hfi. By speaking of an
energy level, we imply that the adjacent energy value is another level
not less than hf units of energy
above or below the first.
Ad,

Energy Bands

For many reasons energy levels
frequently occur in groups, and
such a series of energy levels is
called an energy band. There are
some series of energy levels that
are never observed experimentally.
In other words, electrons have never
been found that have energy levels
in these series.
Such groups of energy levels are
called forbidden bands or energy
gaps. The concept of energy bands
and forbidden energy levels is of
particular importance in the study
of semiconductors and transistor
theory.

Previous Article
Part

I-Introduction
p

ELECTRONICS

to Transistor Action,

98, March 1953

-

The abscissa on Fig. 2 has no
scale; a vertical series of points
would do just as well. The ordinate is energy in suitable units. At
the top of Fig. 2 is shown a series
of energy levels marked with possible, though not necessarily realizable, energy values, and this set of
energy levels constitutes a band.
It is called conduction band to indicate that in our discussion of
germanium, electrons with energy
levels that fall within this band
are the ones that are taking part in
the conduction process or are carriers of electric current.
Below this conduction band other
energy levels are theoretically possible. In the case of germanium, at
room temperature electrons which
have energy values that fall in this
range are never observed. These
energy levels that are not observed
experimentally constitute a forbidden band or energy gap.
An electron volt is a unit of
energy used by physicists in the
quantitative description of electrical
phenomena. It is the energy acquired by an electron in falling
through a potential difference of
one volt. In terms of this measure
of energy, the energy gap or forbidden band width for the semiconductor germanium is about 0.7 electron volt (ev), and for silicon,
another semiconductor used in
transistors, it is about 1.1 ev.
Below the forbidden band shown
in Fig. 2 is a series of possible
energy levels which collectively
form a band called a valence -bond
band. For the present it is sufficient to say that these electrons are
bound or fixed in their energy
levels. These electrons cannot readily change their energy level or
wander about under the influence
of electric fields. Within the valence-bond band a single electron
may be found at each of the possible
energy levels. As the electrons cannot readily change their energy
level, the entire band ordinarily remains filled and therefore is called
a filled band.
For an insulator such as diamond
the energy gap is 7.0 ev (compare
Ge 0.7 ev, Si 1.1 ev). For a conductor, the conduction and valence
bonds overlap and an energy gap
does not exist. It is thus seen that
the energy gap may be used to

April, 1953

classify insulators, semiconductors,.
and conductors.
It is important to observe that.
the levels in the valence-bond band
are below the levels in the conduction band. If sufficient energy is
imparted to electrons in the valencebond band, they may acquire sufficient energy to jump across the energy gap. In verification of the
quantum hypothesis, the electrons
never land within the forbidden
band. They will either acquire
enough energy to suddenly appear
at levels in the conduction band
or they will stay in the valence -bond
band.
Quantum State
The reader is now familiar with
the fact that electrons may have
different energy levels. This difference, as well as other differences
between electrons, may be completely described by a set of numbers peculiar to quantum mechanics
called the quantum numbers. These
quantum numbers which completely
specify the condition or state of an
electron define its quantum state.
It is sufficient to remember that
surface states and quantum states
of particles such as electrons or
atoms may be described by these
quantum numbers.

Summary
The following points should be
retained from this article.
(1) An electron, when in the
sphere of influence of the nucleus,
has certain possible, discrete values
of energy, or energy levels, which
are integer multiples of hf. No intermediate values of energy are
permitted.
(2) Groups or ensembles of energy levels are called bands.
(3) For a semiconductor, there is
a conduction band, a forbidden band
or energy gap, and a valence -bond
band.
(4) One electron can be distinguished from another by specification of its quantum state.
BIBLIOGRAPHY

Linus Pauling and E. Bright Wilson, Jr.,
"Introduction to Quantum Mechanics,"
McGraw-Hill Book Co., Inc., New York,
1935.
Robert Bruce Lindsay and Henry Margenau, "Foundations of Physics," John
F. K. Richtmyer and E. H.. Kennard,
141

www.americanradiohistory.com

,


X-Ray Absorption Gage

Detects and records voids as small as $10^{-4}$ cubic inches in artillery projectile filling. System is insensitive to x-ray voltage fluctuations, reduces limiting noise from multiplier phototubes by novel negative feedback arrangement.

By GEORGE M. ETTINGER

Standard Electronics Research Corp.
New York, N. Y.

S U P E R S E D I N G the slower x-ray photography method of detecting voids in artillery shell fillers, the instrument described here meets the problem of adequate signal-to-noise ratio without bandwidth reduction. Noise is caused by statistical fluctuation of phototube sensitivity and by x-ray fluctuation due to line voltage variation.

General Description

A photoelectronic method is employed where x-rays, after passing through the part under test, strike a pair of potassium iodide scintillation crystals which emit visible light approximately proportional to x-ray intensity. The light from the crystals is brought to the cathodes of secondary emission phototubes whose output is amplified and applied to a d-c meter and a chart recorder.

In common with recent industrial x-ray systems, the generator employed is of the self-rectifying type and produces short pulses of x-rays at 60 cps repetition rate. It is therefore possible to employ a-c couplings in the various amplifiers, so drifts due to phototube and amplifier warm-up and aging are very much reduced.

To eliminate variations due to line voltage changes, the whole system is operated as a self-balancing bridge where output is substantially independent of excitation voltage and varies only when unbalance between the bridge elements is present (Fig. 1).

When equal x-ray absorption takes place along the paths from the x-ray generator to the two scintillation crystals, the outputs from the two preamplifiers (60 cps repetition rate pulses) will be equal, and no voltage is induced in the secondary of the differential transformer shown. If the thickness of material facing one scintillation counter is reduced due to a void, the output of that preamplifier will become greater than that of the other preamplifier; therefore a difference signal appears across the transformer secondary, providing...
input to a vacuum-tube amplifier which drives a phase-sensitive detector whose output polarity changes if the unbalance between the two x-ray absorption paths reverses. The signal is further amplified in a push-pull stage and fed back to the dynodes of the photomultipliers so as to reduce the unbalance between the two signals, by varying the dynode potentials of the two phototubes (Fig. 2).

The cathode voltage is constant and the potential of the positive end of the bleeder chain is changed as required to vary photomultiplier gain. The total accelerating voltage, distributed over nine or ten stages, is therefore controlled. Since the photomultiplier is essentially a constant current device, with anode current almost independent of anode-to-last-dynode voltage, this arrangement is satisfactory for accelerating voltage changes of the order of 100 volts.

The dynode feedback system gives self-balancing bridge operation where the input to the metering and recording instruments is the voltage necessary to restore balance. In addition, the feedback system reduces those components of the phototube noise which are of a modulation nature (shot effect) since an increase of emission from one multiplier phototube causes reduced accelerating voltage to be applied to that tube, as well as increased voltage to the other tube. These tend to reduce the effects of changes of phototube characteristics. The system may be analyzed by the well-known techniques of envelope feedback, and stability conditions determined. Figure 3 shows pulses due to a small change of x-ray absorption in one channel, when the system is connected for positive feedback or regeneration (Fig. 3A) and for negative feedback or self-balancing action (Fig. 3B).

**Mechanical Considerations**

Projectiles of 3.5-inch diameter, having a 3/4-inch steel casing, were to be inspected for the presence of cavities in their filling. To scan the complete volume, it was found desirable to employ a helical scanning method, with two fixed scintillation crystals at a small distance apart (Fig. 4). A scanning pitch of 1/4-inch was chosen, and the speed of rotation adjusted so that faults 1/8-inch apart would produce signal pulses separated by 0.2 second, which could be handled by an electronic system having a bandwidth greater than 5 cycles per second. Where signal-to-noise ratio is not so important, as when inspecting a component for larger faults, the mechanical scanning speed may be increased and the amplifier bandwidth extended by switching capacitors out of the low-pass filter structures.

The end view of Fig. 4 shows a

**FIG. 3—Pulses with regeneration (A) and negative feedback (B)**

**FIG. 4—Details of balanced x-ray detector system with two scintillation crystals fixed a small distance apart to allow scanning complete volume**

**FIG. 5—Output of absorption gauge for 0.002-inch change in 0.5-inch steel equivalent, obtained with 180-kvp x-rays, 4-ma beam current**
projectile, an x-ray generator, and two multiplier phototubes. Type 5819 tubes are preferred to the type 1P21 in this application, because of their higher sensitivity and their flat window. To keep the two potassium iodide crystals in close proximity and yet allow for the diameter of the phototubes, curved light guides of clear Lucite were employed. The crystals were cemented to one end of the guides whose other ends were cemented to the phototube windows.

One of the x-ray beams passes through the center of the projectile; the other beam is some distance off center. This arrangement is necessary to avoid a blind spot which exists with symmetrical beams where a small cylindrical volume around the center line is never inspected.

The x-ray beams were each 3/4-inch diameter; the potassium iodide crystals themselves were only 1/2-inch square, so that further collimation between the projectile and the crystals was unnecessary.

Figure 5 shows the system output, as displayed on a chart recorder, when a steel shim 0.002 inch thick was placed between the projectile and one of the scintillation crystals. The projectile, at an x-ray voltage of 160 peak kilovolts, had an x-ray absorption equal to approximately 0.5 inch of steel. The signal-to-noise ratio under these conditions is approximately six to one, indicating unity signal-to-noise ratio would be obtained for a thickness change of less than 0.0005 inch in 0.5 inch of steel. This signal-to-noise ratio can be controlled by variation of amplifier bandwidth; the bandwidth of 5 cycles per second is adequate in this application.

Typical Results

A typical record obtained when testing a projectile is shown in Fig. 6. The pulses correspond to artificial defects in the filling, 3/4 and 1-inch diameter, and one inch, 1/2 inch and 1/4 inch deep. Signal-to-noise ratio of three to one is main-
tained for the smallest void, whose volume is approximately 0.0008 cubic inch.

Figure 6 also shows the improvement of signal-to-noise ratio obtained by reducing photomultiplier voltage from 750 volts to 500 volts. The increase of amplifier gain or x-ray voltage necessary to compensate for the relatively low phototube sensitivity at these accelerating voltages can be achieved easily. In the present case, the x-ray voltage was increased from 120 peak kilovolts to 160 peak kilovolts.

The effect of x-ray voltage variations is shown in Fig. 7. A change of voltage from 120 to 170 peak kilovolts, at constant beam current, produced a change of output no greater than that due to a steel thickness change of 0.005 inch in 0.25 inch.

Circuit Details

Figure 8 shows the preamplifier and photomultiplier circuits employed in each pickup head. The amplifiers employ miniature pentodes, type 6AK5, operated in a starved pentode circuit.

Figure 9 is a circuit of the differential amplifier and phasesensitive detector. Signals from the two preamplifiers are fed by a pair of cathode followers to the differential transformer, wound on a Permalloy toroidal core. The cathode resistances are taken to a negative supply of 150 volts, to ensure that no overloading takes place in the system before the difference-taking process is carried out in the transformer.

The phase-sensitive detector, deriving its input from a 6SK7 pentode, consists of a 6SN7 double triode whose plates are connected to a center-tapped 60-eps trans-
phototube performance

in the balanced x-ray detecting system, signal-to-noise ratio is largely determined by phototube noise. to be considered are thermionic emission from the photocathode and secondary emitter surfaces, and shot effect, which produces a noise modulation of the carrier and cannot be removed by means of tuned circuits.

To study these effects, the electrical output from several types of multiplier phototubes was displayed on a recording spectrum analyzer, to yield the spectra reproduced in fig. 10. These were taken with the phototube excited by short light pulses at 1,400 cps repetition rate. the noise level is small while there is no signal; however the noise level is only a few decibels below signal level when signal is present, showing the noise is of a modulation nature. analysis shows that phototube voltage signal-to-noise ratio due to shot effect alone is approximately proportional to the square root of the signal amplitude.

The records of fig. 10 indicate the desirability of reducing dynode voltage to obtain high signal-to-noise ratio. the noise is concentrated in a band extending approximately 30 cycles per second on either side of the modulation frequency, so signal-to-noise ratio will be approximately inversely proportional to bandwidth for pass bands less than about 15 cps wide.

Further tests have indicated the desirability of reducing the voltage between photocathode and first dynode, as well as the voltage between last dynode and anode, to a lower value than the accelerating voltages between the secondary emission dynodes. in recent published work on scintillation counters, it has been suggested that signal-to-noise ratio can be improved by operating with very large potential differences between photocathode and first dynode. measurements made on a number of 5819 and 1p21 tubes, however, have indicated that better signal-to-noise ratio may be obtained with low cathode-first dynode voltage (fig. 10). These measurements were made with a bandwidth of only a few hundred cycles per second so that the shift of the maximum of the phototube noise power spectrum due to change of cathode-first dynode voltage had little effect.

some improvement was obtained by using the 10-stage 5819 tube rather than the 9-stage 1p21. signal-to-noise ratio for a 5311 (british) photomultiplier tube was higher than for the other tubes. most of the noise in the 5311 tubes was due to thermionic or field emission, rather than due to shot effect.

this instrument may be employed quite generally in thickness gaging as well as in fault detection. for thickness gaging, one of the crystals is irradiated by x-rays passing through a reference piece of the same material as the part or parts to be tested; a discrimination of 0.0005 inch of steel in 0.25 inch, or one part in 500 thickness change, can be obtained. for the detection of small faults or irregularities a method where the part under inspection acts as its own reference piece is preferred, as in the present application where two identical pickup heads are employed.

acknowledgments

thanks are due to f. fua, standard electronics research corp. for much helpful advice and criticism. facilities for the multiplier phototube investigation were provided by paul onkley, department of electrical engineering, columbia university. this work was done under contract da 30-069-ord-116, ordnance department, department of the army.

references

1. f. fua and r. c. woods, iron age, nov. 1945.
2. w. h. volkers, direct-coupled amplifier starvation circuits, electronics, p. 126, march 1951.
4. oak ridge national laboratory, quarterly report on instrument research and development, july 1952.
5. m. h. greenblatt, h. w. davisson, and g. a. morton, nucleonics, aug. 1952.

FIG. 9—Differential amplifier and phase sensitive detector circuits. Signals from preamplifiers feed differential transformer with toroidal core

FIG. 10—Output spectra of 1p21 tube at various accelerating voltages indicate better signal-to-noise ratio at lower dynode voltages.
RELiability is the paramount factor in the design of large systems such as electronic digital computers. Present operating machines are so large that the limit imposed by the frequency of failures prohibits further expansion. Pulse circuits in these machines have been pushed to the upper limit of operating speed. Yet the need for larger-capacity higher-speed systems is urgent.

A new material for increasing reliability is a ferrite (ferromagnetic ceramic) having a nearly rectangular hysteresis loop. The most important application for this material is a high-speed arbitrary-access memory in which tiny ferrite toroids are used to store binary information. Many other pulse-circuit applications are significant, some depending on the hysteresis of the material for memory and others using its non-linear characteristic for switching applications.

Coincident-Current Memory

Magnetic drum and acoustic delay line storage units are inherently serial devices and use time as one selection coordinate, resulting in a great loss in computing speed or flexibility. The electrostatic storage tube, now the most widely used high-speed arbitrary-access memory, is a complex device requiring considerable maintenance and lacking satisfactory reliability for many applications. The coincident-current memory, using ferrite toroids for storage of binary information, is an inexpensive, simple, high-speed, arbitrary-access memory.
Digital Computers

Memory units and matrix switches using new square-loop ferrite material increase speed and reliability of digital computers. Storage units with arbitrary-access and read-out time of five microseconds or less makes stored information rapidly available without scanning time required by other systems.

which promises to provide the degree of stability and reliability required.

Operation

A flux-current (φ-I) characteristic of a ferrite toroid is shown in Fig. 1A. The positive and negative remanent magnetizations are defined as the one and zero states respectively. In the 4-by-4 memory array illustrated in Fig. 2, information is read out of the array by applying coincident current pulses of amplitude $-I_n/2$ to one vertical and one horizontal element, causing a large change in the flux of the selected core if it holds a one and a very small change if it holds a zero.

A flux change in any core in the array will induce a voltage on the output winding which threads every core. Voltages obtained by reading a one or a zero from a single core are shown in Fig. 1B. Since reading out always leaves the selected core in the zero state, rewriting is necessary if information is to be retained. This is accomplished by applying coincident-current pulses, of amplitude $+I_n/2$, to one horizontal and one vertical element. Writing new information is accomplished during a normal read-rewrite cycle by disregarding the old information read out and writing the new information by the same mechanism used for rewrite.

A possible arrangement for a parallel computer memory is shown in Fig. 2B. An array is placed in each column and only one $x$-coordinate switch and one $y$-coordinate switch are used to provide the coincident-current pulses for the entire memory. If $n$ is the number of $x$ or

![Fig. 1 - Characteristic curve (A) of ferrite toroid. Voltages produced (B) by a one or zero stored in a toroid](image)

![Fig. 2 - A 4-by-4 memory array (A) with current pulses $-I_n/2$ reading out the selected core. Arrangement in (B) permits selecting from a number of arrays](image)

![Fig. 3 - A four-position magnetic matrix switch using ferrite toroids](image)
elements, each switch can be set by a binary number containing log₂ digits, and n² binary digits are stored in each column of the memory. When the two switches are pulsed for read, the information is read out of the selected x-y location in all columns simultaneously into the memory register.

For rewrite, the switches write into the same x-y location in all columns. However, in each column in which the memory-register flip-flop holds a zero, a coincident current pulse of amplitude $+I_m/2$ is applied to every toroid in the array. The z-coordinate switch provides this inhibiting current pulse for each column in which a zero is to be written, to limit the magnitude of the current through any toroid in that column to $I_m/2$.

**Squareness**

Squareness ratio for coincident-current memory cores may be determined from the hysteresis loop

$$R_s = \frac{\Phi \left( -\frac{I_m}{2} \right)}{\Phi (I_m)}$$

Note that $R_s$ is a function of $I_m$. Any given ferrite toroid, however, will have a single maximum $R_s$ which occurs at the optimum value of $I_m$.

**Magnetic-Matrix Switch**

A 2¹-position matrix switch employing 2² non-linear magnetic cores is very similar to the familiar diode-matrix switch. An n-digit binary number sets the flip-flops which bias the cores so that all but one are biased into the saturation region. This selected core is then the only one which is switched when the current pulse from the driver is applied.

A driving pulse of opposite polarity must be applied to reset the switch before it is again ready for operation. Two 16-position switches have been used to drive a 16-by-16 coincident-current memory array during the last year at MIT. These switches employ the same rectangular-hysteresis-loop material as that used for the memory array.

Slightly different characteristics are desired for switch cores, however. Instead of a high squareness ratio as defined for the coincident-current memory, a high ratio of remanent magnetization to saturation magnetization is desired together with a low coercivity.

**Other Applications**

Ferrite toroids possessing rectangular hysteresis loops may be used for high-speed storage of binary information in other ways than the coincident-current memory. If the total number of digits to be stored is small, so that direct selection is practical, a single-coordinate selection scheme may be used. In this case, the current pulses used for reading and writing may vary between rather wide limits provided they exceed a certain minimum amplitude.

Where time selection may be used, rectangular loop ferrites may be employed in a static-magnetic delay line of the type developed by the Computation Laboratory of Harvard University.

Magnetic cores possessing non-linear characteristics can be used for other switching or logical operations besides the magnetic-matrix switch, particularly for operations similar to those performed by crystal-diode and or gates.

**Testing**

A high squareness ratio is a necessary but not sufficient condition for a satisfactory toroid. To properly evaluate ferrite toroids for the memory application, a pulse test has been designed which subjects a single toroid to the conditions that might be encountered in an operational array. Actually, two tests are performed, one to determine the smallest possible voltage from a selected toroid holding a one and another to determine the largest possible voltage from a selected toroid holding a zero.

Figure 4 shows a pulse pattern which writes a one into a toroid, followed by a number of half-selecting read pulses which disturb the one and tend to decrease its magnitude, as shown on the hysteresis loop. The disturbed one is finally read out by a full-amplitude read pulse. In the case of a satisfactory toroid, the voltage from the disturbed one is not a function of the number of half-selecting pulses, provided that the number of half-selecting pulses is greater than some small number, usually two or three.

A test which determines the largest zero is shown in Fig. 5. In this case, the zero is disturbed by a number of half-selecting write pulses. A large ratio of disturbed-one voltage to disturbed-zero voltage is necessary for a satisfactory toroid. This ratio may be calculated on a peak-amplitude basis or on the basis of instantaneous voltages sampled at the time that the ratio is a maximum.

To prevent the voltage from half-selected toroids in a large array from adding so that the total voltage from all half-selected toroids might swamp the voltage from the selected toroid, the output winding is arranged so that the polarity of the voltage induced on it will alternate with each toroid along any element of the array. This, incidentally, means that the voltage from the selected toroid may be positive or negative.

The total voltage observed on the output winding is

$$V_r = \pm \left[ V_s - 2V_s + (n-2) \right] V_s + V_t$$

where $V_s$ is the magnitude of the voltage from the selected toroid, $V_s$ is the magnitude of the voltage from a half-selected toroid, $V_s$ is the uncanceled voltage from a pair of half-selected toroids of opposite polarity, and $V_t$ is the voltage induced in the output winding due to leakage flux or flux not con-
fined to the toroids.

The voltage $V_s$ may be positive or negative; in the ideal case it would be zero. Since it appears in the expression for the total voltage with a coefficient $(n - 2)$ it establishes an upper limit on the size of the array. Perhaps the most important factor behind $V_s$ is the uniformity of the magnetic characteristics of the toroids. The requirement for small $V_s$ makes a high degree of uniformity essential. Another contribution to $V_s$ may come because $V_s$ will be different for a given toroid depending on whether it contains a one, a zero, a once-disturbed one, a twice-disturbed one and so on. However, although the difference between the voltage from a half-selected undisturbed one and a half-selected undisturbed zero may be significant the number of such pairs is limited to two. The large number of $V_s$'s will be from half-selected cores containing disturbed ones or disturbed zeros, where the difference will be much less.

**Ferrite Characteristics**

The rectangular-loop ferrite now used at MIT was developed by the General Ceramics and Steatite Corporations from a magnesium ferrite. The saturation flux density of this body, MF-1118, is approximately 2,000 gausses and the coercivity is 1.5 oersteds. A family of hysteresis loops is shown in the photograph, and other characteristics are listed in Table I.

The toroids for coincident-current-memory application have an outside diameter of 0.090 inch. The small size is necessary to reduce the power requirements for driving the arrays. The $L_s$ for this toroid is 1.0 amperes and the maximum squareness ratio is 0.7. The disturbed one voltage has a peak amplitude of 0.1 volt and a duration of 1 microsecond. The ratio of disturbed one to disturbed zero is 10

<table>
<thead>
<tr>
<th>$\mu_s$</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_{max}$</td>
<td>5.15 at 1,040 gausses</td>
</tr>
<tr>
<td>$B_s$</td>
<td>1,780 gausses at 25 oersteds</td>
</tr>
<tr>
<td>$B/E$</td>
<td>1,590 gausses</td>
</tr>
<tr>
<td>$H/E$</td>
<td>0.9 approx.</td>
</tr>
<tr>
<td>$H_s$</td>
<td>1.5 oersteds</td>
</tr>
<tr>
<td>Volume Resistivity</td>
<td>$2 \times 10^5$ ohm-cm</td>
</tr>
<tr>
<td>Curie Temperature</td>
<td>300 deg C</td>
</tr>
</tbody>
</table>

**BIBLIOGRAPHY**


Video Inset System

Television camera scanning foreground subject against plain background is used to switch a second camera, focused on inexpensive background. Resulting composite is economical, particularly for trick effects. Circuits are given both for the novel keying separator and commercially available effects amplifier.

TELEVISION broadcasters are beginning to make increased use of a technique whereby the scene from one camera may be used as a background into which the picture from another may be inset as a foreground. Background scenery is automatically cut out over the area silhouetted by the foreground subject to avoid the double exposure effect of ordinary superimpositions. Highlights do not bleed through the foreground, and the composite picture may be in true or fantastic perspective as desired.

The so-called matte process employed in the film industry achieves these results through meticulous photography together with special processing and combining. In television, the video inset system combines the scenes by instantaneous and automatic camera switching. Many novel effects are practical in both media and in motion pictures, production costs are sometimes drastically reduced by miniaturization of large background sets. This same cost saving may be feasible for television in the near future.

The video inset system permits using any properly synchronized camera as a source of background scenery or action. The camera may be located in the studio originating the foreground picture or in a different one. The background may be derived from a small flip card, a transparency, a motion picture film or a live action scene in the same or a different studio.

Basically, the present system is merely a method of switching from the background camera to the foreground camera whenever the latter scans anything other than black. Essential elements, functions and results are shown in Fig. 1. Here, the foreground camera pictures only a man, strumming a ukulele; the background camera pictures a tropical scene, while the composite as viewed on the monitor, shows the man still strumming, but now standing in front of the tropical scene.

First known experimental development in the use of electronic backgrounds was conducted several years prior to the war by NBC. Fundamental ideas were proved successful, although difficulty was encountered in properly switching cameras. By 1940 various patents had been issued on the basic system, one of which included both a foreground-background combination and a middleground as well. Experimentation was resumed at NBC in 1948, with materially improved results. A method of pulse shortening, applied to electronic background systems, has been described in the literature.

During the past year it is understood that at least three broadcasters have tested and used electronic systems similar to the present video inset, with varying degrees of success. All known sys-

By J. L. HATHAWAY
and F. L. HATKE
Development Group
National Broadcasting Co.
New York, N. Y.

FIG. 1—Elements of the video inset system show a simplified camera relay

FIG. 2—Special interconnections, including delay cables, are used to insure proper register of composite video signal

April, 1953 — ELECTRONICS

www.americanradiohistory.com
tems are subject to certain inherent limitations and are capable of proper performance only under carefully controlled conditions.

The apparatus required, in addition to the usual camera equipment, consists basically of a double-throw selector switch that can be actuated as a function of foreground picture content. While foreground camera A scans the black back-drop, the switch conducts video from the background camera B. Then, as the foreground scanning leaves the black area, the switch throws so that camera A becomes active, replacing the background camera signals. Reverse action occurs as scanning returns to the black area. Practically, the selection could not conceivably be accomplished by the mechanical switch indicated in Fig. 1.

Actually, switching must occur in considerably less than 1 microsecond and can best be achieved at the required rate electronically. Actuation as a function of foreground camera video output requires reshaping this camera’s video output. Signals corresponding to shades other than black operate the switch or gate to the foreground camera signals whereas on blacks it reverts to the background.

A block diagram of the video inset equipment, including the necessary video delays and interunit connections, is shown in Fig. 2. This comprises two major components: the keying separator, which develops keying pulses from the foreground camera output; and special effects amplifier type TA-15A, which further shapes and amplifies the keying pulses and also switches cameras as a function of these pulses.

**Keyer Equipment**

The first component is essentially a clipper capable of making square-topped pulses from any and all video signals that depart from black level. Camera equipment contains some irregularity in the black level base line, caused by miscellaneous noise voltage, burns, improper shading, and redistribution effects.

The clipping level is therefore adjusted to avoid these spurious voltages by operating somewhat above theoretical black level.

A complete schematic of the separator unit is shown in Fig. 3. Video signals are first amplified and then clamped to preserve a constant black level. All stages are shunt peaked for minimum delay time and optimum transient characteristics. Frequency response is flat to 7 mc and no compression is evident with as much as 45 volts peak-to-peak at the clamped grid. The clamping diodes are each driven by horizontal pulses, amplified to approximately 80 volts. The clamped stage, a cathode follower, feeds two series-connected biased diodes that function as clippers.

Capacitance neutralization from the cathode-follower plate provides cancellation of the capacitance coupled video components, which would otherwise pass through in an unclipped state. Both white and black portions of the signals are eliminated by the diodes, leaving approximately a 2 percent segment. This is normally derived from the near-black portion of the video wave. The segment can be clipped from any desired portion of the amplitude range, by adjustment of a black level control potentiometer in the clamp diode circuit. Clipper output is amplified and then fed from a cathode follower as the keying signal, into the special effects amplifier.

Circuits of the separator unit are designed for stable operation since the separating process is inherently critical.

The high levels employed in clamping and clipping reduce variations that would be caused at lower levels by tube and temperature changes. The avoidance of video wave compression prior to clipping is essential, to accommodate axis shifts with typical television pictures. Otherwise, after
initial adjustment, clipping would not fall within the same limits for all video signals. Total delay time in the video channel of the separator unit approximates 0.15 microsecond. A length of properly terminated coaxial cable delays clamp-driving pulses by at least an equal amount to permit clamping during blanking time.

A block diagram of the special effects amplifier is shown in Fig. 4, and a complete schematic is in Fig. 5. Tube numbers correspond in these diagrams, although certain portions unnecessary for an understanding of the operation are omitted from the block diagram. The signal from the separator unit consists essentially of flat topped pulses of white and black in accordance with the signals clipped from the foreground camera video information.

These pulses are amplified by tubes $V_{na}$ and $V_{nb}$ and are then shaped in the regenerative clipper stage $V_{sn}$, which removes any possible remaining noise or gray components. The signal then passes through the phase splitter $V_{s}$ and the push-pull cathode follower stage $V_{v}$ to key on and off the switch or gate tubes $V_{n}$ and $V_{v}$.

The foreground video signal is applied to $V_{n}$, a gain-controlled amplifier and then to the clamped grid of gate tube $V_{n}$. The background video signal is amplified in a gain-controlled amplifier stage $V_{n}$ and then is applied to the clamped blanking mixer stage $V_{nb}$. Blanking pulses are added here to obtain setup and to facilitate switching of the video signals. The gate tube associated with this background channel is always keyed on during the blanking period as well as during the scanning of black areas of the foreground picture. Thus it is necessary to add blanking only in the background channel.

Video signals applied to the gate tubes are transmitted through them in accordance with the keying pulses impressed on their suppressor grids. If at the gate tubes the keying pulses are correctly timed to the foreground video signal, they cause background scene to be cut out over an area exactly matching the outline of the object to be introduced. Since the keying signal passes through a greater number of stages than the video and each introduces some delay, it is necessary to increase the video delay in order to attain correct timing at the gate tubes.

Four high-level and three low-level clamps are utilized in the special effects amplifier. It is the purpose of each of these to maintain a fixed black setting at the various grids, under conditions of changing duty cycle. The selected video from the gate tubes is clipped in $V_{b}$ to remove excessive blanking and is then amplified in $V_{n}$, $V_{a}$, $V_{v}$ and $V_{n}$.

**Operation**

At present, the system does not function properly if a foreground person has dead-black hair. In addition, some back-drop materials develop high light reflections along folds and so cause incorrect camera selection.

The system may be operated in reverse, employing a white back-drop or a back-lighted translucent screen. Difficulties are encountered here from white areas in the foreground, such as shirts, teeth and eye whites. Less critical keying can be obtained, however, provided the camera is irised down to the stop where the back-drop light level is just sufficient to operate the camera pickup tube over the knee of the saturation curve.

The video inset technique at the present state of the art is valuable in producing special novel effects, such as headless men, bodyless heads and feet of magic. When camera pickup tubes are produced that accommodate greater ranges of light levels, tremendous savings, through use of less large-scale scenery, may be possible.

**References**

FIG. 5—Schematic diagram of the RCA type TA-15A special effects amplifier used as an integral part of the video inset system.
Transistorized Hearing Aids

Hard-of-hearing public expected to accept higher initial cost of junction transistor hearing aids to take advantage of operating economy. Manufacturers divide on question of all-transistor versus combination tube and transistor instruments

By JAMES D. FAHNESTOCK
Associate Editor, ELECTRONICS

FIRST LARGE-SCALE commercial application of transistors was announced by several hearing-aid manufacturers at the end of last year. Immediately after the first announcements of hearing aids using transistors, it became apparent that there were two schools of thought as to the best way to employ transistors in hearing-aid instruments.

On one side, designers decided that the poor noise characteristics of even the junction transistors made them unsuitable for use in the low-level stages of high-gain units, since noise introduced in the first stages would be amplified by succeeding stages. To keep noise levels down, the designers chose to use subminiature vacuum tubes in preamplifier and driver stages and a transistor to replace the usual power-output tube.

On the other side, many manufacturers decided that the noise level of the all-transistor circuit was sufficiently low for most purposes. The impressive reduction in battery cost made possible by the elimination of the need for B voltage tipped the scale in favor of the transistors for all stages.

Combination Circuit

An example of a hearing aid using a combination of tubes and transistors (Sonotone "1010") is shown in block diagram form in Fig. 1. For the tubes, this instrument uses a 15-volt B battery with a life estimated at 2,000 hours at a drain of 60 microamperes. A 1.25-volt A battery powers the transistor and heats the tube filaments. Life of the A battery is 63 hours at an average current drain of 13 milliamperes.

In this unit a special transformer was required to match the high plate impedance of the driver tube to the low base-input impedance of the transistor. A primary impedance of over a half megohm is achieved by winding 10,000 turns of No. 48 wire (657 feet, at 1.3-thousandth-inch diameter) on a core built up of subminiature mu-metal laminations. Special techniques are, of course, required to form this winding without breaking the fine wire used. The 250-ohm secondary consists of 200 turns of No. 45 wire.

A tantalic capacitor is used in the circuit of the brute-force filter in the constant-current source for the base circuit of the transistor.

Available power output of this tube-transistor instrument is 14 mw, which provides 124 db of sound pressure in the ear. The acoustic gain is 65 db, and residual noise level is at least 50 db below maximum output at full-gain setting.

The transistor used is an npn junction unit manufactured by Germanium Products Corp. of Jersey City, N. J.

All-Transistor Units

The circuit diagram of one of the all-transistor hearing aids is shown in Fig. 2. This circuit

Table I—Battery Data for "Radioear" All Transistor Hearing Aid

<table>
<thead>
<tr>
<th>Battery Type</th>
<th>Estimated Life in Hours</th>
<th>Estimated Battery Cost</th>
<th>Estimated Cost Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—1RM-12 or equal</td>
<td>2,000</td>
<td>$0.65</td>
<td>1/31 cent</td>
</tr>
<tr>
<td>1—1015E or equal</td>
<td>500</td>
<td>0.15</td>
<td>1/33 cent</td>
</tr>
<tr>
<td>2—1RM-1 or equal</td>
<td>250</td>
<td>0.60</td>
<td>1/4 cent</td>
</tr>
<tr>
<td>3—1RM-1 or equal</td>
<td>150</td>
<td>0.90</td>
<td>2/3 cent</td>
</tr>
</tbody>
</table>

Typical Drains: 1.5 ma at 1.25 v; 3.5 ma at 2.5 v; 6 ma at 3.75 v

Typical of all-transistor instruments is Meyers' "Radioear" using three pnp's
A test on this all-transistor unit showed the distortion to be about 17 percent at saturation output and 4.4 percent with the output set at one decibel. Distortion decreases with output level.

Raytheon CK718 npn junction units are used in both all-transistor circuits discussed.

**Noise**

The tube-transistor hearing aid has a residual noise level of at least 50 db below maximum output at full gain. The all-transistor units have a somewhat higher noise level at the output, but advocates of this type of circuit claim that noise is not a problem for persons with hearing deficiencies and that a noise level 40 to 50 db below signal level is negligible for all practical purposes. One manufacturer reports a lower noise level in an all-transistor unit (Gem Ear Phone Co. "V-70-T") than in vacuum-tube hearing aids.

**Accessories**

The usual variety of accessories are made available with transistorized hearing aids. No evidence of all-transistor hearing aids with automatic volume control has been reported. Several designers have provided sockets and switches for attachment of telephone pickup coils. By this means, the user is able to hear telephone conversations without the distortion introduced by the telephone ear piece and the hearing-aid microphone.

To date, only junction transistors have appeared in hearing aids, and grounded-emitter circuits are universally used. Packaging continues to show subminiaturization; thickness of the instruments varies between \( \frac{3}{8} \) inch and 1 inch, with heights from 2\( \frac{1}{4} \) to 3 inches and widths of from 1\( \frac{1}{4} \) to 2 inches.

Low operating voltages permit use of smaller lower-voltage capacitors. Virtually no heat is generated by the transistor units.

Costwise, all-transistor hearing aids compare reasonably well with all-tube and tube-transistor instruments. Special circuits such as response-shaping networks and volume compression circuits are refinements found in the more expensive units.

One manufacturer gives battery-cost-reduction figure of 1/25 that for typical tube units. These remarkable savings have become strong inducements for users to pay the somewhat higher initial cost for transistorized units.

---

**FIG. 1**—Block diagram of tube-transistor hearing aid using two subminiature tubes and one npn junction transistor

**FIG. 2**—Circuit diagram of Zenith hearing aid using transistors exclusively.

Battery cost is 1/25 that of comparable all-tube instrument.

Zenith "Royal") operates on a single penlight battery with a drain of 4.5 ma, to give a battery life of 400 hours. Compensation for changes in transistor characteristics due to temperature variations is automatic. Sound-power output of the unit is 135 db with an overall gain of 62 db.

Transformer coupling is used in this circuit between three grounded-emitter transistor amplifier stages. Constant base current for the first two stages is provided by a divider arrangement across the single-cell battery supply; a large series resistance provides constant current for the output stage.

One type of all-transistor instrument (Edward A. Meyers' "Radio-ear") gives the user a choice of battery supplies. This unit can be powered by one, two or three 1.25-volt cells, as indicated in Table I. With three cells, saturation sound-pressure output available will run as high as 135 db or more (re 0.0002 d.s.e.) at 1,000 cps. With a highly-damped receiver and two cells (2.5 volts), the saturation output is slightly under 130 db. Electrical-power output is approximately 10 mw (with 3.75 volts) and total power gain is between 80 and 90 db.

Sennheiser "1010" uses two tubes and one npn junction transistor.
Testing UHF-TV

Characteristics of germanium mixer crystals for uhf television and other receivers can be measured with laboratory setup in five minutes using fuse bolometer and standard test equipment. Alternative production testing method for untrained personnel measures admittance at audio frequencies.

Conversion loss \( L \) of a crystal mixer is the ratio of the available input signal power to the available output signal power. It is a measure of the efficiency of conversion from r-f signal to i-f output.

Noise temperature \( t \), also called output noise ratio, is the ratio of the available noise power output from the crystal mixer to that of a resistor. It differs from unity for semiconductor mixers because of noise generated by the biased crystal in excess of thermal or Johnson noise and is akin to the excess noise in a carbon microphone.

By including the effect of the i-f amplifier noise figure, \( F_{i-f} \), a useful relationship can be drawn for determining the r-f noise figure \( F_{r-f} \):

\[
F_{i-f} = L(F_{r-f} + t-1)
\]

The value of \( F_{r-f} \) will generally be a function of the mixer's i-f admittance compared to the admittance for which the i-f amplifier noise figure is optimized.

Measurement Theory

To evaluate the effect of the mixer crystal upon overall noise figure, \( L \) and \( t \) must be known at the desired operating point. Noise temperature may be measured by determining the ratio of the noise output from an i-f amplifier whose input terminals are loaded by the mixer under test to the noise output when that amplifier is loaded by an ohmic resistor with the same value as the crystal resistance. This ratio is denoted as \( Y \) factor.

Mixer noise temperature can be determined from \( Y \) factor and the i-f noise figure of the amplifier when resistively loaded

\[
t = F_{i-f}(Y-1) + 1
\]

Conversion loss can be calculated from \( F_{r-f} \), \( F_{i-f} \), and \( t \):

\[
L = \frac{F_{r-f}}{(t-1 + F_{i-f})} = \frac{F_{r-f}}{(Y)} \cdot \frac{F_{i-f}}{(Y)}
\]

If the i-f noise figure is measured with the amplifier terminated at the input by the mixer, a correlation check may be made against \( Y \) factor,

\[
F_{i-f \ \text{mixer}}/F_{i-f \ \text{resistor}} = Y
\]

This measurement method assumes that the crystal has been biased at the desired operating point in local oscillator power injection and d-c bias, and that the mixer is terminated through lossless transformers by the desired impedances. The bias conditions will affect all the crystal parameters, including the crystal impedances.

The terminating impedances of the crystal mixer at input, image, local oscillator, local oscillator harmonic and output signal frequencies will have an effect on the measured effective conversion loss. These terminations at other than input and output signal frequencies are important, because of undesired parasitic responses that occur in the mixing process.

The input signal will heterodyne with the local oscillator power to generate both sum and difference-frequency energy. The difference-frequency power is normally the desired i-f output signal. The energy at sum frequency can be partially recovered by a direct beat with the local oscillator second harmonic that is generated by the nonlinear crystal characteristic.

Image power is generated in the mixer by the beat between the input frequency and the local oscillator second harmonic, as well as by a beat between the output signal voltage and the local oscillator. It may be partially recovered by reflection back to the mixer and a beat with the local oscillator, or it may be absorbed by the source impedance.
Mixer Crystals

By NICHOLAS DeWOLF
General Electric Co.
Schenectady, N. Y.

that is driving the mixer.

Several special definitions for conversion loss have been derived. To achieve a result typifying the average application and to simplify the measurement, the conversion loss that is commonly measured is \( L_r \), the broad-band conversion loss. It is measured with the signal and image terminated in the same impedance, and the mixer matched to the local oscillator wave. The conversion loss in a given application may vary by 1.5 db above or below the broad-band loss, but \( L_r \) will equal the average result.

Measuring Equipment

A block diagram of the laboratory equipment for measuring mixer crystal parameters is shown in Fig. 1. It is essentially a uhf receiver, arranged for the measurement of \( F_{1r} \), \( F_{1i} \), \( Y \), i-f mixer admittance and r-f mixer admittance. In addition, the biases on the crystal can be varied and monitored, and the r-f match may be adjusted. From this data, the conversion loss, noise temperature and crystal impedances may be measured as functions of the operating conditions.

The local oscillator frequency is 900 mc, selected to observe the crystal characteristics at the upper end of the uhf band, where variations in r-f reactance have a maximum effect. The intermediate frequency must be chosen as a compromise between \( F_{1r} \), which increases and \( t \) which decreases with increasing frequency. A mean value of 30 mc was selected because the noise figure of crystal-mixer receivers optimizes, equipment is easily available at this frequency and noise temperature can be accurately measured.

The crystal under test is clipped into the mixer test board, which consists of a flat-strip transmission-line circuit shown in Fig. 2 and the photograph. The mixer circuit is intended to tune out the capacitance of the average crystal, match its resistance to 50 ohms and prevent loss of either signal input to the crystal or output signal from the crystal.

In addition, second-harmonic energy generated by the crystal is reflected to the crystal by harmonic shorting terminations at either end. Two sheets of \( \frac{1}{4} \)-in. Teflon-impregnated glass fiber board are sandwiched together about a 0.003-in. flat-strip photographically etched circuit, with copper sheeting on the top and bottom of the sandwich. A General Radio 874C connector is used at the r-f input, and advantage is taken of its tapered configuration to provide a smooth transition between the strip line and coaxial elements.

Insertion loss of this mixer circuit, measured by determination of the swr with the load terminals shorted and opened, is less than 0.05 db. When loaded with a passive resistor and matched to 50 ohms at the local-oscillator frequency, the swr at 30 mc either side of the local-oscillator frequency (signal and image frequencies) is 1.25. This will cause a mismatch error of less than 0.05 db.

The shorted tuning stub is cut to resonate the average crystal capacitance of 1.1 \( \mu \)f and the quarter-wave transformer, adjusted by varying the width of the transmission line strip, is centered to match the mean 1N72 crystal resistance of 150 ohms to the line. Of all 1N72 crystals tested at the design bias conditions, 90 percent fall within a swr of 2.5 in the mixer. These bias conditions are set at 0.7 mw local-oscillator injection, and forward d-c bias from a 250-ohm 0.25-volt source.

Dielectric Slug Transformer

At other bias conditions and with other mixer crystal types, the mismatch may increase. The dielectric-slug matching transformer preceding the test mixer is used to match out these variations. It consists of a GR 874LB coaxial slotted line
with \( \lambda \) wavelength polystyrene sections that can be moved along the line by polystyrene rods extending through the slot. This device, commonly called a slug tuner, requires a line 14 wavelengths long, and will match out any swr up to \( \varepsilon \), where \( \varepsilon \) is the effective dielectric constant.

The position of the slugs determines the mixer impedance presented to the local oscillator wave when they are used to match the mixer to the line. At 900 mc the tuner used will match a swr of any phase and amplitude up to 5.2 and has a maximum insertion loss of less than 0.1 db for all settings.

The tuner and mixer are driven from the noise generator through a Hewlett-Packard 805A parallel-plate slotted line, used for measuring the swr of the mixer. The local oscillator power is injected into the line by a capacitive-tuned probe, illustrated in Fig. 3. The probe is driven from a uhf oscillator, isolated by a 10-db pad to prevent spurious responses. Power injected to the transmission line is 12 db down from the power available to the probe. At the local oscillator frequency, the probe introduces a swr of 1.15 on the line, causing a mismatch error of less than 0.05 db.

The injection method has a bandwidth of 12 mc at 900 mc reducing the noise sidebands of the local oscillator at signal and image frequencies by approximately 15 db. This reduction assists in preventing the oscillator noise sidebands from increasing the effective noise temperature. The mismatch introduced on the line by the probe at the signal and image frequencies is less than 1.02.

An untuned detector probe is constructed near the main injection probe, and serves to monitor the local-oscillator injection power. It is located near the end of the injection probe, but well out of the fields in the main transmission line. Calibrated against the available power in the line, it has been found to have a frequency dependence over an 80-mc bandwidth of only 0.05 db per megacycle, with an almost linear decrease in sensitivity with frequency.

### Noise Generator

The r-f noise figure of the mixer is measured with a Polytechnic Research and Development type 904 uhf noise generator, to which an external precision meter has been added to improve the accuracy of the noise diode current measurement. A value of 3 db must be added to the measured noise figure to allow for the noise signal injected into the unwanted image channel. If a narrow-band tuned circuit was inserted in the line to reject the image power input this correction would not be necessary, but the conditions for broad-band loss measurement would be violated. The i-f noise output from the uhf noise generator is prevented from being injected into the mixer by the shorted tuning stub. An additional correction is necessary for the noise diode's transit time.

The Y-factor box, shown in Fig. 4, terminates the i-f amplifier input and provides an adjustable admittance that duplicates the mixer i-f admittance. It can be exchanged with the mixer for the measurement of \( Y \) factor. A temperature-limited noise diode is included for the measurement of i-f noise figure and is arranged so that noise figure can be measured with either the mixer or the duplicating admittance terminating the amplifier.

Because of the extreme sensitivity of the noise diode plate current to filament current changes and therefore to line-voltage change, a storage battery is used in the filament supply. In addition, the d-c bias on the mixer crystal is injected at the Y-factor box. Good filtering is necessary for all the supply voltages. The use of ceramic disk by-pass capacitors soldered directly to the chassis is recommended. If the input and output leads to the bypass disk are soldered on opposite sides, the mutual coupling impedance between filter sections may be kept at a lower value than possible with button mica bypass capacitors.

To adjust the comparison admittance to the same value as the mixer i-f admittance at the noise diode an admittance bridge is provided. For convenience and accuracy the bridge is located at the end of a cable half the i-f wavelength as measured from the noise diode. The cable will present the same admittance to the bridge as its terminating impedance, and may be easily measured for electrical length by measuring its susceptance when terminated in an open circuit. The circuit capacitance is tuned out, and the bridge admittance reading used in the noise-figure calculation.

The admittance bridge, a Wayne Kerr B701, is driven by a buffered 1-kc square-wave modulated i-f electron-coupled oscillator. The amplitude of this signal at the mixer must be kept at a low level to prevent upsetting the nonlinear crystal impedance and may be checked by observing that it does
not alter the d-c crystal bias. Since this level is generally below 25 millivolts, a sensitive null detector must be used. A single-stage broadband i-f amplifier, followed by a crystal detector and a high-gain audio amplifier tuned to 1 kc is used. This method permits fixed-tuned measurements for changes in the oscillator frequency as large as 4 mc.

Once the crystal mixer i-f admittance has been measured and a duplicate ohmic termination has been substituted, the Y-factor box output is switched from the admittance bridge to the i-f amplifier and the bridge oscillator is turned off to prevent spurious coupling of i-f power to the amplifier.

The i-f amplifier has a gain of 120 db and a bandwidth of one megacycle. The input is a Wallman cascode circuit and in the complete circuit used has a noise figure of 1.8. It is preceded by an L match.

FIG. 4—Contents of Y-factor box used in noise temperature test

ing section adjusted for the best noise figure when driven from the average mixer crystal, an impedance of approximately 250 ohms. The line from the amplifier to the switch is made identical in length to the line from the bridge to the switch. The impedance presented to the amplifier is then the same as the impedance presented to the bridge.

In measuring the relative noise output from the amplifier, it was desired to avoid the use of a diode video detector. A rectifier requires linearization for successful use in noise-figure measurements employing the noise diode method and still has a limited range over which accurate measurements can be made. The most satisfactory method for power measurements is the bolometric, or thermal measurement, and it yields results that are truly proportional to power output.

A biased Wollaston wire bolometer consisting of a 1/100 ampere Littelfuse is used and its resistance change caused by output power heating is measured. The incremental change in resistance is proportional to the input power, provided that the input power is a small fraction of the d-c biasing power. Another limitation on the amount of output power that can be linearly measured is imposed by the possibility of overload in the last i-f amplifier stage that drives the bolometer.

It is desirable for the noise peaks to be at least 15 db below the overload power output of the amplifier. An additional 15 db should be allowed for the ratio of peak-to-rms noise power. This generally limits the maximum usable output power to below 0.1 milliwatt, which makes stability in bolometer bridge measurements extremely difficult to maintain, particularly in light of the zero drift caused by thermal charges and variations in the bolometer bias.

Bolometer Driver

To avoid the instability of the bridge method the i-f amplifier stage preceding the bolometer driver stage is gated with a 1-ke square wave, as illustrated in Fig. 5. The control grid is driven to cutoff by a square wave derived from a multivibrator and buffer amplifier. The buffer is a triode stage with the plate load grounded, and a negative d-c supply. This references the square wave to ground, and flattens the top of the output pulse thereby improving the i-f output pulse shape.

The i-f pulses are injected to the bolometer fuse by the driver stage. The bolometer has a thermal time constant of approximately 1/3 millisecond, which allows it to vary in resistance at a 1-kc rate. The bolometer is biased by a direct current passing through a transformer coupled to a high-gain tuned Hewlett-Packard 415A swr indicator. The scale of the meter is calibrated in db based on a square-law detector and is therefore a direct measure of relative output noise power. This method is usable at an input level of 2 microwatts, but is normally used at a level of 50 microwatts and gives a more stable noise output reading than any other method observed.

It is possible, when familiar with the equipment, to make a complete crystal measurement in five minutes, including adjustment of the d-c and local-oscillator bias, a measurement of the mixer r-f and i-f impedance and a calculation of the broadband conversion loss and the noise temperature. Rapid and simple measurements are necessary because a number of operating conditions must be investigated to determine optimum biases and the distribution of parameters of a representative group of crystals. In addition, the results can be transposed to a given uhf converter design, enabling calculation of its noise figure.

Production Testing

In production testing 1N72 uhf-ty mixer crystals, the laboratory method outlined is too complex for rapid testing.

Variation in noise temperature is relatively unimportant in uhf-ty mixers because the high intermediate frequencies and the high i-f noise figure make the contribution of excess noise temperature negligible for normal crystals, particularly if biased by a well-filtered local oscillator.

Variation in i-f mixer admittance will affect the i-f noise figure and the bandwidth of the input circuits. It is desirable, then, to measure this admittance and reject those units that seriously deviate from the mean value. This measurement may be accomplished at audio frequencies, for the i-f impedance is
relatively independent of frequency. The uhf noise figure of a receiver employing a given mixer crystal depends directly on the conversion loss of the crystal.

The conversion loss may be conveniently measured for production testing by the amplitude modulation method used in the production testing of microwave silicon crystals. A block diagram of the method used is shown in Fig. 6.

The crystal under test is mounted in the printed-circuit test mixer illustrated and a 900-mc signal is injected from a source that is matched to the mean crystal impedance. This signal is at local oscillator level, of impedance and a regulated supply. The circuit used, shown in Fig. 7, consists of a commercially designed regulated power supply with a means for modulating the grid of the amplifier stage without upsetting the normal a-c or d-c feedback. Feedback is sufficient to make the gain essentially independent of tube variations, and lowers the output impedance. The supply used had an a-c gain of 2, an a-c and d-c impedance of less than 10 ohms and a maximum modulation capability of 20 percent.

The modulation depth is fixed by a careful measurement of the oscillator output power versus input supply voltage characteristic, and a calculation of the modulating voltage required.

The crystal mixer 1-kc resistance is measured with the bridge and bias circuit illustrated in Fig. 8. It is desirable to have the bridge output read equally for values of mixer resistance above or below the design value of 250 ohms by the same ratio. This is accomplished if the mixer is shunted by the design value and balances against a resistor of half the design value. In addition, the desired d-c bias source impedance is equal to the design value, and this same value is the desired terminating impedance for the conversion-loss measurement.

All these conditions are satisfied by the circuit illustrated, which is also designed to permit grounding of both the mixer and the millivoltmeter. In addition, only the 1-kc input needs switching in changing from the conversion loss to the resistance measurement.

The voltage output from the mixer when is measured and the voltage level at the mixer when the i-f resistance is measured must both be kept at a low level.

The millivoltmeter used shown in Fig. 9 is a two-stage amplifier and bridge rectifier with sufficient degeneration effectively to stabilize the instrument from the effect of tube variations. The gain is controlled by adjustment of the feedback to take advantage of the maximum usable degeneration. Additional low-frequency negative feedback is supplied to reduce the sensitivity to hum voltage input without impairing the 1-kc characteristics. This circuit is normally adjusted to 4 millivolts full scale.

The production test equipment has proven extremely stable and will maintain its calibration within 0.1 db for a day’s operation.

The author wishes to acknowledge the suggestions and assistance of C. J. Goodman and E. J. Jarrold in the measuring equipment.

REFERENCES

(2) Same as Reference 1, p. 122.
R-F Irradiation of Seeds

Dry seeds of carrots, onions and celery irradiated for short periods at 44.5 mc show higher percentage of germination than those untreated. Theory, optimum exposure and equipment for controlled experiments are described with a view towards possible conveyor-belt method of mass irradiation.

**Imperfect Germination** is a problem for farmer and horticulturist. Various procedures for increasing percentage germination of seeds have been developed. Some of these use hot-bath or radiant heating techniques. Seeds have also been irradiated with selected radio frequencies for internal heating.

Preliminary experiments with a resonant-line, push-pull oscillator using two type 5-250A tetrodes feeding r-f power to a Pyrex beaker containing carrot, onion and celery seeds indicated that the rate of germination is a function of power input, d-c voltage gradient across the seed mass, frequency, time of exposure and state of the seed.

The period of exposure had to be limited to a few seconds. Experiments with the apparatus described below showed that the maximum germination rate was obtained when 103 cc of seed in a 17 x 88-mm Petri dish were irradiated from 10 to 11 seconds; 37.5 cal of r-f energy were introduced per cc of seed at a rate of 14 w per cc across an rms r-f gradient of 340 to 360 v per cm.

These parameters produced external post-irradiation temperatures of between 42 and 50 deg C in various seeds. Higher temperatures were detrimental or even lethal. They may have caused internal temperatures of more than 70 deg C, which can inhibit biochemical systems. The distribution of some sugars in irradiated seeds exhibited a complete reversal from the controls. About 11 to 14 cal per cc were required to double the sugars subject to inverase action at the expense of a proportionate decrease of keto-sugars.

The r-f oscillator used for seed irradiations utilizes a grid-controlled type 3X2500A3 medium-µ triode at 44.5 mc. The seeds can be considered as aggregates of colloids of high viscosity with low r-f skin effects. Therefore, the r-f current passing through the seed is largely composed of the two vectors: \( I_1 = 2n/C,KE \) and \( I_2 = I\tan \delta = I, \cos \theta \).

**R-F Currents**

The in-phase current \( I_1 \) is a function of the bulk capacitive leakage resistances, such as occur in vacuolar fluids with high \( K \) values. The reactive current \( I_2 \) is a function of capacitances across membranes of living cells and between woody cells and large macromolecular complexes of proteins, fats and carbohydrates.

A mass of seeds is a uniform population of units of equal electrical characteristics arranged at random in the electrical field. The potential across this mass is a function of the interelectrode potential, dielectric constant, integrated ellipticity of all seeds and orientation of these ellipsoids in the r-f field. Thus, as shown in Fig. 1, a carrot seed parallel to the field will absorb more energy than one normal to it.

An evaluation of r-f effects on seed germination required quanti-
serves as a cathode-voltage shield and as the cathode r-f coupling. The filament socket is air cooled with a supply pressure of 13 lb per sq in. Load coupling is at the edge of the plate-tuning disk opposite a slot in the cavity wall. The adjustable h-v electrode is supported by two inverted Pyrex U's.

Interelectrode potential and r-f power absorption in the sample were determined indirectly by calculation from the d-c plate and grid potentials. It was assumed that the angle $\theta$ of the r-f current conduction in each cycle remains constant at any d-c plate potential higher than cutoff. This angle was calculated from the d-c plate and grid potentials. Then the rms voltage during the conduction period of each cycle can be found. This rms value was selected in preference to the rms value of the total cycle because the conducting fraction of each cycle determines the power input into the load.

Then the conducting negative...
r-f swing has a potential \( E = E, - E,(41.28/0) \sin(0.0345 \theta) \), where \( E, = r-f \) volts, \( E_0 = d-c \) plate volts, \( E = \) rms volts across the electrodes, and \( \theta = \) angle of current flow. The power input into the sample \( P_s = 5.58 \times 10^{-7} f(E_0/d_s)K_0 \cos \phi (1/s) \), or \( P_{m1} = 16.417 P_s \), and the energy input \( W = P_t (t/4.183) \), where \( P_t \) and \( P_{m1} = r-f \) power in watts per gram or watts per ce of load, \( E, = \) rms potential across the sample, \( d_s = 0.9 \) cm of sample thickness, \( K_0 = \) dielectric constant 3.20 of sample, \( \cos \phi = \) load power factor of 0.090, \( s = \) relative density of sample, and \( f = \) frequency.

Seed temperatures were determined at the exact instant of the end of irradiation by an immersion thermocouple built into a number 26 hypodermic needle by John E. Gullberg of the University of California.

These experiments help to explain inconsistent results of earlier investigators who used frequencies anywhere between 20 and 225 m/c. This range covers energy absorption bands of those macromolecules most common in seeds, as proteins and saccharide polymers. Whenever the period of exposure was less than 15 seconds some increase of the rate of germination occurred, especially when the external seed temperature did not rise more than 30 deg C and not above 60 deg C. Prerequisites for this were anode potentials of more than one kilovolt and consequent high r-f potentials across the load.

Most earlier experiments failed because requisite equipment was unavailable. Further work may concentrate on reducing the exposure period even more and on finding means to increase the rms r-f potential gradient across the seed mass without arcing. For this purpose centimeter waves may be of value. Then the energy input could be raised. There is still the question whether the enhancement of germination rates is part of a universal phenomenon comparable to other well known biological r-f stimulations particularly in r-f therapy. It would also be interesting to know if the biological reaction results solely from the dielectric heating effect or also from some undefined molecular resonance.

REFERENCES


(7) A. M. Gurewitch, Cavity Oscillator Circuits, Electronics 19, p 146, 1946.


Circuit diagram of the radiation equipment includes timer for accurate dosage and safety controls for non-technical personnel.
Bistable multivibrators, such as the one shown in Fig. 1A, can remain quiescent indefinitely with either tube conducting and its opposite cutoff. This characteristic gives the circuit widespread usefulness in digital computers, counters and other pulse circuits.

If the basic circuit is modified as shown in Fig. 1B by addition of a triggering network, it may be switched from one stable state to the other. The transition between stable states is not treated in detail here, but certain factors that are related to the dynamic behavior of a complete circuit, such as minimum time between successive triggers, plate and grid waveforms and coupling capacitors, will be examined later.

The rudimentary circuit shown in Fig. 2A may be designed to insure stability of the stable states under adverse combinations of resistor deviations, supply voltage regulation and vacuum-tube emission deterioration. Since the circuit is symmetrical, it demands nominal symmetry of resistance values for proper operation. The design procedure described yields nominal values of resistance having a specified percentage tolerance, in conjunction with supply voltages $E_{pp}$ and $E_{cc}$ having specified regulation.

**D-C Stability**

The circuit of Fig. 1A will have two stable states if the conducting tube causes the voltage on the opposite grid to fall to cutoff or below, and if the cutoff tube causes the voltage on the opposite grid to rise to some point above cutoff. These two conditions are the basis of the design equations, with the second condition modified to read “the cutoff tube causes the voltage on the opposite grid to rise to zero.” Zero is a more-or-less arbitrarily chosen point which, for all tubes, will insure conduction. It should be noted that although the coupling capacitors are essential for triggering the circuit they have no bearing on the d-c stability.

For a given tube, given resistors $R_1$, $R_2$, $R_3$ and given supply voltages $E_{pp}$ and $E_{cc}$, plate voltages, grid voltages and all currents can be determined. If allowable resistance variation is specified as $z$ percent and the supply variation as $y$ percent, the conditions for d-c stability can be imposed in the form of two equations. One states that under the most adverse combinations of resistance and supply voltages the high grid is at cathode potential, which is assumed to be zero. The other states that under the opposite extremes the low grid is not above cutoff. Since the two conditions prevail in a common circuit, a third
Bistable Multivibrators

Arrangement of flip-flop circuits for reliable operation despite adverse combinations of resistor deviations, supply voltage regulation and loss of tube emission. Guides are given for selecting the proper coupling capacitor and triggering network.

\[
\frac{E_{bb}(1+c) - E_b}{R_1(1-d)} = I_s + \frac{E_b - E_g}{R_2(1-d)} \quad (3)
\]

These equations can be solved for nominal resistances \( R_1, R_2 \) and \( R_3 \). Results are expressed in terms of \( E_{bb}, E_{ee} \), the arbitrary values \( E_b \) and \( I_s \), the specified negative grid voltage \( E_{bb} \), the resistor tolerance \( d \), and the voltage tolerance \( c \).

\[
R_1 = \frac{1}{(1-d)I_s} \left[ \frac{(1+c)E_{bb} - E_b + \left( \frac{1-d}{1+d} \right)^2 \left( 1+c \right) E_{bb} E_g}{E_{ee} - \left( \frac{1-d}{1+d} \right)^2 (1+c) E_{bb}} \right] \quad (4)
\]

\[
R_2 = \frac{E_b - E_g}{(1-d)I_s} \left[ \frac{(1+c)E_{bb} - E_b + \left( \frac{1-d}{1+d} \right)^2 \left( 1+c \right) E_{bb} E_g}{E_{ee} - \left( \frac{1-d}{1+d} \right)^2 (1+c) E_{bb}} \right] \quad (5)
\]

\[
E_{bb} \left( 1+c \right) - E_b = \left( 1-d \right)^2 \left( 1+c \right) E_{bb} E_g + \left( \frac{1-d}{1+d} \right)^2 \left( 1+c \right) E_{bb} E_{ee} - \left( \frac{1-d}{1+d} \right)^2 \left( 1+c \right) E_{bb}\left( E_{bb} - E_b \right) \quad (6)
\]

In order that positive values of resistance for \( R_1, R_2 \) and \( R_3 \) are insured, \( E_{bb} \) must be greater than a certain lower limit, and \( E_{ee} \) must be algebraically less than a certain upper limit. These restrictions on \( E_{ee} \) and \( E_{bb} \) may be written

\[
E_{bb} > \frac{E_b - E_g}{\left( \frac{1-d}{1+d} \right)^2 \left( 1+c \right)} \quad (7)
\]

\[
E_{ee} < \frac{\left( \frac{1-d}{1+d} \right)^2 \left( 1+c \right) E_{bb} E_g}{\left( 1+d \right)(1+c)} \quad (8)
\]

Three equations are thus derived which, when used to select values for \( R_1, R_2 \) and \( R_3 \), will insure that the circuit of Fig. 3 is bistable even.
under the extreme deviations of the resistances and voltages from their nominal values, and even when the tube emission becomes so low that the arbitrarily selected point $E_n$, $I_n$ corresponds to zero bins. By choosing the point $E_n$, $I_n$ deeper in the shaded portion of Fig. 2A, that is, by lowering the ratio of $I_n$ to $E_n$, the design can be made even more conservative, insuring bistability for a long life. This, however, results in larger values for $R_c$, $R_t$ and $R_{es}$ since all resistors are inversely proportional to $I_n$, and therefore it results also in a lower permissible trigger rate.

The actual operating point of a nominal tube is not at $E_n$, $I_n$ but at the intersection of its load line with the nominal zero-bias plate characteristic. Therefore, $I_n$ in the actual circuit is always greater than the arbitrarily chosen value; thus, the point $E_n$, $I_n$ should never be taken at or near the maximum allowable plate current.

**Coupling Capacitor**

The coupling capacitor allows switching between stable states. If it were not present, the reversing impulse would bring both halves to identical conducting states and the final state would be independent of the initial state. A practical way to obtain the proper size of this capacitor is the empirical approach guided by some basic facts.

In order to convey most efficiently the leading edge of the rising plate waveform to the grid of the cutoff tube, the coupling capacitor should be larger than the interelectrode capacitance between grid and cathode of the cutoff tube.

The rate-of-change of the rising plate waveform will affect the size of the coupling capacitor, since a slowly rising plate waveform, due either to high stray capacitance or slowly falling trigger, requires a higher coupling capacitance to pass the rising waveform to the grid of the cutoff tube. The falling plate always drops faster than the ascending plate rises; therefore, it is only necessary to insure that the rising waveform be satisfactorily conveyed to the grid of the cutoff tube.

The first two criteria tend to increase the size of the coupling capacitor. However, although higher capacity increases the certainty of switch-over, it also increases the time required for the rising plate voltage to reach its quiescent value.

**DESIGN PROCEDURE**

In the following expressions resistor tolerance is assumed to be $\pm 10\%$ and the voltage tolerance $e = \pm 5\%$. With $d \approx 10\%$, this means that $5\%$ resistors must be used in the circuit, and that the remaining percentage accounts for the inaccuracy of choosing RMA values different from the calculated value.

**STEP 1** — Select point $E_p$, $I_p$ somewhere below the zero-bias line, keeping in mind that small ratios of $I_p$ to $E_p$ will mean larger resistors (therefore slow triggering rates), and that plate dissipation must not be exceeded by the actual $I_p$, which will always be larger than the chosen value of $I_p$, except when tube emission deteriorates to the extent where $E_p$, $I_p$ is actually the operating point.

**STEP 2** — If the tube being used is a pentode, for a given screen grid voltage obtain the cutoff bias $E_p$. This will be a negative number. If the tube being used is a triode, the cutoff bias varies with plate voltage, and may be approximated by $E_p = -K E_{bb}$. This equation may be plotted using published tube characteristics, and the constant $K$ is obtained as the slope of the line.

**STEP 3** — The lower limit for $E_{bb}$ can now be calculated. For a pentode, $E_{bb} > E_p - 0.576$ and, for a triode, $E_{bb} > E_p - 0.576 - R$.

**STEP 4** — Select a value for $E_{bb}$ greater than the lower limit. The desired plate voltage swing will be a factor in determining this, for it is approximately equal to $E_{bb} - E_b$.

**STEP 5** — The upper limit for $E_{bb}$ may be calculated. For a pentode

$$E_{bb} \leq -0.605 E_b E_{bb} + 0.576 E_{bb}$$

and, for a triode

$$E_{bb} \leq -0.605 K E_{bb}^2$$

If the pentode equation is used, the magnitude of the boundary value always decreases for increasing $E_{bb}$ and, if the triode equation is used, the magnitude of the boundary value decreases with increasing $E_{bb}$ until $E_{bb}$ is twice the value of its lower limit. Then it increases with increasing $E_{bb}$.

**STEP 6** — Select a value for $E_{bb}$ less than the upper boundary. Notice that the boundary is a negative number and that a value must be taken more negative.

**STEP 7** — Calculate the resistance $R_c$, $R_t$ and $R_{es}$ from Eq. 1, 5 and 6. They are,

$$R_c = \frac{1}{E_b} \left[ 0.527 E_{bb} - 1.11 E_b + 0.672 \frac{E_{bb} E_b}{E_{ee}} \right]$$

$$R_t = \frac{E_b - E_p}{I_b} \left[ 0.527 E_{bb} - 1.11 E_b + 0.672 \frac{E_{bb} E_b}{E_{ee}} \right]$$

$$R_{es} = \frac{V_{ee} - 0.95 E_{bb}}{I_b} \left[ 0.431 E_{bb} - 0.91 E_b + 0.552 \frac{E_{bb} E_b}{E_{ee}} \right]$$

These equations may also be used in cases where triodes are employed, simply by substituting the equation $E_p = -K E_{bb}$. From these equations, it can be seen that $R_c$ is independent of $E_{bb}$, however, $R_t$ and $R_{es}$ increase as $E_{bb}$ increases.

Figure 4A is an equivalent circuit of one half of Fig. 1A during the time that the opposite grid is conducting and $R_t$ and the coupling capacitor $C_t$ are essentially clamped.
Pentode

Tube—6AN5 ($E_{cc} = 40$ volts)

$C = \pm 10$ percent

d = $\pm 20$ percent (This permits 10 percent resistors)

**STEP 1**—The point $E_b = 10$ volts, $I_b = 8$ ma was chosen. Since the point is below the knee of the zero-grid-bias characteristic, the plate voltage will be relatively insensitive to the plate load resistor.

**STEP 2**—$E_p = -15$ volts ($E_{cc} = 40$ volts)

**STEP 3**—$E_{bb} > 76.5$ volts (see Eq. 7)

**STEP 4**—$E_{bb}$ was chosen to be 120 volts to give a plate swing of approximately 120 – 10 = 110 volts.

**STEP 5**—$E_{ce} < -45.8$ volts (see Eq. 8)

**STEP 6**—$E_{ce}$ was chosen to be –30 volts.

**STEP 7**—From Eq. 4, 5 and 6

$R_1 = 18,150$ ohms
$R_2 = 75,200$ ohms
$R_3 = 114,200$ ohms

The RMA standard values chosen were

$R_1 = 18,000$ ohms
$R_2 = 75,000$ ohms
$R_3 = 110,000$ ohms

The d-c measurements on this circuit were:

<table>
<thead>
<tr>
<th>Tube 1</th>
<th>Tube 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>High plate voltage</td>
<td>96.5</td>
</tr>
<tr>
<td>Low plate voltage</td>
<td>8.6</td>
</tr>
<tr>
<td>High grid voltage (tube removed)</td>
<td>27.8</td>
</tr>
<tr>
<td>Low grid voltage</td>
<td>-26.6</td>
</tr>
<tr>
<td>Plate swing voltage</td>
<td>87.9</td>
</tr>
</tbody>
</table>

Triode

Tube—12AU7 (cutoff constant $K = 0.1$)

$C = \pm 5$ percent

d = $\pm 10$ percent (This permits 5 percent resistors)

**STEP 1**—From the limit inequality for $E_{cc}$ given by Eq. 8, solve for $E_b$

$$ E_b < \frac{0.665 KE_{ce}^2}{E_{cc}} + E_{bb} (0.576 - K) $$

and by substituting for $E_{bb}$ and $E_{ce}$

$$ E_b < 53.2 \text{ volts.} $$

**STEP 2**—On the 12AU7 plate characteristic curves, choose a point such that $E_b < 53.2 \text{ volts}$ which will lie below the zero bias line. The point chosen was $E_b = 40$ volts, $I_b = 2$ milliamperes.

**STEP 3**—Calculate the three resistors $R_1$, $R_2$, and $R_3$ from Eq. 4, 5 and 6:

$R_1 = 58,000$ ohms
$R_2 = 241,000$ ohms
$R_3 = 202,500$ ohms

The RMA standard values chosen were

$R_1 = 56,000$ ohms
$R_2 = 210,000$ ohms
$R_3 = 200,000$ ohms

With these resistance values, the nominal value of the high grid voltage (with the tube out) was calculated to be

$$ E_{beh} = \frac{R_1 (E_{bb} - E_{ce})}{R_1 + R_2 + R_3} + E_{ce} = 15.6 \text{ volts.} $$

The low grid voltage, for nominal voltages and resistances and the tube operating point at $E_b = 40$ volts, was calculated to be, approximately

$$ E_{beh} = \frac{R_1 (E_{bb} - E_{ce})}{R_1 + R_2 + R_3} + E_{ce} = -22.7 \text{ volts.} $$

For comparison, the measured values on this circuit were as follows:

<table>
<thead>
<tr>
<th>Tube 1</th>
<th>Tube 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>High plate voltage</td>
<td>105</td>
</tr>
<tr>
<td>Low plate voltage</td>
<td>23.6</td>
</tr>
<tr>
<td>High grid voltage (tube removed)</td>
<td>16.5</td>
</tr>
<tr>
<td>Low grid voltage</td>
<td>-30</td>
</tr>
<tr>
<td>Plate swing voltage</td>
<td>81.4</td>
</tr>
</tbody>
</table>

In circuits of this type, it is often desirable to know how far off the nominal values the supply voltages can go and still have stable operation.

Measurements with this 12AU7 triode flip-flop showed that the undamped grid voltage (that is, the potential at the junction of $R_2$ and $R_3$ when the tube is removed) could be brought to zero by lowering the bias supply from –75 volts to –96 volts, a change of 20 percent, or by lowering the B+ supply from 150 volts to 125 volts, a change of 17 percent. Conversely, it was found that to turn on the cutoff tube the bias supply would have to rise to –36 volts, a change of 52 percent, or the B+ supply would have to rise to 190 volts, a change of 21 percent. These results indicate that the design is quite conservative, and stable operation would probably be obtained over wider variations of the supply voltages than those tolerances used in establishing the size of $R_1$, $R_2$, and $R_3$.

Capacitor $C_2$ of Figure 4A is stray capacitance between plate and cathode. From Thévenin's theorem another equivalent circuit, Fig. 4B, can be derived, where

$$ E_{beh} = \frac{R_1}{R_1 + R_2} E_{bb} $$

$$ R_{eq} = \frac{R_1 R_2}{R_1 + R_2} $$

Thus, the rising plate waveform may be approximated by a rising exponential, Fig. 4C, representing

ELECTRONICS—April, 1953
the charging of the coupling and stray capacitances toward the quiescent value of the high plate voltage. The initial sharp rise of the curve is essentially the amplified version of the negative trigger signal on the grid. A break or discontinuity occurs when the opposite grid is driven to conduction, and the coupling capacitor is clamped to ground and effectively shunted across the plate-to-cathode capacitance.

**Triggering Rate**

Minimum time between reversals is affected by the size of the coupling capacitor by virtue of the fact that it is related to the time needed by the coupling capacitor connected to the high plate to discharge to its quiescent low voltage. During this transient, the discharge current passing through $R$, temporarily lowers the voltage on the cutoff grid beyond its steady-state bias. Consequently, if it is desired to reverse the circuit before it completely relaxes, a greater trigger amplitude is needed. To obtain the time constant of the discharge, the equivalent circuit of Fig. 5 is developed, from which it may be written

$$T = R_m C_e$$

where $T$ is the time constant, and

$$R_m = \frac{R_2 \left( R_1 + \frac{R_1 R_T}{R_1 + R_T} \right)}{R_3 + R_1 + \frac{R_1 R_T}{R_1 + R_T}}$$

As a check on the size of the coupling capacitors, connect a trigger circuit to the multivibrator grids. Connect all appendages to the circuit such as cathode-follower grids and resistance voltage dividers. Reduce the trigger amplitude until the multivibrator just fails to flip over. This can be verified by a scope probe on the low plate. If the coupling capacitor is large enough, the trigger amplitude at this critical point should not drive the grid much more than half-way toward cutoff. Should pulses larger than this be needed for triggering, reliable operation will be uncertain when using tubes with reduced $G_m$.

**Trigger Networks**

The trigger network connects to the rudimentary circuit in a symmetrical way and steers the trigger pulse to the proper tube to cause reversal. The trigger is either positive or negative. Positive pulses effect switching by turning on the off tube. Negative pulses turn off the on tube.

Generally, the negative pulse can be smaller than the positive pulse because the on tube amplifies the trigger pulse.

The circuit of Fig. 6A uses large-amplitude negative pulses or steps. If a negative trigger is applied to the capacitor, it will appear attenuated at both plates, but the attenuation is greater at the plate of the conducting tube. Therefore, only a small negative pip passes through the coupling network to the negative grid. The cutoff tube does not attenuate the signal as much and a large negative pulse is applied to the conducting grid. The coupling-circuit time constant is not critical since differentiation of a step wave occurs in the cross-coupling network.

**Smaller Pulses**

The circuit of Fig. 6B takes negative triggers or steps of smaller amplitude. The diodes steer the negative wave to the high plate and thence to the high grid; they also isolate the trigger source from the plate as soon as regeneration starts. If the coupling circuit does not have a sufficiently small time constant compared to the turn-over time, the rising plate will be depressed slightly near the top of its excursion by the negative input waveform.

The input time constant should be small enough compared to the repetition period of the triggers to prevent biasing of the coupling diodes.

Since the high plate is somewhat below $E_0$, the input wave must overcome the differences between the high plate voltage and $E_0$, before passing through the diode.

If thermionic diodes are used, the relation of $R_s$ to $R$, is unimportant. But germanium diodes may have a back resistance, $R_s$, comparable to the plate resistor so that the effective plate resistor is $R_s$ in shunt with $R$, and $R_s$ in series.

The circuit of Fig. 6C takes directly on the grid negative pulses whose duration is short with respect to turnover time. This circuit requires the smallest-amplitude pulses.

If $R_s$ is not small compared to $R$, of a germanium diode, the negative grid will be raised.

---

**Fig. 6**—Flip-flop with triggering network designed for large-amplitude negative pulses or steps (A); for smaller negative pulses (B); and for still smaller negative pulses of short duration (C)
Judicious choice of tube types by television receiver designers can forestall development of cathode interface resistance thereby extending useful life of tubes. Principles apply also to design of mobile radio equipment and electronic computers.

Sleeping sickness, the popular term for cathode interface resistance, has long been a bugbear to computer engineers. This article analyzes its effects in typical television receiver applications.

Interface resistance acts circuit-wise like an inadequately bypassed cathode resistor. It affects primarily high $g_m$ tubes with small cathode areas. In television and i-f stages, interface resistance causes loss of gain; in video amplifiers it causes loss of low-frequency response as well. Interface resistance can also produce malfunctioning in multivibrators and blocking oscillators.

Interface impedance builds up to some degree in all cathodes but reaches rather high values in active cathodes. The resistance compound is barium-ortho-silicate, a semiconductor. The higher the percentage of silicon in the cathode, the greater will be the formation of interface resistance. Interface resistance

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Cathode Area in Cm²</th>
<th>Predicted Interface Resistance in Ohms</th>
<th>Loss of $I_E$ in Percent</th>
<th>Loss of $g_m$ in Percent (h-f)</th>
<th>Normalized Resistance in Ohm-Cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>12AT7</td>
<td>0.270</td>
<td>93</td>
<td>79</td>
<td>163</td>
<td>20</td>
</tr>
<tr>
<td>6B8A</td>
<td>0.335</td>
<td>75</td>
<td>225</td>
<td>375</td>
<td>40</td>
</tr>
<tr>
<td>6AF6</td>
<td>0.215</td>
<td>116</td>
<td>38</td>
<td>380</td>
<td>30</td>
</tr>
<tr>
<td>6AU6</td>
<td>0.740</td>
<td>33</td>
<td>100</td>
<td>165</td>
<td>15</td>
</tr>
<tr>
<td>6CB6</td>
<td>0.199</td>
<td>59</td>
<td>150</td>
<td>230</td>
<td>15</td>
</tr>
<tr>
<td>6H16</td>
<td>0.443</td>
<td>56</td>
<td>108</td>
<td>280</td>
<td>35</td>
</tr>
<tr>
<td>6AH6</td>
<td>0.925</td>
<td>27</td>
<td>81</td>
<td>135</td>
<td>10</td>
</tr>
<tr>
<td>6SN7GT</td>
<td>0.745</td>
<td>33</td>
<td>99</td>
<td>165</td>
<td>5</td>
</tr>
<tr>
<td>12AU7</td>
<td>0.405</td>
<td>62</td>
<td>186</td>
<td>310</td>
<td>10</td>
</tr>
</tbody>
</table>

Column Normalized Resistance in Ohm-Cm²
A 25
B 75
C 125

Note—Regular bias by means of bypassed cathode resistor in every case except 6SN7GT and 12AU7.
varies inversely with cathode area.

Operation with no space current develops higher interface resistance than if space current is drawn. Higher-than-normal operating temperature accelerates formation of interface resistance. However, Fig. 1 shows that, consistent with the negative temperature characteristic of semiconductors, measured interface resistance varies inversely with cathode temperature. 

A barrier capacitance is associated with interface resistance. For our purposes, interface impedance will be treated as a parallel R-C circuit with time constant of 0.2 to 0.5 microsecond.

What It Does

Since operational effects are exactly the same as for an inadequately bypassed cathode resistor, low-frequency sine waves show the effect of added bias and cathode degeneration, while high-frequency sine waves exhibit only the effect of added bias. Waveforms with steep wavefronts have overshoots, a typical result of poor low-frequency response.

It is easy to reach the false conclusion that tube emission is the cause of low transconductance when interface resistance is the actual culprit. Assume we find a 6BQ7A with $g_m$ 30 percent low and emission is suspected. According to curve C, Fig. 2, 30-percent-low $g_m$ indicates a possible interface resistance of 20 ohms. Referring to Fig. 1, if the heater voltage is lowered 1 volt or 8 percent, the interface resistance increases to 75 ohms and the apparent $g_m$ is now 55 percent low. On the other hand, if heater voltage is increased to 6.8 volts, 8 percent high, the interface resistance will drop to 10 ohms and the apparent $g_m$ becomes almost normal. With a transconductance variation of this sort with heater voltage, it is certainly easy to convict the tube of having low emission.

At high frequencies the interface resistance is bypassed and the loss in transconductance is not nearly as severe as Fig. 2 shows. Only d-c degeneration is present. Thus the loss of gain in the presence of interface is actually less than low-frequency transconductance measurements imply.

In the case of waveforms containing steep wavefronts there will be, in addition to the loss of gain, overshoots proportional to the amount the plate current has fallen off as the result of interface development. The percentage decrease in plate current as a function of $R_t$ was also determined for the same tubes. The plate current drop, of course, is not as great as the transconductance drop.

For example, a 6BQ7A with 50 ohms of interface resistance would show an overshoot of 25 percent if a square wave were applied to its grid, and the input signal appropriately increased to give the original output voltage.

Figure 3 shows the plate waveform of a 6AH6 having an interface impedance of 17 ohms and 0.02 microfarad when measured at 6.3 volts heater voltage. The three waveforms are for operation with heater voltages of 5.5, 6.3 and 7 volts and demonstrate the extreme sensitivity of interface resistance to cathode operating temperature.

Application

To obtain actual values of interface resistance, a group of 12SN7GT's, half of which had moderate silicon in the cathode sleeves and half of which had relatively high silicon in the cathode were run for 2,000 hours under various operating conditions, 2,000 hours being representative of a year's operating life for a television set. The results varied so widely that only broad average conclusions could be drawn.

When operated at rated heater voltage and a range of space current of from one to ten milliamperes, both normal and active cathodes developed about the same interface resistance, its normalized value ranging from zero to over 100 ohm-cm². With high-heater-voltage operation, 12 percent high, normal cathodes had about the same range, but the active cathodes were substantially higher, averaging about 125 ohm-cm². There was some indication that interface resistance developed higher values in multivibrator operation.

Using values obtained in this life test we can consider what may happen if such interface resistance values develop in service. Table I shows several common television tubes with assumed normalized interface resistance values of 25, 75 and 125 ohm-cm². Tubes with small cathode areas and high $g_m$ and/or high $\mu$ such as the 6AP4 and 6BQ7A are particularly vulnerable to interface effects. In low-frequency circuits these tubes may lose 80 percent of their $g_m$. Even in the usual h-f or vhf applications, it is entirely possible in 2,000 hours to have the transconductance decreased almost 50 percent by interface effects.

Both the 6SN7GT and the 12AU7 have similar ratings and both have been used in the same type of service, but the 12AU7, because of its smaller cathode area, can develop almost twice as much interface
resistance as the 6SN7GT in the same length of time. In i-f amplifiers also, the tubes with the larger cathodes are the best from a life standpoint.

In 2,000 hours, three 6AU6 i-f amplifiers would be down about 30 percent in gain if 25 ohm-cm² of interface resistance is present. On the other hand, 6BH6's with the same normalized interface would be down 50 percent. Power output tubes and deflection amplifiers generally have large cathodes and low $\mu$, and ordinarily are little affected in usual service by interface resistance.

Video Amplifiers

In video amplifiers, the poor low-frequency response which is the result of interface predicts that black areas turning sharply to grey would have a white trailing edge, while white areas turning to grey would have a black edge. This can be demonstrated by the addition of external capacitance and resistance to simulate interface impedance. However, with typical television signals it was found necessary to use rather high impedance values before such edge effects occurred. Apparently, in the usual television system the high-frequency response is none too good and low values of interface impedance only add a form of high-frequency peaking.

However, with values of 200 ohms in a single-stage video amplifier pentode, it was possible to get edge effects. Also, overshoot on the leading edge of the blanking pulse caused sync to occur sometimes on the blanking rather than the synchronizing pulse, with the result that the picture moved to the left and showed a tendency to vertical instability. However, it is not likely that 200 ohms interface resistance can be developed in 2,000 hours in tubes of this description because of their large cathode areas.

Other Effects

In the usual ringing-coil horizontal multivibrator it was found that when a simulated impedance having a resistance of 300 ohms was used, it was no longer possible to hold sync by the usual front panel controls, and with 400 ohms it was impossible to hold sync with any control. The same 300-ohm figure gave similar results in the usual syncro-guide circuit. In neither case was it found that the time constant of the impedance was of any importance.

Values of 300 ohms are entirely possible in some tubes used in multivibrator and syncro-guide service, particularly if the set runs a great deal on high line voltage and is occasionally called upon to operate at low line. Vertical blocking oscillators were found to be quite unaffected by cathode impedance. For low values of simulated resistance the vertical size actually increased, and it was necessary to get up to values of 800 to 1,000 ohms before performance suffered.

Real difficulty with interface resistance is most likely to occur when the tubes operate at high heater voltage during most of their life but are called upon occasionally to operate at low voltage. The classic case of this is the automobile receiver where the source voltage with the generator charging may be 7 volts with perhaps 6.8 volts at the tube heaters. However, operation is also expected without the battery charging and with tube heaters working at 5.5 volts, where any interface resistance which may have been developed is increased about three times.

Fortunately, long tube life is not expected in auto sets; 500 hours at full 6.8-volt represents many thousand miles of normal use. However, there are other mobile applications such as police and taxicab sets where 2,000 hours can be run up in a short time.

References

(2) C. C. Eaglesfield, Life of Valves With Oxide-Coated Cathodes, Electrical Comm., June 1951.

FIG. 3—Plate-voltage waveform for 6AH6 with 50 kc square-wave excitation. Overshoots due to cathode interface resistance are noted as heater voltage is reduced.
Electrodes take bioelectric potentials from arm muscle and frontal lobe of brain to measure strain and effort of subject exercising on isometric dynamometer

Bioelectric Integrator

Circuit quantifies bioelectric potential from muscles to measure strain and effort of human subjects performing various tasks. Data obtained may aid engineers in reducing operator fatigue and inefficiency through proper design of instrument controls.

Electronic measuring instruments are widely used in experimental psychology. Work, fatigue, effort, sensory-motor control and even mental attitude can be better understood from measurement of bioelectric potentials taken from human subjects.

Importance of measuring strain and effort was suggested by an Air Force research assignment the goal of which was to design machines and instruments better adapted to the characteristics of human operators.

Although the Air Force project was restricted to measurement of speed and error when instrument controls were changed in various experimental ways, it was felt that measurement of strain and effort would be a valuable addition to speed and error data. A direct index of strain and effort can be obtained by recording the bioelectric effects of the muscles used.

Amplification

Electrical output of warm-blooded tissue taken from the surface of the skin varies, after conduction losses, from 10 to 500 microvolts depending upon the size of the pickup electrode. This output is a summation of the activity of millions of body cells acting generally in unsynchronized bursts of volley impulses. Frequency analysis show that frequencies from \( \frac{1}{2} \) to 5,000 cps are involved.

Three similar instruments are commonly used for amplification of bioelectric potentials: the electrocardiograph for making tracings of heart action; the electroencephalograph for making tracings generally called brain waves; and the electromyograph for making tracings from the bioelectric output of muscles. A commercial instrument is now available that can be used for all three functions merely by adjusting calibrated filter networks to pass the characteristic dominant frequencies found in each.

Most commercial instruments have been built to yield paper tracings that discriminate severely against higher frequencies, and
Gages Strain and Effort

By ADELBERT FORD
Department of Psychology
Lehigh University
Bethlehem, Pa.

from such data only qualitative interpretations are generally possible. On the basis of such recordings the alpha and beta brain waves were discovered. However, custom-made assemblies have included cathode-ray tube photography and these have produced tracings of the higher frequencies complicated only by the problem of noise. Amplification to a million times is often needed.

Integration

Bioelectric output may be quantified by securing the integral of the complex potential waveform. Earlier instrumentation for summing the area under the amplified bioelectric output curve provided a

EASIER KNOB-TWISTING

Design of controls can be as important to the performance of electronic equipment as design of circuits.

Poorly designed controls create operator fatigue that can lead to inefficient operation and substandard performance of the man-machine team.

After World War II, the Air Force began to study radar operator’s speed versus error with a view to improving the design of knobs used for linear scale settings. The operator ranged on targets displayed on an A-scope simulator. His speed and errors were recorded and correlated with changes made in range-dial diameter, dial friction and ratio of range-step travel to dial rotation.

Results suggested that a direct measure of strain and effort would be a valuable addition to speed versus error data.

It now appears that both physical and mental strain and effort may be quantified. Such data may soon enable equipment designers to tailor instruments to fit best the characteristics of the average operator.
series of \( \frac{1}{4} \)-second integrations registered on photographs of a crt face.

The instrument described is capable of summing a record three minutes or longer in duration or any fraction of this time. Output is measured directly by a vacuum-tube voltmeter.

To record accurately the smallest electrical effects from subjects in a completely resting state, the assembly is housed in a double-shielded laboratory.

Figure 1 is a block diagram of the instrumentation used with the bioelectric integrator. The eeg, ekg and emg are combined in a standard instrument for making tracings on paper.

The integrator is a four-channel system such that the output from four pairs of electrodes can be integrated simultaneously in four parallel channels. Push-pull amplification and integration are used.

The outer shield of the subject's room is of sheet steel; the inner shield is a copper net. Windows and lamp openings are covered with two layers of electrically conduc- tive glass, continuous with the shielding. The shielding properties of this glass are such that a subject's electrode, held a foot away from a tungsten lamp will not gather appreciable radiation.

**Operation**

A given channel, beginning with the human subject, is divided at junction \( J \), one line running by shielded cable through the wall to the eeg, ekg or emg, where paper tracings are made with a signal marker superimposed to show the exact time duration for which the integrator computes its answer. If an unusual curve should appear, the paper tracing can often show the reason for the unexpected answer.

The other branch from \( J \) goes to a battery-operated preamplifier equipped with filter controls that can provide either broad-band amplification or selective amplification of selected frequency components. The output goes then by shielded cable to the integrator and a double-gun crt whose face can be photographed on continuously moving film.

**Timing**

Intervals over which bioelectric potential is integrated are governed by a timer consisting of a synchronous motor geared to a cam and microswitch system. The relays in the integrator can be opened and closed for a large number of different time intervals selected by changing the gears and cams.

Marks are placed on both the paper tracing and the crt film to show the portion of the curve integrated. The timing control also controls a camera that photographs the vacuum-tube voltmeter dial to record on 16-mm microfilm the result of each integration.

For example, in present experiments, a subject lying flat on his back with no voluntary body movement begins his task of mental computation. A series of 5-second samples accurate to \( \pm 0.002 \) second is taken during a three-minute period without the subject's knowledge. During a rest period of comparable time, the subject's basal electrical potential is taken for comparison.

**Circuit Details**

Amplified bioelectric potentials run through a full wave rectifier into the R-C integrator. The input from the bioelectric amplifiers is applied to \( R \) by closing the switch. The rate of charging of the capacitor is determined, for a given voltage, by the value of \( R \) and is relatively linear if the charge at \( C \) is held well below maximum value. Provision is made for increasing the value of \( R \) to allow integrations to be made over longer periods. The value of \( C \) must be large, 50.0 microfarads for this instrument.

The value of the capacitor charge is given by \( Q = C \cdot V \) where \( Q \) is in microcoulombs, \( C \) is in microfarads and \( V \) in microvolts. Since the capacitors in the integrator are fixed, charge can be measured with a vacuum-tube voltmeter. The capacitor plates are shorted after each integration.

Figure 2 shows one of the four integrator channels schematically. Input is from the preamplifier in the subject's room. While this diagram shows one stage of R-C amplification preceding the full-wave rectifier, provision is made for switching in an additional stage of amplification when dealing with unusually low bioelectric output.

Output switches are relay controlled by the synchronous timer. The step-resistance is varied by a dial calibrated in approximate time intervals during which integration is expected to be carried on. Charge on the capacitor is measured by a vtm having an input resistance of approximately six megohms. Although the capacitor is an oil-filled, low-loss type, dielectric losses are such that the meter must be photographed within the first two seconds to avoid drift.

**References**


UHF Grid-Dip Meter

Permits determining the approximate tuning of filters and amplifiers, frequency of spurious resonance, values of circuit components and approximate value of Q at frequencies between 390 and 1,000 megacycles

By A. E. HYLAS and W. V. TYMINSKI

A tunable oscillator, coupled inductively or capacitively to circuits under test, comprises the usual grid-dip meter. Loose coupling between the meter and the circuits under test is desirable for accuracy, and implicit in the procedure is that the distance between them be a small fraction of a wavelength.

The conventional circuit used for this application is a modified Colpitts oscillator employing capacitance tuning between plate and grid. As operation at higher frequencies is attempted, the required external inductance becomes so small, both physically and electrically, that it is difficult to couple the oscillator to circuits under test.

The upper frequency limit of most commercial meters employing shunt capacitance tuning is approximately 400 mc. With the allocation of tv broadcasting service in the band between 470 and 890 mc, extension of the grid-dip meter technique to this region is found to be desirable.

Extension of this range requires operation of tubes above their self-resonant frequency. Another design consideration is that the coupling point remain at a fixed position as the frequency is varied, and also that this coupling point be readily available.

Figure 1 shows several possible schemes for tuning a uhf oscillator. The inductive tuning shown in Fig. 1B limits operation to frequencies below the self-resonant frequency of the oscillator.

Pettit has shown that series capacitance tuning, as indicated in Fig. 1C, extends the range of oscillators above their self-resonant frequency. In this particular circuit, variation of the maximum-current position with frequency does not lend itself easily to grid-dip-meter applications. A re-arrangement of the series capacitance into a balanced circuit, as shown in Fig. 1D, provides a maximum current point, the location of which remains fixed with tuning. Figure 1E has similar characteristics and will be considered later. Both balanced circuits satisfy the essential requirements mentioned, operation of available oscillator tubes above their self-resonant frequency and a fixed coupling point with frequency.

Circuit Analysis

To determine the feasibility of balanced series tuning using reasonable values of capacitance, an analysis was made to determine the length and number of probes necessary to cover the range of approximately 400 to 1,000 mc. Figure 2 shows the equivalent circuit of an oscillator employing balanced series capacitance tuning. The tube is represented by a capacitance-loaded transmission line with bb' being the plate and grid terminals of the tube and the length of line between bb' and aa' is the necessary connection between the tube and the tuned circuit. The equivalent capacitance of the tube is C, and the length of the external probe is l. A condition for resonance at aa' is

\[ X_T + X_D = 0 \] (1)

By substituting the reactances as determined by transmission line

---

**FIG. 1—Several methods of tuning a uhf oscillator**
theory where

\[ X_T = \frac{1}{j\omega C_1} + jZ_1 \tan \beta Z \]

and letting \( C = k_1 C_0 \), \( 0 = \frac{1}{Z_2} \tan \beta Z \)

\[ X_T = \frac{1}{j\omega C_0} + jZ_1 \tan \beta Z \]

Eq. 1 may be solved for the reciprocal of \( k_0 \)

\[ k_0 = \left( \frac{Z_1}{Z_2} \right) \frac{\tan \alpha x + \frac{x}{\tan \beta z - 1}}{\frac{\tan \beta z + 1}{x}} \]  

(2)

When a particular tube is employed, the constants of Eq. 2 may be determined and a plot of \( k_0 = f(x) \) may be plotted. For an oscillator employing balanced series tuning and a 6AF4, the constants are \( C_s = 2.27 \mu F \), \( f_0 = \frac{\omega_0}{2\pi} = 452 \times 10^4 \) cycles and \( b = 0.296 \).

By setting an upper frequency limit and a minimum capacitance, the probe length \( l \) can be determined. For a maximum frequency of 975 mc (\( x = 2.16 \)) and a minimum capacitance of 1.2 \( \mu F \) (\( k_1 = 0.265 \)), a probe length \( l \) of 1.9 in. (\( a = 0.462 \)) is obtained.

For an upper frequency limit of 700 mc (\( x = 1.55 \)), a probe length of 3.2 in. is required. A plot of Eq. 3 showing the variation of \( k_0 \) with frequency for the two probes is shown in Fig. 3. As the tuning capacitance becomes very large, the frequency changes slowly. If the capacitance were infinite, probe 2 would tune to 455 mc and probe 1 to 372 mc.

Although a frequency range from approximately 390 to 1,000 mc would be preferred, several practical considerations dictated 425 and 975-mc limits for this particular arrangement. High-frequency operation was limited to 975 mc because previous experience with the 6AF4 showed that operation above this frequency is marginal if the maximum plate dissipation is not to be exceeded. The lower limit of 425 mc was used because the longer probes necessary for operation at lower frequencies were subject to multiple-mode operation.

An experimental model of a grid dip meter employing balanced series capacitors and the probe lengths calculated is shown in one photograph. The two series capacitors are ceramic trimmers with a nominal range of 2 to 12 \( \mu F \) and a measured variation of 1.2 to 16 \( \mu F \). The lead length of these capacitors was considered as part of the transmission line.

A plot of the variation of grid current with frequency for this arrangement is shown in Fig. 4. The 430 to 700-mc range for probe 1 and the 510 to 975-mc range for probe 2 are in close agreement with the calculated values. The variation of grid current is greater than would be desired, but is still within useful limits.

Since a special capacitor would
have to be built for the grid-dip meter, an analysis was made to determine the feasibility of using both shunt and series tuning to cover a wider range of frequencies with a single probe. The resonant condition for this circuit at aa’ as shown in Fig. 5 is

$$X_f + X_p = 0$$  
(3)

where

$$X_f = \frac{1}{X_p} = \frac{1}{X_m}$$

and

$$X_m = \frac{1}{j \omega C_m}$$

Using the same relationship as indicated for Eq. 1, Eq. 3 may be solved for the reciprocal of $k$, and

$$\frac{1}{k} = \left( \frac{Z_a}{Z_{in}} \right) z \tan az + \frac{1}{z \tan bx - 1}$$  
(4)

where

$$k_1 = \frac{C_a}{C_0}$$

The variation of $k_1$ with frequency for series tuning ($k_s = 0$), is shown as the dotted line in Fig. 6. The solid curve shows a desired variation of $k$ as a function of frequency and the curve in the lower left-hand corner indicates the necessary value of shunt capacitance in the form of $k_s$ versus frequency. In the shunt-series tuning illustrated, no parallel capacitance is added until a frequency of 700 mc is reached so as not to affect operation at the upper end of the band.

A simple air-dielectric shunt and series capacitor was built for the grid-dip meter shown in the second photograph. While this capacitor arrangement is simple to fabricate, it has the disadvantage that the effective transmission-line length is increased as the series capacitance decreases, thus reducing the probe length and frequency range. Series variation is from approximately $\frac{1}{4}$ to 20 $\mu$pf, and the shunt variation from 0 - 2 $\mu$pf. This unit uses the 6F4 to provide more output power at the high end of the band, and the tube and its associated circuits are mounted on a movable carriage which may be translated in motion to vary the series capacitance.

The complete, enclosed unit can be used with commercial grid-dip-meter power supplies and extends grid-dip-meter techniques to over 1,000 mc. As in conventional grid-dip-meter technique, the stationary maximum current point of the probe should be coupled to maximum current points in circuits under test. For coupling into high-impedance points, voltage probes consisting of open lines may be used.

Coupling to cavities may present some difficulties if the maximum current point is not readily accessible. In measurements of this type, it is necessary to provide a hole at the maximum current point so that the probe can be coupled to the H field of the cavity. Here the small width of the probe is a definite advantage.

The meter described has been found useful in uhf development work and appears to provide a solution for the extension of the grid-dip-meter technique to over 1,000 mc. The assistance of Herbert Colomy in devising the mechanical arrangements and building the developmental models is gratefully acknowledged.

**REFERENCE**

Production-Line Gas Test for Picture Tubes

By R. E. Ostrowski
Tube Department
General Electric Co.
Syracuse, N. Y.

As a check of quality, manufacturers of cathode-ray tubes use JAN specifications based on the gas ratio, designated as \((I_e - I_k) / I_k\), where \(I_e\) is grid No. 2 current in ma, \(I_k\) is gas current in \(\mu\)a and \(I_k\) is leakage current in \(\mu\)a. For \(I_k\), \(E_v = +25v\) and \(E_o = 0v\); for \(I_e\), \(E_v = -25v\) and \(E_o = 0v\); for \(I_e\), \(E_v = -25v\) and \(E_o = -70v\). For all three, \(E_o = 250v\). \(I_e\) is read within 10 seconds of reversal of \(E_v\).

A circuit typical of that used for measuring gas ratio is shown in Fig. 1. When operated to read ion current, this circuit resembles that of an ionization gage, with the picture tube replacing the gage tube. With this circuit more sensitive metering is required than is used in the ionization-gage circuit. The cathode current is in the order of 1 ma instead of 10 ma, and ion currents may be as low as 0.01 \(\mu\)a or less for a good tube instead of 0.1 \(\mu\)a. Leakages in the cathode-ray tube are even more critical than in the ionization gage and must be taken into consideration.

Using zero-bias emission, gas currents will vary according to gas pressure and beam current. By dividing the numerator of the gas ratio formula by the grid No. 2 current the resultant ratio is in microamperes of ion current to milliamperes of electron current. Since at pressures of less than one micron the ion current is proportional to the gas pressure and the number of ions formed by collisions is proportional to the electron beam current, the gas ratio is a constant regardless of the emission current ranges available in present-day cathode-ray picture tubes. This fact is brought out by the curves in Fig. 2. Tube A is an excellent tube with respect to gas content, having a gas ratio of 0.016. The maximum limit for an acceptable tube is in the order of 0.25. Tube B is not quite as good as A but is still satisfactory, with a gas ratio of 0.074. Tube C, however, has a gas ratio of about 2.2 and is well outside the satisfactory limit, even though the linearity still exists. This tube, while exhibiting poor gas-ratio readings, has within it a vacuum of about 0.2 micron. This indicates how important it is to maintain high vacua in picture tubes.

To determine sources of gas molecules and ions, the tube may be checked for gas by means of an attached ionization gage before it is operated with a raster upon the screen, checked again with a pattern on the middle of the screen, then checked with the raster overscanning the screen so the electron beam is striking the walls of the glass bulb. The electron beam bombarding these various surfaces results in the striking the walls of the glass bulb. The electron beam bombarding these various surfaces results in the striking the walls of the glass bulb. The electron beam bombarding these various surfaces results in the striking the walls of the glass bulb. The electron beam bombarding these various surfaces results in...
Gas-buggy test unit used at Electronics Park plant to check for gas in tube and leakage between elements, at rate of one tube per minute. Four tubes are connected at a time so that three are being preheated while the fourth is checked. Tubes are aged for several days in storage before this final checkup.

FIG. 2—Gas ratio for any given tube is a constant regardless of emission when gas current in µa is plotted vertically against cathode current in µa.

FIG. 3—Production-type gas ratio test.

in gas and ion emission which affects tube operation adversely.

With this arrangement a number of gas-ratio readings were compared to those of the ionization gage. It was found that the gas pressure in microns was equal to the gas ratio divided by a factor of approximately 10. The significance of this comparison is clouded by the fact that there may be ions derived from sources other than residual gases when measuring gas ratio. Since any ions could be detrimental to the satisfactory performance of the tube, it appears that the gas-ratio method is a test indicative of tube quality.

Production Gas Testing

Figure 3 is a circuit diagram of a semiautomatic means of measuring gas ratio which is particularly applicable to production testing. Regulator tube \( V_1 \) controls the voltage on grid No. 1 of cathode-ray tube \( V_0 \). The regulator tube derives its signal from a voltage divider whose output is proportional to the cathode current of the picture tube under test. The level of this signal may be varied by \( R_e \).

By proper adjustment of \( R_e \) and \( R_c \), the electron current in the cathode-ray tube may be arbitrarily selected and other tubes of the same type will automatically be set at this value of current. If the tube to be tested delivers more than the pre-set amount of current, the control grid of \( V_0 \) becomes more positive, causing the plate voltage to decrease. This lowers the grid voltage on the cathode-ray tube and tends to reduce the electron current to the proper value.

Ions attracted to the negative second anode result in a current which develops a voltage across the 1-meg precision resistor and causes a deflection of the vacuum-tube voltmeter. The meter may be calibrated in terms of gas ratio where \( I_p \) is the figure for electron current as set up by \( R_e \) and \( R_c \). The vacuum-tube voltmeter circuit compensates for leakage currents.
Miniaturization of

Use of smaller window than usual in laminations reduces space and weight 30 percent and cuts power losses about 20 percent for same temperature rise. New calculation chart speeds design of optimum chokes using standard cores, and applies also to single-ended audio transformers

POWER SUPPLIES for airborne equipment frequently become excessively large and weighty when designed by standard methods. To maintain well-engineered designs and concurrently minimize weight and space, the problem of miniaturization of power supplies and their associated components has been investigated. To incorporate questions of weight into the design of power supplies, it was necessary to conduct a survey encompassing the functions of inductivity, resistance, size and temperature rise of filter chokes. The information presented herein is a preliminary synopsis of this miniaturization program.

Filter Choke Heating

The problem of miniaturizing any electronic equipment ultimately leads to an investigation of the equipment's heat dissipation. For filter chokes, this starts with the basic iron-core inductor formula

\[ L = 1.256 \times 10^{-8} N^2 K \]

\[ K = a_1 \mu (l_1 + l_2\mu) \]

where \( N \) is the number of turns, \( a_1 \) is iron-core cross-section in sq cm, \( l_1 \) is length of magnetic path in cm, \( l_2 \) is length of airgap in cm and \( \mu \) is initial relative permeability. One part of the formula is governed by the coil \((N)\) and one depends on the shape of the iron core \((K)\). However, the two terms are not independent. The number of turns \( N \) depends on the window space of the iron core, and \( K \) is a function of ampere-turns \( AT \).

Assuming now a certain shape of iron core (standard lamination with square core), \( K \) becomes only a function of \( \mu \) and \( l_4 \). As \( \mu \) is a function of \( l_4 \) and \( AT \), \( K \) can be expressed in terms of \( l_4 \) and \( AT \). \( K \) goes through a maximum when \( l_4 \) is varied and \( AT \) is kept constant. These maxima of optimum values of \( K \) are the only points which are of interest for further calculations, hence \( K_{opt} \) can be expressed in terms of \( AT \) only. At the same time, the optimum value of \( l_4 \) has a direct relation to \( AT \).

Consider now the power losses \( P_{cu} \) which determine the temperature rise of a certain size of choke.

\[ P_{cu} = \frac{I^2 R}{W} \]

where \( I \) is direct current, \( l_4 \) is average length of one turn in cm, \( \zeta \) is specific resistance in ohm-cm, \( W \) is window area of iron core in sq cm and \( \xi \) is filling factor (copper area — window area).

Repeating \( N \) in Eq. 1 by its equivalent in Eq. 2 and rearranging to put all variable quantities to the left and the core constants to the right side gives

\[ PL = 1.256 \times 10^{-8} \frac{P_{cu} W \xi}{l_4 \zeta} K l_{cu} \]

It has been shown earlier that \( K \) is a function of \( AT \) only. Equation 2, however, gives a direct relation between \( P_{cu} \) and \((IN)^\prime\) which allows the expression of \( K \) in terms of \( P_{cu} \).

The term on the left side has the dimension of an energy, hence the problem of filter chokes is a problem of storing energy. The amount of energy which can be stored depends mainly on the permissible losses \( P_{cu} \) and on some technological properties of the iron core \((K)\) and the coil \((\xi)\).

Miniaturization Procedures

Equation 3 represents the key to miniaturization. It is apparent that an increase of \( P_{cu} \) although resulting in higher coil temperatures, is most beneficial. However, the problem arises whether to remove the additionally produced heat by means of forced cooling, or to run the coils at higher temperatures. The temperature limit is imposed today by the insulating material, which in the case of silicone compounds can resist temperatures up to 250°C. There is not much reason for trying to pass this limit because of a rapid drop in the permeability of the iron core above 300°C (Curie point 770°C) and an appreciable increase in the copper resistance. For iron alloys and ferrites, the Curie point is generally much lower and the situation is even worse.

Another angle of attack is the filling factor, which is as low as 15 percent in conservative coils. By using random-wound coils, it seems possible to obtain a filling factor close to 50 percent.

The factor \( K \) depends on the core material and on the shape of the core. Since most of the energy stored in a choke is located in the

---

**FIG. 1—Lamination shape and dimensions for standard square-stack core**

---

April, 1953 — ELECTRONICS

www.americanradiohistory.com
airgap in the form of a magnetic field, the inductivity of the choke becomes higher as the saturation becomes greater and the cross-section of the airgap becomes larger.

The only function of the iron core is to provide the airgap with a maximum flux for a given number of amperes turns on the coil. This is done best with a core material which combines a high magnetic induction with a reasonable initial permeability (about 50 and over). Silicon steel is one of the best materials in this respect, hence the calculation chart refers to such cores.

**Core Lamination Shape**

The following comparison of different core shapes is done with the assumption that the coil diameter, which determines the permissible heat dissipation, is kept constant and the heat produced in the coil is taken as a parameter.

Substituting $AT$ for $IN$ in Eq. 2, then substituting for window area $W$ and airgap $l_a$, the expressions of Fig. 1 give an equation for $AT$ as the first step in expressing $PL$ as a function of $a/d$ and the copper losses:

$$\text{Eqn. 4}$$

$$(AT)^2 = \frac{P_{cu} a b (1 - a/d)}{\tau (s - \pi)(a/d) + \pi}$$

$$AT = \sqrt{\frac{P_{cu} b a}{\tau}} \times \frac{b}{z}$$

The calculation chart in this article gives the relation between $AT$ and $PL$ for one ratio of $a/d$, namely $a/d = 0.45$ for EI-21 cores. Comparing two arbitrarily chosen core shapes with the same magnetic path length, which is approximately the case for the choke under investigation, gives

$$PL = 1.3 L_n \frac{a^2}{a_d^2}$$

With constant magnetic path length, the thickness of the airgap remains the same, and the energy content $PL$ of the derived core represents again an optimum value.

Equations 4 and 5 permit plotting $PL = f(a/d)$ as shown for silicone steel in Fig. 2.

The parameter $\beta$ is proportional to $P_{cu}$; as will be seen later, $\beta = 1$ means a temperature rise of 24°C for average coil construction.

Figure 2 shows that an optimum core shape is reached at about $a/d = 0.65$; this value is not critical, and it does not depend on $\beta$, or in other words, on the power losses $P_{cu}$. The inductivity at $a = 0.65$ $d$ is up to 50 percent higher than with the standard $a = 0.45$ $d$. This means that for a given inductivity the size of the choke can be reduced by 33 percent.

**Stack Thickness**

An investigation made to find a favorable stack thickness showed that the ratio of $PL$ to weight is practically independent of the stack thickness. This permits the selection of core dimensions to give square cores, which are most suitable from the point of view of winding technique.

**Calculation Chart**

The principles outlined have been used to develop the calculation chart in Fig. 3 for chokes with standard iron cores. Starting with the three fundamental quantities: inductivity $L$, direct current $i$ and the permissible temperature rise $\Delta T$, the optimum size and airgap, the resistance $R$ and all specifications of the coil are easily determined with this method.

The chart makes use of Eq. 3 which shows that maximum $PL$ depends only on $P_{cu}$ and, in other words, on the number of amper-turns. This relation has been empirically evaluated for EI-21 standard core of 3.75-percent silicon steel, and the resulting curve has been expanded to include other core sizes in common use also.

As noted previously, there is for each core a direct relation between airgap and $AT$. It is therefore possible to plot a scale for the airgap along the curve $I \sqrt{L} = f(\Delta T)$.

Introducing a temperature-rise factor, another group of curves (dotted lines) can be plotted which connect the points of equal temperature rise for different sizes of chokes. This factor is defined as

$$\beta = \frac{(AT)^2}{\frac{L_n}{W} \times 10^4}$$

where $O$ is the surface of the coil; $\beta$ depends on the core size, but not on the type of winding used.

The actual hotpoint temperature rise $\Delta T$ is found from

$$\Delta T = \frac{\beta}{\xi_0} \times 10^4$$

where $x$ is the heat transfer coefficient in $(W_{cu}^{-1})$ (°C') between the hotpoint and the surrounding medium. Heat measurements on random-wound coils with natural convection cooling lead to

$$\frac{1}{\xi_0} \times 10^4 = 24°C$$

The filling factor $i$ is in average practice about 0.3 to 0.35, and $x$ ranges from 2.4 to 2.1 $\times 10^7$. The first value is valid for small sizes, the second for large ones. The product $i \times x$ stays fairly constant.

The calculation of the coil specifications is simplified by introducing two quantities, $S$ and $T$, which are characteristic constants for each core dimension:

$$T = F \frac{a}{\pi} \frac{4}{\xi W}$$

$$S = i_{cu} \frac{a}{\xi W}$$
FIG. 3—Calculation chart for chokes using 7-mil laminations of 4-percent silicon steel with square stack. Dash-dotted lines show solution worked out for Example 1, and long dashed lines apply to Example 2.
where \( F \) is the ratio of diameter \( \phi \) for insulated wire to \( \phi \) for bare wire.

**Use of Calculation Chart**

*Step 1.* To calculate size and coil data of a choke, assume first the permissible hotpoint temperature rise \( \Delta t \) by subtracting the ambient temperature from the maximum permissible temperature (90°C to 110°C for average construction). The temperature rise factor \( \beta \) is obtained from Eq. 7 as

\[
\beta = \frac{\Delta t}{(10^6 \cdot \tau / L)}
\]

where \( 10^6 \cdot \tau / L \approx 24°C \) for average construction (randomly wound heavy enameled wire).

*Step 2.* Find \( I / L \), where \( I \) = direct current in amperes and \( L \) = wanted inductivity in henrys. Now find on Fig. 3 for a given \( I / L \) and temperature rise factor \( \beta \) the core size and the required amper-turns (\( AT^o \)) as well as the airgap dimensions.

*Step 3.* Determine the number of turns from \( N = AT / L_0 \).

*Step 4.* Determine the approximate coil resistance from \( R = SN^2 \) where \( S \) is a constant depending onchoke size, as follows:

<table>
<thead>
<tr>
<th>Core</th>
<th>Value of ( S^* )</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 4-25</td>
<td>0.23 \times 10^{-4}</td>
</tr>
<tr>
<td>EE 26-27</td>
<td>0.31 \times 10^{-4}</td>
</tr>
<tr>
<td>EI 21</td>
<td>0.21 \times 10^{-4}</td>
</tr>
<tr>
<td>EI 70</td>
<td>0.20 \times 10^{-4}</td>
</tr>
<tr>
<td>EI 100</td>
<td>0.17 \times 10^{-4}</td>
</tr>
<tr>
<td>EI 125</td>
<td>0.11 \times 10^{-4}</td>
</tr>
</tbody>
</table>

*Based on \( S = 1.75 \times 10^{-4} \) ohm-em.

If necessary, choose a larger size of choke for lower resistance.

*Step 5.* Calculate wire diameter from \( \phi = T / \sqrt{N} \), where \( \phi \) is the diameter in mils with insulation and \( T \) is a core constant, as follows:

<table>
<thead>
<tr>
<th>Core</th>
<th>Value of ( T^\circ )</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 4-25</td>
<td>256 mils</td>
</tr>
<tr>
<td>EE 26-27</td>
<td>300 mils</td>
</tr>
<tr>
<td>EI 21</td>
<td>366 mils</td>
</tr>
<tr>
<td>EI 70</td>
<td>472 mils</td>
</tr>
<tr>
<td>EI 100</td>
<td>636 mils</td>
</tr>
<tr>
<td>EI 125</td>
<td>780 mils</td>
</tr>
</tbody>
</table>

Choose the next smaller wire size from a standard wire chart (Table 1).

*Step 6.* Calculate coil resistance from \( R = N \cdot \Delta R_{/1,000} \), where \( R \) = resistance of 1,000 feet of wire and \( \Delta R_{/1,000} \) = average length of one turn in feet, as follows:

<table>
<thead>
<tr>
<th>Core</th>
<th>Value of ( \Delta R_{/1,000} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 4-25</td>
<td>0.148 ft</td>
</tr>
<tr>
<td>EE 26-27</td>
<td>0.19 ft</td>
</tr>
<tr>
<td>EI 21</td>
<td>0.25 ft</td>
</tr>
<tr>
<td>EI 70</td>
<td>0.33 ft</td>
</tr>
<tr>
<td>EI 100</td>
<td>0.47 ft</td>
</tr>
<tr>
<td>EI 125</td>
<td>0.68 ft</td>
</tr>
</tbody>
</table>

This calculation chart is suitable only for alternating currents \( I_0 \). lower than 1 percent of the direct current \( I_{\infty} \). For \( I_0/ I_{\infty} > 1 \) percent, the resulting \( L \) is up to 100 percent higher and special charts are needed. The nomogram on the bottom of the chart serves to determine \( N \) and \( R \). Run a straight-edge from \( AT \) through \( I_{\infty} \), to get \( N \), then run the straight-edge from \( N \) through \( S \) to get \( R \).

**Example 2:** Ratings of a high-voltage filter choke are 20 h, 50 ma, ambient temperature 100°C and maximum coil temperature 200°C. Calculate first the value of \( \beta \). Considering that the specific resistance \( \chi \) at 200°C is just about twice the value for copper at room temperature, use 12°C for 10^6 / L. Then \( \beta = 100/12 = 8.3 \). With \( I/V / L = 0.05 \sqrt{20} = 0.244 \), the dashed line on the chart gives: Core size = EE-50 (EI-21 is equivalent); airgap \( l_1 = 18 \) mils; amper-turns = 460; turns \( N = 9,200 \) (for 50 ma); \( R+ = 2,200 \) ohms (for EE-50 core) but this value has to be doubled due to the elevated operating temperature, hence \( R = 4,400 \) ohms; wire size \( \phi = 366/9,200 = 3.8 \) mils.

**Table 1. Wire Table for Choke Design**

<table>
<thead>
<tr>
<th>AWG B&amp;S</th>
<th>Diameter in Inches</th>
<th>Turns per Inch (Formvar)</th>
<th>Ohms per 1,000 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>0.0506</td>
<td>0.0524</td>
<td>0.0538</td>
</tr>
<tr>
<td>17</td>
<td>0.0453</td>
<td>0.0469</td>
<td>0.0482</td>
</tr>
<tr>
<td>18</td>
<td>0.0403</td>
<td>0.0418</td>
<td>0.0431</td>
</tr>
<tr>
<td>19</td>
<td>0.0339</td>
<td>0.0347</td>
<td>0.0366</td>
</tr>
<tr>
<td>20</td>
<td>0.0320</td>
<td>0.0334</td>
<td>0.0356</td>
</tr>
<tr>
<td>21</td>
<td>0.0285</td>
<td>0.0299</td>
<td>0.0310</td>
</tr>
<tr>
<td>22</td>
<td>0.0253</td>
<td>0.0266</td>
<td>0.0277</td>
</tr>
<tr>
<td>23</td>
<td>0.0226</td>
<td>0.0239</td>
<td>0.0249</td>
</tr>
<tr>
<td>24</td>
<td>0.0201</td>
<td>0.0213</td>
<td>0.0223</td>
</tr>
<tr>
<td>25</td>
<td>0.0179</td>
<td>0.0190</td>
<td>0.0200</td>
</tr>
<tr>
<td>26</td>
<td>0.0159</td>
<td>0.0169</td>
<td>0.0179</td>
</tr>
<tr>
<td>27</td>
<td>0.0142</td>
<td>0.0152</td>
<td>0.0161</td>
</tr>
<tr>
<td>28</td>
<td>0.0126</td>
<td>0.0135</td>
<td>0.0143</td>
</tr>
<tr>
<td>29</td>
<td>0.0113</td>
<td>0.0122</td>
<td>0.0131</td>
</tr>
<tr>
<td>30</td>
<td>0.0100</td>
<td>0.0109</td>
<td>0.0116</td>
</tr>
<tr>
<td>31</td>
<td>0.0099</td>
<td>0.0097</td>
<td>0.0104</td>
</tr>
<tr>
<td>32</td>
<td>0.0060</td>
<td>0.0074</td>
<td>0.0089</td>
</tr>
<tr>
<td>33</td>
<td>0.0071</td>
<td>0.0079</td>
<td>0.0084</td>
</tr>
<tr>
<td>34</td>
<td>0.0063</td>
<td>0.0070</td>
<td>0.0075</td>
</tr>
<tr>
<td>35</td>
<td>0.0056</td>
<td>0.0062</td>
<td>0.0067</td>
</tr>
<tr>
<td>36</td>
<td>0.0050</td>
<td>0.0056</td>
<td>0.0060</td>
</tr>
<tr>
<td>37</td>
<td>0.0045</td>
<td>0.0050</td>
<td>0.0054</td>
</tr>
<tr>
<td>38</td>
<td>0.0040</td>
<td>0.0045</td>
<td>0.0048</td>
</tr>
<tr>
<td>39</td>
<td>0.0035</td>
<td>0.0040</td>
<td>0.0042</td>
</tr>
<tr>
<td>40</td>
<td>0.0031</td>
<td>0.0036</td>
<td>0.0038</td>
</tr>
</tbody>
</table>
Nuclear Resonance

Qualitative and quantitative analysis of materials is provided by measuring effect on nuclei of unidirectional magnetic and r-f fields. Test specimen may be in any form, though liquid is most convenient. Continuous measurement is possible.

Physicists of the leading research laboratories have been giving increased attention to nuclear resonance during the past few years.\(^1\)

The art has now advanced to the point where it has been possible to construct engineering instruments having designs based on the new principles evolved. Such instruments are already in use by commercial companies and others engaged in chemical and nuclear research.

Nuclear Resonance

The nuclear resonance field being of comparatively recent origin, many engineers may not be familiar with the phenomenon involved. Nuclear resonance is in reality quite complex, particularly in view of the fact that the exact nature of the nucleus is even now not fully understood and much is still to be learned of its various properties. However; a general idea of the theory of operation may be obtained by taking a simplified viewpoint.

Considering particles at the atomic level, we find that they are composed of a central, relatively heavy, charged nucleus and a number of circulating or orbital electrons. As the nucleus rotates or spins, it creates a magnetic field which may be regarded as being similar to that of a small magnet. In other words, the nucleus has a magnetic moment.

If the nuclei are subjected to a strong external unidirectional magnetic field, for instance that produced between the pole faces of a large electromagnet, the magnetic moments of the nuclei will tend to line up with this field in the same way that a small magnet will orient itself in a strong magnetic field. If these nuclear particles are, in addition, then excited by a radio frequency field that may be created by r-f current in a coil—then, at a certain well-defined frequency, precession of the nuclei will occur. This precession may be compared to the precession of a gyroscope which will precess in a certain direction when an external force couple is applied. The external force couple, in the case of the nuclei, is the r-f field. When the frequency of the field is at nuclear resonance, that is, equal to the precession frequency, a large number of the nuclei will precess in phase. The rotating nuclear magnetic field so produced can then be detected by the voltage that it induces in a small coil placed with its axis perpendicular to the polarizing field.

Precession Frequency

From the foregoing discussion it may be appreciated that the frequency of precession, or the frequency of nuclear resonance will be related to the magnetic moment and spin of the nucleus and the constant magnetic field. Fortunately, the various elements and their isotopes have widely separated resonance frequencies. With a controllable electromagnet, covering a sufficiently wide field range, say 500 to 10,000 gauss, the nuclear precession frequencies may be concentrated in the 2 to 16 megacycle band and thus cover the majority of detectable isotopes.

There is a fundamental equation that relates precession frequency with the isotope and the strength of the polarizing field.

\[
\omega = \gamma H
\]

where \(\omega = 2\pi f\); \(f\) is the precession frequency; \(\gamma\) is a constant which is related to the magnetic moment and spin of the isotope, or the gyromagnetic ratio; and \(H\) is the strength of the polarizing field.

If any two factors of this expression are known the third can be determined. With a known isotope and a measurable frequency, the field can be found. If the field and frequency are known, the isotope can be identified.

![Block diagram shows use of r-f transmitter, receiver and associated equipment](image)

FIG. 1—Block diagram shows use of r-f transmitter, receiver and associated equipment.
Spectrometer

By LEONARD MALLING
Varian Associates
San Carlos, California

It should be mentioned that there are a few isotopes which do not respond to nuclear resonance techniques, because of the particle arrangement of their nuclei. However, most elements have at least one isotope which has spin and magnetic moment and is susceptible to nuclear resonance excitation. The manner in which the various fields are applied to obtain precession will be discussed later in the article.

Sensitivity

Presently constructed instruments can readily detect the deuterium which is present in natural water in an abundance of 0.02 percent in a one or two cubic centimeter sample of water. Sensitivity depends to a considerable extent on the volume of the test sample. A larger sample, other factors being equal, would give a greater signal, as there are more nuclei present. Possibly the only limitation to using really large test samples for greater signals would be in the construction of a sufficiently large magnet for the required polarization of the nuclei in the sample.

Another factor affecting sensitivity is the strength of the polarizing field. By using strong fields and a higher radio-frequency excitation, stronger signals may be picked up by the receiver coil. Large signals are readily obtained from protons and thus large clear signals may be observed when a natural water sample is used due to the high percentage of hydrogen present.

The special advantage of the nuclear resonance technique from a chemical point of view is that samples may under proper circum-
stances be in various chemical and physical forms and that an analysis can be made without changing in any form the properties of the sample. In particular, the method is well adapted to continuous flow observations of chemical processes.

Apparatus Used

With this brief discussion of the general principles of nuclear induction, we can proceed to the description of some of the apparatus that goes to make up a radio-frequency nuclear-resonance spectrometer. Such an instrument, for example, may be used to detect and measure the abundance of isotopes that are present in various substances. The instrument is particularly applicable to measurements and investigations of liquid samples.

The photograph shows a typical laboratory setup for making measurements on liquid samples. The electromagnet used for polarizing the nuclei is in the center of the picture. The sample in the test tube is about to be placed in the sample probe, which for convenience of insertion may be withdrawn from the magnetic pole pieces. During the measurement, the sample is slid to the center of the large circular pole faces.

The electromagnet is controlled by the unit to the right which has all the necessary control features required for producing the required strength of fields. It is necessary to hold the field to a very constant value during nuclear tests as the precession frequency is directly dependent on the value of the magnetic field. While the techniques of obtaining very constant radio frequencies are well established, techniques for establishing corresponding magnetic fields of the same order of stability have only recently been established. Highly regulated electronic stabilizers are used to provide the necessary stability of the electromagnetic field for making measurements to the desired accuracy.

Stabilization

Complete stabilization of the magnetic field to any desired degree can be achieved by use of special nuclear resonance methods; in particular, by the use of a nuclear resonance fluxmeter which will hold the magnetic field to the same tolerance as it is possible to hold a given radio frequency, where such an accuracy of field is required for a
through modulated netic polarizing in such cable, to a cession placed coaxial contained sample. The signal, contains complete very solid sample, which is also contained in a test tube, is placed in a special probe which is inserted between the pole faces of the electromagnet.

**Sample Probe**

The sample probe, which if of very solid construction to ensure complete stability of the received signal, contains three sets of coils surrounding the sample, as shown in Fig. 2. The first set provides the r-f excitation field through the sample. The current for these coils is supplied from the transmitter contained in the rack through a coaxial cable. The second coil, placed at right angles to the transmitter coil, picks up the minute precession signals from the sample and transmits these signals, via coaxial cable, to a sensitive radio receiver, which is also contained in the rack.

The third set of coils is positioned in such a way that the electromagnetic polarizing field is amplitude modulated by an audio frequency. As the field is swept sinusoidally through the nuclear resonant frequency, the precession of the nuclei will be greater or less, depending on the magnitude of the sweep field. Thus an effectively amplitude-modulated r-f signal is picked up by the receiver coil.

After r-f amplification and detection, an audio signal is obtained that can be readily amplified and used for observation and recording. The type of signal observed may be very similar to the typical symmetrical resonance curve of a receiver as shown in Fig. 3. Other types of signals are obtained of various shapes, depending on the sample nuclei and the adjustment of the various controls. Their complexity will not be discussed in this article.

**R-F Equipment**

A 10-watt r-f transmitter is used, and since it is coupled directly to the receiver coil, complete blocking of the sensitive radio receiver would occur unless special precautions were taken in the probe. To prevent this, the cross-coil arrangement of transmitter and receiver coils is used. Special techniques have been developed in the building of sample probes for insuring that only an extremely small transmitter signal is picked up by the receiver coil even when a powerful transmitter is used. This insures that a large percentage of the signal at the receiver coil is the signal received from the precessing nuclei of the sample. A small signal from the transmitter is desirable at the receiver input terminals as the principle of reception is similar to that of the homodyne used in radio receivers.

The radio receiver should receive no signals whatever from the transmitter directly, so shielding of each is required to avoid direct pickup. The requirements for the r-f transmitter are rather stringent. It must be continuously tunable, stable, well-shielded, and have a variable output, as it is necessary in certain nuclear experiments to use very small r-f excitation fields. When searching for very weak nuclear signals, the transmitter in particular should be free from undesirable modulation components. Such expedients as running the heaters from a d-c source have been found desirable in transmitters used for nuclear resonance measurements.

The major requirement for the radio receiver used is extreme sensitivity. The receivers are possibly the most sensitive receivers that have been developed for any purpose. For this reason, it is only to be expected that the input circuits use the low-signal-to-noise ratio devices outlined by Wallman and others. The theory of the signal-to-noise ratio of the nuclear resonance phenomenon is fairly well-established and experiments indicate that it agrees quite closely with practice.

Extreme sensitivity for a favorable signal-to-noise ratio may be obtained in the nuclear resonance field by continual reduction of bandwidth in a way that would not be possible with communication systems required for transmission of instantaneous complex intelligence. Generally speaking, the rate of obtaining data is not a major consideration in the design of a nuclear receiver. In extreme cases, several minutes may be taken to obtain data. This can lead to bandwidth reductions completely beyond the scope of the normal communication receiver design; bandwidths may be measured in seconds rather than in cycles. Therefore receivers with sensitivities of the order of a few hundredths of a microvolt are realizable, and such sensitivities are in demand for work of this type.

Techniques of direct receiver measurements of sensitivities of this order have not as yet been developed by radio engineers. Noise diodes cannot be used because the diode current required is often too small for satisfactory diode operation. Almost the only reliable checks are those obtained by nuclear sample, and it has been

---

FIG. 2—Probe contains three sets of coils

FIG. 3—Proton signal symmetrically formed

April, 1953 — ELECTRONICS
found in practice that a relatively good check of the operating sensitivity of the receiver by this method is one of the best methods of determining the absolute sensitivity of the receiver. It is particularly advantageous in this connection that the natural abundance of isotopes in certain substances appears to be remarkably uniform. The main disadvantage of testing the receiver in this way is that a fairly complex nuclear laboratory setup is required.

**Band Reduction**

Some of the means used to reduce bandwidth and to record and observe the nuclear signal may be of interest. The signal from the probe, which is in reality a vector addition of a small signal from the transmitter and the nuclear signal picked up from the sample, is amplified with a wide-band r-f amplifier and applied to a detector that extracts the audio signal produced by sweeping the static magnetic field. After further audio amplification, the nuclear signal may be readily observed on a conventional oscilloscope which obtains a sweep voltage from the same generator that supplies the sweep field to the sample. A somewhat different signal is obtained by using a linear sweep; the sine wave sweep gives a more coherent picture.

The signal observed on the oscilloscope would, of course, have a bandwidth which may be several hundred cycles, depending on the sweep frequency. Thus, an observed signal on the oscilloscope will be limited on a signal-to-noise basis in accordance with the bandwidth of the system used for observing the signal. A 60-cycle sweep, such as is commonly used, requires a system response of the order of 1 kc. In many cases, the corresponding sensitivity is inadequate. With the 60-cycle sweep full advantage is not taken in such a simple system of observation of the fact that it is permissible to run a test for several minutes in order to record a signal, and rapid observation is not necessarily required.

To take full advantage of a long recording time, the audio signal is fed to a mixer tube of the phase discriminator type which has its quadrature signal supplied from the sweep generator. By this means, it is possible to extract from the discriminator an extremely low frequency signal that corresponds to the oscilloscope signal, and to reduce its bandwidth to mere fractions of a cycle. Thus, good signal-to-noise ratios are obtained with extreme sensitivity. These signals may be observed either on a d-c meter or with a graphic recorder that will draw out the signal on paper at any desired speed in accordance with the requirements of the particular nuclear test. The sensitivity obtained by this method may be some hundreds of times greater than that of direct observation on an oscilloscope.

The particular nature of the graphic recording process necessitates that some other parameter besides the sweep field be changed in order to record a signal of a time interval of the duration discussed. In the spectrometer shown in the photograph, two methods are made available. The radio frequency may be very slowly changed by means of an electric motor which can be seen just below one of the radio frequency units, or alternatively, a small potentiometer may be slowly rotated to change the field of the magnet. As the frequency is slowly swept through resonance, a curve of the familiar discriminator type will be obtained on the recorder. That is, the signal will slowly climb to a maximum, pass through the center zero and pass to an oppositely poled maximum (see Fig. 4). The amplitude of the signals obtained will be directly proportional to the abundance of that particular isotope in the sample.

**Frequencies**

A brief discussion of the nuclear resonant frequencies of isotopes corresponding to a given magnetic field and the observed sensitivities should be of interest. The greatest sensitivity for nuclear resonance equipment of the type discussed is obtained with the hydrogen 1 isotope or proton. Thus natural water, 

\[ \text{H}_2\text{O}, \]

which has an abundance of this isotope will give a large clear nuclear resonance signal. Theoretical considerations indicate that with a magnetic field of 5,000 gausses and a system bandwidth of 1 cps, the signal-to-noise amplitude ratio should be approximately a million to one. Observed sensitivities correspond to theoretical values within a factor of 2 or 3. The signal-to-noise ratio is approximately proportional to both the square of the magnetic field and the volume of the sample; thus greater sensitivities are obtainable with higher frequencies and greater volumes, other factors remaining equal. With a 10,000-gauss polarizing field, the proton resonance is 42.5 mc; deuterium resonance, 6.52 mc and oxygen 17 resonance, 5.76 mc. The proton resonance may be observed at 4.25 mc with a corresponding reduction in the polarizing field, that is, a field of 1,000 gausses.

The above brief discussion gives

![Fig. 4—Record of blip showing abundance of oxygen 17 in water. Nuclear resonance is at point where curve crosses centerline](image-url)
Increasing use is being made of distributed-constant electromagnetic delay lines as circuit elements in present-day electronic equipment. The characteristic impedance of these lines has been limited to values between 400 and 3,000 ohms. Applications exist for lines with higher characteristic impedance. A brief discussion of the factors that determine the delay time and characteristic impedance will first be given, then ways of increasing the characteristic impedance will be discussed in detail.

The delay time, phase velocity, and characteristic impedance of a distributed-constant delay line can be derived from the simplified equivalent circuit of Fig. 1 where all losses have been neglected. These are

$$t_o = \sqrt{LC} \quad (1)$$

$$\beta = \omega \sqrt{LC} \quad (2)$$

$$Z_o = \sqrt{\frac{L}{C}} \quad (3)$$

where $L$ = inductance per unit length and $C$ = capacitance per unit length. If $R$ and $G$, the resistance and conductance per unit length, are present but $R << \omega L$ and $G << \omega C$ the following more general equations apply:

$$T_o = \sqrt{LC} \left[ 1 + \frac{1}{2} \left( \frac{R}{2\omega L} - \frac{G}{2\omega C} \right) \right] \quad (4)$$

$$\beta = \omega \sqrt{LC} \left[ 1 + \frac{1}{2} \left( \frac{R}{2\omega L} - \frac{G}{2\omega C} \right) \right] \quad (5)$$

$$Z_o = \sqrt{\frac{L}{C}} \left[ 1 + \frac{1}{2} \left( \frac{Re}{4\omega L^2} + \frac{RG}{2\omega LC} - \frac{3G^2}{4\omega^2 C^2} \right) + j \left( \frac{G}{2\omega C} - \frac{R}{2\omega L} \right) \right] \quad (6)$$

It has been found that the attenuation of delay lines increases very rapidly with frequency above several megacycles. The largest part of this increase was attributed to insulation loss. Experimental evidence in the form of lines wound with low-loss hand-coated wires substantiates this fact. At high frequencies $R$ is proportional to $\sqrt{f}$. From reference 4 it is estimated that $G$ is proportional to $f'$ for For-

mex insulated wire.

It has been observed that the inductance of a delay line decreases at higher frequencies. This is caused by phase shift per turn increasing so that although the turns are still magnetically linked as the frequency increases they add less and less to each other's magnetic field. A plot of normalized inductance $L/L_o$, and time delay $T/T_o$ vs $dTo/l$ appears in Fig. 2 where $d =$ diameter of line, $T_o = $ time delay for low frequencies, $l = $ length of line and $f = $ frequency.

The effect of turn-to-turn capacitance has been studied. At low

April, 1953 — ELECTRONICS
Artificial Delay Lines

Distributed-constant delay lines for short pulses may be designed with characteristic impedances as high as 10,000 ohms. Typical line is 10 in. long, 0.2 in. in diameter, weighs less than 10 grams and provides delay of 3.7 microseconds

frequencies the effect of this capacitance is negligible as the phase of the voltage in each turn of the coil is the same. As the frequency increases the phase of the voltage in each turn changes. Thus the effect of the turn-to-turn capacitance increases with frequency until the phase shift per turn equals 360 degrees. This turn-to-turn capacitance has the effect of increasing $C$ to the value

$$ C = \frac{C_s}{1 - \left(\frac{\omega}{\omega_0}\right)^2} \quad (7) $$

where $\omega$ is the angular frequency of the input signal

$$ \omega^2 = \frac{1}{LC} \quad (7') $$

where $L' = L/N = \text{effective inductance per turn}$, $C'$ is the self capacitance between two adjacent complete turns and $C_s$ is the capacitance per unit length from winding to core at low frequencies.

The inductance thus decreases with frequency and the capacitance increases with frequency. If the magnitude of these two effects were the same, delay time would be constant with respect to frequency. If $2\pi d > 13 (\lambda = \text{wavelength})$ a fair equalization of delay time could be obtained. This would require

$$ C' = \frac{2\pi^2 N}{2\pi} \quad (8) $$

but

$$ C = \frac{3.6 \log \left(\frac{S + \pi}{S}ight) + \frac{1}{2}(\frac{S + \pi}{S}) - 1}{\pi d K_r} \quad (9) $$

where $K_r = \text{dielectric constant of wire insulation, } S = \text{wire separation and } d = \text{diameter of coils.}$

Substituting $N = 1/\pi$ (for a close wound coil) and Eq. 9 in Eq. 8 we obtain

$$ K_r \approx \frac{SC_{\mu\mu f}}{15} \quad (10) $$

where $C$ is in micromicrofarads per axial centimeter.

The equalization of delay time by this procedure is done at the expense of decreasing characteristic impedance.

Another method of equalization of the delay time, likewise at the expense of characteristic impedance, is the use of patches. If patches are bridging capacitors over a number of turns, effectively increasing $C$ as the frequency increases, lumped-constant phase correcting networks have also been studied.

Equations 1 through 6 are derived on the assumption that the parameters $R$, $L$, $G$ and $C$ remain constant. Above a certain frequency we now see that $R$ is proportional to $\sqrt{f}$, $G$ is proportional to $f'$, $L$ decreases with increasing frequency and $C$ increases with increasing frequency.

The resistance effect may be minimized by using small wire sizes

![FIG. 1—Simplified equivalent circuit of a distributed-constant delay line of helix parameters](image)

![FIG. 2—Curves show effect on line inductance and delay](image)

![FIG. 3—Simplified block diagram of setup for testing distributed-constant lines](image)
such as B & S gauge numbers 41, 44, 46 and 48. Little can be done about the conductance except to use low-loss insulation. Teflon-insulated magnet wire is now available which should have much lower insulation loss. The effects on both \( L \) and \( C \) may be reduced appreciably by winding the lines on a small diameter form such that the phase difference per turn is reduced. As shown by Eq. 3 one could increase the characteristic impedance by increasing \( L \) or decreasing \( C \). If \( C \) were decreased, the time delay would decrease.

**High-Z Lines**

The purpose of the investigation, reported in this paper, was to produce lines having relatively large delays and high characteristic impedances. To achieve these goals both \( L \) and \( C \) were increased, but \( L \) was increased by a considerably larger factor than \( C \).

To obtain as large a delay as possible it was decided to use the complete core as a ground. The capacitance per unit length can be varied by controlling the thickness and dielectric constant of the insulation material placed between the core and the winding. This large capacitance per unit length would necessitate a correspondingly large inductance per unit length to secure a high characteristic impedance.

The secret of success for the high characteristic impedance line is the method of obtaining the high inductance. First, a small wire size was chosen. As B & S gauge No. 48 copper magnet wire had a large attenuation and was too easily broken most of the work was done with No. 46 wire. With this wire a bank winding with approximately 3 layers was found necessary to obtain the necessary inductance.

The theoretical discussion of the compensation of a multilayer line will not be taken up at this time. The problem is quite complex with self capacitance from one turn to several neighboring turns and has not been completely solved. The discussion of the variation of time delay with frequency in the previous section is directly applicable only to single layer lines. A comparison of the calculations for single layer lines with the experimental results of multilayer lines appears later in this paper.

**Line Construction**

The lines were wound on \( \frac{3}{8} \)-inch diameter polystyrene cores 12 inches long. These cores were given several coats of silver conducting paint to form the ground strip. After an overnight drying period, the cores were axially slotted forming 36 thin strips, each strip being about 0.015 inch wide between 0.003-inch slots. A one-inch length of the core was left unslotted to facilitate the connection of the external ground lead.

The core was covered with a layer of insulating material to serve the dual purpose of insulating and controlling the winding-to-core capacitance. A 0.85 \( \times \) 11.5 inch piece of Teflon tape 0.005 inch thick was wound around the core. This made 1.4 turns around the core. A number of small pieces of cellophane tape held the Teflon on the core until the line was wound. The tape was removed piece by piece as the line was wound.

The winding was done on a lathe.

To provide uniform wire tension, both to secure a good winding and to prevent breakage, the wire feeding device shown in the photograph was used. The wire tension is adjustable over a range of about 10 to 70 grams and is continuously indicated by a pointer.

A wire guide attached to the longitudinal feed of the lathe was placed about \( \frac{1}{8} \) inch from the core, which was chucked in the lathe. The longitudinal travel of the wire guide was 0.00066 inch per turn. As this distance is a fraction of the wire diameter, the result was a multiple layer coil approximately bank wound. The far end of the core was attached to a counter chucked in the tailstock. A steel drill rod was inserted through a hole in the core for rigidity. A 10-inch long winding was wound on the core. Lines have been wound with speeds varying from about 200 to 500 rpm.

A piece of No. 26 wire was soldered to the ends of the winding and secured to the winding with polystyrene dope.

The method for determining the characteristic impedance of these delay lines is based upon the fact that no reflections occur in an ideal-

---

### Table I—Summary of High-Impedance Distributed-Constant Delay Line Characteristics

<table>
<thead>
<tr>
<th>L (mh)</th>
<th>C (µµF)</th>
<th>( Z_0 ) (ohms)</th>
<th>( t_0 ) (µsec)</th>
<th>( t_{1/2} ) rise times (µsec)</th>
<th>attenuation (db/µsec delay)</th>
<th>winding length (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mes</td>
<td>calc</td>
<td>mes</td>
<td>calc</td>
<td>t1</td>
</tr>
<tr>
<td>No. 14 line</td>
<td>24.0</td>
<td>540</td>
<td>5,600</td>
<td>6,600</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>No. 46 line</td>
<td>22.1</td>
<td>655</td>
<td>5,600</td>
<td>6,600</td>
<td>3.75</td>
<td>3.6</td>
</tr>
<tr>
<td>No. 48 line</td>
<td>21.70</td>
<td>166</td>
<td>5,600</td>
<td>6,600</td>
<td>3.4</td>
<td>3.2</td>
</tr>
<tr>
<td>High Impedance</td>
<td>40.7</td>
<td>450</td>
<td>9,000</td>
<td>9,700</td>
<td>4.5</td>
<td>4.3</td>
</tr>
<tr>
<td>No. 44 line</td>
<td>40.7</td>
<td>450</td>
<td>10,000</td>
<td>9,300</td>
<td>4.5</td>
<td>4.3</td>
</tr>
</tbody>
</table>

---

April, 1953 — ELECTRONICS
ized delay line terminated in its characteristic impedance. The characteristic impedance of a line whose parameters are a function of frequency would most certainly be a function of frequency. The value of the characteristic impedance in a practical case involving complex waves must therefore be compromised for minimum reflections over the band of frequencies for which the line is designed to operate.

**Measurements**

In making measurements, the lines are terminated at the input as well as the output to minimize any possible secondary reflections at the input. A suitable means of determining the effective characteristic impedance when the line is used to delay rectangular pulses is to feed the pulse itself into the delay line and to adjust the terminating impedances for minimum reflections.

A block diagram illustrating the experimental method for determining the characteristic impedance of these delay lines and for recording the response of the delay lines to rectangular pulses appears in Fig. 3.

The oscilloscope sweep is triggered by the input pulse. A camera, mounted on the oscilloscope, records the input and output wave shapes of the delay line. The load impedance of the video amplifier was made equal to the characteristic impedance of the line. A diagram of the video amplifier appears in Fig. 4.

The pulse distortion and attenuation were also measured with the equipment connected as shown in Fig. 3, using the oscilloscope camera. The delay time as well as the rise and fall times was likewise measured on the oscilloscope. The delay time was defined as the time between the midpoint of the leading edge of the input and output wave forms. The rise and fall times were defined as the time duration between the 10 and 90-percent values of the pulse amplitude. The pulse duration was defined as the time between the 10-percent values. The attenuation was measured by comparing the amplitudes of the input and output pulses.

**Results**

The data on a particular line, typical of those wound follows:

- Core diameter is 0.188 inch, with 36 slots.
- Dielectric is Teflon 0.006 x 0.85 x 11.5 inches.
- Length of winding is 10 inches with 1,520 turns per inch (0.00066 inch per turn) of No. 46 HF wire 0.0019 inch in diameter.

The electrical characteristics of the line measured at 1,000 cps were:

- \( R = 3,600 \, \text{ohms} \)
- \( L = 22.1 \, \text{mh} \)
- \( C = 0 \) and \( C = 652.1 \, \mu \text{f} \).

Impedance and time delay calculated from these measurements, are

- \( Z = 5,830 \, \text{ohms} \) and \( t_s = 3.8 \) microseconds.

The experimental data obtained on this line were:

- \( Z = 5,600 \, \text{ohms} \) resistance in series with a parallel network of a hundred-microhenry choke and a 2,200-ohm resistance (determined for minimum reflection with 0.3-microsecond pulse).

Time delay was 3.75 microseconds and \( t_r = \) rise time of 1-usec input pulse = 0.1 microsecond; \( t_f = \) rise time of 1-\( \mu \)-sec output pulse = 0.14 microsecond as

\[
\tau = \sqrt{\tau_r^2 + \tau_r^2}
\]

(11) where \( t_r = \) rise time output pulse if a perfect input pulse were applied to the line. Thus \( t_r = 0.1 \mu \text{sec} \).

Photographs of the input and output waveforms appear in Fig. 5 for pulse durations of 0.30, 0.37, 0.62 and 1.0. Input and output waveforms superimposed to a larger scale are also included. The reflections appearing between the input and output pulses no doubt occur at points where the spill over from true bank winding was particu-
The value of \( \omega \), may be calculated from Eq. 7. If \( L' = 1.46 \mu \text{h} \) and \( C'' = 2.2 \mu \text{uf} \) from Eq. 9, \( \omega \approx 0.56 \times 10^9 \). The resonant frequency thus is 89 mc.

**Resonant Frequencies**

Resonant frequencies of 124, 165, 215, 235, 332 and 375 mc were obtained experimentally. The 235-mc reading had a considerably higher Q than the others and was probably the resonant frequency of a single turn. The 124-mc frequency had a very low Q. No readings were observed from 60 to 124 mc.

The thickness of the dielectric used in calculating the resonant frequency was determined by measuring the overall diameter of the insulated wire with 1/10,000-inch micrometers. The wire was coated with X-Var which chemically attacks the Formex. After the wire was wiped clean the diameter was measured again. This method does not give extreme accuracy.

The resonant frequency of the inductance of one turn and the core capacitance of that turn is calculated to be 368 mc. This value checks the 375-mc value very closely. If one assumes that we have a fictitious single layer winding and each turn has an inductance 3 times that of the former single turn (\( L' = 4.58 \mu \text{h} \)). We have effectively lumped up the inductance of three layers into one.

If the equivalent single-layer winding outlined above is assumed, the resonant frequency of the inductance of one turn and the capacitance to core of one turn is 212 mc. This checks the 215 megacycle value very closely.

No explanation is apparent for the 124 and the 323 megacycle readings. The fact that there were two layers of insulation over 40 percent of the core and one layer over 60 percent of the core might account for some of these resonances.

**Waveforms**

Photographs of the waveforms of a line of similar dimensions except 1.5 layers of Teflon and wire size changed to No. 44 with 55 grams tension appear in Fig. 6. The winding was approximately 4 layers. The termination was the same

<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
<th>INPUT AND OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05 ( \mu \text{SEC} )</td>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
<tr>
<td>0.37 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05 ( \mu \text{SEC} )</td>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
<tr>
<td>0.62 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
<tr>
<td>10 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.25 ( \mu \text{SEC} )</td>
<td>0.25 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
</tbody>
</table>

FIG. 5—Pulse response of 5,800-ohm line wound with No. 46 wire

<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
<th>INPUT AND OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05 ( \mu \text{SEC} )</td>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
<tr>
<td>0.37 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05 ( \mu \text{SEC} )</td>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
<tr>
<td>0.62 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.1 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
<tr>
<td>10 ( \mu \text{SEC} ) PULSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.25 ( \mu \text{SEC} )</td>
<td>0.25 ( \mu \text{SEC} )</td>
<td>0.5 ( \mu \text{SEC} )</td>
</tr>
</tbody>
</table>

FIG. 6—Pulse response of 5,800-ohm line wound with No. 44 wire

larly bad. All photographs were taken with the same value of terminating impedance which was the value obtained as the best impedance match with a 0.3-\( \mu \text{sec} \) pulse applied. In the case of the longer pulse durations, slightly better waveforms can be secured by re-terminating the line. An example will be shown later.

Substituting in Eq. 10, on the supposition that this equation holds for a bank winding, we find the winding-to-core capacitance should be 0.29 \( \mu \text{uf} \) per centimeter for proper equalization. This value was obtained using 3.6 for the dielectric constant of Formex and 0.0002 inch as the thickness of the dielectric. From the measurements, the capacitance to core was 25.7 \( \mu \text{uf} \) per centimeter. The effect of the stray capacitance is therefore much higher for the multilayer line. Equations are being derived which give very good agreement.
...it is known that Cinch Components are available for new electronic developments as fast as the need occurs.

With a reputation of a quarter of a century of solving electronic component problems in emergency, Cinch is today recognized as source headquarters for sockets, shields, plugs, jacks, terminals, connectors, etc. Consult Cinch!
except the series inductance was raised to 250 μH. A comparison of Fig. 5 and 6 shows the delay and attenuation to be slightly less for the No. 44 line although the phase distortion and small reflections along the line are slightly greater. This is probably due to the spill over being greater with the four layer winding.

A line was wound using 1.8 layers (1.1 inch wide strip) of Teflon and wire size changed to No. 48 with 20 grams weight tension with an average of 2.2 layers on this winding. The terminating impedance used was the same as in the previous case except the series inductance was changed to 200 μH. The line was terminated for minimum reflection using a 0.3-μsec pulse input. The waveforms of this line appear in Fig. 7. It will be noted that the attenuation has increased appreciably. There is more ringing on the top of this wave. The line was reterminated with a 1-μsec pulse applied. The terminating impedance turned out to be a 5,600-ohm resistor.

Lines with higher characteristic impedances than 5,600 ohms have been obtained using a 1-inch diameter core and 21 layers of Teflon tape. The characteristic impedance, when terminated with a 0.3-μsec pulse applied, was increased to 9,000 ohms in series with a 400-μH choke. The input impedance (shunt impedance in output of video amplifier) was 7,400 ohms in series with an inductance of 400 μH. Photographs of the waveforms of this line appear in Fig. 8.

This particular line had only 14,165 turns and the winding was 9.3 inches long. It had a time delay of 4.5 μsec, or a time delay of almost 0.5 μsec per inch. When the line was reterminated using a 1-μsec pulse, the terminating impedance turned out to be a 10,200-ohm resistor. The output impedance of the video amplifier was increased to 11,000 ohms. The waveforms of this termination also appear in Fig. 8. This line was wound with No. 44 wire.

The characteristics of these lines are compared in Table 1. The real part of the terminating impedance (the best value for 0.3-μsec pulses) is listed in all cases. In the case of the high characteristic impedance line, the characteristics for the best one-microsecond pulse termination also appear. The attenuations listed were measured values with a one-microsecond pulse applied to the line. From Fig. 5 and 6 it will be noted that the attenuation is greater for shorter pulse durations.

From the data presented, delay lines with impedances of 5,600 ohms and reasonable attenuations for pulse widths less than 1-μsec can be obtained. It appears likely that lower attenuations can be obtained if better winding techniques can be developed for the No. 44 gauge wire. The availability of Teflon-insulated magnet wire in small wire sizes should aid in the reduction of attenuation and improvement of phase response.

The authors are indebted to J. F. Peoples for his assistance and to M. F. Davis for his encouragement.

REFERENCES

Mallory Mercury Batteries provide a constant voltage power supply

Mallory Mercury Batteries are especially well suited for transistor power requirements. They deliver constant voltage and constant current...an absolute necessity for the best performance of transistor circuits. In addition, they will not deteriorate or lose their energy during long periods of storage...even under the most adverse climatic conditions. Their high ratio of energy to size and weight permits miniaturization of electronic equipment.

New transistor hearing aids are a good example of the substantial size reduction and operating economy that can be accomplished by using Mallory Mercury Batteries and tiny new Mallory Capacitors.

If you are designing equipment around transistor circuits, our engineers will be glad to work with you in selecting a power supply to meet your requirements. Multi-cell packs and stacks are available for applications requiring greater capacity or higher voltages than provided by a single cell. Various combinations can be built for virtually any capacity or space requirement. Write us today for more information.

Use Mallory Mercury Batteries for applications where:
- Constant voltage or current is required
- Size and weight are important
- Long storage periods are involved
- Battery leakage cannot be tolerated
- Wide temperature and pressure ranges are encountered
- Severe impact and shock are expected

SERVING INDUSTRY WITH THESE PRODUCTS:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

MALLORY
P. R. MALLORY & CO. INC., BATTERY DIVISION, NORTH TARRYTOWN, N.Y.

ELECTRONICS — April, 1953
Want more information? Use post card on last page.
**ELECTRONS AT WORK**

Including INDUSTRIAL CONTROL

Edited by ALEXANDER A. MCKENZIE

Demonstration Equipment for Electronic Courses

Ever increasing complexity of military electronic equipment places a burden on military personnel charged with operating and maintaining the gear. With training time and personnel both at a premium, much of the work at the Navy's Special Devices Center, Sands Point, N. Y. concerns design of demonstration devices, technical training aids and full-scale working models of operational electronic equipment.

One piece of equipment used for classroom demonstration, has components mounted on boards that show the circuit schematically. One such board is shown in the photograph. Nine basic circuits are available. These circuits are: (1) simple a-c circuits that can be arranged to demonstrate series and parallel resonance, differentiation, integration, and phase shift; (2) diode characteristics and diode circuits such as shunt and series limiters; (3) triode characteristics; (4) full and half-wave rectifiers with various filter combinations; (5) cathode-coupled multivibrators both free-running and driven; (6) shock-excited oscillator; (7) hard-tube, nonrecurrent sweep generator; (8) blocking oscillator; and (9) cascade amplifiers with various coupling arrangements. The last board can also be used to show pentode and tetrode static characteristics.

Two variable B+ supplies deliver 0 to 350 volts to the circuits. A variable C-supply delivers -50 to +50 volts while the alternating filament voltage is adjustable from 0 to 13 volts.

Sine-wave, square-wave, positive or negative pulse and sawtooth inputs may be applied to the demonstration circuits. The sine wave can be varied in frequency from 20 cps to 150 kc; rms value is 10 volts. The square wave retains its shape up to 4,000 cps while the sawtooth seems linear to between 6,000 and 7,000 cps.

An electronic switch permits display of waveshapes at various points in the circuit both on the built-in oscilloscope and on the projection oscilloscope. A vacuum-tube voltmeter may be switched to show voltage and currents throughout the circuit under study. Meter readings can be projected on a screen by the projector shown in the photograph.

Another training device devel-

---

**OTHER DEPARTMENTS**

- Production Techniques...260
- New Products ..........312
- Plants and People .......384
- New Books ............410
- Backtalk .............420

---

196

FIG. 1—Classroom demonstration board allows nine different circuits to be demonstrated to a large group. Projection oscilloscope at right makes it possible to show what is happening at various points in the circuit.
SIGNAL GENERATOR
Type 202-D
Frequency Range 175-250 mc.

With the type 202-D Signal Generator, you can quickly and accurately test, analyze and evaluate the performance of telemetering receivers and associated equipment. Note that the frequency coverage of the instrument is provided in a single range between 175-250 mc.

SPECIFICATIONS:

RF RANGE: 175-250 megacycles in one range, accurate to ±0.5%. Main frequency dial also calibrated in 24 equal divisions for use with vernier frequency dial.

VERNIER FREQUENCY DIAL: This dial is divided into approximately 100 equal scale divisions and is coupled to the main frequency dial by a 24.1 gear train. The approximate frequency change per vernier division is 35 kc.

FREQUENCY MODULATION (DEVIAION): The FM deviation is continuously variable from zero to 240 kc. The modulation meter is calibrated in three FM ranges (1) 0-24 kc., (2) 0-80 kc., and (3) 0-240 kc. deviation.

AMPLITUDE MODULATION: Utilizing the internal audio oscillator amplitude modulation may be obtained over the range of 0-50%, with meter calibration points of 30% and 50%. By means of an external audio oscillator the RF carrier may be amplitude modulated to substantially 100%. A front panel jack is provided which permits direct connection of an external modulating voltage source to the final stage for pulse and square wave modulation. Under these conditions the rise time of the modulated carrier is less than 0.25 microseconds and the decay time less than 0.8 microseconds.

MODULATION CONTROLS: Separate potentiometers are provided for continuous control of FM and AM levels.

MODULATING OSCILLATOR: The internal AF oscillator may be switched to provide either frequency or amplitude modulation. It may also be switched off. Eight fixed frequencies between 50 cycles and 15 kilocycles are available, any one of which may be selected by a rotary type switch.

RF OUTPUT VOLTAGE: The RF output voltage is continuously variable over a range from 0.1 microvolt to 0.2 volts at the terminals of the output cable. The impedance of the RF output jack, looking into the instrument, is 53 ohms resistive.

DISTORTION: FM: The overall FM distortion at 75 kc. is less than 2%, and at 240 kc. less than 10%. AM: The distortion present at the RF output for 30% amplitude modulation is less than 3% and for 50%, AM less than 6.5. At 100%, the distortion is 12% to 15% depending upon the modulating frequency.

SPURIOUS RF OUTPUT: All spurious RF output voltages are at least 25 db. below the desired fundamental. Total RMS spurious FM from the 60 cycles power source is down more than 50 db., with 75 kc. deviation as a reference level.

EXTERNAL MODULATION REQUIREMENTS:

Frequency Modulation: The deviation sensitivity is 50 kc. per volt. For external FM the input impedance is 1500 ohms.

Amplitude Modulation: Approximately 45 volts are required for 50%, modulation and 100 volts for 100% modulation. For external AM the input impedance is 7500 ohms.

Audio Voltage for External Use: There is available at the FM external oscillator binding posts about 5 volts a.c. maximum and at the AM external oscillator binding posts, 50 volts maximum.

DIMENSIONS AND WEIGHT: Outside cabinet dimensions: 17" high, 13½" wide, 11½" deep. Weight: 35 pounds.

Price: $980.00 F.O.B. Boonton, N. J.
opened at Sands Point is an ultrasonic radar simulator to aid crews of intercontinental bombers. To provide a radarscope view of the terrain an ultrasonic transmitter bounces 15-mc pulses on a base relief map immersed in water. The return signals are heterodyned up to 3 mc and used to feed a standard radar video device.

Sorting Eggs by Shell Color

BECAUSE New Englanders prefer brown eggs and denizens of New York, Philadelphia and Cleveland like them white, an electronic sorter has been designed to discriminate among six or more shades.

Two photocells make up two arms of a self-balancing bridge with span adjusting resistors and a balancing rheostat forming the other two arms, as shown in Fig. 1. The amplifier detects any unbalance in the bridge and amplifies this voltage differential to drive a synchro motor until a new balance is obtained.

When differences of shell color cause a change in the ratio of the light received by the two photocells, the motor assumes a new position.

For this reason, the cam angle becomes an indication of color. Auxiliary mechanical devices can be arranged to load the eggs into the machine and distribute them into proper bins. For example, the holding switch can be used to lock the motor in place while the color information is transferred to the loading mechanism.

In the A position, the range switch accommodates eggs of all colors. In the B and W positions, eggs from light to dark brown and those from white to light brown, respectively, are graded.

The circuit was developed by the U. S. Department of Agriculture at Beltsville, Md., but no complete machinery is available for purchase there.

**Magnesium Waveguide Characteristics**

REPLACEMENT of conventional waveguides, particularly in aircraft, by those of lighter weight, may be possible according to the Air Force.

Magnesium waveguides can be produced in substantially all the sizes and shapes in which brass and aluminum guides are made. Their use makes possible a weight reduction of about 80 percent over brass waveguides. There is a 35-percent weight saving over those fabricated from aluminum. Development work now going on may effect a further...
There's a 10-turn Helipot to meet your requirements

With the development of the original HELIPOT—the first multi-turn potentiometer—an entirely new principle of potentiometer design was introduced to the electronic industry. It made possible variable resistors combining high resolution and high precision in panel space no greater than that required for conventional single-turn potentiometers.

The Helipot Principle...

High resolution and precision settings require a long slide wire. But by coiling a resistance element into a helix, it is possible to gain desired resolution and precision without wasting panel space. This principle is applied in various Helipot models with slide wires ranging from 3 to 40 helical turns.

Advantages are immediately apparent. In the case of the widely-used 10-turn Model A Helipot, for example, a 45" long slide wire—coiled into ten helical turns—is fitted into a case 1/4" in diameter, and 2" in length. Another advantage of the 10-turn pot is that, when equipped with a turn-indicating RA Precision Duodial, slider position can be read directly as a decimal, or percentage, of total coil length traversed.

### 10-TURN HELIPO T MODELS—CONDENSED SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model A</th>
<th>Model AN</th>
<th>Model AJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of turns</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Resistance Range</td>
<td>10 ohms to 300,000 ohms</td>
<td>100 ohms to 250,000 ohms</td>
</tr>
<tr>
<td>Resistance Tolerance:</td>
<td>±5%</td>
<td>±5%</td>
</tr>
<tr>
<td>Best</td>
<td>±1%</td>
<td>±1%</td>
</tr>
<tr>
<td>Linearity Tolerance:</td>
<td>±0.05%</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Standard</td>
<td>±0.05%</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Best</td>
<td>±0.05%</td>
<td>±0.5%</td>
</tr>
<tr>
<td>Power rating @ 40° C</td>
<td>5 watts</td>
<td>5 watts</td>
</tr>
<tr>
<td>Mechanical Rotation</td>
<td>3060° ± 3°</td>
<td>3060° ± 3°</td>
</tr>
<tr>
<td>Electrical Rotation</td>
<td>3060° ± 3°</td>
<td>3060° ± 3°</td>
</tr>
<tr>
<td>Starting Torque</td>
<td>2 oz-in.</td>
<td>1.0 ± 3 oz-in.</td>
</tr>
<tr>
<td>Running Torque</td>
<td>1.5 oz-in.</td>
<td>0.6 ± 3 oz-in.</td>
</tr>
<tr>
<td>Net Weight</td>
<td>4 oz.</td>
<td>4 oz.</td>
</tr>
</tbody>
</table>

*i.e. INDEPENDENT LINEARITY. The above linearity tolerances are based on the following definition recently proposed to clarify and standardize nomenclature related to precision variable resistors..."Independent linearity is the maximum deviation in percent of the total electrical output of the actual electrical output at any point from the best straight line drawn through the output versus rotation curve. (This line shall be measured through the extent of the effective electrical angle.) The slope and position of the straight line from which the linearity deviations are measured must be so adjusted as to minimize these deviations."

### 10-Turn Helipot Highlights

From the basic Helipot principle, model variations have been developed to meet new requirements:

**Model A Helipot**

- The original 10-turn Helipot provides a resolution from 12 to 14 times that of conventional single-turn potentiometers of same diameter (1/4"), linearity as close as ±0.05% in resistances as low as 1K ohms.

**Model AN Helipot**

- An ultra-precision version of the basic 10-turn Helipot. Produced in volume to extremely close electrical and mechanical tolerances, this unit features precision ball bearings (Class 5), servo mounting lid, plus linearity tolerances as close as ±0.025% as low as 5K. A 3-turn unit (Model CN) is also available.

**Model AJ Helipot**

- A 10-turn miniature Helipot only 3/4" in diameter, weighs 1 oz., has slide wire 18" long. Also available with servo mounting (Model AJ5) and servo mounting with built-in bearings (Model AJSP). Linearity as close as ±0.1% as low as 5K.

Designed for long life under severe operating conditions, the AJ Series is widely used where small size and weight are vital.

Only Helipot is able to supply—in volume—multi-turn helical potentiometers with special features to meet your particular needs: Special Shafts, Extra Spot Welded Tabs at any position, Ganged Assemblies (except AJ), Special Temperature Coefficients, etc. Send us your requirements!

For complete details contact your nearby Helipot representative. Or write direct.

THE HELIPO T CORPORATION

A subsidiary of Beckman Instruments, Inc.

SOUTH PASADENA 2, CALIFORNIA


ELECTRONICS — April, 1953

Want more information? Use post card on last page.
Ultrasonics available from any color with their Germany, at be
that manganese with magnesium, 108.6 1.74.

In the pure state it weighs 108.6 pounds per cubic foot. By alloying zinc, aluminum and mag-
ganese with magnesium, a combined strength-weight ratio is obtained that is the highest and lightest ratio available from any common metals.

Dust and filings ignite easily and attachment of flanges by welding re-
quires special techniques.

The full report, PB 107,675, may be obtained in photostat or micro-
film from the Library of Congress.

German Brewers Use Ultrasonics

Savings up to 40 percent in hops is claimed by a 96-year-old brewery
at Weissenthurn, near Koblenz, Germany, through the use of ultra-
sonic vibrations at one stage of their operations.

Water and malt are boiled at 75°C four to six hours. The mixture
is drawn off, clarified and hops are added. The resultant mixture is
boiled an additional two hours. During this time, the ultrasonic trans-
ducer is lowered into the vat and some 300 watts of 1-mc power ap-
plied. It is believed that the bitter substances from the hops are more
effectively extracted by this means.

The equipment is essentially a 1-mc crystal oscillator followed by a
buffer and a final amplifier. The transducer employs six quartz-
crystal capsules.

PERTINENT PATENTS

An unusual application of electronic techniques is involved in
patent 2,617,852 for an "Electrical Well Logging System" issued to
H. C. Waters and assigned to Perforating Guns Atlas Corp., of Hou-
ton, Texas.

In the electrical logging of oil wells, resistivity values and the
natural d-c potential of the earth formations in an oil borehole are
made at various penetrations and between and across the varying
formations traversed by the bore-
hole.

This invention provides a method and apparatus as illustrated in Fig.
1, for obtaining and indicating the resistivity values and/or potential
from a combination of three points or two different distances and any
one point in the borehole. For ex-
ample, electrical resistivity at two
different distances of penetration
may be measured and are trans-
mittted to the surface in the form of
slowly varying direct-current values
simultaneously with natural d-c
potential of the earth as it exists
between a moving electrode in the
borehole and a fixed reference elec-
trode at the surface.

Resistivity measurements are
made by generating a 400-cycle field
into the earth between a pair of
terminals near the bottom of the
borehole. Probe electrode pairs se-
lectively pick up the a-c field at
various levels in the borehole. Na-
tural d-c potential is picked up at
one probe terminal capacitively iso-

Hand Transmitter Eliminates Mike Cable

This 25-milliwatt fm transmitter was de-
signed by Motorola engineers to ex-
tend the range of the microphone used
with a loudspeaker system in railroad
yards. It operates in the 155-to-174 mc
band, produces a 15-kc deviation and
measures approximately 2 × 3 × 7
inches.
Los Gatos Type 254 Triode with tantalum anode. Plate dissipation is 75 watts.

Addition of Sintercote anode raises rating to 125 watts. Operating life more than doubles.

ANOTHER PLUS for the traditional nine-plus lives of Los Gatos electron tubes. Development by Lewis and Kaufman engineers of the exclusive new Sintercote black-body anode surface gives you tubes with much more than twice their former service lives.

SINTERCOTE consists of finely-divided particles having a high spectral emissivity—several times that of a bright surface. Result: Increased plate dissipation. In addition, Sintercote is a strong getter which keeps Los Gatos tubes hard throughout their lives; protects cathodes against ion bombardment. Result: Increased life.

Get further details from your regional Los Gatos field-engineering representative, or write:

LEWIS and KAUFMAN, Ltd.

LOS GATOS 1  CALIFORNIA

www.americanradiohistory.com
Quality Engineered for lasting Performance...

Durability and good performance are qualities that begin with and are largely dependant on good engineering. Amphenol’s entire engineering staff is dedicated to the goal of unsurpassable quality. To accomplish this goal, Amphenol has gathered a staff of engineers whose combined experience covers every phase of electrical and electronic applications. This vast background is continuously being extended by an unceasing program of research and development.

Amphenol’s methods and production engineers further this devotion to quality by insisting that production methods and machines accurately produce finished products that match the quality of the original design.

No details are provided in the patent description as to what specific use is made of the information collected through the application of the equipment of this invention beyond that substantially disclosed above.

In patent 2,617,926 issued to the late Louis Cohen, entitled “Interference Reducing Radio Receiving System”, many variations of a principle to be employed for radio interference reduction are shown applied to antenna coils of radio receivers.

The simplest embodiment of the invention is shown in Fig. 2A. An antenna coil is so constructed in conjunction with a metal plate that the metal plate is adjustable and may be brought closer to or further from the coil to vary its effective electrical length by varying the distributed capacitance. A second antenna coupled to the metal plate collects energy just as the regular antenna. The degree of transfer of the energy from the second antenna...
is varied by the position of the metal plate with respect to the coil.

In Fig. 2B is shown how the technique of the invention is applied to employ only one antenna through the use of a split stator capacitor.

Figure 3 illustrates a further refinement of the technique of this invention with its connection to the radio receiver input transformer. Adjustable metal strips capacitively couple the interference reducing coil and plate arrangement to the antenna and the primary and secondary of the antenna input transformer of the radio receiver.

In accordance with this invention the inventor shows that the phase and amplitude relationships of an electrical disturbance which sets up oscillatory currents in a wave conductor and associated circuits may be represented by the formula.

\[ I = E \psi(f) \]

where \( E \) is the applied voltage and \( \psi(f) \) is a function of the frequency determined by the circuit parameters. If the energy is applied to the circuit components in such a relationship that a current \( E_1 \psi_1(f) \) is generated of equal amplitude and opposite polarity to a current \( E_2 \psi_2(f) \) produced by applying the disturbance to some point on the
conductor, then the resultant transmission of the disturbance is zero
\[ E, \phi, (f) - E, \phi, E (f) = 0 \]

It is known that traveling-wave tubes as conventionally constructed are elongated structures in order to accommodate the various tube components incorporated within the traveling wave tube envelope. In patent 2,617,961 granted to Lothar Brueck of Paris and assigned to Compagnie General de T.S.F. of France, a structure for traveling-wave tubes is disclosed that proposes to reduce the length requirements thereof, among other advantages.

The Brueck invention is shown in Fig. 4, 5, and 6. Figure 4 shows plane spirals in elevation and plan views as employed in the traveling wave tube of this invention. Figure 5 indicates the radial electric field that exists between successive turns of the spiral. Figure 6 is a cut-away view of the structure of a traveling-wave tube incorporating the plane spiral of the invention in the form of a spiral waveguide.

The inventor claims that in conventional traveling-wave tubes, because of the small pitch of the helix along which the traveling wave is propagated, short-wave amplification cannot be obtained at will. When the diameter of the helix is smaller than a quarter wavelength the field within the helix becomes too weak, because the field lines produced along the axis of the helix by the various parts of one single turn are in opposition, and are partially destroyed.

In Fig. 4, the input channel may be a coaxial cable. The inner conductor C may be one of the spirals (S.). Outer conductor R, is connected to the envelope. The output channel is a second coaxial cable connected to the two spirals and the outer conductor R, is also connected.
TUNG-SOL'S STATISTICAL QUALITY CONTROL METHODS produce tubes of unsurpassed reliability.

Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes.

TUNG-SOL ELECTRIC INC.
Newark 4, N. J.
Sales Offices: Atlanta, Chicago, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle

Want more information? Use postcard on last page.
Ballantine Model 300
SENSITIVE ELECTRONIC VOLTMETER
Featuring a Logarithmic Voltage Scale and Uniform Decibel Scale

PRICE...$200.

- Measures 1 millivolt to 100 volts over a frequency range from 10 to 150,000 cycles on a single logarithmic scale by means of a five decade range selector switch.
- Accuracy: 2% at any point on the scale over the ENTIRE RANGE.
- Input Impedance: 15 megohm shunted by 30 mfd.
- Generous use of negative feedback assures customary Ballantine stability.
- Output jack and output control permit voltmeter to be used as a flat high gain (70DB) amplifier.
- Available accessories permit range to be extended up to 10,000 volts and down to 20 microvolts.
- Available Precision Shunt Resistors convert voltmeter to microammeter covering range from 1 to 1000 microamperes.

For additional information on this Voltmeter and Ballantine Battery Operated Voltmeters, Wide-Band Voltmeters, Peak to Peak Voltmeters, Decade Amplifiers, Inverters, Multipliers and Precision Shunt Resistors, write for catalog.

BALLANTINE LABORATORIES, INC.
100 FANNY ROAD, BOONTON, NEW JERSEY

ELECTRONS AT WORK

FIG. 6—Sector division by means of bars as explained in text
to the envelope. Field coils $N_1$ and $N_2$ are similar to loudspeaker field coils and provide a constant magnetic field. The lines of this field follow the radial direction. Its purpose is to trap electrons within the walls of the waveguide or turns of the spiral. The cathode is of the tube indicated at $K$; $G$ is the control electrode.

In Fig. 6 the waveguide input is shown at $A$ and the output at $E$; $P$ represents the walls of the waveguide spiral that is split along the line $L$.

Microwave energy applied to the waveguide input travels through the split waveguide spiral while electron beams move radially through the split from the cathode that is axially disposed in the spiral. The envelope is maintained at a positive potential with respect to the cathode.

Bars at $B$ are maintained at cathode potential so that radial electron beam sectors are generated for specific control of the beams. Variable potentials applied to the bars would, in effect, modulate the electron stream and, accordingly, the output of the traveling wave tube.

In the patent description, various techniques are disclosed by which the fields may be directed and concentrated within the waveguide spirals to effect differences in electron speed within the guide and the phase relationship of the waves propagated within the guide.

The inventor also claims that by connecting reactive coupling means in appropriate places in the circuit the traveling-wave tube can be made into an oscillator at very high frequencies.

Patent 2,600,961 on a very similar device that does not show waveguide structures was issued some five months earlier to one Diemer, and is assigned to Hartford Na-
Throughout the free world's sky lanes, EAD electrical devices protect, control and actuate aircraft equipment on both commercial and military planes of many nations. Wherever the design requires small, lightweight, dependable rotating electrical units, the aviation industry has learned to rely on EAD for the answer.

Type B302H-1C VARIABLE FREQUENCY Centrifugal Blower. 115 volts, 320/1000 cycle, 50 C.F.M. at 0" S.P., single phase.

Type J31E-23 DUAL FREQUENCY Capacitor Run Induction Motor. 115 volt, 50/60 cycle—360/1600 cycle, single phase.

Type N2B-2 LOW HARMONIC Alternator. Content less than 2% total distortion on each phase. 7 volt, 30 cycle, 2 phase.

Type P4092H-1CC 400 CYCLE—RING MOUNTED Propeller Fan. 115 volt, 400 cycle, 130 C.F.M. at .5" S.P., single phase.

Type B7P3K-3 DOUBLE ENDED—VARIABLE FREQUENCY Centrifugal Blower. 115 volt, 320/1000 cycle, 80 C.F.M. at 0" S.P., single phase.

SOLVING SPECIAL PROBLEMS IS ROUTINE AT E A D

If your problem involves rotating electrical equipment, bring it to EAD. Our completely staffed organization will modify one of our standard units or design and produce a special unit to meet your most exacting requirement.

EASTERN AIR DEVICES, INC.
585 DEAN ST., BROOKLYN 17, NEW YORK
GAMEWELL LINEAR AND NON-LINEAR

Precision Potentiometers

To solve your specific precision potentiometer problem, send your specs and sample orders to Gamewell. With over 98 years of experience in manufacturing precision electrical products, Gamewell can provide the answer promptly.

Linear and non-linear units are described in the Gamewell Precision Potentiometer booklet. The booklet also contains a convenient glossary of terms used in conjunction with precision potentiometers. Write for your copy.

THE GAMEWELL COMPANY
Newton Upper Falls 64, Massachusetts

ELECTRONS AT WORK

The inventor points out that every disturbance voltage is characterized by its own frequency, generally of a lower order than the desired frequency received by the radio receiver. When the system of the invention is properly adjusted for minimum interference, voltages of interfering energy are of the same character in both antennas and equal in magnitude but opposite in polarity, thus, balancing out. The desired signal voltages will not balance out. A lengthy mathematical justification is incorporated in the patent to which the reader is referred for further study.

Recent patent 2,617,854 issued to H. E. Van Valkenburg for an "Induced Voltage Flaw Detector", describes a technique for detecting flaws in the surface of magnetic metals. The patent is assigned to the General Electric Co.

The arrangement of apparatus is shown in Fig. 8. Horizontal sweep voltages are generated for a cathode-ray oscilloscope indicating sys-
range of voltage regulator ratings and types available from stock

STANDARD TYPE "CV" UNITS:
15 VA to 10,000 VA
Most voltage regulating requirements can be met from these "stock" voltage regulating transformers. Regulation is ±1% or less with a total primary voltage variation as great as 30%. This is the static-magnetic voltage regulator that has become the "Standard of the World."

CUSTOM DESIGNED UNITS: 1 VA to 25,000 VA
The wide flexibility of the Sola Constant Voltage principle makes possible special designs to meet your specific requirements. Often, time and money can be saved by direct use or modification of a regulator from the several hundred special designs on file. Custom designs can include: Special Voltage Ratios, Special Frequencies, Compensation for Frequency Variation, Multiple Output Voltages, Three-Phase Service, and Military Specifications.

SOLA Constant Voltage TRANSFORMERS

HARMONIC NEUTRALIZED
...less than 3% harmonic distortion
±1% regulation.

PLATE AND FILAMENT
...±3% regulation or less...single, compact voltage source.

VARIABLE AC VOLTAGE SUPPLY
...less than 3% harmonic distortion
±1% regulation.

TELEVISION ACCESSORY REGULATOR
...±3% regulation...inexpensive...plug-in type.

COMPLETE CATALOG
Write on your letterhead for our new Constant Voltage Catalog. It gives complete specifications and operating data on SOLA Constant Voltage Transformers, including special units. Request Bulletin D.CV-142

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Airport Lighting • Series Lighting • Luminous Tube Sign • Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois

ELECTRONICS -- April, 1953

Want more information? Use post card on last page.
**VICTOREEN'S**

**VOLTAGE REGULATOR TUBES**

Replace expensive electronic regulating circuits.

- RELIABLE
- LONG LIFE
- SPACE SAVING

For applications requiring reliable voltage regulation in low current circuits... Consider the advantages of a single tube to perform one of these vital functions:

- Voltage regulation of power supplies.
- Voltage reference for control of higher currents.
- Voltage limiting to prevent circuit overloading.
- Voltage adjustment for fine control of precision power supplies.

Write for additional specifications.

<table>
<thead>
<tr>
<th>GLOW TUBES</th>
<th>Maximum Current 800 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>57 Volts</td>
<td>Regulation 200-800 µA is 3.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH VOLTAGE REGULATORS</th>
<th>Maximum Current 100 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 to 2500 Volts</td>
<td>Regulation 5-55 µA is 1.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH VOLTAGE REGULATORS</th>
<th>Maximum Current 250 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000 to 5000 Volts</td>
<td>Regulation 5-55 µA is 1.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH VOLTAGE REGULATORS</th>
<th>Maximum Current 100 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000 to 15,000 Volts</td>
<td>Regulation 10-60 µA is 1.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADJUSTABLE REGULATORS</th>
<th>Maximum Current 55 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>645 to 705 Volts</td>
<td>Regulation 5-55 µA is 3%</td>
</tr>
</tbody>
</table>

**DISTRIBUTORS**

- Allied Radio Corp., Chicago
- Gifford-Brown, Des Moines
- Harrison Equipment Co., Houston
- Radio Shack Corp., Boston
- Terminal Radio Corp., New York City
- W and W Distributing Co., Memphis

**WEST COAST REPRESENTATIVE**

Carlton Engineering Co., Los Angeles

**BETTER COMPONENTS MAKE BETTER INSTRUMENTS**

**The Victoreen Instrument Co.**

3800 Perkins Ave. - CLEVELAND 14, OHIO

---

**ELECTRONS AT WORK**

(continued)

**FIG. 8—Induced-voltage flaw detector**

The system by the action of a motor-driven slider and crank-link mechanism driving a potentiometer back and forth across a source of voltage. A permanent horseshoe magnet coupled to the slider crank link oscillates across the surface area of the magnetic material under examination. A pickup coil is wound about one leg of the magnet. The pickup coil is coupled to an amplifier. The amplifier output is applied to the vertical plates of the oscilloscope.

The system operates similarly to the sweep analysis of a radio or audio-frequency spectrum. Horizontal sweep voltages are synchronized with the scanning of the metal under analysis. During the sweep as the magnet oscillates over the surface of the metal, which is moved at a slow uniform rate beneath the magnet, any discontinuity in the granular structure of the metal or any mechanical flaws or cracks will result in a difference in the magnetic flux induced within the metal by the magnet. The flux changes induce a voltage in the pickup coil. The variable voltage resulting therefrom is amplified and displayed on the scope. Fig. 9A, 9B and 9C show, respectively, the waveform produced by a crack in a homogenous portion of the metal, a crack in a welded portion and an unbroken, welded portion of metal under test.

A variation of the system is shown in Fig. 10. Here, a high-resolution oscilloscope...

**FIG. 9—Typical patterns for**

(A) cracked, (B) crooked and welded, (C) welded metal

April, 1953 — ELECTRONICS
Another new member of the CLEVELITE* family

Torkrite Tubing in foreground, enlarged to show detail.

TORKRITE Clevelite EE Internally Threaded and Embossed Tubing

ELIMINATES TORQUE AND STRIPPING PROBLEMS

Electronic engineers find that TORKRITE, this newly designed and constructed Coil Form, has definite advantages over all other types requiring the use of threaded cores.

TORKRITE is one of the many items of CLEVELITE... a complete line of tubing for coil forms, collars, bushings, spacers, tubes and other items.

CLEVELITE has long been giving continuous satisfaction because of its dependable performance, uniformity and close tolerances.

Consult our Research and Engineering Laboratory. It is at your service.

WHY PAY MORE? FOR THE BEST ... CALL CLEVELAND!


The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Plymouth, Wis., Chicago, Detroit, Ogdensburg, N. Y., Jemison, N. J.

ABRASIVE DIVISION at Cleveland, Ohio

CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 GENERAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 515 N. RAVENSWOOD AVE., CHICAGO

ELECTRONICS — April, 1953
Meet the Redheads... tops for tape recording

See how the latest additions to the Brush family of magnetic recording components can improve your tape recorders!

The BK-1090 record-reproduce head has the standard track width designed for dual track recording on ¼ inch tape. It provides unusually high resolution and uniformity over an extended frequency range. Cast resin construction assures dimensional stability, minimizes moisture absorption, and affords freedom from microphonics. Its balanced magnetic construction, precision lapped gap, Mu-metal housing, and single-hole mounting provide important design advantages.

The BK-1110 erase head has the same basic construction as the companion record-reproduce unit. Its outstanding feature is its efficient erasing at low power consumption—less than ½ voltampere.

Investigate these new "Redheads" for your magnetic recording. Your inquiries will receive the attention of capable engineers. Write Brush Electronics Company, Department K-3, 3405 Perkins Avenue, Cleveland 14, Ohio.

ELECTRONS AT WORK

(continued)

FIG. 10—Alternative technique using electronic sweep for flaw detection

frequency oscillator excites a winding about the center leg of a laminated E-shaped core and induces a voltage in a second winding. The latter winding is coupled to a detector and amplifier, the output of which in turn is applied to the vertical plates of the scope. Horizontal sweep is applied internally to the scope.

So long as the metal is moving beneath the laminated E-shaped induction coil, the coupling between the oscillator winding and the pick-up winding is constant. Any variation in the metal structure owing to flaws in the granular structure, or cracks, will result in a difference in the coupling and a change in the amplitude of the resultant signal displayed on the scope.

An invention of Heinz E. Kallman of New York, N. Y., entitled "Electron Multiplying Device" was awarded patent 2,617,948. The inventor claims that the novel features of his invention are applicable to all types of electron multiplier devices whether photocathode or grid controlled.

It is well known that there is a residual current (termed the inventor, standing current) in the conventional electron multiplier. The amplification of the electron multiplier applies as well to the residual direct current as it does to the modulation component. Since some of the input signals to such a tube are relatively weak, the ratio of the signal level to the residual d-c remains in the output. This limits the usable magnification range of the electron-multiplier devices within which the residual current is manageable.

It is the inventor's object to make...
Here's a completely new rotary exhaust machine for higher speeds, higher vacuums

On a continuous, non-indexing basis, CVC's new rotary exhaust machine provides automatic base sealing, tube exhaust, and final tip-off at rates 25 to 30% above normal. And it produces a pressure of 1 micron or lower at each tube port as compared with the usual 10 to 100 microns.

Designed for miniature electronic tubes, this new machine can be converted for use on larger or smaller tubes if necessary. An indexing feature is easily added if required for such an operation as precise forming.

To reduce down time and maintenance to a minimum, each of the 16 pumping units is a readily removable package containing mechanical pump, diffusion pump, cycling valve and tube port—the entire head can be removed and replaced in a matter of minutes. One electric motor operates all the mechanical pumps, another drives the turret.

A simpler version of the machine is now being employed to pump vacuum bottles and can be adapted to other continuous vacuum pumping and sealing tasks.

To find out more about how this new exhaust machine can speed tube production, reduce costs and improve tube quality, write to Consolidated Vacuum Corporation, Rochester 3, N. Y. (A subsidiary of Consolidated Engineering Corporation, Pasadena, Calif.) Sales offices: Menlo Park, Calif. • Chicago, Ill. • Camden, N. J. • New York, N. Y.

Consolidated Vacuum Corporation
Rochester 3, N. Y.
high vacuum research and engineering
much greater magnifications possible in a single-stage electron-multiplier circuit by constructing the multiplier to include an extra control grid, interposed either between a pair of dynodes in the electron stream, or between the final dynode and anode, and an external circuit for coupling a modulation component derived from an early dynode such as No. 1 in Fig. 11 to the control grid following a subsequent dynode closer to the anode.

By this technique, the originally low depth of modulation may be increased by amounts approaching 100 percent.

The technique may be termed remodulation of the electron multiplier and has been described in the literature: H. E. Kallman, Remodula-

FIG. 11—Electron multiplying device applicable to television


An invention relating to a method for analyzing combustible gases has been awarded U.S. Patent 2,617,716. The inventor, Ralph E. Hartline, of Tulsa, Oklahoma, has assigned the patent to Stanolind Oil and Gas Co., of Tulsa.

In the previously used combustible gas analyzing systems one of the problems encountered has been zero drift of the indicating apparatus employed and also in local heating filamentary sampling chambers results in ambient temperature changes that upset the accuracy of such instruments.

Combustible gas analysis is accomplished by permitting a gas sample under analysis to pass through a chamber containing a filament that acts as a load across a source of a-c potential. The heating of this filament in the gas...
Litton is now building a new addition to its vacuum tube plant at San Carlos, California. This expansion will approximately double tube development and manufacturing facilities and will allow expansion of our affiliate, Litton Engineering Laboratories, which has taken over the manufacture of glassworking lathes and other machine products. Like the plant completed last year, the new building has been designed specifically for vacuum tube manufacture; it has similar reinforced concrete block walls with large glass-block panels for diffused daytime illumination.

Included is complete environmental control of temperature, sound, light and air for optimum manufacturing conditions.

Increasing demand for Litton products has brought about this expansion, and we expect that the added capacity will provide greater volume and service to our friends in industry.

Concurrent with plant expansion is a marked increase in the variety of pulse and CW magnetrons for radar, beacon and countermeasure equipment. It is quite possible that Litton Industries now has in production or development the specific tube to meet your needs.

Application of Litton design and processing criteria to all our tube types permits manufacture of tubes that require no aging racks in the plant or in the field and have long shelf life with snap-on operation to full rated power output immediately after completion of the cathode warm-up period.
PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC BLDG. Bronx
Boulevard at 216th St., N.Y.C. 67

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.

PYROFERRIC IRON CORES
are scientifically manufactured,
under strictest quality controls
and rigid maintenance
of close electrical
and mechanical tolerances.

PYROFERRIC services
are available for the engineering
of your core production requirements
... your letterhead request
for Catalog 22A
will bring you complete information
including the manufacture of iron
cores, their electrical properties,
materials, design considerations,
standardization data,
uses and other
helpful data.
A is for Advanced design...

Transport radar for terrain mapping and weather avoidance has taken a bold step forward. The AN/APS-42A is an advanced redesign by Pacific Division for the Services. It has been selected as the standard design.

This Bendix-Pacific development provides simplicity of operation, maximum reliability and minimum maintenance...all with a substantial saving in weight.

The advanced design of the Bendix-Pacific APS-42A is typical of what this Division's electronic engineers are accomplishing in designing new equipment for practical use. In addition to airborne radar systems, our engineers have established leadership in the fields of sonar, tele-metering, missile guidance systems and radio control. Our engineering achievements are backed up with manufacturing capacity and know-how in the form of three large, modern plants. We are interested in developing new, practical designs in these fields for you.

You are invited to write for a copy of the booklet "Electronic Progress at Bendix-Pacific"
for

Consistent

Highest

Quality

Rectifiers...

\[ \sqrt{\text{VICKERS REFINES ITS OWN SELENIUM!}} \]

A QUALITY CONTROL THAT MEANS MORE UNIFORM, DEPENDABLE PERFORMANCE FOR YOU!

Selenium rectifier performance depends upon the purity of selenium used. Vickers Electric Division establishes complete quality control at the very beginning . . . with its own refining plant and testing laboratories. Producing uniformly pure selenium for Vickers rectifiers is an important step in assuring more consistent performance characteristics, and stable, long-life rectifiers.

more reasons why VICKERS makes a better rectifier:

- 255 separate tests and inspections.
- Automatic electroforming "pre-stressed" cells.
- Precision-matched cells prevent overload-overheating.
- Hydraulic assembly assures mechanical strength and dimension.
- Rectifiers shock and vibration tested to military specifications.

Write for Bulletin 3000. Vickers engineering service is available without obligation.

ELECTRONS AT WORK (continued)

geochemical analysis in oil wells. It is one of many examples of the increasing employment of the electron tube arts in the oil and other geophysical industries.

X-Ray Image Amplifier

Fluorescent screens used by physicians in examining patients by x-ray have an efficiency of about 5 percent. To see the fluoroscopic image, the radiologist must dark-adapt his eyes for at least 20 minutes. A newly developed image amplifier reduces this time to about four minutes.

Increased brightness of the x-ray image has been attained by converting x-ray energy into light with a fluorescent screen and thence to electrons by means of an adjacent photoelectric surface. Electrons are accelerated by a high potential placed across the vacuum tube to give a brightness gain of 10 or more. Further gain is attained by electrostatic focusing of the electron stream to reduce the image to approximately a fifth its original size.

The reduced image, made up of high-speed electrons, impinges on a phosphor output layer that converts the electron stream back to a visible image, brightened 200 times. As a final step, the intensified image is magnified by means of an optical system without loss of brightness.

The intensification achieved by reducing the image size in the electron-optical system is possible because the brightness is increased in inverse proportion to the area. This results from all the electrons being utilized in forming the image. When the area is reduced, the total energy therefore remains constant. Thus the energy per unit area, which is
good transformers must begin with good components!

ARCO Transformers

The Arco Transformer and Electric Corporation—Division of the National Mill Supply Corporation—of Fort Wayne, Indiana, uses Heldor transformer cans and compression-type terminals as a practical production practice that saves time, money and worry in meeting MIL-T-27 and commercial specifications.

You, too, can effect substantial savings in your transformer (and other electronic equipment) assemblies when you STANDARDIZE ON THE CONSISTENTLY UNIFORM, HIGH QUALITY HELDOR COMPONENTS. Better still, you'll effect even GREATER SAVINGS when you use Heldor's complete "package"... cans with Heldor's compression-type bushings ASSEMBLED in can covers.

It will pay you to secure quotations from HELDOR on your requirements. Just send prints or specifications on your needs... and you'll receive FACTS that prove what other manufacturers already know... HELDOR is QUALITY you can count on... at money-saving prices.

Send for that quotation today!

WRITE FOR HELDOR'S NEW CAN CATALOG!

HELDOR MANUFACTURING CORPORATION
HELDOR BUSHING & TERMINAL CO., INC.
225 Belleville Ave., Bloomfield, N. J.

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

Heldor CANS and TERMINALS

HELDOR DRAWN CANS Now Available!
Several sizes and types. Write for Details!

www.americanradiohistory.com
TO:

Engineering Dept.
The only miniature snap switch where size and high rating come to terms with cost!

Illustrated. Model BF, single-pole, double-throw, 15 A; 125 V. A. C. Overall length, 1/4".

The most practical and economical solution to difficult switching problems ever devised . . . TYNISWITCH.

Like no other snap switch made, this compact, low cost, snap-action unit permits high load switching in a minimum amount of space. It eliminates the need for costly, non-functional bulk in new or redesigned products. Its high force-to-inertia-ratio spring blade inhibits mechanical resonance . . . assures smooth, high-speed operation with positive, bounceless closure. And as for dependability—conclusive laboratory tests have proven that TYNISWITCH is consistently reliable at high operating speeds . . . for over millions of cycles!

Consider these important design and production advantages now. New TYNISWITCH models can be developed to fit your exact switching speeds and specifications—or you can select conventional circuit arrangements from a variety of standard units. Write for complete details. TYNISWITCH Division, The Sessions Clock Company, 104 East Main St., Forestville, Conn.

ELECTRONS AT WORK (continued)

proportional to brightness, must go up.

Limitations of the optical magnification that can be obtained without loss of brightness make it unprofitable to reduce the electron image to less than one fifth the size of the x-ray image. The reduced image seen through an ordinary optical magnifier appears normal size.

Radiation hazard to radiologist and patient is basically the same as with conventional fluoroscopy, but there are two ways in which significant reductions of the hazard are possible. First, the radiologist may reduce the intensity of the x-ray beam, for example to one fourth the usual amount. Under these conditions he will still have an image 50 times brighter than the conventional. Second, because he learns what he wants to know so much quicker, the examination time and hence the radiation exposure is greatly reduced.

In addition to shorter examinations, such techniques as stereo-fluoroscopy and even the televising of fluoroscopic images may become practical. These possibilities are in addition to the advantage that the physician is able to perceive objects presently indiscernible.

Replenisher for Hydrogen-Filled Tubes

By J. H. JUPE
Middlesex, England

A DEVICE for automatically replenishing hydrogen removed from tubes by clean-up consists of an evacuated nickel capsule that contains a small amount of zirconium hydride. When the capsule is heated to a temperature exceeding 400 deg. C, hydrogen evolved from the hydride can diffuse through the walls. When cold, the nickel container prevents the return of the hydrogen to the hydride where it would be reabsorbed.

Automatic operation is obtained by attaching the capsule to the plate of a hydrogen-filled tube. As pressure within the tube falls owing to the clean-up process the voltage drop across it rises increasing the power dissipated at the plate. The increased dissipation raises the
miniaturization through critically precise components

RDM is dedicated to the research, development and/or manufacture of custom-made, high precision components for electrical, mechanical and electronic devices.

Component reliability is the sole aim... the result, a perfect reproduction of the design. Made-to-order parts meet your most exacting tolerances and diverse requirements.

Production schedules assured.
A brochure is yours for the asking. WRITE.

RESEARCH DEVELOPMENT MANUFACTURE INCORPORATED 425 EAST COLLOM STREET, PHILADELPHIA 44, PA.
Busy as Beavers at MILO

Yes, we are busy as beavers. But we take the time to gnaw on your component problems, because we do give a "dam" about the people who build electronic devices.

If you are sure what you want and want to be sure you will get it, call MILO.

If uncertain a component will do exactly what you want, or fit exactly as it must, call MILO. We may know more than the book says about it. Or know of a part that will do it better.

We have many lines and many numbers. And men who know our stock from origin to end use.

MILO sells components. We gladly give of our experience. Gained from busy years as industrial distributing specialists for the leading brands of electronic components and test instruments.

CHECK LIST (A-C) of LEADING BRANDS IN STOCK

<table>
<thead>
<tr>
<th>Acro-Switch</th>
<th>A.T.B.</th>
<th>Cetron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Electric</td>
<td>Barker &amp; Williamson</td>
<td>Chicago Telephone</td>
</tr>
<tr>
<td>Aerovox</td>
<td>Belden</td>
<td>Supply Co.</td>
</tr>
<tr>
<td>Aircraft Marine Products</td>
<td>Birnbach</td>
<td>Chicago Transformer Co.</td>
</tr>
<tr>
<td>Allen Bradley</td>
<td>Billey</td>
<td>Cinch-Jones</td>
</tr>
<tr>
<td>Allied Control</td>
<td>Bogen</td>
<td>Clarostat</td>
</tr>
<tr>
<td>Alpha Wire</td>
<td>Bud</td>
<td>Conant Labs</td>
</tr>
<tr>
<td>American Beauty</td>
<td>Burgess</td>
<td>Consolidated Wire Co.</td>
</tr>
<tr>
<td>Amperite</td>
<td>Busmann</td>
<td>Continental Carbon (Nobelay)</td>
</tr>
<tr>
<td>Amphenol</td>
<td>Cannon</td>
<td>Cornell-Dubilier</td>
</tr>
<tr>
<td>Arco</td>
<td>Cardwell</td>
<td>Crest labs.</td>
</tr>
<tr>
<td>Arrow-Hart &amp; Hegeman</td>
<td>Carter</td>
<td></td>
</tr>
<tr>
<td>Astron</td>
<td>Centralab</td>
<td></td>
</tr>
</tbody>
</table>

JAN-APPROVED COMPONENTS

FREE INDUSTRIAL TUBE BOOKLET

Chief Engineers, Purchasing Agents, Purchasing Executives! Write now if you haven't received our Industrial Electronic Tube Booklet #EB. Use company letterhead and state your title. Address Dept. E-4.

the ONE source for ALL your electronic needs

MILO RADIO & ELECTRONICS CORP.

ELECTRONICS FOR INDUSTRY

200 GREENWICH STREET, NEW YORK 7, N. Y. • Phone Beeckman 3-2980

Teletype NY1-1839 • Wire MILO-WUX-N.Y. • Cable MILOLECTRO-N.Y.

222 Want more information? Use post card on last page.

ELECTRONS AT WORK (continued)

Remote Control Caps TV Camera Lens

By C. J. Auditors
Facilities Engineer
WOR-TV
New York, N. Y.

IT IS SOMETIMES desired to operate a television camera in a fixed position, focused on a predetermined scene without the benefit of a camera operator in attendance. To avoid retention of a scene, called burning-in, the image orthicon camera tube should never be allowed to remain focused on a stationary bright scene for more than a few minutes at a time. Therefore, it is necessary effectively to cap the lens by some other than physical means.

An electronic lens capping method has been tested at WOR-TV and has proved to be satisfactory. To understand it, it is necessary to examine the operation of the image section of the tube. The image section contains a semitransparent photocathode on the inside of the face plate, a grid to provide an electrostatic accelerating field, and a target that consists of a thin glass disk with a fine mesh screen very closely spaced to it on the photocathode side. Focusing is accomplished by means of a magnetic field produced by an external coil, and by varying the photocathode voltage. Light from the scene being televised is picked up by an optical lens temperature of the plate and causes the capsule to operate. When sufficient hydrogen has been evolved to restore the correct pressure, plate heating is reduced and the evolution of hydrogen ceases.

FIG. 1—Effective lens capping for a camera in the TK-10A chain is accomplished by insertion of a toggle switch as shown

April, 1953 — ELECTRONICS
"Designed for Application"

Delay Lines and Networks

The James Millen Mfg. Co., Inc. has been producing continuous delay lines and lump constant delay networks since the origination of the demand for these components in pulse formation and other circuits requiring time delay. The most modern of these is the distributed constant delay line designed to comply with the most stringent electrical and mechanical requirements for military, commercial and laboratory equipment.

Millen distributed constant line is available as bulk line for laboratory use and in either flexible or metallic hermetically sealed units adjusted to exact time delay for use in production equipment. Lump constant delay networks may be preferred for some specialized applications and can be furnished in open or hermetically sealed construction. The above illustrates several typical lines of both types. Our engineers are available to assist you in your delay line problems.
system and focused on the photocathode, which emits electrons from each illuminated area in proportion to the intensity of the light striking the area. This stream of photoelectrons is focused on the target by the magnetic and accelerating fields. On striking the target, the photoelectrons cause secondary electrons to be emitted by the glass. The secondaries thus emitted are collected by the adjacent mesh screen. Emission of the secondaries leaves on the photocathode side of the glass a pattern of positive charges corresponding to the pattern of light from the scene being televised. Because of the thinness of the glass target the pattern will burn-in if it is stationary and prolonged in duration.

This pattern will be completely discharged by the scanning beam on the opposite side of the glass if the flow of photoelectrons from the photocathode is interrupted either by capping the lens or by removing the electrostatic accelerating potential between the photocathode and the target.

The photocathode is normally operated at approximately −425 volts while the target voltage is somewhere within the range of ±3 volts. The photoelectron stream can be cut off, therefore, simply by grounding the photocathode and its associated accelerating grid 6. This voltage is controlled by a potentiometer in the remotely located camera control unit of the RCA TK-10A camera chain. The addition of a toggle switch is all that is required effectively to cap the lens as shown in Fig. 1. It is necessary only to remove dashed wiring between points X-X and install a single-pole double-throw toggle switch.

**Ultrasonic Method of Tire Inspection**

ULTRASONIC EQUIPMENT can be used to detect internal flaws in tires, but because of the geometric shape of a tire, the tread pattern and the need for inspecting a relatively large area in a short time, special problems are introduced. In the device described a circuit...
Features:

1. Ruggedized construction
2. Welded anchor pins
3. Triple moisture protection
4. Self-insulating case
5. Vibration resistant
6. Shock resistant
7. Higher efficiency
8. Stability of characteristics
9. No flaking

Types Available

- 1N48
- 1N51
- 1N52
- 1N60
- 1N65
- 1N69
- 1N70
- 1N75
- 1N81
- JAN types

All types available for prompt shipment
MILLION-DOLLAR DIALS

... for pennies!

Self-luminous, fluorescent, phosphorescent, or nonluminous—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—better dial design, or lower cost, or both—write Dept. E-4, U. S. Radium Corp., 535 Pearl Street, New York 7, N. Y.

Other Products of U. S. Radium

RADIOACTIVE FOILS
(alphabetic ionization sources)
IONOTRON STATIC ELIMINATORS
RADIONUM LOCATORS:
pendants, lenses, buttons, screws, markers

LUMINOUS RETICLES
and other specialties
POWERS:
cathode-ray tube and television tube
SILHOUETTE ILLUMINATION
of clocks, watches and instruments

UNITED STATES RADIONUM CORPORATION

BE T T E R  D I A L S  A T  L O W E R  C O S T

ELECTRONICS AT WORK (continued)

providing a frequency-modulated signal sweeping from 34 to 46 kc is used. To allow moving the tire while in contact with the microphone and transmitting unit a liquid bath is used as a sound transmitting agent. The tire is placed in the liquid bath and a transducer and a microphone are placed opposite each other in the liquid with the portion of the tire under examination between the two. Rotating the tire allows inspection of the entire surface.

Inspection in this manner will detect separations in the tire structure, internal breaks, and porosity or looseness around the cords. Cuts and external breaks will give an indication if there is a film or pocket of air trapped in or around the break. Most small clean cuts will give little or no indication. If, however, there is a rotted or separated area around the cut where the liquid does not penetrate the fault will be indicated.

Electronic Equipment

The ultrasonic driver unit is shown in Fig. 1. A Colpitts oscillator circuit is used, the frequency of which is continuously varied by a motor-driven capacitor. The motor operates at 1,200 rpm sweeping the frequency range forty times a second. Trimmer capacitors are used to set the sweep range to the desired values. A 6N7 resistance-coupled amplifier provides about two watts of power to drive the crystal transmitter. The crystal is...
For maximum tube life and performance, include G-E Inductrols as "original equipment"

Automatic voltage regulation provides an effective and economical means of avoiding losses in power capacity

The life and efficiency of the electronic equipment you manufacture depends, to a large extent, on the performance of the electronic tubes. Tube life is adversely affected by over- or under-voltage conditions that can easily be prevented.

G-E dry-type induction voltage regulators, called Inductrols, offer you an effective and economical means of maintaining correct operating voltage. Two types are available for indoor service on circuits 600 volts and below, single-phase 3 to 240 kva; three-phase 9 to 520 kva.

1. **Automatic** Inductrols maintain a closely regulated output voltage from a varying supply voltage with a bandwidth of ±1%. The standard range of regulation is plus and minus 10%.

2. **Hand-operated** or **manually controlled motor-operated** Inductrols provide a variable output voltage from a relatively constant supply voltage. They supply 100% raise and 100% lower regulation.

**Typical applications** for G-E Inductrols that have proved highly effective include: radar equipment, induction heating equipment, medical and industrial x-ray equipment, TV and radio transmitters.

For further information, contact your nearest G-E sales office, agent or distributor...or return the attached coupon.

**HERE’S HELPFUL G-E DATA ON INDUCTROLS**

For full details on dry-type induction voltage regulators, return this coupon...today!

- Single-phase **INDUCTROLS**, indoor service
  - 600 volts and below on circuits 3 to 240 kva—GEC-795A
- Three-phase **INDUCTROLS**, indoor service
  - 600 volts and below on circuits 9 to 520 kva—GEA-5824
- Application bulletin, Inductrols and electronic equipment—GEA-5936
- General Electric Company
  - Section 423-201, Schenectady 5, N. Y.

Name _______________________

Company ___________________

Address ____________________

City ________________________ Zone ______ State ________
AIRPAX has the most revolutionary miniature chopper!

weighs only 1.2 ozs.

the AIRPAX "MIDGET"

Small size and big performance have won wide acclaim for the C747 MIDGET chopper in the short time since production was released. Available with SPDT contacts, a 6.3 volt drive for 400 cycle operation, usually a 380 to 420 cycle frequency range. Phase angle measured from a driving sine wave to midpoint of contact dwell is a nominal 65°, with a dwell of approximately 135°. Units operate successfully over a very wide temperature range, are fully hermetically sealed and may be exposed to high altitudes, humidity, vibration and shock without damage. Write for bulletin C747.

surrounded by castor oil and enclosed in a waterproof rubber housing.

The microphone pickup (Fig. 2) is in contact with a thin metal diaphragm in the end of a watertight cylindrical metal container. To make the response of the microphone directional the metal container is surrounded by a metal wall with an air space between.

The amplifier contains two high-gain resistance-coupled stages, the output being rectified and observed on a microammeter. A portion of the rectified output voltage is filtered and applied to the grid of a thyratron as a negative bias. When the amplifier output drops below a predetermined value, the thyratron fires, actuating a relay that turns off a green pilot lamp and turns on a red one indicating a defect in the tire. Since the plate supply of the thyratron is from the high voltage a-c winding of the power transformer the tube will be extinguished as soon as the negative bias is resumed.

In use the input potentiometer is adjusted to give about 80-percent full-scale reading when a tire without defects is placed on the test stand. The bias of the thyratron is then adjusted so that it will be triggered when the reading drops to about 50 percent of full scale.

Gearing permits the transducer and microphone to be moved together across the tire from shoulder to shoulder. This movement together with rotation of the tire allows the inspection of any portion...
Precision MANUFACTURING Services
by the
HAMILTON WATCH COMPANY
America’s Leading Precision Manufacturer

THE Hamilton Watch Company’s Precision Services Division can produce small quantities of precision rolled strip or precision drawn wire in special alloys to your exact specification.

Special equipment and highly trained personnel enable us to offer a complete service, from melting and pouring the ingot to producing the finished strip or wire.

We can cast 3 to 25-pound ingots to extremely exacting specifications. Our Sendzimir Mill can roll strip in widths of 2 to 4 inches, down to thicknesses as fine as .001, with tolerances of plus or minus .0001. We can draw wire to even finer tolerances.

Hamilton’s Precision Services are set up to accurately melt, cast, forge, roll, and finish special alloys. We can do these jobs for you:
- Precision Sendzimir mill rolling
- Precision slitting of wide strip
- Hot and cold rolling of strip to standard mill specifications
- Re-rolling of strip to accurate dimensions
- Accurate wire drawing to closer than commercial tolerances
- Wire straightening
- Polishing

For complete information about Precision Services available at the Hamilton Watch Company, call or write—

Precision Services Division

Hamilton WATCH COMPANY
Lancaster 5 • Pennsylvania

Want more information? Use post card on last page.
SEEING IS BELIEVING

Supplying the right answers to pilots and navigators by means of accurate, reliable instruments has been our work for more than twenty-four years.

AIRCRAFT INSTRUMENTS AND CONTROLS
OPTICAL PARTS AND DEVICES
MINIATURE AC MOTORS
RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT

Current production is largely destined for our defense forces; but our research facilities, our skills and talents, are available to scientists seeking solutions to instrumentation and control problems.

A Recorder Bias and Audio Level Measuring Instrument

DOUGLAS E. TAYLOR
Asst. to Div. Engineering
Dictaphone Corp.
Bridgeport, Conn.

The correct A-C bias and audio signal level at the recorder head are two important factors in obtaining the best possible results from a magnetic recording machine. These two values are combined in the voltage across the recording head. They can be separated by making the audio measurement with the high-frequency bias set at zero, or making the bias measurement with the audio signal set at zero.

However, it is almost always more convenient to make these measurements with both currents at normal operating levels. The circuit described here shows how this can be done with a single instrument using a dpdt switch and a combination of two inductances, two capacitors and some resistors. These are all contained in a small meter box as shown in the photograph.

This unit is normally connected to the recording machine panel by two well-insulated but unshielded cables. One end of each cable is plugged into the instrument box and the other ends are plugged into receptacles on the recording machine panel that are directly connected to the terminals of the recording head.

The a-f signal may extend over

of the tire.

Thorough, rapid wetting of the tire by the liquid bath is necessary for accurate and quick inspection. For this reason denatured industrial grain alcohol was used with the added advantage of rapid drying after inspection.

Inspection of a bus tire takes from five to fifteen minutes depending on the tire quality and the thoroughness desired.

This article has been abstracted from a paper entitled “Ultrasonic Method of Tire Inspection” by W. E. Morris, R. B. Stambaugh and S. D. Gehman appearing in the Dec. 1952 issue of Review of Scientific Instruments.
It’s helping to win the Battle of the Watts

When you keep down the power needed to send voices by telephone you keep down the special equipment needed to supply that power. A great new power saver for telephony is the Transistor, invented at Bell Telephone Laboratories, and now entering telephone service for the first time.

Tiny, simple and rugged, the Transistor can do many of the things the vacuum tube can do, but it is not a vacuum tube. It works on an entirely new principle and uses much less power than even the smallest tubes. This will mean smaller and cheaper power equipment, and the use of Transistors at many points in the telephone system where other equipment has not been able to do the job as economically.

It’s another example of how Bell Telephone Laboratories makes basic discoveries, then applies them to improve telephone service while helping to keep its cost down.

TRANSISTOR FACTS

Created by Bell scientists. First announced in 1948.

Has no glass bulb, requires no filament current or warm-up period. Operates instantly when called upon. Uses no energy when idle.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

Want more information? Use post card on last page.
ELECTRONS AT WORK

(continued)

THE Mayhill PLATING PROCESS GUARANTEES ACCURATE PLATING IN ELECTRONICS!

Since 1946, M-W LABORATORIES has electroplated precious metal for suppliers to the U. S. Army, U. S. Navy, Atomic Energy Commission and to leading manufacturers in the electronics industry.

M-W LABORATORIES, featuring their Mayhill Plating Process, are equipped to plate these precious metals: gold, silver, rhodium, palladium, albaloy and indium.

Controlled thickness, smoothness, color, hardness and adhesion of plating is assured through constant testing by our own chemists and engineers, in our chemical and metallographic laboratory.

Contact us for a no-cost-to-you consultation on your plating problems.

M-W Laboratories, Inc.
1824 N. Milwaukee Ave.
Chicago 47, Illinois

the range of 30 to 15,000 cycles, but for many purposes a much narrower band suffices. The bias frequency is four or more times the highest recorded frequency. For 5,000 cycles, the bias frequency would be 20,000 cps or more. This separation makes possible a simple filter circuit that will pass one frequency and reject the other to a degree sufficient for a practical measuring device.

In the particular application for which this instrument was designed the actual voltage readings were not important, so the resistors were chosen to give a midrange reading. The current from the recording head is first passed through a series resistor $R_s$, which should be high enough to make the current drawn by the instrument small compared to that of the recorder. The load resistors $R_l, R_2$ are given a value that provides the correct filter termination impedance. The bias voltage is usually higher than the signal voltage so an additional resistor $R_b$ is connected to the junction point of $R_l-R_s$, providing a meter deflection for bias that is similar to that for correct signal level.

The two filters $L_1C_1$ and $L_2C_2$ are series and parallel-resonant filters both tuned for the a-c bias frequency, in this case 20,000 cps for a recording range of 200 to 5,000 cps. When the dpdt toggle switch is in the bias position, the series-resonant filter is in series with the meter and presents a very low impedance to the bias current, allowing it to pass through to the meter. The parallel-tuned filter bridged across the meter presents a very low impedance to all frequencies except the bias frequency.
TEFLON is a trademark of E. I. DuPont Co. for polytetrafluoroethylene. It is supplied by C-D-F in tapes and sheets, both plain and fibre glass cloth supported.

HEAT RESISTANT
Teflon may be used continuously at 200°C (392°F.), or for short periods at 250°C (482°F.). Meets A.I.E.E. Standards for Class H electrical insulation.

MOISTURE RESISTANT
Teflon products have practically zero water absorption and are unaffected by fungus, humidity and temperature changes. It remains pliable at -87.5°C (-130°F.).

ARC RESISTANT
Teflon will not carbonize, but rather will vaporize. When the arc is extinguished, full insulation is restored.

CHEMICAL RESISTANT
Teflon is the most inert of all commercial thermoplastics and is not affected by any known solvent.

THAT'S WHY C-D-F TEFLOM TAPES AND SHEETS CAN OFFER THESE BIG ADVANTAGES

FOR LINING SLOTS C-D-F sheets of fibre glass cloth supported Teflon can be cold-formed into easily loaded slot liners. Teflon is naturally slippery smooth, with plenty of "snap back." High in dielectric strength, liners are rated Class H insulation.

FOR WRAPPING CABLES C-D-F Teflon tapes are tough, strong, and stretchable. Teflon can be supplied unsupported, or combined with fibre glass fabrics in a variety of widths and thicknesses. It is suitable for winding around sharp bends or odd shapes.

FOR CHEMICAL AND MECHANICAL USES
Remember, Teflon is non-adhesive and chemically inert. Bakers, food packagers, and pump manufacturers use it. For applications requiring extreme electrical insulation stability, high temperature or resistance to corrosion, C-D-F unsupported and fibre glass cloth supported products can do a job for you.

C-D-F's work with Teflon is really rolling! New applications are being developed daily in our laboratories by specialists who are devoting their entire time to improving and developing new Teflon products. Start talking Teflon with the man from C-D-F (sales offices in principal cities)—he's a good man to know!

Continental-Diamond Fibre Company
NEWARK 16, DELAWARE

Want more information? Use post card on last page.

ELECTRONICS — April, 1953
STANDARD

Radio Interference
and Field Intensity

MEASURING EQUIPMENT

Complete Frequency Coverage—14kc to 1000 mc!

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

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

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

**UHF**
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 MIL-I-6181, MIL-I-16910, PRO-MIL-STD-225, ASA C63.2, 16E4, AN-I-24a, AN-I-42, AN-I-27a, MIL-I-67722 and others.

STODDART AIRCRAFT RADIO Co., Inc.
6644-A Santa Monica Boulevard, Hollywood 38, California • Hillside 9294

allowing these frequencies to bypass the meter.

In the audio position, the parallel-tuned filter is in series with the meter presenting a maximum impedance to the bias frequency but allowing the lower audio frequencies to pass through. The series resonant filter now bridges the meter presenting a very low impedance to any residual bias current that may have passed through the parallel-resonant filter so that essentially only audio current is passing through the meter.

Figure 1 shows the meter and its filter circuit bridging the recorder. The voltage drop across a resistance of about 5 ohms in series with the recorder coil could be used as a source of potential but some amplification would then be necessary. The output from the amplifier would be fed to the filter network. This arrangement was not used in this case because portability was important. The amplifier and its battery power supply would have made the unit bulky and much heavier.

This circuit has worked satisfactorily in a multiple-channel recording system where signals from a variety of sources are all recorded simultaneously on a single tape. The measuring device provides a quick and accurate method of occasionally checking the various amplifier and bias oscillator control settings for optimum operating values.

**Repairable Plug-in Circuit**

BY ROBERT H. HARWOOD
U. S. Navy Electronics Laboratory
San Diego, California

A NEW REPAIRABLE plug-in package unit that simplifies maintenance and reduced replacement parts inventory, has been developed by the U. S. Navy Electronics Laboratory. Made
It takes Class “H” insulation to withstand the relentless severity of extreme operating conditions... physical, chemical, dielectric, very high or very low temperatures... to remove the danger of breakdown under overload... to minimize fire hazards... to permit the design of longer life electrical components and equipment of minimum weight and size, without sacrifice of rated output.

You can depend upon MITCHELL-RAND for a full line of Class “H” insulation to meet every extremely severe electrical insulation requirement.

Write to MITCHELL-RAND for free samples and descriptive data.

MITCHELL-RAND INSULATION COMPANY, INC.
51 MURRAY STREET CORNELL 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 FOTHED 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

Want more information? Use post card on last page.
"Skew" ANTENNA*  
for VHF and UHF television

The ANDREW "Skew" Antenna is the only antenna which provides a circular radiation pattern from antenna elements placed around a supporting structure which is larger than a half wave-length on a side! With the "Skew" Antenna, it is possible to mount a multiplicity of TV antennas on the sides of tall buildings, on the sides of existing towers—even towers which also support a standard antenna on top. The economy offered by a joint operation of this type is obvious.

At present, the "Skew" Antenna is custom built for each installation and consequently general performance specifications cannot be delineated. However, ANDREW engineers will be glad to discuss its application to specific situations.

ANDREW four element "Skew" Antenna on the conical end of the mooring mast of the Empire State building, used as auxiliary by WJZ-TV. Lower on the mooring mast, artist’s sketch shows the 48 element ANDREW "Skew" Antenna to be installed for WATV.

*Patents applied for

FIG. 1—Navy Electronics Laboratory packaged replacement unit with section cut away to show placement of components

in one, two, three and four-tube sizes the units are all of the same width and height although length varies with the number of tubes. All circuit connections are brought out to an eleven-pin plug on the base of the unit. The plug is recessed to permit the body of the unit to come in contact with the mounting panel for maximum heat transfer.

The units shown in photographs are constructed on a fiber mounting board with holes punched and marked for all probable combinations of terminals required. The parts board slides into a pair of slots at the base of the package and another set in the cap. These slots provide a snug fit for the board, holding it firmly in place when the

FIG. 2—Plug-in package unit removed from housing. Standardization of base plug wiring reduces possibility of damage by plugging in wrong type of unit

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Miniaturized DC Relay

for military aircraft applications

IMPORTANT FEATURES
- Designed to meet U.S. Air Force Relay Specification MIL-R-5757
- Palladium Contacts... Six-pole, double-throw design
- Moisture-free-gas-filled... Hermetically sealed

Immediately available to prime suppliers and sub-contractors of military aircraft equipment, the new RCA-203W1 DC Relay is designed for general use throughout the electrical systems of military aircraft.

Built to operate under severe service conditions, and in any mounting position, the RCA-203W1 will provide longevity of service under extremes of temperature, humidity, shock, vibration and voltage variations. Because it is hermetically sealed in a steel envelope which is evacuated and filled with moisture-free gas, the coil and contacts are impervious to dust, moisture, and corrosion.

Its 6-pole, double-throw construction features palladium contacts rated to handle 2 amperes with a resistive load at 26.5 volts dc and 1 ampere with an inductive load at the same voltage. Contacts are arranged in a break-before-make sequence.

A technical bulletin covering ratings, dimensions, terminal connections, operating information, and descriptive data on shock, vibration, and life tests, is yours for the asking. Just write RCA, Commercial Engineering, Section 42DR, Harrison, N. J. . . or contact the nearest RCA field office.

FIELD OFFICES: (East) Humboldt 4-3900, 415 S. 5th Street, Harrison, N. J. (Midwest) Whitehall 4-2900, 580 E. Illinois St., Chicago, Illinois (West) Madison 9-3671, 420 S. San Pedro St., Los Angeles, California.

RADIO CORPORATION of AMERICA
ELECTRONIC COMPONENTS
HARRISON, N. J.
Take a good look at this New Powerhouse!

LOWEST COST per kilowatt!

HIGHEST OUTPUT per pound!

MOST COMPACT!

The ONAN "CW" Electric Plant
5,000 or 10,000 WATTS

Designed to fit every application better... standby, portable, mobile and stationary. Whatever your need for electric power, the new Onan CW-5 and 10 give you top performance and value!

Here for the first time are 5 and 10KW electric plants powered by revolutionary, new air-cooled gasoline engines, designed and built by Onan exclusively for electric plant use!

Both engines are 1800 R.P.M. The 13HP Onan engine which powers the CW-5 and the 20HP Onan engine used for the CW-10 weigh much less than general-purpose engines, and are amazingly compact. Built to deliver dependable, trouble-free service in heavy-duty use. Two-cylinder, alternate-firing design assures smooth, vibration-free power. New, quiet, highly-efficient vacuum air cooling drives out all heated air through one side duct. The same duct carries exhaust gases, simplifying installation.

Impulse-coupled, high-tension magneto ignition for quick starting under all conditions. Both models in all standard voltages 60-cycle A.C., single or three phase.

Far Out Front in design and engineering

- Twin-cylinder, horizontally-opposed, air-cooled, alternate-firing engines
- Aluminum-alloy cylinder heads
- Extra-large, replaceable bearings
- Full-pressure lubrication, 6-quart oil capacity, oil filter
- Impulse-coupled, high-tension magneto ignition, radio suppressed
- Quiet, vacuum air-cooling of generator and engine
- Excellent accessibility; snap-off air housings
- High-performance generators
- Completely equipped with controls and instruments.

Write for folder and specifications

D. W. ONAN & SONS INC.

7833 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINNESOTA

ELECTRONS AT WORK

(continued)

FIG. 3—Mounting board and tube chassis. Terminals are placed on board depending on type of circuit being wired

cap has been secured.

Tubes are mounted on chassis that are bolted to the mounting board. Tube wells in the aluminum housing are designed to fit any miniature tube as are the springs that hold the tube in place.

A gasket placed between the base and cap make the unit drip-proof when assembled. By using a special type of 11-pin socket and sealing the base and cap joint with waterproof cement the unit can be made waterproof and gasproof.

Circuits developed so far include a complete audio amplifier from pre-amplifier to power output, servo amplifiers and gating circuits.

Quartz Crystal Growing Technique

IN THE MANUFACTURING of quartz crystals the dissolving of quartz requires one temperature and its deposition requires a lower temperature. This fact led to the development of the two chamber vessels shown in Fig. 1, in which the two processes could be separated. Because of the elevated pressure required, the process employs a specially designed and fabricated autoclave of heavy alloy steel tubes capable of withstanding up to at least 6,000 psi at 400 deg C. The two chambers are joined near each end by small diameter tubes to provide a continuous circuit. The autoclave is mounted with the chambers substantially horizontal and is mechanically driven to rock at about three times per minute.

Each chamber is provided with

April, 1953 — ELECTRONICS

238 Want more information? Use post card on last page.
Underwriters' Laboratories specify that a ceramic capacitor used in AC line by-pass applications must withstand a 1500 volt AC 60 cycle one minute test.

RMC has developed Type UL DISCAPS for this or any application where a steady or intermittent higher voltage may occur. Capacities between .001 MFD and .02 MFD are now in production.

The use of Type UL Discaps will effect considerable cost savings over any other type of capacitor acceptable to the Underwriters' Laboratories.

**NEW**

**HIGH VOLTAGE DISCAPS DESIGNED FOR 90° DEFLECTION YOKES**

Designed especially for 90° deflection yokes, these RMC DISCAPS are rated at 2000, 3000, 4000, and 5000 volts DC.

The voltage safety factor required in this application is insured when DISCAPS are used. Now available in any capacity between 15 MMF and 240 MMF, their smaller size and lower initial cost offer definite production ease and overall savings.

**SEND FOR SAMPLES AND TECHNICAL DATA**
A COMPLETE LINE OF VIBRATORS


"A" Battery Eliminators, DC-AC Inverters, Auto Radio Vibrators
See your jobber or write factory

AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

Want more information? Use post card on last page.

its own heating devices and temperature control. Chunks of quartz are placed in the dissolving chamber and an array of quartz seed plates is supported in the other. The remainder of the autoclave space is filled to approximately 70 percent with sodium carbonate solution. The chambers are then sealed with high-pressure closures and the autoclave heated. The mean temperature is brought up to about 350 deg C, the dissolving chamber being maintained about 10 deg higher than the other during the operation.

The degree of filling and the temperature mentioned above result in the liquid phase expanding to fill the autoclave. The fact that circulation occurs under such conditions was shown by the actual transfer of quartz from the raw material to the seed plates, and has been demonstrated and studied in a small glass model. The solution in the dissolving chamber is at the higher temperature and less dense than the solution in a crystallizing chamber.

When the autoclave is tipped in one direction during the rocking cycle, the less dense solution rises and the heavy solution falls causing a flow of solution that reverses its direction when the autoclave tips in the opposite direction in the next half of the rocking cycle. The reciprocating flow of solution causes a slow, regular exchange of solutions between the two chambers, one at higher temperature and unsaturated with respect to silica, and the other cooler and super-

FIG. 1—Autoclave method of growing quartz crystals requires rocked chambers under heavy pressure
Items like these available QUICKLY at CHASE® warehouses

Items:
- Copper Nails and Tacks
- Copper Storm Nails
- Brass and Bronze Bolts and Nuts
- Brass and Bronze Cap, Machine and Lag Screws
- Brass Cotter Pins
- Brass and Copper Rivets, Burs
- Brass, Bronze and Copper Washers
- Soldering COPPERS
- Industrial Wire Cloth and Brass Strainer Cloth
- Industrial and Automotive Fittings
- Perforated Metal in Brass, Bronze and Copper
- Bearing Bronze Bars

Call us for anything from Bearing Bronze Bars to Brass or Bronze Bolts . . . or any other brass or copper item for maintenance, repair, operating or production.

Twenty-three Chase warehouses are located in major industrial centers from coast to coast. Phone the one nearest you. We can usually fill your orders from stock.

Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT - SUBSIDIARY OF KENNECOTT COPPER CORPORATION
The Nation's Headquarters for Brass & Copper

Electronics — April, 1953

Want more information? Use post card on last page.
SOLVED THIS MARKING PROBLEM

PRINTING LABEL INFORMATION ON CARTRIDGE ENCLOSED FUSES

Working closely with Underwriters' Laboratories, Inc. and with leading fuse manufacturers, Markem has developed a method which makes possible for the first time the printing of label information directly on cartridge enclosed fuses at production rates. Markem's direct ink imprints cannot "fall off" and are unaffected by moisture or ordinary chemical atmospheres. Paper label inventory and wastage problems are eliminated. Print is larger and color coding and identification are simplified. Fuse manufacturers anticipate better labeling at higher production rates and with lower costs. The Markem Method—Markem Machine, Markem type and ink and the special recording die roll for use when UL Manifest is required—as well as the imprint itself meet with UL approval.

ELECTRONS AT WORK

(continued)

saturated with respect to silica. The amount of flow is only estimated, and it is difficult to obtain actual measurement, yet practice has shown it to be large enough to transfer quartz satisfactorily.

A powerful tool for research on quartz has been the gamma radiation from Cobalt-60, which permits photographing the growing crystals within the high-pressure autoclave to observe the progress of their growth. The visible detail does not extend to quality of the deposited quartz, but the approximate dimensions and weights can be obtained readily from the gammarograph. An experiment using new conditions is now inspected as the run proceeds, and if the seeds were to show signs of thinning down or disappearing, conditions would be altered or the experiment terminated. Previously it was not known whether an experimental run would yield crystals until the run was ended and the autoclave opened.

Comparison of Quartz

Quartz crystals to be useful must have a high degree of freedom from defects, which includes and goes beyond the obvious virtue of clarity. A modern oscillator circuit cannot tolerate a quartz plate containing many or large inclusions. The oscillating plate depends on a uniform mechanical elasticity to give its vibration an accurate and constant period. It is obvious that it can be disturbed by flaws such as cracks and included bubbles or solid particles.

The oscillator plate receives its impulse to vibrate from the alternating electrical signal brought to the faces of the plate through the metal coatings applied thereto. Thus another purity of the crystal is required in addition to the absence of flaws visible under the microscope. The plate must consist of one crystal and not be twinned.

Quartz shows two types of interpenetration twinning—known as optical and electrical—and the presence of either on opposite sides of a boundary in a quartz plate means that the two portions will not move in unison and in the same direction in the electromechanical vibration process. Such a plate has
If your research program calls for recording variables that change with split-second speed—investigate the new ElectroniK High-Speed recorder. Its pen can streak across the full width of the 11-inch chart in only one-half second!

This exceptional speed across a wide chart assures faithfully detailed recording of swiftly changing conditions...shows every significant "wiggle" that other instruments have to overlook.

To achieve high pen speed without overshoot, the instrument embodies an improved velocity damping circuit that brings the pen to a fast, smooth stop at its balance position. Chart speeds as fast as 4 inches per second spread out the vertical time base for maximum readability. Power reroll of paper is available at the high chart speeds.

Like all ElectroniK instruments, this model records any d-c millivoltage signal...operates with thermocouples, strain gauges, and a host of other transducers. It can be supplied for full scale spans as small as one millivolt.

Your local Honeywell engineering representative will be glad to discuss how this new instrument can help you in your laboratory. Call him today...he is as near as your phone.


REFERENCE DATA: Write for Data Sheet No. 10.0-13
VIBRATION and shock are natural enemies of electronic equipment and precision instruments... To control the damage which these enemies can do, Lord Vibration Control Mountings and Bonded Rubber Parts are used to very profitable advantage. More than a quarter century's experience in dealing with vibration and shock is yours when you take advantage of Lord engineering assistance. The result of such consultation is full protection for electronic units and sensitive instruments by correctly designed and precisely manufactured Lord Mountings and Bonded-Rubber parts.

44x756

ELECTRONS AT WORK (continued)

a reduced activity and is likely to be worthless as an oscillator.

This material has been abstracted from "The Properties of Synthetic Quartz Crystals and Their Growing Technique", by Dr. D. R. Hale, Brush Strokes, Dec. 1952.

Two Synchronized Clock Circuits

By D. Sachs
Los Angeles, Calif.

Using an oscilloscope as a remote indicator for a master clock can be accomplished with the circuit shown in Fig. 1A. A 60-cycle voltage is applied through the tube and 90-deg phase shifting network to the plates of the c-r tube, producing a circular sweep.

At the master clock a 60-cycle synchronous motor drives a set of contacts mounted 90 deg apart. The contacts are arranged so that each time they pass one of the clock hands a circuit will be closed pulsing an r-f transmitter. The contact for the minute hand is outside the radius of the hour hand so that it will contact only the longer hand. The minute-hand contact also produces a larger pulse voltage making a larger trace on the oscilloscope screen.

An r-f amplifier and detector at the oscilloscope receives the pulses from the master station, and since the circular sweep of the c-r tube is in synchronism with the 60-cycle motor driving the contactors, traces will be produced on the screen at a position corresponding to the posi-
HUGHES
SETS NEW STANDARDS OF
DIODE CONDUCTANCE

HUGHES now offers for commercial application eight new RTMA germanium diode types equivalent in every respect to Hughes regular subminiature types—and in addition carrying forward current minima of 10 ma. and 20 ma. at +1 volt.

These high conductance Hughes Diodes, a product of Hughes pioneer research in semiconductors, provide better combinations of high peak inverse voltage, high back resistance and low forward resistance than have ever before been available in production quantities. Volume orders for these new types can be filled from stock.

Hughes Germanium Diodes have proved consistently able to meet exacting requirements in airborne electronic equipment for navigation, fire control, and guided missiles. Besides having the advantages of germanium diodes over vacuum tubes, Hughes Diodes alone are

<table>
<thead>
<tr>
<th>Description</th>
<th>RTMA Type</th>
<th>Test Peak Inverse Voltage (volts)</th>
<th>Maximum Inverse Working Voltage (volts)</th>
<th>Minimum Forward Current @ +1 v (ma)</th>
<th>Maximum Inverse Current (ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Peak</td>
<td>1N50B</td>
<td>190</td>
<td>150</td>
<td>5.0</td>
<td>0.500 @ -150 v</td>
</tr>
<tr>
<td></td>
<td>1N50A</td>
<td>190</td>
<td>150</td>
<td>5.0</td>
<td>0.625 @ -100 v</td>
</tr>
<tr>
<td>High Back Resistance</td>
<td>1N67A</td>
<td>100</td>
<td>80</td>
<td>4.0</td>
<td>0.005 @ -5 v, 0.050 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N67D</td>
<td>100</td>
<td>80</td>
<td>4.0</td>
<td>0.005 @ -5 v, 0.050 @ -50 v</td>
</tr>
<tr>
<td>High Back Resistance</td>
<td>1N60D</td>
<td>100</td>
<td>80</td>
<td>4.0</td>
<td>0.005 @ -5 v, 0.050 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N60A</td>
<td>100</td>
<td>80</td>
<td>4.0</td>
<td>0.005 @ -5 v, 0.050 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N60B</td>
<td>100</td>
<td>80</td>
<td>4.0</td>
<td>0.005 @ -5 v, 0.050 @ -50 v</td>
</tr>
<tr>
<td>High Back Resistance</td>
<td>1N90</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.005 @ -5 v, 0.100 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N91</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.005 @ -5 v, 0.100 @ -50 v</td>
</tr>
<tr>
<td>High Back Resistance</td>
<td>1N92</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.005 @ -5 v, 0.100 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N93</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.005 @ -5 v, 0.100 @ -50 v</td>
</tr>
<tr>
<td>High Back Resistance</td>
<td>1N94</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.005 @ -5 v, 0.100 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N95</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.005 @ -5 v, 0.100 @ -50 v</td>
</tr>
<tr>
<td>General Purpose</td>
<td>1N90</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.100 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N91</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.100 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N92</td>
<td>100</td>
<td>80</td>
<td>10.0</td>
<td>0.100 @ -50 v</td>
</tr>
<tr>
<td>JAN Types</td>
<td>1N126A**</td>
<td>75</td>
<td>60</td>
<td>5.0</td>
<td>0.050 @ -10 v, 0.850 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N127A**</td>
<td>125</td>
<td>100</td>
<td>10.0</td>
<td>0.250 @ -10 v, 0.300 @ -50 v</td>
</tr>
<tr>
<td></td>
<td>1N128A**</td>
<td>50</td>
<td>40</td>
<td>5.0</td>
<td>0.025 @ -10 v</td>
</tr>
</tbody>
</table>

*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.
**Formerly 1N90A.  †Formerly 1N90A  ‡Formerly 1N91A
New types in red.

Address inquiries to Dept. E

HUGHES
Aircraft Company
Culver City, California

Want more information? Use post card on last page.

www.americanradiohistory.com
Go to page 247
FREED TRANSFORMERS & INSTRUMENTS

PRODUCTS OF EXTENSIVE RESEARCH

SEND FOR LATEST CATALOG!

FREED TRANSFORMER CO., INC.
1722 WEIRFIELD ST., (RIDGEWOOD) BROOKLYN 27, NEW YORK

www.americanradiohistory.com
SELENIUM RECTIFIERS

Power Type
Available over a range that includes a few volts and milliamperes of current to hundreds of volts and thousands of amperes. Fourteen cell sizes provide widest available range of selection.

Radio Type
Versatile low-cost rectifiers that have found application in all types of electronic equipment as well as radio and television receivers. A complete line is available.

Embedments
A recent "first" in the industry, Sarkes Tarzian embedments offer the advantages of hermetically sealed rectifiers at a fraction of the size, weight and cost.

Diodes
Currently available in two sizes, (1/8" and 5/16" housings) Sarkes Tarzian diodes are designed for use as limiters, bias voltage, low current relay voltage and many other very low current applications.

High Voltage
This popular line of tubular rectifiers offers the design engineer a compact—long lived high voltage—low current source of DC power.

Neon Lamp Flip-Flop and Binary Counter

BY H. A. VUYLSTEKE
Technische Laboratoria
University of Ghent
Ghent, Belgium

NEON GLOW LAMPS in place of the usual triodes or thyatrons in flip-flop and binary counter circuits have many advantages including low current consumption, low cost and stable operation when bulbs having the same operating characteristics are used. The circuits described here use NE-2 lamps.

The basic circuit is shown in Fig. 1A. Two glowlamps are connected in series with a resistance R. The midpoint voltage V/2 is chosen between the firing and extinction voltage of the lamps being used.

A triggering pulse applied through capacitor C to the midpoint will cause one of the lamps to ignite;
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. Answer simple—we changed to Belden Cords.

Jim

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.
4625 West Van Buren Street
Chicago 44, Illinois

CORDITIS-FREE CORDS BY...

Belden

WIREMAKER FOR INDUSTRY

ELECTRONICS — April, 1953

Wont more information? Use post card on last page.

249
ELECTRONS AT WORK

Waterman RAYONIC CATHODE RAY TUBES

Waterman RAYONIC CATHODE RAY TUBES have reached still greater heights. Since the introduction of the Waterman RAYONIC 3MP for miniaturized oscilloscopes and the Waterman developed rectangular 3SP CATHODE RAY TUBE, scientists in our laboratories have diligently searched for a more perfect answer to the perplexing problem of trace brightness versus deflection sensitivity. The 3XP RAYONIC CATHODE RAY TUBE is their answer to providing a brilliant and sharply defined trace and high deflection sensitivity at medium anode potentials. When the 3RP or 3SP tubes are operated at 1000 Volts second anode and compared against the 3XP at 2000 Volts on the second anode, the results are astonishing. For the same size spot, the 3XP light output is improved by a factor of 4 and its vertical sensitivity is improved by a factor of 2, with the horizontal sensitivity remaining equal to that of the other tubes. Because the 3XP is enclosed in a shorter envelope and is equivalent to the 3RP and 3SP with respect to interelectrode capacities, it lends itself readily for high frequency video work, as well as for low repetitive operation.

3XP TECHNICAL DATA

<table>
<thead>
<tr>
<th>SIZE</th>
<th>FACE</th>
<th>1½ x 3 inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LENGTH</td>
<td>8.875 inches</td>
</tr>
<tr>
<td></td>
<td>BASE</td>
<td>Local</td>
</tr>
<tr>
<td>TYPICAL OPERATING CONDITIONS</td>
<td>FILAMENT</td>
<td>6.3 Volts</td>
</tr>
<tr>
<td></td>
<td>ANODE #2</td>
<td>0.6 Amps</td>
</tr>
<tr>
<td></td>
<td>Max. 2750 Volts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANODE #1</td>
<td>2000 Volts</td>
</tr>
<tr>
<td></td>
<td>GRID #1</td>
<td>-22.5 to -67.3 Volts</td>
</tr>
<tr>
<td></td>
<td>DEFLECTION FACTOR IN VOLTS/INCH</td>
<td>D1 to D2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3 to D4</td>
</tr>
</tbody>
</table>

AVAILABLE in P1, P2, P7, and P11 Phosphor.

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.

WATERMAN PRODUCTS INCLUDE

3JP1 & 3JP7 JAN RAYONIC CR TUBES
3JP2 & 3JP11 RAYONIC CR TUBES
3MP7 & 3MP11 RAYONIC CR TUBES
3RP1, 2, 7, 11 RAYONIC CR TUBES
POCKETSCOPES PULSESOSCOPES
RACKSCOPES
And Other Associated Equipment

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Are any of these problems yours?

1. Need rubber-like properties for long periods of time under extreme temperatures? EMPIRE® Silicone Rubber Coated Glass Cloth (Class H insulation) is suitable for use over a temperature range of -70°F to 400°F. It is resistant to thermal shock, will not crack, become brittle or deteriorate at high or low temperatures. Offers good resistance to lubricating oils and most chemicals. Has good dielectric strength and low power factor.

2. Looking for molding plate for Class H installations? Silicone molding plate for Class H applications which could not be produced successfully with regular built-up mica splittings can now be manufactured from ISOMICA® (built-up continuous mica sheets). ISOMICA silicone bonded molding plate has excellent moldability...excellent retention of shape...and an extremely high degree of homogeneity.

3. Looking for a versatile material with special mechanical, electrical and structural properties? LAMICOID®—a laminated plastic made with various fillers—is available in standard NEMA grades and others, with characteristics such as punching adaptability, heat and moisture resistance, tensile strength, impact strength, low loss factor, high dielectric strength, and properties "custom-made" to your specifications.

4. Want your signs, instrument panels, nameplates and dials to look better, last longer, be easier to install and maintain? DECORATIVE LAMICOID lends itself readily to marking by engraving, sandblasting, silk screen and rubber-plate printing, painting, filling or use of printed matter. Resists wear, aging, weathering, oils, corrosive vapors, moisture and temperature extremes. Wipes clean with a damp cloth.

Whatever electrical insulating materials you need, MICO makes them best. We manufacture all standard types and many special materials, or fabricate parts to your specifications. Send us your blueprints or problems today.
Designed as a companion unit to Century’s famous Model 409 Oscillograph, the Model 1809 Bridge Control Unit is the latest addition to Century’s line of industry-standard vibration and stress analyzing equipment. Packaged in a small, compact space, the unit contains all of the facilities necessary for use with 12 channels of resistance strain gages or bridge-type transducers. Where used with the Model 409 Oscillograph, it is necessary only to connect strain gages and power source to have a complete stress-strain measuring and recording system, small and rugged enough to be placed in an aircraft wing tip or guided missile warhead.

FEATURES:
- Size: 4½" x 7" x 11".
- Weight: 10½ pounds.
- Aluminum case.
- Up to 12 channels.

For any resistance strain gage or bridge-type transducer, may be used with direct indicating instrument.

Power: Control unit, 22-28 Volt D.C.
Strain gage, 6-28 Volt D.C.

Write for Bulletin CGC—307

MODEL 409 OSCILLOGRAPH

The Century Model 409 Oscillograph has been designed for recording data where space and weight requirements are limited. The Oscillograph has been tested to record faithfully while subjected to accelerations up to 20 G’s.

FEATURES:
- Size: 5" x 6½" x 11½".
- Weight: 13 pounds.
- Cast aluminum case.
- Paper speeds variable ½" to 6" and 2" to 24" per second.

Detachable daylight loading magazine with a capacity of 3½" x 100" paper.
2 to 14 individual channels.
Trace identification.
Trace viewing.

Write for Bulletin CGC—303

TABLE I—Bulb Temperature at Sea Level

<table>
<thead>
<tr>
<th>Bulb Area (Sq In)</th>
<th>T0</th>
<th>T½</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10.5</td>
<td>4.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Watts Dissipation</td>
<td>18.7</td>
<td>16.8</td>
<td>7.8</td>
</tr>
<tr>
<td>Watts per Square Inch</td>
<td>1.78</td>
<td>4.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Max. Bulb Temp deg C</td>
<td>Ambient 93C</td>
<td>160</td>
<td>555</td>
</tr>
</tbody>
</table>

There are some absolute limits on the permissible glass temperature, one being the softening point of the glass and another the point at which appreciable conductivity occurs—called electrolysis. Below these limits there is an indefinite region in which varying kinds and degrees of trouble are encountered, especially owing to evolution of gas from the bulb, itself the getter and other tube parts. The temperature of concern is that at the hottest spot on the envelope, which usually occurs midway between the top and bottom micas. The location can be readily found by the use of temperature sensitive lacquers marketed by Tempil Corporation, 11 West 25th Street, New York City.

During manufacture, while the vacuum tube is on the production pumping set-up, the envelope and the metal parts within the tube structure are heated to much higher temperatures than those to which they would normally be subjected during operation in order that all of the absorbed and adsorbed gases may be removed. If, however, during operation, the operating tem-

ELECTRONS AT WORK (continued)
The Dimensional Stability of NILVAR*
Spells Perfect Product Performance

Schematic diagram shows how useful movement of Nilvar rod corresponds faithfully to the dimensional changes of the copper tube.

How Robertshaw-Fulton built a better Water Heater Control with Driver-Harris NILVAR

The new "Unitrol" Robertshaw-Grayson gas water heater control streamlines three essential controls into one valve body: a snap action thermostat, a snap action pilot, and a large-capacity gas cock. This reduces inventory for the water heater manufacturer and simplifies part stocking for the dealer.

The "Unitrol" provides a thermostat capable of delivering maximum amount of useful movement, by employing a copper tube enclosing a Nilvar alloy rod. The tube expands and contracts very appreciably in response to immersion temperatures. But the Nilvar rod, because it is dimensionally stable, does not vary in length. Since the free end of the Nilvar rod actuates the working gas valve, the slightest movement of the temperaturesensitive copper tube is fully utilized to control flow of gas to the burner.

 Says Robertshaw-Fulton: "The outstanding dimensional stability of Nilvar actually permits minute changes in water temperature to regulate the heat supplied by the burner, thus assuring extremely accurate operation."

Nilvar has a temperature coefficient of expansion as low as .000001 per degree C., lowest of any alloy, comparable to that of quartz. Somewhere in your engineering operations such extraordinary dimensional stability may solve a problem—help to perfect product performance. We shall be glad to make recommendations based on your particular needs.

Nilvar is produced only by

Driver-Harris Company
HARRISON, NEW JERSEY
BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco
In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario.

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
MORE WAYS TO
SQUEEZE PENNIES
OUT OF
UPSET SPECIALS COSTS

Specially designed upset products are solving thousands of problems. Dozens of design pointers on them are yours for the asking. Send us your sketches, prints, finished products for suggestions.

A squarely sheared-off point costs less than a rounded or any other shape, and is just as effective for most purposes.

An integral washer adds very little to the cost of an indented head part, and can save the cost of a washer.

An untreated area of less diameter than the thread crests costs less than having both of the same diameter.

The lead of a rolled thread makes little difference to the cost. But the pitch, if too great in ratio to the stock diameter, can raise the cost.

ELECTRONS AT WORK
(continued)

perature of the envelope or the parts themselves exceeds the temperatures reached while the tubes were being pumped during production, it is likely that varying amounts of gases will adversely affect tube life.

Normally, the function of the getter that produces the silver-like deposit or the black deposit on some of the newer tubes is to provide a means for removing any gases that may subsequently be set free during the operation of the tube. There is a limited amount of gas that this getter material can safely pick up. Amounts beyond this will result in the tube's gas content being materially increased. In addition, if the glass bulb should be heated sufficiently the getter patch may be caused to migrate or leave the bulb.

It may redeposit itself on some cooler part of the tube so that a considerable amount of gas trapped by the getter will now be released and may not recombine when the getter condenses on the cooler portions of the tube. In this instance, then, the gas content would also be materially increased. Should the getter condense on the mica supports of the tube there is a possibility that leakage between elements supported in the mica may be increased. This leakage may affect performance materially.

As seen from Table I, a tendency to decrease the size of electronic gear aggravates the bulb-temperature condition. Tube life, in general, can be extended by maintaining low temperatures for the glass envelope. This is especially important in high-power output tubes because of their higher plate and cathode dissipations. The tempera-
### FREQUENCY CONTROL FOR MILITARY APPLICATION

<table>
<thead>
<tr>
<th>MIL CRYSTAL UNIT</th>
<th>BLILEY CRYSTAL HOLDER</th>
<th>FREQUENCY RANGE (MEGACYCLES)</th>
<th>OPERATING TEMPERATURE RANGE (Centigrade)</th>
<th>FREQUENCY TOLERANCE OVER OPERATING RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR-15</td>
<td>AR23W</td>
<td>0.080 - 0.19999</td>
<td>-40° to +70°</td>
<td>±.01%</td>
</tr>
<tr>
<td>CR-16</td>
<td>AR23W</td>
<td>0.080 - 0.19999</td>
<td>-40° to +70°</td>
<td>±.01%</td>
</tr>
<tr>
<td>CR-18</td>
<td>BH6A</td>
<td>0.8 - 15.0</td>
<td>-40° to +90°</td>
<td>±.005%</td>
</tr>
<tr>
<td>CR-19</td>
<td>BH6A</td>
<td>0.1 - 15.0</td>
<td>-55° to +90°</td>
<td>±.005%</td>
</tr>
<tr>
<td>CR-23</td>
<td>BH6A</td>
<td>10.0 - 75.0</td>
<td>-55° to +90°</td>
<td>±.005%</td>
</tr>
<tr>
<td>CR-24</td>
<td>BH7A</td>
<td>15.0 - 50.0</td>
<td>-55° to +90°</td>
<td>±.005%</td>
</tr>
<tr>
<td>CR-27</td>
<td>BH6A</td>
<td>0.8 - 15.0</td>
<td>-80° to +80°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-28</td>
<td>BH6A</td>
<td>0.2 - 15.0</td>
<td>+70° to +80°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-29</td>
<td>AR23W</td>
<td>0.080 - 0.19999</td>
<td>+70° to +80°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-30</td>
<td>AR23W</td>
<td>0.080 - 0.19999</td>
<td>+70° to +80°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-32</td>
<td>BH6A</td>
<td>10.0 - 75.0</td>
<td>+80° to +80°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-33</td>
<td>BH6A</td>
<td>0.1 - 15.0</td>
<td>-55° to +90°</td>
<td>±.005%</td>
</tr>
<tr>
<td>CR-35</td>
<td>BH6A</td>
<td>0.800 - 20.0</td>
<td>+80° to +90°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-36</td>
<td>BH6A</td>
<td>0.800 - 15.0</td>
<td>+80° to +90°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-37</td>
<td>BH9A</td>
<td>0.090 - 0.250</td>
<td>-40° to +70°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-42</td>
<td>BH9A</td>
<td>0.090 - 0.250</td>
<td>+70° to +80°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-44</td>
<td>BH6A</td>
<td>15.0 - 20.0</td>
<td>+80° to +90°</td>
<td>±.002%</td>
</tr>
<tr>
<td>CR-45</td>
<td>BH6A</td>
<td>0.455</td>
<td>-40° to +70°</td>
<td>±.02%</td>
</tr>
<tr>
<td>CR-46</td>
<td>BH6A</td>
<td>0.2 - 0.500</td>
<td>-40° to +70°</td>
<td>±.01%</td>
</tr>
<tr>
<td>CR-47</td>
<td>BH6A</td>
<td>0.2 - 0.500</td>
<td>+70° to +80°</td>
<td>±.002%</td>
</tr>
</tbody>
</table>

**BULLETIN NO. 43 CONTAINS A QUICK REFERENCE INDEX FOR MILITARY TYPE CRYSTAL UNITS—SENT UPON REQUEST**

**Bliley CRYSTALS**

**BLILEY ELECTRIC COMPANY**

**UNION STATION BUILDING, ERA, PA.**

---

Want more information? Use post card on last page.
LEDEX ROTARY SOLENOIDS

...give positive, powerful snap action!

here's how a
LEDEX ROTARY SOLENOID operates...

The magnetic pull moves the armature along the Solenoid axis. This action is efficiently converted into a rotary motion by means of ball bearings on inclined races. The inclined ball races are made to compensate for the magnetic pull increase as the Solenoid air gap closes, thereby providing substantially constant torque throughout the Solenoid stroke. The rotary snap-action power of the Ledex can be efficiently harnessed with a minimum of linkages, through the use of one or more standard features available on all models.

here's why LEDEX ROTARY SOLENOIDS are dependable!

As can be seen from the exploded view, Ledex Rotary Solenoids are simply constructed with few moving parts. All parts are manufactured to exacting tolerances and are carefully inspected and assembled.

The copper wire coil, the heart of the Solenoid, was developed especially for this product. It is wound by a precision winding process that puts a maximum amount of magnet wire into available space ..., giving tremendous power to compact Ledex Rotary Solenoids.

six basic LEDEX ROTARY SOLENOIDS to choose from!

Engineering data is available upon request. Write for descriptive literature today!

G.H. Leland Inc.

123 WEBSTER STREET, DAYTON 2, OHIO

ELECTRONS AT WORK

(continued)

... temperature rise in the envelope may be limited by: reduction of total tube dissipation; provision for improved ventilation; maintenance of low ambient temperatures.

In general, the envelope temperature of small receiving-type power tubes should be kept below 175 deg centigrade for increased reliability. The chief effect of high temperature on vacuum tubes is not a sudden change in operating characteristics but a gradual deterioration of characteristics. Table II indicates the operating bulb temperatures for five types of tubes, having various sized envelopes for plate dissipations ranging from 20 percent up to maximum rated dissipations. This gives an idea of the extent to which it is possible to reduce bulb temperatures by decreasing the total tube plate dissipation.

TABLE III—Sea Level Bulb Temperatures vs Dissipations and Ambient Temperature Variations

<table>
<thead>
<tr>
<th>Ambient</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulb Temp deg C at Hottest Spot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23C</td>
<td>100</td>
<td>170</td>
<td>230</td>
<td>280</td>
<td>310</td>
</tr>
<tr>
<td>45C</td>
<td>220</td>
<td>260</td>
<td>300</td>
<td>340</td>
<td>370</td>
</tr>
<tr>
<td>55C</td>
<td>310</td>
<td>350</td>
<td>390</td>
<td>430</td>
<td>450</td>
</tr>
</tbody>
</table>

The ultimate bulb temperature depends not only upon the dissipation within the tube itself but also upon the temperature of the surrounding air immediately adjacent to the tube envelope. Table III shows how these ambient temperatures affect the bulb temperature for various watts per square inch dissipation. From these data it is apparent that precautions must be taken to keep the ventilation around the tubes such that the temperature will be as low as possible.

The importance of bulb temperatures on tube life can be noted in recent information published by various tube manufacturers showing the life which may be expected for subminiature tubes. Most of these tubes are rated for maximum bulb temperatures of 200 deg with a few having a rating of 250 deg C. A reduction of bulb temperature on the order of 20 percent when
Simplify
Your Search for the Right Protection

Standardize on BUSS Fuses...
the complete line for Television · Radio · Radar Instruments · Controls and Avionics

Plus a complete line of fuse clips, blocks and fuse holders

Whatever your protection requirements, you'll find the right fuse faster when you look first to BUSS. All types and sizes, from 1/500 ampere up, are included in the complete BUSS line. This can simplify your purchasing and stock handling.

To assure protection to both the product and your good name, every BUSS fuse is tested on a sensitive, electronic device for correct construction, calibration and physical dimensions.

TO HELP YOU GET STARTED THE RIGHT WAY
BUSS Fuse Engineers will gladly assist you in selecting the fuse to suit your needs best ... a fuse that if possible will be available in local wholesalers stocks.

BUSSMANN MFG. CO., Division of McGraw Electric Co.
University at Jefferson, St. Louis 7, Missouri

Want more information? Use post card on last page.

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.
Please send me bulletin SP9 containing facts on BUSS small dimension fuses and fuse holders.

Name
Title
Company
Address
City & Zone
State

ELRC 451

ELECTRONICS — April, 1953
Easy to pack, handle, display—this Heavy-Duty corrugated box means more product protection...more freight savings...more dealer goodwill. To get full value from your shipping box dollar—send for booklet, "Creative Package Engineering." Hinde & Dauch, 5314-D Decatur St., Sandusky, O.

HINDE & DAUCH
17 MILLS AND FACTORIES • 40 SALES OFFICES
Our 65th Year

operating in the region of 200 deg C bulb temperatures will result in a substantial increase in the life expectancy of the tubes. The cooling of the tube envelope is the most important consideration in mounting the tube.

A loose-fitting shield such as is commonly employed with miniature tubes may increase the temperature appreciably. The situation arises because the shield is not tight fitting but instead provides a blanket of hot air around the tube. Thus the shield does not provide a good thermal contact with bulb of the tube or to the chassis and cannot effectively cool the bulb.

If shields are employed, and they are tight fitting and can be fastened directly to the chassis, a considerable amount of heat can usually be removed in this manner. To obtain maximum heat radiation, the shield should not be plated and should not be polished.

So far, sea-level altitudes have been assumed. Many tubes operate at high altitudes some or all of the time. This environment aggravates the cooling problem still more since the density of the air decreases with altitude. The decreased effective cooling of a tube at higher altitudes requires that the total tube dissipation be derated in order not to exceed critical bulb temperatures. This derating depends upon the altitude and may amount to as much as 40 or 50 percent.

To obtain maximum reliability from vacuum tubes and equipment, it is important that pains be taken to keep the operating temperature of the bulb at its hottest spot within the limit specified by data sheets.

BIBLIOGRAPHY

"Data on Subminiature Tubes," Raytheon Manufacturing Company, Newton, Massachusetts.

258 Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Shrimp boats encounter rough seas. Their safe return can depend upon the reliable electrical power supply, provided by Onan generators.

To insure performance for these and all AC and DC, military and commercial regulated power units they manufacture, D. W. Onan & Sons Inc., has standardized on Regohm voltage regulators. Whether on sea, land or air applications, this low cost, compact, electro-mechanical controller demonstrates rugged ability to withstand severe vibration, shock or ambient temperature conditions. And you can’t beat the band of Regohm’s voltage regulation. Standard models provide constant voltage output within less than ±2%.

Onan Engineers like these additional advantages of Regohm Voltage Regulators:
1. **Size**—Regohm is small in size, light in weight, but big in performance. It is a natural where economy of space and weight are major considerations.
2. **Low Cost**—Regohm costs less, does more, than the complex equipment that once was the only available solution to control problems.
3. **System Stabilizing**—With its high speed averaging effect and a built-in, thoroughly reliable dashpot, Regohm will stabilize control systems with widely varying characteristics.
4. **Low Operating Power**—Low signal power requirement of one watt for solenoid bias makes Regohm easily applicable to special units.
5. **Long Life**—In properly engineered installations, Regohm’s life is measured in years. Shelf life is substantially unlimited.
6. **Simplified Maintenance**—Regohm’s plug-in feature simplifies replacement and maintenance—there are no parts to renew or lubricate.

Call on our engineering and research facilities to help you develop optimum design for your equipment and system. Learn how Regohm can help you with your regulation problem. Write for Bulletin 50500. Address Dept. F, Electric Regulator Corp., Norwalk, Connecticut.
Production Techniques

Edited by JOHN MARKUS

Keyed Mandrels and Dereelers Speed Winding of Coils 280
Radar Antenna Lens Made from Square Tubing 282
Production Testing of Rectifier Plates 282
Holding Fixtures for Controls 288
Twisting Filament Leads 288
Trimming Metal Shells 272
Capacitor Winding Techniques 274
Sponge Rubber Mallet 290
Spring Rack Holds Parts 292
Making Concrete Dust-Free 294
Blower Speeds Cooling of Induction Soldering 296
Soldering Iron Stakes Plastic Pegs 296
Tweezer-Type Soldering Iron 298
Production-Testing Filters 303
Testing Employee Vision 310

OTHER DEPARTMENTS
featured in this issue:

Electrons At Work 198
New Products 312
Plants and People 384
New Books 410
Backtalk 420

Keyed Mandrels and Dereelers Speed Winding of Coils

HORIZONTAL flyback coils are wound four at a time by a single operator with practically no machine off-time for loading and unloading, through use of multiple mandrels designed especially for the purpose by Cros-ley Division of Avco Mfg. Corp. The operator disassembles a filled mandrel and reassembles it with empty coil forms during the winding cycle time.

Each flyback transformer has four coils, one of which is tapped, giving a total of nine leads. These must be brought out at identical positions on each unit, to insure positive identification during subsequent assembly operations. Keying of the coil forms and all parts of the mandrel achieves this by insuring that the mandrel can be assembled only one way. Appropriately spaced metal pins on keyed spacers are used between the coil forms; as each coil lead is brought out, it is wrapped around the correct pin. The lead is then anchored in position on the coil with a tab of paper, to insure correct positioning of leads after they have been unwound from the metal pegs during disassembly of the mandrel.

On this and other winding machines in Crosley's television receiver plant, simple dereelers are used to maintain essentially constant wire tension with stationary spools of wire. A free-spinning wire eyelet is mounted on top of each spool in such a way that it rotates at a speed directly related to that at which wire is being wound on the coils.

When a spool is empty, the mounting bolt of the dereeler is loosened with a wrench so that the entire assembly can be spun out with the fingers for changing

April, 1953 — ELECTRONICS
Whether it's shells or beads — or good old American dollars, for that matter — you just can't operate successfully without showing a profit. That's why so many progressive companies depend on Kester quality and performance to insure maximum results in production at the lowest possible cost. And we'll bet Kester Solder can mean more "wampum" in your "wigwam," too!

An engineered adaptation can be made to your specific requirements with Kester "44" Resin, "Resin-Five" or Plastic Rosin-Core Solder... varied core sizes or flux-contents are available in many different diameters.
spools. The mounting bolt applies pressure to the spool when tightened.

A shaft for the spool is set into a steel strap that is part of the coil-winding machine. A small spring applies enough drag to the flying eyelet arm to prevent overshooting and backlash of fine wire when the machine is stopped.

Production Testing of Rectifier Plates

BY JACK BRADSHAW
Quality Control Engineer
Bradley Laboratories
New Haven, Conn.

Human error in reading meters, formerly a bottleneck in testing daily production of copper-oxide and selenium rectifier plates, has been eliminated by the development of a new and entirely automatic tester that makes the required reverse leakage test on approximately 25,000 plates a day. Time required per test is only a fraction of that for the former manual operation.

Plates to be tested are loaded into the hopper at the top of the machine in batches of about 10,000, hence loading is required only two or three times a day. The machine then runs unattended, passing acceptable units down the slide to a waiting tote box and dropping rejects through the slide to a pan underneath. Fingers in the slowly-rotating motor-driven hopper push the plates one at a time out onto the start of the plastic chute, down which they slide by gravity to a solenoid-actuated gate. This opens

Radar Antenna Lens Made From Square Tubing

Use of thin-wall seamless square Monel tubing solved a fabricating problem in connection with the production of an experimental eggcrate radar screen lens for the U. S. Signal Corps. The requirement was a small compact parabolic antenna lens having 988 precisely dimensioned square tubular openings with comparatively thin walls. The overall size of the lens was 30 inches by 20 inches.

The standard method of making this type of lens, involving assembly of metal strips much in the fashion of the cardboard strips for egg crates and then soldering, was found to be unsatisfactory for this design. The chief problem was making openings which were absolutely square while maintaining thin walls and sharp corners.

The next technique tried by the contractor, I-T-E Circuit Breaker Co., Philadelphia, Pa., was assembling square brass tubing cut to exact length, then furnace-brazing in a jig. Although the softest available silver solder was used, the tubing failed to braze properly and serious cracks developed at the sharp corners.

Investigation then revealed that one grade of hard-drawn seamless Monel tubing made by Superior Tube Co. of Norristown, Pa., would provide the desired strength, corrosion resistance, electrical properties and ease of brazing. The pieces were ordered already cut to their exact lengths, then were flash nickel-plated, tin-plated, coated with soft silver solder, assembled in an adjustable jig and furnace-brazed.

Automatic tester for tiny rectifier plates. Parts are loaded into circular rotating hopper at upper left, sorted according to polarity at V junction in chute, and tested for reverse leakage at bottom. Test rack is at right

262

April, 1953 — ELECTRONICS
"We had a high voltage power supply problem...

"Our problem was to find a 30,000 volt power supply to be used as a source of voltage for kinescopes. It also had to be suitable for experimental work and in airborne equipment. The main considerations were small size and light weight, but also we needed a design that would conform to military specifications.

"We consulted 'CP' and told them what we needed..."

The "CP" Engineering Department designed a power supply with the following characteristics:

- **Input voltage:** 115 V AC
- **Frequency:** 320 to 1000 CPS
- **Output voltage:** 0-30 KV continuously variable — 0.3 ma rated current.
- **Ripple voltage:** Less than .1 peak-to-peak at maximum rated current of 0.3 ma
- **Temperature:** To operate over a range of -10°C to +55°C and 95% relative humidity.
- **General:** To operate effectively in any position.

Taking advantage of hermetic sealing and oil-filled construction in addition to new techniques and use of plastic film for high voltage capacitors, Condenser Products' Engineers developed type PS30-3C400 to comply with all requirements. Size of unit is 5 1/2 x 5 1/2 x 6 1/4". Total weight: 11 lbs.

"CP" is now filling orders for HiVolt Power Supplies in the following ranges: 2,000 V, 5,000 V, 12,000 V, 15,000 V, 30,000 V, and 50,000 V, at frequencies of 60 cycles and 400 to 1,000 cycles. HiVolt Power Supplies are engineered for various applications. Because of their small size, light weight, flexibility, and ease of operation "CP" HiVolt Power Supplies are ideal for operation of display tubes, radiation counters, photoflash devices, dust and electrostatic precipitators, oscilloscopes, insulation testers, spectographic analyzers and other equipment.
THE HIGH-PRECISION LINEAR POTENTIOMETER

BORG MICRODIAL: Two concentrically mounted dials: one for counting increments of each turn and the other for counting turns delivered completely assembled with dials synchronized. Outstanding features include smooth, uniform action ... no backlash between incremental dial and potentiometer contact ... less wear, only one moving part aside from the two dials ... contact position indicated to an indexed accuracy of 1 part in 1,000.

MICROPOT — MICRODIAL CATALOG SENT PROMPTLY ON REQUEST

BORG MICRODIAL 746-A
A precision ten-turn indicating dial assembly. Has screw locking device on operating knob.

BORG MICRODIAL 746-B
Same as 746-A but has knurled locking screw mounted externally to operating knob.

BORG MICROPOT-TEN-TURN POTENTIOMETER

E ETER: Built to fit the specifications of control system engineers and designers ... constructed with Micro accuracy for precise voltage adjustments ... featuring an assembly scientifically designed, machined, assembled and automatically machine tested for linearity of ±0.1% and 0.05%, zero-based. MICROPOTS ARE AVAILABLE IN 1.15 to 3 OHM and 30 to 250,000 OHM RANGES FOR IMMEDIATE SHIPMENT.

BORG MICRODIAL: Two concentrically mounted dials: one for counting increments of each turn and the other for counting turns delivered completely assembled with dials synchronized. Outstanding features include smooth, uniform action ... no backlash between incremental dial and potentiometer contact ... less wear, only one moving part aside from the two dials ... contact position indicated to an indexed accuracy of 1 part in 1,000.

MICROPOT—MICRODIAL CATALOG SENT PROMPTLY ON REQUEST

BORG Equipment Division
The George W. Borg Corporation
Janesville • Wisconsin

at regular intervals under control of a motor-driven sequence timer to let the plates through with adequate spacing so they do not pile up and touch each other at the test stations below. The tiny plates, only \( \frac{1}{8} \) inch in diameter, ride flat down the chute.

As each plate emerges from the first gate in the chute, a contact arm is pressed down on it by a motor-driven linkage and the resistance of the plate is measured. Since forward and reverse resistance values vary greatly, the resistance reading serves to tell which side of the plate is up. An electrical circuit responds to this resistance and actuates either of two gate solenoids, one controlling the entrance to each of the two slides at the fork in the chute. Plates with positive side up go down the left-hand chute. All other plates go down the right-hand chute to a gate and second polarity-checking station. This applies a d-c voltage across each plate and measures resulting current to verify that the plate is upside-down, then actuates a motor-driven linkage that inverts the plate and lets it go down the chute.

A second check is necessary because some correctly-positioned plates can get into this chute also; these are passed without being inverted.

Since plates are positive-side-up in both chutes when approaching the bottom, the test stations here are identical. Solenoid-operated gates again stop the plates and let them through at spaced intervals, and motor-operated linkages again push contacts against each plate in turn for the reverse-leakage test.

A conventional multistage amplifier in the associated test rack amplifies this leakage current. If the resulting value is too high, one relay operates to actuate a rejecting mechanism that drops the plate through a hole in the slide into a scrap bin. If the leakage value is within tolerance, another relay operates to actuate the lowest solenoid-operated gate in that chute, allowing the plate to slide out into the tote box below the end of the chute.

The test rack contains controls and meters that permit setting up...
Bring your tough problems to us at
ELECTRONIC TRANSFORMER CO.

If standard, mass-produced transformers won’t do for your product or application, consider this...

Since 1938 we’ve concentrated exclusively in the specialized field of CUSTOM-DESIGNED and CUSTOM-BUILT Transformers for government and industry.

Our engineering staff can solve your transformer problems by assimilating your circuitry in Electronic Transformer Co.’s fully equipped laboratory.

Why not write or phone us regarding your special requirements... today!

TRANSFORMERS • REACTORS • RESONANT FILTERS

ELECTRONIC TRANSFORMER COMPANY
209 WEST 25th STREET • NEW YORK 1, N. Y.
Telephone: WATkins 4-0880
For more than 18 years, Eclipse-Pioneer has been a leader in the development and production of high precision synchros for use in automatic control circuits of aircraft, marine and other industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer has available a complete line of standard (1.431" dia. X 1.631" lg.) and Pygmy (0.937" dia. X 1.278" lg.) Autosyn synchros of unmatched precision. Furthermore, current production quantities and techniques have reduced cost to a new low. For either present or future requirements, it will pay you to investigate Eclipse-Pioneer high precision at the new low cost.

AVERAGE ELECTRICAL CHARACTERISTICS—AY-200 SERIES**

<table>
<thead>
<tr>
<th>Type Number</th>
<th>Input Voltage (DC)</th>
<th>Input Current (Milliamperes)</th>
<th>Input Power (Watts)</th>
<th>Input Impedance (Ohms)</th>
<th>Stator Output Voltage (Volts)</th>
<th>Stator Resistance (1000 Ohms)</th>
<th>Stator Resistance (100 Ohms)</th>
<th>Maximum Error Speed Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY201-1</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>225</td>
<td>1.25</td>
<td>25 +/115</td>
<td>11.8</td>
<td>6.5</td>
<td>3.5</td>
<td>15</td>
</tr>
<tr>
<td>AY202-4</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>100</td>
<td>0.45</td>
<td>45 +/-225</td>
<td>11.8</td>
<td>16.0</td>
<td>6.7</td>
<td>20</td>
</tr>
<tr>
<td>Receivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY203-2</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>100</td>
<td>0.45</td>
<td>45 +/-275</td>
<td>11.8</td>
<td>16.0</td>
<td>6.7</td>
<td>45</td>
</tr>
<tr>
<td>Control Transformers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY201-3</td>
<td>From Trans. Autosyn</td>
<td>Dependent Upon Circuit Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY201-5</td>
<td>From Trans. Autosyn</td>
<td>Dependent Upon Circuit Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolvers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY273-3</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>60</td>
<td>0.35</td>
<td>108 +/-425</td>
<td>11.8</td>
<td>13.0</td>
<td>12.5</td>
<td>20</td>
</tr>
<tr>
<td>AY274-5</td>
<td>1V, 30 Ohms, 1 ph.</td>
<td>3.7</td>
<td>0.45</td>
<td>240 +/-120</td>
<td>0.24</td>
<td>239.0</td>
<td>180.0</td>
<td>40</td>
</tr>
<tr>
<td>Differentials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY233-3</td>
<td>From Trans. Autosyn</td>
<td>Dependent Upon Circuit Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Also includes High Frequency Resolvers designed for use up to 100KC (AY251-24)

AY-500 (PYGMY) SERIES

<table>
<thead>
<tr>
<th>Type Number</th>
<th>Input Voltage (DC)</th>
<th>Input Current (Milliamperes)</th>
<th>Input Power (Watts)</th>
<th>Input Impedance (Ohms)</th>
<th>Stator Output Voltage (Volts)</th>
<th>Stator Resistance (1000 Ohms)</th>
<th>Stator Resistance (100 Ohms)</th>
<th>Maximum Error Speed Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY503-4</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>235</td>
<td>2.2</td>
<td>45 +/-100</td>
<td>11.8</td>
<td>25.0</td>
<td>10.5</td>
<td>24</td>
</tr>
<tr>
<td>AY502-2</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>235</td>
<td>2.2</td>
<td>45 +/-100</td>
<td>11.8</td>
<td>23.0</td>
<td>10.5</td>
<td>24</td>
</tr>
<tr>
<td>Receivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY503-3</td>
<td>From Trans. Autosyn</td>
<td>Dependent Upon Circuit Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY503-5</td>
<td>From Trans. Autosyn</td>
<td>Dependent Upon Circuit Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolvers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY523-3</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>45</td>
<td>0.5</td>
<td>290 +/-190</td>
<td>11.8</td>
<td>210.0</td>
<td>42.0</td>
<td>30</td>
</tr>
<tr>
<td>AY543-5</td>
<td>26V, 400 Ohms, 1 ph.</td>
<td>9</td>
<td>0.1</td>
<td>900 +/-200</td>
<td>11.8</td>
<td>560.0</td>
<td>165.0</td>
<td>30</td>
</tr>
<tr>
<td>Differentials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY533-3</td>
<td>From Trans. Autosyn</td>
<td>Dependent Upon Circuit Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For detailed information, write to Dept. H.

ECLIPSE-PIONEER DIVISION of BEHAND AVIATION CORPORATION

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
**STRONG THERMOSETTING ADHESIVE**, tough backing and thin caliper make “Scotch” Yellow Flat-back Paper Tape No. 39 ideal for outside wraps on primary windings.

TOUGHNESS AND CONFORMABILITY of “Scotch” Yellow Crepe Paper Tape No. 38 with Thermo-setting Adhesive means dependable, compact TV deflection coils.

“Scotch” paper tapes speed coil winding!

Here are the real workhorses of the coil construction industry—“Scotch” Electrical Tapes with unified paper backings! They’re easy to use and strong, have superior electrical properties. And they work equally well in hand or machine application. Most important: these tapes are tailored for specific needs.

For example, the toughness and conformability of “Scotch” No. 38 Yellow Crepe Paper Tape, and the holding and protecting properties of “Scotch” No. 39 Yellow Flat-back Paper Tape have made them favorites. Their thermosetting adhesives, pioneered and perfected by us, cure thoroughly—leave no wet spots to cause trouble.

See what “Scotch” Electrical Paper Tapes can do for you! Call your supplier today!

---

FREE! POCKET TAPE CALCULATOR quickly gives you exact amount of tape needed for production coil winding operations. Includes “Scotch” Electrical Paper Tapes plus 17 others with a wide range of specialized backings in the famous “Scotch” Brand Electrical Tape family. Write Minnesota Mining & Mfg. Co., Dept. E-43, St. Paul 6, Minn.
also prevent pulling out the entire control accidentally when working with pliers on the joints. One jaw is rigidly mounted on the base plate of the fixture, and the other is on a spring-loaded arm. Pressing the back end of this arm separates the jaws for unloading and loading.

Another type of holding fixture for controls is used at subassembly positions in DuMont's television receiver plant in East Paterson, N. J. This is an individual fixture having a setscrew for fastening it to the front edge of the workbench. The hole in the fixture is a loose fit for the shaft of the control. A knurled knob is provided for locking the shaft in the fixture. The multi-contact switch can be rotated as required for soldering work, but the switch has sufficient detent action so it cannot spin around during the work.

Twisting Filament Leads

The problem of twisting together two four-foot lengths of insulated wire to serve as filament leads in a chassis was solved through use of...
GREATER LOWELL, MASSACHUSETTS

Offers Your Company

BIG-CITY LOCATION Country Style

at the LOWELL INDUSTRIAL PARK

a part of a New Industrial Frontier

\[\sqrt{\text{Check these Features!}}\]

1. A PREPARED LOCATION at intersection of 2 major highways. Only 2 miles from center of Lowell. Country setting valuable as morale factor and with ample room for expansion and parking. Easily accessible to personnel.

2. TRANSPORTATION—Site is bisected by New York, New Haven and Hartford Railroad. Superservice also furnished by Boston and Maine Railroad. Over 200 trucking companies offer service to all points. 24 miles to Boston's air and seaport facilities.

3. LABOR SUPPLY—Workers of diverse basic skills earn over $10 less than the U. S. average weekly wage and are deeply attached to the community.

4. LOW COST AREA. In a survey Lowell was 38th in 38 cities surveyed for cost of housing and 25th of 38 cities surveyed for food costs.

5. TECHNICAL RESOURCES. Facilities of Lowell Technological Institute available for your industrial research. Close proximity to M. I. T., the greatest electronics research center in the world.

6. UTILITIES—All on premises. Abundant water, electric power and low cost natural gas.

OTHER INDUSTRIAL SITES—Choice of 35 industrial sites selected and approved by experts in the Greater Lowell Area. 5 acres to 400 acres.

The Executive Director of the Lowell Development and Industrial Commission is available to meet with you or your representatives and furnish information of the type you require in confidence.

WRITE, WIRE, OR PHONE

EXECUTIVE DIRECTOR

LOWELL DEVELOPMENT & INDUSTRIAL COMMISSION

24 MERRIMACK ST., LOWELL, MASS.

LOWELL, MASSACHUSETTS, the big-city industrial center of a cluster of small New England towns, offers every metropolitan advantage together with low production costs made possible by country living. Here, only 2 miles from the center of Lowell, but with ample room for parking and expansion, local capital has selected a 110 acre park and built a modern 42,000 square foot plant as the first step in intensive industrial development. This plant (illustrated) is ideally suited to horizontal electronics manufacturing, and is ready for you now. It has concrete floor, 14' stud and 35' x 40' bay, steel roof, trucking facilities at floor level, railroad siding, sprinklers throughout, fluorescent lighting throughout, handsome modern design and quick accessibility to metropolitan Lowell.

Any portion of the 110 acre park will be conveyed almost at cost, provided a new industrial building is promptly built.

Long an industrial center, Lowell possesses well developed technical resources and a reservoir of skilled artisans whose deep attachment to the community makes them hard to lure elsewhere.
"Nice looking hair you're pulling out," said the G.M. of Station XYZ, "but when do we get lighting clearance on the new tower?"
"See that!" groaned the engineer. "That's a whoozit. It takes 5 whoozits to light our tower—about $4 worth of metal. But there just aren't any whoozits right now. No whoozits, no lights."

"Then let's do it the easy way," counselled the G.M. "Get in touch with our nearest Hughey & Phillips distributor and order a complete, packaged tower lighting kit. Just give 'em the tower specs. They'll ship pronto and include every item to light our tower—down to the last nut, bolt, and whoozit. And you'll save wear and tear on your hair."

The G.M. is right—but he told only half the story. Through years of experience in buying, designing, testing and packaging, Hughey & Phillips have gained world leadership in the field of tower lighting. And because of this specialized "know-how" H & P tower lighting kits cost less to buy, less to install, less to maintain. Drop us a line for the name of your nearest H & P distributor.

HUGHEY & PHILLIPS TOWER LIGHTING DIVISION ENCINO, CALIFORNIA LEADERSHIP IN THE FIELD OF TOWER LIGHTING

PRODUCTION TECHNIQUES (continued)

an air gun in Sylvania's Buffalo plant. The gun is clamped into a simple stand that is fastened to the workbench. A machined metal disc having two drilled holes is inserted in the chuck of the gun in place of the conventional screwdriver bit or nut-driving socket.

In using the setup, the operator pushes the ends of the wires into the diametrically opposite holes and bends the wires outward just enough so they stay in position. Now, while holding the wires near their other ends at an angle of about 30 degrees apart, she operates a foot valve to turn on the air gun. This twists the wires together uniformly at high speed.

Twisting of long leads after their ends had been soldered to the pins of a plug was solved at Olympic Radio & Television by modifying an old tapping machine. In place of the tapping chuck, a hook was mounted on the drive shaft. The hook passes through an extra pulley that is used with a leather strap and 1½-lb weight to obtain braking after declutching.

The operator places the plug end of a pair of wires in the hook, grasps the other ends of the wires and spreads them apart, then pulls to actuate the clutch and start the twisting. When the desired amount of twisting has been obtained, releasing the tension stops the twisting chuck, and a flip of the twisted wire unhooks the plug end.

The tapping machine used for the purpose employs a simple clutch;

Method of using modified tapping machine for twisting leads together
IN TAPE-WOUND CORES
JUST NAME YOUR REQUIREMENTS!

RANGE OF MATERIALS

Depending upon the specific properties required by the application, Arnold Tape-Wound Cores are available made of DELTAMAX . . . 479 MO-PERMALLOY . . . SUPERMALLOY . . . MUMETAL . . . 4750 ELECTRICAL METAL . . . or SILECTRON (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 made in twenty-two 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

Let us help with your problems of cores for Magnetic Amplifiers, Pulse Transformers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Peaking Strips, Reactors, etc.

Address: ENG. DEPT. E

THE ARNOLD ENGINEERING COMPANY
SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
General Office & Plant: Marengo, Illinois
DISTRICT SALES OFFICES

Want more information? Use post card on last page.
FOR THE PAST 20 years we've been applying our skills to problems in research, design, engineering, and manufacture of connectors and component parts for many of America's best known companies in the electronics and communications industries.

OUR CRAFTSMEN have been and are now producing parts that exceed the most exacting requirements. Our task is to make the H. H. Buggie And Company symbol even more important to you through manufacture of products equal to the importance you attach to them.

IN ADDITION to the products illustrated at left, H. H. Buggie And Company designs, engineers, and manufactures many special parts and assemblies. We invite your inquiries.

Trimming Metal Shells

A MACHINE for quickly trimming edges of shells after drawing or welding corners is used at Karp Metal Products Co., Brooklyn, N. Y.

The cutting arrangement consists of two motor-driven circular rotating heads. The one on the outside of the chassis has a knife edge, pulling on the twisting hook moves a steel disc against a motor-driven leather-faced wheel, giving speed reduction along with transmission of torque.

Trimming excess metal from edge of formed shell for electronic equipment housing. Rollers on bottom of pressure arm permit sidewise movement while maintaining downward pressure.
ROTOR SO LIGHT
…it floats on water!

Teilechron Synchronous Timing Motors

Hard, special-formula steel. Yet the rotor floats. It’s so light, mere surface tension holds it up. Imagine what an advantage like this can mean to you when you specify Telechron Synchronous Timing Motors for your equipment.

There’s little inertia to overcome. So Telechron motors start almost instantly—reach full speed in less than 3 cycles (1/20th sec.). Low-weight rotor virtually floats in the magnetic field. Rotor shaft rides on a film of oil—no metal-to-metal contact—giving longer life, and assuring true synchronous operation.

These advantages are yours in all models of Telechron Synchronous Timing Motors—no matter what the application. Let us help you select the model that will best give you the performance you are looking for.

Write for complete catalog and information on our Application Engineering Service. Telechron Department, General Electric Company, 44 Homer Ave., Ashland, Mass.
and the one on the inside has a mating groove to accept the knife. In use, the shell is placed over the grooved head. An air-operated plunger with freely-rotating pressure wheels is brought down on top of the shell to prevent it from riding up during the cutting operation. The rotating knife-edged cutting head is then brought against the outside of the shell. Excess metal is removed as the shell is moved between the wheels, to give a quick trimming job.

**Capacitor Winding Techniques**

Accurate winding of both conventional and metallized paper capacitors to pre-determined capacitance values is achieved in the North Bergen, N. J., plant of Pyramid Electric Co. through use of three different types of winding machines, each best suited for a particular type of production.

The simplest machine winds one capacitor at a time. The operator rotates the mandrel so its lengthwise groove is up, holds the strips of paper and foil over this groove, then inserts the arbor pin to lock the start of the winding onto the arbor. The pointed end of the arbor pin fits into a hole in an enlarged portion of the arbor near the head-stock. The metal disc on the other end of the pin has a center hole to fit over the free end of the arbor. The pin is sufficiently springy and tight to stay in position when in
Why Motorola uses Corning Metallized Glass Inductances in new UHF converter

UHF converters present a tough design problem. Not only must they tune an unusually broad band, stability is extremely important. Motorola solved their problem with a specially designed Corning metallized glass inductance. As can be seen from the illustration, the tuning elements are a combination of distributed capacitance and inductance. The variable pitch winding tailors the unit to the desired tracking curve. One end of the turns is broadened to provide termination surface. The accuracy and rigidity of the glass assure stable, noiseless tuning.

The exceptionally high electrical stability and low temperature coefficient of Corning metallized glass inductances are a result of the integral contact of the fired-on metallizing with the dimensionally stable glass coil forms. Drift is negligible, even under unusually variable ambient temperatures. High Q is inherent.

Corning metallized glass inductances may well be the answer to your problem. All it takes to find out is a letter to us. Our engineers are ready to go to work for you.

Corning Glass Works
New Products Division • CORNING, N. Y.

Corning means research in Glass
The basis of these frequency standards is an electronically actuated high-precision fork, temperature-compensated and hermetically sealed against barometric changes. The partial list of uses at the right not only suggests the broad range of applications but also proves dependability where there can be no compromise with accuracy. Please request details by Type No. Our engineers are available for advice or cooperation on related problems.

**American Time Products, Inc.**

580 Fifth Avenue  
New York 36, N.Y.

OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
serrated. All of the winding machines employ variations of this basic arbor pin design for anchoring the start of a winding.

A small piece of Kraft paper is inserted between layers to protect against shorts at the start of the winding. Operation of a foot pedal now actuates a clutch to start the actual winding operation.

When the correct number of turns is indicated on an attached mechanical counter, the operator stops the machine and cuts the foil and paper layers with a sharp knife. A gummed tab is then applied to anchor the ends on the roll. These tabs are provided in various colors and have different colors of printed dots to serve as a coded indication of the type of impregnation to be given the capacitor.

Guide bars and rollers prevent the paper and foil strips from dropping back into the machine when a cut is made. One roller is free-floating and gravity-loaded to provide the necessary friction for this.

The cutoff knife was made from a hacksaw blade, ground, sharpened and honed to the razor edge required for cutting the thin paper and foil without tearing it. Tape is wound around one end of the blade to serve as a handle.

_Dual Semiautomatic Machine_

For higher production rates on small as well as large capacitors, another type of machine is used. This saves time by winding one section while the operator is gluing and unloading the other section. The operation can be described by starting at the instant when the...
When TV manufacturers discovered that higher voltages of the new 27 and 21-inch television receivers rendered existing wax corona ring sweep transformers inadequate, they brought the problem to Guthman.

In a cooperative program with these TV engineers, a flyback transformer with a cast resin corona ring was developed—the perfect answer to this difficulty.

Your problems in the development of coils and transformers are welcome at Edwin I. Guthman & Company, Inc., 15 South Throop St., Chicago 7, Telephone: CH 3-1600, also Attica, Indiana.
When is Steatite Better Than Steatite?

Ans: When it is "Lavite" STEATITE!

---and here's why!

1. Any material that is kept under perpetual research and re-development, as "Lavite" Steatite has always been, is naturally superior to like material produced to conventional standards.

2. Your parts (trimmer bases, coil forms, strain reliefs, tube base sockets and hundreds of others), produced in "Lavite" Steatite may be extruded or pressed, and in either case machined to close tolerances.

3. Being a product of private research, you are assured laboratory control in every step of production.

4. Selection of specific properties is no problem.

5. Unusual shapes and mechanical oddities are accepted as routine.

6. Perhaps metallizing of your parts will help you cut assembly time—a Steward Specialty.

Remember—Steward's Engineers are Your Engineers. Use them often. Our recommendations are a service to you—no obligations.

- Ask for booklet giving characteristics of all "Lavite" Ceramics ("Lavite" Steatite, "Lavite" Titanates, "Lavite" Ferrites and others).

D. M. STEWARD MANUFACTURING CO.
3604 Jerome Avenue, Chattanooga, Tenn.
Sales Offices in Principal Cities

---

A machine has just finished winding a capacitor and has stopped automatically. The operator at this time has finished applying the gummed locking label to the previously finished unit. She flips out of the way the hinged righthand support end for the arbor closest to her, pulls out the pin on this arbor, slips off the finished unit, then rotates the entire geared head of the winding machine half a turn so that the newly completed capacitor is now in front of her and the empty arbor is under the strips of paper and foil.

The arbor pin is now inserted in the empty arbor to lock the start
Here it is...!

**The Magnetic Modulator**

*Now Available in 60 and 400 Cycle Designs*

A converter with high shock and vibration resistance and practically unlimited life operation in ambient temperatures from $-55^\circ C$ to $+200^\circ C$.

**Low Level Dual Polarity DC Signals**

\[ \text{CONVERTED TO} \]

**Phase Reversing Suppressed Carrier Modulated Envelope**

**Input Information**

- Photo Cell
- Thermocouple
- Strain Gauge
- Magnetometer
- Microsen

**Output Information**

- Servo Amplifiers
- Recorder
- Motor Control
- Speed Control
- Flight Control
- Fire Control
- Auto Positioning

**Low Level DC Voltage**

**Actual Size**

The IMM 182 Magnetic Modulator is designed to convert low level dual polarity DC signals into 400 cycle signals of corresponding amplitude and phase sense.

**400 Cycle Unit Specifications**

- Nominal input signal $\pm$ 40 microamps.
- Weight: 4 oz.
- Nominal output volts: 0.9 volts
- Temp. rise: negligible
- RMS @ 400 cycles
- Life: unlimited
- Output at null: 10 mv. rms. max.
- Input res.: 2,000 ohms.
- Output phase: 0 or 180 $\pm$ 5 deg.
- Output impedance: 5,000 ohms.
- Harmonic Distortion: Less than 10%, above 0.1V output

The same precision engineering which has made our Magnetic Modulators outstanding in the field of electronics is applied in the production of our magnetic converters, computers, magnetic amplifiers, and thermocouple converters.

On request, we will be pleased to furnish complete details. Our Engineering Department will give prompt attention to your specific magnetic modulator and amplifier specifications.

We specialize in control systems and components for automatic flight, fire control, analog computers, guided missiles, nuclear applications, antennas and gun turrets, commercial power amplifiers, and control systems.

For further details write Dept. E.

**General Magnetics**

135 Bloomfield Ave., Bloomfield, N. J.
Headstock end of dual semi-automatic machine with protective housing removed to show cam and quick-change gears that shut off machine when correct number of turns is wound. Push rod under cam goes down through table to actuate motor clutch of the next winding, and the right-hand arbor support is flipped back into position. The strips are cut between the arbors with a knife, about two inches of foil are pulled out from between the layers of paper at the start of the new winding to avoid direct shorts, and the operator then steps on a foot pedal to start the winding operation. She now returns to the other arbor, tears out a similar amount of foil from between each layer to avoid end-of-winding shorts, turns this arbor manually with her fingers to finish the winding, then applies the anchoring sticker to complete the cycle of operation.

The geared head is arranged so that only one arbor is driven at a time. Diametrically opposite notches on the head mate with a detent spring underneath to give precise positioning of the arbors.

The machine is automatically stopped, after winding the desired number of turns, by a cam-and-gear arrangement. The cam is driven by the powered arbor through a train of gears. When starting a new winding, the operator holds down the foot pedal long enough for the cam to rotate out of its depressed part and hold the clutch closed. The cam then holds the clutch open for a predetermined fraction of its revolution. As the end of the winding is reached, the roller on the clutch-locking lever

**SIMPSON MODEL 480 GENESCOPE FOR ACCURATE TESTING**

- All the necessary signal sources for alignment of FM and TV receivers
- Includes the Simpson High Sensitivity Oscilloscope and high frequency crystal probe for signal tracing
- Independent, continuously variable attenuators and step attenuators for both AM and FM units offer complete control of output at all times
- 0-15 megacycle sweep is provided by a noiseless specially designed sweep motor based on D'Arsonval meter movement principles
- The exclusive Simpson output cable (illustrated) includes a variable termination network, quickly adapted to provide open, 75 or 300 ohm terminations — the addition of a pad provides attenuation and isolation. Use of appropriate resistors across certain terminals will provide any other termination required.
- A .002 MFD blocking condenser can be added on any termination for use on circuits containing a DC component
- The FM generator output voltage is constant within 2 DB per MC of sweep.

**ELECTRONICS — April, 1953**

**SIMPSON ELECTRIC COMPANY**
5200 W. Kinzie St., Chicago 44, Illinois
Phone: COlumbus 1-1221 * In Canada: Bach-Simpson, Ltd., London, Ont.

dealer's net $395.00
TRIAD
Sub-Miniature Pulse Transformers

Designed for simplifying and miniaturizing short-pulse circuits, these new Triad sub-miniature transformers meet the continuing demand for higher performance in smaller packages. In many cases they meet exacting circuit requirements-saving engineering time. In every case they save space and weight. Prices on types shown hereon request. For special designs, submit outline of contemplated circuit.

Tandem Winding Machine
A still more automatic two-arbor machine winds two capacitors simultaneously on each arbor and automatically glues the ends of the finished units. Here, however, the arbor is split into two equal sections along a diameter and the paper and foil strips are locked between the two halves of the arbor to hold the start of each winding. An operating cycle is as follows, starting at the instant when winding has been completed:

1. Index the machine by giving crank lever half a turn with left hand, to transpose position of arbor. The empty arbor head is now farthest away from the operator and ready for loading, with both halves of its arbor retracted to the left.

2. Push in first half of empty arbor. This is mounted on a slide along with the pointed rod that later serves for flipping the cut ends onto glue pads. This first half moves up into the recessed part of the cam, releasing the clutch and stopping the winding.

The number of turns is changed in two ways, by changing the easily removed gears and by adding or removing cam inserts. These inserts are fastened to the cam with machine screws.

PRODUCTION TECHNIQUES
(continues)

TRIAD
Transformer Mfg Co
1055 Redwood Ave. - Venice, Calif

Want more information? Use post card on last page.

PANELS, LIDS, DOORS MADE RF-TIGHT BY LOW COST METHOD

Electronic Weatherstripping, made of knitted wire mesh compressed to required sizes and shapes, effectively "shields" these openings against RF leakage just as weatherstrips seal doors and windows.

Openings such as these are necessary for operating and servicing the electronic equipment housed in the metal cabinet. Yet these same openings destroy the full shielding efficiency which an "unbroken" metal container would otherwise provide. Careful machining of mating surfaces at these openings is an obvious answer. But such work is expensive, and the initial close fit is often destroyed by repeated openings and closings, by warping of the lid or door and by corrosion of the mating surfaces. Numerous latches, screws, bolts and other fasteners, closely spaced, will help keep these joints RF tight, but they are a time consuming nuisance whenever the cabinet must be opened and closed, and they are expensive to purchase and install.

Metex Electronic strips and gaskets eliminate these objections. Being made of metal, they are conductive; and being knitted they are resilient and conform to normal surface irregularities. They actually "block" the otherwise leaky openings with a gasket of flexible metal, and make the cabinet as effective a conductive shield as if the openings had never been made.

Metex electronic strips and gaskets are easy to install. Not only are they inexpensive, but their use may well save more than their cost by eliminating many operations that would otherwise be necessary. They are available in different shapes, dimensions and resilientities to meet the varied requirements of specific electronic applications and can be made of metals or alloys selected to meet actual or anticipated corrosive conditions.

A bulletin giving detailed information is available on request from the manufacturer, Metal Textile Corporation, 641 East First Avenue, Roselle, N. J. Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Time Delay Timers are designed for application on circuit controls where a time delay is required between the closing of one circuit and the predetermined closing or opening of another.

Series TDAF and Series TDAB Time Delay Timers are built to stand abuse, and afford the dependable, consistent operation which modern industrial applications demand.

These timers are designed to handle time cycles up to 3 hours. They employ an external, magnetically-operated clutch that not only assures exceptional accuracy but permits instantaneous, automatic reset. Thus these timers are ideal for use where rapid recycling is necessary.

**OUTSTANDING FEATURES**

**Automatic, Instant Reset**—As soon as the clutch is disengaged, an internal spring brings the actuating arm back to its reset position in a fraction of a second.

**Time Setting Adjustment**—Adjustment is accomplished by simply moving the black-button pointer to the time cycle required. Quick, easy, accurate.

**Dial**—Dials of both series have large, easily read numerals.

**SERIES TDAF Timers**

For panel mounting. Terminal strip for electrical connections located at back. 115 volt and 220 volt, A.C.—25, 50, and 60 cycles. (For time ranges, see chart.)

**SERIES TDAB Timers**

For surface mounting. Terminal strip for electrical connections located at front, below dial. If required, can be supplied in steel housing, as illustrated—eight knockouts for easy hook-up. 115 volt and 220 volt, A.C.—25, 50 and 60 cycles. (For time ranges, see chart.)

**TIME RANGES**—Series TDAF and Series TDAB Timers

<table>
<thead>
<tr>
<th>DIAL CALIBRATION</th>
<th>MAXIMUM TIME CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 Second</td>
<td>5 Seconds</td>
</tr>
<tr>
<td>1/4 Second</td>
<td>15 Seconds</td>
</tr>
<tr>
<td>1/2 Second</td>
<td>30 Seconds</td>
</tr>
<tr>
<td>1 Second</td>
<td>60 Seconds</td>
</tr>
<tr>
<td>2 Seconds</td>
<td>3 Minutes</td>
</tr>
<tr>
<td>5 Seconds</td>
<td>5 Minutes</td>
</tr>
<tr>
<td>15 Seconds</td>
<td>15 Minutes</td>
</tr>
<tr>
<td>30 Seconds</td>
<td>30 Minutes</td>
</tr>
<tr>
<td>60 Seconds</td>
<td>60 Minutes</td>
</tr>
<tr>
<td>2 Minutes</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

For complete technical data request bulletin 39

MANUFACTURERS OF THESE AND OTHER TIMERS AND CONTROLS FOR INDUSTRY—Cam Timers • Manual Set Timers • Tandem Automatic Recycling Timers • Instantaneous Reset Timers • Running Time Meters

Timers that Control the Pulse Beat of Industry

INDUSTRIAL TIMER CORPORATION
115 EDISON PLACE, NEWARK 5, N. J.

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

283
R 45 SERIES—Small telephone type relay, with pin hinge construction. Available with multiple contact springs up to six pole double-throw. Capacities: 1 amp., 3 amp., or 5 amp. Normally supplied for D.C. operation. Hermetically sealed or open. 1-13/32 x 1-1/4 x 1-7/32 to 1-5/8 high.

R 83 SERIES—Available with A.C. or D.C. coils. Contact ratings up to 30 amperes continuous, 150 amperes inrush with single pole double-break arrangement. Multiple contact springs with proportionately lower ratings also available. Size: 1-7/8 x 1-5/16 x 1-5/8 high.

R 84 SERIES—Similar to R 45 with the exception that it is designed to fit the hermetically sealed enclosure shown. Three stud mounting; solder terminals. Available up to 4 pole double-throw. Widely used in aircraft and ground communication equipment. Size: 1-5/8 x 1-7/16 x 2-1/4 D.

R 94 SERIES—Hermetically sealed small telephone type relay with pin hinge construction for long life. Available in D.C. only with contact springs up to 4 pole double-throw. In 1 amp., 3 amp., or 5 amp. capacity. Plug-in or solder terminals. Overall size 1-5/8 x 1-1/4 x 2-1/4 D.

"Diamond Quality" TIME SWITCHES...

Automatic Electric also produces a complete line of Time Switches and Timers, both manual and automatic reset. Write for information.

PRODUCTION TECHNIQUES (continued)

Inserting first half of split arbor along with pointed rod by pushing slide with left hand, preparatory to anchoring start of next winding so that strips can be cut of the split arbor goes under the strips as it passes through center and right-end bearing supports. The arbor thus has three points of support while winding its two units.

(5) With right hand, push guillotine-blade slide to left and depress slightly. This causes a compression bar, also on the slide, to push the strips of foil and paper against the flat surface of the arbor half that is in position.

(6) Insert second half of arbor over top of strips, flat face down, by pushing it in with left hand. This locks the start of the next winding.

(5) Push guillotine blades all the way down to cut strips, then release and retract blades to right out of way. The cut ends of the finished units now flip over glue pads on the table in front of the machine.

(6) Press handle at right of machine to start winding operations. This drives both arbors, hence also

April, 1953 — ELECTRONICS
**NE-11-20-S SPECTRUM ANALYZER**

**Description**

The Spectrum Analyzer is test equipment designed primarily for use with aircraft radar and beacon equipment operating over a frequency range of 8470 to 9630 mc/s. Housed in a compact portable carrying case, the whole assembly weighs approximately 90 pounds.

In operation, the Spectrum Analyzer displays on an oscilloscope a pattern representative of the distribution of energy among the various frequencies in the output of a pulsed oscillator. This equipment is equal to our government models TS-148/UP.

**Applications**

This very sensitive micro-wave receiver will provide accurate measurement of the spectra of radio frequency oscillations in radar and beacon equipment. It will also measure, within its own range, frequencies of echo boxes, magnetrons, test sets, local oscillators and a variety of resonant cavities. It can also be used to check magnetron pulling and AFC circuits, and as a frequency-modulated oscillator to tune T/R Boxes and R/T Boxes in transmitter-converters.

The Analyzer is so sensitive that the magnetron signal can usually be picked up at some distance from the source, thus making the equipment easy to use in any convenient location.

**Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>50-1200 Cps; 105-125 Volts; 125 Watts</td>
</tr>
<tr>
<td>Frequency-meter Range</td>
<td>Calibrated directly from 8470 mc/s to 9630 mc/s</td>
</tr>
<tr>
<td>Sweep Frequencies</td>
<td>Continuously Variable from 10 to 30 Cps</td>
</tr>
<tr>
<td>Attenuation (Spectrum Amplitude)</td>
<td>Uncalibrated. Variable from 3 to 70 db.</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-40°C. to +55°C.</td>
</tr>
<tr>
<td>Frequency swing of analyzer r-f oscillator (sawtooth FM)</td>
<td>40 to 50 mc/s</td>
</tr>
<tr>
<td>Overall i-f bandwidth at half power points</td>
<td>50 kc/s</td>
</tr>
<tr>
<td>Sensitivity to CW Spectrum Amplified Pos.</td>
<td>80 db. below 1 watt for 1 inch of deflection on Oscilloscope Screen.</td>
</tr>
<tr>
<td>Spectrum Position</td>
<td>55 db. below 1 watt for 1 inch of deflection of Oscilloscope Screen.</td>
</tr>
<tr>
<td>Maximum dispersion of spectra</td>
<td>1.5 mc/s per inch</td>
</tr>
<tr>
<td>Maximum error</td>
<td>± 5 megacycles</td>
</tr>
</tbody>
</table>

We will gladly furnish all details regarding specifications, prices, and delivery.

Write, wire or telephone for information.

---

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

Manchester, New Hampshire

NE-11-20-S SPECTRUM ANALYZER

Describe the equipment designed primarily for use with aircraft radar and beacon equipment operating over a frequency range. Explain its operation and applications. Provide specifications and where to obtain more information.
After cutting, ends of papers flip over glue-saturated felt pads on top of glue pump. In another fraction of a second, when machine starts, these strips will have been pulled over the pads to complete the winding of two capacitors completes the winding of the finished unit; its loose ends are dragged over the glue pads as they are pulled in, and the loose ends are thus automatically glued at the instant that the rolling is completed. The arbor with the finished units continues spinning, as this does not interfere with unloading.

(7) Pull out one half of arbor for finished unit by slipping forked tool under sleeve on left end of this arbor half and pushing it to left.

(8) Strip second half of arbor by moving to left the cross bar on which are mounted the pointed paper-flipping rod and the free-turning half arbor. This releases the finished capacitor sections, allowing them to drop down the chute and into a tote tray. By now the winding on the other arbor has been completed and both arbors have been stopped by the predetermined electrical counter mounted on the right of the machine. This acts through solenoids and snap-action switches to stop the machine
**GRAMER Hermetically Sealed**

**TRANSFORMERS MEET MIL-T-27 GRADE 1 CLASS A SPECIFICATIONS WITH IN-PLANT TESTING FACILITIES**

**TEMPERATURE and IMMERSION CYCLING**

FIVE (5) CONTROLLED CYCLES OF 15 MINUTES EACH STEP

- Step 1. Oven 185°F.
- Step 2. Room Temperature
- Step 3. Cold Chamber --67°F.
- Step 4. Room Temperature
- Step 5. Saturated Salt Bath Total Immersion

**EXACT ELECTRICAL MEASUREMENTS**

INSULATION RESISTANCE measured accurately to 2,000,000 Megohms

**TEMPERATURE RISE TEST**

**MOISTURE RESISTANCE**

Transformers withstand 10 humidity cycles shown at left and are subjected to a 15 minute vibration test, 10 to 55 cycles per second. Some specifications require DC polarizing voltage applied from terminals to case during the entire time units are in humidity cabinet.

**GRAMER TRANSFORMERS CAN TAKE IT!**

We Invite You—Send Your Specifications c/o Dept. E.

**GRAMER TRANSFORMER CORPORATION**

2734 NORTH PULASKI ROAD - CHICAGO 39, ILLINOIS

*ELECTRONICS — April, 1953*
The Inside Story Is Always "Quality"

When the carton is marked PHALO . . . the inside story is always quality!

The most graphic endorsement of this claim is the steadily increasing number of PHALO cartons and spools being shipped daily!

Closeup of glue pump, with pad removed to show hole through which glue is squirted up through pad each time round bar strikes lever, as shown here, during indexing of head

at the precise instant when the desired number of turns is achieved. One type of unit suitable for this purpose is the Microflex Counter made by Eagle Signal Corp., Moline, Ill.

(9) Index the head of the machine 180 degrees to start next cycle of operation.

Automatic Glue Pump

The pointed paper-flipping rods on the outer circumference of the indexing head serve the added purpose of actuating a pump lever that forces glue up into the felt pads each time the head is indexed. An ordinary automotive-type oiler serves as the pump. The long nozzle of the oiler is replaced with

Details of glue pump, along with standard oiler (at left) from which it is made

Want more information? Use post card on last page.
circuit engineers! transistor manufacturers!

an unexcelled

TRANSISTOR TEST SET

A Precision Laboratory Instrument to test small signal behavior of all POINT CONTACT and JUNCTION TRANSISTORS

TRANSISTOR TEST EQUIPMENT—Model T-61 measures four independent parameters of the four terminal equivalent circuit of the transistor. These measurements can be carried out over the complete operating range of the transistor, and thus directly lead to the quantitative data necessary for circuit design.

Its function in the transistor field is comparable to that of a vacuum tube bridge in the vacuum tube field, but much simpler to operate and is not a null instrument.

FLEXIBILITY—COMPLETENESS insure continued maximum usefulness in anticipation of the development of new types of transistors.

FEATURES:

Overall accuracy is 2%. The unit contains separate metering circuits for all applied D.C. currents and voltages, a precision vacuum tube volt-meter for direct reading of the parameters under test, and a precision single frequency audio-oscillator. It is powered by 8 separate self-contained regulated power supplies, making operation without adjustment over all normal line voltage variations.

DIMENSIONS: Housed in an open front, enclosed relay rack cabinet, with panel space of 26½ x 19". The overall dimensions of the cabinet are 28" x 21½" x 15".

OPERATIONAL CHARACTERISTICS:

D.C. BIAS CONDITIONS OF EITHER POLARITY ARE PROVIDED IN THE FOLLOWING RANGES:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emitter current</td>
<td>0—10 milliamperes</td>
</tr>
<tr>
<td>Collector current</td>
<td>0—10 milliamperes</td>
</tr>
<tr>
<td>Emitter voltage</td>
<td>0—limit set by 15 milliamperes through emitter</td>
</tr>
<tr>
<td>Collector voltage</td>
<td>0—limit set by 15 milliamperes through, or 0—100 volts reg.</td>
</tr>
</tbody>
</table>

TRANSPRITOR PRODUCTS INC.
55 UNION ST.
BRIGHTON 35, MASS.

An operating unit of the CLEVITE Corp.
a casting that in effect provides a T-shaped nozzle for squirting two pads at once. The T-shaped channels in the brass casting were obtained by drilling through the casting from three directions mutually at right angles, then plugging the ends of the holes appropriately with Allen screws. A lever was then mounted on the casting in such a way that its lower end pushed in the pump-actuating piston each time the pointed rod passed over the upper end during the indexing operation.

A polyvinyl acetate glue is used. This remains sufficiently fluid for continuous use in the oiler even without a cover on the oiler, and provides adequate adherence for the kraft capacitor tissue.

**Sponge Rubber Mallet**

Intermittent connections and microphonic tubes are safely detected without risk of damaging other parts by using a mallet made from three pieces of half-inch sponge rubber. Each piece is approximately 2 inches wide and 4 inches long. The pieces are fastened together with rubber cement, a hole is drilled through them and a wood handle made from dowel rod is glued into this hole.

If handle and strips tend to

**PRODUCTION TECHNIQUES (continued)**

**CAROL POWER SUPPLY AND CHARGING CABLE**

Really rugged ... but unusually easy to handle. . . . Carol Charging Cable is designed to carry heavy currents for rectifiers, battery chargers, large motors and other equipment needing portable power cable.

Soft copper wires are rope lay stranded for extra flexibility. They are either tinned, or bare and served, then enclosed in high dielectric, long-wearing rubber compound. For most severe service, the jacket is made of Carol Neoprene . . . a specially compounded material which resists acids, alkalis, sunlight, corona, oil and grease; withstands extremes of weather and temperatures.

Carol Charging Cable is supplied in sizes from No. 4/0 to 10 AWG, with either rubber or neoprene jacket.

Write or call today for full information on our complete line of cable for electronic applications.
G-E Electronic Timer Has High Repetitive Accuracy

General Electric Electronic Timers assure precise timing of repetitive operations. One manufacturer reports the use of G-E timers on bearing grinding machines where they control cutting time and drift time. Here, G-E timers perform over 500 repetitive time cycles per hour. Where you require a uniform product turned out at high speed, put the accuracy of the General Electric Electronic Timer to work for you.

Controls F-hp Motor Directly

Here, a G-E Electronic Timer controls directly the small motor of a box conveyor. The timer tells the motor when enough boxes have been delivered to the gravity conveyor. A limit switch, actuated by the first box, tells the timer when to start. You can get a G-E Electronic Timer to start fractional-horsepower motors directly or handle motor starters up to NEMA Size 3.

Can Be Remotely Adjusted

Here a steel company, through a furnace control desk, controls the time cycle of high-speed rolls even though the timer is inaccessible. A limit switch actuated by the steel slab starts the electronic timer. Your G-E Electronic Timer can be located wherever necessary and remotely adjusted from a convenient location.

SPECIFICATIONS

EXCELLENT REPETITIVE ACCURACY
High-quality capacitors permit errors no greater than \( \pm 2\% \) of dial setting, independent of normal temperature changes.

THREE TIME RANGES AVAILABLE
.06-1.2, .6-12, 6-120 seconds, each continuously adjustable through a 20:1 range.

TWO TYPES OF OPERATION
Can be set for immediate or delayed start.

HIGH CONTACT RATING
One million operations at full load, up to ten million at less load. Handles motor starters to NEMA Size 3, starts f-hp motors directly.

REMOTE CONTROL
Timing potentiometer and dial assembly may be located where most convenient.

CONSTRUCTION
High quality components, conservatively rated for top performance and long life.
"Most consistent 'chopper' on the market"

That's what a lot of people who use vibrators say about the Honeywell Synchronous Vibrator WG-178.

They know from experience that performance is consistent from one unit to the next—a most important consideration. This high consistency in the performance of the WG-178 is a direct result of the quality of design and workmanship that is a distinctive feature of all products manufactured by the Honeywell Aero Division.

Here are some of the other characteristics of the little "chopper":

1. It's versatile, can be used as a DC-AC modulator, or as a rectifier.
2. It's longer-lived, operating for an average of 500 hours.
3. It's adjustable. Open and closed times can be varied.
4. It's tough. When shock mounted (in any position) it exceeds rigid Air Force environmental specs.
5. It's a precision instrument. Quality design guarantees exceptionally clean signals.

If you'd like to know more about the WG-178 Synchronous Vibrator, we'd be pleased to send details. The address is Honeywell Aero Division, Dept. 401(E), Minneapolis 13, Minnesota.

**Specifications for Synchronous Vibrator**

**WG-178**

- ** Coil Supply:** Suggested supply voltage is 115 volts, 600 cps for WG-178A and 12.6 volts, 400 cps for WG-178B when suitable voltage-dropping resistors are included in the circuit with the field coil.
- ** Power:** Approximately 0.7 watts, excluding the phasing circuit.
- ** Contact Rating:** Contact rating depends on circuit in which units are used. All applications should be referred to our engineering department for approval. The devices have been used in circuits with approximately one milliampere (nominal) current and up to 35 volts dc supply.
- ** Environment:** When used on a shock-mounted chassis type mounting the units conform to Spec 41000B as follows:
  - ** Humidity Test:** 10 days (24 hour cycle).
  - ** Temperature Test:** -65°F. to 160°F. (-54°C. to 71°C).
  - ** Altitude Test:** 55,000 feet.
  - ** Vibration Test:** Up to 200 cps (5G maximum). This is a modified test.
  - ** Sand and Dust Test:** As specified.
  - ** Mildew Resistance Test:** 24 days.
  - ** Salt Spray Test:** 50 hours.
  - ** Weight:** Approximately 0.5 lb.

**Spring Rack Holds Parts**

In small-quantity subassembly work where one operator completes the entire job at DuMont, a simple coil spring rack is used to hold the parts needed for a run of perhaps three units. Before starting, the operator places on this rack the required number of each part, taking them from paper bags alongside her.

The rack consists of a plywood stand on which are mounted pre-stretched coil springs. Each spring is bolted to its own metal strip to loosen after a period of continuous use, vinyl plastic adhesive tape is wrapped around as reinforcement. This improvised tool is used in the test section of Olympic's television plant in Long Island City.

Stand made from springs, metal strips and plywood here holds parts needed for three terminal board subassemblies. Operator keeps original sample in front of her to serve as guide, supplementing prints mounted above sample.
Unexcelled for Accuracy and Dependability

The COLLINS 51J Communications Receiver

The Collins 51J Communications Receiver in addition to its outstanding performance in the communications field, is being widely used in industrial laboratories as a sensitive and accurate measuring instrument. Write today for complete details and specifications.

Condensed Specifications

FREQUENCY RANGE: .54 to 30.5 megacycles.
CIRCUIT: Double Conversion Superheterodyne.
CALIBRATION: Direct reading in megacycles and kilocycles. One turn of main tuning dial covers 100 kilocycles on all bands.
TUNING: Linear, divided into 30 one-megacycle bands. Each dial division represents one kc.
FREQUENCY STABILITY: Overall stability within 1 kc under normal operating conditions.
SELECTIVITY: 5.5 to 6.5 kilocycles at 6 db down. 17 to 20 kilocycles at 60 db down.
AUDIO OUTPUT: 4 and 600 ohms impedance. 1 1/2 watts at 1000 cps with less than 15% distortion overall. "S" meter may be switched to read audio output.
RF INPUT: High impedance single-ended. Break-in relay mounted internally. Antenna trimmer will resonate input circuit when used with any normal antenna.
POWER REQUIREMENTS: 85 watts 45/70 cps, 115 volts or 230 volts.

Your inquiries will receive prompt attention

COLLINS RADIO COMPANY
Cedar Rapids, Iowa
EXTRUDED TEFLOW (Tetrafluoroethylene) hook-up wire is organically capable of sustained operation from +210°C to −90°C with no appreciable decomposition. This wide range of operating efficiency continually opens new applications for EXTRUDED TEFLOW — especially where constant stability under exceptional temperature conditions is required for long periods. EXTRUDED TEFLOW +210°C to −90°C is non-inflammable ... is resistant to most chemicals ... has no known solvent.

Because of low electrical losses, EXTRUDED TEFLOW is adaptable for high frequency use. It has very high volume and surface resistivity. EXTRUDED TEFLOW is available in thin wall and specified hook-up wire sizes, with shield or jacket, also as coaxial cable.

NOW AVAILABLE in 10 colors—black, brown, red, orange, yellow, green, blue, violet, gray, white. Samples available.

Spraying concrete blocks for cosmotron with dust-preventing resin. Preliminary tests indicate the solution also has waterproofing value.
The unusually high insulation resistance at 20° C. in turn insures unusually high resistance at temperatures up to 75° C. The insulation resistance of these capacitors at 75° C. is approximately ten times that of commercial oil capacitors at 20° C. This is well illustrated in Curve #1109.

Performance curves illustrating various characteristics of the Stabelex "D" Capacitor will appear in this magazine each month.

OUTSTANDING FEATURES

- Insulation resistance at 20° C. after three minutes charge: 900,000 megohm microfarads
- Insulation resistance at 75° C.: 78,000 megohm microfarads
- Insulation resistance at -75°: In excess of 5 million megohm microfarads
- Change in capacitance from 25° C. to -80° C.: ±0.76%
- Self time constant of 10 MFD capacitor: 14800 hours
- Q at 50 kilocycles: 10,000
- Power factor at 1 KC: 0.00025

SEND FOR CATALOG 1117 TODAY

After a long period of research, Industrial Condenser Corporation now offers to industry for the first time the first of their family of Stabelex capacitors, stabelex "D", which has been produced for special applications for some time.

Complete information performance curves, characteristics, and suggested applications of the various types now available will be found in this catalog.

INDUSTRIAL CONDENSER CORPORATION

3244 N. California Avenue
Chicago 18, Illinois, U.S.A.

Please send me my FREE copy of your new Catalog 1117 on Stabelex "D" Capacitors.

Name
Company
Position
Street
City Zone State

Mfrs. of Oil, Wax, Electrolytic, Plastic Capacitors and Radio Interference Filters

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
New JOHNSON NYLON TIP JACKS

- Recessed Head
- Chamfered Contact Facilitates Insertion
- Annular Rings for Sealing
- Sealed Shank

Completely insulated with integral head and body molded of tough, low-loss Nylon. High breakdown voltage, low capacity to panel are characteristics of these completely new JOHNSON tip jacks.

JOHNSON Nylon Tip Jacks are furnished in eleven bright, uniform colors adapting them to coded applications. Contact is securely anchored in the jack body, recessed to avoid accidental contact. Standard contact materials are phosphor bronze and beryllium copper, both silver plated. Solder terminal is hot tin dipped. Mating plug is firmly engaged with virtually all its surface area in contact with the jack. Thus, low, stable contact resistance is assured. Jack body threaded 3/4"-32, mounted by single nickel plated brass nut.

For complete information on the JOHNSON line of tip jacks and other JOHNSON electronic components, write for your copy of General Products Catalog 973 today!

E. F. JOHNSON COMPANY
CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS, JACKS, DIALS, AND PILOT LIGHTS
228 SECOND AVENUE SOUTHWEST • WASECA, MINNESOTA

SPECIFICATIONS
DC breakdown, 11,000 volts
Nominal capacity to 1/8" panel, 2.0 mmf.
Mating pin, .081" diameter
Mounting hole required, 1 3/8"
Head diameter, 1/4"
Insulating hardware required, NONE

BERYLLIUM COPPER CONTACTS
Cat. No. 105-601-1 105-602-1 105-603-1 105-604-1 105-605-1 105-606-1 105-607-1 105-608-1 105-609-1 105-610-1 105-611-1

PHOSPHOR BRONZE CONTACTS
Cat. No. 105-601-2 105-602-2 105-603-2 105-604-2 105-605-2 105-606-2 105-607-2 105-608-2 105-609-2 105-610-2 105-611-2

Color White Red Black Dark Green Light Blue Orange Yellow Brown Light Green Dark Blue Ivory

Blower Speeds Cooling of Induction Soldering
A small blower aimed directly at the work coil of an induction soldering setup for hermetic soldering cools the solder much faster after completion of the heating cycle, thereby boosting the production rate appreciably. On short heating cycles the blower does not affect the temperature of the work, nor does it affect the work coil because that is already water-cooled internally. A successful application of this technique at Utility Electronics used an induction heater made by Marion Instrument Co.

Soldering Iron Stakes
Plastic Pegs
Loop antennas are rapidly mounted on the back covers of portable radio receivers through use of a simple lever-operated holding jig and a modified soldering iron. The plastic cover, resting on a newspaper pad to protect it from scratches, is set in position under the holding jig. A flattening plastic peg by applying heat and pressure with electric soldering iron, while clamping jig holds antenna flat against inside of cover for threeway radio.
This is the life story of 3 of numerous Federal power triodes used by the Canadian Broadcasting Corporation at station CBX, Lacombe, Alberta: Since October, 1948, to recent date, these tubes have served for 69,000 hours. Both F-9C31's appear to have full emission and capability of many more hours. The F-9C29 — used in modulator unit — is on standby after 21,015 hours.

Behind the long performance of these 3 tubes is Federal's pioneering in the multi-strand thoriated tungsten filament, which permits hairpins to expand individually ... eliminates stresses which might be conducive to filament warping.

Cathodes of this type provide lower operating temperatures ... keep components cooler, more durable. Because less filament power is consumed, tube life is longer ... operating costs are lower. The power saved per-tube-per-year equals the price of a new tube!

For full information on Federal's F-9C31 and F-9C29, or Federal quality-controlled tubes of any power output, write Dept. 'K'-113.

Federal always has made better tubes"
FM/AM SIGNAL GENERATOR TF 995
A crystal standardized generator either frequency or amplitude modulated. Frequency range: 13.5 to 216 megacycles. Output range 0.1 microvolts to 100 millivolts. Internal or external modulation gives F.M. deviations to 600 kilocycles and A.M. depths to 50 per cent.

FM DEVIATION METER TF 934
With crystal-standardized deviation ranges of 5, 25 and 75 kilocycles, alternative high- and low-level buffered inputs, visual checking for optimum tuning and level, together with a separately buffered audio outlet, this ruggedized deviation meter is ideal for carriers in the range 2.5 to 200 megacycles.

UNIVERSAL BRIDGE TF 868
Measures inductance and capacitance at 1,000 cycles, resistance at d.c.; direct reading 1 microhenry to 100 henries, 1 micro-microfarad to 100 microfarads, and 0.1 ohms to 10 megohms. Q range 0.1 to 1,000, tanδ 0.001 to 10.

STANDARD SIGNAL GENERATOR TF 867
For precision receiver measurements: Covers on an expanded full-vision scale 15 kilocycles (or less) to 30 megacycles, crystal standardized, with an output continuously variable from 4 volts to 0.4 microvolts. Up to 100 per cent. A.M., with unmeasurable F.M., monitored by dual rectification.

MARCONI INSTRUMENTS
VACUUM TUBE VOLTMETERS • FREQUENCY STANDARDS • OUTPUT METERS
WAVE METERS • WAVE ANALYSERS • Q METERS • BEAT FREQUENCY OSCILLATORS
23-25 BEAVER STREET • NEW YORK 4
CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED, ST. ALBANS, HERTFORDSHIRE
Managing Agents in Export:
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS

PRODUCTION TECHNIQUES (continued)
loop antenna is now dropped over the pegs molded into the thermoplastic cover, and the handle of the jig is pulled forward. A combination of cam and lever action moves the pressure block down on the antenna and holds it there for the remainder of the operation. The operator now applies the flattened end of the soldering iron to each plastic peg in turn. This softens and flattens the peg, much as if peening a red-hot rivet.

A backward push on the lever handle releases pressure, so that the finished unit can be taken out to complete the work cycle. This procedure is used in Emerson's Jersey City plant.

Tweezer-Type Soldering Iron

IN SOLDERING deflection yoke leads to special terminal lugs that are to fit inside the female connector for the deflection yoke of Olympic's television receiver, surplus solder would prevent insertion of the lugs in the connector. To offset this, a Pres-To-Heat soldering tool made by Triton Manufacturing Co., East Haddam, Conn. is used to heat the joint. This is a resistance type tool operating from a step-down transformer. Pressing a button on the tool closes the tweezer-type jaws against opposite sides of the joint. Current flows through the joint, heating it in a few seconds. The operator then
"Why should you give blood? Ask me—I ought to know. I fought in Korea. But since then I've been through the biggest battle of all—the battle for life itself. And it was blood—and blood alone—that saved me. Don't know when I'll be in a position to start repaying my debt by giving some blood of my own. But I will—some day. You can count on it!"

All kinds of people give blood—for all kinds of reasons. But every reason for giving blood is a special reason... just as every American life that can be saved at any time and at any place... is special. So whatever your reason for giving blood, this you can be sure of: Whether it goes to a combat area, a local hospital, or for Civil Defense needs—this priceless, painless gift will some day save an American life!

The difference between Life... and Death...

Business Executives! 

Check These Questions!

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- Have you given your employees time off to make blood donations?
- Has your company given any recognition to donors?
- Do you have a Blood Donor Honor Roll in your company?
- Have you arranged to have a Bloodmobile make regular visits?
- Has your management endorsed the Local Blood Donor Program?
- Have you informed employees of your company’s plan of cooperation?
- Was this information given through Plant Bulletin or House Magazine?
- Have you conducted a Donor Pledge Campaign in your company?
- Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?

Remember, as long as a single pint of blood may mean the difference between life and death for any American... the need for blood is urgent!

Give Blood Now
CALL YOUR RED CROSS TODAY!
NATIONAL BLOOD PROGRAM
Do you have production, purchasing, stocking or delivery problems on threaded fasteners? Pheoll ... the COMPLETE source ... has all the answers! And here they are:

**STOCKS?** Pheoll has 'em ... largest in the industry ... kept up to level by perpetual inventory controls!

**TYPES AND SIZES?** Pheoll has 'em ... the industry's most complete line ... by types, head styles, finishes and sizes!

**LARGE ORDERS?** Pheoll can generally ship immediately on most standard types and sizes!

**STOCK INFORMATION?** Always available for immediate reply to phone calls, telegrams or letters!

**QUALITY?** Tops for 50 years ... kept that way by constant production line and laboratory inspection!

**FAST SHIPMENT?** Yes! Efficient mechanized order-handling procedures minimize errors and hustle orders along to fast, sure completion!

In every way, you get better service at Pheoll! That means less work for you ... fewer orders, reduced paper work, less follow-up, simplified stocking. Test Pheoll on your next threaded fastener requirement and see how headaches vanish!

---

**PRODUCTION TECHNIQUES** (continued)

applies a small amount of solder to complete the joint.

A simple wood fixture is used for this operation to permit handling seven leads at a time. The connecting lugs are pushed over headless nails driven into the wood, so that they are in the optimum position for attaching and soldering the wire.

---

**Production-Testing Filters**

*BY WALLACE RIANDA*

Applications Engineer
Beckman Scientific Division of Beckman Instruments, Inc.
Richmond, Calif.

New test methods employing Berkeley digital-reading frequency meters are used at Lenkurt Electric Co. to provide frequency determinations to an accuracy of ±1 cycle. The training period for test operators is materially decreased, and frequency checking time is cut to 30 seconds as contrasted to several minutes for older methods.

A major problem encountered in the development of increased production of carrier telephone and telegraph equipment is that of adapting former laboratory test techniques to production line requirements. Typical is the precise determination of characteristics of filters and meshes, critical components in carrier equipment. Es-

---

Production setup for checking large quantities of filters at Lenkurt plant, using new equipment and technique for checking any test frequency up to 500 kc to accuracy of 1 cycle per second in measuring time of only 30 seconds.

---

*April, 1953 — ELECTRONICS*
No. 108 machine makes coil winding more profitable
Quick set-up and greater accuracy
LOWER COSTS

Leesona® No. 108 Coil Winder for high accuracy, top production and lowest costs in shops where change-overs are frequent. Takes long or short runs; easy to set up; no cams or gears to remove when making set-up changes; all controls are within easy reach of the operator even when seated.

Prize-Winning Design

So simple, the operator can make set-up changes in a matter of minutes. So moderate in price you can easily replace older, less satisfactory equipment and soon see savings write off your investment.

This is the manual paper feed machine which won the "Electrical Manufacturing" magazine's design prize. Set-up time is reduced to a minimum by external controls and change-over from job to job is quick and easy. It winds wires from #20 to #44 (A.W.G). Coil lengths may be from 1/4" to 3 3/4", with outside diameters up to 5" round or square.

ACCURACY CONTROLLED, because lead screw traverse and quick-reversing clutch give positive control of wire layer. Indicators help operator time paper feeding accurately even at high speed.

Send for Bulletin 108A and read all the good news about this flexible high production, low cost coil winder.

UNIVERSAL WINDING COMPANY
P. O. Box 1605, Providence 1, R. I.
Chicago office and Demonstration Room, 9 So. Clinton St., Chicago 6, Ill.

For winding coils in quantity accurately . . . automatically use Universal Winding Machines

ELECTRONICS — April, 1953
Want more information? Use post card on last page.
To an established and proven record of original Connector designs we add a NEW

First... in

CONNECTOR RECEPTACLES FOR PRINTED CIRCUITS

First in...

DESIGN ...An original Winchester creation developed expressly for printed circuits.

SUPPLY ...A complete line of receptacles for ALL printed circuit requirements.

QUALITY ...Again, as always, electronic components of precision manufacture embodying the quality features that distinguish Winchester Electronics' Connectors from all others.

SPECIAL FEATURES

POLARIZING pin permits engagement in correct position only.

WIPI NG ACTION of contacts insures positive contact at all times.

MONOBLOC* CONSTRUCTION eliminates unnecessary creepage paths and reduces the number of moisture and dust pockets.

MOLDED MELAMINE bodies (in accordance with MIL-P-14) mineral filled ... are fungus-proof and provide mechanical strength as well as high arc and dielectric resistance.

CONTACTS are spring temper phosphor bronze (QQ-B746a), gold plated over silver for low contact resistance, prevention of corrosion and ease of soldering.

Raised barriers between contacts increase surface creepage. Solder cups are .043" dia. for #20 A.W.G.

*Trade Mark

WINCHESTER ELECTRONICS INCORPORATED

GLENBROOK, CONN., U.S.A.

PRODUCTION TECHNIQUES (continued)

sentially a matter of determining db versus frequency, the actual checking involves determination of frequency up to an accuracy of 1 cycle, precise measurement of the output voltage of an audio oscillator and of a filter, and determination of the effective a-c resistance of a mesh.

Old Method

The method previously used to determine frequency is shown in Fig. 1. The Lissajous pattern on the oscilloscope was used to determine the frequency of the interpolation oscillator against a multiple of one of the selectable basic standards. The output of the interpolation oscillator was then beat against a signal generator in a varistor-type modulator. The dif-

FIG. 1—Block diagram illustrating method formerly used for measuring frequency during testing of filters for carrier telephone and telegraph equipment

ference frequency was passed by the low-pass filter and applied to the amplifier. The frequency meter then read the difference frequency.

As an example of this operation, assume that the operator wished 3,535 cycles. The interpolation oscillator would then be adjusted until a 3.5 to 1 pattern was obtained on the oscilloscope using the 1-kc standard. The signal generator would then be adjusted until a frequency of 35 cycles was obtained on the frequency meter. One of the important limitations of this particular system was that the operator might not know if the actual frequency was 35 cycles above 3,500 cycles, or 35 cycles be-
When Struthers-Dunn, Inc., Philadelphia relay manufacturers developed their "181CXC100" Frame Relay for military and industrial applications they made exhaustive tests to find the "right" insulation for never-fail protection...it was BH "649" Fiberglas Tubing...and here's why...

"We selected BH Tubing because of the Hi-temperatures encountered in hermetically sealing our relays, and its ability to withstand flexing and still pass the hi-potential test."

The 181CXC100 uses 14 two-inch lengths of tubing...a small part of the manufacturing cost, but big insurance against failure.

BH 649, a vinyl-coated, braided Fiberglas tubing, is made flexible and stays flexible in continuous operation at temperatures ranging from minus 50°F. to 266°F. Superior flow-resistant characteristics permit exposure to processing temperatures of 325°F. plus, for eight hours or more — hot spot temperatures to 500°F., too. It is rated up to 7000 volts, has excellent chemical and oil resistance, and is available with inhibitors for fungus protection.

You can easily get full information on BH "649" — and the other superior BH Fiberglas Tubings and Sleevings. Send us facts on your requirements, voltages and temperatures encountered. We'll make recommendations and send you free production testing samples.

Address Dept. E-4
Bentley, Harris Manufacturing Co.
Conshohocken, Pa.
NOW

..Wire Lead Micas with 500 times better moisture resistance than ever before!

Sangamo HUMIDITITE* Mica Capacitors

When you use Sangamo HUMIDITITE molded Mica Capacitors, you gain all the advantages of an amazing moisture seal that offers previously unheard-of moisture resistance characteristics for compression molded plastic-encased mica capacitor components.

*what is HUMIDITITE?

Humiditite is a remarkable new plastic molding compound, developed by Sangamo, that gives Sangamo Mica Capacitors moisture resistance properties far superior to any others on the market.

HERE'S THE PROOF... The standard moisture resistance test described in MIL-C-5A (proposed) Specification requires mica capacitors to offer at least 100 megohms of insulation resistance after ten 24 hour cycles in a humidity chamber at 90% to 95% relative humidity. The best competitive micas barely meet this requirement... but Sangamo HUMIDITITE Micas, under the same conditions, all tested in excess of 50,000 megohms! Continued tests, over and above requirements, with the same HUMIDITITE Micas, proved them capable of withstanding from 21 to 52 cycles (from the smallest sizes to the largest) before failure.

Humiditite is just another example of the advanced engineering that enables Sangamo to meet the existing and future needs of the electronic industry. For additional information about HUMIDITITE, write for Engineering Bulletin No. TS-111.

Those who know... choose Sangamo

SANGAMO ELECTRIC COMPANY
MARION, ILLINOIS

PRODUCTION TECHNIQUES (continued)

FIG. 2—Filter test station using new method

low 3,500 cycles. In other words, when the frequency meter read 35 cycles, the actual frequency could be either 3,535 or 3,465.

Other disadvantages of the old method included the time required (often several minutes for each check) and the necessity of using relatively skilled technicians at each test stand.

New Method

The method now used employs a direct-reading digital events-per-unit-time meter as the frequency-determining device. The setup of the typical present filter test station is shown in Fig. 2, and the block diagram is shown in Fig. 3. Components include a 20 to 200,000-cycle signal generator, a phase-shift panel, a resistance decade, a vacuum-tube voltmeter, a capacitance padder, an oscilloscope for measuring phase shift, an oscilloscope for monitoring the output of

FIG. 3—Block diagram illustrating new method employing an Eput (events-per-unit-time) meter to indicate frequency
The Day the Cake Fell!

Just suppose all the nuts, bolts and screws were suddenly removed from a sparkling new range. A great deal more than a cake would fall—as the illustration above dramatically shows.

Yes, fasteners are important—and worth all the time and care you take in selecting those that are “just right” for your product. Lamson & Sessions is currently supplying most of the appliance manufacturers with bolts, nuts and screws—each type engineered to meet individual requirements.

Regardless of the product you manufacture; it will pay to take a critical look at the fasteners you are now using and ask yourself these questions:

Can I save money by replacing a “special” with a “standard”? Or will the use of a “special” simplify production, thereby, saving time and perhaps materials?

Remember, whatever your problem, to check with Lamson & Sessions—one of the few manufacturers offering a complete line of fasteners teamed with expert engineering service.
No. 301 KLEIN LONG NOSE PLIERS
Extra long reach at your fingertips getting into difficult places. Hordened and tempered to assure positive grip at poor. Available in 5, 6 and 7 inch lengths.

No. 202 KLEIN NARROW NOSE OBLIQUE CUTTING PLIERS
One of the most useful tools in your kit. Narrow head permits use in confined places. Individually honed knives meet accurately at all points and stay sharp. Available in 5 or 6 inch sizes.

- There is a Klein Plier made for every job in wiring radios, television or sound system amplifiers. Long nose pliers that assure a tight grip even in confined spaces. Keen edged cutters that stay sharp even after continued service. Flat nose pliers, duck bill pliers, curved nose pliers—many types and sizes to meet every wiring need. By having a full selection of these quality tools, you will save valuable time in any wiring work.

This Klein Pocket Tool Guide gives full information on all types and sizes of Klein Pliers. A copy will be sent without obligation.

ASK YOUR SUPPLIER
Foreign Distributor
International Standard
Electric Corp.,
New York

Since 1857

Mathias KLEIN & Sons
Established 1857
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

PRODUCTION TECHNIQUES

(continued)

the oscillators, an events-per-unit-time meter and an events-per-unit-time meter modulator.

The signal generator employs an oscillator circuit which uses feedback with resultant high-frequency stability. The oscillator has three controls—a range selector switch for frequency, a calibrated frequency dial and an amplitude control dial. The frequency dial calibration is held to ±\( \frac{1}{2} \) or a dial division.

FIG. 4—Method of using resistance decade box to determine effective a-c resistance of a mesh

The phase-shift panel is used in conjunction with the phase-shift oscilloscope to determine the characteristics of meshes (portions of filters consisting of a single series inductance and capacitance). The input frequency is applied to the mesh which is connected to the phase-shift panel and then to the phase-shift oscilloscope. The Lissajous pattern on the oscilloscope shows the phase shift of the mesh. Zero phase shift is obtained by padding the mesh capacitor with the precision capacitance pad.

The resistance decade box is used as in Fig. 4 to determine the effective a-c resistance of a mesh. The input is fed through a transformer and through divider networks to the horizontal and vertical deflection plates on the oscilloscope. Precision resistors \( R_1 \) and \( R_2 \) give a fixed distance \( A \). After this distance is noted, the mesh is inserted.
Simplify your production procedure with High-precision Stupakoff

CERAMIC to Metal ASSEMBLIES

for Electrical and Electronic Applications

To combine ceramic and metal parts into one permanent unit, Stupakoff draws upon extensive experience with both materials. Methods of assembly employed by Stupakoff include: metallizing, soldering, pressing, spinning and others. Among the metals assembled to ceramics are silver, copper, brass, stainless steel and monel.

The rotor shafts shown above consist of metal bands attached securely to ceramic rods, and exemplify Stupakoff precision manufacture. On a mass production basis, concentricity of components, for example, are held to less than ±0.001 in. Likewise, the strains and spreaders, stand-offs and trimmers shown below meet the exacting requirements of the service for which they are made.

Stupakoff high-precision ceramic assemblies offer many opportunities to reduce costs, increase production and improve electrical and electronic equipment. We will be glad to discuss your requirements with you and to submit samples for your inspection.

STUPAKOFF CERAMIC & MANUFACTURING CO.
LATROBE, PENNSYLVANIA
In the ELECTRONICS industry, buyers have learned to depend on ANTI-CORROSIVE for fast, dependable service on all types of stainless steel fastenings. Draw on our IN STOCK inventory of more than 7,000 items and sizes and a production capacity geared to produce precision fastenings in large or small quantities, from huge 7/8" hexagon head bolts to tiny #0-80 machine screw nuts.

Write for Catalog 53F today.

antcorrosive metal products co., inc.
castleton-on-hudson, new york

Want more information? Use post card on last page.
Super dependable... 56 standard types available!

Another example of E-I advanced engineering, these multiple headers are produced under an exclusive E-I process. By a radically new process the glass, sealed under tremendous compression, is extremely strong and difficult to put under stress. This results in a new, far greater resistance to shock and vibration. E-I Compression Seals are silicone treated for maximum immunity to humidity, tin dipped for easy soldering and guaranteed vacuum tight. New Bulletin 960 completely describes E-I Compression Type Multiple Headers. Calif. or write for your copy, now!

E-I... your reliable source for all hermetically sealed terminals.

Hundreds of standard types of multiple headers, octal plug-in terminals, color-coded terminals, and end seals for electronic and electrical requirements.

Export Agents
PHILIPS
EXPORT CORP.
100 East 42nd Street
New York 17, N.Y.

BULLETIN 960

ELECTRICAL INDUSTRIES
DIVISION OF AMPEREX ELECTRONIC CORP.
44 SUMMER AVENUE
NEWARK 4, NEW JERSEY
TRANSPORT ANALYSIS
Type 513-D—High Writing Rate Oscilloscope

TWELVE KV accelerating potential provides the light intensity necessary for photographic recording of single high-speed sweeps, or visual observation of pulses of low duty cycle. Increased brightness and removal of residual charge from previous sweeps result from use of metallized CRT screen.

TRIGGERED橇SHEPES. Signals producing 0.5 cm or greater deflection will trigger the sweep. Trigger pulses may be as short as 0.05 µsec. Sweep easily made recurrent when desired.

WIDE BAND. Factory adjusted for optimum transient response, the Type 513-D distributed vertical amplifier has a risetime of 0.025 µsec with no appreciable ringing or overshoot.

VERTICAL AMPLIFIER
Sensitivity
0.3 v/cm to 100 v/cm dc
0.03 v/cm to 100 v/cm ac
Transient response
0.025 µsec risetime
Signal delay
0.25 µsec

CALIBRATING VOLTAGE
Square wave, approximately 1 kc
Seven ranges, 0.05 v to 50 v
Accurate within 3% of full scale

TIME BASE
0.1 µsec/cm to 0.01 sec/cm
Continuously variable
Accurate within 3% of full scale

REGULATION
All dc voltages electronically regulated

WAVEFORMS AVAILABLE
Calibrating voltage
Gate
Delayed gate
Delayed trigger
Sweep sawtooth
Trigger rate generator
(200 to 5000 cps)

SELF-CONTAINED
Weight 79 lbs.

TEKTRONIX Type 513-D Cathode-Ray Oscilloscope, $1650 f.o.b. Portland, Oregon

TEKTRONIX, Inc.
P. O. Box 831A, Portland 7, Oregon • Cable: TEKTRONIX

Television Scope
Designed especially for TV Broadcasters, the Type 524-D permits observation of a field one line at a time with push-button, shift-to-corresponding line in opposite field. New magnifier, 3x or 10x, expands sweep to right and left of center. Time markers for accurate sync pulse timing.

TIME BASES — 0.1 µsec/cm to 0.01 sec/cm continuously variable, accurate within 5%.

VERTICAL SENSITIVITY
dc to 10 mc — 0.15 v/cm to 50 v/cm
2 cps to 10 mc — 0.015 v/cm to 50 v/cm

TRANSIENT RESPONSE — 0.04 µsec risetime

SIGNAL DELAY — 0.25 µsec

5" CRT — flat-faced, 4 kv accel. potential

Type 524-D — $1150

WIDE TIME BASE RANGE
Read time and amplitude directly from the screen. 24 accurately calibrated time bases...12 accurately calibrated vertical sensitivity positions.

TIME BASES — 0.1 µsec/div to 5 sec/div

VERTICAL SENSITIVITY
dc to 5 mc — 0.1 v/div to 50 v/div
3 cps to 5 mc 0.01 v/div to 50 v/div

TRANSIENT RESPONSE — 0.07 µsec risetime

3" CRT — high definition, flat-faced

Type 315-D — for use on 50-60 cycle line. . . . . . . . . . . . . . $770

Type 315-D — for use on 50-800 cycle line. . . . . . . . . . . . . . $785

Prices f.o.b. Portland, Oregon

These three and other oscilloscopes fully described in the 1953 Tektronix Catalog. Write to the above address.

PRODUCTION TECHNIQUES (continued)

frequency is between 100 kc and 500 kc, the selector is placed in the appropriate position. The unknown is then amplified and mixed in a varistor-type mixer, with the sum and difference frequencies being applied at the low-pass filter. The difference is then passed through the amplitude control to the output monitoring meter. This output is then applied directly to the input to the 100 kc frequency meter. When placed in the direct position, the frequency read on the Eput meter is the actual frequency. When placed in the modulator position, the frequency read on the Eput meter must be increased by a multiple of 100,000.

Assume that the operator wished to set an input frequency of 35,152 cps. Since the dial calibration on the signal generator is held to ±0.1 of a dial division, the operator can rapidly swing the dial controlling the frequency up to 35 kc. By monitoring the Lissajous pattern on the oscilloscope, the operator can rapidly and momentarily set his oscillator to exactly 35 kc. He then makes the slight frequency adjustment on the oscillator while reading the frequency directly on the Eput. When the Eput meter reads 35,152 his test generator frequency is established for the test. During the test a glance at the scope shows, without waiting for the Eput to recycle, if his oscillator has drifted.

In frequency response tests of filters the operator runs his test oscillator out on each side of the mid-band point until the vacuum-tube voltmeter reads a predetermined attenuation ±0.2 db. He then reads the frequency of the signal generator required to obtain this attenuation. The tolerance specifications are tabulated in frequency versus 3-db, 20-db, 40-db points, etc.

Testing Employee Vision

INAUGURATION of a system of testing employee vision eliminated almost 75 percent of the defective units that formerly got past the inspection department at Motorola. Since most inspection work is done at a distance of about 13 inches, good short-range vision is highly essential.

April, 1953 — ELECTRONICS
The art of cutting jewels is a thing of consummate skill and delicate touch. Gem cutting requires great accuracy.

But even gem cutting is not so precise or exacting as crystal processing by Midland’s methods. As a result, you get the finest quality and highest accuracy scientific skill can produce in a frequency control crystal.

Midland Crystal Processing operations in many respects exceed the requirements of gem-cutting. Raw quartz is selected with regard to high electrical quality... proceeds through slicing, lapping, etching; and the final plating and sealing corresponds to setting a jewel. And at every step Midland’s critical inspection and test procedures are applied, including precise angular control by X-ray.

Your Midland crystal is a gem of stability, accuracy, high output, long life. Whatever may be your requirements for better crystal performance, you’ll get them in fullest measure from Midland.

Whatever your Crystal need, conventional or specialized, when it has to be exactly right, contact Midland.

MANUFACTURING COMPANY, INC.
3155 Fiberglas Road • Kansas City, Kansas

WORLD’S LARGEST PRODUCER OF QUARTZ CRYSTALS

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

311
NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

Control, Testing and Measuring Equipment Described and Illustrated . . . Recent Tubes and Components Are Covered . . .
Twenty-Three Trade Bulletins Reviewed

Clipper Diode and Rectifier Tube
AMPEREX ELECTRONICS CORP., 230 Duffy Ave., Hicksville, L. I., N. Y., announces the type 6269, a new, high-vacuum clipper diode and rectifier tube that is only 2 in. long (without leads) and 11/2 in. in diameter. It is cooled by liquid-immersion (silicone oil). Although developed primarily for military radar applications, it shows possibilities for use in the high-voltage electronic field where space requirements are critical. Maximum peak voltage is 16 kv and peak current is 250 ma.

DPDT Relay
PHAOSTREAM CO., 151 Pasadena Ave., South Pasadena, Calif., is now manufacturing a miniature, hermetically-sealed, dpdt relay, weighing only 31/2 oz and designed to operate through a wide range of environment. Due to its perfectly counterbalanced features this relay will withstand high acceleration, vibration, shock and tumbling. It meets the shock requirements of MIL-E-5400 and will withstand continuous acceleration of 50 g without malfunctioning. Certain contact combinations can be furnished with a required coil power as low as 20 mw and any relay in this series can be obtained with a coil resistance as high as 15,000 ohms.

H-V Capacitors
ERIE RESISTOR CORP., Erie, Pa., announces a line of high-voltage disk Ceramicon capacitors. Exhaustive tests for life and other qualities have been carried on over a period of years to establish required dielectric thicknesses for safe ratings. Standard sizes in the new line are 3 in., 19/32 in., and 6/32 in. maximum diameter. They have phenolic dipped, vacuum-wax-impregnated case insulation. Leads are No. 22 tinned copper wire. Standard d-c working voltage ratings are 1,000, 1,500, 2,000, 3,000, 5,000 and 6,000, with a dielectric strength test of twice the rated working voltage.

Regulated Power Supply
LAWN ELECTRONICS Co., East Freehold Road, Freehold, N. J., is now...
with this New Sylvania Integral Eyelet Socket

You'll speed up radio and television set assembly and pare down costs with this new Sylvania socket! The eyelets are formed into the saddle and actually function as rivets. Just 2 simple operations and these sockets are firmly secured to the chassis. You save rivet costs, save time, and get a sturdy, durable, top-quality job.

Made with 3 types of bases

These new Sylvania sockets are now available with 7-pin, octal, or 9-pin bases. Insulators are either general-purpose or low-loss phenolic.

For prices and full information about this latest Sylvania quality part, write today to: Sylvania Electric Products Inc., Dept. 3A-1004, 1740 Broadway, New York 19, N. Y.
producing the model 603-A regulated d-c power supply. The unit features 0.1-percent regulation, less than 1-mv ripple, and less than 0.5-ohm output impedance. Output voltage is continuously variable from 0 to 600 v with either the positive or negative terminal grounded, and the unit will supply up to 300 ma at any voltage setting. The power supply also features a bias supply variable from 0 to -250 v stabilized to 0.1 v and a 6.3 v, 6 ampere center tapped filament supply. Dimensions of the unit are 19 in. wide x 8½ in. high x 10½ in. deep.

**H-F Oscilloscope**

INTERNATIONAL ELECTRONICS CORP., 137 Hudson St., New York 13, N. Y. The Mullard type E.7581 oscilloscope is intended to cover a wide field, particularly in connection with tv development, radar and nuclear research. The instrument is built around a c-r tube with a useful screen diameter of 18 cm, and a blue-white trace suitable for visual or photographic work. Final anode voltage of the tube is adequate for normal use with recurrent phenomena. The X and Y amplifiers are as far as possible identical, thus enabling quantitative measurements of phase relationships to be made. Each amplifier has a bandwidth extending from d-c to 15 mc. Provision is made for beam modulation with a special amplifier of 5-mc bandwidth and of sufficient sensitivity to give reasonable modulation from an r-f signal generator.

**Multipurpose Signal Generator**

HEWLETT-PACKARD Co., 395 Page Mill Road, Palo Alto, Calif. Receiver and amplifier gain, selectivity, sensitivity and image rejection are just a few of the uhf-tv measurements made quickly and easily with the model 612A master-oscillator power-amplifier generator. It offers continuous coverage between 450 and 1,200 mc. Frequency and output are directly set and read on large dials. No charts or interpolation are necessary. Maximum output is 0.5 v into 50 ohms throughout frequency range. The instrument offers broad band modulation up to 5 mc, and has low incidental f-m.

**Wire-Wound Resistors**

RESISTANCE PRODUCTS Co., 714 Race St., Harrisburg, Pa., has announced new midget precision wire-wound resistors. Their small size and light weight make them self-supporting. This is especially useful in aircraft applications. They are made in the following sizes: ½ in. long x ⅛ in. in diameter; ⅔ in. long x ⅛ in. in diameter; and ⅔ in. long x ⅛ in. in diameter. These type C resistors are completely insulated and enclosed in rugged plastic jacket. Steatite winding forms have high insulation with low coefficient of expansion. Windings are impregnated in special compound with protection against dust, salt spray, humidity and mechanical damage.

**Air-Cooled Igniton**

NATIONAL ELECTRONICS, Inc., Geneva, Ill., has developed a 56-ampere igniton that does not require water cooling and is electrically similar to the 5551 size B igniton tube. The NL-1005 tube is designed for forced air cooling but may be used at reduced ratings with free ventilation. In the welding control application it is the approximate equivalent of a 300-ampere magnetic contactor. The tube is capable of controlling maximum rms demand current of 2,400 amperes at 250 v a-c or 1,200 amperes at 500 v a-c. Maximum average anode current rating is 56 amperes d-c.

**D-C Train Power Supply**

FEDERAL TELEPHONE AND RADIO CORP., Clifton, N. J., has developed a 12-v d-c train power supply that eliminates the need for an a-c converter and incorporates a plug-in vibrator cartridge capable of operating both transmitter and receiver. Type M322-1 power supply.
Do you have a problem involving the design of gears or gear drives for electronic application? For operation of servomechanisms, computers, adjustment of radar or other antenna systems, for autotune transmitters? Do you require "just ordinary" gearing or extremely accurate "precision class" gears?

Whatever your need, whatever the type gear or gear train, you will find the engineering assistance and complete facilities available at Western Gear Works. Specialists who know and understand your problems are ready to go to work for you. Your inquiries are invited; write, wire or telephone us now, at Western Gear Works Executive Offices, Post Office Box 182, Lynwood (Los Angeles County), California, Telephone NEvada 6-2161.
Recently one of our admirers (yes, we have one) wrote saying he enjoyed our advertising even though he was not a customer for our "realys." Our advertising agency (which we consult on rare occasions) picked up this apparent typographical error and gave us this definition:

"Realys"—a Sigma Sensitive Relay that, at long last, has really been delivered to the customer.

Although this jest comes dangerously close to the truth, some unknown force compels us to pass it on to you, our public. Those of you who are our customers (bless you) know these problems of ours and will perhaps gain hope in the knowledge that our spirits, at least, are high. And you non-users of sensitive relays—why do you read these advertisements anyway?

SIGMA INSTRUMENTS INC.
62 PEARL ST., SO. BRAintree, BOSTON 85, MASS.

features simplicity of design. This results in improved system-wide performance, and enables substantial savings in initial installation costs and maintenance. The unit's circuit employs a heavy-duty rail-road-type plug-in vibrator with full-wave tube rectifiers, weighs 35 lb and has a temperature range of -30 C to +60 C. Nominal input voltage is 12.6 v d-c, while the output voltage is rated at 300 v d-c at 110 ma for the receiver and 300 v d-c at 325 ma for the transmitter.

Tiny Mercury Batteries
P. R. MALLORY & Co., Inc., North Tarrytown, N. Y., has introduced a new line of low-voltage, tiny mercury batteries for junction-type transistor applications, in hearing aids and miniature radio receivers. These Energy Capsules and Power-Pak batteries are designed to meet the specific requirements and characteristics of transistor operations, such as increased energy per unit volume, long service life, constant discharge characteristics and long, corrosion-free shelf life. They maintain a substantially constant voltage and energy output level over wide temperature ranges at current drains from 10 µa to 10 ma.

Carrier Telegraph System
LENKURT ELECTRIC Co., Inc., County Road, San Carlos, Calif. Either physical or carrier-derived

Want more information? Use post card on last page.
One of the big reasons for the success of North American Aviation's Electromechanical Department is its painstaking attention to small details—like the millionth of an inch on a gear or the hairline accuracy of the tiny part shown on the contour projector. These small details are some of the factors contributing to the complex missile guidance and automatic control systems which are being designed and developed by this department for projects which stagger the imagination.

North American's fine reputation for pioneering in far-reaching technical fields is part of the answer to the question: "Why do so many talented engineers choose North American as a place to work?" Another is the extremely advanced equipment—much of it invented and built by North American itself—available to the engineers who work here.

In addition to North American's popularity as a place to work, there are always fine career openings for imaginative scientific minds. If you like theory, you will discover an exciting and secure future in the fields of operations analysis, advanced dynamics, mathematics, noise, error or information theory, systems engineering, statistical quality control or servo analysis.

If research, development, or design is your specialty, you'll find attractive opportunities in radar and communications systems, analogue and digital computers, automatic guidance systems or optics.

Why not write for complete information, giving us your education and experience?

**NORTH AMERICAN AVIATION, INC.**

Engineering Personnel Section, Missile and Control Equipment Operations

12214 Lakewood Boulevard, Dept. 93-E, Downey, California

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

ELECTRONICS — April, 1953

Want more information? Use post card on last page
maintenance and replacement are simplified with Fairchild

plug-in potentiometers

These plug-in type ganged potentiometers are another excellent example of Fairchild's service in meeting the special requirements of customers. The problem was to provide ganged precision potentiometers that would simplify maintenance of airborne fire control equipment through quick and easy replacement. A series of packaged plug-in units like that shown was the answer.

An entire gang can be replaced in a few minutes because only the end mounting plates are fastened down. There are no wires to disconnect or solder. Test points are provided on the top of each potentiometer so it can be checked quickly.

Maximum rigidity of the gang is assured by mounting the individual units on a single shaft. These plug-in potentiometers have the same mechanical and electrical tolerances and performance characteristics that have made the Model 746 unit the first choice for many critical applications.

Use the coupon below to get full information.

---

Small Pneumatic Transmitter

The Bristol Co., Waterbury 20, Conn., has announced a miniature pneumatic transmitter for measuring and transmitting readings of temperature, pressure, vacuum, differential pressure and liquid level to recording, indicating, and controlling receivers, including miniature type receivers. Transmission is by means of air pressures of between 3 and 15 psi that have a direct relation to the measured quantity. The series 650 transmitter uses standard Bristol measuring elements and a simple transmitting mechanism with only one pivot and no flexures. It is sensitive to extremely small changes in the...
ELECTRONIC TRANSFORMERS

Built to Customer Specifications and Requirements

PULSE & FILTER NETWORKS with FERRITE CORES

Complete Test Facilities

AUDIO, POWER CHOKE MODULATION

DEPENDABILITY and ACCURACY

Inquiries Invited on Sample or Production Quantities

EXCELLENT DELIVERY ON BOTH MILITARY & COMMERCIAL UNITS

A RELIABLE SOURCE SINCE 1941

AIRDESIGN, INCORPORATED
MANUFACTURERS OF QUALITY TRANSFORMERS FOR ELECTRONICS
TWO FORTY-ONE FAIRFIELD AVENUE

Upper Darby, Pa.

Telephone: GGranite 4-8000

ELECTRONICS — April, 1953

Want more information? Use post card on last page.
The high quality audio connectors shown above are available from all Cannon Franchised Distributors. In their great variety of sizes, shapes and contact arrangements there is no problem or technical requirement in the radio, sound, TV or related fields that cannot be met. Cannon plugs are standard on leading makes of audio equipment and microphones.

CANNON ELECTRIC


NEW PRODUCTS (continued)

measured value, as little as 0.03 percent of range, including reversal. It weighs 7½ lb, is weatherproof, can be installed in any location and will operate in any position.

Modulator

BRADLEY LABORATORIES, INC., New Haven, Conn. A copper-oxide rectifier with a low threshold voltage rating is being used as a modulator in an electronic unit used in aircraft. The hermetically sealed modulator is relatively unaffected by subzero temperatures, high altitudes or unequal atmospheric pressures. The modulator, approximately 1 in. × 1½ in. × 3 in., has no moving parts. Current and temperature characteristics are balanced to better than 1 percent. The modulator operates over a range of −65 to +85°C and at the audio frequencies.

Film Multiplexer and Shadow Box

FEDERAL TELECOMMUNICATION LABORATORIES, INC., Nutley, N. J., has developed a new film multiplexer and shadow box designed for use with image orthicon camera chains. The FTL-263A consists of a light-tight wooden shadow box

www.americanradiohistory.com
**General Ceramics' high frequency FERRAMIC CORES**

Specified with confidence for—

- **Soft Magnetic**
- **High Permeability**
- **Low Loss Factor**
- **High Efficiency**
- **Light Weight**

**The Most Complete Line of Ferrites**

- for Commercial and Military Electronics
- CUP CORES
- EI CORES
- TUNING CORES
- TUNING SLUGS
- TOROIDS
- SPLIT RINGS
- "C" CORES
- "U" CORES
- TV COMPONENTS
- ANTENNA RODS

Ferramics offer many outstanding advantages. These widely adopted magnetic core materials have reduced assembly time by eliminating laminations in inductive components, cut costs and reduced space requirements by replacing tubes in digital computers, and revolutionized microwave transmission design by use of gyrator effect. Ferramics have improved designs in numerous other equipment, and have resulted in the development of basically new techniques in some others. Current research indicates still greater gains to come. The complete story on Ferramics is available without obligation.

**TABLE OF MAGNETIC PROPERTIES OF FERRAMICS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Permeability</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>1 m/sec</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Core Loss</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Saturation Magnetization</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Magnetic Core Loss Factor</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Non-Linearity</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Remanent Magnetic Density</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Initial Permeability</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>1 m/sec</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Core Loss</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Saturation Magnetization</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Magnetic Core Loss Factor</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Non-Linearity</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Remanent Magnetic Density</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

---

**General CERAMICS and STEATITE CORP.**

Want more information? Use post card on last page.
The Henkel-Clauss Co.
Fremont, Ohio
New York Office
1837 Broadway

The May Engineering Co., 6055 Lankershim Blvd., North Hollywood, Calif., offers low-cost laboratory-built lumped-constant delay lines with apertures for accepting the outputs of two 16-mm projectors, an optical mirror multiplexer, a high-resolution screen, and an aperture for the camera that is focused on the screen. The mirrors are adjustable in three planes for best possible operation, and the entire unit is mounted on four adjustable metal legs to permit the unit to be properly leveled. An important advantage of the unit is the total overall length which allows placement of the shadow box through an opening in a wall so that either a standard film camera or a studio camera may be used.

Melamine Laminate
Synthane Corp., Oaks, Pa., is producing a new glass-mat melamine laminate that combines high fire and arc resistance with good mechanical and chemical properties. Designated as G-8, the new laminate is available to suppliers of electrical and power equipment at a considerable saving under the cost of the continuous filament glass base materia (NEMA-grade G-5) whose electrical properties it matches. The new material is laminated in thicknesses from $\frac{1}{6}$ in. upward. Sheet sizes are standard 36 in. x 36 in.

Lumped Constant Delay Lines
The May Engineering Co., 6055 Lankershim Blvd., North Hollywood, Calif., offers low-cost laboratory-built lumped-constant delay lines with apertures for accepting the outputs of two 16-mm projectors, an optical mirror multiplexer, a high-resolution screen, and an aperture for the camera that is focused on the screen. The mirrors are adjustable in three planes for best possible operation, and the entire unit is mounted on four adjustable metal legs to permit the unit to be properly leveled. An important advantage of the unit is the total overall length which allows placement of the shadow box through an opening in a wall so that either a standard film camera or a studio camera may be used.

New products (continued)

CLAUSS ELECTRONICS
SNIPS SPRING TO THE JOB!
Developed in close cooperation with electronics workers... Sharp points for accurate, minute work. Closed handles far enough apart to prevent fingernails from digging into palm... close enough together to produce maximum leverage easily.

Clauss
FINE CUTLERY SINCE 1877

HOT HAMMER-FORGED
ELECTRONICS SCISSORS & SNIPS
Set New Cost and Time Cutting Records!

CLAUSS ELECTRONICS
SCISSORS CUT FILAMENT QUICKLY, WITH WATCHMAKER PRECISION
 Feather-light scissors for snipping fine filament. Cut perfectly even at very tips. Available with blades plain... or with one blade finely saw-toothed to prevent slippage.

Here are tools developed by the industry, itself... job tested and proven perfect for every filament cutting need... even to the finest miniature work. Tough, cutlery steel tweezers—magnetic and non-magnetic—are also made by Clauss in several patterns... tweezers made to the tube manufacturer's specifications. Clauss is a major supplier of dependable tools to this vital industry.

Write or wire for information

Want more information? Use post card on last page.
ONE EVERY TWENTY SECONDS! These tiny motor-like Autosyn Synchros are precision built by Eclipse-Pioneer at the rate of one every twenty seconds to meet the demands of modern aviation. These small “nerve centers” are used literally by the hundreds in vital indicating and control systems in today’s aircraft.

Eclipse-Pioneer Division of Bendix Aviation, Teterboro, N. J., through development and manufacture of instruments and accessories, has been a major factor in the rapid expansion of the Aviation Industry. Although their production is now more than 5 times its pre-Korea level, this growth has been accomplished without sacrifice in the quality of its precision products.

To insulate stators of Autosyn Synchros, Eclipse-Pioneer specifies and uses Natvar varnished cambric because of its consistently good electrical and physical properties.

All Natvar flexible insulations are dependably uniform, no matter when or where purchased. They are immediately available either from your wholesaler’s stock or direct from our own.

MIGHTY MITES! In spite of their size, Autosyn Synchros must operate with extreme reliability over a wide temperature range. Stators are being assembled in approximately 150 varieties at Eclipse-Pioneer, and strict adherence to engineering specifications is a must. They are insulated with strips of Natvar bias cut varnished cambric because of its uniformly high dielectric strength and flexibility.

NATVAR CORPORATION
FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION
TELEPHONE RAHWAY 7-8800  CABLE ADDRESS NATVAR: RAHWAY, N. J.
201 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

ELECTRONICS — April, 1953
Want more information? Use post card on last page.
HERMETICALLY SEALED
TO MIL-T-27 SPECIFICATIONS

NYT offers a wide variety of transformer types to meet military and civilian specifications, designed and manufactured by specialists in transformer development.

Latest NYT service for customers is a complete test laboratory equipped and approved for on-the-spot MIL-T-27 testing and faster approvals.

NEw YORK
TRANSFORMER CO., INC.
ALPHA, NEW JERSEY
Because they’re factory-calibrated under laboratory conditions... incorporate more features... have unusual accuracy and stability... in short, offer you more for your money—RCA VoltOhmysts outsell all other makes of vacuum-tube voltmeters.

All RCA VoltOhmysts employ a degenerative bridge circuit to compensate for line-voltage changes... a sturdy 200-microampere meter movement electronically protected against burn-out... large, easy-to-read scales... metal shielding against external fields... and have an input resistance of 11 megohms on all dc ranges.

Before you buy a vacuum-tube voltmeter, be sure to get the full details on the RCA VoltOhmyst best suited to your needs. See your RCA Test Equipment Distributor today... or write RCA, Commercial Engineering, Section 42DX, Harrison, N.J.
American Beauty
makes perfect Soldered Connections
FOR THE GLENN L. MARTIN CO.
HERE'S WHY AMERICAN BEAUTY is the Standard-of-Perfection on the world's production lines . . .
where dependability, long life and efficiency are demanded . . .

- Nickel-coated, corrosion-resistant tips, easily and quickly replaced
- Super-flexible cord, American Beauty made, resists wear due to flexing
- Heating element of chrom-nickel ribbon resistance wire
- Insulated with pure mica
- Built-in adapter for ground wire
- Five sizes . . . from 50 to 550 watts

AMERICAN BEAUTY Electric Soldering Irons are Service Proven . . . since 1894

At the Glenn L. Martin Co., Baltimore, Md., American Beauty Soldering Irons are used to fasten parts to an overhead switch control panel for the pilot's compartment of Martin 4-0-4 twin-engine commercial transports.
MORE AND MORE ENGINEERS ARE SPECIFYING

Klincher
LOCKNUT

for
High Temperature
Fastening up to
1600°

... particularly where high frequency vibration, tensile strength and re-usability are factors!

Reasons are many why Klincher is getting first call on more and more of the really tough fastening jobs in the Electronics industry. For instance, on critically vital thermocouples Klincher Locknut permits use of desired torques without causing stud failure or unnecessary wear of stud threads.

In rectifiers, too; in chassis connections and terminal posts... wherever bolts, studs or axle shafts must be preserved, Klincher Locknuts excel.

Inquiries invited regarding specialized locknut problems. Write for data and experimental samples, giving size and application.

Klincher
LOCKNUT CORP.
3532 Hillside Ave., Indianapolis, Indiana

Klincher ADVANTAGES:
Spin freely down to work. Stays positively locked.
After breakaway, nut spins off freely, ready for reuse, without impairment of locking efficiency.
Only one piece to stock and handle... saves time installing and removing.
Ideal for standard and power wrenches.
Manufactured in stainless steel and other materials.

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

www.americanradiohistory.com
IBM Announces

A Great New Engineering Research Laboratory

Model of new IBM Research Laboratory now under construction at Poughkeepsie, N. Y.

In this building, ideas will be born, developed, and become part of America's future. Here, engineers and scientists will have facilities for creative work such as were undreamed of yesterday.

In IBM's other fine engineering laboratories in Poughkeepsie and Endicott, N. Y., and San Jose, Cal., engineers and scientists are working on exciting projects for the future. These include electronic digital computers, electronic and electric business machines and time systems, and electric typewriters.

IBM's continuous program of research, development, and manufacture has created a constant flow of new services for business, industry, science, and the nation.

Today there are opportunities in IBM for development engineers, physicists, and design engineers. You are cordially invited to investigate these opportunities. Inquiries should be directed to Mr. W. W. McDowell, Director of Engineering, International Business Machines, Room 164, 590 Madison Avenue, New York 22, N. Y.

NEW PRODUCTS (continued)

active tracer work and useful in other applications. Ten Geiger tubes banked in parallel on the rear panel give high counting efficiency over six ranges of sensitivity necessary for making many rapid comparisons of samples with a control standard, directly in percentage of the stronger source. The unit may be carried about the laboratory for quick surveys. A sliding shield is provided for beta discrimination.

Ignition Cable

GENERAL ELECTRIC Co., Bridgeport 2, Conn., has announced Bureau of Ordnance approval for its insulated, high-tension ignition cable under specification MIL-C-3162 as type 1 grade C, class 2. This cable, which is used for ignition systems of internal combustion engines in aircraft, automotive vehicles and marine service, has a temperature range of 250 to \(-65\) F, and must remain flexible even under the severe cold conditions encountered by modern, high-altitude flying ships. The new cable has a stainless steel conductor with a synthetic rubber insulation. Over the insulation is a glass-reinforcing braid and an overall low-temperature sheath. The cable is available in 5-mm size.

Hermetically-Sealed Connectors

CANNON ELECTRIC Co., 3209 Humboldt St., Los Angeles 31, Calif., has added the KH and RKH connector.
defeats vibration
at 140 blows
per second!

Not even 8,650 jarring blows a minute can shake the tenacious grip of an EVERLOCK washer in its role as a vital part of the Master Tamper. On any job its alternating chisel edges maintain a never-failing BITE into both the face of the work and the nut, under powerful spring tension. Now available in four standard types; or special—made to your precise specifications. When ordering screw-washer assemblies from screw manufacturers, always specify EVERLOCK washers for dependability and fast service.

WRITE FOR LATEST CATALOG AND PRICES

DOUBLE CHISEL EDGES
LOCK CONNECTIONS
2 WAYS
Permanently

Everlock washers give added dependability to the Master Tamper, manufactured by the Master Vibrator Company, being used here as an asphalt cutter.
NEW PRODUCTS (continued)

TOROIDS and COILS by Lenkurt Specialists

FILTERS by Lenkurt Specialists

From selection and manufacture of proper cores to the final coil tuning, each Lenkurt toroid or precision-wound toroidal coil undergoes numerous tests to assure full compliance with specifications.

Whether produced from your data or designed by Lenkurt engineers to meet your requirements, Lenkurt filters are made of highest quality, 100 per cent tested components and have rigid construction for maximum reliability.

DECADE INDUCTORS

Guaranteed to an accuracy within one percent of inductance value, this new Lenkurt tool for laboratory or field use provides required inductance values in 1-mh steps up to a total of 11.11 h. Write for your copy of new bulletin DE-P2 for complete information.

LENKURT ELECTRIC SALES CO.
SAN CARLOS 1, CALIFORNIA

series to its hermetically-sealed lines. The new plugs and receptacles are made for relays, position indicators, direction finders, tachometers and the instrument industry in general. Chief feature of their steel shell is the heavy-duty special Acme thread. The KH receptacles mate with standard K plugs, and RKH plugs with standard RK receptacles. The hermetic seal is achieved by the special vitreous insulation surrounding the steel contacts and fused to the shell. The KH connectors will withstand 200 to 900 psi, depending on size and contact complement. Temperature operating range varies from —320 F to +600 F, emergencies to 1,000 F if mating fitting and finish are expendable. All MIL-C-5015 vibration and thermal shock tests are met.

Comparison Bridge

GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Accurate and simple production tests are possible on the new general-purpose type 1604-A comparison bridge. With a basic accuracy of 0.1 percent, the bridge can be used for direct comparison of resistors, capacitors and inductors over the wide impedance range of about 2 ohms to 20 megohms. Two impedance-deviation ranges, ±5 and ±20 percent, are provided. Dissipation-factor differences are also indicated. The bridge is completely self-contained with a cathode-ray visual detector and an oscillator operating at either 1 kc or 5 kc. Operation is from the a-c line. The point at which the bridge is grounded can be switched, so that measurements can be made with the
New ELECTRICAL TUBING gives Better Performance 5-WAYS

Here's why...
VARGLAS Tubing is now impregnated with G. E. PERMAFIL

Here's how...

1 BETTER DIELECTRIC RETENTION
... 7,000 volts — and keeps its high dielectric value under toughest service conditions.

2 BETTER FLEXIBILITY
... twist it — tie it — bend it — wrap it! No crack — no peel — no dielectric loss.

3 BETTER HEAT RESISTANCE
... withstands more than 2,000 hours at 105° to 110° C — 1,000 hours at 125° C — extensive periods even at 150° C.

4 AVAILABLE IN COILS
... so that you can cut the length you need — no more, no less, no waste. Standard colors — wide range of sizes — meets or exceeds all A.S.T.M. specifications.

5 CAN BE AFTER-TREATED
... in baking and varnishing operations. Reacts better than most oleoresinous materials and other synthetic coated tubings.

Send for FREE Sample — Full Information

VARFLEX Corporation, 308 Jay St., Rome, N.Y.

Please send me full information as well as a free sample of your new Varglas Tubing impregnated with General Electric Permafil. I am particularly interested in samples suitable for

Name:
Company:
Street:
City Zone State

Want more information? Use post card on last page.
New Way

to wrap
electronic parts!

SHERMAN SPOT-SEAL
MAKES A FAST, ECONOMICAL WRAP FOR ELECTRONIC PARTS AND ASSEMBLIES!

Goes on more easily than any other wrap, too. That's because Spot-Seal is a specially coated wrap that sticks only to itself. Wrap it around the part, press it together...the package is sealed! Spot-Seal makes a quick, economical wrap for parts that need dust and dirt protection. And because Spot-Seal sticks only to itself, it will not mar finishes, requires no fastenings. A perfect way to store or ship sub-assemblies and replacement kits without loss of parts.

Switch to labor-saving Spot-Seal for convenient protective packaging of electronic units. Write for free samples today, Dept. U. See for yourself the protection and quick-wrapping Spot-Seal gives.

Sherman PAPER PRODUCTS CORPORATION
NEWTON UPPER FALLS 64, MASS.
CHICAGO LOS ANGELES NEW YORK

Want more information? Use post card on last page

NEW PRODUCTS
(continued)

unknown either grounded or un-grounded.

Voltage-Regulated Power Supply
KEPCO LABORATORIES, INC., 131–38 Sanford Ave., Flushing 55, New York. Model 1520 features a regulated h-v d-c power supply with excellent regulation, low ripple content and low output impedance. The h-v supply is continuously variable from 0 to 1,500 v and delivers from 0 to 200 ma. In the 30 to 1,500-v range the output voltage variation is less than 0.5 percent for both line fluctuation from 105 to 125 v and load variation from minimum to maximum current. Ripple voltage is less than 30 mv peak to peak.

EPUT Meter
BERKELEY SCIENTIFIC DIVISION OF BECKMAN INSTRUMENTS, INC., 2200 Wright Ave., Richmond, Calif. Model 5558 events-per-unit-time meter is a high-speed electronic counter combined with an accurate time base to provide an instrument that will automatically count and display the number of events that occur during a precise time interval. The EPUT will count events occurring either regularly or with ran-
New Plant Locates in Telecasting Heart of U. S.

Things are humming in Wapakoneta, Ohio. There, about 10 miles west of the Dayton-Toledo coaxial cable is the new plant of Superior Tube Company. This plant complements the production capabilities of the Superior main plant, takes care of your ever-increasing demands for television and military purposes.

Superior nickel cathodes are made in a wide range of types, O.D.'s, wall thicknesses and lengths—with or without bead—and in active, normal and passive alloys, depending upon the application and the degree of emission required.

Superior produces both Seamless and Lockseam nickel cathodes. For many electron tubes Lockseam—made by a patented process from strip stock—has an economic advantage. Superior Seamless shows great advantages in uniformity, close tolerances, and small O.D. for sub-miniature tubes.

Superior equipment is more than matched by the care taken in production. Each melt of alloys is laboratory-checked for emission and performance. Many extraordinary precautions are taken in manufacture to avoid contamination.

Before you order cathodes, first see what Superior engineering, quality, and delivery can do for you.

Many other types of nickel cathodes—made in Lockseam† from nickel strip, disc cathodes, and a wide variety of anodes, grid cups and other tubular fabricated parts are available from Superior. For information and Free Bulletin, address Superior Tube Company, Electronics Division, 2500 Germantown Avenue, Norristown, Pa.

---

*Main Superior Tube plant at Norristown, Pa.
**NEW Superior Tube plant at Wapakoneta, Ohio.

---

Seamless Nickel Cathode
Round, single bead. .045" O.D. x .002" Wall. 27 mm long.

Lockseam† Nickel Cathode Rectangle, single bead. .030" x .100" O.D. x .002" Wall. 13 mm long.

Seamless Monel, Expanded and Ranged. Exp. to .165"/.168" I.D. — Fl. to .235". 1.09 O.D. x .002" Wall x 1.100" long.

Disc Cathode .121" O.D. .312" long.

(Manufactured under U.S. Patents)

Electronics — April, 1953

Want more information? Use postcard on last page.
**NEW PRODUCTS**

(NEXT PAGE)

dom distribution at rates from 20 to 1,000,000 events per second with an accuracy of one count. The result is displayed on the illuminated number panels of 6 decimal counting units and read directly in digital form. Because of its direct readout feature with no lights to add or interpolate it is ideally suited for production line operation by relatively unskilled personnel.

---

**Subminiature Tube Sockets**

HUGH H. EBY, INC., 4722 Stenton Ave., Philadelphia 44, Pa. A new line of standard subminiature tube sockets is available in two styles. The rectangular socket is made in 5, 6, 7 and 8 pin with contacts in two lengths for conventional and printed circuit application. The round style is available with or without saddle. Both sockets are produced to recognized industry standards and dimensions. Contacts are beryllium copper silver plated, tin dipped, or gold flash over silver. Bodies are of low-loss mica-filled phenolic, and the saddle is nickel-plated brass.

---

**TV Picture Tubes**

THE RAILAND CORP., 4245 N. Knox, Chicago, III., has announced two new 21-in. rectangular tv picture tubes with spherical faceplates. The 21VP4 has electrostatic focus and magnetic deflection requiring a focusing voltage from 0.4 to 2.2 percent of the anode voltage. The 21ZP4A has magnetic focus and magnetic deflection. Both tubes have gray filter faceplates that improve picture contrast. Each type tube has external conductive coating that acts as filter capacitance. Each also uses the company's indicator ion

---

**TYPICAL OPERATION—215-235 mc.**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Plate Voltage</td>
<td>775 volts DC</td>
</tr>
<tr>
<td>Final Plate Current</td>
<td>220 milliamperes</td>
</tr>
<tr>
<td>Driver Plate Voltage</td>
<td>500 volts DC</td>
</tr>
<tr>
<td>Driver Plate Current</td>
<td>100 milliamperes</td>
</tr>
<tr>
<td>Screen Voltage</td>
<td>250 volts DC</td>
</tr>
<tr>
<td>Screen Current</td>
<td>20-40 milliamperes</td>
</tr>
<tr>
<td>Power Output</td>
<td>100 watts</td>
</tr>
<tr>
<td>Heater Voltage</td>
<td>6 or 24 volts AC or DC</td>
</tr>
<tr>
<td>Blower Voltage</td>
<td>6, 24 volts DC or 115 volts 400 cycles</td>
</tr>
<tr>
<td>Size</td>
<td>4 1/2 inches high, 2 1/4 inches wide, and 8 1/4 inches long not including the transmitter</td>
</tr>
<tr>
<td>Weight</td>
<td>5 lb. 6 oz.</td>
</tr>
<tr>
<td>Assembly Number</td>
<td>557731</td>
</tr>
</tbody>
</table>

Write for complete information.

---

**Bendix-Pacific**

**100 WATT R.F. AMPLIFIER for TELEMETERING TRANSMITTERS**

This new Bendix-Pacific TAV-2 Amplifier will extend the range of low power transmitters, such as the Bendix-Pacific TXV-13, by increasing the output power. It nominally provides 100 watts of RF output power to a 50 ohm load through a type N coaxial fitting. The unit requires two watts drive at 50 ohms. The power connection is a multicore, quick disconnect plug.

The amplifier is unusually compact and is rigidly constructed to withstand extremes of vibration and shock. Provision is made for mounting the Bendix-Pacific TXV-13 Transmitter directly to the amplifier, as shown in the photo, making a complete 100 watt transmitter of very small size.

---

**Pacific Division**

Bendix Aviation Corporation

EAST COAST OFFICE: 475 FIFTH AVE., NEW YORK 17, N.Y.

EXPORT DIVISION: BENDIX INTERNATIONAL, 72 FIFTH AVE., NEW YORK 11, N.Y.

Want more information? Use post card on last page.

---

**Power Screen Driver**

Final Plate Current: 100 milliamperes

---

NOV. 4-

---
GPL Introduces

"STATICON"

INDUSTRIAL TELEVISION

Standard or portable type cameras designed with

New "STATICON" TUBE...GPL Remote Control optional

A SPECIAL SERVICE
For Users of
INDUSTRIAL TV

GPL announces a special engineering service for firms studying industrial TV. You are invited to submit your problems to GPL engineers for a survey of camera type needed, lenses, monitors, remote control, and complete installation for maximum economy and efficiency.

STANDARD STATICON
A very compact camera, designed for fixed installation and continuous duty under minimum light conditions. Separate control monitor and sync generator at master control point. Standard TV receivers can be used as optional monitors. Available with remote control of pan and tilt, lens change, focus and iris adjustment.

PORTABLE STATICON
For field use, multiple set-ups...hand-held or tripod-mounted. Packaged as one unit with built-in sync generator, monitor and transmitter in camera housing. Standard TV receivers as added monitors. Rugged but compact for reliability in portable uses.

Specifications for both cameras available on request

Write, wire or phone

General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK
Cable address: Prelab

TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment

Want more information? Use post card on last page.
began with—bombsights . . .

continues with—highly advanced instruments and systems . . .

for all branches of the Military Services and many segments of Industry.

Skilled instrument makers and engineers find a challenge here.

NEW PRODUCTS (continued)

trap gun that provides outstanding picture quality with a minimum of installation servicing time.

Fine Wire Bobbin Winder
GEO. STEVENS MFG. CO., INC., Chicago 30, Ill., has announced the model 111-A miniaturized high-speed fine-wire bobbin winder. An automatic counter permits instant resetting of the winding cycle by merely touching a lever. Dimensions of the unit are 211 in. long × 8 in. wide × 12 in. high. Net weight is 42 lb. A slow-start feature avoids possibility of wire breakage. Top winding speed is 7,000 rpm. The model 111-A winds all types of random-wound bobbin coils, solenoids, repeater coils and precision, noninductive resistors.

Inductance Bridge
CLOUGH-BRENGLE Co., 6014 Broadway, Chicago 40, Ill. Model 712 capacitance - resistance - inductance bridge is used to measure the capacitance of paper, mica, electrolytic, ceramic and air capacitors; the stray capacitance of bushings, switches and wiring; the dissipation factor of capacitances; the leakage current of electrolytic capacitors; the resistance of composition and wire-wound resistors; the inductances of coils and transformers; the storage fac-
For over 33 years P-M has been a dependable source for small metal stampings. An extensive modern plant, complete equipment, specialized engineering experience and toolmaking skill combine at P-M to produce stamped metal parts accurately, economically, promptly. Moderate die charges. Modern facilities for large volume production. Special stamping problems are gladly accepted; recommendations for the most efficient and economical solutions are made promptly. Send prints for your next stamping job to P-M.

TERMINALS FOR ELECTRIC WIRES

Being long experienced specialists in the terminal field, we have dies to produce over 400 different kinds of separate terminals, and every modern facility to meet your standard or special requirements. We also provide terminals in continuous form, supplied on reels, with machine for attaching and soldering tandem terminals to wires in one continuous operation. Send for folder.

PATTON·MacGUYER COMPANY

201 CHAPMAN STREET, PROVIDENCE 5, R. I.

HEATHKIT TEST EQUIPMENT

Heathkits are completely engineered instruments supplied unassembled. Every kit goes together smoothly and easily. All drilling, punching, and planing has already been done for you. All parts are finished and of highest quality.

Detailed construction manual shows clearly where each wire and part goes and tells exactly how to build the kit. Write for free catalog.

THE BIRTCHEL CORPORATION

4371 Valley Blvd. Los Angeles 32, Calif.

Please send catalog and samples by return mail.

Company

Attention of:

Address

City State
Hi-Q®

ceramic disk capacitors

Seven sizes. Capacities of from .3 mmf. to .026 mfd. Ceramic dielectric materials with K factor ranges from 14 to 6000, provide excellent opportunities for diversified applications. Used for by-passing, blocking, coupling, etc. Sturdily constructed. Precisely tested. Moisture-proofed. Also available in temperature-compensating, multi-section, stacked units and other types to meet every electronic need. And backed by highly informative data, such as the Preferred Value Chart here shown, available on request.

*FUNCTION-FITTED: The outstanding application-engineering experience with ceramic dielectric capacitors, is yours for the asking. Let us collaborate for the most economical and satisfactory answer to your requirements.

NEW PRODUCTS (continued)

Dot Generator

RESEARCH ELECTRONICS, Roslyn, Pa. Model 102 pin-point dot generator is a new type burst pulse generator for laboratory or production testing. The 65-v, 0.05-sec output pulse width is determined by a plug-in pulse transformer, and is controllable in burst duration from approximately 10 to 150 usec at an adjustable 315,000-pps rate. This new tool is of special interest in the development and manufacture of tv receivers, deflection yokes, focus devices, ion traps and picture tubes.

Plug-In Audio Amplifiers

GATES RADIO CO., Quincy, Ill., has announced a new line of versatile plug-in audio amplifiers. An idea of the compactness of the plug-in units may be had from the fact that eight of the new preamplifier units occupy only 7 in. × 19 in. panel space. The same space will hold two program amplifier units and two regulated power-supply units. Other features of the new assemblies include self-aligning plugs and receptacles; simplified rear wiring, since cable harness clamps and troughs are all a part of the panel and shelf assembly; a new low in noise and distortion char-
Characteristics; better shielding; and greater flexibility.

CRT Test Set
RESEARCH ELECTRONICS, Roslyn, Pa., has perfected a portable CRT test set for all TV picture tubes and magnetically deflected radar tubes, which measures all characteristics including emission, cutoff, gas ratio, heater-cathode leakage positive and negative, grid-cathode leakage, A leakage and G leakage. It features electronically controlled and regulated circuits of high accuracy and sensitivity, but is simple and rugged enough for warehouse and portable use. It operates from standard 115 v a-c lines.

Precision Phasemeter
DELTRON INC., P.O. Box 192, Glen-side, Pa. Model 100A phasemeter is a 2-cycle to 200-ke unit designed for use in the audio, ultrasonic, servomechanism, industrial control and acoustical fields for determination of phase characteristics and time relationships. It is applicable to the power field and general laboratory use for power factor measurements and electronic component testing. Error is less than 4 deg from 20 cycles to 20 kc; increasing gradually to 8 deg above

* Aerovox capacitors can be fitted to your circuitry, associated components and operational requirements, often at substantial savings, always for better performance, and never at added cost. Let us tell you about it.

AERVOX CORPORATION
NEW BEDFORD, MASS.

ELECTRONICS — April, 1953

Want more information? Use postcard on last page.
NEW PRODUCTS (continued)

20 ke and below 20 cycles. Input impedance is approximately 20 megohms shunted by 10 µuf. Input voltage is 1 to 50 v sine wave; to 500 v with accessory input dividers.

Program Equalizer

CINEMA ENGINEERING CO., 1510 West Verdugo Ave., Burbank, Calif., has announced the type 4031-B program equalizer that has wide applications in the sound and electronic laboratories for research and control. The broadcasting, recording and motion picture industries are using it as a practical, high-quality program equalizer that provides corrections for frequency response in audio equipment, sound pickup and transmission lines. Easy operation of two control knobs allows wide range of over 395 available curve combinations. Controls provide for independent adjustment of the high and low frequencies in 2-db steps. Minimum input level is -70 dbm; maximum, +20 dbm.

D-C Power Supply

NEUTRONIC ASSOCIATES, 83-56 Victor Ave., Elmhurst 73, N. Y., announce the availability of model 33HRR, 1 to 30 kv, regulated, reversible, 5-ma rating, r-f d-c power supply. This equipment was

Program Equalizer

CINEMA ENGINEERING CO., 1510 West Verdugo Ave., Burbank, Calif., has announced the type 4031-B program equalizer that has wide applications in the sound and electronic laboratories for research and control. The broadcasting, recording and motion picture industries are using it as a practical, high-quality program equalizer that provides corrections for frequency response in audio equipment, sound pickup and transmission lines. Easy operation of two control knobs allows wide range of over 395 available curve combinations. Controls provide for independent adjustment of the high and low frequencies in 2-db steps. Minimum input level is -70 dbm; maximum, +20 dbm.

D-C Power Supply

NEUTRONIC ASSOCIATES, 83-56 Victor Ave., Elmhurst 73, N. Y., announce the availability of model 33HRR, 1 to 30 kv, regulated, reversible, 5-ma rating, r-f d-c power supply. This equipment was
NEW PRODUCTS (continued)

developed to provide a tool for serious research beyond the usual current limitations of r-f h-v power supplies. Output is from below 1 kv to 30 kv at 5 ma in three ranges. Regulation is 0.1 percent at all voltages. Line voltage stabilization is 0.1 percent from 105 to 130 v a-c. Ripple voltage is less than 0.05 percent of d-c output voltage.

Coaxial Terminal Triode
MACHLETT LABORATORIES, INC., Springdale, Conn., announces the ML-6257, a water-cooled ring-seal triode incorporating an integral anode water jacket. Designed specifically for r-f heating application in the 2-to-3 kw range, but well adapted to a-m, f-m and tv transmission, the ML-6257 has plate input and dissipation ratings of 7 kw and 5 kw, respectively; stress-free thoriated tungsten filament operates at 12.6 v, 27 amperes. Maximum ratings apply to 110 mc. The tube is also available in a forced-air cooled model and in a version designed for use with the company’s quick-change automatic seal water jacket.

Magnetic Recording Tape
MINNESOTA MINING AND MFG. CO., 900 Fauquier St., St. Paul, Minn.,
ELECTRONICS — April, 1953

Announcing with pride the development of the NEW EUREKA "SNAPPER" THERMAL TIME DELAY RELAY


The ELIMINATION of CHATTERING is accomplished with the incorporation of "POSITIVE SNAP ACTION" in the EUREKA "SNAPPER"... LEADING ELECTRONIC MANUFACTURERS have acknowledged the new EUREKA "SNAPPER" as a major advancement in this field, and have already accepted this relay as a standard component of their latest equipment.

Voltage ... 6.3, 26.5, 115 volts (A.C. or D.C.) or as required.
Ambient Temperature Range . . . -60°C. to + 80°C.
Envelope ... Miniature (7 and 9 pin), or octal (8 pin) metal.
Time Delay Periods ... Preset from 5 seconds up.
Vacuum ... Evacuated, inert gas filled.
Height ... 1¾” maximum seated.

Inquiries are invited ... send for our "Bulletin Number Snapper"

EUREKA TELEVISION AND TUBE CORPORATION
Manufacturers of Cathode-Ray Tubes and Electronic Products
69 FIFTH AVE., HAWTHORNE, N. J. • TEL. HAWTHORNE 7-5800
ferrites

You'll be well repaid by getting the facts on a special group of Pure Ferric Oxides, developed by Williams especially for use in the manufacture of ferrites.

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.

Tell us 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 Dept. 25, C. K. Williams & Co., Easton, Pa.

WILLIAMS
COLORS & PIGMENTS
C. K. WILLIAMS & CO.
Easton, Pa. - East St. Louis, Ill.- Emeryville, Cal.

P. S. We also produce IRN Magnetic Iron powders for the Electronic Core Industry, the Magnetic Tape Recording Industry and others. Write for complete technical information.

New
LOW COST—PRECISION
Direct Reading
PHASEMETER

Model 100A Phasemeter

- 0° to 180° lead or lag in 90° expanded scale ranges.
- 2 cycles to 200 kilocycles.
- Error less than 4° from 20 cycles to 20 kilocycles; above 20 kilocycles and below 20 cycles increasing gradually to 8°.
- Input impedance approximately 20 megohms shunted by 10 mmf.
- Input voltage 1 to 50 volts sine wave; to 500 volts with accessory input dividers.
- Invaluable in the audio, ultrasonic, servomechanism, industrial control and acoustical fields for determination of phase characteristics and time relationships.
- Applicable to the power field and general laboratory use for power factor measurements and electronic component testing.

Literature on request.
Price: $145.

DELTRON INC.
P.O. Box 192
Glenside, Pa.

TAKE NO CHANCES WITH VITAL EQUIPMENT... Specify
SERIES 6918 or 6924
RACKS
by PAR-METAL

18½" or 24" DEEP, for 19" WIDE PANELS
- Panel Spaces: 61½", 70", or 77" high.
- Finished in Prime Coat, Black Wrinkle, Grey Lacquer, Grey Wrinkle.
- Series 6918 or 6924 Racks may be used in "rows" or "gangs," as corner trims are removable from front of cabinet.
- Standard shelves and roller trucks are manufactured by us for use with these Racks.

THESE RACKS ARE MODERATELY PRICED and AVAILABLE FOR SHIPMENT FROM STOCK

Planning an electronic product? Consult Par-Metal for RACKS • CABINETS • CHASSIS • PANELS

Remember, Par-Metal equipment is made by electronic specialists, not just a sheet metal shop.

Made by Electronic Specialists!

WRITE FOR CATALOG!
has announced the Scotch No. 120 High Output magnetic recording tape that is designed especially for use in radio, tv and recording studios, in computer work and in other critical applications. With the new tape at least 8 db greater signal-to-noise ratio is obtainable on conventional professional magnetic recorders. In the pulse recording field it will enable manufacturers of electronic computing equipment to get improved pulse definition and to keep signals high enough above noise level for more accurate work. The new tape has a strong and flexible coating, dry lubricated by a special process to prevent squealing on critical machines. Output uniformity at 1 kc is guaranteed not to exceed ±1 db within a reel and ±1 db from reel to reel. The No. 120 tape is available in lengths of 2,400 ft on the NARTB reel or hub, and in 1,200 ft lengths on the 7-in. plastic reel with the 21-in. hub. All lengths are guaranteed splice-free.

Double-Shield Screen Room

ERIK A. LINDGREN & ASSOCIATES, 4515 North Ravenswood Ave., Chicago 40, Ill., is manufacturing a screen room that uses a double screen design in which the outer and inner screens are physically and electrically insulated from each other to assure minimum interference for testing and evaluating many types of electronic equipment. The lightweight prefabricated panels are 81 in. x 91 in., easily assembled to various dimensions, and the screening is heavy copper, securely attached to the panel frames. Construction is entirely portable, easily dismantled and moved to any desired location. Six power line entrances are provided as well as a special copper-covered power-line

'DIAMOND H' RELAYS

pack more performance into less space

Rating for rating, "Diamond H" Series R hermetically sealed, miniature aircraft type 4PDT relays are smallest (16 cubic inches), lightest (3.76 ounces), have widest temperature range (-65° to +200°C.), greatest operating shock resistance (to 50 G and higher) and excel all others in their field in ability to break high currents and high voltages.

Ideal for high frequency switching, their inter-electrode capacitance is less than 5 micro-microfarads contacts to case, less than 2½ mmf between contacts, even with plug-in type relay and socket. Vibration range is from 0 to 500 cycles per second and upward at 15 "G" without chatter. Coil resistances up to 50,000 ohms are available, with contact loading through 10 A. resistive for 100,000 cycles (30 A. resistive for 100 cycles) at 30 V., D.C., or 115 V., A.C. Sensitivity approaches 100 milliwatts at 30 "G" operational shock resistance. They meet all requirements of USAF Spec. MIL-R-5757.... and far surpass many. Various standard mounting arrangements available.

"Diamond H" engineers are prepared to work with you to develop variations for guided missiles, jet aircraft, fire control, radar, communications, geophysical and computer apparatus... any application where peak performance is vital under critical conditions.

Illustrated Bulletin R-150 gives detailed performance data under varying conditions. Write for a copy today.

THE HART MANUFACTURING COMPANY

202 Bartholomew Avenue, Hartford, Connecticut

THE HART MANUFACTURING COMPANY, 202 Bartholomew Ave., Hartford, Conn.

Please send me Bulletin R-150 with detailed performance data on Series R Relays

NAME ____________________________  TITLE ____________________________

COMPANY ____________________________

ADDRESS ____________________________

CITY ____________________________ STATE __________________________

Want more information? Use post card on last page.
GET THE EYE-OPENING STORY OF FLEXIBLE SHAFT ECONOMY

The 256-page flexible shaft handbook has full details on flexible shaft selection and application. Get your free copy by writing for it direct on your business letterhead.

S.S. WHITE Flexible shafts

The "spot" is a variable element which has to be controlled from some point outside the circuit. In most cases, you can make substantial savings by controlling it with an S.S. White Remote Flexible Shaft.

Here's why. You only need a single S.S. White flexible shaft to provide smooth, accurate control between the element and its control knob. This allows you to dispense with the extra parts that might otherwise be needed for this purpose.

An S.S. White flexible shaft needs no alignment. This means big savings in assembly time and the elimination of close tolerance machining of control panels and parts.

A flexible shaft can be quickly and easily installed — just couple one end to the element and the other end to the control knob — and the coupling is complete.

Added to this, an S.S. White flexible shaft gives you added freedom in mounting controls and circuit elements to meet wiring, circuit and assembly requirements.

Yes, every step of the way — in design — in production — in assembly — you'll be able to make important savings in equipment costs. And to save your own valuable time, S.S. White engineers will be glad to cooperate with you in working out application details.

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

Western District Office • Times Building, Long Beach, California

Metal-Cased Paper Capacitors

CORNELL-DUBILIER ELECTRIC CORP., South Plainfield, N. J., has expanded to twelve types the Demicon series of miniaturized, tubular metal-cased paper capacitors. The Demicons are hermetically sealed in metal cases, with glass-to-metal seal terminals, and are available in seven mounting and container styles. Impregnants, tolerances and internal constructions are provided to meet the most popular applications encountered in present-day engineering practice. All Demicons will comply with applicable parts of specifications JAN C-25 and MIL-C-25A.

Damping Diodes

SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa., has announced two new diodes for use in TV horizontal frequency damper circuits. Types 6AX4GT and 12AX4GT are half-wave, indirectly heated diodes contained in T-9 envelopes. They are designed to withstand the extremely high voltage pulses of line frequency between cathode and both heater and plate elements, normally encountered in direct drive circuits. The tubes are identical except for heater characteristics. The 6AX-
NEW PRODUCTS (continued)

4GT requires 6.3 v at 1.2 amperes. The heater of the 12AX4GT requires 12.6 v at 600 ma.

Tiny Electrolytics
MICAMOLD RADIO CORP., 1087 Flushing Ave., Brooklyn 37, N. Y., is now producing the Microlytic capacitors in a range of sizes and ratings. The smallest unit is only 0.175 outside diameter and 1/8 in. long. These tiny electrolytic capacitors were intended to serve in the circuits of such units as very small amplifiers, hearing aids and transistor devices. Maximum temperature rating is 65 C. Complete ratings and mechanical variations can be supplied to the customer's specification.

Power Supplies
JERSEY CITY TECHNICAL LABORATORY, 880 Bergen Ave., Jersey City 6, N. J., has added to its line two Mini-Pack power supplies. The Mini-Pack is a small selenium rectifier source of instant power. Model R gives 108 v regulated low-ripple d-c with an OB2 voltage-regulator tube. It will maintain constant voltage output with load variations up to 15 ma, or lightly loaded with input variations from 100 to 130 v a-c. Model P is a voltage doubler.

THE S.S. WHITE "AIRBRASIVE" UNIT

Ideal for high precision cutting, surface film removal, etching and light deburring

This remarkably versatile machine can be used for a wide variety of high precision operations from cutting hard, brittle materials to producing fine matte surface finishes. Using a high speed jet of gas-propelled abrasive particles, it can produce cuts as fine as .018" diameter. Its basic advantages are that it cuts cool and without shock or vibration – its accuracy is unaffected by surface irregularities of the work – and it can be accurately regulated for depth and type of cut.

Many manufacturers are now using the Unit to remove surface coatings on deposited carbon resisters and on printed circuits – for light deburring on inside surfaces of tubular parts – drilling fine holes through glass – cutting germanium.

We will be glad to make tests to determine the suitability of the "Airbrasive" Unit to your production requirements. Send us a sample of the part or material as well as details of the job you have in mind. There's no obligation.

WRITE FOR BULLETIN 5212
It has full facts and data on the Airbrasive Unit. It tells you how the "Airbrasive" Unit works and provides information on where, when and how it can be used.

THE S.S. WHITE INDUSTRIAL DIVISION
DENTAL MFG. CO.

Dept. EB 10 East 40th St.
NEW YORK 16, N. Y.

Western District Office · Times Building, Long Beach, California

Want more information? Use post card on last page.
AGASTAT
Compact...Dust-Proof
TIME DELAY RELAYS
solenoid actuated—pneumatically timed

Introduces time delays into a-c or d-c circuits. Easily adjusted to provide delays ranging from 0.1 second to five or more minutes.

The AGASTAT is small, light, and operates in any position. Dust-proof timing chamber assures long operating life with a minimum of maintenance.

Write for Bulletin.
Dept. A1-44,
Division of Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth 3, New Jersey

For HEAVY DUTY
HIGH VOLTAGE

MagnaTran®

PRODUCTS ARE BETTER*
YES...WE BUILD BETTER EQUIPMENT
BASED ON MANY YEARS OF EXPERIENCE

*While this word has been overworked in many instances, we will be pleased to demonstrate the extras built into our transformers to make them better.

NEW UNITIZED RECTIFIERS
For high voltage D.C. sources...lower initial cost...minimum upkeep...convenient — ready to connect to A.C. line and D.C. load...compact — requires minimum floor space.

AIR...OIL...ASKAREL
Plate Transformers, Filament Transformers, Filter Reactors, Modulation Transformers, Distribution Transformers, Pulse Transformers, Testing Transformers, Precipitation Transformers, General Purpose Transformers, Hi-Voltage Transformers.

WRITE FOR DETAILED INFORMATION
A NAME SYNONYMOUS WITH EXPERIENCE
MagnaTran Incorporated
Transformers and Electrical Equipment
Walter Garlick, Jr., President
246 Schuyler Ave., Kearny, New Jersey

H. Cross Co.
15 BEEKMAN ST., N. Y. 38, N. Y.
WOrth 2-2044 and COrtlandt 7-0470

1953 HANNOVER
GERMAN INDUSTRIES FAIR
APRIL 26—MAY 5

Plan now to visit West Germany’s Hannover Fair! See over 4,000 exhibits that include Materials & Equipment for these industries:

- Mining, Milling, Metalworking Machinery
- Motors & Engines
- Electrical Manufacturing & Construction
- Tools
- Chemical & Other Processing
- Electronics
- Textile Machinery
- Automotive
- Office Supplies...and products for every industry!

Get full FREE facts. Call or write:
GERMAN-AMERICAN TRADE PROMOTION
350 Fifth Avenue, New York 1, N. Y.
Wisconsin 7-0727

see
New Products!
New Ideas!

1953
HANNOVER

for the ELECTRONIC INDUSTRIES
MOLYBDENUM
TUNGSTEN
TANTALUM
FORMED PIECES

Your Special Metals Rolled to Thin Sizes & Close Tolerances

YOUR INQUIRIES WILL RECEIVE PROMPT ATTENTION

H. Cross Co.
15 BEEKMAN ST., N. Y. 38, N. Y.
WOrth 2-2044 and COrtlandt 7-0470

Want more information? Use post card on last page.
April, 1953 — ELECTRONICS

www.americanradiohistory.com
NEW PRODUCTS (continued)

10 w power source of low-ripple d-c. The no-load voltage output is 330 v. At 50 ma, the maximum constant-duty current, the output is 200 v. For intermittent use, the current may go as high as 65 ma.

Amplifier Bridge

ROBINSON AVIATION, INC., Teterboro, N. J. In the new Simmonds amplifier bridge for the Pacitron fuel gage system, new standards of lightness and compactness have been achieved by a unique system of Meta-L-Flex (all-metal) internal vibration and shock mounts. Need for external mounting is eliminated and the sensitive tubes are fully isolated from vibration and shock. The entire unit is so small it fits in the palm of one's hand and weighs only 1 lb 3 oz. An effective center of gravity type of mounting permits the unit to be mounted also in the inverted position.

Retaining Rings

INDUSTRIAL RETAINING RING CO., 8 West Sidney Ave., Mt. Vernon, N. Y. Open-type retaining rings measuring 5/8 in. and applicable to a 3/8 in. diameter shaft are being stacked for manufacturers. Stack-

Electronic equipment manufactured by the Electronics Division of Westinghouse Electric in Baltimore must meet rigid performance specifications. To evaluate this equipment under controlled atmospheric conditions, Westinghouse uses a Bowser Walk-In Room which will simulate temperatures from -85° F. to +176° F., and relative humidity from 20% to 95%. In addition, pressures found at altitudes up to 80,000 feet can be created. The entire test facility is operated and controlled from a remote control station.

The complete room was designed, built and installed by Bowser.

This unit is an example of what Bowser can do to help anyone whose products require testing, processing, or stabilized storage. Environmental simulation units, as well as other Bowser equipment, can be engineered to meet individual requirements with unlimited specifications for size, temperature and humidity ranges and peak altitude.

Why not take advantage of Bowser's long continuous experience, the first and best in the field. Our trained engineers are available for consultation at your plant without obligation.
Any pulse width from 0.1 to 40 microseconds  
Any impedance from 5 to 500 ohms  
Any voltage rating from 1000 to 25000 volts*  

Tobe pulse forming networks have an excellent record of performance, both in radar sets and in seasoning equipment for magnetrons and hydrogen thyratrons. Our design experience and production facilities assure delivery to your schedule requirements. Widely used networks are tabulated below. Many others are available — write for data sheet.

*Over 25 KV, pulse-type capacitors with external coils are usually recommended; write for data sheet.

<table>
<thead>
<tr>
<th>TOBE TYPE</th>
<th>CODED IDENTIFICATION</th>
<th>DIMENSIONS</th>
</tr>
</thead>
</table>
| DPN-1     | 66                   | 2.0 x 0.75 x 3.00  
|           | 99                   | 2.25 x 3.00 x 3.00  
|           | 29                   | 3.00 x 4.00 x 3.00  
| GEPN-2    | 2.64E2  04 x 400 50P2T 11/4 x 1 1/4 x 2 1/2  
| GEPN-4    | 142                  | 2.0 x 0.5 x 2000 1.5  
|           | 162                  | 2.0 x 1.0 x 2000 2.0  
| RCN 2     | 1729                 | 2.0 x 400 50P2T 2.0 x 6.0  
|          | 2421                 | 2.0 x 600 50P2T 2.0 x 6.0  
|          | 3352                 | 3.0 x 1000 50P2T 3.0 x 1000  
| SFPN-5    | 1454                 | 4.0 x 43 x 2000 50P2T 4.0 x 43 x 2000  
| SFPN-8    | 232                  | 4.0 x 8 x 2000 4.0 x 8 x 2000  
| SFPN-14   | 86                   | 4.0 x 10 x 1000 4.0 x 10 x 1000  
| SFPN-24   | 232                  | 10 x 1000 50P2T 10 x 1000 50P2T  

NEW PRODUCTS (continued)

Scintillation Count Rate Meter  
NUCLEAR RESEARCH AND DEVELOPMENT, INC., 6425 Etzel Ave., St. Louis 14, Mo., has developed the CRM-500 scintillation count rate meter that may also be used for Geiger and proportional counting. It incorporates three basic features: (1) A fast pulse amplifier with a rise time of 0.25 usec and a variable amplification up to 1,500. (2) A true electronic discriminator that accepts pulses from −100 to +50 v. (3) A well-regulated h-v supply that is variable from 500 to 1,800 v and is regulated to 0.005 percent per 1-v change in line voltage between 95 and 100 v. The count-rate circuit is normally supplied with counting rate multiples of 1,000, 5,000, 10,000, 20,000 and 50,000 counts per minute, but can
also be supplied with scales up to 500,000 counts per minute. A switch on the front panel allows the selection of percent error over the range of 1, 2, 5, 10 and 20 percent.

Rectangular CRT
WATERMAN PRODUCTS CO., INC., Philadelphia 25, Pa. Model 3XP
Rayonic rectangular cathode-ray tube provides unusually brilliant and sharply defined trace and high deflection sensitivity at medium anode potentials. The tube provides a light output four times greater and a vertical sensitivity twice as great as comparable CRT's operating at similar anode potentials. All this has been accomplished without sacrificing low interelectrode capacitances. These characteristics make it ideal for h-f video work as well as low repetitive operation. Because of its unique shape and size, the 3XP lends itself readily to multi-tube oscilloscopy. The tube is available in P1, P2, P7 and P11 phosphors.

Microwave Receivers
POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y., announces a series of four wideband microwave receivers covering the frequency range from 1,000 to 10,750 mc. These receivers include such desirable features as linear db indication, single dial tuning, low noise figure, a-m and f-m reception and AFC. The video bandwidth is such that a 1-μsec undistorted pulse of 10 v will appear across an output impedance of 100 ohms. Model RL covers the frequency range from 1,000 to 2,100 Mc.

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>VOLTS DC</th>
<th>AMPERES</th>
<th>FREQUENCY (Mc)</th>
<th>ATTENUATION (at 15 Mc)</th>
<th>TERMINALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1338</td>
<td>50</td>
<td>1.5</td>
<td>0.15-400</td>
<td>65 db.</td>
<td>Screw</td>
</tr>
<tr>
<td>1338-1</td>
<td>50</td>
<td>2.0</td>
<td>0.15-400</td>
<td>65 db.</td>
<td>Screw</td>
</tr>
<tr>
<td>1338-2</td>
<td>400</td>
<td>2.0</td>
<td>0.15-400</td>
<td>45 db.</td>
<td>Screw</td>
</tr>
<tr>
<td>1338-3</td>
<td>50</td>
<td>2.0</td>
<td>0.15-400</td>
<td>65 db.</td>
<td>Solder lug</td>
</tr>
<tr>
<td>1338-4</td>
<td>50</td>
<td>1.5</td>
<td>0.15-400</td>
<td>65 db.</td>
<td>Solder lug</td>
</tr>
<tr>
<td>1338-5</td>
<td>50</td>
<td>2.0</td>
<td>0.15-400</td>
<td>70 db.</td>
<td>Solder lug</td>
</tr>
<tr>
<td>1338-5A</td>
<td>50</td>
<td>2.0</td>
<td>0.15-400</td>
<td>72 db.</td>
<td>Solder lug</td>
</tr>
<tr>
<td>1338-6</td>
<td>50</td>
<td>2.0</td>
<td>0.15-400</td>
<td>65 db.</td>
<td>Shld. lead</td>
</tr>
<tr>
<td>1338-7</td>
<td>50</td>
<td>1.0</td>
<td>0.15-400</td>
<td>65 db.</td>
<td>Solder lug</td>
</tr>
</tbody>
</table>
Federal Telephone and Radio Corporation reports increased production and reduced loss of compound in potting transformers by using the Robinson Metering Pump. You, too, may benefit by investigating this new production tool. Specifications: Adapts to any production technique. Not a gravity dispenser — Forcibly ejects hot waxes and cements. Thermostatically controlled heat — Variable with a maximum reservoir temperature of 450°F. Motor driven, clutch actuated — 2/3 second per ejection. Variable discharge — Ejection changed in 2 seconds, without tools. Reduced unit costs — No skilled operator required. Saves material — reduces rejects. Write for Bulletin No. 2A.

**EDWARD E. ROBINSON**

**INCORPORATED**

95 PARK AVENUE • HUTLEY 10, N. J.

---

**TWO ADJUSTABLE MINIATURE THERMOSTATS**

from the extensive line of

**ULANET THERMAL CONTROLS**

Whether you need miniature or standard built-in units... call us for the Thermostat that will exactly meet your requirement.

GEORGE ULANET COMPANY, 417 Market St., Newark 5, N. J.

---

**SINCE 1931**

**ULANET**

**ELECTRICALLY CONTROLLED ENGINEERS**

**THE ULANET ORGANIZATION SPECIALIZES IN THE DESIGN AND MANUFACTURE OF THERMAL UNITS FOR ALL TYPES OF TIMING & THERMOSTATIC CONTROLS**

It will pay you to compare our units — contact us and you’ll save time & money by using engineered Ulanet Controls.

Since 1931 Precision Engineered Thermostats for Industry... by Ulanet

---

**NO SHORT CIRCUITS when you use EthoLoc CABLE CLIPS**

Made of Ethyl Cellulose... A Tough, Durable Plastic

Now... For Extra Strength "D" WASHERS to fit our CABLE CLIPS

Write for Sample and Full Information

WECKESSER CO.

5267 N. AVONDALE AVE. • CHICAGO 30, ILL.

West Coast Representative:

5777 West Pico Blvd. • Los Angeles 19, Calif.

---

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
NEW PRODUCTS

mc; model RS, 2,000 to 4,500 mc; model RM, 4,400 to 8,400 mc; and model RX, 7,000 to 10,750 mc.

Potentiometer Element
MARKITE CORP., 155 Waverly Place, New York 14, N. Y., has available the type 2028 potentiometer element. This is a rectilinear model of 20,000 ohms resistance having an active length of 10 in. and a linearity of ± 1 percent. These elements are of particular interest in applications where the advantages of extreme wear resistance and substantially infinite resolution are important. They feature outstanding operational reliability when used in conjunction with the input-output tables of analog computers such as the 10-101A input-output table of the REAC computer.

Variable Speed Drive
THE ARROW-HART & HEGEMAN ELECTRIC Co., 103 Hawthorn St., Hartford 6, Conn., has a new development in motor-control equipment, the electronic variable speed drive for fractional h-p motors. With the optional Dual Range feature, speeds from 100 to 3,500 rpm are available. The series motor used can be started, stopped or dynamically braked and can be rapidly accelerated to preset speeds. The series motor makes use

FREQUENCY-TIME COUNTERS...
Automatically reads frequency, time interval and period

Every known need in frequency and pulse measurement is now satisfied by four completely new designs of Potter frequency-time counting equipment.

The simplified Potter 100 KC Frequency Time Counters, Models 820 and 830, are suitable for rapid and precise production line applications. The versatile Potter 100 KC and 1 MC Frequency-Time Counters, Models 840 and 850, include all gating, switching, timing and counting circuitry required for any conceivable counting-type measurement.

All models feature the convenience of smaller size, lighter weight, and functional panel layout. And, optional readout indication—either the dependable Potter 12-4-8 decimal readout or the conventional 0-9 lamp panels—is available.

For further data or engineering assistance write Dept. 4-C.
When called upon to
HARNESS TIME

Call in
HAYDON
AT TORRINGTON
HEADQUARTERS FOR
TIMING

A.C. and D.C. TIMING MOTORS • TIMING DEVICES
TIME DELAY RELAYS • SPECIAL TIMING DEVICES
TIMING ENGINEERING SERVICES

HAYDON* specializes in a varied line of standard timing components and custom engineered devices for volume application.

Our research and engineering staffs are constantly seeking to develop new and better ways to harness time for industrial, commercial and military applications.

In the field, HAYDON maintains a staff of engineers whose training, backed up by years of experience, enables them to help manufacturers insure, insofar as timing components can, the satisfactory performance of their products. The entire staff and rapidly expanding plant facilities of HAYDON are devoted solely to the production of timing motors, timing devices and clock movements.

AT YOUR SERVICE

The knowledge and skill of our field engineers and our research and engineering facilities are available to help you solve timing problems. Write us in detail or ask that we send a field engineer to talk things over.

HAYDON Mfg. Co., Inc.
Subsidiary of GENERAL TIME CORP.
2428 ELM STREET
TORRINGTON, CONNECTICUT

Laboratory Monitor

BERKELEY SCIENTIFIC Division of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif. Model 1800 laboratory monitor is a general-purpose count rate meter with provision for a visual and/or aural indication. A front panel control permits selection of five different meter ranges: 300, 1,000, 3,000, 10,000 and 30,000 counts per minute. Aural volume control is also provided. The instrument may be obtained with a G-M tube and probe. Accuracy is approximately ±5 percent. Dimensions are approximately 6½ in. x 6½ in. x 10½ in. Net weight is approximately 8 lb.

Constant-Frequency Control

GENERAL ELECTRIC Co., Schenectady 5, N. Y., has announced a new con-
stant-frequency control designed to hold alternator frequency within 0.001 percent on motor-generator sets supplying up to 10 kw of power. It is available in 50, 60 and 400 cps standard in single or three phase, and nonstandard frequencies are available on special order. Specific applications include the prevention of undesired hysteresis and eddy current effects in testing due to frequency variation; a standby source of emergency power for automatic and synchronous equipment; and as a plant frequency standard where one 60/400 cycle source supplies power to many parts of a plant and eliminates the need for a number of smaller sources. The electronic control consists basically of a tuning fork and a phase comparator enclosed in a case approximately 6 x 24 x 33 in.

Tiny Pressure Transducer

CONSOLIDATED ENGINEERING CORP., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Pressure measurements ranging from theoretical investigations of aircraft turbulence-distribution patterns to practical surveys of hydraulic-system and pipeline pulsations are simplified by a miniature pressure transducer recently announced. The type 4-310 Star pickup measures only ½ in. in diameter and less than 3 in. in length, and weighs only 20 oz. Its flush diaphragm is designed for insertion directly into a process vessel or stream of either liquid or gas for test and monitoring purposes. The unit may be used with recorders for permanent test records or with visual indicators and meters for on-the-spot measurements. For detailed specifications, electrical characteristics and pres-
To get the most from recordings...

POWER WITH GENERAL INDUSTRIES' Smooth Power PHONOMOTORS

Assure the purchasers of your record players, portables, and combinations that they will get all that the recording artists put into the recordings... faithful tones and shadings, free from wow, rumble, and waver... make General Industries' Smooth Power Phonomotors standard equipment for your line.

Write for bulletin describing the full line of Smooth Power Phonomotors, with specifications and design data.

Soldering Unit

SUNRISE PRODUCTS Co., P. O. Box 173, Hawthorne, N. J. Model L-72 Glo-Point soldering unit features a metal ground plate on which jigs could be mounted in addition to the adjustable heat control that allows the electrodes to heat up instantly to 1,250 F. The unit is desirable for soldering capacitors, capacitor cans, lugs, terminal boards and electronic parts. A descriptive pamphlet is available on request.

Rack Mounting Adapter

ALLEN B. DUMONT LABORATORIES, INC., 1500 Main Ave., Clifton, N. J. Type 2598 rack mounting adapter was designed for use with types 303, 303-A, 303-AH and 322 c-r oscillographs. The adapter was intended to provide a rigid mount for the instrument and to present a neat, yet completely accessible unit in standard 19-in. relay racks. It bolts to the rack frame and provides a sufficiently large front opening to permit all but the front panel of the c-r oscillograph to pass through. The adapter is shipped disassembled with simple instructions on its...
assembly and the insertion of the instrument.

Special-Purpose Screwdriver

XCELITE, INC., Orchard Park, N. Y., has introduced to the electronic industry a special-purpose screwdriver for adjusting focalizer coils. It has a 10-in. shank to reach into the tv chassis, and its 1-in. blade is flared at the tip and tapered to fit snugly in the focus adjustment screw. Advantages of this tool are that it is nonmagnetic, fatigue-resistant and does not need frequent regrinding, as do fibre or plastic blades.

Miniature Relay

AUTOMATIC ELECTRIC SALES CORP., 1033 West Van Buren St., Chicago 7, Ill. Bantam-sized class S relays are now available in a new small hermetically-sealed enclosure. The entire unit measures $2\frac{3}{4} \times \frac{3}{4} \times 1\frac{1}{4}$ in. and weighs only 1 oz. Mounting studs may be arranged on base or narrow side of housing. This miniature relay was designed for minimum inductance and maximum make-and-break speeds. It is tamper-proof and atmosphere-protected and meets or betters all provisions of MIL-R6106. It is recommended for applications wherever a 10-in. driver is required.

What makes GOOD Miniature Motor Design?

AMERICAN ELECTRIC'S answer is the ultimate utilization of all available magnetic materials to convert electric input to maximum power output! This is possible not only by proper choice of material and precision craftsmanship, but by individually designing the laminations for the conditions of operation and the specific job to be done! As a result, AMERICAN ELECTRIC has now developed tooling for almost any conceivable miniature requirement in both production and prototype models.

AMERICAN ELECTRIC Miniatures are noted for their high power-to-weight ratio, furnish compact means for driving airborne and ground equipment, such as cams, clutches, timing devices, antennas, actuators, optical equipment, fans, blowers, recording devices, etc.

Quiet, light in weight, extremely rugged and reliable. Specify AMERICAN ELECTRIC! Recommendations gladly given. Write, wire or phone requirement details.

TWO MINIATURE DRIVE MOTOR TYPES

Available for 60, 400 or 2000 c.p.s. operation, and variable frequencies from 320 to 1200 c.p.s. single or polyphase.

Induction Motors—Output torque range: 1/16 in. oz. to 12 in. oz.

Synchronous Motors—Output torque range: .01 in. oz. to 10 in. oz. in both Hysteresis and Reluctance types.

TWO MINIATURE COOLING TYPES

Centrifugal Blowers

Propeller Fans
Precision molded products with exacting tolerances in precious and non-precious solid metals of all alloys. All types of Thermo-Plastic and Thermo-Setting materials.

Slip Ring Assemblies fabricated or one-piece precision molded to your specifications in Nylon, Kel-F, Mineral filled Melamine, Phenolic, and other materials. Rings and leads spot welded or brazed together for positive electrical circuit.

Our Swiss methods and techniques are geared to meet exacting requirements. We invite your inquiries.

COLLECTRON CORPORATION
Murray Hill 2-8473 • 216 East 45th Street • New York 17, N.Y.

ELECTTRAN

Specialists in SMALL quantities of custom built transformers from milliwatts to 50 KVA, single or polyphase—designed and manufactured to best meet your exact requirements.

Each Electron Transformer is built to the highest standards of quality and precision. There is no "second" grade at Electron.

ELECTTRAN MFG. CO.
1901 CLYBOURN AVENUE • CHICAGO 14, ILLINOIS

A NEW RACK-MOUNTING 5" BASIC SCOPE

A new 5" rack mounted basic oscilloscope of high quality parts and design.

- Push-Pull input with blocking post.
- Patented power transformer.
- 2,100 volt anode supply for short, medium and long persistence screens.
- Astigmatism control on panel.
- ½" baffle safety glass and grating.
- Flanged bezel for scope cement.
- Mu metal C.R. tube shield.
- Standard 8 ½" x 19" rack panel in black or grey enameled enameled.

All high quality parts and workmanship are used in this excellent indicating unit. Balanced input signal connections are at rear of C.R. tube with low capacity leads. Furnished with SUP7, SUP7 or SUP11 as requested. Available for immediate delivery.

Manufactured by
TINKER & RASOR
P.O. Box 281 San Gabriel, California

Now PL-4D21
POWER TETRODE

More about CAPABILITIES.
AVAILABLY IMMEDIATELY.
For details: Write:
PENTALABORATORIES INC.
216 North Milpas Street
SANTA BARBARA, CALIFORNIA

ELECTRONICS
April, 1953
Magnetic Amplifiers

KEystone Products Co., 904 Twenty-Third St., Union City, N. J., announces a series of five packaged magnetic amplifiers. In place of the conventional output transformer and power amplifier tubes, the Moto-Mag KP10-400 utilizes a phase-sensitive vacuum tube, demodulator and magnetic amplifier output stage that eliminates the need for rectifiers and assures greater reliability. It operates from an input voltage of 115 v. 400 cycles single phase; output is 10 w reversible phase. The KP10-400 operates from -55 to +70 C with minimum variation. The unit measures 4 in. high, 9½ in. wide and 2½ in. deep.

Accelerometer

G. M. Giannini & Co., Inc., 117 E. Colorado St., Pasadena 1, Calif., announces a new, long-life accelerometer designated as the 24182. Smallness and compactness are noteworthy features of this instrument that utilizes a potentiometer resistance and is hermetically sealed in an inert gas. It also features a low, natural frequency and a large output requiring no amplifying unit in most cases. The 24182 is obtainable in resistance ranges from 1,000 to 20,000 ohms and for any accelerometer measurement up to 50 g with special adaptations possible. The potentiometer element safely carries current up to 10 ma. Opti-

Illustration shows Honeywell Mercury Switch installations on two windows (upper and lower) for complete burglar alarm protection.

ADT finds Honeywell Mercury Switch ideal alarm protection when applied to tilted windows

- Electric protection services of the American District Telegraph Company include the use of a Honeywell Mercury Switch as part of the burglar alarm protection applied to horizontally pivoted windows of the fenestra or projected type. When the window is closed, the switch is in its normal or protected position. Opening of the window activates the mercury switch and causes the alarm to be transmitted to the ADT Central Station.

This use of the Honeywell Mercury Switches by ADT engineers is typical of the many uses for these versatile switches where tilt motion and low operating force are provided. Often the proper tilt motion can be developed and MICRO field engineers, experienced in switch application problems, are at your service to review your requirements as to mounting, actuating linkages, lead supports, terminal blocks and enclosures.

There are more than 125 designs of Honeywell Mercury Switches from which to select the exact characteristics your application may require. Write for a catalog or contact your nearest MICRO branch office for complete information and engineering assistance.
NEW PRODUCTS (continued)

imum operation between -54 and +71°C is obtained. Damping is 0.5 ±0.075 of critical for a 7.5 g instrument as a typical case.

Heavy-Duty Line Switch

Stackpole Carbon Co., St. Marys, Pa. Designed primarily for handling high currents at low voltages as in auto radio, TV and similar uses, the type A-12 dpst line switch is rated 12 amperes at 12 V d-c. Only ½ in. in diameter and ⅞ in. deep exclusive of terminals, it is designed for attachment to types LR and LP and other standard volume controls. Terminals are hot tin dipped for easy soldering. They are doubly locked in position by means of both ears and rivets. Heavy wires can thus be attached to the terminals without danger of loosening them. The design of the switch avoids the possibility of solder and flux flowing to the contact and impairing performance.

I-F Transformer

The Plessey Co. Ltd., Ilford, Essex, England. The new E/19 i-f transformer is an all-purpose unit developed to meet the requirements of modern miniature tubes and receivers. Permeability tuned in the normal manner, this transformer has a Q factor of 85 and an overall bandwidth for two stages of 7.7 kc at 6 db, and 15.4 kc at 20 db. An improved method of core positioning, which utilizes a new high viscosity, chemically stable, packing compound between core threads and bobbin, allows the core to be ad-
justed over a substantially wider temperature range than hitherto.

Special Purpose Motors
BIL JACK SCIENTIFIC INSTRUMENT Co., Solana Beach, Calif. This new series of special purpose d-c and a-c motors for velocity servo, position servo and actuator applications is based upon improved lamination design. The motors are available in ratings from 1/100 to 1 horsepower with clutch, brakes and control tachometer.

High-Speed Capacitor
HAMMARLUND MFG. CO., INC., 460 W. 34th St., New York 1, N.Y., has announced a butterfly-type variable capacitor capable of continuous operation at speeds as high as 3,200 rpm. The capacitor, designed for sweep circuits and other applications requiring alternating capacitance values, eliminates rotor contact springs and uses commercial ball bearings in addition to a novel alignment and end-thrust take-up device. Soldered brass rotor and stator assemblies, nickel or cadmium plated are used. Units are available with series effective capacitance values ranging from 5.4 to 17.0 μF nominal. Air gap between

NEW PRODUCTS (continued)

FOR RAPID SERVO ANALYSIS

ONLY THE SERVOSCOPE

* is applicable to both AC carrier and DC servo systems.
* has a built-in low frequency sine wave generator for obtaining frequency response of DC servo systems
* has a built-in electronic sweep with no sweep potentiometer to wear out and require replacement.
* has a dynamic frequency control range of 200 to 1.

MORE and MORE aircraft companies, universities, process control manufacturers, government laboratories and others are adding the Servoscope to their list of required laboratory equipment. If you are designing, developing or producing servomechanisms or process controls, the Servoscope will save many hours of design and engineering time.

The Servoscope is available in two standard models — 1100A (.1 to 20 cps.), 1100B (.15 to 30 cps.) Custom modifications quoted on request.

For bulletin giving complete specifications:
write Dept. E-4.

SERVO CORPORATION OF AMERICA
2020 Jericho Turnpike, New Hyde Park, N.Y.
Fieldstone 7-2810

Want more information? Use post card on last page.
Contact arrangements up to and including DP DT 3 Amp at 28 volts D.C., or 100 Milliamperes at 150 volts D.C. resistive load.

Hermetically Sealed.

Required coil power as low as 20 milliwatts.

Coil resistance up to 15,000 ohms.

Weight, maximum 3.5 oz.

DUE TO ITS PERFECTLY COUNTER-BALANCED FEATURES THIS RELAY WILL WITHSTAND HIGH ACCELERATION, VIBRATION, SHOCK AND TUMBLING

Mass Production Requirements Invited

Detailed information on request.

PHAOSTRON COMPANY • 151 PASADENA AVE. • SOUTH PASADENA, CALIF.

SHOCKPROOF VACUUM TUBE RETAINERS

These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350°F. The insulated plate can readily be fastened or released by hand.

Available for envelope types T7, T8, MT3, T9, T12, ST12, T122D1, ST14, ST14, ST16, T5/2, T6/2, MT-IC, ST19, T14, ST128CT-9.

Manufacturers of Electronic Components

JAMES IPPOLITO & CO., INC.
401 CONCORD AVENUE.
BRONX 54, N.Y.

COMMUNICATIONS ENGINEERS
• Design
• Project

A limited number of experienced engineers required for responsible positions in engineering departments. Specific projects include commercial carrier and radio systems as well as military equipment.

These are permanent positions with an expanding company offering good working conditions and liberal pension and insurance plans. Salaries are commensurate with training and experience.

Ideal location 20 miles south of San Francisco.

LENKURT ELECTRIC CO., INC.
SAN CARLOS, CALIF.

INCREASED INSULATION BETTER CONNECTIONS

JONES BARRIER Terminal Strips

Leakage path is increased—direct shorts from frayed terminal wires prevented by bakelite barriers placed between terminals.

Binder head screws and terminals brass, nickel plated. Insulation, molded bakelite.

No. 3-4-0-4, W

Six series meet every requirement: No. 140, 5-40 screws; No. 141, 6-32 screws; No. 142, 8-32 screws; No. 150, 10-32 screws; No. 151, 12-32 screws; No. 152, 1/4-28 screws.

Catalog No. 18 lists complete line. Send for your copy.

HOWARD B. JONES DIVISION HOWARD B. JONES, INC.
TELEPHONE: 24-4100
WEBSITE: www.americanradiohistory.com
plates is 0.030 in. nominal. Outside dimensions of each silicone-treated steatite base is 1\(\frac{1}{4}\) \(\times\) 1\(\frac{3}{8}\) in.

Selectivity Converter

J. L. A. McLaughlin, P. O. Box 529, La Jolla, Calif., announces the development of a continuously variable straight-sided selectivity converter. The type MCL-50 Signal-Splitter is designed to provide jam-free bandwidths for every e-w or speech receiving condition. Its continuously variable filters provide bandwidths from 0.4 kc to 6.0 kc with 60-db cutoffs of from 500 to 600 cps. It can be used with any standard a-m receiver and requires a rack-panel space of only 3\(\frac{1}{4}\) in. It has self-contained power supply and audio amplifier with an output of 18 dbm across 600 ohms.

Picture Tube Brightener

C-B-C ELECTRONICS Co., INC., 1310 Cullowhill St., Philadelphia, Pa. The Picboost Pacemaker illustrated will restore brilliance to any size or type picture tube for periods up to several years. It can be installed within a few minutes, just by plugging in. No soldering is necessary, no 110-v a-c lines are used, and no adjustments are needed. Four models are available in this series. Models 1F and 2F restore new tube brightness to dim picture tubes in parallel and series circuits respectful.
from any point of view

You'll save with ARWKRIGHT

 Arkwright Tracing Cloths are made to help you do your best work more easily.
 Arkwright cloth saves time. There's never a pinhole, uneven yarn or other imperfection to slow you down.
 Arkwright cloth saves trouble. You can draw over erasures time and again and not have an ink line "feather".
 Arkwright cloth saves money. If needed, you can get clean, ghost-free reproduction from a drawing years after you make it—years after paper or inferior cloth would have turned brittle and opaque with age.
 Wouldn't you like to see for yourself why Arkwright Tracing Cloth is best?
 Write for samples to Arkwright Finishing Co., Industrial Trust Bldg., Providence, R. I.

ARKWRIGHT
Tracing Cloths
AMERICA'S STANDARD FOR OVER 30 YEARS

NEW PRODUCTS
(continued)

Models 3F and 4F relieve heater to cathode shorts only, in parallel and series circuits respectively.

Connector Guide Pin and Socket

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City, N. Y.
The polarizing guide pin and guide socket can now be provided on the series 20 miniature rectangular connector from 7 to 104 contacts. This screw-lock type of guide pin provides positive means of locking the plug and receptacle against vibration or accidental disconnection. It also provides a mechanical means of disconnecting the plug from the receptacle without prying or forcing, thus preventing unnecessary damage and providing a very positive connection.

Single Ear-Phone Unit

THE CANADIAN RENAVID CO. LTD.,
P. O. Box 1255 Ottawa, Ontario,

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Canada, has developed a new single earphone unit that offers important advantages in all cases where headsets are not required. It may instantaneously be placed about the ear where it hangs freely therefrom, its very light weight bringing no discomfort to the user. The unit's receiver is interchangeable and various impedances up to 15,000 ohms, frequency ranges and sensitivities can be provided as may be required. The sound is carried through a specially designed tube provided with a flexible mushroom-shaped tip that automatically closes the ear channel to any external noise and outside interference. Other advantages include abolition of the head band, only one hand being required to place the unit on the ear, ease of interchangeability of the unit between users and robustness against rough handling.

Timing Motor
A. W. Haydon Co., Waterbury, Conn., has developed a practical 400-cycle synchronous a-c timing motor for use where light weight, accuracy and dependability are required. It was developed as a result of increased use of 400-cycle power in the expanding field of guided missiles, as well as the aircraft industry. The motor features almost instantaneous starting and stopping. Use of an spdt switch accomplishes effective reversing. One winding 90 deg out of phase assures rapid starting, smooth operating and absolute ease of reversal. The timing motor operates on 115 v ±10.0 percent with frequency of 400 cps ±20.0 percent. The torque

QUALITY • QUANTITY • QUICKLY
ALWAYS SPECIFY

DAGE

RADIO FREQUENCY CONNECTORS

To be sure your RF connectors are right, specify DAGE. Dage RF connectors are expertly designed, carefully made. Each part and each completed connector is thoroughly checked, carefully shipped—further assurance that your order placed with Dage receives the attention it deserves. Dage offers versatility to your demands for superior RF connectors; any standard or special connector can be quickly produced at Dage.

When you write your next specification, remember Dage—makers of the finest Radio Frequency Connectors.

DAGE ELECTRIC COMPANY, INC., 67 NORTH SECOND STREET, BEECH GROVE, IND.
HEILAND Series "700" Oscillograph Recorders have been designed and developed to enable the testing engineer and scientist to solve the wide variety of industrial and laboratory problems involving the measurement of physical phenomena such as strains, stresses, vibrations, pressures, temperatures, accelerations, impact, etc. Accurate and dependable oscillograph records permit the study of various recorded data comparatively, individually and collectively making for better product design and performance.

HEILAND Series "700" Oscillograph Recorders are being widely used today for the analysis of static and dynamic strains, vibrations, etc. in aircraft and guided missile flight testing; structural tests; performance tests; riding quality evaluation; voltage and current measurements; medical research; general industrial problem analysis.

Other "700" models up to 60 channels are available. Write today for a complete catalog of Heiland "700" oscillograph recorders.

The Heiland Research Corporation
130 East Fifth Avenue, Denver 9, Colorado

NEW PRODUCTS (continued)

in 0.025 oz-in. at 3,000 rpm starting and running. The motor operates with a power input of 6 w, including the phase shift network (4.5 w motor winding). It meets the temperature, altitude and vibration requirements of MIL-F-5272.

High-Temperature Insulation
SUN CHEMICAL CORP., Electro-Technical Products Div., Nutley 10, N. J., has announced two new products that meet all class H requirements and offer design economies at higher temperatures. The Sil-Thin-Glas 0.002 and 0.003 and Sil-Thin-Bestos 0.003 to 0.0035 possess exceptional dielectric and tensile strength. Their thinness, flexibility and light weight permit compact construction, and size and weight reduction of electronic and electrical equipment. Available in rolls, sheet or tape form, they are especially recommended for coil and relay insulation, layer and barrier insulation for transformers, and coil wrappings for fields and stators.

Molded Coil
DELUXE COILS, INC., First and Webster Sta., Wabash, Ind., has developed a molded waterproof type of electrical coil winding for intense moisture conditions, and explosion proof applications. The coils are enclosed in Luxolene Green molding resin which allows operating temperatures continuously of 90 to 250 F. The core tube is made of the same resin or exterior casting making the complete coating one homogeneous mass. Lead wires are of the 105C UL approved polyvinyl-chloride type and a bond is achieved between the resin and lead.
Use WEST - CAP miniature CAPACITORS to meet exacting requirements

Hermetically sealed in metal case

Check these important features:
- Positive hermetic sealing
- Small physical size
- Tab or ext, foil construction
- Grounded or insulated sections
- Designed and built to meet most exacting requirements for:
  1. Mechanical
  2. Electrical
  3. Temperature
  4. Humidity

Send for complete catalog and specifications

SAN FERNANDO
ELECTRIC MFG. CO.
Box 952
12900 Foothill Blvd., San Fernando, Calif.
Phone EEmpire 1-9683
Office: WASHINGTON, D.C., CHICAGO, DETROIT, N. Y.

GEARED FOR FAST DELIVERY

ELECTRONICALLY REGULATED
LABORATORY POWER SUPPLIES

BENCH MODEL 25

* STABLE * DEPENDABLE * MODERATELY PRICED *

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 Volts DC at 100 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 3A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

For complete information write for Bulletin E

LAMBDA ELECTRONICS
CORPORATION
NEW YORK

MIL-B-333A
JOINT ARMY-NAVY SPECIFICATIONS

SPARE AND REPAIR
PARTS BOXES

Manufactured to meet material, workmanship and finish requirements of Army-Navy specifications.

Accessories: Internal framing, partitions, trays and wood chucks as required.

Complete Facilities under one roof for quality mass production, including Helarc welding, baking and finishing. Whistler and Wiedermann equipment for short runs. Tool and die engineering and designing. Completely conveyorized finishing facilities. Large assortment of stock and special dies for radio and television and electronic field.

Write for Catalog and Price List.

ART-LLOYD
Metal Products Corp.
2973 Cropsey Ave., Brooklyn 14, N. Y. • CO 6-5100

PRECISION SHEET METAL PRODUCTS, MASS PRODUCTION SPECIALISTS.
The Secret is in the CORE!

Hidden in the heart of your product is the little component that means the big difference between robust, responsive performance and mere adequacy . . . between long life expectancy and premature failure. Give your product the core it needs to deliver its full performance potential. Specify a Moldite core specifically designed and precision-made for your equipment.

MAGNETIC IRON CORES • FILTER CORES
MOLDED COIL FORMS • THREADED CORES
SLEEVE CORES • CUP CORES

FULL PERFORMANCE POTENTIAL FOR YOUR EQUIPMENT
WITH CORES BY

NATIONAL MOLDITE COMPANY
1410 CHESTNUT AVE., HILLSIDE S. N. J.

Samples promptly submitted upon request for design, pre-production, and test purposes
SEND FOR CATALOG 110

NEW PRODUCTS (continued)

wire. Production shipments of coils are all tested in water for 24 hours. Each shipment is certified that after 24-hour immersion with 500 v d-c applied, the leakage resistance through water to ground has been found in excess of 200 megohms.

Relay Rack

INSULINE CORP. OF AMERICA, 36-02 35th Ave., Long Island City 1, N. Y., has brought out an open-face relay rack designed to take standard 19-in. panels. Sturdily made of 1/4-in. steel, it measures 38½ in. high, 20 in. wide and 18½ in. deep, weighs 39 lb and has 36½ in. of vertical panel space. Catalog No. 3913 rack is intended for radio transmitters and transmitter-receiver combinations, p-a amplifiers and distribution systems, tape or wire recorders, laboratory or service shop test equipment, and similar electronic applications.

Voltage-Regulated Power Supplies

KEPCO LABORATORIES, 131-38 Sanford Ave., Flushing, N. Y. Model 750 voltage-regulated power supply features one regulated d-c voltage supply with excellent regulation, low ripple content and low output impedance. The h-v supply is continuously variable from 0 to 600 v and delivers from 0 to 750 ma. In the 30 to 600-v range the output voltage variation is less than 0.5 percent for both line fluctuations from 105 to 125 v and load variation from minimum to maximum current. The ripple voltage is less than 10 mv peak to peak. Cabinet height is 28 in., width, 21½ in., and depth, 16 in. Also available are the
STURTEVANT
TORQUE TESTING
FIXTURE

FOR TESTING: Screws, thread-cutting and thread-forming screws— all types of threaded fasteners; threaded parts and threaded connections.

FOR MANUFACTURERS, DESIGNERS, TOOL ENGINEERS, LABORATORIES and for PRODUCT CONTROL in assembly.

Write for Bulletin No.

VERSATILE

Multi-channel -- telegraph, A1 or telephone A1.

STABLE
High stability (0.003%) under normal operating conditions.

RUGGED
Components conservatively rated. Completely tropicalized.

Model 156 transmitter operates on 7 crystal-controlled frequencies plus a 2 slowly swept frequency in the band 2.5-240 Mc (1.6-2.5 Mc available). Operates on one frequency at a time, channeling time 2 seconds. Carrier power 350 watts; 41 or 45 AM. Stability 0.003% using Cr7: Cr3: Cr2: Cr1 crystals. Operates in ambient 0° to +45° C using mercury rectifiers. -35° to +15° C using gas-filled rectifiers. Power supply: 200-250 volts, 50/60 cycles, single phase. Consistently made and sturdy constructed. Complete technical data on request.

Fine WIRE

In line with our specialization in wire for new applications, we produce wires of composition suitable for the manufacture of Transistors, including Gallium Gold and Antimony Gold. These alloys have been made to fill a specific need arising from new developments in this field. Other wires we make regularly for similar application are Phosphor Bronze, bare or electroplated, and Platinum Alloys produced to meet rigid specifications of tensile strength, size and straightness.

Write for latest list of products.

SIGMUND COHN CORP. 121 So. Columbus Avenue • Mount Vernon, N.Y.

Want more information? Use postcard on last page.

ELECTRONICS — April, 1953
Everything that goes into the making of DYNAPRENE Flexible Cord is checked and tested for quality. Whitney Blake is proud of the reputation for long life and hard service that DYNAPRENE has earned. You can be sure that this good reputation will be carefully safeguarded.

Only by using flexible cord of the finest quality can a manufacturer be sure that his electrical products will give completely satisfactory performance. It was to meet manufacturers' demands for a better flexible cord that the rugged neoprene compound used for DYNAPRENE jackets was developed. DYNAPRENE is tough and long lasting, it is extra flexible and unusually resistant to those substances and conditions that play havoc with rubber-jacketed cords. Safeguard your product's performance by specifying Whitney Blake DYNAPRENE SO, SJO and SV-neoprene-jacketed type on your next requisition.

Gear Train Kit
Bowman Instrument Corp., Smith Municipal Airport, Fort Wayne, Ind., has added to its product line a new universal precision gear train kit. The new kit features standard ratios from 20 to 1 to 1,250 to 1, with special ratios up to 15,000 to 1 available where required. All ratios are obtained in the same basic gear housing simply by changing gear clusters according to instructions provided. The unit is designed for servo breadboarding and general laboratory use. Combination data are printed on the inside of the box cover for easy reference.

Flexible Coil Forms
Precision Paper Tube Co., 2035 W. Charleston St., Chicago 47, Ill., has announced the Flexiform coil forms with special flexible flanges that completely eliminate taping operations on motor-field coils. This is a highly important factor in speeding up assembly lines, especially where mass production techniques are desirable. Since automatic equipment is used in the
ELECTRIC HEATING UNITS

Ring Heaters
The same standard construction as Vulcan cartridge and strip heaters. Coil is of highest grade resistance wire and is insulated and supported in refractory materials of proven quality. Easily installed by clamping against the surface of hot plates, pots, defrosters, vulcanizers, molds, jets, water heaters, etc.

Rust resisting sheath for temperatures to 750° F.
Stainless steel sheath for temperatures to 1200° F.
6 standard sizes. Special sizes available.

ELECTRIC COMPANY
DANVERS 10, MASS

VULCAN

WHAT CLAMP TO USE WHERE TOLERANCES ARE LARGE

AUGAT'S NEW TWO TENSION LOOP CLAMPS

Augat two-tension loop clamps are the long-sought answer for uses where socket tolerances vary up to .040. The bands of these sturdy clamps are made of Beryllium copper, heat treated to retain original tension and nickel plated to withstand a 96 hour salt spray test with no adverse effect.

The remaining parts of Augat's two-tension loop clamps are made of 18% nickel silver.

Write today for catalog and samples.

AUGAT BROS. INC.
31 PERRY AVENUE • ATTLEBORO, MASS.

PRIMAR Y BATTERIES
for your Specialized Needs

DRY TYPES

78 Standard Industrial, Laboratory and Government Types.

LAB-BILT BATTERIES

Our engineers will design and create to your requirements. Send us your specifications.

RESERVE TYPES

Water activated "One Shot" Batteries.

HI-DRIVE MINIATURE MOTOR

Precision-built, low-cost, battery-operated—available for delivery now.

Send for FREE Catalogs

SPECIALTY BATTERY COMPANY
A Subsidiary of the Ray-O-Vac Ray-O-Vac Company
MADISON 10, WISCONSIN

WHAT CLAMP TO USE WHERE TOLERANCES ARE LARGE

AUGAT'S NEW TWO TENSION LOOP CLAMPS

Augat two-tension loop clamps are the long-sought answer for uses where socket tolerances vary up to .040. The bands of these sturdy clamps are made of Beryllium copper, heat treated to retain original tension and nickel plated to withstand a 96 hour salt spray test with no adverse effect.

The remaining parts of Augat's two-tension loop clamps are made of 18% nickel silver.

Write today for catalog and samples.

AUGAT BROS. INC.
31 PERRY AVENUE • ATTLEBORO, MASS.

PRIMAR Y BATTERIES
for your Specialized Needs

DRY TYPES

78 Standard Industrial, Laboratory and Government Types.

LAB-BILT BATTERIES

Our engineers will design and create to your requirements. Send us your specifications.

RESERVE TYPES

Water activated "One Shot" Batteries.

HI-DRIVE MINIATURE MOTOR

Precision-built, low-cost, battery-operated—available for delivery now.

Send for FREE Catalogs

SPECIALTY BATTERY COMPANY
A Subsidiary of the Ray-O-Vac Ray-O-Vac Company
MADISON 10, WISCONSIN
NOW
a direct-reading
0-42 megacycle
FREQUENCY
METER
the Berkeley Model 5570

description

Model 5570 is a single, compact instrument for rapid, precise measurement of frequencies from 0 cps to 42 mc. Basic sections are (1) a high-speed events-per-unit-time meter (EPUT), and (2) a heterodyne unit. Frequencies of 2 mc and below are applied directly to the heterodyne unit and selector knob turned until an output meter indicates the proper harmonic has been selected. External adjustment of crystal control unit to WWV is provided, to obtain an accuracy of 1 part in 107, ± 1 count.

applications

Rapid, accurate transmitter monitoring, crystal checking, general laboratory and production line frequency determination. Addition of a Berkeley Digital Recorder will provide an automatic printed record of the last 6 digits, ideal for plotting frequency drift or indicating stability.

specifications

<table>
<thead>
<tr>
<th>RANGE</th>
<th>0 cycle to 42 megacycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACURACY</td>
<td>±1 count, ± crystal accuracy (short term: 1 part in 10⁶)</td>
</tr>
<tr>
<td>POWER REQUIREMENTS</td>
<td>117 volts, ±10%, 60 cps, 260 Watts</td>
</tr>
<tr>
<td>INPUT REQUIREMENTS</td>
<td>Approximately 1 volt rms. (50 ohm impedance)</td>
</tr>
<tr>
<td>DISPLAY TIME</td>
<td>1 to 5 seconds continuously variable</td>
</tr>
<tr>
<td>TIME BASE</td>
<td>0.00002, 0.0002, 0.002, 0.02, 0.2 and 2 seconds</td>
</tr>
<tr>
<td>DIMENSIONS</td>
<td>Approximately 32&quot; high x 21&quot; wide x 16&quot; deep</td>
</tr>
<tr>
<td>PANELS</td>
<td>Two 8½&quot; x 19&quot;; one 12½&quot; x 19&quot;</td>
</tr>
<tr>
<td>ACCESSORIES</td>
<td>Available soon to extend range to 100 mc.</td>
</tr>
<tr>
<td>PRICE</td>
<td>$1990.00, F.O.B. Richmond, California</td>
</tr>
</tbody>
</table>

Prices and Specifications subject to change without notice.

Berkeley Scientific
division of BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

NEW PRODUCTS

(continued)

making of Flexiform bobbins, they can be readily supplied in shapes and sizes as specified at an economical price. Flanges are flexible rope paper and are fastened to the core by an exclusive process that eliminates swaging. Dielectric kraft paper is used for the core.

Microwave Equipment

WESTINGHOUSE ELECTRIC CORP.,
P. O. Box 2099, Pittsburgh 30, Pa.

A new 2,000-mc microwave system that utilizes microwave radio (type FR) and frequency-division multiplex equipment (type FJ) is available. The microwave carrier is divided into 30 voice channels or equivalent telegraphic functions (15 per voice channel) by the type FJ multiplexing equipment. The multiplexing equipment was designed specifically for use with the microwave equipment and provides maximum flexibility of arranging various combinations of services on the channels. The basic units of the type FR microwave radio equipment are the same for both terminal and repeater station assemblies. Either type of assembly requires a single fixed rack or cabinet, and each is readily changeable from one type of operation to the other to facilitate system expansion.

Insulated Test Clips

INDUSTRIAL DEVICES, INC., Edgewater, N. J. Model 1410A test clips feature a plastic insulation that covers the entire clip, including the nose, without the bulkiness of rubber boots or insulating tape. They can be used in pairs as a
**LAMINATED PHENOLIC**

- LABEL PLATES
- DISCS
- PANELS
- STRIPS

Fabricated to specifications
Ask for price list.

**HERMES Plastics, Inc.**
13-19 University Pl. • N.Y. 3, N.Y.

---

**OLYMPIC METAL PRODUCTS COMPANY, INC.**
P. O. BOX 71A
PHILLIPSBURG, N. J.

---

**HERMES Plastics, Inc.**
13-19 University Pl. • N.Y. 3, N.Y.

---

**STERLING TRANSFORMER CORP.**
297 North 7th St., Brooklyn 11, N. Y.

---

*We solicit only samples and short run production*

**A NAME YOU CAN RELY ON FOR**

**TRANSFORMERS**

- Pulse
- Audio
- Power
- Filter Choke
- Filament
- RF Coils

Custom Built to your Specifications

---

**“INDUSTRIAL”**

for

**ELECTRONIC COMPONENTS**

Precision engineered electronic components and connecting devices for all your needs.

- LAMINATED TUBE SOCKETS
- TERMINAL STRIPS
- WIRED ASSEMBLIES
- METAL or BAKELITE STAMPINGS
- TERMINAL BOARD ASSEMBLIES
- SCREW MACHINE PARTS
- NEW ITEMS
- TUNER STRIPS, SOCKETS and BRACKETS for UHF

---

**INDUSTRIAL HARDWARE Mfg. Co., Inc.**
109 PRINCE STREET • NEW YORK 12, N. Y.
MISSION: To eliminate the needless waste of manpower, machines, and technical skill in the modification of servo components.

In applying servo systems to their operations, many engineers are restricted by "stock" components. They either sacrifice efficiency by building systems around the components available, or waste manpower, machines, and skill in modifying units to make them usable.

It is the mission of the Transicoil Corporation to provide precision components for each particular servo application ... ready for immediate application ... with all the accuracy and efficiency for which they are designed.

REFERENCE: Technical catalog "Precision Components" available upon request.

source of power for equipment under test without the danger of a short circuit due to the clips touching each other or other components. In use on test equipment leads, the clips may be changed from one connection to another without cutting off the power in the equipment. A highly-efficient nylon insulation conforms to the shape of the metal clips thus allowing the same degree of flexibility and easy handling as bare metal clips. A nylon sleeve is threaded to the clip for easy connection to leads. Terminals are provided for either a soldered or screw terminal connection. Strain relief is provided by means of usual wire clamps.

Literature

Product Catalog. Phalo Plastics Corp., 25 Foster St., Worcester 8, Mass., has available a 46-page booklet that features easy reference indexing of all the company's major product groups. It shows the company's important strides in the manufacture of insulated wire and cables and cord set assemblies for electronics, electrical manufacturing, radio, television, communications and industrial applications.

Photoelectric Densitometer. Photovolt Corp., 95 Madison Ave., New York 16, N. Y. Bulletin No. 800 announces the model 525 photoelectric densitometer for chromatography. The instrument described and illustrated is designed for the evaluation of filter paper strips and sheets as obtained by partition chromatography and paper electrophoresis. Included are a reference list and a page showing prices for the complete line.

Paste Solder. Fusion Engineering, 4504 Superior Ave., Cleveland 3, Ohio. Bulletin TE-100 describes Electro-Tin, a new material designed to cut out costs, save time and increase production wherever soldering and dip tinning are used. Electro-Tin finds wide application in all fields of assembly and wiring where soft solders are used. The material described is a combination...
ANTENNA MULTICOUPLER

Operates 10 Receivers from One Antenna

- Antenna Impedance 50-1000 ohms
- Frequency Range 2-20 Mc
- Rack Mounting
- Used and Approved by many Government Agencies
- $308.00 FOB Washington, D.C.

SCHUTTG and CO. INCORPORATED
9th and Kearny St., N.E.
Washington 17, D.C.

S178A

WESGO ALUMINA CERAMIC INSULATORS

- High purity . . . free of all impurities such as Iron, Titanic, Alkali group elements.
- Made to various formulations with Alumina content from 94% to a pure sintered Alumina with 99.85% minimum Al2O3.
- Available in porosities ranging from 20% to an impervious, vacuum tight body.
- Formed to dimensional tolerances of plus or minus 1/2 %, minimum of plus or minus .001".
- Completely homogeneous structure.

WESTERN GOLD & PLATINUM WORKS
Ceramic Division
589 BRYANT ST., SAN FRANCISCO, CALIF.

Over 85% of the torque wrenches used in industry are

Sturtevant TORQUE WRENCHES
Read by Sight, Sound or Feel.
- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

in inch ounces . . . inch pounds . . . foot pounds
(All Sizes from 0-6000 ft. lbs.)

DX Announces
a NEW 90° YOKE for 27" TUBES

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

It's Engineered for
TOP PERFORMANCE
... in Production NOW!

This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

DX COMPONENTS
"The heart of a good television receiver"

ELECTRONICS — April, 1953

Want more information? Use post card on last page.

373
Hammarlund Separate Transmitters and Receivers Offer Maximum Design Flexibility!

Two independent operations for signaling, dialing, slow speed telemetering, or supervisory control may be transmitted in one direction by one Dual Transmitter Unit (DTU-1) and one Dual Receiver Unit (DRU-1) now available.

These units were designed for operation over wire lines, telephone or power line carrier and radio or microwave communications circuits, and incorporate the same proven basic features as the Hammarlund Duplex Signaling Unit, except that operations may be carried on in one direction only. Each unit includes its own power supply.

The DTU-1 incorporates a pair of transmitters consisting of a stable tone generator and an amplifier designed to bridge across a 600-ohm circuit, all mounted on a 3½ inch standard relay rack panel. Harmonic distortion is negligible, frequency stability is excellent and a total of 36 frequency channels are available between 2000 and 6475 cycles.

The DRU-1 incorporates a pair of receivers consisting of two stages of amplification, a signal rectifier, relay tube and relay, and a sharply selective band pass filter unit, all mounted on a 5½ inch standard relay rack panel.

Either a continuous or a keyed tone may be used. The units may be installed in multiple and with Hammarlund 2-way signaling units (DSU-2’s) as individual installations require.

Write for Bulletin 113 for detailed information.

NEW PRODUCTS (continued)

of newly developed organic, fast-acting fluxing agents in which is dispersed finely divided metal tinning agents. The combination of the two makes possible soldering under difficult conditions, using nonacid, neutral materials superior to ordinary rosin, and yet possessing characteristics of strongly active acid fluxes.

Potentiometers. Helipot Corp., South Pasadena, Calif. Bulletin No. 128 on the new AJ series potentiometers was recently issued. It contains general features of the AJ, AJS and AJSP models, as well as drawings, specifications and special features of all three models.

Demineralizer. Penfield Mfg. Co., Inc., 19 High School Ave., Meriden, Conn. The purity of the water used in compounding coating solutions and preparing te tubes, infrared and fluorescent lamps often is a real problem to manufacturers of such products. The demineralizers described and illustrated in technical bulletin 023 offer a completely automatic method of producing the extremely high purity water required for both washing molded glass and preparing coating solutions—at a fraction of the cost of distilled water.

Magnetic Tape for Instrumentation. Audio & Video Products Corp., 730 Fifth Ave., New York, N. Y. A single-sheet bulletin announces the type 109 Scotch brand data recording tape developed by the Minnesota Mining and Mfg. Co., for data recording, telemetering, shock and vibration measurements, geophysical applications, computer work and industrial research. The tape described, factory tested and preselected for minimum count of nodule or surface imperfections, is shipped in hermetically-sealed containers and comes in 1/8-in., 1/4-in., 3/8-in., and 1-in. lengths up to 4,800 ft in length.

New Reproducer. Jensen Mfg. Co., 6601 Laramie, Chicago, Ill. Technical bulletin No. 4 describes four-channel high-fidelity system. It gives constructional information for the Transflex bass reflex trans-
**HALF KILOWATT REGULATED POWER SUPPLY**

*Continuously Adjustable*

These Furst Power Supplies are designed for laboratory, production line test stations and other applications requiring 500 watts of closely regulated power.

Electronic regulation provides a constant DC voltage independent of line and load variations within wide limits.

Two models are available with continuously adjustable outputs without switching:

- **Model 1110** Up to 1000 Volts at 500 milliamperes
- **Model 1110A** Up to 1500 Volts at 330 milliamperes

Write for complete specifications of these and other Furst Regulated Power Supplies. We will also design power supplies to fit your exact requirements.

**FURST ELECTRONICS**

3322 W. Lawrence Ave., Chicago 25, Illinois

---

**ELECTRON TUBE TECHNICIANS**

We now have several openings for technicians to work in the fabrication and processing of advanced type electron tube research models.

To qualify for one of these openings you should be experienced in experimental work for research and development in vacuum tubes, which includes the fields of mechanics, electronics, chemistry and high-vacuum techniques.

**DOELCAM**

**FREQUENCY RESPONSE ANALYZER**

Type BA-100 shown here includes:

- Servo-controlled mechanical oscillator operating at frequencies from 1 to 80 cps.
- Electronic analyzer providing direct readings of input frequency, amplification and phase shift.

The Type BA-100 Frequency Response Analyzer is one of the many special types of laboratory test equipment developed by Doelcam for evaluating the characteristics of instruments and control systems. Your inquiry is invited.

**DOELCAM CORPORATION**

SOLDIERS FIELD ROAD, BOSTON 35, MASS.

Instruments for Measurement and Control

- Gyroscopic Instrumentation
- Synchros
- Servomechanisms
- Microsyns
- Electronic Inverters

Mechanical Oscillator

Electronic Analyzer
RAYDIST ultra-sensitive electronic tracking systems 

demand optimum precision

Above—RAYDIST automatic plotting board for continuous plotting and recording of exact location of aircraft or ships.

Below—RAYDIST mobile electronic tracking system, a precision lab on wheels.

that's why they use

CHICAGO TRANSFORMERS

the World's Toughest

HASTINGS Instrument Company, Inc., of Hampton, Virginia, designs and builds RAYDIST—an amazingly sensitive and accurate electronic radio location system. RAYDIST systems are available for air and marine navigation tracking, for marine geophysical surveying, chart making, ship speed trials, hydrography, meteorological studies—for a host of applications requiring infinitely accurate tracking and plotting. Because RAYDIST precision performance is strongly dependent upon the quality of the components used in the systems, HASTINGS specifies and uses CHICAGO MIL-T-27 Sealed-in-Steel Transformers. Wherever optimum precision and absolute dependability are requirements, you'll find CHICAGO—the world's toughest transformers.

Free "New Equipment" Catalog

You'll want the full details on CHICAGO'S New Equipment Line, covering the complete range of "Sealed-in-Steel" transformers for every modern circuit application. Write for your free copy of Catalog CT-123 today, or get it from your electronic parts distributor.

Export Sales Div.: Schoell International, Inc., 4237 N. Lincoln Ave., Chicago, Ill., U.S.A.

CABLE ADDRESS: HARSHEEL

NEW PRODUCTS (continued)

mission line unit and associated 45-cycle crossover network for the frequency range adjacent to the lower limits of audibility. The unit described is a unique arrangement quite compact in terms of the wavelengths involved.

Coax Components and Test Equipment. Microlab, 301 S. Ridgewood Rd., South Orange, N. J. Catalog No. 4 gives an 8-page treatment of a line of coaxial components and test equipment. Included among the items illustrated and technically described are fixed pad attenuators, low-pass filters, coaxial terminations, power-line filters and frequency multipliers. A price list has been inserted.

Miniature Snap Switch. Tyniswitch Division, The Sessions Clock Co., Forestville, Conn. A 6-page bulletin on the construction and operational characteristics of Tyniswitch has just been published. A low-cost, high-rating miniature switch, the specifications and standard adaptations of Tyniswitch are fully described and detailed.

Screw Locking Insert. Brush Nail Expansion Bolt Co., Greenwich, Conn. A recent four-page folder describes and illustrates the knurled insert, a screw locking insert that is distinguished by a large band of diamond knurling on its grip area. Its three-stage principle of operation is shown. Recommended hole sizes and ordering information are included.

Silicone Rubber O-Rings. Bacon Industries, Inc., 192 Pleasant St., Watertown, Mass. Technical data sheet No. 103 provides detailed specifications of silicone rubber O-rings. A feature of the O-rings, as pointed out in the literature, is the special manufacturing method used which makes allowance for the shrinkage factor encountered with silicone rubber and therefore assures O-rings which have the exact dimensions specified. The full information contained in the data sheet on the dimensions of both regular and special sizes and a detailed table of tensile strength, hardness, compressibility and other features, provide the reader with a
High Sensitivity . . Logarithmic AC VOLTMETER
50 MICRO VolTS TO 500 VOLTS
MODEL 47 VOLTMETER

Self-Contained
All AC Operated Unit
An extremely sensitive amplifier type instrument that serves simultaneously as a voltmeter and high gain amplifier.

- Accuracy ±2% from 15 cycles to 30 kc.
- Input impedance 1 megohm plus 15 uuf. shunt capacity.
- Amplifier Gain 23000

Also MODEL 45 Wide Band Voltmeter
.005 to 500 Volts!
5 Cycles 1600 kc

A few of the many uses:
- Output indicator for microphones of all types.
- Low level phonograph pickups.
- Acceleration and other vibration measuring pickups.
- Sound level measurements.

Gain and frequency measurements for all types of audio equipment.
- Dimensional measurements in photography and film production.
- Light flux measurements in conjunction with photo cells.

Write for Complete Information
90 Main Street
Port Washington, N. Y.

Electronics Sales and Application Engineers
High-Frequency Heating, Microwave Communication, V.H.F. Communication, Power-Line Carrier and Military Communication and Radar Equipment

The expanding Electronics Division of Westinghouse has a number of desirable sales and application engineering positions open for men well qualified in one or more of the above fields. These openings require technical graduates with good personalities and business sense, men who like to meet people and work with them on a broad range of equipment application problems rather than specializing in a narrow field of design. Previous technical sales experience is desirable but not necessary.

Permanent positions are available at Headquarters (Baltimore) as well as in various sales offices throughout the country. The latter positions generally require training at Headquarters for a period depending on previous experience.

All these positions offer top pay, commensurate with ability and experience, with excellent opportunity for advancement on merit. They carry the usual generous employee benefits offered by Westinghouse—low-cost group life and hospitalization insurance, an excellent retirement plan, graduate study opportunities and paid vacations. Re-location allowances will be made by the Company.

Send resume of qualifications to:
Manager, Industrial Relations, Dept. CK
Westinghouse Electric Corporation
189 West Lombard St.
Baltimore 1, Md.
NEW PRODUCTS (continued)

For legible permanent marking of metal components use engraved lettering tools. Precision engraved dies and inserts for indented or embossing identification on your parts will

1. Improve appearance.
3. Facilitate reordering.

Write for free catalog on Production Marking Equipment.

Geo. T. Schmidt, Inc.

MARKING MACHINES • MARKING TOOLS
1804 Belle Plaine Ave., Chicago 13, Ill.

COMPLETE MACHINE FACILITIES TO PRODUCE
- Steel Type
- Hand Stamps
- Engraved Inserts for Dies
- Shank Style Stamping Dies
- Embossing Dies
- Code Stamps
- Numbering Heads
- Marking Machines
- Nameplate Marking Equipment


Instrument Transformers. General Electric Co., Schenectady 5, N. Y. The 1953 edition of the company's instrument transformer buyer's guide contains basic, up-to-date information on the complete line. The fully illustrated, 102-page publication, GEA-4626F, contains ratings, ASA accuracy classifications, and prices of all GE indoor and outdoor potential and current transformers. Listings of ratio and phase-angle tests, together with tables covering the mechanical and thermal limits of current transformers, are included.

Power Pentode. Lewis and Kaufman, Ltd., 50 El Rancho Ave., Los Gatos, Calif. A new technical data sheet for Los Gatos brand 4E27A power pentode illustrates the tube, provides dimensions, general electrical characteristics, and constant current characteristics under two modes of operation: 500 screen volts, zero suppressor volts; and 500 screen volts, 60 suppressor volts. Maximum ratings and typical operation data are given for: class-C r-f power amplifier and oscillator (class-C telegraphy, f-m telephony), class-B a-f power amplifier and modulator and class-C r-f plate-modulated amplifier.

Transformer Laminations. Allegheny Ludlum Steel Corp., 2020 Oliver Building, Pittsburgh 22, Pa., is presenting a greatly expanded description of laminations in the fifth edition of its transformer lamination catalog. Included are technical information and full-size drawings of all the available standard shapes. Each lamination is provided with a

Want more information? Use post card on last page.
RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 5 amperes DC,
2 milliamperes to 1 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO

RAWSON METERS

MULTIMETERS and REGULAR METERS
AC and DC types, high accuracy, multiple ranges.
2 milliamperes to 1 amperes DC,
2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS
Ranges 100-v. to 30,000-v. AC or DC.
Resistance exceeds millions of megohms.
Can measure static electricity.

FLUXMETERS
Laboratory and production measurement
on magnets and magnetic circuits.
Single push button return-to-zero.

ROTATING COIL GAUSSMETER
Our most recent development for
measuring magnetic field strengths.
Measures from a few gauss to 120 kilogausses.
Special apparatus built to order.

RAWSON ELECTRICAL INSTRUMENT COMPANY

1616 North Throop
Chicago

CHICAGO
CERAMIC COIL FORMS

National high-grade ceramic coil forms have been designed for a wide variety of communication and industrial applications. Types XR-13, XR-13A and XR-10A are primarily for use in transmitters, diathermy equipment, etc. The XR-60 and XR-70 series are permeability-tuned coil forms, conforming to JAN specifications, with either brass or iron slugs. Write for drawings and specifications.

COMPLETE LINE OF SOCKETS

There is a National socket for every popular tube type and every circuit application. All feature low-loss electrical characteristics, firm tube support and easy, secure mounting. They are recommended wherever the highest quality is required. Write for drawings and specifications.

Write for drawings
Research • Development • Engineering • Manufacturing

CUSTOM BUILT ELECTRONICS!

CDC are designers and engineers of Electronic Devices to fit your requirements.

- Digital and Analogue Computers
- Test and Measuring Equipment
- Servo Systems
- Instrumentation
- Engineering Consulting Service
- Product Engineering and Design
- Parts Machining and Assembly
- Instrument and Electronic Equipment Overhaul
- Field Maintenance of Electronic Computers
- Developments for Armed Forces

YOUR ENQUIRIES WILL RECEIVE PROMPT AND EFFICIENT ATTENTION

COMPUTING DEVICES of CANADA LIMITED

General Offices—338 Queen Street Laboratories—475 Cambridge Street, Ottawa, Ontario, Canada

MANUFACTURERS REPRESENTATIVE
(Metropolitan N. Y. C. Area)
SEEKS
AN ADDITIONAL LINE
(PREFERABLY COMPONENTS)

Presently covering both the radio-TV and military electronic industries in N. Y. C., Northern N. J. and Long Island.

RA-7248, Electronics
330 W. 42 St. • New York 36, N. Y.

The SW-12 Standing Wave Indicator is designed to measure the standing wave ratio within a waveguide or coaxial system used to transmit pulses of R.F. power. It can also be used as a null detector in bridge measurements. SW-12 can be used with both square law crystal detector or bolometer probes. The meter is calibrated directly in VSWR.

INPUTS: Input 1—R.F. probe with crystal rectifier
Input 2—R.F. probe with bolometer

FREQUENCY RESPONSE: Flat within 3 db from 500 to 2000 cps. Can be used down to 200 cps.
Sensitivity: 400-500 cps—20 microvolts full scale
500-2000 cps—15 microvolts full scale
2000-3500 cps—20 microvolts full scale

INPUT IMPEDANCE: 250 ohms nominal

OUTPUT METER CALIBRATION:
SWR scale from 1:1 to 4:1 Linear scale from 0 to 10
LINEARITY: 5% variation in linearity from 15% of full scale to full scale meter reading.

POWER REQUIREMENTS: 115 VAC single phase, 35 watts, 50-800 cps.

TUBE COMPLEMENT: 2-6SJ7 1-6H6 1-6V6GT 1-6X5GT

SPECIAL FEATURES: Shock resistant non-microphonic construction.

DIMENSIONS: Height 8½” Width 8½” Length 16½”

WEIGHT: 20 lbs.

CASE: Cabinet with side handles.
FINISH: Hammertone grey case and satin aluminum panel.
Aircraft fire detection apparatus needs that. Here is the Mycalex glass-bonded mica part that has it.

Mycalex 410 molded with steel ring inserts for thermocoupling device produced by Thomas A. Edison, Inc.

- For permanent endurance Mycalex can take 650°F. continuously without heat distortion or any other injury.

Mycalex is superior for high voltage, high frequency components that must operate in small spaces.

For example, tube sockets like these — now used in over 60% of all television receiver tuners. — Manufactured and sold by Mycalex Tube Socket Corporation, Clifton, N. J.

If your insulation must take heat or get rid of heat, investigate Mycalex!

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
General Offices and Plant
114 Clifton Boulevard, Clifton, N. J.

MYCALEX® THE INSULATOR®

MYCALEX CORPORATION of AMERICA

World's Largest Manufacturer of Glass-bonded Mica Products

Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.

General Offices and Plant

114 Clifton Boulevard, Clifton, N. J.

Now... get

ABSOLUTE D.C.

YOUR
ORDINARY
POWER SUPPLY

SUPER-REGULATOR

OUTPUT IMPEDANCE 0.005 OHMS
NOISE-RIPPLE UNDER 100 MICROVOLTS
STANDARD CELL STABILITY AVAILABLE

WRITE FOR BULLETIN K

KALBFELL LABORATORIES, INC.
1050 Morena Blvd., P. O. Box 1578
San Diego 10, California

DOUBLE BARREL ADVERTISING

Advertising men agree—to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige. Direct Mail supplements your Display Advertising. It pin-points your message right to the executive you want to reach — the person who buys or influences the purchases.

In view of present day difficulties in maintaining your own mailing lists, our efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

Ask for more detailed information today. You'll be surprised at the low overall cost and the tested effectiveness of these hand-picked selections.

130 West 42nd St., New York 36, N. Y.
ELECTRICAL INSULATION THAT CAN BE MADE TO THE SAME TOLERANCES AS STEEL

YES, we do mean any tolerances that can be produced in steel.

For example:

Two of these 14" Mycalex 400 discs revolve with only .004" clearance. Dimensionally stable, too. Mycalex stays accurate.

Chatter-Less Brush Holder

Plate Assembly for PA Timer

Spur Gear

Threaded Coil Form

Coaxial Bushing

Mycalex glass-bonded mica is found in HIGH PRECISION electrical components.

WRITE FOR ENGINEERING DATA BOOK

NEW PRODUCTS (continued)

operated on 110 v, 60 cycle a-c and consumes approximately 10 w. Prices are included.

Miniature Clutch. High Precision Inc., 375 Morse St., Hamden, Conn., has prepared a folder suggesting possible uses and giving specifications for a line of miniature over-running clutches, known as Mini-clutch. Typical applications of the units described are recording instruments and business machines, motion-picture projectors, ratchet-feeds, servomechanisms and control devices such as are used in gun-pointing equipment.

Terminal Boards. Aircraft Radio Corp., Boonton, N. J. A new 4-page brochure deals with ceramic insulated terminal boards developed for use in airborne receivers and transmitters and in signal generators and other industrial electronics equipment where reliable, long operation under extremes in temperature and moisture is important. The boards described are fungus proof and arc resistant. Comprehensive diagrams and photographs of the boards are featured as well as illustrations of typical applications.

Transistor Test Equipment. Transistor Products, Inc., Snow and Union Sts., Brighton Station, Boston 35, Mass. A single-sheet bulletin illustrates and describes the model T-61, a device designed to test the small signal behavior of all point contact and junction transistors. The theory of operation outlined shows the emitter current, collector current, emitter voltage, collector voltage and characteristics measurement ranges. The unit's accuracy is described and price is included.

Regulated H-V Power Supply. Scientific Specialties Corp., Snow and Union Sts., Brighton Station, Boston 35, Mass. A single-page bulletin illustrates and describes the PS-22 electronically regulated supply that is designed for use with photomultiplier tubes, counters, and other devices requiring a closely regulated well stabilized voltage. Output, regulation, input power and mounting information are given. Prices are included.

IS THERE ANYTHING WRONG WITH MYCALEX?

YES

It's inelastic
- But inserts won't shake loose.
It has high density
- But permits reduction of overall size and weight.
It has no color appeal
- But has certain surface finish interest.

MYCALEX GLASS-BONDED MICA IS THE ONLY CERAMOPLASTIC

The only material combining most of the best properties of ceramics and plastics, plus some of its own.

GET THE FULL, FRANK STORY

WRITE FOR ENGINEERING DATA BOOK
Expansion of RTMA Proposed At Board Meeting

The RTMA board of directors accepted in principle the recommendations of a special committee of the technical products division calling for expansion and reorganization of the Radio-Television Manufacturers Association to provide greater recognition for manufacturers in the advanced electronics field. The action climaxed a recent 3-day industry conference.

President A. D. Plamondon, Jr., referred to an expanded organization committee a report presented by director E. K. Forster and C. B. Thornton, of Hughes Aircraft Co.

The major recommendations of the committee were that RTMA change its name to the Electronics Manufacturers Association, or some similar name, a division for manufacturers of advanced electronics products be established within the association, and the engineering department be expanded and technical standards and contract specifications be developed for advanced electronics products in the military and commercial sales areas.

Mr. Thornton, in presenting the report prepared by Mr. Foster and himself, pointed out that the electronics industry has expanded greatly since World War II and that for the last three years the dollar volume of sales of electronics equipment to the Armed Services has exceeded that in the commercial equipment field, including radio and tv sets.

MULLICAN WINS EDISON RADIO AMATEUR AWARD

Don L. Mullican of Searcy, Ark., who helped rally emergency aid to tornado-stricken Arkansas in March of 1952, received congratulatory handshakes from W. R. G. Baker, GE vice-president, and J. Milton Lang, general manager of the GE tube department, after he received the Edison Radio Amateur Award for outstanding public service by a radio amateur during 1952. Don, a 20-year-old Bible student at Harding College in Searcy, stuck to his radio amateur rig almost without relief for more than five days to bring emergency help to Searcy and the nearby towns of Judsonia and Bald Knob.

Teegarden Elected Executive Vice-President Of RCA

ELECTION of L. W. Teegarden as executive vice-president of the Radio Corporation of America was announced by Frank M. Folsom, president.

Mr. Teegarden, a pioneer merchandiser, has been active in the electronics industry for many years. Prior to assuming his new post, Mr. Teegarden was vice-president in charge of technical products of the RCA Victor division. In this position, he supervised the activities of both the engineering products department and of the tube department.

"Under Mr. Teegarden's leadership, the activities over which he has had responsibility have attained new high levels of success," said Mr. Folsom. "His election to the post of executive vice-president of RCA is fitting recognition of his administrative achievements over
Radio set makers everywhere have acclaimed the Monarch automatic record changer—the brilliant new changer with the exclusive 'Magidisk' auto-selector.  
- Now 7", 10" and 12" records may be intermixed and played at 33 1/3, 45 or 78 r.p.m., with a realism and a purity of tone hitherto impossible.  
- Simple centralised control provides easy selection of record speed and 'On,' 'Off,' 'Reject.'  
- New extended frequency range dual stylus crystal pick-up faithfully reproduces the most fragile overtones.  
- Fine engineering guarantees a lifetime of trouble-free service.  
- The price is competitive—send for details.

the many years he has been with RCA.”

Since joining RCA in 1930 as a district sales manager, Mr. Teegarden has held increasingly responsible positions on behalf of RCA Victor activities. In 1936, he became the first to serve as regional manager with responsibility for the merchandising of all RCA Victor products. His success in establishing this position led to the formation of a regional organization on a nation-wide basis.

Six years later Mr. Teegarden was named assistant general sales manager of all RCA Victor product activities. He was appointed general manager of the tube department in 1944, and a year later was named vice-president in charge of this department.

Under his direction, the tube department achieved mass production of television picture tubes for home receivers.

Mr. Teegarden’s responsibilities were increased in 1949 to include supervision of RCA Victor’s engineering products department, which has since established new sales records under his direction.

Beckman Begins Construction On $2 Million Plant

ARNOLD O. BECKMAN, president and founder of Beckman Instruments, Inc., officially broke ground recently for the new $2 million, 200,000 sq ft instrument factory and administrative offices to be erected on a 40-acre site in the La Habra-Fullerton area of California. First occupancy of the plant is scheduled for midsummer.

Westinghouse To Buy Philco’s TV Station WPTZ

E. V. HUGGINS, president of Westinghouse Radio Stations, Inc., and James H. Carmine, executive vice-president of Philco Corp., announced jointly that Westinghouse had arranged to purchase tv station WPTZ in Philadelphia from Philco. Approval of the FCC is being sought. Acquisition of the station will involve approximately $8.5 million.

In commenting on the proposed transfer of ownership, Mr. Carmine said, “Sale of station WPTZ, at this time, will enable Philco to concentrate its activities in its principal fields of research, development and production of tv receiving sets, radios, and major appliances which are merchandised through its distributors and dealers, and the manufacture of electronic equipment for government and industry.”

Mr. Higgins said, “This is another step toward completion of our plans to bring additional service to the millions of people living in areas served by Westinghouse.”

After approval of the purchase by the FCC, WPTZ will become the second tv station to be operated by Westinghouse. The first is WBZ-TV in Boston.

Federal Elects Maginnis V-P and Chief Engineer

THE ELECTION of William P. Maginnis as vice-president and chief engineer of Federal Telephone and Radio Corp. was announced by Henry C. Roemer, president of Federal.

Mr. Maginnis, who will direct telephone, radio and vacuum tube engineering for Federal, joined the company in 1951. He was with RCA for 21 years and headed components engineering at the RCA Camden plant prior to joining Federal. Previous to his Camden assignment, Mr. Maginnis was chief engineer at the RCA manufacturing plant in Bloomington, Ind.

Graduating from the University of Pennsylvania in 1929, Mr. Maginnis started his career in com-
SUPER REGULATED VOLTAGE & CURRENT STANDARD
TYPE M—DC—2

For Accurate Calibration of D. C. Voltage and Current Instruments

THE SUPER REGULATED VOLTAGE & CURRENT STANDARD provides simple, accurate calibration of D. C. Voltmeters and Milliammeters. It is an accurate voltage or current source for Analog Computer instrumentation. The instrument is a rugged, dependable secondary standard for general laboratory and production use, which replaces the Potentiometer and its accessories, i.e., Galvanometers, Standard Cells, Power Supplies, and Precision Resistors.

The instrument is a super regulated power supply with an internal reference standard cell, precision resistance decade and precision load. It is required wherever accurate D. C. current and voltage standards are maintained.

SPECIFICATIONS

OUTPUT:
0 to 109.99 Volts D. C.
(in 0.01 volt steps)
0 to 109.99 mA D. C.
(in 0.01 mA steps)

ACCURACY:
Voltage, 0.05% of indicated voltage.
Current, 0.05% of indicated current.

RIPPLE:
Less than 0.08 millivolts at full voltage output.

LOAD IMPEDANCE:
Full scale voltage,
Load may be as low as 1000 ohms.
Full scale current,
Load may be as high as 1000 ohms.

LOAD DEPENDENCE:
Within the range specified, the load dependence is included in the accuracy of the calibrator and automatically compensated for.

INPUT POWER:
105-125 Volts, 60 cycle, 150 Watts maximum.

MOUNTING:
Aluminum cabinet or relay rack.
Panel size, 19" x 8¾", depth 16".
Net weight 40 pounds.
Shipping weight 65 pounds.
(Data subject to change without notice.)

RADIATION, INC.
MELBOURNE, FLORIDA
PLANTS AND PEOPLE (continued)

William P. Maginnis

communications engineering at the Bell Telephone Laboratories, Inc., in New York. In 1930 he left Bell to begin his long association with RCA.

Clevite Acquires Transistor Products

CLEVITE CORP. announced recently that it is acquiring a majority stock interest in Transistor Products, Inc., of Boston, Mass. Transistor Products, Inc., was formed in March, 1952 to engage in the development and manufacture of transistors and diodes. Roland B. Holt, formerly director of the Nuclear Research Laboratory of Harvard University, is president. The company has a license from Western Electric Co., and is producing transistors on a small scale.

Development work in the transistor field has been going on in the Clevite group for several months. Brush Electronics Co., a Clevite subsidiary, is also licensed by Western Electric. This development program will be consolidated with that of Transistor Products, Inc., it was stated.

CBS-Hytron Plans New TV Tube Plant

PLANS for the construction of an ultra-modern tv picture tube plant and warehouse in Kalamazoo, Mich., were announced by Bruce A. Coffin,
Ground Rods

Low cost drawn steel Ground Rods, heavily copper plated to insure perfect electrical contact—and pointed for easy driving. In 4", 6" and 8" lengths, 3/8" to 5/8" diameter. Send for Bulletin and prices, and use Premax in your TV installations.

PREMAX PRODUCTS
DIVISION CHISNOLM-RYDER CO., INC.
5301 Highland Ave., Niagara Falls, N. Y.

For Originality
LOO TO XCELITE

Pinpoint Accuracy
—For Focalizer Adjustment

XCELITE BERYLLIUM-COPPER screwdrivers are the answer to accurate adjustment of focalizer coils. They're non-magnetic, non-sparking and more fatigue resistant than steel yet their points do not require constant regrinding like fibre or plastic tools. Broad, tapered blade fits adjustment screw SNUGLY. 10" Shank reaches into chassis easily. Why be without this tool—ask your dealer now!

XCELITE INCORPORATED
(Formerly Park Metalware Co., Inc.)
Dept. C
Orchard Park, N. Y.

Electronics — April, 1953

XCELITE Hand Tools
PREFERRED BY THE EXPERTS

Simple or Complex
— We make them all, ranging from 2- and 3-electrode crystal holder bases and standard octal headers, to 14- and 18-terminal headers for sealed Transformer and Relay applications—with a wide selection of styles and sizes in our series of basic designs.

Special Designs
— We also manufacture Sealed Headers and Terminals to meet special requirements, and will be glad to quote upon receiving your specifications.

Complete Assemblies
— We have facilities for handling the complete assembly of many units—including wiring, evacuating and pressure-filling enclosures.

NEW CATALOG
— Just off the press, a new Hermaseal catalog, with descriptions and specifications of some of our standard Sealed Headers and Terminals. Write for your copy today!

THE HERMASEAL CO., Inc.
Elkhart 10, Indiana

For measurement

For more information, use post card on last page.

Mail coupons today

Electronics — April, 1953

measurements Corporation
MODEL 31 INTERMODULATION METER

• Completely Self-Contained
• Direct Reading For Rapid, Accurate Measurements

To insure peak performance from all audio systems; for correct adjustment and maintenance of AM and FM receivers and transmitters; checking linearity of film and disc recordings and reproductions; checking phonograph pickups and recording stylus; adjusting bias in tape recordings, etc.

The generator section produces the mixed low and high frequency signal required for intermodulation testing. A direct-reading meter measures the input to the analyzer section and indicates the percentage of intermodulation.

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY
Are you getting Teflon* with no porosity

Here are cross sections of two Teflon rods which were dye-tested for porosity ... (x 12 magnification). The Fluoroflex-T rod (left) shows no capillary absorption of dye. It makes more stable insulation than the rod at right where porosity has enabled dye to penetrate.

Non-porous Fluoroflex®-T rod, tube, sheet assure optimum electrical stability in parts

At its optimum electrical values, Teflon is virtually the perfect dielectric material for UHF use. If, during extrusion or molding, however, a high degree of porosity results, dielectric strength, power factor and dielectric constant are bound to be affected. That's because porous insulation means absorbent insulators.

As the above photographs show, Fluoroflex-T is non-porous. This is achieved in two ways. (1) By processing on equipment especially designed to compact Teflon powder to the critical density. (2) By not bleaching out Teflon's natural spotting at the expense of optimum density.

Fluoroflex-T products are also stress relieved. Result: Non-porous rods, tubes, and sheets that not only give greater electrical stability but also dimensional stability and fewer rejects in machining. Write for Bulletin FT-18.

*DuPont trade mark for its tetrafluoroethylene resin.
®Resistoflex trade mark for products from fluorocarbon resins.

Resistoflex corporation
Belleville 9, N. J.

Specially engineered flexible resistant products for industry

PLANTS AND PEOPLE

Raytheon Forms Special Products Division

The formation of a Special Products Division of the Raytheon Television and Radio Corp. was announced recently by H. C. Mattes, executive vice-president.

Raul H. Frye, formerly director of research and engineering for the company, was named general manager of the new division. His duties include complete supervision of all planning, research and production for the division, reporting to W. L. April, 1953 — Electronics
Advertisers:

How about the NUCLEAR field?

There are a good many advertisers using ELECTRONICS who should also be advertising in NUCLEONICS.

Particularly in instrumentation and laboratory equipment, there is a cross-over of use in the electronic and in the nuclear field.

But, there is very little cross-over in the subscriber lists of the two publications—a matter of a few percentage points.

It is quite possible that you are doing an effective presentation of your products and abilities in this excellent issue, but are missing such presentation before one of the fastest growing fields in the country's history—the field of atomic energy.

The sales representatives of ELECTRONICS are also the sales representatives of NUCLEONICS. They have much evidence pointing to the opportunities in this great NEW field. Ask them to show you what your potentials can be.

NUCLEONICS

A McGraw-Hill Publication
330 West 42nd St.
New York 36, N. Y.
the most economical way
to FOCUS a TV tube
the original Focomag

CUTS RECEIVER COSTS BY ELIMINATING CENTERING AND FOCUSING RHEOSTATS. Also lowers cost of power transformer. Perfectly focuses 27”, 21” and all smaller tubes having magnetic deflection. Highly efficient ring magnet uses only 4 oz. Alnico P. M.

NO HARMFUL EXTERNAL FIELD. Ring magnet is completely enclosed by the external shunt (an original Heppner design). This prevents the leakage field from having any magnetic effect on other components. Uniform field produced by ring magnet.

FLEXIBLE NYLON ADJUSTING SHAFT ELIMINATES BREAKAGE. Picture-positioning lever. You specify mounting arrangement.

Write today for information on lowering your set costs with this FOCOMAG.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (30 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives: John J. Kopple
60 E. 42nd St., New York 17, N. Y.
James C. Muggia
561 Richley Ave., W. Collingswood, N. J.
Ralph Halley
Irv. M. Cuchran Co.,
488 So. Alvarado St., Los Angeles, Calif.

Robertson Gannaway
director of research and engineering for the Special Products Division.

Sylvania To Erect Lab Building

THE RADIO TUBE division of Sylvania Electric Products, Inc. today announced plans to construct a 120,000 sq ft facility in Williamsport, Pa., to house a group of divisional engineering laboratories.

The new laboratories, according to M. J. Burns, general manager of the radio tube division, will be devoted, among other things, to development work and pilot plant operation in radio receiving tubes for military uses; new product development work; fundamental chemical research; and application engineering, including a rating laboratory in which tubes will be evaluated for performance under abnormal conditions. Other research and developmental activities in various fields of electronics also will be undertaken at the new laboratories. Actual construction is not expected to begin until May or early June. The labs will be in full operation soon after the first of next year. Approximately 400 persons will be employed. Ralph P. Clausen, chief engineer of...
Consolidated Engineering Makes New Moves

Plans for the development of "Instrument Park," a landscaped and architecturally controlled industrial community with a "university campus atmosphere," were revealed by Philip S. Fogg, president of Consolidated Engineering Corp. The firm has filed an application with the Pasadena Planning Commission requesting a zone change to permit light manufacturing use of a 20-acre site north of the company's existing plant.

Mr. Fogg also announced the promotion of Hugh F. Colvin, 35-year-old engineer-executive, to the position of vice-president and treasurer of the company.

Election of Kneeland Nunan as executive vice-president and member of the board of directors of Consolidated Vacuum Corp. of Rochester, New York, newly acquired

Something new in Precision Potentiometers...

... the standardization of a Non-Linear Precision Potentiometer, the type RVP3-SS9 Sine-Cosine potentiometer, one of the many types standard with the Technology Instrument Corporation, performs two operations in a single potentiometer assembly...two wipers spaced 90 degrees apart yield both sine and cosine outputs.

1. Total resistance: 20,000 ohms plus or minus 5 percent between terminals 1 and 3.
2. Accuracy: Plus or minus .5 percent of the full scale.
3. Maximum voltage: Conservatively rated as 80 volts between terminal 1 and 3.
4. Life: Guaranteed for at least 500,000 complete cycles in either direction at 500 V.
5. Potentiometer base: Precision machined aluminum (originated by TIC) finished with corrosion resistant black Alumilite.
6. All fixed connections are soldered.
7. Wipers: Paliney spring wiper with double contact, for positive electrical connection, long wear and light torque.
8. Resistance Element: Karma wire with temperature coefficient of 0.0002 parts per degree centigrade.
10. Full humidity protection with type 76-5 fungus resistant varnish.
11. Units may be ganged, using TIC's patented "Constrict-O-Grip" clamp rings which permit precise phasing with amazing ease.

TIC standard potentiometers have the same built-in precision and craftsmanship normally found only in custom-built products. Research, engineering, and design facilities for special constructions or non-linear or linear functions are an integral part of TIC services. Submit your potentiometer problem, whether it is for standard or custom design.

**TIC-TALKS FEATURE**

**Technology Instrument Corp.**

535 Main Street, Acton, Massachusetts, Tel. ACTon 3-7711

Want more information? Use post card on last page.

ELECTRONICS — April, 1953

(continued)
394 Want Designers Transformers $1535. conditions which coils have been adapted to seal transformers or individual cells for service in humid atmospheres or under conditions which breed fungi.

MINIATURIZATION
Thru constant research, Acme transformer engineers have developed designs, that save pounds and ounces in weight and provide long-life performance. We build miniature transformers by the thousands, each individually performance tested.

PRESSURIZED SEAL
Here is a transformer design with terminals sealed under pressure with a resilient sleeve that accommodates expansion and contraction of temperature changes.

PLASTIC COATING
This is one of a number of ways that plastic has been adapted to seal transformers or individual cells for service in humid atmospheres or under conditions which breed fungi.

ACME ELECTRIC CORPORATION
314 WATER STREET • CUBA, NEW YORK
IN CANADA: ACME ELECTRIC CORPORATION LTD.
50 NORTH LINE ROAD • TORONTO, CANADA

for maximum economy...
5KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT
Simple...Easy to Operate...Economical Standardization of Unit Makes This New Low Price Possible.
Maximum economies can be obtained only by use of correct frequency and power combinations when applying the techniques of induction heating to manufacturing processes.
It is significant that only Scientific Electric in the present market, can offer you a selection of frequencies depending on power required, in wide power range, 2-3½, 5-6-7½, 10-12½, 15-18-25-40-60 KW (all units above 60 KW are considered custom built). This means that electronic heating equipment produced by Scientific Electric is tailored to your needs...fitted perfectly to the task entrusted to it, enabling you to keep your initial investment in equipment to a minimum while affording you all the proven advantages of electronic heating.
Write now for complete information or send samples of work to be processed. Specify time cycle for your particular job. We will quote on proper size unit for your requirements.

$1535.

Scientific Electric
105-119 MONROE ST • GARFIELD, N. J.

PLANTS AND PEOPLE
(continued)

Kneeland Nunan

subsidiary of Consolidated, followed Mr. Colvin’s promotion. Mr. Nunan, former vice-president in charge of sales, will replace Mr. Colvin at the Rochester operation.

Aerovox Plans West Coast Expansions

AEROVOX CORP. recently announced through its president, W. Myron Owen, the construction of a modern, completely-equipped 50,000 sq ft plant in South Monrovia, California for manufacturing most of the Aerovox line of capacitors. Appointment of George M. Ellis as chief application engineer for all Aerovox divisions in the west was also made known.

The new plant is being made available to west coast manufacturers and distributors as a source of electronic components. Thus, Aerovox becomes the first large eastern capacitor manufacturer to establish west coast manufacturing facilities. Construction of the new plant is expected to get under way very shortly and it is estimated that the facility will be in operation early this summer.

Mr. Ellis was formerly vice-president and chief engineer of Acme Electronics, Inc., a subsidiary of Aerovox Corp. In addition to his new duties, Ellis will continue as vice-president of Acme, according to Hugh P. Moore, president of the division.

Mr. Moore has appointed D. A.
Gehlke as Aene's new chief engineer to succeed Mr. Ellis. Mr. Gehlke formerly was associated with Bendix, Lear and Western Electric.

Bloser Named V-P Of Transicoil

DWIGHT W. BLOSER, formerly chief engineer of the Transicoil Corp., was named vice-president of the company, it was announced by William M. Henderson, president. Mr. Bloser's new position involves supervision of the design, engineering and production of control motors, gear trains, induction generators, servo amplifiers and synchros. Prior to joining the company in 1952, he was senior engineer of Kearfott's Motor and Synchro Lab, and served in an engineering capacity with Sperry Gyroscope, Signal Engineering & Mfg. Co., American District Telegraph Co., and the Bendix Aviation Corp. He is a 1933 graduate of Pennsylvania State College.

FCC Appoints Miller

COMMISSIONER Robert T. Bartley announced appointment of Kenneth W. Miller to be his engineering assistant. A member of the FCC's engineering staff since 1940, Mr. Miller has recently been serving as assistant U. S. supervisor for CONELRAD in the office of the chief engineer.

Mr. Miller was an engineer in the...
Models 611 and 612 are popular instruments in research and design laboratories, vacuum tube plants, transmitter manufacturing plants, and in fixed and mobile communication services. They are ruggedly built for portable use, and are as simple to use as a D.C. voltmeter. The power absorbing load resistor is non-radiating, thus preventing transmission of unwanted signals which interfere with message traffic in communication services.

Frequency range: 30 to 500 MC (30 to 1,000 MC by special calibration)
Impedance: 51.5 OHMS - VSWR less than 1.1
Accuracy: Within 5% of full scale

Input connector: Female "N" which mates with UG-21 or UG-21B. Adapter UG-146/U is supplied to mate with VHF plug, PL259.

Special Scale Model "61s" are available as low as 1/2 watt full scale, and other models as high as 5 KW full scale.

Catalog furnished on request.

**PLANTS AND PEOPLE**

(continued)

**Stromberg-Carlson Appoints Engineers**

MALCOLM P. HERRICK has been appointed chief engineer and Rudolph G. Miller assistant chief engineer of the Stromberg-Carlson Company's Radio-Television Division, according to C. J. Hunt, general manager of the division. John H. Craft, Jr. has been appointed national service manager of the division.

Mr. Herrick has been with Stromberg-Carlson as a staff engineer, engaged in radio and television design and production engineering, since his graduation in electrical engineering from the University of Maine in 1944.

Mr. Miller has been assistant chief engineer with both Colonial Radio and Detrola Corp. From 1945 until the present he has been chief mechanical engineer in Stromberg-Carlson's Radio-Television Division, a post he continues to hold.

Mr. Craft joined Stromberg-Carlson in 1946 as a staff engineer. He was transferred to the company's service department in 1949, to hold training clinics for tv service men throughout the U.S.

**Little Plans Second Research Building**

IMMEDIATELY adjacent to its recently constructed Mechanical-Division building, Arthur D. Little, Inc. will build a 60,000 sq ft research laboratory, pictured above. Experi-
mental work in chemistry, chemical engineering, physics, new products and production methods will probably be housed in the building by Jan. 1, 1954. Ground will be broken in April for the two-story E-shaped brick and stone structure, to be located near the Concord Turnpike in Cambridge, Mass. A large auditorium will be incorporated in the building and will be used for seminars and meetings.

Ashman Named President Of Air Associates

ELECTION of J. E. Ashman as president and director of Air Associates, Inc. was announced by the firm's board of directors. His duties include administration of the company's program of product diversification and broadening of markets.

Previously Mr. Ashman was executive vice-president of Rockwell Manufacturing Co., maker of Delta power tools, Nordstrom valves and other products. He also was formerly associated with U. S. Steel and Burroughs Adding Machine.

IRC Founder Is Honored

DR. HAROLD PENDER, educator, inventor and founder of the International Resistance Co., was admitted as Eminent Member into Eta Kappa Nu Association in recognition of his technical attainments and contributions to society through outstanding leadership in the profession of electrical engineering.

Huggins and Baudino Advance At Westinghouse

E. V. HUGGINS has been elected vice-president of corporate affairs for Westinghouse Electric Corp. by the board of directors. This is a newly created position with the company.

Mr. Huggins was also elected president of Westinghouse Radio Stations, Inc. At the same meeting, J. E. Baudino was elected executive vice-president in charge of all operations. Mr. Baudino was formerly general manager of all operations. Since November of 1951 Mr. Hug-
If your design includes a coil, let us help you select proper insulating materials...with high dielectric values, adequate moisture resistance, rugged and serviceable physical properties. Make the coil a strong point in your product, instead of a danger spot. Coto-Coil Company, 65 Pavilion Avenue, Providence 5, R.I., New York Office: 10 E. 43rd Street, New York 17.

Coto PRECISION WOUND Coils

LOW COST ANSWERS

for accurate measurements on many channels, of frequency and narrow-band FM deviation

Primarily useful in maintenance of mobile-radio equipment, to FCC specifications, these LAMPKIN instruments, singly or in combination, offer many possibilities in development, production and communication testing.

TYPE 105-B MICROMETER FREQUENCY METER.
A heterodyne-type, AC-operated instrument of time-proved design, it offers many new features.

- COVERAGE
0.1 to 150 MC., on local CW, AM, or FM transmitters. Continuous 25 to 200 MC., on nearby transmitters.

- CALIBRATION
General-purpose table, plus percentage-deviation curves for any number of specific frequencies. Indicates up to 25 KC. peak deviation, either side of carrier. No charts or tables.

- ACCURACY
0.005% and better; with spot check for WWV. 10% of full scale, can be field-checked.

FEATURES
Checks any number of frequencies. Simulates AM ends and trouble-free. Warm-up time two minutes, tune-up time 60 seconds. A two-finger mixer. Weights 12.1 lbs., 12" wide, price $220.00. Load, weighs 13 lbs., 12" wide, price $240.00.

LAMPKIN LABORATORIES, INC.
INSTRUMENTS DIVISION
BRADENTON, FLORIDA

Gentlemen: Please send more data on the 105-B and 205.

Name
Address

WANT MORE INFORMATION? USE POST CARD ON LAST PAGE.

PLANTS AND PEOPLE

(continued)
gins has been assistant secretary of the United States Air Force with general supervision over the Air Force's world-wide installations, its overseas and off-shore procurement program, and relationships with civil aviation. Mr. Huggins had resigned as executive vice-president of the Westinghouse Electric International Company to accept the Air Force assignment.

Mr. Baudino joined Westinghouse in 1927 after graduation from the University of Illinois. He has been associated with Westinghouse broadcast activities since that time, serving in engineering, business and management capacities in Pittsburgh, Boston, Philadelphia and Washington.

New Clare Relay Plant Completed

THE NEW relay manufacturing plant of C. P. Clare & Co., just completed on Chicago's northwest side, covers 50,000 sq ft. As shown above, it is of one-story windowless design, with the exception of a large glass area for the reception room in the front of the building. Production facilities are being moved to the new plant as rapidly as possible.

Williford Elected President Of Link Aviation

E. ALLAN WILLIFORD has been elected president of Link Aviation, Inc. by the firm's board of directors. He succeeds Edwin A. Link, founder of the company, who continues as chairman of the board and director of research.

Mr. Williford has been vice-president and general manager of the Link firm since he joined the company in 1950. A graduate of the University of Illinois, Williford was previously associated with Union

April, 1953 — ELECTRONICS
Carbide and Carbon Co. for 24 years, during which he rose from salesman to general sales manager of the carbon products division of National Carbon Co.

In 1945 he became vice-president of General Aniline and Film Corp. and general manager of its Ansco division in Binghamton, N. Y., resigning this position in 1949. Soon after he became associated with Link.

**Kleinschmidt Honored**

Edward E. Kleinschmidt, founder and president of Kleinschmidt Laboratories and inventor of teletype and the new portable teletype-writer, was awarded a special citation by the Chicago chapter of the Armed Forces Communications Association, for "his distinguished contributions to the progress of civilian and military communications particularly in the field of printed, electrically transmitted messages."

**Collins To Expand Dallas Plant**

Collins Radio Co. is adding 35,500 sq ft to its 50,000 sq ft building in Dallas, Texas, it was announced by James G. Flynn, Jr., general manager of the Texas division.

The firm began its operations in...
SHOCK PROOF
MOISTURE PROOF
TEMPERATURE PROOF

The NEW Hycor Type "P" toroid coils are hermetically molded in a special tough plastic compound. They will withstand:

- Ambient temperatures from -40 C to 135 C.
- 95% humidity...boiling salt water.
- Amazing degree of mechanical shock.

Space saving: Dimensions of Type EM-3P coils shown in illustration are 1-1/16" O.D. by 1/2" thick. (Inductance up to 7 henries.) Clearance hole for a 6-32 mounting screw is provided.

REPRESENTATIVES:
Jack Beebe, 5727 W. Lake Street, Chicago, Illinois
George E. Harris & Co., Box 3005, Municipal Airport, Wichita, Kansas
Marvin E. Nulsen, 5376 E. Washington St., Indianapolis 19, Indiana
Burlingame Associates, 103 Lafayette Street, New York City

Send for Bulletin TP

HYCOR
Company Inc.
11423 VANOWEN STREET
NORTH HOLLYWOOD, CALIFORNIA
Sunset 3-3860

THE HEYMAN ORGANIZATION WITH 25 YEARS STAMPING EXPERIENCE HAS MODERN PRESS CAPACITY FOR OVER 2,000,000 FINISHED STAMPINGS PER DAY. ASK FOR BULLETIN 33

PLANTS AND PEOPLE

Dallas about 1½ years ago with a 25,000 sq ft building, and a few months later moved into an additional plant. The new addition will bring total square footage in the area to 110,500 sq ft.

The new wing includes a 4,000 sq ft cafeteria for employees and 4,000 sq ft of additional office space, with the remaining area being used for manufacturing. The company expects to have more than 1,000 employees on the payroll by early spring.

General Porter Joins Ultrasonic Board

ELECTION of General William N. Porter as a director of Ultrasonic Corp. was announced by Harold W. Danser, Jr., president. General Porter is president of Chemical Construction Corp., a wholly owned subsidiary of American Cyanamid Company which is engaged in engineering and construction of chemical and metallurgical processing plants throughout the world. A graduate of the U.S. Naval Academy in 1909, General Porter was chief of the Chemical Warfare Service from 1941 through 1945.

Bendix Names Walz

APPOINTMENT of Richard F. Walz, former sales engineer for Audio Products Corp., to Bendix Computer's administrative staff was announced by Palmer Nicholls, vice-president. He will serve as sales and engineering aide to Maurice W. Horrell, assistant general manager.
GE Modernizes Plant

A $400,000 modernization program has been launched by the General Electric Co. at its Bleeker Street plant in New York City, according to an announcement by plant manager Frank Greene, Jr.

The program will involve the installation of machinery to be used in the manufacture of polystyrene cabinets for clock radios and table model radios.

About 8,000 sq ft of floor space will be added in the form of a mezzanine constructed in a two-story bay of the plant. This mezzanine will be used for storage of raw materials. Under it will be the moulding equipment. Machines have been ordered and production of cabinets is scheduled in about 9 months.

Krygier Advances At CBS

The appointment of George Krygier to the position of administrative engineer was announced by Leopold M. Kay, vice-president of engineering for CBS-Columbia.

Mr. Krygier joined CBS-Columbia in 1950, serving as liaison engineer with Underwriter’s Laboratories. In his new position, Mr. Krygier will handle engineering administrative functions and coordinate the activities between the engineering department and other divisions of the company.

Tetrad And Triad Merge

All of the operations of Tetrad Co., Inc., specialists in the production of miniaturized electronic components, have been consolidated with the operations of Triad Transformer Manufacturing Co., according to an
SQUARE PULSE GENERATORS
for the
MILLIMICROSECOND
to
MICROSECOND
RANGE
MODEL 100
SQUARE PULSE GENERATOR
Price: $395. FOB New York
FOR RACK MOUNTING

For nuclear pulse work, radar, TV, wide band amplifiers and in the
design, calibration, and servicing of fast electronic systems:

NOW—A NEW square pulse generator with a rise time of one millimi-
crosecond (10⁻¹⁰ seconds) and a pulse width which can be varied from one
millimicrosecond to several microseconds provides the ideal test instrument
for fast electronic circuits. Both positive and negative pulses of 100 volts
maximum amplitude into low impedance cable, such as 50 ohms, are gener-
ated, the pulse amplitude can be varied from 100 volts to .006 volts in 1
decibel steps by means of selector switches on the front panel. One, two,
or more pulse outputs, each, of which, can be individually attenuated and
delayed are available in various models.

FOR FURTHER DETAILS, write for Bul-
eelin "P-1A", or contact our engineering division.

Electrical and Physical Instrument Corporation
Sales and Business Office
35 West 43rd Street
New York 36, New York
Telephone: Longacre 4-8310

Engineering Division
42-19 27th Street
Long Island City, N. Y.
Telephone: Stillwell 4-6389

April, 1953 — ELECTRONICS
PLANTS AND PEOPLE (continued)

ments committee.
The other two appointees come under the supervision of Richard Huggins, Huggins Laboratories, the WESCON vice-president representing WCEMA. These are: Les Logan, hotels committee; David H. Ross, visitors' service committee.

Radio Club Re-elects Officers

Officers of the Radio Club of America have been re-elected and will serve the club during 1953. They are: president, John H. Bose; vice-president, Ralph R. Batcher; treasurer, Joseph Stantley; corresponding secretary, Frank H. Shepard, Jr.; recording secretary, Frank A. Gunther. Elected to the board of directors were: Ernest V. Amy, Edwin H. Armstrong, George E. Burghard, Alan Hazeltine, Harry W. Houck, Jerry Minter and Harry Sadenwater.

Airborne Advances

Lebenbaum

Airborne Instruments Laboratories, Inc., has announced the appointment of Matthew T. Lebenbaum as supervisor of a newly formed applied electronics section in its research and engineering division. Mr. Lebenbaum was formerly an assistant supervising engineer in the radar section. Peter D. Strum has been appointed assistant supervising engineer of the new section.

From June, 1942 until he joined Airborne in 1945, Mr. Lebenbaum

Matthew T. Lebenbaum

Want more information? Use post card on last page.

www.americanradiohistory.com
any shape . . . length . . .
ID or OD . . . to meet your specific requirements

SEND FOR ARBOR LIST

Free to you upon request . . . lists over 1500 sizes . . . all promptly available.
A free sample is also yours for the asking . . . just send your specifications.

Precision Paper Tubes are spiral-wound of finest dielectric kraft, fish paper, cellulose acetate, or combinations.

Write us today!

PRECISION PAPER TUBE CO.
2041 W. Charleston St., Chicago 47, Ill.
Plant No. 2; 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Bobbins

IF THE WIRING FAILS

SO DOES YOUR PRODUCT'S REPUTATION

FOR DEPENDABLE PRODUCT WIRING USE

UNILETRIC WIRING SYSTEMS

Year after year — for over ten years — UNILETRIC has produced millions of wiring systems, for more than 150 leading manufacturers of electric and electronic products. From controls to complex armed forces equipment, these wiring systems have consistently met the most exacting requirements and provided substantial savings to each customer.

To assure utmost dependability plus cost saving engineering assistance, low cost production and "on-schedule delivery" investigate UNILETRIC today.

PLANTS AND PEOPLE (continued)

was a research associate with the Radio Research Laboratory at Harvard University.

LaPointe Plascomold Changes Its Name

The company name of the LaPointe Plascomold Corp. has been changed to La Pointe Electronics, Inc., it was announced by company president Jerome E. Respess, after authorization by the stockholders of the company at the annual meeting. The name change was desirable, according to Mr. Respess, because the major products of the company are in the electronics field.

Two top-level promotions were also recently made at LaPointe. William A. Damerel was appointed vice-president of LaPointe Electronics and Milby M. Hancock, formerly general manager, was elevated to the position of assistant to the president.

Tuerck Appointed Research Head of Patterson, Moos

WILLIAM TUERCK, JR. has been appointed director of research of Patterson, Moos & Company, Inc., of New York, it was announced by E. M. Patterson, president of the research and development firm. In addition to his new position in charge of one of the six research laboratories of the company, Mr. Tuerck will continue as chief engineer of Magnex Corp., the production affiliate of Patterson, Moos.

Douglas Forms Microwave Co.

R. HARRY DOUGLAS announced the formation of the Douglas Microwave Co. Inc. of New York City, which he heads as president and chief engineer. Mr. Douglas has been in the microwave field since 1943 and was formerly president and chief engineer of the Kings Microwave Co., chief electronics engineer of Bernard Rice's Sons, and an engineer-officer of the Signal Corps Engineering Labs., Ft. Monmouth, N. J. Microwave and radar
components and test equipment units are currently being manufactured to customer specifications as well as to company designs.

Gertsch Appoints Rorden

ROBERT J. RODDEN has been appointed chief engineer for Gertsch Products, Inc., Los Angeles, according to Len Cutler, vice-president and chief engineer. He had previously been with the Point Mugu government projects several years and more recently with Dalmo Victor Co.

Industrial Tubes Expands

INDUSTRIAL TUBES, INC. now occupies a new one-story modern factory building constructed especially for the production of industrial electronic tubes. The corporation, which was formed a year ago, now regularly manufactures industrial rectifier and thyratron tubes. According to John H. Hutchings, president, production has risen steadily during the past seven months and promises to double again by this summer.

OTHER NEWS

Raytheon Sizes Up Its Defense Orders

RESULTS of a recent survey by Raytheon Manufacturing Company indicate that "small business" is doing all right for itself in government defense orders.

E. F. Leathem, assistant to the president of Raytheon, states that small firms are getting 52 percent of all Raytheon orders, and 81 percent of those which these concerns can handle. Raytheon ranks 42nd among the 100 leading government prime contractors and placed orders totaling $57 million during the first three-quarters of 1952.

In a report submitted to the Air Force Small Business Subcontracting Program Committee, Mr. Leathem stated that "Raytheon's normal purchasing practices, which generally are followed by most large concerns, require that we place as many orders as possible with small
Model 109

“Complete Radar Test Facility”

Multi-Purpose X Band Test Equipment

Spectrum Analyzer
- Displays supplied spectra from 8.5 to 10 KMC on a 3” CRT
- Delivers CW, square wave, FM, or pulse (1.5 or 10 µs) modulated RF, 8.5 to 10 KMC up to 25 MW
- Measures average power of CW or pulsed RF, external or internal, from 8.5 to 10.5 KMC
- Measures applied RF from 8.5 to 10.5 KMC
- Accuracy: ±1% accuracy.

All major units plug in, 11” x 10½” x 13”. 45 lbs.

ELECTRONIC DIVISION
Century Metalcraft Corporation
BOX 2098 - 14806 OXNARD STREET
VAN NUYS, CALIFORNIA

New concept in photography

For Electronic Research

ROBOT Star

Motorized For Sequence and Remote Control Photos

Set the Robot-Star just once, and you’re all set for as many as 24 (or 48) exposures, made singly or in rapid-fire sequence, as fast as 8 per second! Robot-Star automatically moves film and resets shutter after each exposure. Sur-passes human efficiency because of its built-in clock-work motor. Remote control release and other accessories bring new camera applications never before thought possible in science and industry as well as for personal use.

<table>
<thead>
<tr>
<th>Models</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum Analyzer</td>
<td>Displays supplied spectra from 8.5 to 10 KMC on a 3” CRT</td>
</tr>
<tr>
<td>Signal Generator</td>
<td>Delivers CW, square wave, FM, or pulse (1.5 or 10 µs) modulated RF, 8.5 to 10 KMC up to 25 MW</td>
</tr>
<tr>
<td>Power Monitor</td>
<td>Measures average power of CW or pulsed RF, external or internal, from 8.5 to 10.5 KMC</td>
</tr>
<tr>
<td>Frequency Meter</td>
<td>Measures applied RF from 8.5 to 10.5 KMC</td>
</tr>
</tbody>
</table>

All major units plug in, 11” x 10½” x 13”. 45 lbs.

Plant and People (continued)

business, not only because this procedure is in line with government requirements but also because we have found that it is good business to do so. Improved liaison, better quality and quantity control, closer personal attention to our requirements and competitive prices are among the advantages resulting.

Raytheon does business with almost 4,000 vendors, of which over 3,000 employ less than 500 people, Mr. Leatherman stated. Of those orders given to big business, 76 percent of the purchases were for items which small business cannot manufacture. Small firms are not equipped to supply such items as glass bulbs for vacuum tubes, specially treated metal in the form of oxygen-free copper, vacuum-cast molybdenum, steel alloys, brass, tungsten and aluminum. These materials and others can be purchased only from big business.

Celebrate Edison's Birthday

The 106th birthday of Thomas Alva Edison was celebrated at the 30th annual luncheon of the Edison Pioneers. Figure at the luncheon are Charles Edison, left, honorary president, and GE president Charles E. Wilson, new president of the Pioneers. The luncheon heard principal speaker James A. Farley discuss the topic “Thomas Edison, the man, the inventor and the philosopher”

Penn State Schedules Transistor Short Course

A TRANSISTOR short course, designed especially for practicing engineers in the industrial field and for engineering faculty members of
RCA To Develop New Airborne Radar

DEVELOPMENT of a new type of airborne weather-detection radar unit will be undertaken by RCA Victor in cooperation with United Air Lines, Inc.

This is the first program RCA has undertaken with the goal of providing commercial air lines with a radar system designed exclusively for weather-mapping use.

This radar unit will operate at new frequencies to "map" weather obstacles on a wide front. It is expected to provide pictures that will give a pilot information on the depth as well as the breath and height of storm fronts.

RCA expects to deliver experimental equipment early next summer so that tests can be conducted during the period of greatest storm activity.

Michigan Offers Courses In Automatic Control

THE UNIVERSITY OF MICHIGAN College of Engineering has announced two intensive courses in automatic control. The first is scheduled for June 15 to 20 and the second for June 22 to 25, 1953. The courses are intended for engineers who want a basic understanding of the field but who cannot spare more than a few days for the purpose.

The purpose of the course is to make it easier to learn by a coherent presentation the fundamentals of modern automatic control and by providing a comprehensive set of notes to serve as a framework for further study.

Extensive use will be made of computing, instrumentation and

"Special" is right down STAR's alley for we have built our business on Custom Porcelain Specialties for more than 30 years. Every piece of STAR porcelain produced is designed and fabricated to meet customers' specific needs for high dielectric strength, low loss factor, heat and moisture resistance, thermal shock resistance and other properties essential to high performance.

Michigan Offers Courses In Automatic Control

THE UNIVERSITY OF MICHIGAN College of Engineering has announced two intensive courses in automatic control. The first is scheduled for June 15 to 20 and the second for June 22 to 25, 1953. The courses are intended for engineers who want a basic understanding of the field but who cannot spare more than a few days for the purpose.

The purpose of the course is to make it easier to learn by a coherent presentation the fundamentals of modern automatic control and by providing a comprehensive set of notes to serve as a framework for further study.

Extensive use will be made of computing, instrumentation and

"Special" is right down STAR's alley for we have built our business on Custom Porcelain Specialties for more than 30 years. Every piece of STAR porcelain produced is designed and fabricated to meet customers' specific needs for high dielectric strength, low loss factor, heat and moisture resistance, thermal shock resistance and other properties essential to high performance.
MOLDED NYLON MOLDED PARTS
A GRIES SPECIALTY

Endless new design possibilities with GRC's Nylon small parts. Greater job adaptability, precision, economy. GRC's unique facilities produce tiniest Nylon parts in one high-speed operation; delivered automatically trimmed, ready for use. Single cavity molds provide more precise tolerances.

LOW MOLD COSTS!

WRITE TODAY FOR FREE SAMPLES AND TEST PARTS.

GRIES REPRODUCER CORP.
100 WILLOW AVE., NEW YORK 54
Phone: OTT HAVEN 5-7400

For the First Time Anywhere
POWER SUPPLIES WITH REGULATION AND STABILITY MEASURED IN PPM* *PARTS PER MILLION

- Regulation within 20 PPM* for line voltages of 105 to 130V.
- Load regulation better than 40 PPM* from zero to 500 ma.
- Stability within 100 PPM* per day under average conditions.
- MORE STABLE THAN BATTERIES. Short warmup period of 20 minutes.

MODEL 301A. - Voltage: 7.5 to 750 volts. Current: 0 to 500 ma. Ripple: less than 10 millivolts. Auxiliary voltages of ±350 and ±200 vdc at 10 ma. -12% regulation, less than 4 millivolts ripple; and 6.3 volts centered-tapped to 10 amperes.

MODEL 300II. - Performance same as 301A but voltage range 750 to 3000 vdc at 0 to 30 ma. No auxiliary outputs.

MODEL 300E. - Performance same as 301A but voltage range ±1000 to ±1500 vdc at 0 to 100 ma. Auxiliary output of 6.3 vdc at 15 amp.

SPECIAL MODELS. - Special models are available with output voltages from millivolts to kilovolts either positively or negatively grounded and at currents from milliamperes to amperes.

ALSO

SERIES 400 PRECISION POWER SUPPLIES
- For nuclear work.
- High stability — close regulation.
- Electronically regulated.
- High voltage — low current.

MODEL 400B. - Output: 1000 to 5000 vdc. Current: 0 to 1 ma. Regulation against line voltage 105 to 130 v is within .01%. Regulation against load is .01%. Short term stability is .01%. Ripple less than .015%.

MODEL 400C. - Same as 400B except output: 500 to 1500 vdc. These models available with positive side grounded.

PLANTS AND PEOPLE (continued)

servo laboratories on the campus. The role of analog computing methods will be emphasized.

Electronic Firepower

ONE of the largest World War II manufacturers of antiaircraft guns is again tooled up to mass-produce the more powerful electronically-controlled gun mounts needed by the U. S. Navy. First three-inch, twin-fifty gun mount, weighing 17 tons, to be produced by the Firestone Tire & Rubber Company is pictured above as it is inspected by Harvey S. Firestone, Jr., (left) chairman of the company, J. E. Trainer (center), and Raymond C. Firestone (right), vice-presidents.

Equipment with automatic loading devices and intricate radar fire-control systems, the guns will hurl three-inch shells at low or high-flying aircraft. The value of the initial Navy contract with Firestone for these new gun mounts has been announced as $62 million.

Components Symposium Set

SIX general sessions have been scheduled for the 1953 Electronic Components Symposium to be held April 29 to May 1 at the Shakespeare Club in Pasadena.

R. Simon Ramo, vice-president in charge of operations at Hughes Aircraft, will be chairman of the opening session. The subject to be covered will be "Critical Problems Being Faced by the Electronics Industry in Meeting Industrial and Military Demands".

The afternoon session of the opening day will be led by Dr. A. W. Rogers, chief of the components branch, Signal Corps Electronic
Conference Examines The Engineer Shortage

THE TRAINING and use of skilled assistants is one way to beat the engineer shortage, according to engineering executives at the Fifth College-Industry Conference at Northwestern University.

Titus G. LeClair, manager of engineering for Commonwealth Edison and Public Service Company of Illinois, said that requiring an engineer to handle all the details of his job is "our greatest source of wasted engineering talent."

"The obvious answer to this problem is to relieve the engineer of his paper work and other non-technical activities by giving him the help of a technical assistant, draftsman, clerk or perhaps all three," LeClair said.

He told the engineers and educators that "the technical assistant might be a technical institute graduate or have one or two years of college. With this type of skilled assistant, the engineer is able to do the engineering without going on to do the "red tape.""

"Not only can the engineers work more effectively," LeClair pointed out, "but they are better satisfied when they feel their technical skills are being usefully employed and that the opportunities for advancement are better."
NEW BOOKS

UHF Practices and Principles

Here is broad, fundamental background theory and practical data on transmitting and receiving equipment for the entire uhf range from 300 mc to 3,000 mc. This includes police, fire department, taxicab, truck and other mobile communication services, television and even radar. Although some mathematical equations are included, the book is not intended for reference use by design engineers; rather, it appears best suited for students in trade and vocational schools, as well as for television and radio service men who seek only a general knowl-
edge of what is going on in this fast-opening new territory of the radio spectrum. End-of-chapter questions facilitate classroom and self study use.

Illustrations are particularly deserving of mention, being carefully selected to show technical details of equipment; there are very few front-panel of transmitter or receiver of housing shots. Examples of some of these illustrations are shown here.

Chapter organization might be called conventionally tutorial. The first three chapters bring the reader up to date on theory by reviewing the history and use of the uhf spectrum, pointing out the differing behavior of components at these higher frequencies, and covering the differing propagation characteristics of electromagnetic radio waves. Five of the remaining chapters then take up new types of components—receiving antennas, trans-

FIG. 7.36—Electrodes in a klystron tube (from Lytel—"UHF Practices and Principles")

the Type H-12 UHF SIGNAL GENERATOR
900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0.1 - 100 dbm, continuously adjustable by a directly calibrated control accurate to ± 2 dbm. The frequency range is controlled by a single dial directly calibrated to ± 1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of siliconetreated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

Built to Navy specifications for research and production testing, the unit is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator
(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/-150 cps localizer, left-center-right on phase localizer, OMNI course sensitivity, operation of T O FROM meter, operation of flag alarms.

Price: $942.00 net, f.o.b. Boonton, N. J.

WRITE TODAY for descriptive literature on A.R.C. Signal Generators or airline LF and VHF communication and navigation equipments. CAA Type Certified for transport or private use. Dept. 3

Dependable Electronic Equipment
Since 1928

Aircraft Radio Corporation
Boonton, New Jersey

Want more information? Use post card on last page.
April, 1953 — ELECTRONICS

Carter Motor Co.
2646 N. Maplewood Ave., Chicago 47

Mail Coupon for Catalog
Carters Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. MAIL COUPON NOW for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

Want more information? Use post card on last page.
mission lines and wave guides, new types of tuned circuits, oscillators and developmental tubes. One chapter deals with receivers and converters, another with transmitters, and the last with test equipment and techniques to round out the picture of uhf at work today.—J.M.

Electronic Engineering Principles


The prime theme of this book is well stated in the preface to the first (1947) edition: "The author has been convinced for a considerable time that electronics has outgrown its position as a subordinate field of communications or radio engineering and should be treated independently as electronic engineering. So considered, it becomes applicable to all electrical engineering, involving as it does theories of conduction, simple atomic structure and generalized circuit analysis with linear and nonlinear elements. Thus, electronic engineering is fundamental to all power or radio applications of electron tubes, but is not necessarily a part of either field."

It is in such thought that the author, now head of the Department of Electrical Engineering at the University of Illinois, distilled the knowledge and varied experience gained over some fifteen years in both the teaching and the industrial practice of communication engineering and applied electronics to produce a book that was

For SPECIFIED PERFORMANCE
Specify JELLIFF RESISTANCE WIRE

COMPLETE CONTROL OF MANUFACTURE . . .
A WIDE RANGE OF EXPERIENCE . . .
A WIDE RANGE OF ALLOYS . . .

make JELLIFF the ideal source of
Resistance Wire to assure your Product's
Performance According to Specs.

Precision resistors—rheostats—
relays—thermocouples—ohmmeters
—bridges—high-temperature furnaces can all benefit from the
PLUS-PERFORMANCE of
JELLIFF RESISTANCE WIRE

Detailed Enquiries Welcomed. Address Dept. 17.

MIDGET TELEPHONE TYPE RELAYS
in hermetically sealed containers

Compact, multiple contact with vibration and shock-proof characteristics. Designed to meet various operating requirements typical of Armed Services applications. Unique pile-up arrangement reduces width below the conventional relay, thereby reducing over-all space volume. Coils are varnish-impregnated to resist high humidity conditions. All ferrous parts are treated to pass salt-spray tests.

Engineering Representatives in Principal Cities

WRITE FOR
BULLETIN MTR-6

Want more information? Use post card on last page.

Comparison of the contents of the old and new editions indicates many improvements and additions. Thus, the context has been rendered easier to use: in the large, by an overall consideration and revision of content; in particular, by consolidation of the material on electron emission encompassed in Chapters 4, 11, and 15 of the first edition into Chapter 4 of the present edition. The treatment of the vacuum triode, of amplifiers and—in connection with the latter—of feedback is extended in scope. The rapidly burgeoning use of transistors and the attendant need for an introduction to the basic theory underlying the functioning of solid-state electronic devices is recognized by inclusion of a new chapter thereon. The table of physical constants encompasses certain improved values effected since publication of the first edition. The number of student exercises and problems has been increased; new line drawings and cuts added; and the list of references at the end of each chapter enlarged to include particularly-apposite lately-published papers.

The physical qualities of the text maintain the publisher's usual standards of excellence. The binding is sturdy, attractive and such that the book lies open at any page; the typography enables easy reading under artificial light—no small
boon to the student; the line drawings are uniform of weight and well-lettered; the illustrations of electronic apparatus and devices are excellently delineated; the numerous equations are well-set and amply displayed; and the boldface type distinguishing vector quantities is easily marked from the ordinary type used for scalar quantities. The general quality of presswork and proofreading is evidenced in the fact that in a careful reading of the text, with attention to factual detail, the reviewer noted only several trivial misprints in this first press run of the new second edition.

In recapitulation, the reviewer is of a mind that the author and his publishers have collaborated to produce a most excellent textbook, and one that well fulfills the author's proposed "fundamental and thorough treatment of basic electronics." In such thought, it is to be remarked that, as well as for formal classroom use in an organized electrical engineering curriculum, it is admirably suited to use by the practicing engineer who—possessing the indicated desirable prerequisites of a knowledge of the elements of "calculus and a-c circuit analysis"—seeks a text for initial self-study, or for revitalization of once-studied content, or merely as a general reference which will bring him abreast of the current status of electronic engineering.—Thomas J. Higgins, Professor of Electrical Engineering, University of Wisconsin.

Theoretical Nuclear Physics

Here is a comprehensive, almost encyclopedic, yet extremely lucid and readable account of the theoretical concepts and methods underlying contemporary nuclear physics. Written by two outstanding nuclear physicists, the book should prove invaluable to graduate students and research workers in physics. To use this volume effectively, the reader must possess at least an introductory knowledge of quantum mechanics and the related mathe-
New Books (continued)

Mathematical Disciplines.

While physicists will undoubtedly be delighted by the publication of this excellent textbook and general reference, electronic engineers will find the book of limited interest. Emphasis is placed upon the development of theoretical models and semi-empirical viewpoints and upon the interpretation of experimental material with the aid of these tools. The design of piles and other topics forming the subject of nuclear engineering are explicitly excluded from consideration, as are, for the most part, nuclear phenomena involving energies greater than 50 Mev.

Beginning with a review of the general properties of nuclei, the book goes on to develop the theory of nuclear forces. Scattering experiments involving protons and neutrons are discussed in the light of present ideas on the nature of the forces between them. This leads to the theory of the deuteron and to the study of three- and four-body problems. The systematics of stable nuclei are presented next, followed by a description of special models of the nucleus such as the liquid drop model.

The theory of nuclear reactions is then presented in an introductory manner. In the central chapter of the book, a vast amount of experimental information is interpreted in the light of the Breit-Wigner theory of nuclear resonance phenomena. The detailed analysis will probably overwhelm the student but should gratify the active research worker. The authors then treat the theory of nuclear reactions in a more formal manner and succeed in revealing the staggering complexity of the problem at hand.

To the subject the authors bring imagination and considerable expository ability. The use of waveguide and electric circuit analogies of nuclear reactions is particularly noteworthy. Unfortunately, the electronic engineer must run a strenuous gauntlet before he can appreciate these analogies in full.

The latter portion of the book deals with spontaneous decay of the nucleus, beta decay, radiative phenomena and nuclear shell structure. It is unfortunate that the authors have not included such topics as neutron diffraction by...
crystals and nuclear magnetic resonance phenomena, but even without them the book is quite lengthy.

As a comprehensive, authoritative, and highly readable introduction to theoretical nuclear physics, this volume is strongly recommended. — FRANK HERMAN, Research Physicist, RCA Laboratories, Princeton, New Jersey.

Fundamentals of Engineering Electronics


FIFTEEN years have elapsed since the appearance of Professor Dow's "Fundamentals Of Engineering Electronics." During this interim, not only did the text gain tremendous popularity since it encompassed physical phenomena with engineering understanding but, also, noteworthy advances were made in the rational comprehension of matter and the physics of electron tubes. Consequently, it was a natural step for the author to modernize his original text into a second edition and to expand his thoughts into two additional books to be published in the near future under the titles of "Fundamentals Of Physical Electronics" and "Microwave Electron Tubes."

The present version has retained its original usefulness as a treatise on engineering concepts. Each chapter is profusely documented. In all, there are over 340 periodical references with approximately 85 per cent dated between the years of 1937-1952. In addition, appropriate books have been separately listed. These references are tabulated under chapter numbers in a section of 24 pages entitled Bibliography, located adjacent to the Index.

Since the first few chapters of the original edition contained topics which were rather involved, the author has rearranged and diffused the subject matter into an orderly sequence which seems to be less formidable. However, a strong mathematical background is still needed to truly appreciate the
NEW BOOKS

(continued)

Meter-Relays in Microwave

Remote transmitters use Simplytrol Contact Meter Relays (CMR) for continuous monitoring. The CMR may be in the oscillator, the final amplifier or, it may be coupled directly to the antenna circuit as it is in the RCA CW20 Microwave Relay.

In this equipment the meter in conjunction with a germanium diode suitably coupled, monitors the r.f. output and serves as a tuning indicator. The low limit contact is set at some predetermined scale point, if the power fails the CMR contacts close circuits sending alarms or energizing standby equipment.

A Model 261-C low limit CMR, range 0-200 DC microamperes is used. Simplytrols are made in ranges starting at 0-20 microamperes.

Why Locking Contacts?
When an armature relay operates, the contact pressure increases due to the shortening magnetic gap. With a moving coil relay the pressure decreases as the contacts close unless some extra force is introduced. If the point of contact coincides with the indication there is no contact pressure.

Because the coil torque balances the springs the contacts may flutter or 'fly'. An electrostatic charge may cause oscillation with alternate closing and opening which may weld the contacts.

In the Simplytrol this is overcome by the 'contact locking coil'. When the contacts close, current flows through the locking coil producing additional torque to build up pressure. When the contacts get close, the locking coil 'grabs' on the first oscillation and forces them together. In fact, the static charge may pull them together before they touch. Simplytrol locking contacts are discussed in Bulletin CMR-78. Write for a copy to Bradley Thompson, Assembly Products, Inc., Chagrin Falls 16, Ohio. Phone 7374.

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
filters and inversion from direct to alternating current and associated circuits.—ANTHONY B. GIORDANO, Polytechnic Institute Of Brooklyn.

High-Energy Particles


PROF. Rossi has given us an outstanding book on the phenomenological aspects of the high-energy particle field. Although the book is written primarily for the specialist in high-energy particle research, it will be of interest to all serious students of nuclear or cosmic ray physics. In it the reader will find a discussion of the developments leading up to the identification of the high-energy particles known at present, together with a detailed account of many of the more important experiments of the last decade dealing with both cosmic ray and artificially generated high-energy particles.

One of the main purposes of the book is to develop the methods by which the experimentalist can interpret the result of observations in terms of particle type, mass, charge and energy. Theoretical derivations are given of all of the principal relationships required. These derivations are concisely presented, frequently using classical methods as a means of explaining the fundamental ideas back of the derivations. When this artifice is used, the corrections introduced by the more exact quantum mechanical treatment are pointed out and the exact formulas given. Where necessary, tables and graphs accompany the analytic relationships. Mathematics is used freely throughout the text, but is of such a form that it should present no serious obstacle to the reader.

The first portion of the book treats the general problems of the interaction between moving particles and electro-magnetic fields, electrons or matter. This section provides a general background of the absorption, ionization, scattering and energy conversion which occurs when particles pass through matter.

The second part of the book deals with experimental methods. A very
for lacings that stay put!

**GUDELACE**

**BRAIDED NYLON LACING TAPE**

A New and Revolutionary Type of Lacing

- Saves time, saves money, greatly reduces the number of rejects
- Won't "bite through" insulation
- Won't cut wiremen's fingers or cause dermatitis
- Ties easier, ties tighter and cuts down on slipping of knots

Let GUDELACE answer your lacing problems.

*Write for FREE samples and prices.*

GUDEBROD BROS. SILK CO., INC.
Electronics Division, Dept A
Main Office: 12 South 12th Street, Philadelphia 7, Pa.
225 West 34th Street, New York 1, N.Y.

**NEW BOOKS**

(continued)

thorough and informative discussion of ionization chambers, proportional counters and Geiger counters is to be found in this section. A very complete discussion is also given on the use of photographic emulsions for particle detection. Cloud chambers and scintillation counters are described in this section also, but given a rather cursory treatment. The electronic circuitry involved with this type of equipment is considered outside the scope of the book.

Following this general background material is a discussion of the elementary particles known to exist, including, in addition to the nuclear particles and the π and μ mesons, a section dealing with the V particles. This is followed by a detailed description of the phenomena associated with cosmic ray showers.

The next three chapters deal with the interaction of artificially generated particles and cosmic ray particles with matter. These chapters describe the many experiments which demonstrate the reactions occurring when high-energy particles encounter matter. Throughout these chapters, a very thorough quantitative account of the analyses of experimental results is given. This is one of the valuable features of the book inasmuch as it provides the experimentalist with a solid background and point of departure for further research in this field. These chapters are profusely illustrated with many plates showing different types of tracks in photographic emulsions. These plates are convincing evidence of the reality of the phenomena described in the accompanying text. The work is well documented by a seventeen-page bibliography.

The book is written in a clear, easily readable style. Its organization is logical and well thought out. The many illustrations and plates are excellently done and well printed. While a few typographical errors are to be found in the text, their number is probably below the average for a book of this type and they do not seriously intrude upon the reader.

In the preface to this book, the author states that the two objec-
New!

CONTROLLED ATMOSPHERE FURNACE
HEATS TO 1150° C IN 5 MINUTES!

(Cools to room temperature just as quickly)

Saves many man-hours in brazing or firing. Has special cooling section. While one work piece cools, others are fired in hot zone—visible from both ends. Work entered and removed with furnace operating. Accurate devices control temperature and flow of hydrogen, nitrogen or other gases.

MODELS
3" muffle with 18" hot zone
5" muffle with 24" hot zone

Write for illustrated Brochure

STEWART-SPELLER ASSOCIATES
SOQUEL, CALIFORNIA • Phone SANTA CRUZ 93W3

MICROWAVE RESISTORS
TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE
(Ideal for Miniaturisation)

TYPICAL APPLICATIONS
Power measurement at any frequency
Matched terminations for waveguides or coaxial lines
Resistive power pickup loops
RF pads or attenuators
Dummy loads
Temperature measurements
Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

FILM THICKNESS offers negligible skin effect, at microwave frequencies.

POWER CAPACITY of 1/4 watt provides high power handling ability.

PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 35°C
Size: 1/16 inch diameter x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 - 1/16 inch
Type R-093 - 3/32 inch
Temperature Coefficient: approx. 0.0015 ohms/ohm/°C
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

Want more information? Use post card on last page.
**BACKTALK**

**Electronic Organs**

WIDE interest in electronic organs has been exhibited by our readers. In the editorial offices of ELECTRONICS, we often receive letters from readers suggesting new and different ideas for generating tones for electronic musical instruments. Since it is, in general, contrary to our policy to publish proposals in the feature section, these ideas cannot be called to the readers' attention unless they are submitted as letters to appear in the Backtalk department of ELECTRONICS.

The following correspondence illustrates the chain of events that often follows the conception of an idea by a private individual. The first letter was written to a large manufacturer of electronic organs by J. B. Winther with the technical description of his idea for a new tone generating scheme. Following this description is a reply from the Patent Counsel of that company reprinted here for the benefit of those who may have conceived similar schemes, but who have not taken the time to call their ideas to the attention of a manufacturer as Mr. Winther has done.

**DEAR SIRS:**

I AM pleased that you are interested in appraising my scheme.

Actually the idea originated over 10 years ago, and I have waited to see it commercialized by someone. I felt that such an idea being basically simple would be apparent to anyone versed in electronics, and might appear on the market at any time.

After reading the article in the January 1951 issue of ELECTRONICS “Gas-Diode Electronic Organ” by R. M. Strassner, I felt convinced that if my method had ever been common knowledge, no one would go to the extent that the author did in designing an electronic organ.

My method achieves all the requirements which Strassner outlines as his objective. These I have outlined below:

“One of the greatest complaints against electronic instruments is that they are generally too perfect,
and therefore unnatural.

"Too many controls confuse or discourage the performer." I believe this is true for the average musician seeking a low priced instrument.

"It was required to develop an organ-like electronic instrument that would retail for $800." Because of low labor costs, I believe my method could easily equal or possibly better this figure.

Following is a description of my scheme along with a diagram. I have not attempted to secure a patent on this method, but have chosen a less tedious, and not nearly so drawn out method, by providing a signed document establishing the date of conception. Although this method does not provide the legal protection of a patent, it does provide a lever for the original inventor, thus he may work with experts in the field to provide mutual benefit to all concerned.

After you review this material, I would appreciate your reaction, and if favorable, please advise what course you propose to follow. I have been in engineering development for many years and fully realize the time, money, and engineering know-how which must yet be put into this new idea to make it productive.

J. B. Winther
Kenosha, Wisconsin

Organ Description

For many years electric keyboard instruments have been manufactured, their primary objective being to duplicate the results obtained with the mighty pipe organ. Various and ingenious methods have been devised, ranging from elaborate electronic circuits to modified reed organs in an effort to create an instrument which sounds just like a real pipe organ. The tone of a single organ pipe has been studied in great detail to obtain data on wave shape of fundamental, harmonics, percent of harmonic content and other characteristics. An electronic circuit is then developed which will duplicate these same tone patterns, or even attempt to improve on them.

The method outlined below seems to be the natural way to accomplish
SHAGGY AUDIO AMPLIFIER STORY

You've heard of the shaggy dog stories, well here's a tale that beats 'em all.

Into the Westinghouse Electronic Division offices one day came a man with a strange request. It was for an audio amplifier of extremely high power, powerful enough to build a whir of sound to a crescendo capable of shattering windows in the next county. (This, however, would not be its function.)

It just so happened we could supply a job to answer the description—a new design that delivers 3 or 10 kilowatts output power. It can actually take a signal of about 10 milliwatts from any conventional 30 to 20,000 cps source and build it up to 5 or 10 KW with uniform response (plus or minus 1.5 db).

But the odd part of the story is that we never were able to learn what the man planned to do with this extremely high power amplifier. And to add confusion to the mystery, since then many other guys have wandered in with the same strange shaggy dog request. We know, of course, that applications are conceivable in producing supersonic vibration, exploring variable frequency vibration phenomena, and producing supply power at any audio frequency (e.g.-400 cycle aviation equipment or 100,000 RPM grinding motor).

We decided there must be a market for it. Hence this advertisement. So— if you know of anyone who'd be interested in a variable frequency audio amplifier of extremely high power— capable of shattering windows in the next county— have them get in touch with Westinghouse Electric Corporation, Electronics Division, Industrial Electronic Devices Section, 2519 Wilkens Avenue, Baltimore 3, Maryland.

YOU CAN BE SURE...IF IT'S

Westinghouse

New A.W. HAYDON COMPANY

STOP CLOCK

High speed stop clock accrued seconds indicator with fluorescent dial and hands. Also available for other intervals.

SPECIAL FEATURES:
- Precision timing measuring hundredths of seconds to one minute.
- Automatic reset.
- Hermetically sealed.
- For operation on 50, 60, or 400 cycles A.C. or 20-35V D.C. 400 cycle unit has D.C. clutch.

This new, hermetically-sealed Stop Clock further enlarges the complete line of A.W. HAYDON COMPANY A.C. and D.C. Timers, timing delay relays and timing motors. This accurate, panel-mounted timer totals hundredths of a second up to a minute. Hermetically sealed, it weighs approximately 2 lbs. Comes with automatic reset.

WRITE FOR CATALOG

A.W. HAYDON COMPANY
235 NORTHELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices

BACKTALK (continued)

our objective. The sound emitted from an individual pipe of a pipe organ is recorded. The method of recording may be an adaptation of sound-on-film or wire recording. A suggested method is outlined below:

After each note is recorded (assume 61 in all) then there will be 61 separate individual patterns on record, each one ready to exactly imitate the original parent note. These 61 recordings or sound tracks are placed on a common conveyor, and set in motion. There will be 61 unit pick-ups involved, each ready to reproduce the recorded note, but not until the circuit is completed at the instrument keyboard by the selected key, during a rendition. Since any individual note is a continuous pattern of successive wave shapes, it is not necessary to extend the recording any longer than would be required to establish the wave pattern. This could be done in several cycles of the fundamental wave.

In a practical way this could be accomplished by recording around the circumference of a cylinder. Thus, the note could be continuous by duplicating itself for each revolution. There are problems which could be overcome, for example, overlap at the start and finish of the recorded note as the second revolution was started. This might be overcome by using two reproducers on one sound track 180 degrees apart and using less than a full revolution of recording, thus there is always one reproducer unit active at any one time.

As pointed out in the drawing a drum of ferrous magnetic material (possibly even Alinco material) of the type used in the wire of wire recorders could be

Suggested electronic organ scheme
TRANSFORMERS
"Fill Your Need to a

SAMPLE SHORT and LONG RUNS

Let us quote on your Specifications, no obligation

DESIGNED TO COMMERCIAL AND MILITARY SPECIFICATIONS (MIL-T-27 and AN-E-19)

EPCO Products Inc.
2500 Atlantic Ave.
Brooklyn 7, New York

PHOTO EQUIPMENT...
Geared to INDUSTRIAL & SCIENTIFIC Uses

FREE CAMERA, LENS and EQUIPMENT CATALOG

72 pages crammed with THOUSANDS of newest Photo Tools, Cameras, Lenses, Projectors, Lighting Equipment, Developing Equipment, Enlargers, etc. for the Amateur and Professional, in every day SCIENTIFIC and INDUSTRIAL WORK.

CAMERAS—of all types! Specal purpose, Photomicrography, Laboratory, NEW POLAROID LAND BACK, etc.

LENSES—World's largest stock from 1½" to 72". — All speeds, and types, Special Mounts, Lenscoating, etc.

LABORATORY EQUIPMENT — Stainless Steel Equipment, Dryers, etc.

Write TODAY to . . .

Burke & James, Inc.
SOLE PHOTOGRAPHIC EQUIPMENT SINCE 1897
321 S. Wabash Ave., Chicago 4, Illinois, U.S.A.

ENGRaving • PROFILING

for heavy production
with the Engravo graph

TRACER GUIDED FOR UNSKILLED LABOR

NEW HERMES, Inc.
13-19 University Place, New York 3, N.Y.

Engravo graph

Write for literature describing:
1. Heavy Duty model (as illustrated) — Catalog H 29
2. Portable models — Catalog IM 29

NEW HERMES, Inc. 13-19 University Place, N.Y. 3, N.Y.
In Canada: 359 St. James St., Montreal
World’s Largest Manufacturer of Portable Engraving Machines

High Current Regulated Power Supplies

New Series

Standard Sizes, 350 Series
0-350 V @ 750. ma.
0-350 V @ 1. Amp.
0-350 V @ 2. Amp.
0-350 V @ 3. Amp.

Featuring: Very low output impedance at high power levels; ½% regulation; 5 MV ripple.
Continuous duty components; short delivery.
Other units available: any voltage and capacity, regulated or unregulated, fixed or adjustable output voltage. We invite inquiries.

PESCHEL ELECTRONICS, INC.
13 GARDEN STREET, NEW ROCHELLE, N.Y. • NEW ROCHELLE 8-3342

Want more information? Use post card on last page.
Now! Royal brings you storage shelving in standard package units

- Now Royal simplifies your planning and purchasing of open or closed type shelving—standard sectional units are adaptable to your exact needs!
- No tools required for installation or adjustment—Royal shelving has 80% fewer bolts, erects quickly, easily, economically!
- Each shelf adjustable without disturbing others! Patented shelf brackets simple to insert into frame, are self-locking and self-supporting, provide better shelf stability than equal amount of bolts.

Royal Metal Manufacturing Co.
175 N. Michigan Ave., Dept. 2104, Chicago 1, III.
Factories Los Angeles - Michigan City, Ind.
Warren, Pa. - Weiden, N.Y. - Gulf, Ontario
Showrooms: Chicago - Los Angeles
San Francisco - New York City
Authorized Dealers Everywhere

Want more information? Use post card on last page.

Backtalk (continued)

formed into a seamless tube.

The 61 notes could probably be recorded in 61 pattern rings in about 24 inches of linear length of roll and probably a 1-ft diameter roll may be used. At 1,800 rpm it would be possible to record 60 complete cycles of a 1,800 cycle note or two complete cycles from a 60 cycle base note.

With the above arrangement it appears possible to build all the components into a small space. It seems that organ notes would be the most practical to reproduce as it appears to be a continuous note right from the start while a piano note would lack the hammer on-string effect. In fact, notes from a more expensive electronic organ could be reproduced this way by using the instrument for recording the parent note.

Also it would appear that a reedless piano accordion with this arrangement could produce unparalleled effects. An electromagnetic air-pressure sensing device in its bellows chamber could be used to modify the notes for expression in the music, to duplicate present playing techniques.

The method as illustrated does appear to have unusual possibilities. It has promise of opening a field of low-priced instruments.

Company Reply

Dear Mr. Wintner:

We thank you very much for your letter and your very lucid explanation of your improved electrical musical instrument.

We have naturally given consideration to various types of signal generators involving recordings of sound produced by pipes and various other instruments. This has likewise been given consideration by a large number of other people as is evidenced by a number of patents which have issued disclosing various schemes for using recorded tones as a basis for the production of tones in an electrical musical instrument. For example, the following patents disclose rotating devices in which the sound is photographically recorded and picked up photoelectrically: 2,199,948, 2,223,489, 1,989,-

At your service, for all small bearing problems, the Bird Company engineering staff designs accurate sapphire and glass jewel bearings used in the world's most famous aircraft, electrical and timing instruments; weather and all types of recorders; and fine indicating apparatus.

Close tolerances, accuracy, and long life qualify Bird Jewel Bearings to insure quality in your finest instruments. Quotations on request for jewels made to specifications for your individual requirements.

The engineering staff of the Bird Company is at your service for all small bearing problems.

Richard J. Bird & Co., Inc.
Sapphire and glass jewels - Precision glass grinding
Perite precision products - Sapphire stylus
7 Spruce Street, Waltham 54, Mass.
Want more information? Use post card on last page.

April, 1953 - ELECTRONICS
High Temperature Hydrogen Electric Furnaces

Hydrogen atmosphere heating chamber, hydrogen drying tower, water cooled unloading chamber, heat control with air cooled transformer with 11 position top switch. Automatic temperature control (optional) standard furnaces from 1" bore 1800° C. to 8" bore 1100° C. Molybdenum wound heating units, loading and unloading chambers equipped with safety doors. Supplied with hydrogen flow gauges. Made to order in many sizes.

High Temperature Furnaces Made by Eisler

EISLER ENGINEERING CO., Inc. 751 So. 13th St. Newark 3, N. J.

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.

leads in the field of

TRANSILLUMINATED PLASTIC LIGHTING PLATES

BECAUSE OF Quality • Uniformity • Performance

Design & Layout "Know-How Service"

Quantity Production Promptly

NEW YORK—19 Railroad Ave., New Rochelle (Home Office) TEXAS—Jefferson Tower Building, Dallas CALIFORNIA—11056 Campst St., N. Hollywood CANADA—313 Montreal Trust Bldg., 67 Yonge St., Toronto

DEMONSTRATION PANEL MIL-P-7788 (AN-P-89) Sent on Letterhead Request

WASHERS—ALL KINDS

WASHER SPECIALISTS for nearly half-a-century. Dies in stock will produce most sizes. Big runs made with automatic presses. An economical, accurate, and highly reliable source for washers, also all kinds of metal stampings. HAVE WHITEHEAD'S CATALOG ON FILE; write for it.

REVELED CUP D-HOLE RETAINER LOCK SPACERS SPRING TENSION SQUARE HOLE STAR LOCK THRUST TONGUE

WHITEHEAD STAMPING COMPANY

1691 W. LAFAYETTE • DETROIT 16, MICH.

WANT MORE INFORMATION? Send for New 32-Page Catalog

CREATORS OF "DI-LESS DUPLICATING"
The -SKL- Model 503 Fast-Rise Pulse Generator has been designed to meet the growing need for a convenient source of extremely fast and short rectangular pulses. In radar, nuclear physics, high speed oscilloscopy, and in the determination of network characteristics, the fast rise time and short pulse capabilities of the Model 503 find many uses. The variable repetition rate of 50 to 150 pps, pulse amplitude of .1 to 150 volts, and impedance of 50 ohms meet the great majority of needs encountered in this type of work. Convenience in the practical situation is enhanced by providing either positive or negative pulses, controlled by a switch, and an external trigger input which allows control of the repetition rate from an outside source. It is housed in a lightweight aluminum cabinet with convenient grouping of controls. The -SKL- Model 503 will be found indispensable for high speed, fast rise time research, development and testing.

SPECIFICATIONS:
- Rise Time: 10⁻¹ sec.
- (1 millimicrosecond)
- Impedance: 50 ohms
- Rep. Rate: 50 to 150 pps
- Pulse Amplitude: 0.1 to 150 volts
- Pulse Width: Calculated maximum width is 6 X 10⁻¹⁴ sec.

In-Res-Co Types CX & BX Wire Wound Resistors

Featherweight!

Sealed in molded bakelite plus lightweight

The dependable resistive elements that combine positive sealing with the important advantage of lightweight. Molded Bakelite core reduces weight by one-half compared to ceramics. Positive seal effectively protects the winding against harmful climatic conditions. Additional IN-RES-CO features include long life stability, hard soldered connections to terminals and extra-ductility, vibration proof terminal leads. Both CX and BX Resistors include space-saving terminal supported axial terminals of tinned wire.

IN-Res-Co Type CX Non-Inductive Resistor

IN-Res-Co Type BX Non-Inductive Resistor

Complementary Symmetry

Dear Sirs:

I HAVE read with much interest the article entitled "Experiments Illustrate Transistor Applications" in the March issue of Electronics. There is one point on which I should like to comment concerning the "complementary-symmetry" amplifier. Figure 1A of the article shows two grounded-emitter transistors, one an npn and the other a pnp, with a common base input terminal. A statement in the article referring to this arrangement says, "Due to the opposite

www.americanradiohistory.com
ELECTRIC INSTRUMENT & CONTROL HEADQUARTERS

YES, OFF-THE-SHELF SERVICE

Electro-Tech maintains one of the largest and most complete stocks in the country of electrical meters, instruments and industrial control equipment—representing over 250 top lines.

Yes, our warehouse is bulging with standard stocks of:

Counters
Panels
Transformers
Micro Switches
Photo Electric Equipment
Relays

Solenoids
Tachometers
Thermistors
Rectifiers
Rheostats
Timers

Toggle Switches
Shunts (Electrical)
Moggers
Pyrometers
Multimeters
Oscilloscopes

In addition, we manufacture and stock Special Test Equipment • Electric Heating Units • Current Transformers • Pyrometers • Thermocouples • Rectifiers.

Our laboratory is available for repair work, recalibration and special calibration of your electrical and industrial instruments. Often months are saved by recalibrating stock instruments to your specifications.

CONSULT US ABOUT YOUR REQUIREMENTS

ELECTRO-TECH EQUIPMENT CO.
55 LISPENARD ST., NEW YORK 13, N. Y.

COIL Quality
COIL Perfection
COIL Dependability
+ COIL Versatility

It all ADDS up to DANO COILS

• Form Wound
• Paper Section
• Acetate Bobbin
• Molded Coils
• Bakelite Bobbin
• Cotton Inter-weave
• Coils for High Temperature Applications

No matter how you figure: If you need custom-made coils tailored to your own special requirements, Dano is your answer. Furthermore, if you require those coils specially treated, Dano is your answer. If you insist on coils that will be perfect in performance and free from any possible defect, Dano long experienced in the manufacture of a wide variety of coils, is your answer.

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

The Green Engraver
ENGRAVES / ROUTS / PROFILES / and MODELS

Used and endorsed by tool and die, electronic, machine, plastics, radio, electrical and instrument manufacturers. A real money saver.

Specify the Green Engraver for precision engraving on metal, plastics, wood, glass, hard rubber etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs — by simple tracing from master. Routing, profiling and three dimensional modeling indicate its versatility. Electric etching attachment available.

FREE: Brochure—yours upon request.

NEW 800-2600 MCS
Frequency Meters
Lightweight-Portable Units... For Field and Laboratory Use!

The input circuit is a type N connector (UG-58/U) . . . . The output is monitored by a N218 crystal and microammeter circuit with adjustable sensitivity control for varying input power levels. The output of the crystal may be obtained from pin jacks provided on the panel of the instrument. A switch is provided to change the output from the microammeter to the pin jacks.

ACCURACY
Better than .05% from 20°F to 120°F
SENSITIVITY
Usable indication with 1 milliamp input Adjustable for higher levels
INDICATOR 50 Microammeter
INPUT
50 Ohm Type N Connector
EXTERNAL DC OUTPUT
Pin Jacks
EXTERNAL SIZE 6% x 9% x 7"
WEIGHT Four pounds

CAVITY UNITS AVAILABLE
Units consist of cavity body, microammeter control, crystal, suitable connectors and calibration chart. Write for specifications and prices.

The Green Engraver
ENGRAVES / ROUTS / PROFILES / and MODELS

Used and endorsed by tool and die, electronic, machine, plastics, radio, electrical and instrument manufacturers. A real money saver.

Specify the Green Engraver for precision engraving on metal, plastics, wood, glass, hard rubber etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs — by simple tracing from master. Routing, profiling and three dimensional modeling indicate its versatility. Electric etching attachment available.

FREE: Brochure—yours upon request.

NEW 800-2600 MCS
Frequency Meters
Lightweight-Portable Units... For Field and Laboratory Use!

The input circuit is a type N connector (UG-58/U) . . . . The output is monitored by a N218 crystal and microammeter circuit with adjustable sensitivity control for varying input power levels. The output of the crystal may be obtained from pin jacks provided on the panel of the instrument. A switch is provided to change the output from the microammeter to the pin jacks.

ACCURACY
Better than .05% from 20°F to 120°F
SENSITIVITY
Usable indication with 1 milliamp input Adjustable for higher levels
INDICATOR 50 Microammeter
INPUT
50 Ohm Type N Connector
EXTERNAL DC OUTPUT
Pin Jacks
EXTERNAL SIZE 6% x 9% x 7"
WEIGHT Four pounds

CAVITY UNITS AVAILABLE
Units consist of cavity body, microammeter control, crystal, suitable connectors and calibration chart. Write for specifications and prices.

The Green Engraver
ENGRAVES / ROUTS / PROFILES / and MODELS

Used and endorsed by tool and die, electronic, machine, plastics, radio, electrical and instrument manufacturers. A real money saver.

Specify the Green Engraver for precision engraving on metal, plastics, wood, glass, hard rubber etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs — by simple tracing from master. Routing, profiling and three dimensional modeling indicate its versatility. Electric etching attachment available.

FREE: Brochure—yours upon request.

NEW 800-2600 MCS
Frequency Meters
Lightweight-Portable Units... For Field and Laboratory Use!

The input circuit is a type N connector (UG-58/U) . . . . The output is monitored by a N218 crystal and microammeter circuit with adjustable sensitivity control for varying input power levels. The output of the crystal may be obtained from pin jacks provided on the panel of the instrument. A switch is provided to change the output from the microammeter to the pin jacks.

ACCURACY
Better than .05% from 20°F to 120°F
SENSITIVITY
Usable indication with 1 milliamp input Adjustable for higher levels
INDICATOR 50 Microammeter
INPUT
50 Ohm Type N Connector
EXTERNAL DC OUTPUT
Pin Jacks
EXTERNAL SIZE 6% x 9% x 7"
WEIGHT Four pounds

CAVITY UNITS AVAILABLE
Units consist of cavity body, microammeter control, crystal, suitable connectors and calibration chart. Write for specifications and prices.
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.

NOW! Immediate Delivery

NYLOK
SELF-LOCKING CLINCH NUTS

Nylon Insert Holds Tight
MEETS MILITARY SPECIFICATIONS

No fastening problem with NYLOK Self-Locking Clinch Nuts. Simply press in nut... clinch, insert screw and run it down. Resilient nylon insert assures positive lock. Assemble either end, speed up assembly. No damage to nut in removing. Can be used again and again, with no loss of locking feature. Available in steel and aluminum, standard sizes #4 to #10, or others to specifications. Write for complete information today.

Don't Design AROUND Your Fastening Problem—Design With NYLOK

Price savings now approximately 20%

The NYLOK CORPORATION, 475 Fifth Ave., New York 17, N. Y.
FACTORY: Elmira Heights, N. Y.

Please send me Bulletin #5 on Nylok Clinch Nuts with new low price list.

Name
Company
Street
City

USE THE COUPON FOR QUICK INFORMATION

Want more information? Use post card on last page.

BACKTALK

Circuit (top) and output waveforms for pnp-npn transistor amplifier signs of the transfer characteristics of these two types of transistors, the output signals will be 180 deg out of phase, one having been shifted 180 deg the other going straight through".

The writer wonders if it would not be better to call this action a "polarity discrimination" or a "phase splitting" rather than a "phase shifting". It would seem well worthwhile to provide as unambiguous an explanation as possible for transistor circuits.

To completely satisfy the writer's thoughts, the above circuit was constructed and tested as indicated. The oscillograms show the actual output voltage waveform for a small input signal and then for a large input signal.

The capacitors and biasing currents of the circuit could be removed with no loss, but an improvement in circuit efficiency; they were included only to allow each transistor to amplify small signals linearly.

R. H. SPENCER
Massachusetts Institute of Technology Dept of Electrical Engineering Servomechanisms Laboratory Cambridge, Massachusetts

April, 1953 — ELECTRONICS
For Long Life - Dependability!
Unconditionally guaranteed for 6 months.

For requirements send bulletin.

Continuous, WALKIE-RECORDALL MILES

Have you problems in -
Metal to Glass Seals?
NAME IT ... WE'LL MAKE IT!
TERMINALS HEADERS
END SEALS ... SPECIAL ITEMS
QUALITY PRODUCTS CO.
387 Charles St., Providence, R. I.

APPLICATION OF BATTERY
WALKIE-RECORDALL

SUBCONTRACTING
MILITARY AND COMMERCIAL.

FM MODULATION METER
Measures maximum modulation deviation in microvolts for any frequency, 25 to 200 MC. Price $240.00
LAMPKIN LABORATORIES, INC.
BRADENTON, FLORIDA

WAVEGUIDE
WAVEGUIDE Assemblies
WAVEGUIDE Components
- Low Cost • Quantity Production • Light-weight "One-piece constructions"
- Dimensions to ±.0005 • Internal finishes, 10 micro-inch • Excellent V.S.W.R
- Copper, Nickel, Silver • Some items shipped from stock.
Others, produced to your specifications, on short notice
Write now for additional information.

Allied Research & Engineering Inc.
1041 North Las Palmas • Hollywood 38, California

Eisler Manufacturing Complete Equipment
Welders for Spot & Wire Butt
Radio, TV Tube Equipment & Repair Units
Insulation, Fluorescent, Neon Equipment
NEON SIGN MAKERS' EQUIPMENT, GLASS LATHES
Electronic Equipment, Vacuum Pumps, Etc.
Wet Glass SLIDING & CUTTING MACHINES for Lab Use
Transformers, Special & Standard Types
Eisler Engineering Co., Inc.
751 So. 13th St. • Newark 3, N. J.

Electro Plating
SPECIALISTS IN
Silver, Cadmium & Zinc
Barrel Plating
Iridite and Cronak
Processes
To Government Specifications
Government Certified

Wide Range
Decade Resistor
Especially designed for use in development and production laboratories where standardized RTMA resistor values are to be determined easily and quickly.

Rochester Electronics Co., Inc.
DEPT 5-4 • BOX 227 • PENFIELD, NEW YORK

We invite inquiries on

Electronic Components

Write for catalog

Rex Rheostat Co.
Baldwin, L. I., N. Y.
DEPARTMENT HEAD
MISSILE ELECTRONICS

Prominent well-established aircraft and missile manufacturer offers an outstanding opportunity to a person qualified to head an expanding electronic organization. Salary commensurate with responsibility. Must have at least ten years experience in airborne electronics, five of which should be in missile or radar design and development. Advanced degree preferred. Position reports to chief engineer. Send detailed resume of background. Recent photograph optional.

P-6690, Electronics
520 N. Michigan Ave., Chicago 11, III.

ELECTRONICS ENGINEERS
FOR DESIGN & DEVELOPMENT WORK IN RADAR COMPUTERS
DIGITAL TECHNIQUES
with a young progressive company, send resume of experience and education, with salary requirements, to
Electronic Engineering Company
200 SOUTH ALVEAR STREET
LOS ANGELES 4, CALIFORNIA

Here is THE outstanding challenge—former President of successful electronic instrument manufacturer needs a man to head up new research and development laboratory in San Francisco Bay Area. Well financed and directed. If interested please send detailed resume to
P-7059, Electronics
65 Post St., San Francisco 4, Calif.

BUILTIN WORLD
ELECTRONICS CENTER
Metropolitan Oakland Area (MDA) house of the University of California and close to Stanford University, offers unmatched research or consultation facilities and personal service for manufacturers, fabricators and users in electronics field. Besides its ideal location in shadow of two world-renowned research centers, MDX provides many additional, exclusive profit advantages to industry; proximity to users in great electronics center, geographic links with million-dollar dollar program, etc. Top management salaries; major terms for all types, also salaried basis. For full facts about MDA and its services send resume to:

Ray Edwards
New Industrial Committee
Suite 601, 427-133 St., Oakland, Calif.

Selling Opportunities Wanted

REPLIES (Box No.): Address to office nearest you
NEW YORK: 255 W. 52nd St. (16)
CHICAGO: 222 W. Michigan Ave. (11)
SAN FRANCISCO: 40 Post St. (1)

POSITIONS VACANT
ASSISTANT CHIEF ENGINEER: Ohio company manufacturing electronic equipment has opening for electronic engineer approximately 25 years of age interested in capacity of administrative assistant to the chief Engineer. Duties will include engineering and sales work, supervision of laboratory projects and occasional traveling. Must have at least 5 years professional experience in circuit design and project supervision. Salary $7500 to $800 per year. Allowances for moving expenses. Replies held in confidence. Application to P-711, Electronics.

EXPANDING ORGANIZATION of established manufacturer's technical representative has excellent opportunity for experienced electrical engineer able to work on own initiative in Los Angeles area. Salary and profit sharing will produce above average income. In return this person must be able to plan his own schedule and assume engineering responsibility for a group of projects. Experiences in switchgear, unit subassemblies, and resistance welding equipment valuable. Please send complete details about yourself, necessary starting salary, etc. Communication will be kept confidential if desired. Wightman and Associates, 140 St., Glen Oaks Blvd., Burbank, California.

POSITIONS WANTED

ENGINEERING/SALES REPRESENTATIVE eastern area with office Washington, D.C., part of Multi-million dollar Professional Engineering concern with excellent electronic background. PW-1111, Electronics.

SALES ENGINEER age 33 currently selling electronic data, industry in east past 6 years. Will travel or relocate west coast for right offer. PW-7875, Electronics.

ENGINEER, ELECTRICAL, 25, married. 4 yrs. exp. Held service position on a major Government program in Metropolitan New York. PW-8970, Electronics.

ELECTRONIC ENGINEER, 23, three years experience in the design of electronic equipment for research including AC/DC low level instrumentation, transducers, and ultra-low radio frequency. PW-7891, Electronics.

Selling Opportunity Wanted

ELECTRONICS ENGINEER $12,200—NO FEE
To solve as a specialist complex electronic design and development problems in circuits, electro magnetic, etc. O'SHEA EMPLOYMENT SYSTEM. 64 E. Jackson, Chicago, Ill. Tel-Wabash 2-1824

ENGINEERS SYSTEMS
RADAR SERVO COMPUTER

You gain MORE with W. L. MAXSON. Top salaries ... greater opportunities ... more responsibilities. Advance with W. L. Maxson.


If you wish on now being fully utilized in a vital defense industrial position, W. L. Maxson does not apply. Kindly send resume and salary requirements to:

The W. L. MAXSON CORP.
440 W. 34TH ST., NEW YORK 1, N. Y.

COMMUNICATIONS ENGINEER

To study and report on new and existing communications systems and develop- ments in ancillary equipment; to act as liaison officer on radio propagation mat- ters. Honors degree in engineering physics or electrical engineering with specialization in communications engineering and knowledge of Multiplex and Telegraphic equipment required. Post graduate train- ing or experience desirable.

ELECTRONICS ENGINEER

To carry out research on electronic telecommunication equipment; to design and develop specialized electronic equipment as required; to carry out technical liaison duties. Honors degree in physics, engi- neering physics or electrical engineering with specialized training in electronics re- quired. Must have interest and ability in circuit design. National interest in or experience with electronic computers. Research experience in circuit work would be useful.

Initial salary up to $5200 per annum de- pending on experience and qualifications. Preference will be given to Canadian applicants.

Apply by mail, giving full details of qualifications and experience, to Chief, Personnel Branch, National Research Coun- cil, Ottawa, Ontario, Canada.
ENGINEERS
FOR ATOMIC
WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, Aerodynamicists, and Mathematicians. A variety of positions in research and development open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

LOCATE IN THE

Healthful Southwest

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

APPLICATIONS NOW BEING ACCEPTED FOR TECHNICAL WRITERS
These are not Civil Service Appointments

Make Application to the
PROFESSIONAL EMPLOYMENT DIVISION

SANDIA CORPORATION
SANDIA BASE
ALBUQUERQUE, N. M.

Want a more interesting job?

Most people do. But the problem is—where do you find one?

Maybe for you it's at Honeywell. A lot of engineers have found interesting jobs here, for the work is pretty fascinating most all the time.

And there's real opportunity for experienced engineers to go places in the growing Honeywell organization. Right now we have openings in six areas:

- Servomechanisms
- Vacuum tubes
- Gyros
- Electromechanics
- Relays
- Control Systems

Duties of the jobs. Take on complex design work requiring analysis and decision to bring into design form the requirements for a new or modified instrument, device or control system.

Requirements. B.S. or M.S. in Electrical, Mechanical or Aeronautical Engineering.

Atmosphere. A company that understands engineering — where one out of every ten employees is actively engaged in engineering or research.


For details write Ross Wagner, Personnel Dept., EL-4-78, Honeywell, Minneapolis 8, Minn. Ask for our book, "Emphasis on Research."

Honeywell

First in Controls
RCA NEEDS ENGINEERS who won't be held back!

RCA, pioneer and leader in every important branch of radio-electronics, has a permanent position for you if you are an experienced ELECTRONIC, COMPUTER, ELECTRICAL, MECHANICAL or COMMUNICATIONS ENGINEER...PHYSICIST...METALLURGIST...PHYSICAL CHEMIST...CERAMIST...GLASS TECHNOLOGIST.

You may choose to specialize in research, development, design and application. Both commercial and defense projects.

POSITIONS OPEN IN RESEARCH—DEVELOPMENT—DESIGN—APPLICATION in any of the following fields:

RADAR—
- Circuits—Antenna Design—Servo Systems—Information Display Systems
- Gear Trains—Stable Elements—Intricate Mechanisms

COMPUTERS—
- Digital and Analog—Systems Planning—Storage Technique—Circuitry
- Servo Mechanisms—Assembly Design—High Speed Intricate Mechanisms

COMMUNICATIONS—
- Microwave—Aviation—Mobile—Specialized Military Systems

MISSILE GUIDANCE—
- Systems Planning and Design—Radar and Fire Control—Servo Mechanisms—Vibration and Shock Problems

NAVIGATIONAL AIDS—
- Loran—Shoran—Altimeters—Airborne Radar

TELEVISION DEVELOPMENT—
- Receivers—Transmitters and Studio Equipment

COMPONENT PARTS—
- Transformer—Coil—Relay—Capacitor
- Switch—Motor—Resistor

ELECTRONIC TUBE DEVELOPMENT—
- Receiving—Transmitting—Cathode-Ray—Phototubes and Magnetrons

ELECTRONIC EQUIPMENT FIELD ENGINEERS—
- Specialists for domestic and overseas assignment on military electronic communications and detection gear.

There’s not a temporary job among them. War or depression, RCA has continued to grow...growth in which you'll share when you launch your lifetime RCA career.

For many other reasons, too, RCA is a good place for you to work. RCA affords unequaled facilities in pleasant surroundings...every chance for advancement in rank and income...enjoyable suburban or country living conditions...professional recognition for achievement...modern retirement program. Many Company-paid benefits for you and the family. PLUS modern tuition-refund plan for advanced study at recognized universities.

Personal interviews arranged in your city.

If you qualify for any of the positions listed above, please send us a complete resume of your education and experience. Please state your specialized field preference. Send resume to:

MR. ROBERT E. MCQUISTON, Manager Specialized Employment Division, Dept. 200D, Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N.Y.

RADIO CORPORATION of AMERICA
SPECIAL OPPORTUNITIES FOR SENIOR ENGINEERS

Convair in beautiful, sunny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in commercial aircraft, military aircraft, missiles, engineering research and electronics development. Positions open in these specialized fields:

- Electrical Design
- Mechanical Design
- Structural Design
- Aerodynamics
- Thermodynamics
- Operation Analysis
- System Analysis

Generous travel allowances to those accepted.
For free brochure, write Mr. H. T. Brooks, Engineering Dept. 900

CONVAIR
IN BEAUTIFUL
SAN DIEGO
3302 PACIFIC HIWAY
SAN DIEGO 12, CALIFORNIA

DO YOU THINK

CREATIVELY
in
ELECTRONICS
PHYSICS
MECHANICS

We are seeking several men with creative minds—men able to think, beyond today's realities. You should have a well-rounded background in electronics or an allied field.

We offer freedom not only to envision your ideas but also to carry them to completion. You will work on the problems of color television, radar, radio with the most advanced equipment, and as a member of one of industry's foremost engineering teams. To the right man we offer a lifetime career opportunity.

Write to us in full confidence. We want an opportunity to explain to you the many benefits of working and creating with this organization.

All the members of our staff know of this advertisement.

Write to P-7131, Electronics
330 W. 42 St. New York 36, N. Y.

April, 1953 — ELECTRONICS
Men of Vision

apply CREATIVE engineering to research, development, and design ... the KEY to SOLID SUCCESS at

GOODYEAR AIRCRAFT

If you are seeking a position where ingenuity, personal initiative, and ability count most, investigate the various opportunities offered by Goodyear Aircraft. We have openings for able, experienced personnel in the following fields:

- Electrical Systems
- Circuit Analysis
- Analog Computers
- Servomechanisms
- Test Equipment
- Applied Mathematics
- Electronics
- Aerodynamics
- Physics
- Flight Test
- Stress Analysis
- Dynamics
- Microwave
- Structures
- Designing in All Fields
- Tool Design
- Tool Planning
- Tool Processing
- Industrial Engineering
- Estimation
- Time Study
- Plant Engineering

Openings also exist for welding, civil, and mechanical engineers with experience in metals fabrication. Needed too are personnel with ability and experience in technical editing, copywriting, illustration, and photography.

Positions are available at several levels; inquiries are also invited from recent graduates. Liberal salaries are based on education, ability, and experience. Paid vacations and holidays, sick leave, insurance, and retirement plans are added benefits.

Goodyear Aircraft is centrally located in the Great Lakes region ... in the heart of northeastern Ohio. Akron, a community of 350,000, is a clean and friendly home town to thousands of Goodyear employees and their families who enjoy metropolitan living and fine cultural and educational advantages. Excellent parks, golf courses, and inland lakes give active, year-round enjoyment. The Aircraft division is a full-fledged member of the Goodyear family ... a name famous the world over.

If YOU are interested in a secure future, write and give full details to

Mr. C. G. Jones, Salary Personnel Department

GOODYEAR AIRCRAFT CORPORATION • 1210 Massillon Road, Akron 15, Ohio
OPPORTUNITIES WITH SYLVANIA
Where Product Development Is The Key To Continuing Growth

Product development has always played a major role in Sylvania’s operations and is largely responsible for the company’s growth to 40 plants throughout the nation. Similarly, Sylvania’s Electronics Division is continuing its expansion program to accommodate increased development engineering and manufacturing activities.

To engineers this means increasing opportunity with this 51 year old leader in the important field of electronics. At the Electronics plants in Woburn, Newton and Ipswich, Massachusetts you will enjoy the unique advantages of small plant operations in suburban areas minutes from the cultural and social activities of Boston. And — with Sylvania’s assistance, you may continue your graduate studies at near-by world-famous universities.

Positions available for engineers with the following backgrounds:

MICROWAVE — with graduate work or experience in microwave theory. Positions will involve applications, measurements, or design of electronic test equipment for semi-conductor devices.

MECHANICAL — with experience in the following fields: 1. Design of small parts, tools, and jigs and fixtures. 2. Design of automatic production equipment.

SOLID STATE PHYSICISTS — Ph.D. or equivalent in experience in physics with a specialty in solid states work preferred. Will study electrical and optical behavior of semi-conducting materials.

METALLURGISTS — advanced degree or experience required. Will work on metallurgical preparations of semi-conducting devices.

ELECTRONIC — with graduate work or experience in product or circuit design and development.

Send complete resume to:
Mr. Robert L. Koller

SYLVANIA-ELECTRIC
Electronics Division
WOBURN, MASS.

RCA VICTOR COMPANY, LTD.
( Canadian Affiliate of RADIO CORP. OF AMERICA)
has vacancies in its expanding research and engineering staff for:

ELECTRONICS ENGINEERS
MECHANICAL ENGINEERS
PHYSICISTS

in such fields as:

MILITARY RADIO AND RADAR
MICROWAVE COMMUNICATIONS
ANTENNA DESIGN
TELEVISION
TV AND RADIO COMPONENTS

If you are interested in the career opportunities of Canada’s expanding economy, coupled with the advantages of associating with a leading member of a growing industry, you should investigate.
Write or apply
RCA VICTOR COMPANY, LTD.
1001 Lenoir Street,
MONTREAL 30, QUE., CAN.

ENGINEERS PHYSICISTS
TAKE INVENTORY OF YOUR FUTURE
WHAT MAKES A GOOD JOB?

Check off the items in the following list that you look for in a good job.

1.—Professional Recognition
2.—Interesting work
3.—Equitable salary
4.—Recognition of Ability
5.—Security
6.—Good future prospects
7.—Reward for ideas
8.—Good working conditions
9.—Liberal benefit program
10.—Family protection
11.—Paid vacations and holidays

If you look for all of the above items and more, in a good job, it will be to your advantage to investigate the opportunities in Electronic Circuit Design and specialized vacuum tube research and development at . . . .

NATIONAL UNION RADIO CORP.
ELECTRONIC RESEARCH DIVISION
P. O. Box 352 Orange, New Jersey

April, 1953 — ELECTRONICS
ELECTRONIC SYSTEMS ENGINEERS
Experienced in:
Development and Design of
Electronic Systems including
experience in
SERVO DRIVES
RADAR MICRO WAVE
TECHNIQUES
PRECISION TIME
MEASUREMENTS
COMPUTERS
GYROS
SYNCHROS
UHF CIRCUITORY

MECHANICAL ENGINEERS
Experienced in:
Design and Development of
Mechanical Systems including
experience in
MACHINE DESIGN
STRESS ANALYSIS
MECHANISMS
CAM DESIGN
GEAR AND GEAR TRAINS

You can aim high at
DAYSTROM INSTRUMENT

a great new division of an old established
company... offers challenging assignments
and splendid facilities in a magnificent
new plant.
Enjoy ideal working and living condi-
tions within 30 minutes driving distance of
world-famous winter and summer resorts
... only three hours from New York or
Philadelphia.
Salary in line with ability. Modern
benefits program. Interview and moving
expenses paid.

Contact
PERSONNEL
DEPARTMENT

A DIVISION OF DAYSTROM, INCORPORATED
ARCHBALD, PENNSYLVANIA

Affiliated Companies: American Type Founders, Inc. • Daystrom Electric Corporation • Daystrom Furniture Division

ELECTRONICS — April, 1953
437
MAKING 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

MAKERS OF THE WORLD'S FINEST ELECTRONIC EQUIPMENT

Applications
ENGINEER

An engineer is needed to study circuit problems involving the use of small electron tubes and semi-conductor devices, in the applications laboratory of motor radio tube manufacturer. A degree in electrical engineering, electronic engineering, or physics is required. Salary commensurate with experience and ability. Applicants without experience will be considered. We offer good pay and many employee benefits. Send resume or apply at
TUNG-SOL ELECTRIC INC.
200 Bloomfield Avenue, Bloomfield, N. J.

TV DEFLECTION YOKE ENGINEER

An established manufacturer of TV Deflection Yokes and other electronic products offers an excellent opportunity for an engineer with experience in manufacturing and supervision of production personnel. Background in design of yokes and winding machinery desirable.

Manufacturer located in Michigan. Attractive salary arrangement and liberal vacation. Please mail resume of education and commercial experience to
P-1332, Electronics
570 N. Michigan Ave., Chicago 11, Ill.
PERMANENT ENGINEERING POSITIONS OPEN WITH
WHIRLPOOL CORPORATION
World's Largest Manufacturer of home laundry equipment
ST. JOSEPH, MICHIGAN

Creative engineering in design and development requiring men of vision and individual ingenuity.

Engineers, Engineering & Experimental Department personnel, at all levels of experience needed now and for future consideration. Open positions are in development, design, research. Constantly expanding firm, with strong & growing emphasis on engineering functions, offers unusual opportunity, incentive, many supplementary benefits, and ideal living conditions in nationally known resort area.

If you are considering a change or qualified to start an engineering career write:

MR. J. M. RANUM, Director of Personnel

All inquiries confidential and all will be acknowledged.

ELECTRONIC ENGINEERS
We are expanding our permanent staff of engineers and scientists working in research and development on such problems as:

ELECTRONIC INSTRUMENTATION, MISSILE GUIDANCE, MICROWAVE APPLICATIONS, DESIGN OF SPECIAL PURPOSE ELECTRONIC COMPUTERS, TELEMETERING AND COMPLEX CONTROL SYSTEMS

While experience is important, general knowledge and breadth are more important than particular specialties.

If you would like to work in the stimulating atmosphere of an applied research and development laboratory where ideas are important, initiative is encouraged and associates are competent, we would be pleased to discuss employment with you. Descriptive material available upon request.

CORNELL AERONAUTICAL LABORATORY, INC.
BUFFALO 21 NEW YORK

STAFF ENGINEERS
Design and Development

Leading Chicago Electronics firm is seeking the services of qualified men to fill several staff openings in its Electronic Design and Development Division. Persons selected will be given intermediate and advanced level assignments in our Television, Radio and Government Equipment Laboratories.

Experience in monochrome receivers, deflection and high voltage circuits, radiation interference, NTSC color receivers, color generating equipment or UHF systems essential.

These are permanent positions and offer excellent opportunities for advancement. Company has well planned, long range program of design and development.

Please write Mr. Walter Wecker, Personnel Division, giving related experience and educational qualifications.—Or telephone SPaulding 2-0100.

Interviews arranged at your convenience.

Admiral Corporation
3800 W. Cortland St. Chicago 47, Illinois
A NEW Bendix Division!
A NEW Electronic Product!
NEW JOB OPPORTUNITIES

In our modern plant at York, Pennsylvania, this new division of Bendix Aviation Corporation is producing a new electronic product. This division has a big future; and this is your opportunity to get in on the ground floor, with excellent possibilities for rapid advancement. We need the following:

- ELECTRONICS ENG.
- MECHANICAL ENG.

Also we have many openings for men qualified by education or experience in all phases of electronics.

YOU BENEFIT

With the Bendix York Division, you will benefit from high wages, paid vacations and holidays and ideal living conditions in a beautiful suburban area.

Write, Wire or Phone, Department Y-1

AVIATION CORPORATION
YORK DIVISION

Write York 5521 York, Penna.

SALES ENGINEER

- ELECTRONIC COUNTERS
- AUTOMATIC CLERICAL SYSTEM
- DATA HANDLING EQUIPMENT
- DIGITAL COMPUTERS
- PRECISION TIMING INSTRUMENTS
- AUTOMATIC MACHINE CONTROL
- FLYING TYPEWRITER

Excellent opportunity for a man with electronic background, mechanical aptitude, and IMAGINATION. Well-established and expanding company. Please send resume of education and experience to Sales Manager.

POTTER
INSTRUMENT COMPANY
115 Cutter Mill Road, Great Neck, N. Y.

ELECTRONICS ENGINEERS
WANTED

SOUTHERN CALIFORNIA

Attractive opportunities offered to Engineers experienced in and qualified to design aircraft flush antennas and radomes.

Complete modern facilities for laboratory testing and evaluation available.

Salary dependent upon experience and ability.

Contact Mr. J. C. Buckwalter, Chief Engineer

DOUGLAS AIRCRAFT COMPANY, INC.
LONG BEACH, CALIFORNIA

YOUNG ENGINEERS WANTED

Recent graduates from engineering colleges in Aeronautical, Mechanical, or Electrical Engineering. After a training course at our factory we will locate men in Dallas, Texas, and Los Angeles, California. Prefer men 25 to 30 years of age.

If you are interested in making connections with a company which is geared to war or peace conditions and which has plans for a long-range program independent of Government defense appropriations, we can offer qualified men an excellent future.

P-6748, Electronics
320 W. 42 St., New York 36, N. Y.

TRANSFORMER ENGINEER

We can offer outstanding opportunity to a man with two or more years experience in transformer design and development. Position requires initiative and ingenuity. Excellent future.

B.S. in E.E. or equivalent required.

PERMOFLUX CORPORATION
4900 W. Grand Ave. Chicago 39, Illinois

April, 1953 — ELECTRONICS
MOTOROLA INC.

NEEDS

ELECTRONIC ENGINEERS

Experienced engineers for television receiver and circuit design. Experienced men also needed in U.H.F. and V.H.F. tuner design.

MECHANICAL ENGINEERS

Experienced mechanical engineers with a degree in M.E. or equivalent. Must have at least five years of actual design experience on electro-mechanical products.

RADIO ENGINEERS

Experienced in the design of broadcast and shortwave receivers for export use.

ELECTRO-CHEMISTS

Experienced electro-chemists needed in our fast growing plated circuit division.

Salaries commensurate with ability and experience. Excellent opportunities for advancement. More than the usual employee benefits.

Your reply will be kept in strictest confidence. Include a summary of your education, background and experience when you write to:

PERSONNEL DEPARTMENT
CONSUMER PRODUCTS DIVISION
MOTOROLA INC.
4345 W. AUGUSTA BLVD.
CHICAGO 51, ILLINOIS

---

ELECTRICAL and ELECTRONIC ENGINEERS

Excellent opportunities in the field of

AUDIO AMPLIFIER DESIGN
SERVO AMPLIFIER DESIGN
COMPONENT DEVELOPMENT
EQUIPMENT DESIGN

Senior and Junior Engineers

Write, giving full details to:

Personnel Director, Dept. A,
GIBBS MANUFACTURING AND RESEARCH CORPORATION
Janesville, Wisconsin

---

We desire personnel of the highest caliber—experienced in the field of airborne automatic electro-mechanical control equipment.

* * *

ENGINEERS

MECHANICAL DESIGN
ELECTRONIC
SERVO

DESIGNERS-LAYOUT MEN

ELECTRONIC
MECHANICAL

This work deals with the manufacture and development of highly complex equipment of the most advanced type in a new and expanding division of an established firm with 20 years of successful experience in the precision instrument field.

We cite a few of the good reasons why you might like to join our organization . . .

** SALARY increases are based on merit and initiative—two weeks VACATION.
HOSPITALIZATION BENEFITS, GM's own INSURANCE PLAN—POSITIONS ARE PERMANENT due to long range manufacturing and developing programs—EXPENSES incident to interviews and moving all absorbed by company—HOUSING and LIVING CONDITIONS among the best and finest of any along Lake Michigan.

... all inquiries answered—write or apply . . .

* AC SPARK PLUG DIVISION

GENERAL MOTORS CORPORATION

1925 E. KENILWORTH PL.
MILWAUKEE 2, WIS.

An invitation to

Engineers & Physicists

Investigate the outstanding record of achievement and future plans of melpar, inc.
The Research Laboratory of Westinghouse Air Brake Co. and its subsidiaries

Write to Personnel Director,
MELPAR, INC.
452 Swann Avenue
Alexandria, Virginia
or 10 Potter St., Cambridge, Mass.
ELECTRONIC ENGINEERS

EE or ME degree, minimum 3 years' experience in research and development work involving circuit development, servomechanisms, analogue computers or related equipment.

FIELD REPRESENTATIVES

A few openings for graduate engineers only with backgrounds similar to above. Continental U.S.A.

What You Can Expect at

General Precision Laboratory

A young company of young, successful men, firmly established as designers and manufacturers of electronic equipment ... a medium-sized stuff in which you receive individual recognition ... a policy of promotion-from-within that helps qualified men move ahead swiftly ... a modern laboratory located in a pleasant suburban community ideal for family living.

Expenses will be paid for qualified applicants who come for interviews. Please submit complete resume to: Mr. H. F. WARE

GENERAL PRECISION LABORATORY

INCORPORATED

A Subsidiary of GENERAL PRECISION EQUIPMENT CORPORATION

63 BEDFORD ROAD, PLEASANTVILLE, NEW YORK

ENGINEERS

Real ability and originality can find new challenge and opportunity in Southern California with a leading west-coast electronic development and manufacturing organization.

Electronic Engineers

Experienced in design-development of electronic devices.

Radio Receiver Specialists

Engineer standard and display types—V.H.F.—U.H.F. areas.

Relocation expenses will be paid if accepted. Excellent conditions including regular advance review, health and disability insurance, 48 hour week, standard paid holidays and annual vacations. Relocation should not disturb present military privileges.

"Send complete resume with invoice history & requirements to engineering employment mgr."

Hoffman LABORATORIES, Inc.

3761 SO. HILL ST.

LOS ANGELES 7, CALIF.

(A Subsidiary of Hoffman Radio Corp.)

UHF and
MICROWAVE ENGINEERS

This rapidly growing Organization in south central Wisconsin, approximately 100 miles from Chicago, has several openings for Junior and Senior Engineers in the U.H.F. and Microwave fields.

UNUSUAL SALARY OPPORTUNITIES exist under ideal working conditions in large, well-equipped laboratories. Personnel benefits such as sickness, accident, and life insurance in addition to a very liberal pension system are offered.

For more information concerning the positions that are open we invite you to write to Personnel Director, Department A.

GIBBS MANUFACTURING & RESEARCH CORPORATION

Janesville, Wisconsin

Engineers

Research & Development Electronic Organs

Well rated company also has government prime contracts. Reasonable rental housing available. Write giving full details—education and experience.

CENTRAL COMMERCIAL INDUSTRIES

1215 W. Washington Blvd.

Chicago 7, Ill.

HOUSTON, TEXAS

Precision equipment manufacturer needs qualified experienced engineer for audio and sub-audio transformer design and development.

Experience with high permeability alloys desirable. Knowledge of magnetic circuitry must be sufficient for development work on magnetic amplifiers. Salary commensurate with ability.

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.

P.O. BOX 13058 HOUSTON 19, TEXAS

April, 1953 — ELECTRONICS
CAREER OPPORTUNITIES
ENGINEERS and PHYSICISTS

Desiring the challenge of interesting, diversified, important projects —
Wishing to work with congenial associates and modern equipment and facilities —
Seeking permanence of affiliation with a leading company and steady advancement —
Will find these in a career here at GENERAL MOTORS.

Positions now are open in ADVANCED DEVELOPMENT and PRODUCT DESIGN, INDUSTRIAL ENGINEERING, TEST and TEST EQUIPMENT DEVELOPMENT.

COMMERCIAL AUTOMOBILE RADIO
MILITARY RADIO, RADAR AND ELECTRONIC EQUIPMENT
ELECTRONIC COMPONENTS
TRANSISTORS AND TRANSISTOR AND VACUUM TUBE APPLICATIONS
INTRICATE MECHANISMS such as tuners, telemetering, mechanical linkage, controls, etc.
ACoustics—loud speakers, etc.

Inquiries invited from recent and prospective graduates as well as experienced men with bachelors or advanced degrees in physics, electrical or mechanical engineering, chemistry, metallurgy.
Salary increases based on merit and initiative.
Vacations with pay, complete insurance and retirement programs.
Location is in a low living cost center.
Relocation expenses paid for those hired.

All inquiries held in confidence and answered — WRITE or APPLY to
DElCO RADIO DIVISION
GENERAL MOTORS CORPORATION
Kokomo, Indiana

GENERAL MAGNETICS INC. has openings for
ELECTRICAL ENGINEERS

With at least three years experience in design and development of MAGNETIC SERVO AMPLIFIERS.
A chance to grow with a young and progressive company. Salary and advancement commensurate with ability. State education, experience and salary requirements.
Address all inquiries to
GENERAL MAGNETICS INC.
135 Bloomfield Ave. Bloomfield, N. J.

WANTED
ENGINEER WITH EXPERIENCE IN VHF OR UHF

Interesting creative work with the most resourceful and progressive firm in the field of television equipment.
This position is permanent. It will offer every opportunity for unlimited advancement and for developing a successful career. The plant is now housed in a newly-acquired larger building, only 11/2 miles from downtown New York city. The surroundings and atmosphere are stimulating and congenial.

Attractive Salary
Write stating qualifications.
BLONDER-TONGUE LABORATORIES
526-536 North Avenue
Westfield, New Jersey

ELECTRONIC ENGINEERS

Wide range of experience including design of wide band receivers, radar display systems, analogue computers, servo systems & CR oscillographs ... thorough knowledge of RF circuits, wave shaping, pulse forming, triggers & gates (microwave techniques unnecessary)

A FEW KEY POSITIONS...
Opening of our own manufacturing facilities creates permanent positions in research and development of vital, high-cash-products.

CONSIDER THESE ADVANTAGES...

Glorious country living, free from big-city pressures, provides a relaxing atmosphere in which you can do your best work ... yet within easy reach of the cultural advantages of New York.
Association with an established yet growing organization with few competitors in the field, where your merit and ability are given full consideration.

Unlimited company-paid benefits ... 40-hour week with considerable premium overtime ... interesting expenses paid.

TAKE ADVANTAGE OF THIS OPPORTUNITY NOW!
Address all inquiries to J. H. McCann

SPERRY PRODUCTS INC.

DANBURY
CONNECTICUT
COAXIAL CONNECTORS

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS IN STOCK UHF—N—PULSE—BN—BNC

OIL FILLED CONDENSERS

PULS TRANSFORMERS

SPRAGUE PULSE NETWORKS

FILEM AMPLIFIER TUBE INPUT 115 V, 50/60 CYCLES

CM TEST EQUIPMENT

Spare Parts

Electronic Research Laboratories

Searchlight Section

Write for our free bulletin

Guaranteed Brand New

Coaxial Connectors

Coaxial Cable

Oil Filled Condensers

Oilmites

Electronic Research Laboratories

715-19 Arch St.


Tel.: 110-771-2-3

April, 1953 — ELECTRONICS
SPECIALS

STANDARD BRANDS ONLY

WRITE FOR OUR FREE BULLETIN

IMMEDIATE

DELIVERY FROM STOCK

GENERAL ELECTRIC ARMA CONTROL INSTRUMENT BENDIX FORD INSTRUMENT KETAY HENSCHEL DIEHL

TYPE "J": POTENTIOMETERS $1.25 ea.

DUAL "J": POTS—$2.95 ea.

TRIPLE "J": POTS—$3.95 ea.

ANTENNAS

GENERATORS AND INVERTERS

TRANSFORMER GENERATOR

Eclipse PM-1—2.9 VDC output per 100 RPM Brand New

AIRBORNE TV EQUIPMENT—mfd. by RCA

GENERATORS L-11 50VA to 5000VA w/ Lear, Lewelling and International. Transmitter-CR-525AB cens. Transformer 25 Amp. Excellent for Instruction or Demonstration Purposes.

TERMS 20% cash with order, balance C. O. D. unless noted. All prices net F. O. B. our warehouse in Philadelphia, Penna., subject to change without notice.

CABLE ADDRESS • "ELECTRONIC PHILADELPHIA"

SYNCHROS

ARMY ORDANCE—NAVY ORDANCE—COMMERCIAL

SYNCHRO OVERLOAD INDICATORS

SYNCHRO BLOW FUSE INDICATORS

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-2A (Army Model NEA-2A) Output AC 115V 180VA to 1000V 16 30 CYCLES 10 AMP 4000 RPM 1226 VA Input 115V 30A 30H 240V 15A 60H 210001 199698 2.69

Eclipse-Pioneer type 1216 Inverter—250V Output up to 115 VAC 60 cy 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1212 Inverter—26 cy 115 VAC 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1217 Inverter—26 cy 115 VAC 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1206 Inverter—2100 Watts Input 230V 60 cy 5 Amp Contact 1.25

VARIABLE TRANSFORMERS

Amatronics—Type B1—Input 115V 100 cy. Output 120V 8 cy. $33.50 ea.

Amatronics—Type D—Input 220V 100 cy. Output 230V 8 cy. $60.50 ea.

Amatronics—Type B2—Input 115V 200 cy. Output 120V 200 cy. $60.50 ea.

Amatronics—Type D2—Input 220V 200 cy. Output 230V 200 cy. $120.00 ea.

Eclipse-Pioneer type 1212 Inverter—26 cy 115 VAC 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1217 Inverter—26 cy 115 VAC 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1206 Inverter—2100 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1216 Inverter—250V Output up to 115 VAC 60 cy 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1212 Inverter—26 cy 115 VAC 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1217 Inverter—26 cy 115 VAC 2500 Watts Input 230V 60 cy 5 Amp Contact 1.25

Eclipse-Pioneer type 1206 Inverter—2100 Watts Input 230V 60 cy 5 Amp Contact 1.25
<table>
<thead>
<tr>
<th>TYPE</th>
<th>PRICE</th>
<th>TYPE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OX2</td>
<td>11.40</td>
<td>TC2</td>
<td>17.95</td>
</tr>
<tr>
<td>OZ2</td>
<td>1.10</td>
<td>TC12</td>
<td>14.00</td>
</tr>
<tr>
<td>OZ1</td>
<td>1.95</td>
<td>TC22</td>
<td>15.95</td>
</tr>
<tr>
<td>OZ5</td>
<td>1.25</td>
<td>TC32</td>
<td>18.50</td>
</tr>
<tr>
<td>OZ3</td>
<td>1.95</td>
<td>TC33</td>
<td>17.95</td>
</tr>
<tr>
<td>C33</td>
<td>3.95</td>
<td>TC13</td>
<td>14.00</td>
</tr>
<tr>
<td>H51A</td>
<td>2.75</td>
<td>TC16</td>
<td>18.50</td>
</tr>
<tr>
<td>N25</td>
<td>17.95</td>
<td>TC23</td>
<td>13.50</td>
</tr>
<tr>
<td>R25</td>
<td>2.95</td>
<td>TC24</td>
<td>20.00</td>
</tr>
<tr>
<td>R26</td>
<td>2.95</td>
<td>TC26</td>
<td>18.00</td>
</tr>
<tr>
<td>R27</td>
<td>1.95</td>
<td>TC31</td>
<td>20.00</td>
</tr>
<tr>
<td>R28</td>
<td>2.95</td>
<td>TC34</td>
<td>15.95</td>
</tr>
<tr>
<td>R34</td>
<td>2.95</td>
<td>TC35</td>
<td>18.00</td>
</tr>
<tr>
<td>R35</td>
<td>3.75</td>
<td>TC36</td>
<td>12.00</td>
</tr>
<tr>
<td>R36</td>
<td>3.75</td>
<td>TC37</td>
<td>15.95</td>
</tr>
<tr>
<td>R37</td>
<td>18.60</td>
<td>TC38</td>
<td>15.95</td>
</tr>
<tr>
<td>R38</td>
<td>2.95</td>
<td>TC40</td>
<td>22.00</td>
</tr>
<tr>
<td>R39</td>
<td>2.95</td>
<td>TC49</td>
<td>20.00</td>
</tr>
<tr>
<td>R40</td>
<td>2.75</td>
<td>TC50</td>
<td>25.00</td>
</tr>
<tr>
<td>R41</td>
<td>2.75</td>
<td>TC51</td>
<td>28.00</td>
</tr>
</tbody>
</table>

**Other test equipment, used checked out, surplus.**

- **TSK1/SE X Band Spectrum Analyzer**
- **TS3A/AP Frequency and power meter S Band**
- **RF4A/AP Phantom Target S Band**
- **TS10/APN Altimeter Test Set**
- **TS12/AP VSWR Test Set for X Band**
- **TS13/AP X Band Signal Generator**
- **TS14/AP Signal Generator**
- **TS15/AP Flux Meter**
- **TS16/AP Altimeter Test Set**
- **TS18/AP X Band Power Meter**
- **TS33/AP X Band Power and Frequency Meter**
- **TS/34AP Western El Synchroscope**
- **TS34A/AP Western El. Synchroscope**

**MICROWAVE TEST EQUIPMENT TS148/UP SPECTRUM ANALYZER**

Field type X Band Spectrum Analyzer, Band 8430-9580 Megacycles.

Will check Frequency and Operation of various X Band equipment such as Radar Magnetrons, Klystrons, TR Boxes. It will also measure pulse width, c-w spectrum width and Q or resonant cavities. Will also check frequency of signal generators in the X band. Can also be used as frequency modulated Signal Generator etc. Available new complete with all accessories, in carrying case.

Also available of new production TS239A Synchroscope.

**MINIMUM ORDER 25 Dollars**

**SPECIAL**

Wide Band S Band Signal Generator 2700/3200MC using 2K41 or PD B165 Klystron, Internal Cavity Attenuator, Precision individually calibrated Frequency measuring Cavity, CW or Pulse, Modulated, externally or internally.

**Large quantities of quartz crystals mounted and unmounted.**

Crystal Holders: FT243, FT1718 others.

Quartz Crystal Comparators.

North American Philips Fluorescopes Type 80.

Large quantity of Polystyrene beaded coaxial Cable.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1K5</td>
<td>16.00</td>
</tr>
<tr>
<td>1K25</td>
<td>15.00</td>
</tr>
<tr>
<td>1K30</td>
<td>14.00</td>
</tr>
<tr>
<td>1K35</td>
<td>13.00</td>
</tr>
<tr>
<td>1K40</td>
<td>12.00</td>
</tr>
<tr>
<td>1K45</td>
<td>11.00</td>
</tr>
<tr>
<td>1K50</td>
<td>10.00</td>
</tr>
<tr>
<td>1K55</td>
<td>9.00</td>
</tr>
<tr>
<td>1K60</td>
<td>8.00</td>
</tr>
<tr>
<td>1K65</td>
<td>7.00</td>
</tr>
<tr>
<td>1K70</td>
<td>6.00</td>
</tr>
<tr>
<td>1K75</td>
<td>5.00</td>
</tr>
<tr>
<td>1K80</td>
<td>4.00</td>
</tr>
<tr>
<td>1K85</td>
<td>3.00</td>
</tr>
<tr>
<td>1K90</td>
<td>2.00</td>
</tr>
<tr>
<td>1K95</td>
<td>1.00</td>
</tr>
<tr>
<td>1K100</td>
<td>0.60</td>
</tr>
<tr>
<td>1K105</td>
<td>0.50</td>
</tr>
<tr>
<td>1K110</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Cables: TELERSUP

**Minimum Order $25.00**
HIGH VOLT OIL CAPS

<table>
<thead>
<tr>
<th>Model</th>
<th>Volts D.C.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1082</td>
<td>3000V</td>
<td>$11.50</td>
</tr>
<tr>
<td>1083</td>
<td>3000V</td>
<td>$12.50</td>
</tr>
<tr>
<td>1084</td>
<td>3000V</td>
<td>$13.50</td>
</tr>
<tr>
<td>1085</td>
<td>3000V</td>
<td>$14.50</td>
</tr>
<tr>
<td>1086</td>
<td>3000V</td>
<td>$15.50</td>
</tr>
<tr>
<td>1087</td>
<td>3000V</td>
<td>$16.50</td>
</tr>
</tbody>
</table>

MICA CAPACITORS

<table>
<thead>
<tr>
<th>Style</th>
<th>MFD.</th>
<th>DCVW</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.001</td>
<td>3000</td>
<td>$1.55</td>
</tr>
<tr>
<td>B</td>
<td>0.002</td>
<td>3000</td>
<td>$2.55</td>
</tr>
<tr>
<td>C</td>
<td>0.005</td>
<td>3000</td>
<td>$3.55</td>
</tr>
<tr>
<td>D</td>
<td>0.01</td>
<td>3000</td>
<td>$4.55</td>
</tr>
<tr>
<td>E</td>
<td>0.025</td>
<td>3000</td>
<td>$5.55</td>
</tr>
<tr>
<td>F</td>
<td>0.05</td>
<td>3000</td>
<td>$6.55</td>
</tr>
<tr>
<td>G</td>
<td>0.1</td>
<td>3000</td>
<td>$7.55</td>
</tr>
<tr>
<td>H</td>
<td>0.25</td>
<td>3000</td>
<td>$8.55</td>
</tr>
<tr>
<td>I</td>
<td>0.5</td>
<td>3000</td>
<td>$9.55</td>
</tr>
<tr>
<td>J</td>
<td>1</td>
<td>3000</td>
<td>$10.55</td>
</tr>
</tbody>
</table>

RADAR SETS

MODEL BM. Portable radar set, 10CM. Operates on 100-160 volts, 100 ft. range, V.V., and P.P. presentation. Complete with mechanical and manual set of operating and service parts.

MODEL RG.1. Consists of complete component including transmitter, receiver, power supply, transmitter syncing switch and controls. Complete set also includes aessories for testing. Complete set also includes mittens and gloves. Suitable for field use.

MODEL AMG. 1. Radar unit consisting of receiver and transmitter. Complete with all accessories necessary for operation. Suitable for field use.

MODEL AC-G-1. Antenna Assembly, Complete, with all accessories necessary for operation. Suitable for field use.

MODEL RC-1. Receiver Assembly, Complete, with all accessories necessary for operation. Suitable for field use.

MODEL RC-2. Receiver Assembly, Complete, with all accessories necessary for operation. Suitable for field use.

Model BM. $325.00
Model RG.1. $350.00
Model AMG.1. $400.00
Model AC-G-1. $450.00
Model RC-1. $500.00
Model RC-2. $550.00

SYNCHRO CAPACITORS

G.E. BATTERY CHARGER Charges 54 cell battery at 10 to 100 amperes each

Input 115V, 60 c.p.s., 1 Phase

Model BM. $125.00
Model BM. $135.00
Model BM. $145.00
Model BM. $155.00
Model BM. $165.00
Model BM. $175.00

PANORAMIC ADAPTER

Provides 4 Types of Presentation:

1. (Panoramic) 2. (Aural) 3. (Chromatic) 4. (Oscillographic) Designated for use with receiving equipment, Audio-Visual Machines, Radio Receivers, etc.

SCR-522 EQUIPMENT


Panasonic SCR-522 System $125.00
Panasonic SCR-522/M System $135.00

SEARCHLIGHT SECTION

TEST EQUIPMENT

Television Test Set

Television Test Set, 40-50-100-150-200 K. 40-50-100-150-200 K. 40-50-100-150-200 K.

60 CYCLE TRANSFORMERS

60-cycle Transformer 1000 VA. 60-cycle Transformer 1000 VA. 60-cycle Transformer 1000 VA.

HIGH POWER TRANSFORMER

Westinghouse, Inc. 60 c.p.s. 3000 VA. 60 c.p.s. 3000 VA. 60 c.p.s. 3000 VA.

PULSE TRANSFORMERS

K.W. 800 VA. Pulse 1000 VA. Pulse 1000 VA. Pulse 1000 VA.

RAYTHEON VOLTAGE REGULATORS

Raytheon Engineering Co. 500 V.D.C. 500 V.D.C. 500 V.D.C. 500 V.D.C.

HIGH QUALITY CRYSTAL UNITS

Western Electric—One C.H.1-AAR In stock. 100 units available. Available in stock. 100 units available. Available in stock. 100 units available. Available in stock.

1 K.W. MODULATION TRANSFORMER

B.C.A. 1500 VA. 1500 VA. 1500 VA. 1500 VA.

IN212X DIODE

Sunny, N.B. Individuals bond and pocket in sealed tube. $3.00
Available for Immediate Delivery

**SEARCHLIGHT SECTION**

- **SELF-EXCITED 400 CYCLE GENERATOR** — G.E. #5A353J3D. Output 115 volts 400 cycle, @ 7.2 amp. Designed for pulley drive @ 8000 rpm. 6/4" long x 6" diam. Only small qty. available. SA-292 .......... $129.50

- **REVERSIBLE DUAL SPEED D-C MOTOR** — John Oster Type, DESTI-3-18. Western Electric #XS-1517-LO1. 26 volts @ 1.3/2.3 amps. 4500/10,000 rpm. @ 2 oz-in. torque. 4½' long x 2½' diam. 3/16" shaft extends 9/16". Weights 2 lb. SA-228 .......... $6.75


- **PIONEER 12124-A INVERTER** — Input 115 volts d-c @ 1.0 amp. Output 115 volts 400 cycle single phase @ 42 amp. Shown with magnifying amplifier. SA-405 .......... $89.50

- **AIRCRAFT GENERATOR** — Eclipse #716-2A, Navy #1800-A. Dual output, 115 volts @ 10.4 amps., 600 cycles and 30 volts d-c @ 80 amps. Driving speed 2400 rpm. Weights 44 lbs. SA-306 .......... $29.50

- **G-E AMPLIDYNES**
  - SA-111 SAM31J1BA .............. $49.50
  - SA-147 SAM42D815 .............. $139.50
  - SA-257 SAM33A89S .............. $169.50
  - SA-197 SAM32A85S .............. $169.50
  - SA-196 SAM31J1PA .............. $49.50

- **AMPLIDYNE MOTORS**
  - 27 volts d-c field, 60 volts d-c armature. SA-245 SBA30L122 .............. $29.50
  - SBA35S177 .............. $49.50
  - SBA27S0166 .............. $49.50
  - SBA17S0125A .............. $49.50
  - SBA29K SBA32D3000 .............. $49.50
  - SBA29KD SBA33J13 .............. $49.50
  - SBA39S0129 .............. $49.50
  - SBA35S0121 .............. $49.50
  - SBA39K SBA55G11 .............. $49.50
  - SBA296c SBA55EJ8 .............. $49.50

- **NAVY SYNCHRO CAPACITORS** — Delta connected. Sections matched to 1%. Improves accuracy of synchro systems when used with each control transformer and differential.
  - SA-127 Type 1C 1.8 mfld. ea. .............. $2.75
  - SA-155 Type 3C 30 mfld. ea. .............. $6.75
  - SA-205 Type 6C 60 mfld. ea. .............. $7.50
  - SA-346 G-E #259679-9 mfld. ea. .............. $4.75

- **A-C AIRCRAFT MOTOR** — G-E #5K311J11. 200 volts 3 phase 400 cycle @ 30 amps. 9000 rpm. @ 80 oz. m./f. (Approx. 3/4 hp.) Thermal protected. 9" x 5½" diam. Weights 17 lbs. SA-402 .......... $85.

- **BALL BEARING D-C MOTOR** — Ritter Motor. Electric, #721-221. 24 volts d-c @ 8.8 amps. 3/16 hp. @ 3550 rpm 40 deg. C. temp. rise, continuous duty. Compound wound, 8½ long x 5½ diam. ½" shaft extends 11½". Ball bearing construction. Weights 21 lbs. SA-397 .......... $9.75

- **DUAL D-C OUTPUT GENERATORS** — Manuf. Dual D.C. Electric, Navy #211219. Input 3/16 hp. @ 3450 rpm. Output #1, 240 volts 115 volts. Output #2, 12.5 volts @ 4.0 amps. Ball bearing construction. 9" long x 5½ diam. 1½" shaft extends 11½". Weights 21 lbs. SA-398 .......... $9.75

- **D-C GENERATOR** — Manuf. Russell Electric, Navy #211220. Input 3/16 hp. @ 3450 rpm. Output 86 watts @ 430 volts. Ball bearing construction. 9½" long x 5½ diam. 1½" shaft extends 11½". Weights 21 lbs. SA-399 .......... $9.75

- **REMOTE POSITION TRANSMITTER** — GE BT-18, 120 degrees (Continuously rotatable) potentiometer. Taps @ 120 deg. Two contacts 180 degrees apart. 24 volts d-c. Weights 4 oz. SA-13 .......... $3.75

- **AIRCRAFT A-C ROTARY ACTUATOR** — Riter #D2162. 208 volts, 3 phase, 400 cycle. Gear ratio 5500:1. 1 rpm, output @ 500 in-lb torque. Thermal protected. Built-in potentiometer follows up and limit switches. Used on Northrop Flying Wing. 11" long x 4½" diam. 1½" shaft extends 1½". Weights 10 lbs. SA-400 .......... $49.50

- **400 CYCLE BRAKE MOTOR** — AiResearch #27770. 115 volts single phase. 50 hp. @ 6500 rpm. 4.6 oz-in. torque. Used with 2.5 mfd. capacitor. 2½" long x 1½" diam. 3/16" shaft extends ¾". Weights 1 lb. SA-392b .......... $8.75

- **AIRESERCH #27780 — Similar to SA-392a above except .025 hp. and shaft detail. SA-392c .......... $8.75

- **AIRESERCH #27652 — Similar to SA-392c except it does not have brake and 5500 rpm. speed. SA-392c .......... $8.75

- **AIRCRAFT A-C ROTARY ACTUATOR** — Riter #D2162. 208 volts 3 phase 400 cycle, 1280 watts. With potentiometer follow-up, 600: 1 gear reduction. 20 rpm. output @ 1000 in-lb. torque. Used on Northrop Flying Wing. SA-404 .......... $165.

- **AIRCRAFT A-C ROTARY ACTUATOR** — AiResearch #291-80. 200 volts 3 phase 400 cycle, 10,000 in-lb. torque, with clutch overload rated @ 11, 250 in-lb. Static 27,000 in-lb. Output speed 7 rpm. Thermal protected motor rated @ 2 hp. Weights 22 lbs. SA-509 .......... $165


---

Prices F.O.B. Hawthorne
Telephone: HAwthorne 7-3100

1086 GOFFLE ROAD
HAWTHORNE, NEW JERSEY
Cable Address: SERVOTEK

PRODUCTS CO. INCORPORATED

April, 1953 — ELECTRONICS

www.americanradiohistory.com
A LEADING SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

INVERTERS
WINCHARGER CORP., PU 16/AP, MG1750, input 24 vts. 60 amps. outputs 115 vts., 400 cycle, 6.5 amp., 1 phase.
HOLTZER CABOT, TYPE 149F, input 24 vts. at 36 amps., output 26 vts. at 250 V.A. and 115 vts. at 500 V.A., both 400 cycle, 1 phase.
PIONEER TYPE 12117, input 12 vts., output 26 vts. at 6 V.A., 400 cycle.
PIONEER TYPE 12117, input 24 vts., output 26 vts. at 6 V.A., 400 cycle.
WINCHANGER CORP., PU/7, MG2500 input 24 vts. at 160 amp., output 115 vts. at 21.6 amp., 400 cycle, 1 phase.
GENERAL ELECTRIC, TYPE SD21J3A, input 24 vts. at 35 amps., output 115 vts. at 485 V.A., 400 cycle, 1 phase.
LELAND, PE 218, input 24 vts. at 90 amps. output 115 vts. at 1.5 K.V.A., 400 cycle, 1 phase.
LELAND, TYPE D.A., input 28 vts., at 12 amp., output 115 vts. at 115 V.A., 400 cycle, 3 phase.

ENGINE HOUR METER
JOHN W. HOBB, MODEL MI-277 records time up to 10,000 hours, and repeats, operates from 20 to 30 volts.

VOLTAGE REGULATOR
LELAND ELEC. CO., TYPE B, CARBON PILE. Input 21 to 30 volts D.C. regulated output 18.25 vts. at 5 amp.
WESTERN ELEC. TYPE BC97B, input 110 to 120 volts 400 cycle. Output variation 0 to 7.2 ohms at 5 to 7.25 amps.
WESTERN ELEC. TRANSTAT, input 115 vts., 400 cycle output adjustable from 92 to 115 vts., rating .6 K.V.A.
AMERICAN TRANS. CO., Transtat input 115 vts., 400 cycle output 75 to 120 vts. or 0 to 45 volts, rating .72 K.V.A.

SYNCHROS
1 F SPECIAL REPEATER 115 vts. 400 cycle.
2J1F GENERATOR, 115 vts. 400 cycle.
2J1F3 GENERATOR, 115 vts. 400 cycle.
2J1G1 CONTROL TRANSFORMER 57.5 vts. 400 cycle.
2J1H1 DIFFERENTIAL GEN. 57.5/57.5 vts. 400 cycle.
5G GENERATOR, 115 vts. 60 cycle.
5DG DIFFERENTIAL GEN. 90/90 vts. 60 cycle.
SHC CONTROL TRAN. 90/55 vts. 60 cycle.
SCT CONTROL TRAN. 90/55 vts. 60 cycle.
SDG DIFFERENTIAL GEN. 90/90 vts. 400 cycle.

ALL PRICES F.O.B. GREAT NECK N. Y.

TACHOMETER GENERATOR & INDICATOR
GENERAL ELECTRIC, GEN. TYPE AN5331-1. Pad mounting 3 phase variable frequency output.
GENERAL ELECTRIC, GEN. TYPE AN5331-2. Screw mounting 3 phase variable frequency output.
GENERAL ELECTRIC, IND. BDJ13AAA, works in conjunction with above generators, range 0 to 3500 RPM.

D. C. ALNICO FIELD MOTOR
DIEHL TYPE F06-23, 27 vts. 10,000 RPM.

RECTIFIER POWER SUPPLY
HAMMETT ELECTRIC MFG. CO. MODEL SPS-130. Input voltage 208 or 230 volts, 60 cycle, 3 phase, 21 amps. Output 28 volts at 130 amps. continuous duty, 8 point tap switch, voltmeter ammeter, thermo reset all on front panel.

MISCELLANEOUS
PIONEER MAGNETIC AMPLIFIER ASSEMBLY. Saturable reactor type, designed to supply variable voltage to a servo motor such as CK1, CK2, CK5 or 10047.
SPERRY AS CONTROL UNIT, part No. 644836.
SPERRY AS AZIMUTH FOLLOW-UP AMPLIFIER, part No. 650830.
SPERRY AS DIRECTIONAL GYRO, part No. 656029, 115 vts. 400 cycle, 3 phase.
SPERRY AS PILOT DIRECTION INDICATOR, part No. 645262 contains AY 20.
ALEN CALCULATOR, TYPE C1, TURN & BANK IND., part No. 21500, 28 vts. D. C. TYPE C1, AUTO-PILOT FORMATION STICK, part No. G1080AA.
PIONEER GYRO FLUX GATE AMPLIFIER, type 12076-1-A, 115 vts. 400 cycle.
SIGNAL CORPS COMPONENTS

OVER 250,000 SIGNAL CORPS AND NAVY COMPONENTS IN STOCK. MOSTLY NEW ORIGNAL PACKING. PRODUCTION QUANTITIES IN MANY TYPES. CALL OR WRITE FOR QUOTATIONS AND PRICES.

Radio Surplus Corp.
732 South Sherman Street
Chicago 5, Illinois
Phone: Harrison 7-5923

ELECTRONICS — April, 1953

451

www.americanradiohistory.com
Headquarters for
MICROWAVE TEST EQUIPMENT
— the widest assortment, the strongest depth and the most immediate availability of any source on test equipment.

One of the most popular pieces of war-borne equipment still in everyday use is the X-Band 3 cm Signal Generator, TS-13. We at Weston have modernized this instrument slightly and are now producing them in larger quantities than ever before. Attractively priced, this instrument may be obtained in less than two weeks from receipt of your order. May we send a leaflet of specifications on it to you? Besides the TS-13 Weston Laboratories, Incorporated makes available a still larger inventory on military electronic test equipment.

BEFORE SELLING YOUR IDLE TEST EQUIPMENT... ... please get our offer

Weston Laboratories
INCORPORATED

HARVARD, MASS.

Cable: WESLAB Tel: Boston: WE 5-4500

April, 1953 — ELECTRONICS
**Van Allen Electronics**

See our Ad February, 1953 Electronics
PHONE! WIRE! WRITE! YOUR NEEDS

**GET ON OUR MAILING LIST**

**ELECTRONICS** — April, 1953

---

**RELIANCE SPECIALS**

GEAR ASSORTMENT
100 small assorted gears. Most are stainless or brass. Experimenter’s dream... Only $0.50

**HAYDON TIMING MOTOR**
1 R.P.M., 115 V., 60 Cycle... $1.79

**400 CYCLE INVERTERS**
Leland Electric Co.
21055 48th St. N.E., Seattle 80, Wash.

**3 AG FUSES**

<table>
<thead>
<tr>
<th>Amp.</th>
<th>Per 100</th>
<th>Amp. Per 100</th>
<th>Amp. Per 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>$4.00</td>
<td>$0.04</td>
<td>$0.40</td>
</tr>
<tr>
<td>1.0</td>
<td>$8.00</td>
<td>$0.80</td>
<td>$0.80</td>
</tr>
<tr>
<td>2.0</td>
<td>$16.00</td>
<td>$1.60</td>
<td>$1.60</td>
</tr>
</tbody>
</table>

**3 AG FUSE HOLDERS (Finger)** $2.50

---

**BALL BEARINGS**

<table>
<thead>
<tr>
<th>Qty</th>
<th>No.</th>
<th>ID OD</th>
<th>Thick Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>MG-12B</td>
<td>1/16 0.063</td>
<td>0.063 0.95</td>
</tr>
<tr>
<td>16</td>
<td>MG-12C</td>
<td>1/16 0.063</td>
<td>0.063 1.60</td>
</tr>
<tr>
<td>8</td>
<td>MG-12D</td>
<td>1/16 0.063</td>
<td>0.063 2.20</td>
</tr>
<tr>
<td>8</td>
<td>MG-12E</td>
<td>1/16 0.063</td>
<td>0.063 2.20</td>
</tr>
<tr>
<td>2</td>
<td>MG-12F</td>
<td>1/16 0.063</td>
<td>0.063 9.50</td>
</tr>
</tbody>
</table>

**NEW COAXIAL CABLES**

<table>
<thead>
<tr>
<th>Freq</th>
<th>Price per 1000 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>$0.30</td>
</tr>
<tr>
<td>50</td>
<td>$0.20</td>
</tr>
<tr>
<td>100</td>
<td>$0.15</td>
</tr>
<tr>
<td>250</td>
<td>$0.12</td>
</tr>
</tbody>
</table>

**NEW COAXIAL CABLE CONNECTORS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAG171</td>
<td>$1.10</td>
</tr>
<tr>
<td>UAG172</td>
<td>$1.10</td>
</tr>
<tr>
<td>UAG173</td>
<td>$1.10</td>
</tr>
</tbody>
</table>

**COAXIAL CABLE CONNECTORS**

<table>
<thead>
<tr>
<th>MFG</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEJ</td>
<td>171/</td>
<td>$1.10</td>
</tr>
<tr>
<td>TEJ</td>
<td>172/</td>
<td>$1.10</td>
</tr>
</tbody>
</table>

**DIAL**

<table>
<thead>
<tr>
<th>MFG</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEJ</td>
<td>HU1</td>
<td>$1.10</td>
</tr>
</tbody>
</table>

**RELAY**

<table>
<thead>
<tr>
<th>MFG</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEJ</td>
<td>174</td>
<td>$1.10</td>
</tr>
</tbody>
</table>

---

**TIMING MOTOR**
8 RPM 115V 60 Cycles
E. Ingraham Co.

---

**SEARCHLIGHT SECTION**

**PRECISION RESISTORS—1/4 WATT—$3c**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>$0.02</td>
</tr>
<tr>
<td>8</td>
<td>$0.03</td>
</tr>
<tr>
<td>15</td>
<td>$0.04</td>
</tr>
<tr>
<td>25</td>
<td>$0.05</td>
</tr>
<tr>
<td>50</td>
<td>$0.07</td>
</tr>
<tr>
<td>100</td>
<td>$0.10</td>
</tr>
</tbody>
</table>

---

**2J1GI SELSYN**

**DIA. 221 FREQUENCY METER**

Price

---

**OLY Filled Condensors**

<table>
<thead>
<tr>
<th>MFG</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
</tbody>
</table>

---

**OIL FILLED RESISTORS**

<table>
<thead>
<tr>
<th>MFG</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
</tbody>
</table>

---

**Ahmad**

1.00 $140.00
2.00 $295.00
3.00 $540.00

**NEW DIAL**

<table>
<thead>
<tr>
<th>MFG</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
<tr>
<td>400</td>
<td>$0.85</td>
</tr>
</tbody>
</table>

---

**TIMING Motor**
8 RPM 115v 60 cycle
E. Ingraham Co.

---

**PRECISION FUSES—$3c**

---

**NEW COAXIAL CABLES**

---

**NEW COAXIAL CABLE CONNECTORS**

---

**COAXIAL CABLE CONNECTORS**

---
### Communications Equipment Co.

#### Shock Mount Racks
- FT-156
- FT-255A
- MT-62-ARC-S
- FT-156
- FT-157
- MT-170A
- FT-255
- MT-5/ARR-2
- MT-171A

#### Silver Mica Button Cond.
- MFD
- Price

<table>
<thead>
<tr>
<th>MFD</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>15.00</td>
</tr>
<tr>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>20</td>
<td>15.00</td>
</tr>
<tr>
<td>25</td>
<td>15.00</td>
</tr>
<tr>
<td>30</td>
<td>15.00</td>
</tr>
<tr>
<td>35</td>
<td>15.00</td>
</tr>
<tr>
<td>40</td>
<td>15.00</td>
</tr>
<tr>
<td>50</td>
<td>15.00</td>
</tr>
</tbody>
</table>

#### Flexible Coupling Shafts
- **MC 124**
  - **(All Lengths in inches)**
  - **(Continued)**
  - Price: MC 124 or MC 255

#### Selenium Rectifiers—Complete Wave Bridge Types
<table>
<thead>
<tr>
<th>Current</th>
<th>Voltage</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Amp</td>
<td>5.25</td>
<td>5.00</td>
</tr>
<tr>
<td>2 Amps</td>
<td>3.50</td>
<td>3.25</td>
</tr>
<tr>
<td>5 Amps</td>
<td>2.75</td>
<td>2.50</td>
</tr>
</tbody>
</table>

#### Power Transformers
- Comb. Transformers—515V-500 vips Input
- **MC 125**
- **(All Lengths Shown in Inches)**
- **(Continued)**
- Price: MC 124 or MC 255

#### Circuit Breakers
- AM 155—30 VDC to 600 AMP
- AM 156—20 VDC to 500 AMP
- AM 157—20 VDC to 500 AMP
- AM 169—100 VDC to 500 AMP
- AM 170—100 VDC to 500 AMP
- AM 171—100 VDC to 500 AMP
- AM 172—100 VDC to 500 AMP

#### Dynamotors
- **Input Motors**
- **Output Motors**
- **Output Motors**
- **Output Motors**

#### Inverters
- **Inverters**

#### This Month's Special
- **Phase-Shifting Helmholtz Coils**
- **Bleeder Resistor Type of 50 Degrees**
- **Lamont 250 VDC to 600 VDC**
- **1W, 23 OHM—1W with Mfg. Brack.**
- **SACT-1A—1 Motor Driven Transformer from 115VAC to 260VAC, Completely Enclosed**
- **SACT-2A—1 Motor Driven Transformer from 220VAC, Completely Enclosed**
- **SAPT-1—115VAC—50-60 Cycles, Completely Enclosed**
- **SAPT-2—115VAC—50-60 Cycles, Completely Enclosed**

#### Filter Chokes
- **Model**

#### Rectifier Transformers
- **Input Watts**

#### Interphase Amplifier
- **Description**

---

**131 Liberty St., New York 7, N. Y. Dept E-4 Chas. Rosen Phone: Digby 9-4124**

---

**Searchlight Section**

**Cable Co.**

**Coax Cable**

<table>
<thead>
<tr>
<th>Capacity</th>
<th>MFD</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>15 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>20 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>25 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>30 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>35 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>40 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>50 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
</tbody>
</table>

**Ceramic Type Capacitors**

<table>
<thead>
<tr>
<th>MFD</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>15.00</td>
</tr>
<tr>
<td>1200</td>
<td>15.00</td>
</tr>
<tr>
<td>1500</td>
<td>15.00</td>
</tr>
<tr>
<td>2000</td>
<td>15.00</td>
</tr>
</tbody>
</table>

**Price**

$3.00/100

---

**Wire Co.**

**Coax Cable**

<table>
<thead>
<tr>
<th>Capacity</th>
<th>MFD</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>15 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>20 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>25 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>30 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>35 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>40 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
<tr>
<td>50 OHM</td>
<td>15</td>
<td>15.00</td>
</tr>
</tbody>
</table>

**Ceramic Type Capacitors**

<table>
<thead>
<tr>
<th>MFD</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>15.00</td>
</tr>
<tr>
<td>1200</td>
<td>15.00</td>
</tr>
<tr>
<td>1500</td>
<td>15.00</td>
</tr>
<tr>
<td>2000</td>
<td>15.00</td>
</tr>
</tbody>
</table>

**Price**

$3.00/100
PULSE TRANSFORMERS

DEPENDABLE ELECTRONIC EQUIPMENT

CHECKED TESTED and APPROVED

RADAR LABORATORY EQUIPMENT

Multi-Purpose Test Set for APS-3, APS-4, APS-6, APS-15, APQ-13 and SCR-720

Originally designed for the U.S. Navy by the J. P. Seeberg Company for the primary purpose of testing and calibrating APS-4 Radar, this precision test equipment provides an artificial signal for calibrating the Radar indicator and indicator amplifier. Although the markers now indicate 4, 20, 50, and 100 miles and Beacon, they may be adjusted for other ranges according to the particular requirement of the Radar set that is to be aligned. Because of the unusual and versatile power facilities of this equipment, it is readily adaptable for testing other AIRBORNE RADAR equipment, namely, APS-3, APS-4, APS-15, APQ-13 and SCR-720.

This equipment consists of two panel-mounted cabinets with components as follows:

• Rack No. 1 contains:
  • Range and Alarm Calibration Unit.
  • Antenna Scanning Simulating Unit—Provides antenna elevation and azimuth control.
  • Noise and Echo Generator—Gives noise and echo amplitude and echo position.
  • Trigger Generator—For variation of timing pulses to radar units.
  • Regulated Dual Power Supply.
  • Universal Power Supply.
  • Dimensions: 20½" x 16¾" x 7½". Weight: 382 lbs.

• Rack No. 2 contains:
  • High Voltage Safety Panel.
  • 800-Cycle, 500-Watt Power Supply & Power Amplifier.
  • Universal Power Supply.
  • 800/2400-Cycle, 500-Watt Power Supply and High Voltage Power Unit.
  • 800/2400-Cycle Power Supply and High Voltage D.C. Section.
  • 800/2400-Cycle Power Supply and Amplifier.
  • Measurements and Accessories.

APPLIED ING

VHF Signal Generator—Frequency: 100 to 156 mc. Master oscillator tunable or may be crystal controlled. IF Frequency, 12 mc. 110-V, 60-cy. AC power supply or battery operated. A complete test set for SCR-522, BC-639, BC-526, BC-624, or other airborne equipment covering this frequency.

MG-149R-Holtzer Cabot
Input: 28V DC-38 Amp. Output: 26V 400Cy-500VA Single Phase. 115V-400Cy Single Phase...
$ 60.00

MG-149R-Holtzer Cabot
Input: 28V DC-44 Amp. Output: 26V 400Cy-500VA Single Phase. 115V-400Cy Single Phase...
$ 125.00

MG-152P-Holtzer Cabot
Input: 28V DC-52 Amp. Output: 26V 400Cy-500VA Single Phase. 115V-400Cy-750VA Single Phase...
$ 125.00

10295-iland
Input: 27V DC-60 Amp. Output: 26V 400Cy-500VA Single Phase. 115V-400Cy-750VA Single Phase...
$ 90.00

10465-iland
Input: 27V DC-60A. Output: 26V 400Cy-500VA Single Phase. 115V-400Cy-750VA Single Phase...
$ 90.00

11705 or 1088-iland
$ 75.00

PE-109
Input: 12V DC-29 Amp. Output: 15V 400Cy-151VA Single Phase...
$ 65.00

PE-206-iland
Input: 28V DC-38 Amp. Output: 500V 400Cy-500VA Single Phase...
$ 40.00

PE-7-Wincharger
Input: 28V DC-60 Amp. Output: 15V 400Cy-2500VA Single Phase...
$ 100.00

PE-16-Wincharger
Input: 28V DC-60 Amp. Output: 15V 400Cy-63A Single Phase...
$ 90.00

PE-218-iland-Wincharger-Gen. Electric
Input: 28V DC-92 Amp. Output: 115V 500Cy-1000VA Single Phase...
$ 90.00

776-B-Bendix
Input: 24V DC-250 Amp. Output: 26V 400Cy-500VA Single Phase. 115V 400Cy-180VA Single Phase...
$ 65.00

800-1-Bendix
Input: 24V DC-75 Amp. Output: 115V AC-80Cy-10 SA Single Phase...
$ 40.00

12116-3A-Pioneer
Input: 24V DC-5 Amp. Output: 115V-400Cy-45W Single Phase...
$ 35.00

12117-2A-Pioneer
Input: 24V DC-1 Amp. Output: 26V 400Cy-6VA Single Phase...
$ 25.00

12117-6D-Pioneer
Input: 12V DC-2A. Output: 26V 400Cy-6VA Single Phase...
$ 25.00

12119-1B-Pioneer
Input: 24V DC-1 Amp. Output: 26V 400Cy-6VA Single Phase...
$ 25.00

12126-2A-Pioneer
Input: 24V DC-25A. Output: 26V 400Cy-10VA Three Phase...
$ 35.00

All merchandise carries our unconditional guarantee. Quotations are on new surplus or completely overhauled equipment.
Wilgreen Industries
99 MURRAY ST., NEW YORK 7, N. Y.
Worth 4-2490-1-2

48 Hour Delivery on AN
PROMPT Service on UG

We carry a complete and diversified stock of "AN" connectors at all times and are in a position to make deliveries within 48 hours, thereby eliminating all unnecessary stoppages due to the lack of "AN" connectors.

Many manufacturers have come to depend upon our prompt deliveries of AN & UG connectors from stock, without delay.

AN 3100 A/B
AN 3101 A/B

"AN" CONNECTORS "AN"

"UG" CONNECTORS "UG"

THE ABOVE INSERTS ARE AVAILABLE IN ALL TYPE SHELLS "AN-3055"—ADAPTERS "9760"—CAP & CHAINS

AN 3102 A
AN 3106 A/B
AN 3107 A/B
AN 3108 A/B
AN 3057

ELECTRONICS — April, 1953

457
WIRE-CABLE

CORDAGE
CO-122 3 conductor each 222 AWG neoprene jacket 550' lengths
CO-127 single 224 AWG braid and tinned copper braid shield

MULTI-CONDUCTOR
2 conductor AWG 14 7 conductor AWG 18
7 conductor AWG 16 18 conductor AWG 20
14 conductor AWG 16 6 conductor AWG 20
11 conductor shielded 10 conductor AWG 18
AWG 20 22 conductor AWG 16
2 conductor AWG 18 2 conductor shielded AWG 10

AMOUR
DRIA-23 DDRA-100 FRIA-4

SINGLE CONDUCTOR AWG 10 shielded cable with terminal lug each end
100' and 150' lengths

WIRES
AWG 18 copperweld
AWG 28 tinned copper
Resistance wire AWG 32
AWG 22 with nylon core plastic insulation

LINEAR WIRE WOUND POTENTIOMETERS
10 Ohm 25 Watt 5.00 15000 Ohm 25 Watt $3.70
15 25 .95 2000 50 2.60
20 25 .95 6 50 1.40
25 25 .95 110 switched 50 2.15
50 25 .95 220 switched 50 2.15
100 25 .95 440 switched 50 2.15
200 25 1.20 900 35 2.95
350 25 1.20 .5 Max 16' Shaft Ah .14
600 25 1.20 2000 1/8 SQ. END .14
1000 25 1.20 5000 1/8 SQ. END .14

SPECIALS
80-86 Crystal in Holder $2.50
Ballast with Hydrogen Generator $2.50
200 Foot Aerial Wire $2.00

TUBES

MICROWAVE TEST EQUIPMENT
10 CM echo box CAVY 1448-1 of ORU-3
Frequency range 2860 MC to 3770 MC
Direct reading microammeter, Ring
precision, scale plus 9% to minus 9%
Type "N" input, Resistance indicator meter.
With accessories, spares and 10
CM directional coupler, Brand New.

TUBES
2C315 4.50 R10A .25 5000 .30
2J779 4.50 R81 1.60 CM 8.90
3B84A 4.50 820 .45 CM 7.80
3C21A 4.50 846 .45 CM12 4.8
7C6 1201A .70 513A 4.45 MY 615 .70
1BY 4.50 1050 1.60 MM 714 .70
15R .65 557 .35 SP64 1.75
3B Spec 40 CM 1055 .45 SPF7 1.75
3944 .25 CM 1067 .25 145 0.70
45 Spec 10,050 .35 HI-GY 1.70
WE 201A 6.75 1029 .25 344 .50
1804A 10,050 .35 1029 .50
12A3 1.06 2051 1.10 5G4G .50
7012A .90 1058 1.50 3718 .75

HI VOLTAGE FILTER CHOKES
4 X 4.5 Amp DC 5 ohms 1230 RMS to ground.
New. 1 NT 2.5 Amp DC 7.5 ohms GE9495.
New. 1.7-3 NT 2 AMP DC 34,000 VDC GEY346A.

NAVY ENTERING TYPE INSULATOR
Porcelain flanged bowl with brass rod, fit-
ings and aluminum shield. Dimensions 4½" high, 6-½" OD at base. Brand new
$24.50.

10 CM ROTATING ANTENNA
24" Variable in 360° span at 12 RPM
DC, motor control and reversing switch New.

TIME DELAY SWITCHES
1 Minute 115 VAC 60 cycle Enc. in Waterproof Metal Case. New $5.25
3 Minute Switches Compact at 40-41/2 Second Time Delay 110 VAC Motor New $4.50
Thermo Switch 50° to 300° F 115 VAC @ 6A
300 VAC @ 5A
Breaks Contact with increase in Tempera-
ture. New $1.50

CONTACTORS
DPST 115 VAC 60 cycle 15 Amp De-Ion Line
Starter Westinghouse $6.95
DPST 115 VAC "AS" $7.00 $5.95

RELAYS
12 VDC DPST Allied Control Box 32...$1.25
24 VDC DPDT Allied Control Box BID98...$1.45
24 VDC DPDT 8 Amp...$1.50
10 VAC DPST 1 Amp Contacts Struthers
Dunn CKA 1970...$3.85
115 VAC DPST Struthers Dunn CKA
$3.65
220 VDC DPDT Struthers Dunn CK 2124 $4.50
220 V 50 cycle DPDT G.E. 12MGA4122. $4.00

OIL FILLED CONDENSERS
# FVDC Each Ten 1/200 Sec $1.15
1 600 .85 .85 1/200 2.00 1.90
2 600 .85 .85 1/200 1.90 1.80
4 600 1.40 1.40 .5 1800 2.95 2.90
5 600 1.65 1.60 .2 2000 3.20 3.10
1-4 600 2.50 2.50 .1 7500 3.95 3.95

METERS
Portable 0-25 Amps AC Weston #433 Brand
New $37.50
Switch Board Panel 0-100 Amps DC Weston
$288 with 100 Amp Shunt Brand New $24.95

EQUIPMENT
Walkie-Talkies 2.3-4.6 MG
MW-87Y Bendix Compass Receiver
BC-773 Glide Path Receiver
DAB-2—Direction Finder
RDF Receiver Equipment 200-500 KC Fixed

TERMS: Minimum order 5.00 — Mail orders promptly filled—All prices F.O.B.
Boston, Mass. Send M.O. or check.

SEND ORDER FORM, QUANTITY WANTED, PARTS NEEDED.

RESISTORS
Always the Best
from LEGRI S COMPANY
since 1945 Resistors is our business

RESISTORS

ANY RESISTORS
Fixed or variable (EB + GB + HB and others)
Carbon or wirewound
1/8 Watt up to 300 Watt
Precision of 1/4 of 1% or 20%
Any, Yes... any makes—any types—any values
One piece or one million
Potentiometers, type J, JJ, JJJ Rheostats,
Attenuators
For development, research or production
Guaranteed aged resistors.

LEGRI S COMPANY

Phone: UNiversity 5-4110

April, 1953 — ELECTRONICS
ELECTRONIC VALUES FROM TALLEN

FOR QUANTITY USERS ONLY

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>P 4 Computers</td>
<td>150.00</td>
</tr>
<tr>
<td>E 78 Signal Generator</td>
<td>60.00</td>
</tr>
<tr>
<td>Antenna ATS/ARR-1</td>
<td>.50</td>
</tr>
<tr>
<td>60,000 used Headsets on sale 1.00 each</td>
<td></td>
</tr>
<tr>
<td>AS pilot director indicator New</td>
<td>5.50</td>
</tr>
<tr>
<td>Spare parts for SCR 595 with Antenna—Plugs, etc.</td>
<td>3.00</td>
</tr>
<tr>
<td>MG 149 Filters New</td>
<td>5.00</td>
</tr>
<tr>
<td>Micro Switch W27RTC New</td>
<td>2.00</td>
</tr>
<tr>
<td>Vibrators for EE 101 A New</td>
<td>.75</td>
</tr>
<tr>
<td>BC282 Oscilloscopes New</td>
<td>20.00</td>
</tr>
<tr>
<td>Loops LP 21 Lousy New</td>
<td>5.00</td>
</tr>
<tr>
<td>Loop MN 20 E New</td>
<td>2.50</td>
</tr>
<tr>
<td>Motors PE73 New</td>
<td>5.00</td>
</tr>
<tr>
<td>Antennas AN 104 New</td>
<td>2.50</td>
</tr>
<tr>
<td>Antennas AN 104 Copper</td>
<td>2.00</td>
</tr>
<tr>
<td>PE 218 Checked 9.50 New</td>
<td></td>
</tr>
<tr>
<td>EE65 Telephone Test Set New</td>
<td>20.00</td>
</tr>
<tr>
<td>Vibrators VB8 New</td>
<td>.35</td>
</tr>
<tr>
<td>MC125 Remote Tuner New</td>
<td>5.00</td>
</tr>
<tr>
<td>MC124 Cable New</td>
<td>1.50</td>
</tr>
<tr>
<td>MC215 Cable New</td>
<td>.60</td>
</tr>
</tbody>
</table>

MELOMINE BLOCKS

in 1/4"—3/16"—7/32"—5/32"—5/16"

Thicknesses

4000 pounds Available at 50c per pound

Oxygen Gas Masks New | 2.50  |
| Control Boxes BC434 New | 3.50  |
| Antennas 37-50 MC 72 inch. | 1.50  |
| AS97/ART—Antenna with coax | 1.50  |
| Vinyl tubing 5/16" I.D. x 7/32" Wall | 1.00  |
| Neoprene tubing 5/16" I.D. x 7/64" Wall 80 ft. | 2.00  |
| R142 Antenna motors Lousy | 1.50  |
| BC357 Receivers Used | 3.50  |
| Recorder for underwater sound equipment | 60.00  |
| Transmitter—Aircraft T9/APQ-2, 115v. 400 cy., 26VC NEW | 20.00  |
| Radar Transmitter T26/APT-2, 115v. 400 cy., 200 Watts, NEW | 30.00 |
| Corner Radar Reflector NEW | 15.00 |
| RS/ARN-7 Type Certified | 250.00  |
| TS125 Test Set, complete, NEW | $125.00 ea. |
| TS10 Test Set, NEW | 30.00  |
| TS16 Test Set, NEW | 20.00  |
| Tuning Units TU-10 NEW | 20.00 |
| Tuning Units for BC-810 NEW | $12.50 |

MOTORS

1/2 H.P., 115V., 60 Cy., 3400 RPM
Mfg. Delco Diehl
Good for fans

WANTED

ARG-1 or Component Parts
ARG-2 or Component Parts
ART-13 or Component Parts
DC348 or Component Parts
AN/TRG-1 or Component Parts
SCR 720 Material all type
SCR 508 Material all type
SCR 608 Material all type
SCR 609 Material all type
Cables all types
Test Sets
PE 104 and 98
DM 40, 41, 42 and 43
SCR 808 and SCR 608

We buy all types of electronic materials.
We pay cash in advance.
What do you have to sell?

CRYS'TALS

25,000 Pieces in FT. 241 Holders
New @ $.10 each

This is only a partial listing. We have a quantity inventory on our shelves consisting of Colls—Relays—Condensers—Transformers—Radio and Radio Receivers and Transmitters—Handsets—Headsets—Microphones etc. etc. All are ready for IMMEDIATE DELIVERY.

TERMS: Open A/C net 10 days. All prices F.O.B. our warehouse.

ELECTRONICS IN ALL ITS BRANCHES

ELECTRONICS — April, 1953

159 CARLTON AVENUE
BROOKLYN 5, N. Y.
TRIANGLE 5-8241

www.americanradiohistory.com
COMING IN JUNE

Yes, coming up in June is the great Annual BUYERS' GUIDE issue of ELECTRONICS—the 15th issue of the year.

And it is just that—the buying guide for those in the electronics industry. They find the GUIDE indispensable to them in their work and turn to it whenever they seek sources of supply for equipment or component parts.

For that reason advertising in the SEARCHLIGHT SECTION is a vital MUST for the alert dealer in surplus new or used electronic components or parts.

Closing date is May 25.
PULSE TRANSFORMER

Tube base plug in type
Here are precision made, high quality compo-
nent pulse transformers wound on hypereosil-
core. They are built in octal bakelite tube bases
and can be adapted to many uses. They are
completely impregnated and sealed.

SUGGESTED USES
- Blocking Oscillator, Multivibrator and
Scope Circuits.
- Mandatory Timing circuits for
- Multipulse power amplifiers and low volt-
- Also can be used in circuits utilizing repetition
- On wave output over 1 MC and pulse
- Price $4.50 each Immediate Delivery


MARITIME SWITCHBOARD
INSTRUMENT & ACCESSORIES

336 Canal St., Waltham 4-8216, N. Y. 13, N. Y.
**SEARCHLIGHT SECTION**

<table>
<thead>
<tr>
<th>POWER UNITS</th>
<th>4-600</th>
<th>40-000</th>
<th>50-0000</th>
<th>2-5000</th>
<th>5-10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA-50</td>
<td>10.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P 0 BC-342</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE-157</td>
<td>12.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/W SCR-511</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE-112</td>
<td>12.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/W SCR-518</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP-39/TRC-2</td>
<td>15.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/W BC-1306</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA-RD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/W AN/APO-7</td>
<td>25.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TUBES</th>
<th>814</th>
<th>803</th>
<th>304TL</th>
<th>204A</th>
<th>WL-218</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.50</td>
<td></td>
<td></td>
<td>5.00</td>
<td>10.00</td>
<td>25.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>METERS</th>
<th>WESTON 430</th>
<th>30 V DC</th>
<th>SIMPSON 6130</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25.00</td>
<td></td>
<td>4.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OIL CAPACITORS</th>
<th>HEADSETS</th>
<th>P-20</th>
<th>24,000 Ohm</th>
<th>HS-30</th>
<th>600 Ohm</th>
<th>HS-18</th>
<th>8000 Ohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-600</td>
<td>1.25</td>
<td>3.00</td>
<td>4.00</td>
<td>2.50</td>
<td>50.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-600</td>
<td>2.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-1000</td>
<td>1.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-2000</td>
<td>3.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-2500</td>
<td>3.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-5000</td>
<td>4.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-10,000</td>
<td>50.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSFORMERS</th>
<th>SOLA 500 VA</th>
<th>95-125 115</th>
<th>G.E. 1.5 KVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50.00</td>
<td>7.50</td>
<td>25.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MICA CAPACITORS</th>
<th>CERAMIC CASED</th>
<th>.08-1500</th>
<th>.005-5000</th>
<th>.002-15,000</th>
<th>.015-1,000</th>
<th>.00015-20,000</th>
<th>.00005-30,000</th>
<th>.001-30,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10.00</td>
<td>7.50</td>
<td>25.00</td>
<td>40.00</td>
<td>20.00</td>
<td>50.00</td>
<td>75.00</td>
</tr>
</tbody>
</table>

**western engineers**

ELK GROVE, CALIFORNIA

GEORGE WHITING, OWNER

We have one of the largest stocks of special purpose tubes in the United States for immediate shipment. We sell tubes and consequently each order receives individual attention from tube specialists. We sell only new tubes, standard brands, either JAN or commercial specifications depending on stocks on hand.

We have one of the largest stocks of special purpose tubes in the United States for immediate shipment. We sell tubes only and consequently each order receives individual attention from tube specialists. We sell only new tubes, standard brands, either JAN or commercial specifications depending on stocks on hand.

**IN STOCK FOR IMMEDIATE DELIVERY**

**BRAND NEW JAN-C-25 CAPACITORS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP53</td>
<td>25.00</td>
</tr>
<tr>
<td>CP54</td>
<td>25.00</td>
</tr>
<tr>
<td>CP55</td>
<td>25.00</td>
</tr>
<tr>
<td>CP61</td>
<td>25.00</td>
</tr>
<tr>
<td>CP63</td>
<td>25.00</td>
</tr>
<tr>
<td>CP65</td>
<td>25.00</td>
</tr>
<tr>
<td>CP67</td>
<td>25.00</td>
</tr>
</tbody>
</table>

Every "E" Characteristic Item Listed In Jan-C-25 Also Every "F" Characteristic Where The Size Is Smaller Than "E" Also

**O'DEL ELECTRONICS CORPORATION**

293 WEST BROADWAY

NEW YORK 13, N. Y.

WORTH 4-2176 WORTH 4-2177

**MARITIME INTERNATIONAL COMPANY**

11 STATE STREET

NEW YORK 4, N. Y.

Phone: Digby 4-3192

Cable Address: FOXCROFT

April, 1953 — ELECTRONICS
## WHAT DO YOU NEED?

### Here's our inventory...

OUR NORMAL INVENTORY INCLUDES OVER 80,000 DIFFERENT ITEMS IN THE ELECTRONIC, RADAR AND RADIO FIELDS.

<table>
<thead>
<tr>
<th>RELAYS</th>
<th>Approximately 300,000 in over 1100 types</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPACITORS</td>
<td>Approximately 450,000</td>
</tr>
<tr>
<td>OIL * TUBULAR * MICA * FIXED and ADJUSTABLE CERAMIC FEED-THRU</td>
<td></td>
</tr>
<tr>
<td>* STAND-OFF * APC TRIMMERS * VARIABLES * SILVER MICA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESISTORS</th>
<th>Over a million</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBON * WIRE WOUND * FERRULE * POTENTIOMETERS &amp; RHEOSTATS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DYNAMOTOR BRUSHES</th>
<th>Approximately 400,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUSES</td>
<td>Approximately 800,000 in stock</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIRE and CABLE</th>
<th>Millions of feet</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SWITCHES</th>
<th>Approximately 200,000</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CHASSIS</th>
<th>Dozens of sizes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COAXIAL CABLE</th>
<th>Many sizes in stock</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SPRINGS</th>
<th>Over 5000 pounds</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>JONES CONNECTORS</th>
<th>Many types in stock</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>INVERTERS</th>
<th>From 1100 to 60 cycle AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVERSERS</td>
<td>From 20 to 500 Watt</td>
</tr>
<tr>
<td>RECTIFIERS</td>
<td>Also some 400 cycle units</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NU-METAL LAMINATIONS</th>
<th>Made to your specifications</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>KOVAR GLASS SEALS</th>
<th>Approximately 400,000 in stock in several dozens of types</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CERAMIC and HI-FREQUENCY STAND-OFFS</th>
<th>Approximately 300,000 in stock</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TAPE</th>
<th>Cellulose, Textile, Masking and Electrical</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>GUY WIRE</th>
<th>Both Light and Heavy</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>INTERCOM SYSTEMS</th>
<th>Best Buys</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SOLENOIDS</th>
<th>Approximately 75,000 in stock</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TELEPHONE RELAYS, RETARDATION COILS and CAPACITORS</th>
<th>GROMMETS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Approximately 20,000 pounds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TUBES</th>
<th>Most receiving types and many special types in stock</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>IRON CORE SLUGS</th>
<th>Over a million in stock</th>
</tr>
</thead>
</table>

### WE ALSO HAVE A LIMITED ASSORTMENT OF THE FOLLOWING ITEMS IN STOCK:

<table>
<thead>
<tr>
<th>DIAL LIGHT ASSEMBLIES</th>
<th>TELEGRAPH KEYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIAL PULLEYS</td>
<td>VARNISHED and VINYL TUBING</td>
</tr>
<tr>
<td>DIAL PLATES</td>
<td>ALNICO MAGNETS</td>
</tr>
<tr>
<td>PILOT LAMPS</td>
<td>JACKSON PLUGS</td>
</tr>
<tr>
<td>EYELETS and RIVETS</td>
<td>SOLDER</td>
</tr>
<tr>
<td>BOLTS, NUTS, SCREWS and WASHERS</td>
<td>LINE CORDS</td>
</tr>
<tr>
<td>SPEAKERS</td>
<td>LUGS—Terminal, Soldering, Stakon</td>
</tr>
<tr>
<td>SOCKETS</td>
<td>POWER RHEOSTATS</td>
</tr>
<tr>
<td>HEADPHONES</td>
<td>ROTARY SWITCHES</td>
</tr>
</tbody>
</table>

### SEND US YOUR SPECIFIC REQUIREMENTS FOR OUR QUOTES

**Universal**

324 Canal St., N.Y.C., 13, N.Y. Walker 5-9642

---

**C & H Sales Co.**

Box 356-PASadena Sta., PASadena 6, Calif.

---

**YOUR BEST SOURCE FOR**

NEW JAN TUBES FULLY GUARANTEED

<table>
<thead>
<tr>
<th>DELOUXE 5W6</th>
<th>DELOUXE 12AT7</th>
<th>DELOUXE 12AT7</th>
<th>DELOUXE 12AT7</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**BEST SELLER**

<table>
<thead>
<tr>
<th>5W24</th>
<th>5W24</th>
<th>5W24</th>
<th>5W24</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**ALLIED ELECTRONIC SALES**

74 Cortlandt Street, New York 7, N.Y.
Phone Barclay 7-5839—5840
BLOWERS
115 Volt 60 Cycle POWER INPUT: 150 CFM Installed on Gas Range Dimensions: 8-1/2" W x 9-1/2" H x 3-1/2" D. Sold complete. Price: $155.00 Order No. 20905 $89.95

DUAL BLOWER—Base an RN-SID above except Use Eaton Honeywell in all cases or order. Order No. 10980 $13.95


AIRCRAFT CONTROL—4-7/8 x 7 Strand, Weatherproof, Gasketed. Preferred. 930 in. test. Takes two small batteries. Many others. Prices: 41/4¢ per FT.-1000 FT. or more at $2 per FT. $10.95

AERIAL WIRE—Plated-conductor House #2 stranded. 200 ft. test. Weatherproof. 100 ft. on reel. 11-1...400 DC. Connectors #28 holes for routing. Weight: 1 lb. TELEPHONE WIRE—3 Cond. copper & steel, 27¢. Weight: 1 lb.$1.75

DC SMALL MOTORS
24 VDC REVERSIBLE MOTOR—5.75 lbs. Torque Motor: 5-1/4" x 2-1/2" x 1.5". Each. Price: $100.00 Note: No. 1158 DC-6000 RPM. In. Shaft 1/4-28 x 1/4-28, Motor Size: 3/4" x 3/4". Air Noise: No. 235 $2.85

20-60 VDC-1000 RPM. Shaft Size: No. 3/8-24. Motor Size: 3" x 3", 11-1/4 lbs. No. 3 INSULATED. $10.50

28-30 VDC-1000 RPM. Shaft Size: No. 5/16-24. Motor Size: 3" x 3", 5 lbs. No. 5 INSULATED. $10.50

ANTENNA EQUIPMENT
MAST BASES—INSULATED:
MP-122 BASE—(As illustrated at left) 1" heavy duty copper insulated. Overall: 11" High. Weight: 2-1/8 lbs. Price: $10.00

MP-5-33 BASE—Insulated type with heavy copper coating and 5" insulated. Dimensions: 7-1/2" x 7-1/2". Price: $12.00

MAST SECTIONS FOR ABOVE BASES
Tubular steel, copper coated, galvanized, in 3 ft. sections, across-the-board approved. To be used to make any length with INS-50-21-32-49 for taper. Any section used by itself is suitable. In stock: 26-1/2" - $1.50 30" - $1.50 35" - $1.50 40" - $1.50 45" - $1.50 50" - $1.50 55" - $1.50 60" - $1.50

ANTENNA—Heavy duty aluminum. No. 10-117 Whip Beam—$11.95

KLEIN MCF-211014, MCF-311014, MCF-111014. Two 3200 Megohm, 1 Watt Wirewound AMPLIFIERS: $29.95 each. $32.00 pair.

THE PARTS YOU NEED to operate your units are available at all authorized dealers. Take advantage of long range savings and assure yourself of the freshest parts at this time. Whether you use or not, these units will be invaluable in case of emergency. They are always needed and are used by every amateur. The parts are always in stock. Write us and let us know what you need. We will be glad to help you or your dealer. You will be interested in the equipment listed above and we are sure that you will want to get it if you have not already done so.

THE PARTS YOU NEED to operate your units are available at all authorized dealers. Take advantage of long range savings and assure yourself of the freshest parts at this time. Whether you use or not, these units will be invaluable in case of emergency. They are always needed and are used by every amateur. The parts are always in stock. Write us and let us know what you need. We will be glad to help you or your dealer. You will be interested in the equipment listed above and we are sure that you will want to get it if you have not already done so.

THE PARTS YOU NEED to operate your units are available at all authorized dealers. Take advantage of long range savings and assure yourself of the freshest parts at this time. Whether you use or not, these units will be invaluable in case of emergency. They are always needed and are used by every amateur. The parts are always in stock. Write us and let us know what you need. We will be glad to help you or your dealer. You will be interested in the equipment listed above and we are sure that you will want to get it if you have not already done so.

THE PARTS YOU NEED to operate your units are available at all authorized dealers. Take advantage of long range savings and assure yourself of the freshest parts at this time. Whether you use or not, these units will be invaluable in case of emergency. They are always needed and are used by every amateur. The parts are always in stock. Write us and let us know what you need. We will be glad to help you or your dealer. You will be interested in the equipment listed above and we are sure that you will want to get it if you have not already done so.
RELAYS

Our stock of more than a million relays—in over a thousand different types—is the world's largest. Don't delay your production for want of large or small quantities of relays of any type.

Telephone, wire or write for quotations.

NEW AND MORE COMPREHENSIVE 1953 RELAY SALES CATALOG NOW READY

Be sure to send for your copy

Telephone
Skeeley 8-4146

24 HOUR DELIVERY FROM STOCK!
SURPLUS SPECIALS
Anemometer—Wattless Tube AX-10. Aerm. Type C-550. 6-500 amperes D.C. with matching shunt. 2" clock for temperature scale. New—original box. Stock #A-110. Price $5.75 each.
Vatt-Ammeter—General Electric Type DW—Model D24AL, 0-0.1 amperes D.C. and 0-30 volts D.C. Black face with luminous scale. Meter is equipped with dampening switch to read volts. Black face movement is 3 in. Bus. Aerm. Type A-60. Should not be included in—original box. Stock #A-59. Price $5.75 each.
Vatt-Ammeter—Wattson Model 666. Type 221-P. 2.5 milliamperes D.C. Black face is identical to 2-56 except center spur is correct with matched shunt for 40 ampere. New—original box. Stock #A-384. Price $9.00 each.
Vatt-Ammeter—Generel Electric Type DW—Model 221AL, 0-30 amperes D.C. and 4-30 volts D.C. Black face with luminous scale. Meter reads current with damping switch to read volts. Bus. Aerm. Type A-60. Should not be included in—original box. Stock #A-59. Price $5.75 each.

Liquid Level Transmitter—General Electric Type EDF172M—Inclined 90°. Excellent unit, designed for use with Units DJ-20 and DJ-30. Includes all necessary parts to make complete new. Stock #A-204. Price $4.75 each.

Liquid Level Transmitter—General Electric Type EDF196A—4-20 milliamperes D.C. Used with most General Electric liquid level indicators. Three glass available. New—original box. Stock #A-255. Price $4.75 each.


Turbo Supercharger Regulator Assembly—Type B-3—Allen P6010A. Minneapolis-Honeywell makes. Device has 25 amp. 400 cycle. Includes original two 72S tubes, one 741 tube and one 6FP tube. Stock #A-235. Price $16.50 each.


Hydraulic Cylinder Stroke— große (7646-10-A)—New. Price $37.50 each.


Check our previous Electronics ads, locate round out your order, and save for catalog or call for details.

REMOVAL SALE!
PRIOR TO OUR MOVING TO NEW QUARTERS WE ARE OFFERING OUR COMPLETE OIL CAPACITOR INVENTORY at 65% to 80% off LIST PRICES
(Limited Time Only)

- BATHTUB TYPES
  (CP-53 CP-54 CP-55)
- CHANNEL TYPES
  (CP-61 CP-63 CP-65 CP-67 CP-69)
- RECTANGULARS
  (CP-70)
- TUBULAR TYPES
  (CP-25 to CP-29 CP-40 CP-41)

NOTE: At time of going to press ample stocks on hand but at these low prices we suggest your early inquiries.

WALKIE TALKIE AND HANDY TALKIE SPARE PARTS

For
BC-1000
(SRC-300)
BC-611
(SRC-530)


LARGE QUANTITIES—ALL NEW
WILL SELL AS A LOT
500 NEW MICROPHONES
Western Electric Model 453A, superior quality single button, air pocket construction, up right telephone type stand with push-talk lever, cord and plug (PI-58 type) $3.10

All in Individual Cartons
PRICE ON REQUEST

SEARCH RECEIVER—ARD-2

Frequency range 80 to 3000 A.Ccs. Measures B.P.F. readings from 80 to 3000 and pulse rates from 50 to 8000 cycles.
The ARD-2 can be used as a Direction Finder to locate stations, or as a frequency meter, by DIAL and AMB indicator. Originally designed and used by WAC air crew. Ideal for military, laboratory and general purpose use.

Equipment consists of the following:
Antenna. Detentor—CMD-SHIFT—Has variable length antennas, detector and silver plated tuning stub with calibrated scale.

APPARATUS—CMD-SHIFT—Has three stage amplifier, a trigger circuit, a pulse rate synchronized, audio frequency, volume signal indicator, rectifier power supply which is operated on 115 Volts, AC 20 to 2500 and current, regulated.

This DIAL—CMD-SHIFT—Has high frequency of 600 cycles with selection of four regulation rates.

ALL CABLES AND FITTINGS, ACCESSORIES INCLUDING RACKING FOR IMEDIATE INSTALLATION, PLUS TWO TECHNICAL MANUALS.

SPARE PARTS—Steel box includes spares for components and one extra power tube. Guaranteed NEW
All the above in individual carton packed except Weight: 113 lbs. Price each $275.00

#AS-1C AIRCRAFT AND MOBILE TRANSMITTER AND POWER SUPPLY

General Electric recent design compact 12 watts output Telephone type Transmitter with 2500 to 3105 KCS crystal. Includes 6V6 XEC 21A, 6X4C, 24V 7A Type Amplifiers, and 24X5 Rectifiers. 12 VDC with wall plug and cable. Measures 9" x 6" x 4½". Weight: 7.7 lbs. New . . . . . . each $59.50

#AS-1C TELEVISION EQUIPMENT

TWX—NY—223 Cable—Communidev, N. Y.
Tel. ADirondack 4-6174
COMMUNICATION DEVICES CO.
2331 TWELFTH AVENUE
NEW YORK 27, N. Y.

A. MOGULL CO.
50 West Broadway, N. Y. 7, N. Y.
Phone: Worth 4-0865

MANY OTHER GOOD BUYS.
(Write for Bulletin.)

FOR SALE! ENTRIE LOT ONLY!
8280—Pieces of W.E.—FT. 241-A Crystal Holders with Crystals. Assorted Sizes—All New. (Complete List on Request)

April, 1953 — ELECTRONICS

** Price each $275.00

468

4 Godwin Ave, Paterson, N. J.
Excellent
"RW" Values!
WRITE FOR PRICES

APR4 with tuning
units
BC69 w/ RAS2
AP54 components
Recoride
AP53 components
TS184/AP53
BC1306
BC611
PE257
SCR14 (BC1137)
BC439G
Dynotran DM28
TSS1
(large quantity
available)
TN16, TN17, TN18,
TN19
BC1033
AP593
BC338
TN61
ARN7
RA22
TS92
SCR269F&G
RTA1B
BC1277
SCR619
CRT3
BC1257
BCONTON SIG.
MP10
IE18A
GEN. I.28 Bj
MN26Y
MN26C
TS 100/AF

Write for our new 1953 catalog!

TS15G/TPX
COMBINATION SIGNAL GENERATOR
AND FREQUENCY METER
Freq. range: 150-200 MC... crystal cali-
brated. Has separate 30MC signal output,
crystal cal: 3-stage, AF amplifier. Power
measurements by built-in VTM circuit
0-1 MA, meter at 2-range voltmeter. Built-
in 400 cps. voltage regulated power sup-
ply. New. ..................... $69.95

BUILD TV-FM-AM SWEEP GENERATOR
You can build "Versatile Sweep Frequency
Generator" with ART-1 magnetic units.$5.95

RM29 with the TS-13 handset
$14.95 ea.
2 for $27.50
HL-42 Reversible Motor with antenna reed
and clutch, used. .................... $2.95

TS10 TEST UNIT
Complete with attenuator, indicators and
350 ft. of coaxial cable, Originally cost
$300.00. new condition ... ONLY $14.95
Parts... large quantity available... write
for prices!

166 171 MC277
167 172 ART13-64U
169 170 U10U

WANTED!
All TS, APR, APS, ARC,
ARN, ART, SCR, R89 and
BC equipment ... write
today!
Quote lowest prices in your
first letter

Electronic Equipment—April, 1953

AMERTRAN-
STAT-TRAN
VOLTAGE
REGULATOR
Pri. 103-126V; Sec. 115/
60 @ 250 V.A. Order
No. RE-4162.

SOLA CONSTANT
VOLTAGE
TRANSFORMER
For 100-260V in-
put. Output 115V
AC @ 1.5 A. Order
No. RE-4195.

RADIO SHACK CORPORATION
167 Washington St., Boston 8, Mass.
COMPASS
Communications Company
393 GREENWICH STREET
NEW YORK 13, N. Y.
CABLE ADDRESS: COMPRADIO, N. Y.
ALL PHONES: BEEKMAN 3-6509
WE MAINTAIN OUR OWN FULLY EQUIPPED TESTING LABORATORY TO TEST AND GUARANTEE ANYTHING WE SELL

TCS—Collins mfd. Navy radiotelephones for shipboard and mobile use, complete with all accessories for operation from 12, 24, 110, 230 volts d.c. and 110 or 220 volts a.c.
TDE—Navy or commercial marine transmitters, complete 110 & 220 volts d.c. and a.c.
TBK—Navy high frequency transmitter, 2-20 mcs; 500 watts output. Supplied complete with m/g and starter for d.c. or a.c. operation.
TBM—same transmitter but with speech input equipment to give 350 watts phone.
TBL—Navy all-wave transmitter; 350 watts output: CW and phone. Supplied complete with m/g and starter for d.c. or a.c. operation.
TAJ—Navy intermediate freq. transmitter, 175-550 kcs; 500 watts output. Supplied complete with m/g and starter for d.c. or a.c. operation.
TBN—200-3,000 kcs, complete with 220/440 volt, 3 ph. 50-60c power supply—conservatively rated at 1 kw. output.
SCR-284—The famous mobile and ground equipment for field use, complete with all accessories. Range 3.8-5.8 mcs; 20 watts cw, 5 watts phone.
SCR-510—Mobile, portable FM radio station. Operates from 6, 12, or 24 volt dc supply. Frequency range: 20.0 to 27.9 mcs.
SCR-610—Same as SCR-510, but with built-in speaker and range of 27.0-38.9 mcs.
SCR-528—Mobile FM radio station, operates from 12 or 24 volt dc. Frequency range: 20.0-27.9 mcs.
SCR-628—Same as SCR-528, but with range: 27.0 to 38.9 mcs.
MAG—10 cm. PORTABLE LINK RADAR transmitter receivers, 6-volt operation.
RADAR BEACONS
AN/CPRN-6 3 cm. AN/CPRN-8 10 cm.
YJ and YG 3.5 cm. for shipboard use.
AN/CPRN-6 3 cm.
AN/CPRN-8 10 cm.
also AN/APS 2, -APS-3, -APS-4, and -APS-15
SA, SF, SG, SD, SJ, SK, SN, SQ—both equipment and spare parts

AND TUBES—SPECIAL PURPOSE AND TRANSMITTING TYPES
WRITE FOR OTHER ITEMS & UNLISTED PRICES

FOR SALE!
39 UNITS BC957A RADAR INDICATOR
UNUSED

Manufactured for the U. S. Army Signal Corps by Western Electric. Units contain a 5" scope tube in addition to 33 various electronic tubes. Dimensions: 17 1/4" x 35 1/4" x 10 1/2" deep.

IDEAL FOR RADAR LAB USE!
Available for inspection

WRITE—WIRE—PHONE
COMMERCIAL SURPLUS SALES CO.
4101 Curtis Avenue, Baltimore 26, Maryland
Telephone Curtis 3300

ELECTRONIC EXPEDITORS
SUPPLYING
THE NEEDS OF INDUSTRY—GOVERNMENT—FOREIGN PURCHASING COMMISSIONS
WITH
COMMUNICATIONS EQUIPMENT, RECEIVING AND TRANSMITTING TUBES, ELECTRIC WIRE AND CABLE.......
AIRCRAFT ELECTRONICS—INSTRUMENTS—HYDRAULICS
PROMPT ATTENTION GIVEN TO ALL INQUIRIES
Rated—Dun & Bradstreet

Electronic Expeditors
Dept. WW, 221 M. Wabash Avenue
Chicago 1, Illinois • Address 3-0841
Cable Address: "EXECPEDITE" • TWXCD158

TELEPHONE RELAYS

IDEAL FOR RADAR LAB USE!

Available for inspection

WRITE—WIRE—PHONE
COMMERCIAL SURPLUS SALES CO.
4101 Curtis Avenue, Baltimore 26, Maryland
Telephone Curtis 3300

April, 1953 — ELECTRONICS
The following is just a partial list of the current electronic and aircraft equipment now in our warehouse. Write for complete information. Prompt reply to all inquiries.

RC-103 & AN/ARN-5 ILS

IE-17 TEST SET
AN/ARN-7 COMPLETE
SCR-289 COMPLETE
TBS 4 & 5, NEW, COMPLETE
AN/ARC-1 VHF EQUIPMENT

BC-611 & BC-721 HANDIE TALKIES, Plus SPARE PARTS. Quantity available.

AN/ART-13 EQUIPMENT
ATC XMT T-47A/ART-13 XMTR
T-47/ART-13 XMTR CU-25 ANT. LOAD
CU-25 ANT. LOAD DY-116 & 12 Dynam't'r
MT-283 MOUNT O-18 LFO
MT-284 MOUNT ATC DYNAM'T'R
SA-22 ANT. LOAD C-87 CONTROL BOX

AN/APG-13A RADAR
Absolutely complete, brand new
AN/APN-2
SCR-729 New
TAZI-24 Components
RTA-18
BC-1016
APA-6 INDICATOR Command Equip'n't
APA-11 INDICATOR R/4 ARR-2 Receivers
APA-17 RADAR BC-640 VHF XMTR
HS-33 HEAD SETS, NEW
SCR-510
MG-149F & H
MG-153
MG-154
MG-155
MG-156

SPARE PARTS
SCR-720
SO-7
AN/ARN-7
AN/ARC-1
SCR-289
BC-611

SCR-718 A, AM, B & C
Altimeter equipment—complete

To the finest of service and quality of merchandise, we have just recently put into operation our own reconditioning and functioning testing plant, complete with all facilities.

WANTED
CFI UNITS ART-13 BC-788
1-132 BC-348 Q & R
TOP DOLLAR PAID

EXPORT INQUIRIES INVITED
We carry an unusually large stock of Aircraft Equipment, Test Equipment, Radar Sets, etc., write for our low prices and complete information. We furnish immediate answers to all inquiries. Write today!

V & H ELECTRONIC INDUSTRIES INC.
2033 West Venice Blvd.—Dept. E-22
Los Angeles 6, California
Phone: Republic 3-1727

ELECTRONICS—April, 1953
FOR THE BEST BUYS IN ELECTRONIC MATERIALS TOPS IN QUALITY AT DOWN TO EARTH PRICES

SENSITIVE RELAYS

SPECIAL SYNO CAPACITORS

472 SEARCHLIGHT

FEDERAL WALL TYPE

Mfg. by

out, like

VDC

GASOLINE ENGINE GENERATOR:

Complete
-

Model

amp -

amp

TS

amp

BC

-26

2X2

2.126

2C51(W.E.)...

2C40 10.00

2C26A

2026..25

0C3

0A2

Used

ATTENTION: PURCHASING

-5

-A

at

HUHF

Complete,

350

leather

RECTIFIER: For

RECTIFIER SPECIALS!

TOND. PER PR

4

T6.47

AIRBORNE TRANSMITTER

&

FIELD

7/6

AIRBORNE

KIT

TS -34 1E-19

LM

TS -34 1E-19

LM

2

5

227A. 4.50

101L

21525 27.50

12AU7 1.00

7Cü

6V6GTY

6V6GT

SEARCHLIGHT

Excel. cond.

Section

FEDERAL WALL TYPE

Mfg. by

out, like

VDC

GASOLINE ENGINE GENERATOR:

Complete
-

Model

amp -

amp

TS

amp

BC

-26

2X2

2.126

2C51(W.E.)...

2C40 10.00

2C26A

2026..25

0C3

0A2

Used

ATTENTION: PURCHASING

-5

-A

at

HUHF

Complete,

350

leather

RECTIFIER: For

RECTIFIER SPECIALS!

TOND. PER PR

4

T6.47

AIRBORNE TRANSMITTER

&

FIELD

7/6

AIRBORNE

KIT

TS -34 1E-19

LM

TS -34 1E-19

LM

2

5

227A. 4.50

101L

21525 27.50

12AU7 1.00

7Cü

6V6GTY

6V6GT

SEARCHLIGHT

Excel. cond.

Section

FEDERAL WALL TYPE

Mfg. by

out, like

VDC

GASOLINE ENGINE GENERATOR:

Complete
-

Model

amp -

amp

TS

amp

BC

-26

2X2

2.126

2C51(W.E.)...

2C40 10.00

2C26A

2026..25

0C3

0A2

Used

ATTENTION: PURCHASING

-5

-A

at

HUHF

Complete,

350

leather

RECTIFIER: For

RECTIFIER SPECIALS!

TOND. PER PR

4

T6.47

AIRBORNE TRANSMITTER

&

FIELD

7/6

AIRBORNE

KIT

TS -34 1E-19

LM

TS -34 1E-19

LM

2

5

227A. 4.50

101L

21525 27.50

12AU7 1.00

7Cü

6V6GTY

6V6GT

SEARCHLIGHT

Excel. cond.

Section

FEDERAL WALL TYPE

Mfg. by

out, like

VDC

GASOLINE ENGINE GENERATOR:

Complete
-

Model

amp -

amp

TS

amp

BC

-26

2X2

2.126

2C51(W.E.)...

2C40 10.00

2C26A

2026..25

0C3

0A2

Used

ATTENTION: PURCHASING

-5

-A

at

HUHF

Complete,

350

leather

RECTIFIER: For

RECTIFIER SPECIALS!

TOND. PER PR

4

T6.47

AIRBORNE TRANSMITTER

&

FIELD

7/6

AIRBORNE

KIT

TS -34 1E-19

LM

TS -34 1E-19

LM

2

5

227A. 4.50

101L

21525 27.50

12AU7 1.00

7Cü

6V6GTY

6V6GT

SEARCHLIGHT

Excel. cond.
### SPECIAL PURPOSE TUBES

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>OA5</td>
<td>3.50</td>
<td>OA5</td>
<td>3.50</td>
</tr>
<tr>
<td>OA5/VR</td>
<td>8.85</td>
<td>OA5/VR</td>
<td>8.85</td>
</tr>
<tr>
<td>OF2</td>
<td>1.85</td>
<td>OF2</td>
<td>1.85</td>
</tr>
<tr>
<td>OCF4</td>
<td>2.50</td>
<td>OCF4</td>
<td>2.50</td>
</tr>
<tr>
<td>OCF5</td>
<td>5.50</td>
<td>OCF5</td>
<td>5.50</td>
</tr>
<tr>
<td>OCF6</td>
<td>10.00</td>
<td>OCF6</td>
<td>10.00</td>
</tr>
<tr>
<td>OCF10</td>
<td>25.00</td>
<td>OCF10</td>
<td>25.00</td>
</tr>
<tr>
<td>OCF16</td>
<td>60.00</td>
<td>OCF16</td>
<td>60.00</td>
</tr>
<tr>
<td>OCF20</td>
<td>100.00</td>
<td>OCF20</td>
<td>100.00</td>
</tr>
<tr>
<td>OCF25</td>
<td>150.00</td>
<td>OCF25</td>
<td>150.00</td>
</tr>
</tbody>
</table>

Above Listing is only partial.

TERMS: NET 12 days to rated firms.

### MICROWAVE EQUIPMENT SUPPLY CO.

**TELEMARINE**

The Best in Electronic Surplus

PARTIAL LISTING OF OUTSTANDING SURPLUS COMMUNICATIONS EQT.

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3824</td>
<td>24.95</td>
</tr>
<tr>
<td>3828</td>
<td>12.95</td>
</tr>
</tbody>
</table>

**MARINE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N27</td>
<td>1.25</td>
</tr>
<tr>
<td>1N26</td>
<td>1.35</td>
</tr>
<tr>
<td>3828</td>
<td>6.95</td>
</tr>
</tbody>
</table>

**ISR**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N21</td>
<td>18.90</td>
</tr>
<tr>
<td>2C51</td>
<td>5.75</td>
</tr>
</tbody>
</table>

**RADIOSONDES**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N21C</td>
<td>18.90</td>
</tr>
<tr>
<td>1N21B</td>
<td>18.42</td>
</tr>
</tbody>
</table>

- **NOW! CUT COSTS! INCREASE PROFITS!**

Save on POTS • TUBES • RESISTORS

**Carbon Potentiometers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 5</td>
<td>1.10</td>
</tr>
<tr>
<td>6 to 11</td>
<td>1.05</td>
</tr>
<tr>
<td>12 to 24</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**ALL TUBES ARE NEW, MOST WITH JAN MARKINGS AND IN ORIGINAL CARTONS**

Write or Phone if your Prices do not subject to change without notice.

304 Riverside Drive - Dept. 68-3

N. Y. C. 23

MOnument 2-1480 until April 15, then Phone TRalagar 9-3776

---

**AN/APR-4 LABORATORY RECEIVERS**

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband dissector and other antennas, waveguides, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-find equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations! We will buy any Electronic Material at top prices. SCHOOLS—unload your dusty surplus for cash or credit.

**ENGINEERING ASSOCIATES**

434 PATTERSON ROAD

DAYTON 9, OHIO
WANTED

Military communications equipment
Job lots of all condensers
Pulse transformers
Meters, Relays, Autosyns

THE OVERBOOK COMPANY
Overbrook, Massachusetts

WANTED

101B Voice-frequency Ringers
Signal Corps type TA-3/FT.
W-4814, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED

Federal type

- AN/TRC-1 Equipments.
- 114 Transmitters.
- R19 Receivers.
- TS52 Test Oscillators.

Any condition or quantity
W-3888, Electronics
330 W. 42nd St. New York 36, N. Y.

ADDITIONAL

EQUIPMENT WANTED
ADVERTISING
On the opposite page

Prompt ANSWERS
to your business problems...

MISCELLANEOUS business problems are daily being solved, quickly and easily, by the use of the Searchlight Section of this and other McGraw-Hill publications.

The Searchlight Section is classified advertising; you can use it at small cost, to announce all kinds of business wants of interest to other men in the fields served by these publications. It has long been the accepted meeting place of men with business needs and the men who can fill those needs.

When you want additional employees or a position, want to buy or sell used or surplus new equipment, want products to manufacture, seek new capital or factory sites or have other business wants—advertise them in the Searchlight Section for quick, profitable results!

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., Inc.
350 West 42nd Street • New York 36, N. Y.

WANTED

Precision test equipment
Special Purpose tubes
Control transformers
Selvsons, Syncrons

WANTED

W-6165, Electronics
330 W. 42nd St., New York 36, N. Y.

WANTED

Western Electric grey-finished
EQUIPMENT CABINETS
For 19" panels. Heights of 2' 6", 3' 6", 7' 0" and 7' 6".
W-8906, Electronics
330 W. 42 St., New York 36, N. Y.

Will buy "ALL"
ART-13 / type T-47A. BC-541 modified, $25.00.
ART-13 / T-47. R77 Ringers, $50.00.
ARM-13, $75.00.
ART-13 / type T-47. BC-541, $50.00.
ART-13 / type T-47. BC-541, $35.00.
Free box via Express C.O.D. subject to inspection:
H. PINNEGAN
49 Washington Ave. Little Ferry, N. J.

SEARCHLIGHT SECTIONS are found in these McGRAW-HILL Publications:
(1) American Machinist
(2) Aviation Week
(3) Business Week
(4) Chemical Engineering
(5) Chemical Week
(6) Coal Age
(7) Construction Method & Equipment
(8) Electrical Construction & Maintenance
(9) Electrical Merchandising
(10) Electrical World
(11) Electronics
(12) Engineering & Mining Journal
(13) Engineering News Record
(14) E. M. J. Metal Mineral Markets
(15) Factories Man. & Maint.
(16) Fleet Owner
(17) Food Engineering
(18) Nucleonics
(19) Power
(20) Product Engineering
(21) Textile World
(22) Welding Engineer

TUBE CLOSE OUTS
FIRST COME
FIRST SERVED

1B63A $45.00 421 AWE 17.95
1N21B 2.25 422 AWE 10.95
1N23B 2.95 703A 1.50
2C39 17.95 724B 1.50
2C40 7.00 717A .49
2C43 13.95 837 1.25
2J34 19.95 956 .29
2J49 34.95 1626 .10
2J50 29.85 L6090 .75
367 AWE 8.95

IMMEDIATE DELIVERY
Write for quotations: many other types available.
20% Deposit with order; balance C.O.D.
All tubes subject to prior sale; prices subject to change without notice.

WRITE, WIRE, CALL—TODAY!
We Buy Anything in Electronics—large or small Quantities!

NAT ADELMAN
168 Washington St. N. Y. 6, N. Y.

Bargain!

ALTERNATORS!

Brand New! Navy Aircraft Type NEA-2
AC OUT: 120V, 800 cy. 1080 VA
DC OUT: 28V or 25 amps.

Will give rated AC output at reduced speed for 12V DC out. Factory instructions furnished free. Quon. $24.95

DYNAMOTOR BARGAINS!

New. Late Model, Factory Surplus,
INPUT OUTPUT SIZE PRICE
11V DC 500V, 250ma 42x611/4 $24.85
14V DC 400V, 225ma 31x21/2 16.95
12V DC 220V, 100ma 31x21/2 9.95
24V DC 500V, 250ma 42x61/4 19.95
25% dep. an C.O.D. Prices f.o.b. Los Angeles.

POSSNER COMPANY 1223 Venice Blvd.
Tel. DUnkirk 80508 Los Angeles 6, Calif.

HIGH VOLTAGE POWER SUPPLY

Many models available in ranges from 2500 to 25,000 volts D.C., with or without built-in meters.
Send for free catalog E-4

PRECISE MEASUREMENTS CO.
942 Kings Highway, Brooklyn 3, N. Y.
Phone EB 5-8135

CONNECTORS IS OUR BUSINESS

WORLD'S MOST COMPLETE STOCK

Types in stock: AF, AN, AP, ARC, BN, BNC, C, CLE, EN, CUF, D, DFB, DPD, E, F, FK, FM, FT, FW, GK, HH, ICH, ICH, JF, JG, LC, LF, LK, LN M, MC, N, NKL, P, PJ, PL, PM, PYE, RT, RPK, ROK, RNK, RST, RST, RSW, S, SF, SK, SKL, SO, S, UA, UHF, WK, XL, ZA.

HAROLD H. POWELL & CO.
2104 Market St. LOCust 7-5285
Philadelphia 3, Pa.

SEARCHLIGHT SECTION

474

April, 1953 — ELECTRONICS

www.americanradiohistory.com
ATTENTION—MANUFACTURERS

WANTED! $500,000.00

WORTH OF
RADIO AND TV PARTS, SPEAKERS, TRANSFORMERS, TUBES, PICTURE TUBES, CONDENSERS, RESISTORS, SWITCHES, WIRE, ETC.

ALSO
TEST EQUIPMENT, RECORD PLAYERS, AUTOMATIC CHANGERS, MOTORS, MICROPHONES, TONE ARMS.

ALSO
PARTIALLY ASSEMBLED OR COMPLETE RADIO AND TV CHASSIS AND ELECTRONIC EQUIPMENT OR COMPONENTS OF ANY KIND

Here’s your chance to dispose of your inventory for cash.

WRITE • PHONE • WIRE

OLSON RADIO WAREHOUSE
275 E. MARKET ST., AKRON 8, OHIO
PHONE: Jefferson 9191
Att’n. I. J. Olson

!! WANTED !!

IN ORDER TO SUPPLY GOVERNMENT AND INDUSTRIAL REQUIREMENTS, WE ARE PAYING TOP DOLLAR FOR ALL TYPES OF RADIO AND ELECTRONIC SURPLUSES. WE SPECIALIZE IN TEST EQUIPMENT AND COMPLETE RADIOS, SUCH AS:

APA, APN, APQ, APR, APS, APT, ARR, ARC, ARN, ART, ATC, BC, DY, J, IE, LM, MG, PE, PU, SCR, TCS, TN, T6, and many others.


Please state accurate description, condition, and your lowest price. Explain modifications, if any. We pay freight charges. PURCHASING AGENTS, ENGINEERS, EXPORTERS, INDUSTRIAL BUYERS, DEALERS, AND INDIVIDUALS, Please send us your requirements.

WRITE FOR OUR LATEST SURPLUS CATALOG

PHOTOCON SALES
417 N. Foothill Blvd., StCamore 2-6131
Pasadena 8, California
Ryan 1-6751

!! ! WANTED ! ! !

Purpose RADAR TUBES Special

CASH REWARD

for

ART-13 XTL CALIBRATORS
ART-13 XMITTERS (or any parts & spares)
BC-348 Q and R

Also need desperately BC-788C, 1152C, HS/ARN7, APN8, DY17.

IF IN YOUR POSSESSION, PLEASE NOTIFY US IMMEDIATELY!

V & H RADIO & ELECTRONICS
2033 W. Venice Blvd. Phone Collect: Republic 2-1127 Los Angeles 6, Calif.
Searchlight Section  

CLASSIFIED ADVERTISING

We grew to help you!!

Selsyns—Synchrons
Immediate Delivery—Fully Guaranteed

2P Synchron Motor 155/70V 60cy 12.50
3CT Control Trans. 90/55V 60cy 7.95
2HCT Control Trans. 90/55V 60cy 8.50
3H Generator 115/70V 60cy 8.50
2M Synchron Motor 115/70V 60cy 8.50
2S Synchron Motor 155/70V 60cy 12.50
2RF Synchron Motor 155/70V 60cy 12.50
2RF Generator 115/70V 60cy 9.50
2S10 GE Generator 115/70V 60cy 10.00
2S20 GE Generator 115/70V 60cy 10.00
2S23 GE Control Trans. 90/55V 60cy 10.00
ID Differential Motor 90/70V 60cy 4.50
2P Synchron Motor 155/70V 60cy 12.50
5S Generator 115/70V 60cy 9.50
5CT Control Trans. 90/55V 60cy 10.00
7600 Transmitter 115V 400cy 12.50
7620 Differential Generator 115V 400cy 7.50
7220 GE Generator 115V 400cy 12.50
2A3988 GE Synchron Motor 155V 400cy 12.50
5S10 GE Generator 115V 400cy 10.00
5S20 GE Generator 115V 400cy 10.00
5S60 ID Differential Motor 90/55V 60cy 10.00
5S61 ID Differential Motor 90/55V 60cy 10.00

Resolvers & Autosyns

Armoe Resolver Type B196. Ord.
Armoe Autosyn Type B196. Ord.
Bendix Style 477, 55, 377, 2477. 24.00
Leland Type B196. Ord.
Leland Type B196. Ord.
Webster Type B196. Ord.
Webster Type B196. Ord.

Diehl Ac Control Motors

DIEHL AC CONTROL MOTORS

PM Miniature Motors

PM Miniature Motors

BLOWERS

BLOWERS

Carbon Pile Voltage Regulators

Bendix Type 966 Style A Model Set

We have in stock over 10,000 Motors of all types & models—DC, AC, Synchronous, Autosyn, Resolver, inverters or motor generators. Let us help you with your electronic problems.

Dynamotors & Inverters

Dynamotors & Inverters

RESOLVERS & AUTOSYNs

RESOLVERS & AUTOSYNs

Price subject to change without notice. TERMS: Rated firms net 10 days, non-rated 25% with order balance COD. Prices FOB Boston. Minimum order $10.00.

Electro Sales Company Inc.

50 Eastern Ave., Boston 13, Mass. Capitol 7-3456
**TRANSFORMERS**
- All 115 V, 60 Cyclic TV TV, 400 Cyclic TV TV, 1500 Cyclic TV TV
- 1200, 60 Cyclic TV TV, 400 Cyclic TV TV, 1500 Cyclic TV TV

**FILTER CHOKES**
- 400 CYCLE XMRS
  - 6 C Screw Drivers, Assorted
  - 6, 12, 18, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, 168, 180, 192, 204, 216, 228, 240, 252, 264, 276, 288, 300, 312, 324, 336, 348, 360

**SCREW DRIVER SET**
- 6 C Screw Drivers, Assorted
- 6, 12, 18, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, 168, 180, 192, 204, 216, 228, 240, 252, 264, 276, 288, 300, 312, 324, 336, 348, 360

**METER SPECIALS**
- 0-100 Volt, 1/10 Volt, 1 Volt, 10 Volt, 100 Volt
- 0-100 Volt, 1/10 Volt, 1 Volt, 10 Volt, 100 Volt

**AUDIO COMPONENTS**
- Re electrolytics, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000, 15000, 20000, 25000

**SHARPENING STONE**
- 6, 12, 18, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, 168, 180, 192, 204, 216, 228, 240, 252, 264, 276, 288, 300, 312, 324, 336, 348, 360

**AUDIO AMPLIFIERS**
- 0-100 Volt, 1/10 Volt, 1 Volt, 10 Volt, 100 Volt
- 0-100 Volt, 1/10 Volt, 1 Volt, 10 Volt, 100 Volt

**ADDITIONAL ITEMS**
- 6, 12, 18, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, 168, 180, 192, 204, 216, 228, 240, 252, 264, 276, 288, 300, 312, 324, 336, 348, 360

**PRECISION RESISTORS**
- 0-100 Volt, 1/10 Volt, 1 Volt, 10 Volt, 100 Volt
- 0-100 Volt, 1/10 Volt, 1 Volt, 10 Volt, 100 Volt

**MICROVAVVE**
- 42.5V/2A SEL UTC Varfmatch SV/20 AMP
- 42.5V/2A SEL UTC Varfmatch SV/20 AMP

**MADCAP WIRING**
- 1M 2.5V/1.5W 5X1.5W 10X1.5W
- 1M 2.5V/1.5W 5X1.5W 10X1.5W

**TAB "SUN-FLASH" LAMPS**
- TAB "SUN-FLASH" LAMPS
- TAB "SUN-FLASH" LAMPS

**TUBE CLAMPS**
- 300w 500w 1000w 2000w 3000w 5000w
- 300w 500w 1000w 2000w 3000w 5000w

**SOLDERING GUNS & IRONS**
- "TAB" TUBE SPECIALS ELECTRICALLY EXCELLENT
- "TAB" TUBE SPECIALS ELECTRICALLY EXCELLENT

**MICHAIR CAPACITORS**
- Brand New. 350000 Volts 100000 Volts 300000 Volts 500000 Volts
- Brand New. 350000 Volts 100000 Volts 300000 Volts 500000 Volts

**TEST EQUIPMENT**
- MODEL 180 Pneumatic Amplifier, 180 Pneumatic Amplifier
- MODEL 180 Pneumatic Amplifier, 180 Pneumatic Amplifier

**VARIABLE CAPACITORS**
- 1000000 Volts 1000000 Volts 5000000 Volts 10000000 Volts
- 1000000 Volts 1000000 Volts 5000000 Volts 10000000 Volts

**FUSES & HOLDER**
- 300w 500w 1000w 2000w 3000w 5000w
- 300w 500w 1000w 2000w 3000w 5000w

**TABOGRAM**
- WRITE FOR IT
- WRITE FOR IT

**THAT'S A BUY**
- THAT'S A BUY
- THAT'S A BUY
"GR" VARIAC

"GR" VARIACS 180-3500-1800-3500VA 1500-7500VA 3600VDC/36MA 500VDC/15MA

SEIZ 1.19
PSGT 1.39
LC6 1.39
LA4 1.59
L6 1.72
H4G 1.89
F7G 2.13
C70 2.43
BATTERIES
STORAGE BATTERIES

IR Infrared

WEIGHTS & MEASURES

1800VDC/35MA

BASE.

TUBES

GUARANTEED "TAB" TESTED

PIECES SUBJECT TO CHANGE

Use Your Priority for SPEEDY DELIVERY—Extend Your C.O. & Contract Nos.

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

THAT'S "TAB" THAT'S A BUY

THAT'S A BUY

Dept. 4E, 111 Liberty Street, New York 6, N. Y. U. S. A. STORE: 111 LIBERTY STREET

April, 1953—ELECTRONICS

www.americanradiohistory.com
INDEX TO ADVERTISERS

Arco Electric Corporation 304
Adams & Westlake Co. 21
Aeronautical Communications Equipment, Inc. 367
Aerovox Corporation 338, 339
A & Q's Div. of Electric Sign Nat
Corporation 346
Aircraft-Marine Products, Inc. 58, 51
Aircraft Radio Corp. 110
Alden Electric Co. 319
Airadministration Products Company 328
Alden Products Company 58, 30
Allen-Bradley Co. 66
Allen Co., Inc., E. B. 429
Allied Industries, Inc. 365
Allied Research & Engineering, Inc. 429
American Chrome Corp. 391
American Electric Motors 355
American Electrical Heater Company 326
American Electronic Laboratories, Inc. 340
American Encaustic Tiling Co. 359
American Lava Corporation 73
American Phenolic Corporation 296, 303
American Television & Radio Co. 219
American Wire Company 376
Ampec Electric Corp. 65
Andrew Corporation 216
Anti-Corrosive Metal Products Co., Inc. 308
Architectural Finishing Company 382
Arnold Engineering Co. 371
Art-Lloyd Metal Products Corp. 365
Austria Products, Inc. 316
Associated Specialties Co. 391
August Brothers, Inc. 369
Automatic Electric Mfg. Co. 284
Aviation Engineering Corp. 107
Ballantine Laboratories, Inc. 290
Barker Corp., The 13
Belden Manufacturing Company 219
Bell Telephone Laboratories 231
Bendix Aviation Corporation 250
Eclipse-Pioneer Div. 350
Friel Instrument Div. 407
Frigidaire Div. 217, 304
Bentley, Harris Manufacturing Co. 303
Berkeley Scientific, Division of
Industrial Instruments, Inc. 370
Beryllium Corporation 104
Bird & Co., Inc., Richard H. 421
Bird Electronic Corp. 396
Birmingham Sound Reproducers Ltd. 385
Birnbaurl Radio Co., Inc. 466
Bird Camera Corp. 337
Billey Electric Company 256
Bomar Industries, Inc. 425
Borg Manufacturing Co. 60
Boonton Radio Corp. 107
Borg Corporation, George W. 264
Bowser, Inc. 547
Bradley Laboratories, Inc. 61
Brew & Co., Inc., Richard D. 375
Bridgeport Brass Company 116
Bristol Brass Corporation. 44
Brush Electronics Company 212
Buggie & Company, B. H. 275
Burke & James, Inc. 253
Burnett & Company 111
Busmann Mfg. Co. 257

C.G.S. Laboratories, Inc. 403
Cambridge Thermionic Corp. 94
Cannon Electric Company 229
Carbolite Dept., General Electric Co. 116, 117
Carborundum Company 196
Carter Motor Co. 410
Centralab Div. of Glove-Union
Inc. ... 11, 12, 13
Century Geophysical Corporation 252
Century Metallcraft Corp. 244
Electronic Div. 490
Chase Brass & Copper Co. 241
Chesapeake Electric Corp. 257
Chicago Telephone Supply Corp. 46, 41
Chicago Transformer, Div. of Essex Wire
Corporation 376
Cinch Manufacturing Corp. 453
Cimarron Engineering Company 422
Clarke & Cie., F., P. 55
Cleveland Container Co. 311
Cohn Mfg. Co., Inc., Sigmund 367
Collection Corporation 357
Columbia Radio Company 293
Communication Accessories Company 124
Communications Div. of Canada Ltd. 381
Consumer Products Company, Div. of
New Haven Clock & Watch Co. 265
Consolidated Engineering Corp. 91
 Consolidated Vacuum Corp. 213
Constantin & Co., L. I. 201
Continental-Diamond Fibre Company 323
Cornell-Dubilier Electric Corp. 199
Corning Glass Works 273
Coto-Coll Mfg. Co. 298
Cramer Co., Inc., R. W. 31
Crescent Company, Inc. 390
Cross Co., H. 346

Dage Electric Co., Inc. 365
Dane Electric Co. 427
Daven Co., The Third Cover
Dex Electric Co. 425
Deltom Inc. 342
Desillette Corporation 36
Dial Indicating Corporation 275
Don Corning Corporation 127
Driver-Harris Company 253
Du Pont Dymon & Co., (Inc.) L. I. 572
Dwyk Instruments & Co. 372

Eastern Air Devices, Inc. 267
Edison Incorporated, Thomas A.
Electric Engineering Co., Inc. 425, 429
Eitel-McCullough, Inc. 90
Electron Mfg. Co. 356
Electrical Regulator Corp. 259
Electrical Industries Division, Amercomp Electric Corp. 300
Electrical & Physical Instrument Corp. 402
Electro-Mc Laboratory 420
Electro-Tech Equipment Co. 427
Electronic Instrument Corp., Inc. 414
Electronics Research Associates, Inc. 397
Emmitt, Ted 423
Ensign-Bickford Co. 423
Erie Products, Inc. 423
Eureka Television & Tube Corp. 341
Eveready Plating Co. 419
Fairfield Camera & Instrument Corp. 318
Fantasia Metallurgical Corp. 358
Federal Telephone & Radio Corp. 297
Flitron, Inc. 497
Fosco & Company, Inc., T. R. 417
Fokus Engineering Company, John 408
Ford Instrument Company, Inc. 58
Fried Transferer Co., Inc. 247
Furnace Standards 437
Furter Electronics Corp. 437
Gannettewell Company 266
General Ceramic & Steelite Corp. 261
General Electric Company 261
Apparatus Dept. 357, 347, 357, 257, 74
Gهرing Co., Inc., 89, 113, 127, 282
Electronics Dept. 31, 85, 420
Tube Dept. 14, 145

General Electric Co., Inc. 254
General Magnetics Corp. 236

from 20 to 3000 cps with

New wide-range wattmeter

Here's a brand new instrument that sim-
plies many power measurements—the
Keithley Model 110 Electronic Wat-
ter. An amplifier drives the potential
coil of a dynamometer wattmeter; fea-
tures include wide response, sensitivity
to low voltages, very little current drain
by the potential circuit.

SIX SCALE RANGES

Precise readings from 0.3 to 300 watts.
In addition, plug-in shunts for 3, 10,
and 30 amperes extend the upper limit
to 900, 3000, and 9000 watts. Overall
accuracy is within 2% of full scale.

20 TO 3000 CPS RESPONSE

Wide frequency response, with no need
for wave form corrections. Input impede-
ance to the potential circuit is 500,000
ohms, eliminating errors caused by
potential coil current, as voltage drops in
ballasts when measuring the power to
fluorescent lamps. Current coil, 0.5 ohm.

SIMPLE CONNECTIONS

Quick, foolproof test setups. Terminals
connect to the power source and to the
load. Excellent sensitivity enables meas-
urement of low-voltage circuits, such as
power to fuses, small motors and, as here,
to transformers in measuring core loss.

For complete literature on the Model
110 Wattmeter, write

KEITHLEY INSTRUMENTS
3868 Carnegie Ave., Cleveland 15, O

Want more Information? Use post card on last page.
ORTHOSIL

3-Phase Laminations
Cut Costs, Weight, Space

When Transformer Engineers of Pasadena, Calif., contracted to build a 3φ 400 cps transformer for the guided missile program, Thomas & Skinner engineers were consulted for assistance. After thorough analysis, the new T & S EI 1/2"-3φ Orthosil 4 mil lamination was recommended. With this new, thin orthographic iron-silicon lamination, Transformer Engineers were able to cut both weight and size 25%, in addition to substantially reducing the unit cost.

This success with 3φ applications is typical of Thomas & Skinner's new Orthosil laminations. The 3φ series of Orthosil laminations also include 3/8" and 5/8"—and will soon include the EI 7/8"-3φ.

Transformers such as power and 3φ, chokes, saturable reactors, and filters are but a few of the many electrical components for which Orthosil oriented laminations are recommended.

Write today—ask for new T & S Electrical Laminations Bulletin No. L-752.

Specialists in Magnetic Materials; Permanent Magnets, and Laminated Cores

THOMAS & SKINNER Steel Products Company, Inc.
1122 EAST 23RD STREET, INDIANAPOLIS 7, INDIANA

Want more information? Use post card on last page.

April, 1953 — ELECTRONICS
Chemelec High Performance Electronic Components include a complete line of Teflon-insulated 7 and 9-pin Miniature Tube Sockets, 9-pin Connectors, Crystal Sockets, Stand-off Insulators, Feed Through Insulators and Terminals.

All provide the same high performance which this superior insulating material assuages. Surface resistivity $3.5 \times 10^{-12}$ ohms. Loss factor less than 0.0005. Dielectric constant 2.0 (20 cycles to 30,000 megacycles). Serviceable at $-110^\circ F$ to $500^\circ F$. Won’t carbonize under arcing. Zero water absorption by ASTM Test. Unaffected by extreme humidity. Won’t DC plate. Chemically inert, non-gassing, immune to corrosive atmospheres, fungus, oil, solvents. Non-flammable, tough, resilient, withstands and absorbs mechanical shock and vibration.

Write for Catalogs: Miniature Tube Sockets, No. SO-428; 9-pin Connectors, No. CN-409-M; Crystal Sockets, No. CS-441; Stand-off Insulators, No. TE-401; Feed Through Insulators and Terminals, No. CF-400.
**Precision**

**SERIES EV-20**

**VTVM and Multi-Range Test Set**

**TRUE ZERO CENTER on all VTVM ranges**

**PLUS Direct Reading High Frequency Scales**

**48 RANGES TO 1200 Volts* . 2000-Megohms, 12 amperes, . . . 63DB**

*O.C. — VTVM ranges to . . . 60,000 volts when used with Series TV-4 Supper High Voltage Safety Test Probe.

---

**Range Specifications**

**★ SIX ALL-ZERO CENTER VTVM RANGES:**

13½ Max Current Input Resistance.

3½ to 12½. 0-120. 0-200. 0-2000 ohms.

**★ SIX SELF-CONTAINED OHMMETER-MEGOHMMETER RANGES:**

0.2-200-2000 Megohms.

**★ FOUR DIRECT READ PeAK HIGH FREQUENCY VTVM RANGES:**

1½-12½-30-120 volts.

**★ SIX AC-DC AND OUTPUT VOLTAGE RANGES at 1000 ohms/volt:**

0.3-12½-30-120-300-1200 volts.

**★ EIGHT D. C. CURRENT RANGES: 0.1 microamps. 0.12-3.12-30-120-1200 milliamps. 0-12 Amperes.**

**★ SIX DECIBEL RANGES from –20 – to +63 DB. CALIBRATED for 0.5 ohm, 1 mw., 0.01 dB. Reference.**

---

**Important Features**

**★ VOLTAGE REGULATED — BRIDGE TYPE CIRCUIT**

**★ DIRECT READING, ALL ZERO-CENTER VTVM eliminates frequent and inefficient shifting of test leads.**

**★ HIGH FREEDOM OF VOLTAGE SCALES—DIRECT READING.**

**★ DUAL-BALANCED ELECTRONIC BRIDGE OHMMETER-MEGOHMMETER**

**★ 1000 OHMS/V. MULTI-RANGE FUNCTIONS permit simple AC-DC voltage, DC and current measurements.**

**★ 4½" RECTANGULAR METER—200 microamperes. ± 2%. Double-glass, Duralon construction.**

**★ 1½% Film type, Metalized and Wire-Wound resistors.**

**★ Heavy gauge, louvered case with plastic handle. Etched, anodized, aluminum panel.**

---

**Net Selling Price $69.75**

Complete with coaxial Circuit Isolating Test Probe, Shielded Ohmmeter Test Cable, Standard Test Leads, Ohmmeter battery. Case dimensions—10½", x 6½", x 9".

**Also ask to see** the “Precision” Series EV-10 Direct-Voltage VTVM—Megohmmeter with extra large 7½" meter, on display at leading radio parts distributors.

**Write for latest catalogue.**

---

**Precision Apparatus Co., Inc.**

5271 NOVA HAVEN ROAD BRIDGEPORT 1, CONNECTICUT

Export: 446 E'way, N.V.C., U.S.A.: Cables: MORHANEX

In Canada: Atlas Radio Corp., Ltd., Toronto 20, Canada

Want more info? Use post card on last page.

---

**PRELACEMENT**

**SERIES EV-20**

**VTVM AND MULTI-RANGE TEST SET**

TRUE ZERO CENTER ON ALL VTVM RANGES

PLUS DIRECT READING HIGH FREQUENCY SCALES

48 RANGES TO

1200 Volts*. 2000-Megohms, 12 amperes, . . . 63DB

*O.C. — VTVM ranges to . . . 60,000 volts when used with Series TV-4 Supper High Voltage Safety Test Probe.

---

**Range Specifications**

**★ SIX ALL-ZERO CENTER VTVM RANGES:**

13½ Max Current Input Resistance.

3½ to 12½. 0-120. 0-200. 0-2000 ohms.

**★ SIX SELF-CONTAINED OHMMETER-MEGOHMMETER RANGES:**

0.2-200-2000 Megohms.

**★ FOUR DIRECT READ PEAK HIGH FREQUENCY VTVM RANGES:**

1½-12½-30-120 volts.

**★ SIX AC-DC AND OUTPUT VOLTAGE RANGES at 1000 ohms/volt:**

0.3-12½-30-120-300-1200 volts.

**★ EIGHT D.C. CURRENT RANGES: 0.1 microamps. 0.12-3.12-30-120-1200 milliamps. 0-12 Amperes.**

**★ SIX DECIBEL RANGES from –20 – to +63 DB. CALIBRATED for 0.5 ohm, 1 mw., 0.01 dB. Reference.**

---

**Important Features**

**★ VOLTAGE REGULATED — BRIDGE TYPE CIRCUIT**

**★ DIRECT READING, ALL ZERO-CENTER VTVM eliminates frequent and inefficient shifting of test leads.**

**★ HIGH FREEDOM OF VOLTAGE SCALES—DIRECT READING.**

**★ DUAL-BALANCED ELECTRONIC BRIDGE OHMMETER-MEGOHMMETER**

**★ 1000 OHMS/V. MULTI-RANGE FUNCTIONS permit simple AC-DC voltage, DC and current measurements.**

**★ 4½" RECTANGULAR METER—200 microamperes. ± 2%. Double-glass, Duralon construction.**

**★ 1½% Film type, Metalized and Wire-Wound resistors.**

**★ Heavy gauge, louvered case with plastic handle. Etched, anodized, aluminum panel.**

---

**Net Selling Price $69.75**

Complete with coaxial Circuit Isolating Test Probe, Shielded Ohmmeter Test Cable, Standard Test Leads, Ohmmeter battery. Case dimensions—10½", x 6½", x 9".

**Also ask to see** the “Precision” Series EV-10 Direct-Voltage VTVM—Megohmmeter with extra large 7½" meter, on display at leading radio parts distributors.

**Write for latest catalogue.**

---

**Precision Apparatus Co., Inc.**

5271 NOVA HAVEN ROAD BRIDGEPORT 1, CONNECTICUT

Export: 446 E'way, N.V.C., U.S.A.: Cables: MORHANEX

In Canada: Atlas Radio Corp., Ltd., Toronto 20, Canada

Want more info? Use post card on last page.

---

**Trade Television Corp.**

**Transformer Metal Products Corp.**

**Transiisol Corporation.**

**Transistor Products, Inc.**

**Transradio, Ltd.**

**Trial Transformer Mfg. Co.**

**Tri-Ohm Products, Div. of Model Engineering & Mfg., Inc.**

**Tung-Sol Electric Inc.**

---

**Celadon Co., The**

**Unilet Company, George.**

**Unigear Electric Tools, Inc.**

**Unified-Carr Fastener Corp.**

**United Manufacturing & Service Company.**

**United States Gasket Corp.**

**United Transformer Co.**

**Universal Windings Company.**

---

**Vacuum Metals Corporation. Sub. of National Research Corp.**

**Varflex Corporation.**

**Varian Associates.**

**Veefer-Booth, Inc.**

**Vickers Electric Division, Vickers, Inc.**

**Victorson Instrument Co.**

**Vulcan Electric Company.**

---

**Waldes Robinson, Inc.**

**Warrd Leonard Electric Co.**

**Warren Wire Company.**

**Waterman Products, Inc.**

**Waves, Inc.**

**Weekender Company.**

**Western Gear Works.**

**Western Gold & Platinum Works.**

**Whitney-Bush Company.**

**Whitney Blinco Co.**

**Williams & Co., R. B.**

**Winchester Electronics, Inc.**

---

**Xcelite, Incorporated.**

**Zophar Mills, Inc.**

---

**PROFESSIONAL SERVICES**

**SEARCHLIGHT SECTION**

(Classified Advertising)

H. E. HILTY, Mgr.

**SEARCHLIGHT ADVERTISERS INDEX**

476, 477

---

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.

April, 1953 — ELECTRONICS
Since Daven originated the first pie-type wire wound resistor more than a generation ago, it has pioneered many innovations in the production of resistors.

Today, only Daven uses a stranded lead wire to connect the resistance wire to the solder terminal of the Super Davohm Precision Wire Wound Resistor.

As a result, no matter how much strain, stress, heat or pressure is applied to the solder terminal, no accompanying shock is put upon the fine resistance wire itself, but is absorbed by the heavy lead wire without adversely affecting the resistor in any way.

Therefore, Super Davohm Resistors are substantially more rugged than conventional resistors and are able to withstand unusual vibration, rough treatment and abnormal shocks.

This exclusive Daven feature, plus the many other quality aspects of Super Davohm Precision Wire Wound Resistors, makes Daven the leader in the resistor field.

The Super Davohm line includes resistors made in accordance with MIL-R-93A specifications, as well as sub-miniature units to give you the most complete selection of resistors available anywhere. Deliveries can be made to meet your requirements.

Write for assistance with your problems, and ask for a copy of Daven's complete, new brochure on Super Davohm Precision Wire Wound Resistors.

THE DAVEN CO.

191 CENTRAL AVENUE, NEWARK 4, N. J.
Now you see it...now you don't!

This is how it's done...

The etched surface on the faceplate of the metal-shell picture tube (right) diffuses the reflection from the lighted match—while the untreated faceplate of the other tube "mirrors" it.

Here is the answer to an awkward problem...and RCA metal-shell kinescopes solve it simply. They suppress bothersome reflections from room lights and other bright objects. And they reproduce clear, graphic pictures over the entire faceplate area.

Give your TV line a powerful new sales lift. Make your sets "reflection-free"—with RCA metal-shell kinescopes.

For technical data or design help, write RCA, Commercial Engineering, Section 42DR. Or just call your nearest RCA Field Office:

(EAST) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J.
(MIDWEST) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill.
(WEST) Madison 9-3071, 420 S. San Pedro St., Los Angeles, Cal.

RCA Metal-Shell Kinescopes
RCA-21AP4 (magnetic-focus type)
RCA-21MP4 (electrostatic-focus type)

—the picture tubes with the faceplates that suppress annoying room reflections

RADIO CORPORATION of AMERICA
ELECTRON TUBES
HARRISON, N. J.