

4

ELECTRONIC INDUSTRIES

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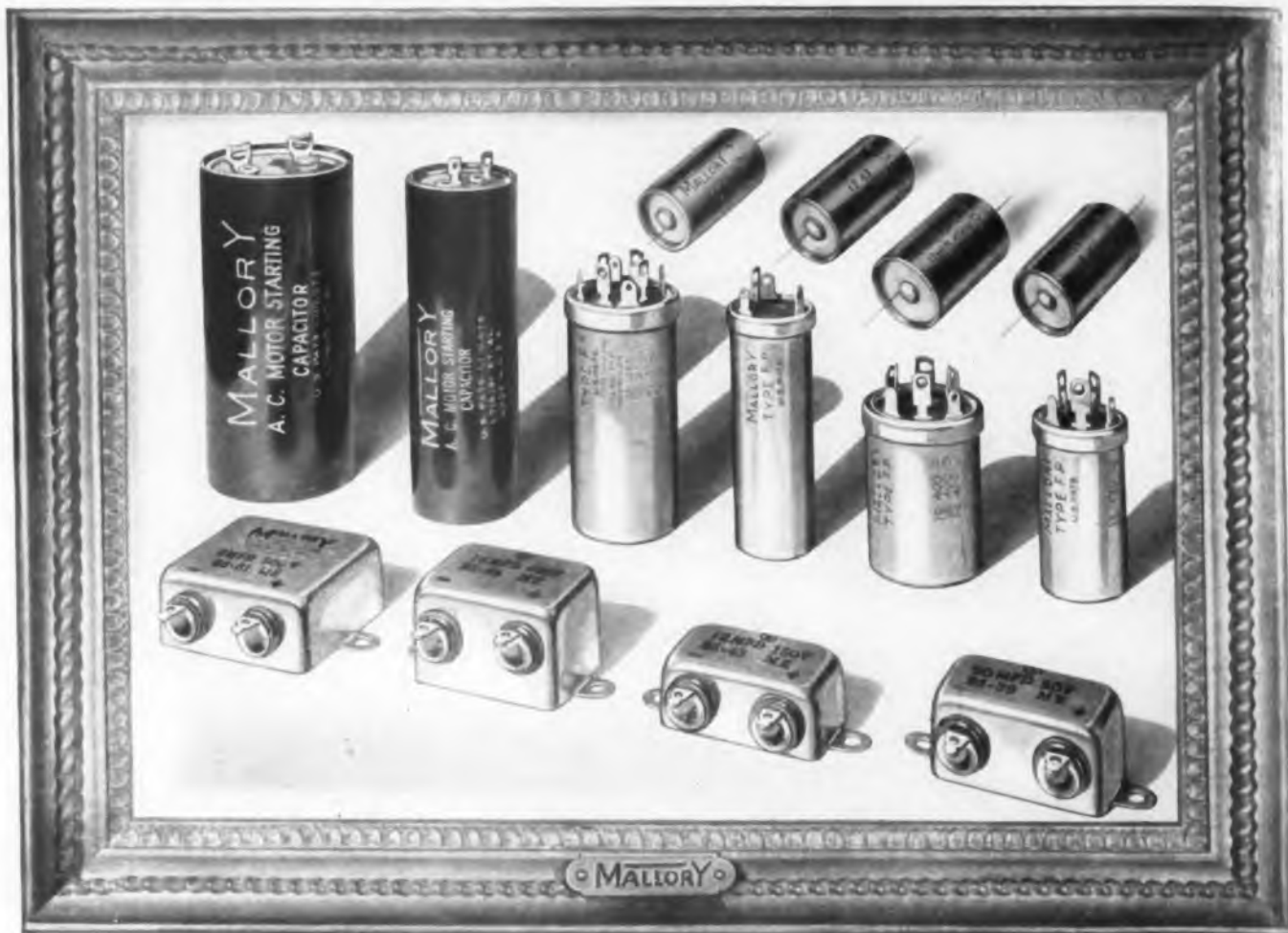
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JULY 1944

Coldwell-Clements, Inc.

JUN 27 1944



Family Portrait...

Bearing the Mallory Stamp of Dependability

REMARKABLY numerous is the family of Mallory dry electrolytic capacitors. So numerous, in fact, that not all its members are pictured here. But one thing the family has in common—*reliability!* You can depend on a Mallory capacitor, no matter what the specific job it was designed to do.

Mallory capacitors are the outgrowth of years of development in Mallory laboratories. They embody improvements which have contributed directly to the growth of radio itself. Today they offer greatly increased operating temperature ranges... remarkable reductions in size for rated capacity... a much greater span of efficiency and life. In addition, Mallory improvements in handling methods, and in control of source materials, assures uniform quality in every capacitor.

Millions of Mallory dry electrolytic capacitors are in service today. They are standard equipment with radio and electronic equipment manufacturers. For specific data, write today for free literature—or see your nearest Mallory distributor.

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MALLORY
ELECTROLYTIC,
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ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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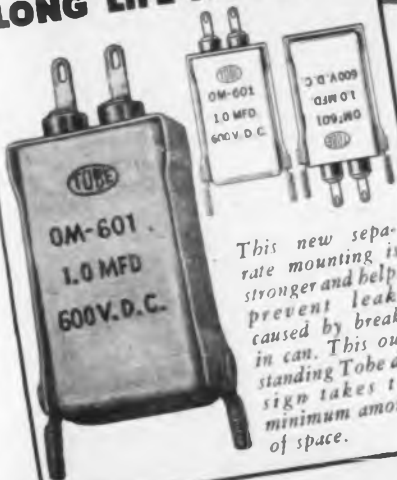
ON THE BEAM-

for nearly two centuries

Tobe Capacitors, too, are "on the beam"—giving years of dependable service . . . for, at Tobe, *long life* is as integral a specification as the dimensions themselves. That is why, with millions of Tobe Capacitors operating under all conditions, "returns" are practically negligible. Continuation of this enviable record rests on long, specialized manufacturing experience—intensive inspections—and constant research. Illustrated below is the Tobe OM-Capacitor. This capacitor is a mineral oil impregnated unit in a streamlined drawn container, hermetically sealed. The hold-down bracket permits the use of either inverted or upright terminals, with wiring underneath or on top of chassis. You will find Tobe engineers ready to cooperate on your own capacitor problems. Why not inquire now?



LONG LIFE ASSURED



This new separate mounting is stronger and helps prevent leaks caused by breaks in can. This outstanding Tobe design takes the minimum amount of space.

SPECIFICATIONS

OM-CAPACITORS

TYPE	OM-*
RATINGS05 to 2.0 mfd. 600 V. D. C. .05 mfd. to 1.0 mfd. 1,000 V. D. C.
STANDARD CAPACITY TOLERANCE	20%**
TEST VOLTAGE	Twice D. C. rating
GROUND TEST	2,500 Volts D. C.
OPERATING TEMPERATURE . . .	-55° F to 185° F
SHUNT RESISTANCE	
	.05 to 0.1 mfd. 20,000 megohms .25 to 0.5 mfd. 12,000 megohms 1.0 to 2.0 mfd. 12,000 megohms
POWER FACTOR	At 1,000 cycles—.002 to .005
CONTAINER SIZE	
	Width 3/8", length 1 5/16", height 2 1/4" MOUNTING HOLE CENTERS
	1 1/2"

MIDGET OM-CAPACITORS

TYPE	OMM-*
RATINGS05, .1 and 2 x .05 600 V. D. C. .05 x .1 1000 V. D. C.
STANDARD CAPACITY TOLERANCE	20%**
GROUND TEST	2,500 V. D. C.
OPERATING TEMPERATURES . . .	-55° F to 185° F
SHUNT RESISTANCE	20,000 megohms
POWER FACTOR . . .	At 1,000 cycles—.0075
CONTAINER SIZE	
	Width 3/8", length 1 5/16", height 1 11/64" MOUNTING HOLE CENTERS
	1 1/2"

*Data sheets showing complete code number for units having a specific capacitance value and voltage rating available on request. **Other tolerances available.

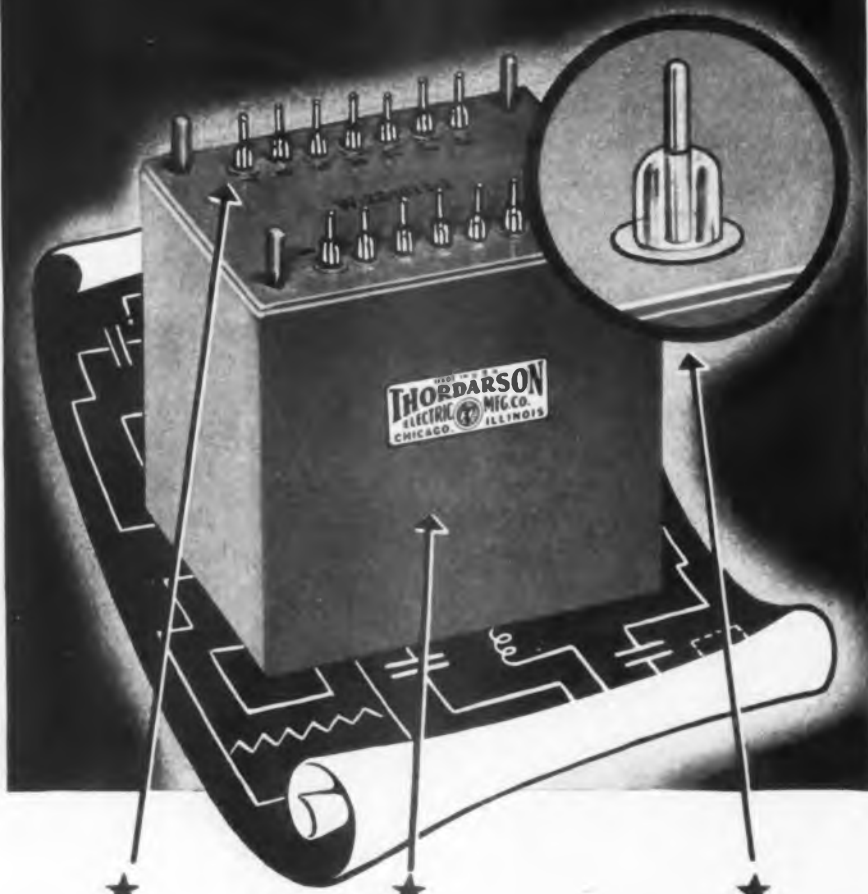
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TRANSFORMER FOR AIRBORNE SERVICE



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LETTERS

Editor, Electronic Industries:

On page 148 of the June issue of "Electronic Industries" there are two charts which purport to show the recommendations of the sub-committee 4, Panel 6, RTPB, concerning frequency allocations in the VHF portion of the spectrum. I should like to call your attention to several errors in these charts which give the impression that Panel 6 is recommending the elimination of two amateur bands.

The charts in question were evidently drawn from data contained in Chart-2, Appendix 6, Document P6-399-A, of the RTPB, date April 14, 1944. The part of Chart-2 showing proposed allocations does not specifically name any of the frequencies left vacant for services other than television, but Chart-4 which is a part of the same document lists all recommended assignments in detail and shows as amateur those frequencies lying between 56 and 60, 112 and 116, and 228 and 234 megacycles. The chart in "Electronic Industries" identifies 56 to 60 as amateur but lists all frequencies between 108 and 120 as being governmental services. The proposed amateur band between 228 and 234 mc is not marked. In addition, the chart in "Electronic Industries" showing present allocations erroneously indicates the amateur 224 to 230 mc band as being A-aircraft.

Several members of Panel 6 have been most outspoken in their appreciation and support of amateur radio and the Panel as a whole has evinced a uniformly cooperative spirit towards the amateur service. It will be most unfortunate if incorrect reports of Panel 6's recommendations give the idea that the television interests are attempting to abolish or usurp amateur frequencies and, knowing your friendly attitude towards amateur radio, I am sure you will wish to print a correct version of the proposed allocations.

Cyrus T. Read
Assistant Secretary
American Radio Relay League



Simple!

Probably the most useful definition we have seen is that appearing in the IRE Standards on Electroacoustics (1938), item 149 for Octave:

"One octave is equal to 1200 cents." This is simple and straightforward, and is without the usual qualifications and cross-references found elsewhere. Whether applied to a neighbor's radio, to Cousin Hetty's girl, Matilda's voice range, or to the actual value of a "high quality" three-inch loud speaker—one with its range plotted by means of a nice "two point" curve—the rule proves an easy starting point for interesting conjectures!—R.R.B.

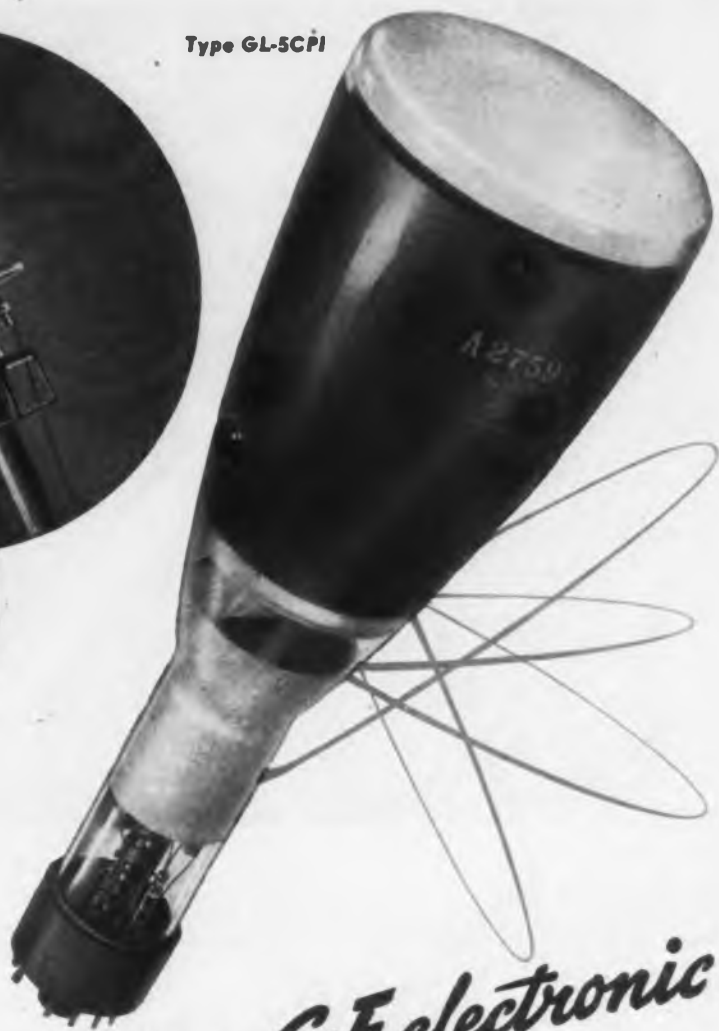
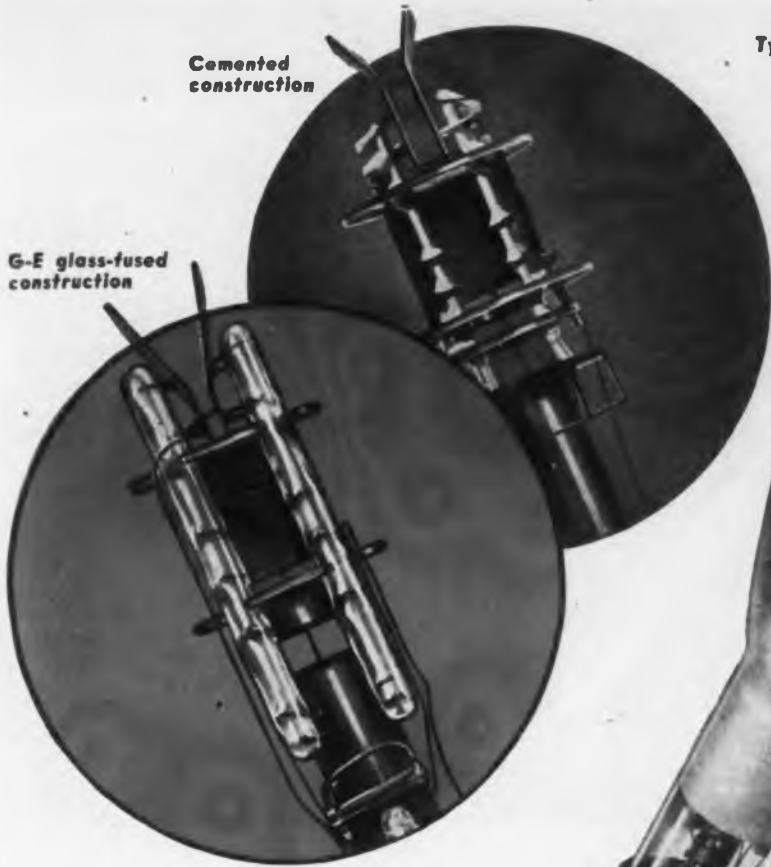


And then there was this note, appended by the censor to a letter received bysylvania Electric Products from a Seabee employe now wearing blue in the South Pacific: "This letter was censored under one of your fluorescent lamps."

Cemented construction

Type GL-5CP1

G-E glass-fused construction



THE NEW RIGID

"SKYSCRAPER" CONSTRUCTION

OF G-E CATHODE-RAY TUBES

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SHOOTING STRAIGHT

another G-E electronic
FIRST!

GENERAL ELECTRIC originated the unique type of "skyscraper" construction which today is used in all G-E cathode-ray tubes. Here the electron gun, which is the heart of the tube, is mounted rigidly so it will position the electron beam accurately throughout the life of the tube.

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WRITE for descriptive literature on G-E cathode-ray tubes. We will be glad to help you in solving your application problems. Electronics Department, General Electric, Schenectady, N. Y.

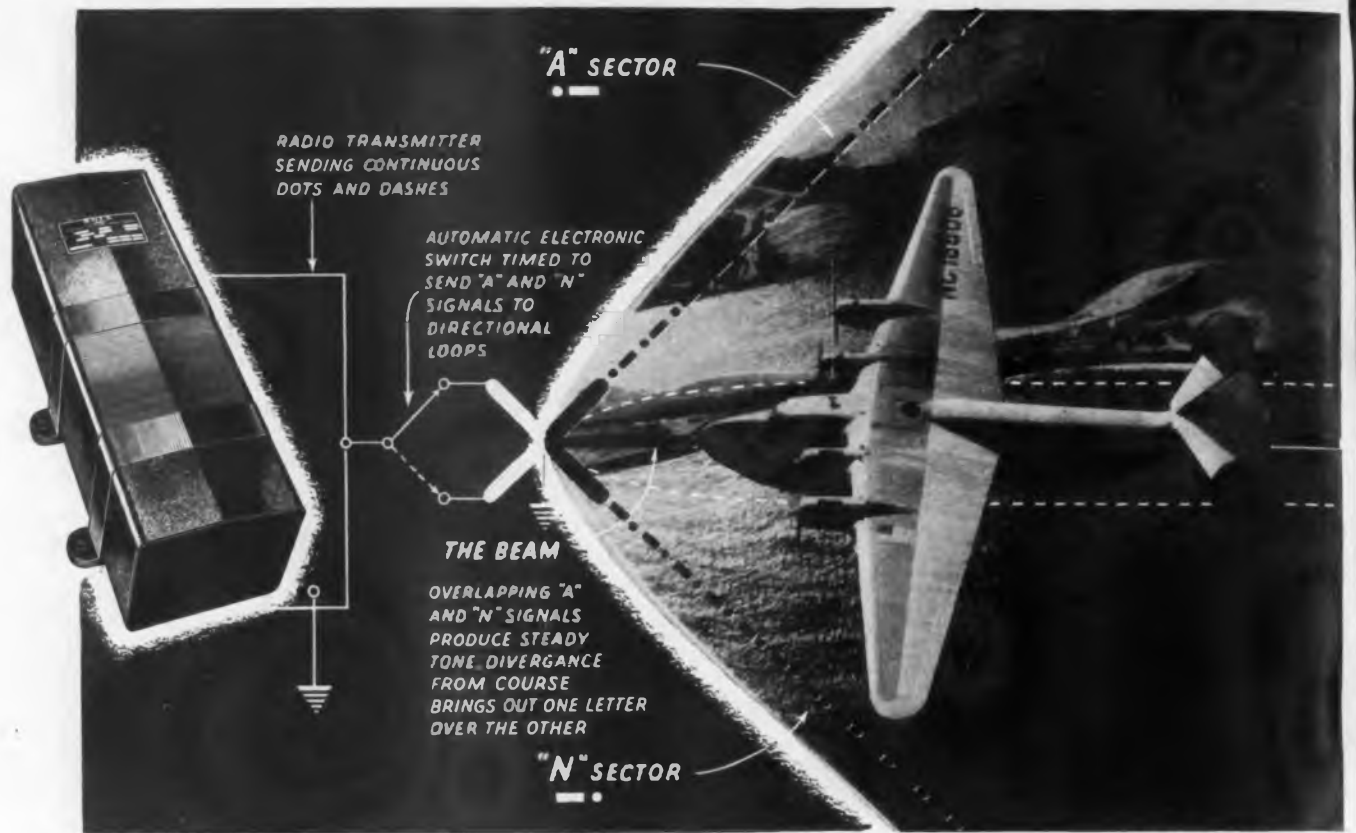
G-E TUBES ARE FIRST IN INDUSTRY, TOO! The G-E phototube, or "electric eye," for instance, performs amazing tasks of counting, sorting, grading, maintaining precise register in printing, detecting flaws in sheet metal, actuating safety devices, and many other functions.

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G. E. HAS MADE MORE BASIC ELECTRONIC-TUBE DEVELOPMENTS THAN ANY OTHER MANUFACTURER

GENERAL  ELECTRIC

161-C6



FAN AMERICAN AIRWAYS PHOTO

COMMERCIAL AIRLINES keep the beam "on the beam" with built-in CONSTANT VOLTAGE

Miles above familiar landmarks, with vision obliterated by fog, sleet or storm clouds, the steady, fused tone of the "dot dash—dash dot" in the head phones is like a soothing symphony to the ears of the airplane pilot. A fading, disrupted signal spells danger.

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they are located at great distances from the airports. Anything short of instantaneous adjustment of the voltage fluctuations would be unacceptable to these instruments, too sensitive to tolerate variations exceeding $\pm 1\%$.

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In designing any device dependent on precise input voltage, the de-

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It is the designer's responsibility to the user to assure the availability of rated voltage at all times, by building automatic voltage control into the unit—or to instruct the user as to how constant voltage might be obtained for those devices not so equipped.

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SOLA Constant Voltage Transformers

To Manufacturers:

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Ask for Bulletin 10 CV-74

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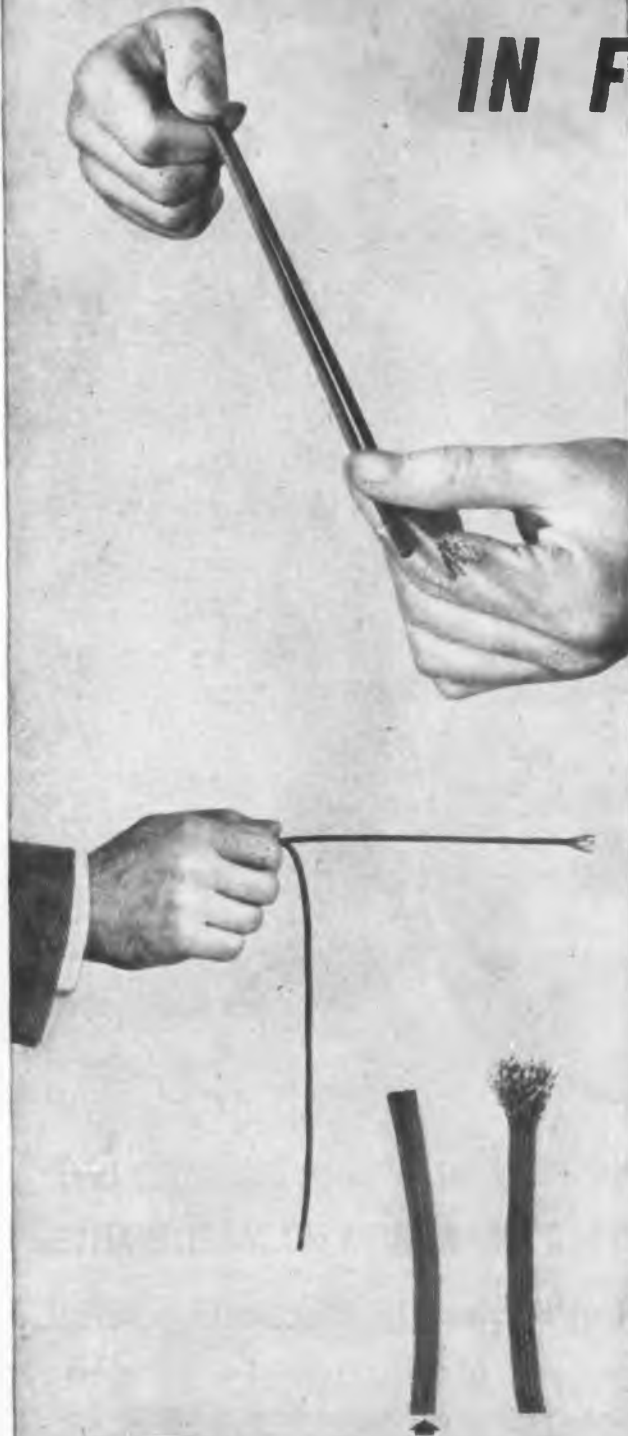
*Available only in S.C.A. Selenium Rectifiers. Trade Mark and Patents Applied For

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DATA SHEET
22-1

SELENIUM CORPORATION of AMERICA

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VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.

Conshohocken, Penna.

That new BH Fiberglas "extra Flex" Sleeving is more flexible than saturated sleeving

WE'VE TOLD YOU about the non-fraying quality of the new BH Sleeving. But don't forget the extra flexibility we've built into it. You can prove this to yourself with the five-second test of sleeving flexibility:

Obtain from us a sample of BH Extra Flexible Fiberglas Sleeving equal in size to the saturated sleeving you use now.

Following Figure 1, hold eight-inch lengths of both BH Extra Flexible Fiberglas Sleeving and saturated sleeving between the thumbs and fingers of both hands. Stretch both sleeveings to make them straight.

Now release the sleeving ends held in your left hand. Instantly, the new BH Fiberglas Sleeving will fall limp, proving its extra flexibility. The saturated sleeving will remain straight, practically inflexible. The comparison is shown in Figure 2.

**NON-FRAYING • FLEXIBLE • HEAT-RESISTANT
NON-INFLAMMABLE • WATER-RESISTANT
NON-CRYSTALLIZING at LOW TEMPERATURES**

The new BH Extra Flexible Fiberglas Sleeving is woven from the choicest continuous-filament Fiberglas yarns. It possesses high dielectric strength, is water-resistant and, like all BH Sleeving and Tubing—is non-inflammable.

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QUALITY RADIO COMBINATION
MANUFACTURERS CAN RELY UPON
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FINE MUSICAL INSTRUMENTS SINCE 1902

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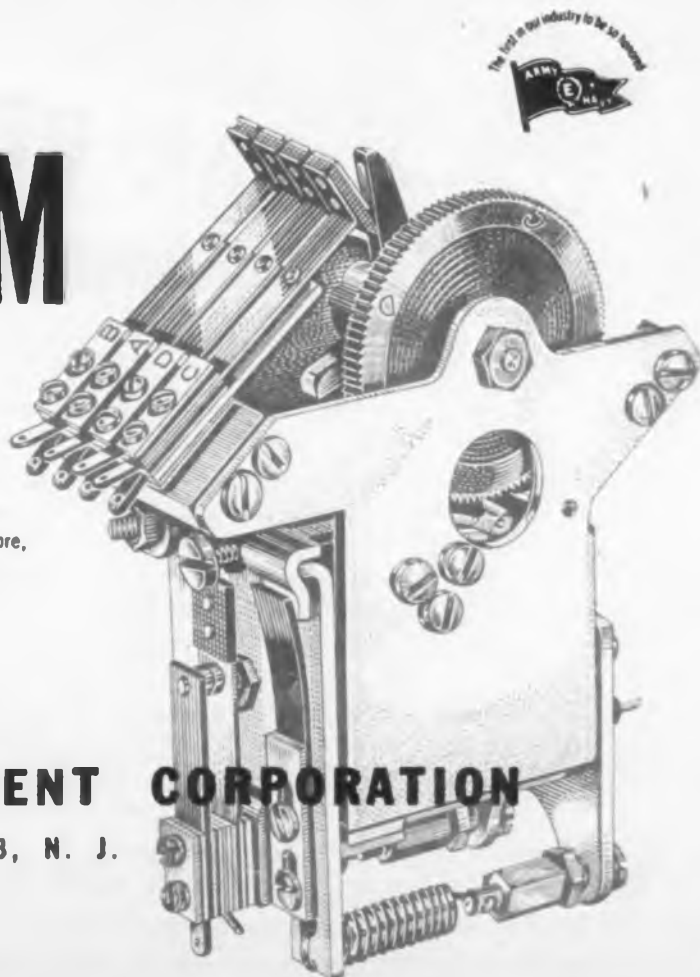
a PLAN for the MAN with a PROBLEM

If your problem is marked Post War we may have the solution to that also, for our plans have long been formulated for the swing back into peacetime production with a minimum of interruption. As before, our Post War forte will be variable condensers and record changers — in addition to which there will be new items of considerable interest.

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ABOUT THE PART

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Before you decide that a product or a part can best be made from glass, steel, wood, or any other material, it will pay

you to find out whether or not that product or part can be made better, cheaper, or faster in laminated plastics. Consultation on such problems with the engineers in our Post-War Development Department is yours for the asking, without cost or obligation. Write us, in complete confidence, about your plans and problems.



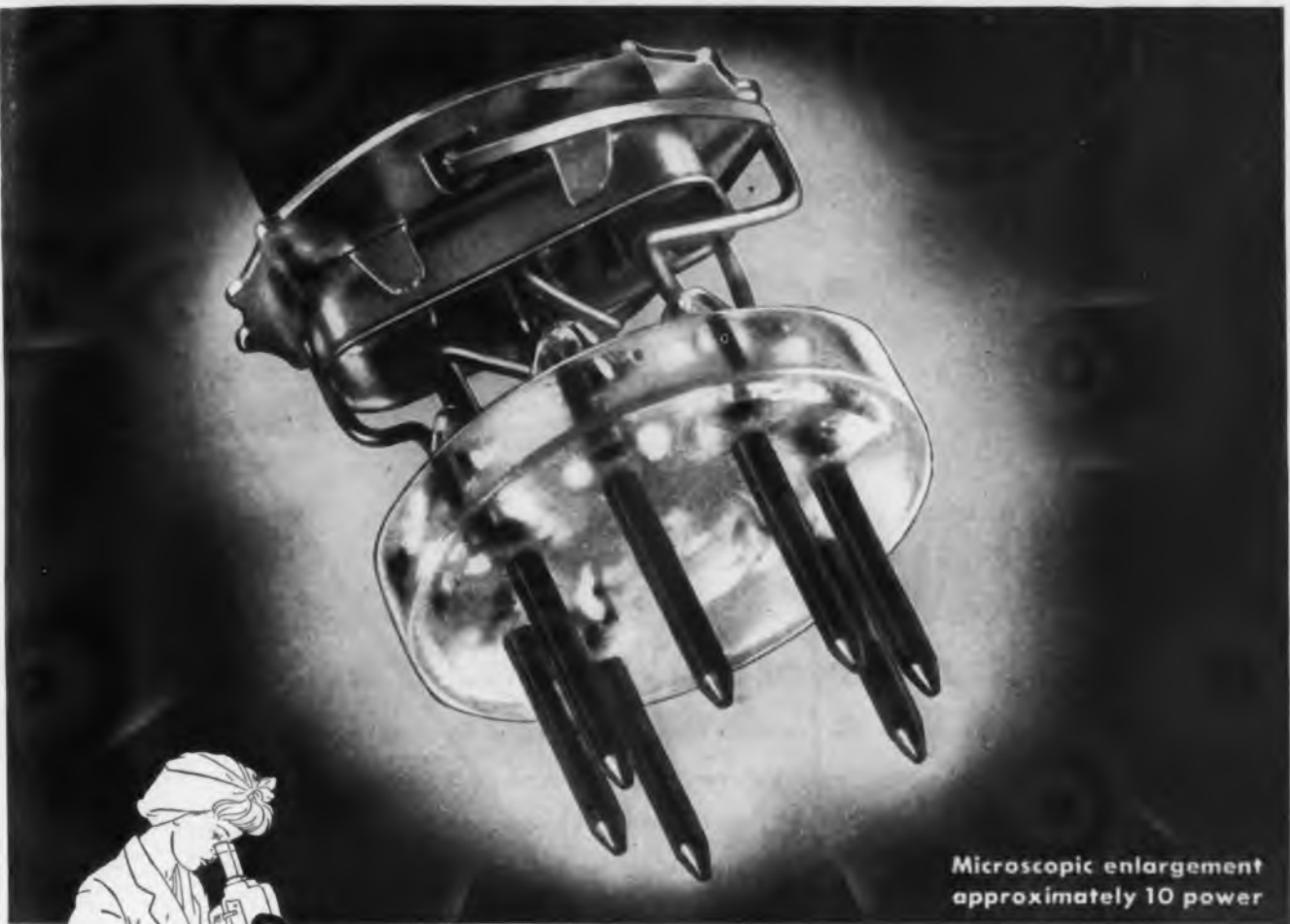
Mass-produced by machining from tubes of Phenol Fibre, this radio part combines light weight, high dielectric quality, low moisture-absorption, and the ability to stand severe shock. Whatever combination of qualities you require, it's a rare case indeed that can't be solved by Laminated Plastics.

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Microscopic enlargement
approximately 10 power

Science on the Production Line

Commonly you think of the microscope as a scientific laboratory instrument. But at National Union, these days, you will find it even more extensively used, as a *production* machine, insuring microscopic precision step by step through many processes of manufacture.

With the aid of microscopes, National Union workers accurately check almost invisibly small parts. They *see* to it that welds are sound, clearances are exact and the structure is mechanically perfect. In the photograph above for example, a N. U. 6AG5 miniature tube mount, no higher than your thumb nail is enlarged approximately 10 times, to permit minute examination of important structural factors. Enlargements up to

500 times—making a hair on your head look as tall as a tree—are just as readily obtained, when needed. Moreover, this tube, assembled from 31 individual parts, must pass 40 individual inspections, in addition to thorough examination under the microscope.

Here, again, is one of those unusual techniques developed by National Union engineers to make tube manufacture a more exact science. Such infinite care makes certain that every electronic tube which carries the National Union name will deliver a uniformly high level of performance with long service life. *Count on National Union.*

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N. J.; Lansdale and Robeson, Pa.



NATIONAL UNION

RADIO AND ELECTRONIC TUBES

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TIMING...

as Important in Peace as in War!

Time is the one invariable factor in the chaos of this changing world... and, like prize fighters, our military strategists realize the value of perfect timing in delivering knockout blows.

Men entrusted with the responsibility of planning now for future peacetime production can learn much about timing... automatic, split-second control of machines and processes... through the modern miracles of ELECTRONICS.

This forward-thinking organization... one of the largest and most progressive in the field of Electronics... is even now working on revolutionary ideas that may readily influence your plans for conversion.

Though our three plants are engaged 100% in essential war work, our Engineering Department will be glad to work with you in making post-war plans now.



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Electronics
INDUSTRIES

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MAGUIRE INDUSTRIES, INC., GREENWICH • STAMFORD • BRIDGEPORT • NEW MILFORD • NEW YORK

14

ELECTRONIC INDUSTRIES • July, 1944

PRINT IN BINDING



NEW!

MYCALEX 400

(Patent Pending)

**THE ONLY HIGH FREQUENCY
INSULATION FOR ELECTRONICS
COMBINING THESE LONG-SOUGHT ADVANTAGES:**

L-4
CHARACTERISTICS

plus

MACHINABILITY TO
TOLERANCES AS
CLOSE AS ± 0.001 IN.

TODAY'S news about low-loss insulation is that MYCALEX 400 is making other glass-and-mica insulation old-fashioned. It is no longer true that "all glass-bonded mica is pretty much the same."

Before the advent of MYCALEX 400, it was impossible to obtain L-4 characteristics plus precise machinability in one and the same insulation. But now MYCALEX 400 combines these long-sought dual advantages. Yet this vastly improved ALL-PURPOSE MYCALEX costs no more.

MYCALEX 400 has a loss factor considerably lower than any other insulation in its class. Its surface resistivity is higher than that of other comparable insulators. This is an important advancement where the application involves high temperature and high humidity, as in the tropics.

Unlike other low-loss ceramic insulators, MYCALEX 400 can be machined with precision . . . drilled, tapped, milled, sawed, turned on a lathe and threaded. It has exceedingly low vapor pressure. It makes a perfect seal with metal.

MYCALEX is not a generic term designating a class of materials, but is the registered trade name for the low loss insulation manufactured in the Western Hemisphere by the Mycalex Corporation of America

Write for samples. Order any quantities, in sheets or rods - or have us fabricate your component products in Mycalex.



COIL FORM

SPECIFICATIONS

Loss Factor,
1 megacycle 0.0018
Dielectric constant,
1 megacycle 7.4
Loss factor, 1 megacycle, 0.013

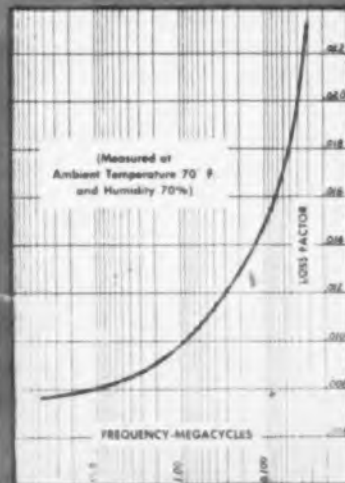
Measured after 48 hours immersion in distilled water in accordance with American War Standard C-75.1-1943 (JAN.-1-10).

Dielectric constant is unchanged from 50 hertz to 10 megacycles.

Surface resistance,
megohms 300,000

After 96 hours at 85° F. and 85% relative humidity, with 1 inch electrode spacing.

Specific gravity 3.0
Impact strength, Charpy, 1/4 in. x 1/4 in. 0.098 ft. lb.



INSULATING BLOCK



MYCALEX CORPORATION OF AMERICA

Exclusive Licensee under all patents of MYCALEX (PARENT) CO. LTD.

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THE SCIENCE OF ELECTRONICS ALSO PROVIDES A NEW TRIUMPH IN
ELECTRO-MEDICAL ANALYSIS AND LABORATORY RESEARCH . . .

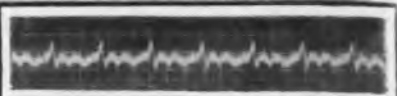


FIGURE A—Photographic Method

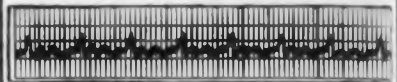


FIGURE B—EPL Method

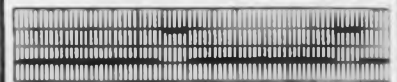


FIGURE C—Calibration

The exact similarity between the standard photographic cardiogram and the direct writing instantaneous cardiogram on this new EPL instrument is indicated in Figures A and B, which are records of the same subject taken a few minutes apart.

New

EPL Direct-recording Electrocardiograph* ...giving instantaneous *standard* readings

- Built to exacting laboratory standards after years of research
- Completely eliminates all photographic procedures
- Useful in the laboratory as well as a benefit to mankind
- Compact, lightweight, portable; simple and efficient in operation
- Cardiograph record appears instantaneously
- Built-in interference filter makes possible perfectly usable cardiograms in strong interfering electrical field
- Operates from any 110-120 volt, 60 cycle, AC service
- Uses no ink or other fluids
- High operating economy

*PATENT PENDING



For Laboratory Procedure

The recorder of this new Electrocardiograph may be used in conjunction with other equipment for laboratory research. It provides an amplifier and recorder which will give a graphic record between .1 cycle and 80 cycles per second at a sensitivity of 1 millivolt for 2 cms total deflection; or a range from zero to 80 cycles for 60 millivolts for 2 cms deflection. A high speed writer can be supplied which will extend the operating frequency to about 200 cycles. Because of the special damping circuit employed, excellent transient response is secured.

Although in the high sensitivity connection, the amplifier is not a true D-C amplifier, the phase correction is such that perfect square wave response from .25 cycles to 80 cycles is realized with the one millivolt sensitivity connection.

At present, deliveries will be made on priority only.
Write for descriptive booklet.

ELECTRO-PHYSICAL LABORATORIES, INC.

45 W. 18th STREET • NEW YORK 11, N. Y. • WAtkins 9-1870

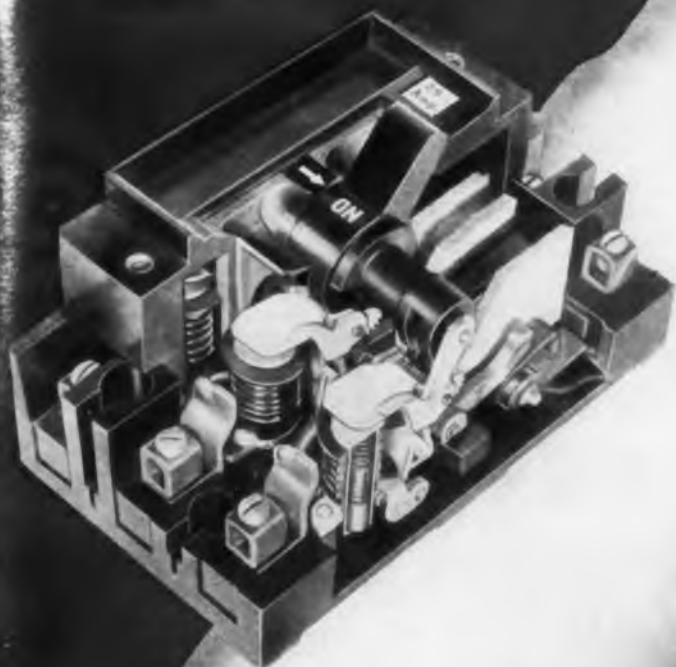
Manufacturers of Electro-Encephalographs and Electric Shock-proof Machines

A Division of the ELECTRONIC CORPORATION OF AMERICA



VITAL PROTECTION

for Radio Tubes



HEINEMANN MAGNETIC CIRCUIT BREAKERS

High speed trip on short circuit means positive protection for costly equipment, while delayed trip on transient overloads means no unnecessary interruption in the normal supply.

The overload trip unit is ELECTRO MAGNETIC, which is inherently accurate and dependable. Fractional ratings which match the characteristics of almost any circuit may be had between 10 milliamperes and 50 amperes, and with any one of three different inverse time delays.

When time delay is not desired, breaker with instantaneous trip only is available.

HEINEMANN CIRCUIT BREAKER CO.

Subsidiary of Heinemann Electric Co., Est. 1888

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TRENTON, N. J.

JAMES

Crystals

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Specialists in the
Development of
Quartz Crystal
Products for All
Applications.

**BUY WAR BONDS
FOR VICTORY!**

The **JAMES KNIGHTS** Co. 
SANDWICH, ILLINOIS



CRYSTALS

CRYSTALS FOR THE CRITICAL

FIRST ON THE NORMANDY COAST

The Army's SCR-299's went ashore with the wave of Allied assault troops that split the 2nd front wide open. These mobile radio units rolled up on the beachhead early in the battle to serve as vitally important front line communications weapons to coordinate and direct the striking power of the land, sea and air forces. . . . In truck or duck, the Hallicrafters-built SCR-299's go anywhere and are sturdy enough to withstand front line action. Highly dependable and powerful, they "get the message through."

hallicrafters RADIO

THE HALLCRAFTERS CO., MANUFACTURERS OF RADIO
AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.



BUY A WAR
BOND TODAY!



The dependable delivery of any urgent message, anywhere, may be commonplace very soon now. The speed with which the electronic industry has created wonders for the war promises to match even the most startling dreams of a short time ago

Doctor, please stop to see the Smith's baby on your way home



We took twenty-five peacetime years to become America's largest manufacturers of portable phonographs—the famous Phonola line. Now, after less than four years, we are old hands at building electronic equipment for our fighters. And our war-spurred progress inspires us to keep going... to increase our former service to normal civilian life. So, when Victory releases all the war-vital electronic discoveries, look for a still finer Phonola *plus* a worthy companion line of new Waters Conley devices—all aimed to better yesterday's dreams of tomorrow and today's hopes for peace.

Phonola

WATERS CONLEY COMPANY, ROCHESTER, MINN.
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IMPORTANT ON CABLE ASSEMBLIES

• For the cable assemblies that go into your products you can use Amphenol-made cables and save precious time and money at every step. Amphenol has the equipment, the skill, the experience and the production line set-up to make them on a mass production basis—and make them properly. Such assemblies will be manufactured exactly in accordance with your specifications.

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The finished Amphenol assembly or harness is a sales asset to your product in service and in appearance. Amphenol quality of product and workmanship is known the world over.

Tell us what you need.

Amphenol assemblies can be made in any combination of connectors, conductors and conductors.

Depend upon

AMPHENOL

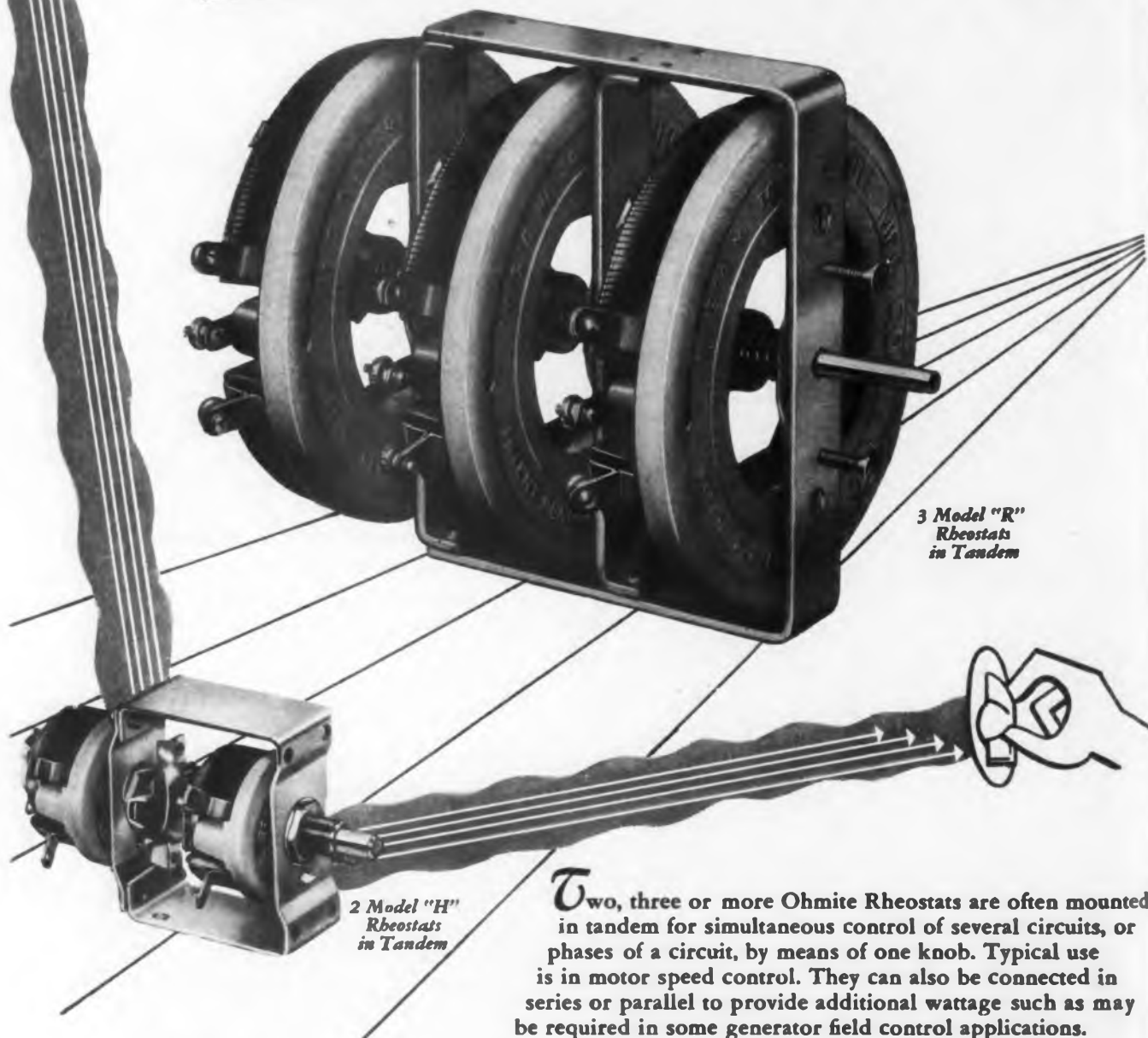
Quality

AMERICAN PHENOLIC CORPORATION
1830 S. 54th Avenue, Chicago 50, Illinois

Connectors
Fittings
Conduit
Cable
Radio Parts
Synthetics

OHMITE Rheostats in Tandem

For Simultaneous Control of Several Circuits



3 Model "R"
Rheostats
in Tandem

2 Model "H"
Rheostats
in Tandem

Two, three or more Ohmite Rheostats are often mounted in tandem for simultaneous control of several circuits, or phases of a circuit, by means of one knob. Typical use is in motor speed control. They can also be connected in series or parallel to provide additional wattage such as may be required in some generator field control applications. Any of Ohmite's ten rheostat sizes, or combination of sizes, may be utilized...rheostats ranging from 25 watts to 1000 watts and from 1-9/16" to 12" diameter... with uniform or tapered windings. Concentric control assemblies can also be produced. *In Resistance-Control, Ohmite Experience Makes a Difference!*

OHMITE MANUFACTURING COMPANY
4983 FLOURNOY STREET • CHICAGO 44, ILLINOIS

Be Right with **OHMITE**
RHEOSTATS • RESISTORS • TAP SWITCHES

• Write on company letterhead for Industrial Catalog and Engineering Manual No. 40. Gives helpful information on the selection and application of Rheostats, Resistors, Tap Switches. Address Ohmite Manufacturing Co., 4983 Flournoy Street, Chicago 44.





Subbing for the Farm Boy

WHO'S GONE TO WAR



Imagine peddling a grindstone, running a corn sheller or fanning mill . . . doing the milking, separating and cooling . . . pumping water, and countless other jobs on the farm . . . for wages of less than a cent an hour!

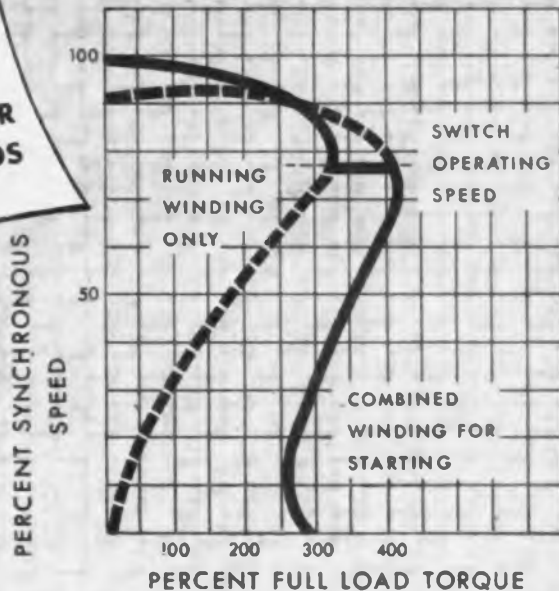
PICK THIS MOTOR

- Where high starting and high breakdown torques are required.
- Where starting current over 20 amperes is permissible.
- Where starting is infrequent.

TYPE FHT HIGH TORQUE SPLIT-PHASE MOTOR
 PHASE—Single
 CYCLES—60, 50, 25
 HORSEPOWER— $\frac{1}{4}$ to $\frac{1}{2}$
 VOLTS—110 or 220
 SPEEDS—(Approximate full load)
 60 cycles—1725
 50, 25 cycles—1425



SPLIT PHASE



Yet that's exactly what the Type FHT motor will do for you on any farm job to which motor power can be applied. It's a high torque, split-phase motor . . . especially designed for continuous and intermittent duty applications where starting current over 20 amperes is permissible. Starting torque is from 200 to 250% . . . with 260 to 300% breakdown torque, in relation to running torque. It's the perfect solution for your worrisome farm problems.

ASK FOR APPLICATION HELP

For condensed information on this and other types of Westinghouse small motors, write today for The Westinghouse Small Motor Selector (Booklet 3075-A). It's a helpful aid to proper motor selection. Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pennsylvania. J-03197



Westinghouse
 PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE
SMALL MOTORS



THE WAR WILL END ON



(YOU FILL IN THE DATE)

Think of it! You as a civilian have the power to decide when the war will end. Use that power to the utmost — NOW — by

1. Buying war bonds to the limit of your capacity.
2. Working harder, longer, and uninterruptedly turning out implements of war.
3. Donating your blood to the Red Cross to save lives on the battle field.
4. Collecting waste paper and other scrap for which the government is asking.
5. Avoiding black markets as you would the plague. (Black markets cause the plague of inflation.)

All these are weapons of war — weapons that strike terror in the hearts of our enemies. Use them.

We, the management and employees alike, at Kenyon, are building better transformers than we ever built before — and building them faster for the armed forces.



THE MARK OF

EXCELLENCE



KENYON TRANSFORMER CO., Inc.

840 BARRY STREET
NEW YORK, U. S. A.



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"IT'S FROM THE U.S.A.!"

with **OWI's New Export Seal . . .**

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O. W. I.'s new Export Seal may be used in any shape or size—in any language—alone or combined with your company trademark or nameplate. O. W. I. does not sell this Export Seal. Purchase may be made from a source of the exporter's own choice.

and tell it with **MEYERCORD DECALS**

Millions of non-lease items exported throughout the world, a basis for incalculable wartime and postwar goodwill—now can be uniformly identified as "made in the U.S.A!"—with this new, official red, white and blue Export Seal designed and recommended by the Office of War Information.

Investigate Meyercord Decals for the reproduction of Export Seals or combination Seals and regular trademarks or nameplates. They provide highly legible product identification that last for the life of the product. They save time, cost, weight and metal, and require no screws or rivets for application. They are durable, washable, and can be produced in any size, colors or design . . . for application on rough, smooth or crinkled surfaces of any known commercial material. Billions are used all over the world.

Tell the world "It's from the U.S.A." . . . and use Meyercord Decals for low-cost reproduction of a multi-language program of product identification. Let us suggest combinations of the Seal with your own trademark. No obligation. Address Dept. 62-7.



The nameplate illustrated demonstrates one of many ways in which the O. W. I. Export Seal may be combined with your own trademark economically with Meyercord decals.

This advertisement is published in cooperation with the Office of War Information. Full information regarding O.W.I.'s Export Seal Program may be obtained by writing to: Special Promotion Division, Office of War Information, 250 W. 57th St., New York (19), N. Y.



the **MEYERCORD CO.**

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DO YOU NEED D.C. AMPERES?



This single unit has an output of 5000 amps at 6 volts D.C. We also build small laboratory units or large group installations. We will custom build units of any capacity to meet your requirements.



We engineer and custom build complete RECTIFIER UNITS to meet the needs of any industrial or laboratory application.

Your problem may call for high current, low or medium voltage, or you may need high voltage and low current.

Selenium disc rectifiers will take care of one — Electronic tubes the other. *We have both.*

Each type of rectifier excels for certain work and it is our job to engineer and build equipments to meet *your* particular needs.

May we apply our engineering skill and construction experience to your D.C. needs?



Write L. W. Reinken, Chief Engineer

W. GREEN ELECTRIC COMPANY, INC.

GREEN EXCHANGE BLDG., 130 CEDAR ST., NEW YORK 6, N. Y.

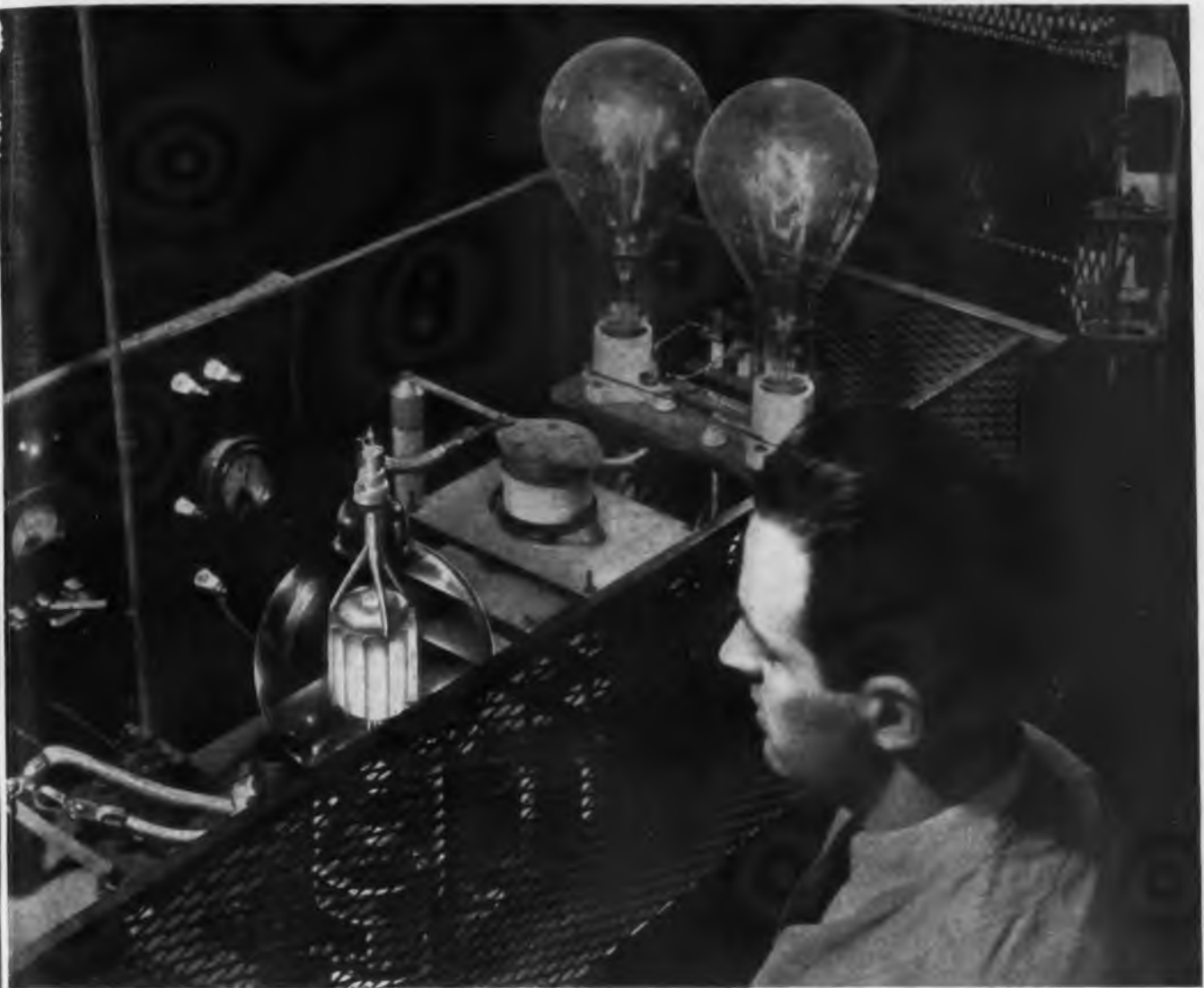
RECTIFIER

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ENGINEERS

1892



DEATH AT 20 METERS

... or another reason for the long life of Gammatrons

ONE out of every thousand Gammatron tubes is sacrificed in the Heintz and Kaufman laboratory so that the operating life of similar Gammatrons may be periodically checked and assured.

This thousandth tube oscillates at 20 meters, pouring its power into light bulbs until it finally fails. The length of its operating life is carefully recorded, and compared with the previous performance of tubes of the same type. This is but one of 17 checks made in the Heintz and Kaufman laboratory to guarantee the efficiency and reliability of every tube bearing the Gammatron label.

Basically correct design, plus continuous mechanical and electrical tests, have led to widespread recognition of Gammatrons as "the tubes that can take it."

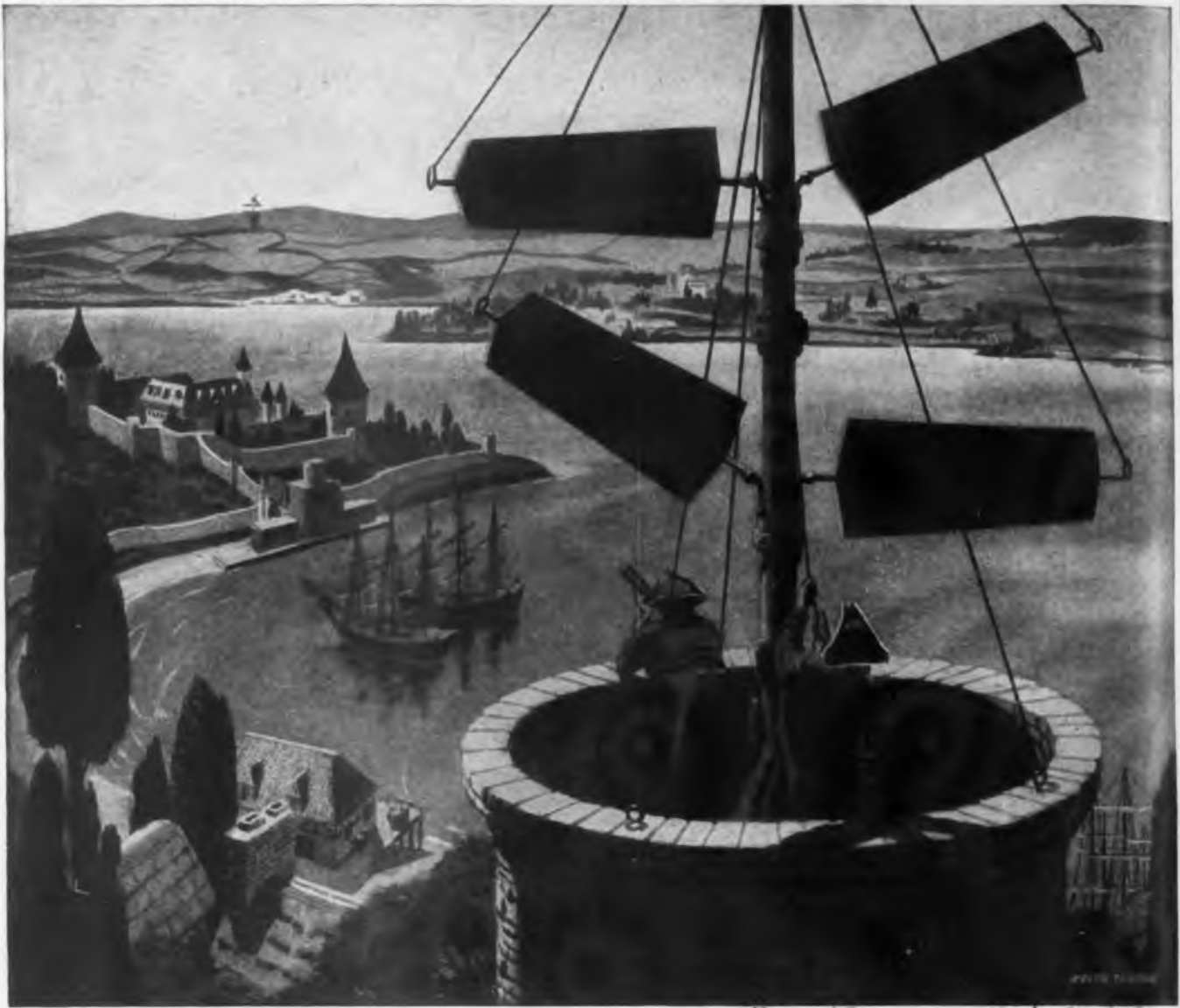
FOR VICTORY AND SECURITY BUY WAR BONDS

HEINTZ AND KAUFMAN LTD.

SOUTH SAN FRANCISCO • CALIFORNIA, U. S. A.



Gammatron Tubes



History of Communications Number Six of a Series

COMMUNICATION BY SEMAPHORE



**MODEL T-45
LIP MICROPHONE**



The Semaphore, as a means of communication, met first commercial acceptance in France under the authority of Napoleon in 1792. Restricted by "line of sight" and low power eye pieces, excessive numbers of relay stations, as pictured above, were required for "directional broadcasting" over rough terrain. Weather conditions, too, were a handicap. Because of the code used and its necessary translation, delays and errors were continually encountered.

Today, in the era of applied electronics, Universal microphones are being used to expedite messages on every battle front in the service of the Allies. Universal is proud of its contribution in the electronic voice communications and its every effort to our ultimate Victory.

Model T-45, illustrated at left, is the new Lip Microphone being manufactured by Universal for the U. S. Army Signal Corps. Shortly, these microphones will be available to priority users through local Radio Jobbers.

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA



FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA -- CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA



COIL FORMS OF

Steatite BODY (302)
and ^{*}**Centradite** BODY (400)

CENTRALAB occupies a distinctive place in the industry with its Coil Forms of Steatite and Centradite*. Countless new uses for these ceramics are being developed daily in industry. The unique electrical and physical characteristics of these ceramics are being combined in various ways to form new applications. Our laboratory and engineering facilities are at your disposal. Write for Bulletin 720.


Centralab
Division of GLOBE-UNION INC., Milwaukee

STANDARD FREQUENCIES — *Octaves of them*



FREQUENCIES

10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 190

Accuracy: 10 parts in 1,000,000

Output: 30 volts at 500,000 ohms

Input: 105-125V, 50-60c, 40 watts

Weight: 50 pounds

Impossible? Well, here it is—

This Multi-frequency generator furnishes the frequencies shown above at the turn of a switch. All frequencies are obtained from a temperature-compensated tuning fork and voltage-stabilized circuit.

With this unit it is possible to calibrate oscillators at many selected points without encountering complex oscilloscope patterns. One of the uncertainties involved in development work on tuned

circuits, filters, reeds—and in time measurement can be minimized with the aid of this instrument.

Developed primarily to check frequency meters for precision war work, this Multi-frequency generator possesses a rugged durability and dependability in service that will prove an extra value to many laboratories.

Additional information available on request.

Manufacturer of
the

Watch Master



and distributor of
Western Electric
Watch-rate Recorders

American Time Products, INC. New York 19, N. Y.

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METALLIZED STEATITE

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LENOXITE

STEATITE BONDED WITH
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Specify • **LENOXITE PRECISION STEATITE**

LENOXITE DIVISION • LENOX, INCORPORATED • TRENTON 5, NEW JERSEY

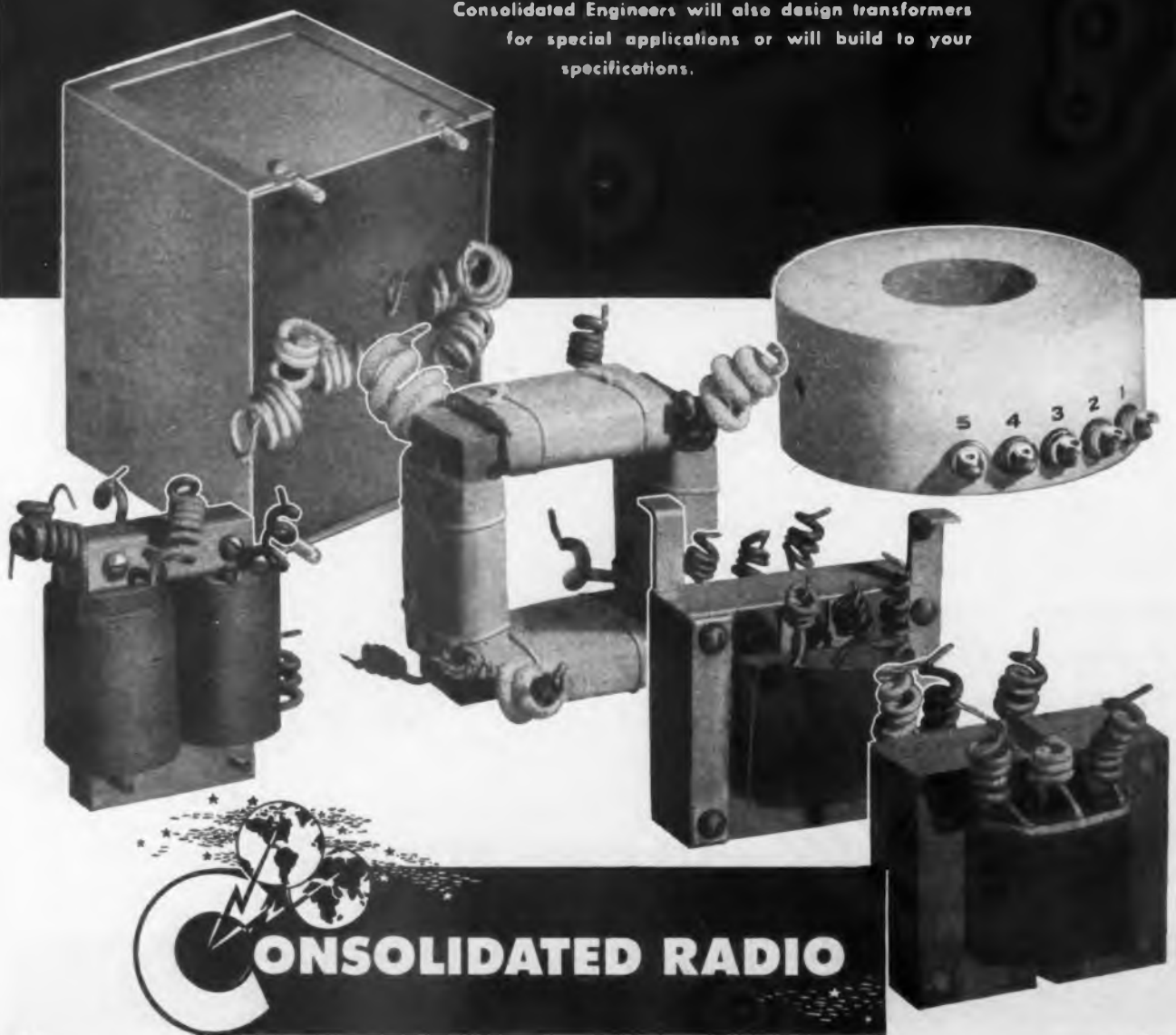
Small and Medium **TRANSFORMERS**

*to meet airborne communications
equipment specifications*

Consolidated Radio Products Company specializes in 400 cycle transformers to meet Army and Navy specifications on airborne communications equipment, and also, supplies prime contractors of the Signal Corps and Maritime Commission.

Greatly expanded production facilities on a wide range of small and medium transformers include Pulse Transformers, Solenoid Coils, Search Coils. Other products include Range Filters and Headsets.

Consolidated Engineers will also design transformers for special applications or will build to your specifications.



CONSOLIDATED RADIO

an eye to the future



The electronic engineer is an important part of the war effort, and his day has too few hours for him. His highly vital, specialized training and knowledge are utilized to the utmost in devising new electronic equipment to keep up with and anticipate the many demands of the modern warfare.

Despite those many work-filled hours, the electronic engineer still finds time, here and there, to dream of the future and plan for the day when his skill will be turned to peacetime pursuits. He has wonderful plans for tomorrow: Ideas for a better and more comfortable life. Today, however, he is working to guarantee tomorrow.

Raytheon is proud of its engineers and the job they are doing . . . and Raytheon is proud to have a part in the vitally important role that advanced electronic tubes and equipment are playing in the Allied Nations' drive for Victory. In the peace to come, Raytheon's advanced research and technique will assure Raytheon's continued leadership in the electronic era.



ARMY-NAVY "E" WITH STARS

Awarded All Four Divisions of Raytheon for Continued Excellence in Production

RAYTHEON

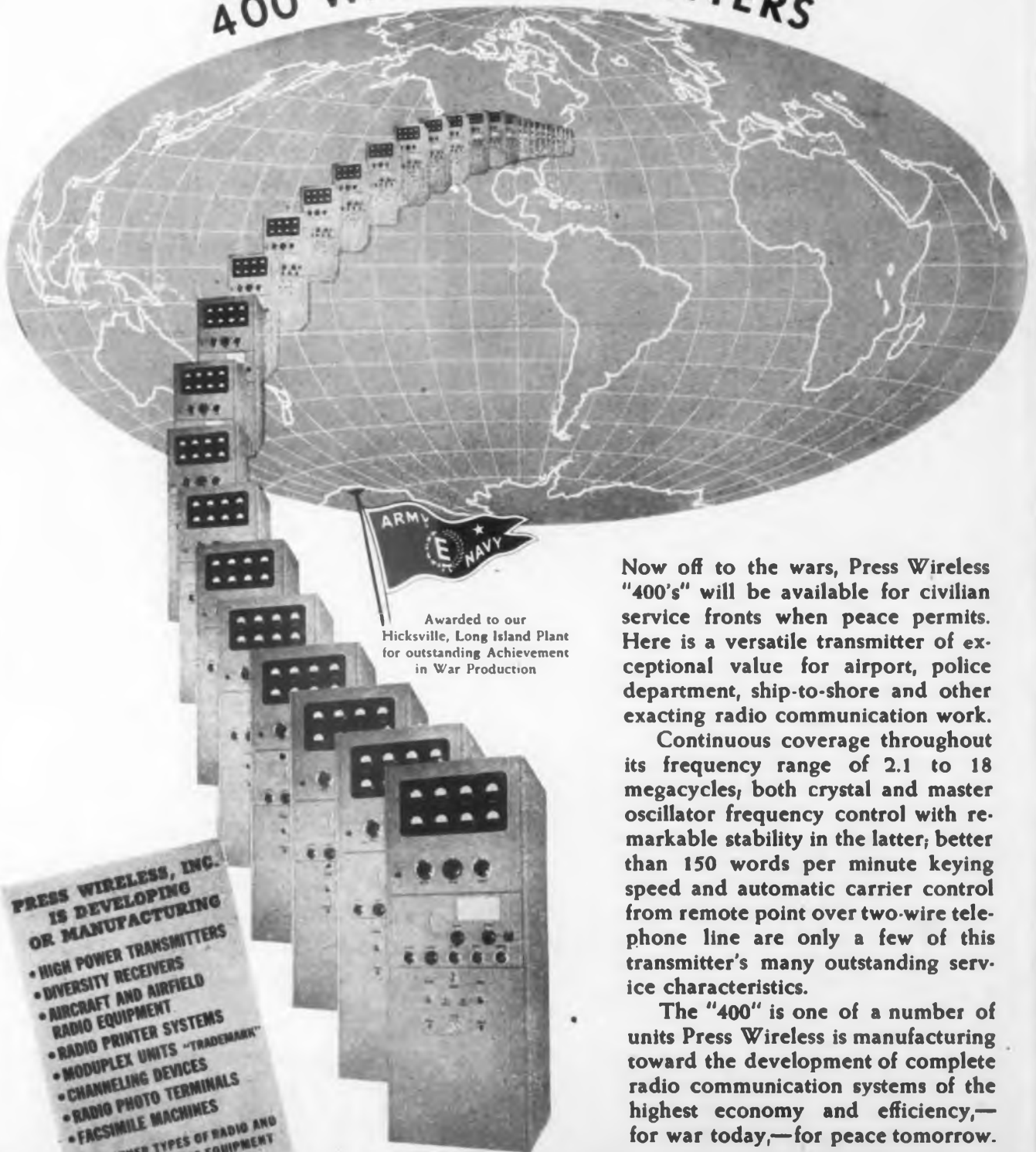
RAYTHEON MANUFACTURING COMPANY

Waltham and Newton, Massachusetts

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES AND EQUIPMENT FOR THE NEW ERA OF ELECTRONICS

PRESS WIRELESS

400 WATT TRANSMITTERS



Awarded to our
Hicksville, Long Island Plant
for outstanding Achievement
in War Production

Now off to the wars, Press Wireless "400's" will be available for civilian service fronts when peace permits. Here is a versatile transmitter of exceptional value for airport, police department, ship-to-shore and other exacting radio communication work.

Continuous coverage throughout its frequency range of 2.1 to 18 megacycles, both crystal and master oscillator frequency control with remarkable stability in the latter; better than 150 words per minute keying speed and automatic carrier control from remote point over two-wire telephone line are only a few of this transmitter's many outstanding service characteristics.

The "400" is one of a number of units Press Wireless is manufacturing toward the development of complete radio communication systems of the highest economy and efficiency,—for war today,—for peace tomorrow.

**PRESS WIRELESS, INC.
IS DEVELOPING
OR MANUFACTURING**

- HIGH POWER TRANSMITTERS
 - DIVERSITY RECEIVERS
 - AIRCRAFT AND AIRFIELD RADIO EQUIPMENT
 - RADIO PRINTER SYSTEMS
 - MODULOX UNITS "TRADEMARK"
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HIGH FREQUENCY HEATING TUBES by UNITED

H EAVY DUTY oscillator tubes are a very desirable nucleus for every electronic RF heating generator. The tubes should be specially designed to withstand the widely varying conditions of load and frequency which are encountered in the many specific applications of this equipment.

UNITED has been the leading producer of such tubes for the most widespread field of RF heating—namely, Diathermy. The fluctuating load conditions in this field are extreme, and have necessitated endless study of tube design. This company therefore is a front line pioneer in tubes for High Frequency electronic heating.

UNITED mercury rectifiers for the power supply are also well known for their rugged design and dependable service life.

The UNITED tubes illustrated are all popular among users of High Frequency heating equipment. Write for technical data and interchange information where it is desired to replace other makes of tubes.

UNITED ELECTRONICS COMPANY

NEWARK 2

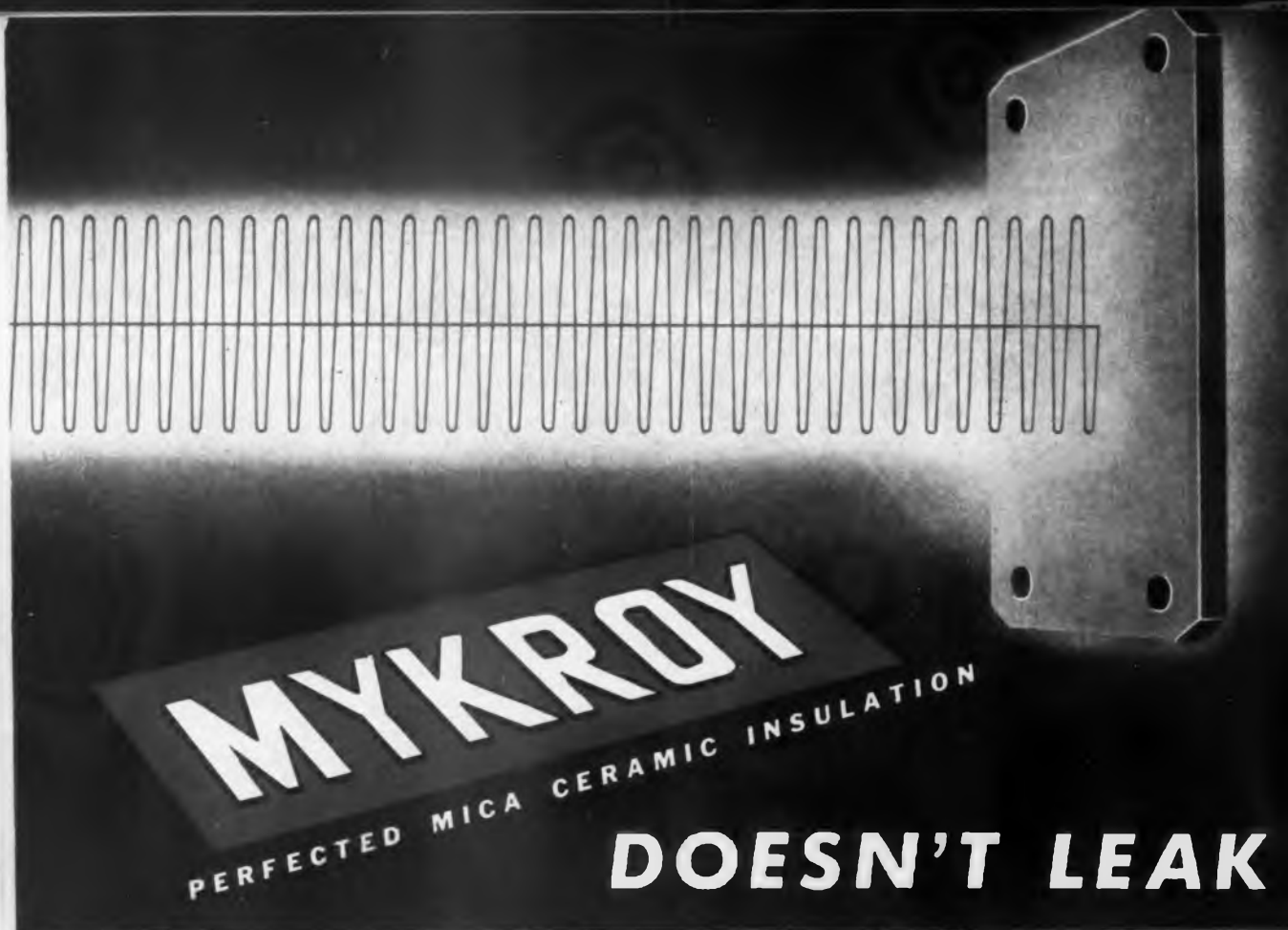


NEW JERSEY

TRANSMITTING TUBES EXCLUSIVELY SINCE 1934



AGO
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MYKROY
 PERFECTED MICA CERAMIC INSULATION

DOESN'T LEAK

To engineers specializing in low-loss high frequency design, energy conservation throughout circuits is so important that a dielectric having the qualities of MYKROY with a *loss factor of 1* is extremely desirable. MYKROY—the perfected glass-bonded mica ceramic insulation, fills this vital need so dependably that it has opened the door to new and greater advances in high frequency research.

Circuits brilliantly conceived on the drafting board are successfully translated into practical application because of the many superior insulating properties of MYKROY.

In addition to possessing a *high dielectric constant* in combination with a *low power factor*, MYKROY is light—yet its mechanical strength is comparable to cast

iron—resists arc-heat carbonization and is impervious to gas, water and oil—keeps its shape (will not warp)—bonds easily with metals—molds readily to any specifications and machines perfectly to closest tolerances.

MYKROY is maintaining the efficiency of such a large variety of electronic equipment of advanced design that your most difficult insulation problems will find a speedy solution in its application.

If you are confronted with a high frequency insulating problem, our engineers will welcome the opportunity to acquaint you with the performance of MYKROY. It is available in ample quantities on rapid delivery schedules from our Chicago, Illinois and Clifton, New Jersey plants.

**IS THIS MYKROY
 ENGINEERS MANUAL
 IN YOUR FILE?**



In this comprehensive manual you will find full information regarding MYKROY . . . the perfected glass-bonded mica ceramic insulation. It tells you about: Machinability, Physical, Chemical and Electrical properties—Applications and uses—Sizes and shapes of stock forms—Design criteria, and includes samples of MYKROY. A request on your letterhead will bring your copy by return mail.

MYKROY IS SUPPLIED IN SHEETS AND RODS . . . MACHINED OR MOLDED TO SPECIFICATIONS

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 Chicago 47: 1917 NO. SPRINGFIELD AVENUE . . . TEL. Albany 4310

Export Office: 89 Broad Street, New York 4, N. Y.

ONE ALWAYS STANDS OUT



IT'S THE QUALITY OF PERFORMANCE THAT COUNTS

ALSIMAG

TRADE MARK REGISTERED U. S. PATENT OFFICE

STEATITE CERAMIC INSULATORS

There are many dancers in the ballet but only one Premiere Danseuse. It's the *quality* of performance that counts... the exquisite skill and precision that is acquired only through long years of training and experience.

One always stands out! Among insulators it's ALSIMAG.

ALSIMAG Steatite Ceramic Insulators are the result of 42 years of Leadership in the ceramic field. The knowledge, skill and precision gained from these years of experience is your assurance of the *quality* of ALSIMAG performance.

AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENNESSEE

42nd YEAR OF CERAMIC LEADERSHIP



ALCO has been awarded for the fourth time the Army-Navy "E" Award for continued excellence in quantity and quality of essential production.

KEN-RAD

TRANSMITTING TUBES

AUSTRALIA

ASIA

AFRICA

NORTH AMERICA

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Lend-lease did not introduce Ken-Rad to foreign service. Years before the war our export accounts were located in sixty countries on every continent and major islands in every sea. In war or peace Ken-Rad serves the world.

TRANSMITTING TUBES
CATHODE RAY TUBES
SPECIAL PURPOSE TUBES

KEN-RAD

EXECUTIVE OFFICES
OWENSBORO, KENTUCKY
EXPORTS 18 MOORE STREET NEW YORK

RECEIVING TUBES
INCANDESCENT LAMPS
FLUORESCENT LAMPS

ELECTRONIC INDUSTRIES • July, 1944

HEADLINE: *HEADLINE*

CONVERTS AC



TO DC

**115 VOLT
DIRECT CURRENT
POWER SUPPLY**

FEDERAL POWER EQUIPMENT—well known for long dependable life, low cost, and high efficiency . . . made in a wide range of sizes and outputs . . . for any DC need from any AC source.

- **PUBLIC UTILITIES**—for station DC bus service, floating storage batteries and operating controls.
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- **FOOD AND DRUGS**—for magnetic separators, operating packaging equipment and power supply for processing.
- **INDUSTRIAL PLANTS**—for DC motor operation, electric brakes, general testing and generator field excitation.



Federal's exclusive **CENTER CONTACT Selenium Rectifier** discs provide new protection against corrosive atmosphere, are now in Federal Power Supply equipment. **FIRST IN THE FIELD . . . STANDARD FOR INDUSTRY.** *Write for Bulletins.*

Federal Telephone and Radio Corporation

ES
MPS
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1944



AIRCRAFT
ENGINEERED POWER
Burbank, Calif.

*A Constellation is
composed of many Stars*

THERE'S a new constellation in the skies, a star of stars... a new master of the heavens. This great ship, conceived by TWA... built by Lockheed, holds a mighty promise, a promise of tremendous developments in peacetime air transport. We are proud to share in its record-breaking glory and in its promise... proud that AAC Hydraulic Controls are among the many stars which make up this Constellation. These precision units are another mark of AAC leadership in Engineered Power Controls... in the air, on land, and on the sea.

(P-74)

POWER CONTROLS DIVISION

BURBANK, CALIFORNIA




ACCESSORIES CORPORATION
ER CONTROLS • PRECISION RADIO and ELECTRONICS
Kansas City, Kans. Cable Address: AACPRO

It's CQ

from the Battlefield Today!



 **Y**ou remember him, the kid next door who tinkered with short wave radio. Well, he's in uniform now, calling his CQ from foxholes in Italy and steaming Pacific jungles. Maybe, he's a radio operator on a bomber ... perhaps, he's an instructor. Whatever it is, you can be sure that his knowledge and experience are serving to help build a wartime communications system. Yes, from the hams came ready trained instructors, operators and engineers at a time when skilled technicians were vitally needed.

The radio amateur will be back one of these days, back to his much-loved tinkering. He'll want new equipment to add to his short wave rig. . . . He'll be looking for a JENSEN speaker because he wants highest fidelity in music, code and voice reproduction. There is no finer acoustic equipment than JENSEN reproducers.

*Manufacturers and Designers
of Fine Acoustic Equipment*



Jensen

RADIO MANUFACTURING COMPANY
6601 S. LARAMIE AVE., CHICAGO 38, U. S. A.

Never Underestimate a Spring



WHEN THE WHISTLES OF VICTORY BLOW

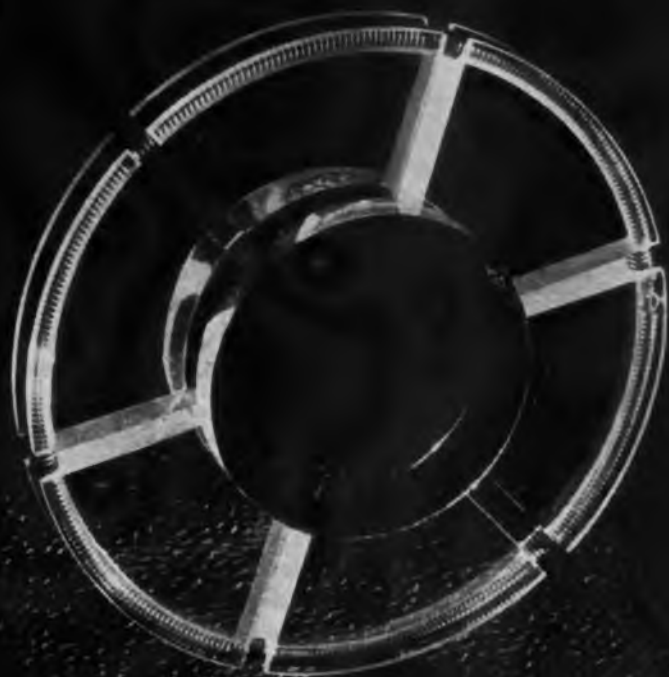
and the Axis starts spinning, a mite of the credit will go to springs on Allied equipment. Some of these springs were designed from the Hunter Data Book, a copy of which should be at your fingertips. Your signature on your Company letterhead brings a free copy to you promptly. You'll find it useful.

THOUGH a spring may be small, its importance can be out of all proportion to its size and cost. Design and manufacture are not necessarily difficult. Usually the tough job is to find the right spring for a specific application, considering the cost and tolerances allowable. This sometimes means boiling down elusive ideas of what the spring should do to concrete purposes from which specifications can be constructed. Clarifying the problem in these cases is not a job for amateurs, but for a

scientific spring maker. Research and calculation, mathematics and metallurgy, statistical control of quality, and unusual and original testing and inspection methods may all have to be recruited in the development of the right spring for your application.

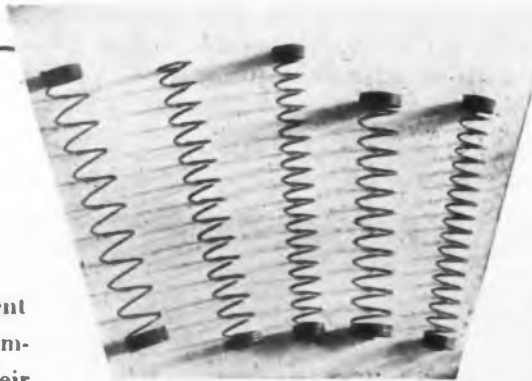
But on such springs you can confidently rest the performance and reputation of your products . . . without a cloud of uncertainty over your head or a lump in your throat. Remember . . . now, and in the future, springs made right, make good!

THE GARTER SPRING—one of a number of basic spring designs, is essentially an extension spring. It is sometimes used as a bell to drive light machines, more often to produce a radial force as in the case of packing ring segments.



HUNTER PRESSED STEEL COMPANY, LANSDALE, PENNA.

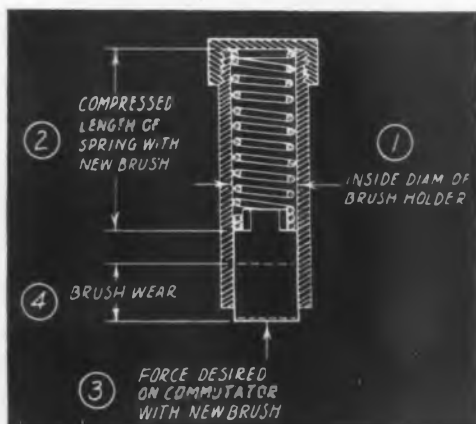
2 WEEK DELIVERY ON MICRO-PROCESSED BRUSH SPRINGS



IN the past six months Instrument Specialties Company has completely redesigned and rebuilt their special coiling machines so that today, production speed on Micro-processed brush springs and other coil springs has been increased by as much as 40%.

This means that all brush spring orders are regularly scheduled for shipment in two weeks; emergency production can begin in one week; adequate production

is at all times available to keep ahead of your maximum assembly requirements; samples, including redesign if required are sent to you in 4 to 5 days, although emergency samples usually can be produced in less time. Take advantage of Micro-processing and get better brush springs quicker. Send drawings or pertinent details to I-S, or call in the I-S Field Engineer in your territory.



Instrument Specialties engineers have devised a simplified design procedure for determining the best brush spring to do a specific job; based upon only four brush holder design details:

- 1 — Inside diameter of brush holder.
- 2 — Working length of spring when assembled with a new brush.
- 3 — Force desired on the commutator.
- 4 — Allowance for brush wear.

From these four details of your motor design, I-S engineers will design the one best "Micro-processed" brush spring giving longest brush life consistent with easy assembly.

EVERY MICRO-PROCESSED BERYLLIUM COPPER BRUSH SPRING GIVES YOU THESE PERFORMANCE ADVANTAGES

1. 100°F. higher service temperature than phosphor bronze.
2. Two times the current carrying capacity of bronze and five times that of stainless steel.
3. Corrosion resistance equal to bronze with strength of steel.
4. Lower drift, set, or creep than any other spring material.
5. Higher safe working stresses which permit redesign for less loss of tension with brush wear — assuring longer brush life.
6. SILVERCOTE "Spring Grade" beryllium copper wire used with certified tensile strength after hardening of 190,000 psi or over.

Your copy of Bulletin No. 5, "Better Brush Springs," will be sent upon request.

I-S Brush Spring Data Sheet

Streamlined procedure for obtaining better brush springs. Write today for I-S data sheets or send specifications.

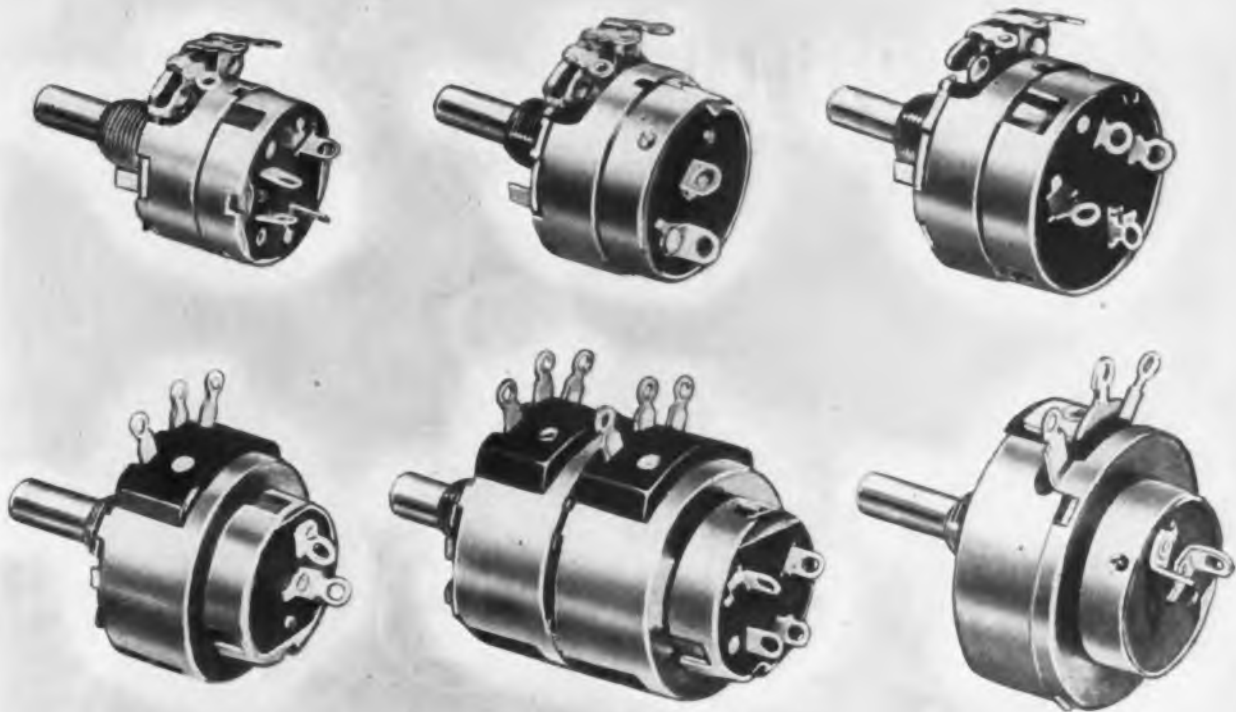


INSTRUMENT SPECIALTIES CO., INC.
260 BERGEN BOULEVARD, LITTLE FALLS, N. J.



FIELD ENGINEERING OFFICES: BOSTON • CHICAGO • CLEVELAND • PHILADELPHIA • NEW YORK

ELECTRONIC INDUSTRIES • July, 1944



Behind Chicago Telephone Supply Company are many years of intensive research and the development of a scientific manufacturing organization devoted to high standards in the mass production of variable resistors, both wire wound and carbon types.

*Manufacturers of Quality
Electro-Mechanical Components Since 1896*

VARIABLE RESISTORS, PLUGS, JACKS, SWITCHES, TELEPHONE GENERATORS, RINGERS

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CHICAGO TELEPHONE SUPPLY
Company

ELKHART • INDIANA



GOAT is Stamping Grounds for Small Tough Jobs. Shown are a few typical electronic tube parts that have been stamped, drawn and formed on GOAT machines, dies and presses.

We can't juggle . . . but we are pretty versatile in our own way. During the past 15 years we have been called upon to handle a great variety of tough jobs requiring skill, precision, efficiency and versatility. Because of experience gained throughout the years, GOAT has been able to meet

the demands of the electronic industry for greater quality, durability and quantity production. Today, GOAT serves almost every electronic tube manufacturer with a tremendous variety of stock and special parts, made of any metal . . . to any required degree of accuracy.

GOAT



*Celebrating our Fifteenth Year of Manufacturing
Electronic Tube Parts and Shields*

METAL STAMPINGS, INC.

An Affiliate of The Fred Goat Co., Inc. • Est. 1897

314 DEAN STREET, BROOKLYN 17, N. Y.

**A highly RELIABLE, FAST and, when necessary,
MOBILE adjunct to radiotelegraph communications!**



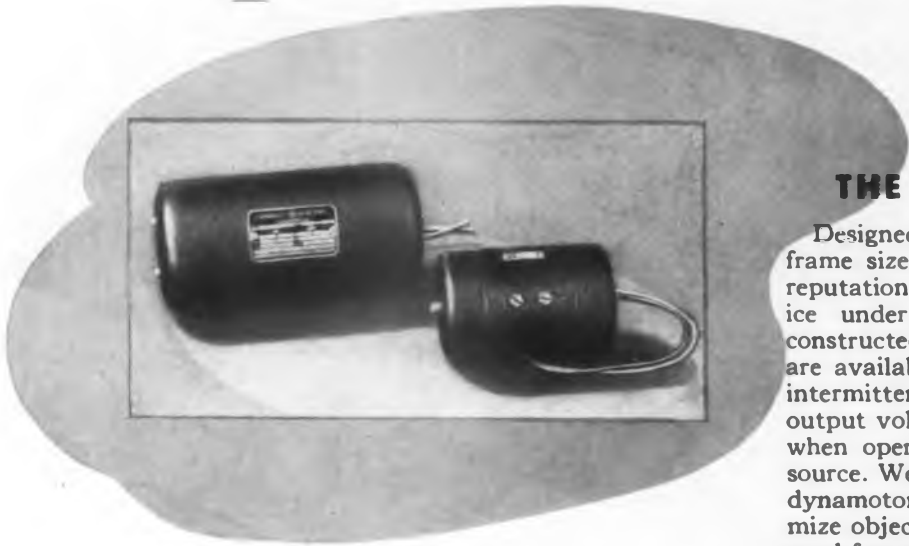
The new
**McELROY WHEATSTONE CODE TAPE PERFORATOR,
PFR 443-A**

Not only can the PFR-443-A, a proud McElroy achievement, be set up to operate immediately as a stationary unit, but it can be used with equal efficiency in moving vehicles. Requiring little or no maintenance, the PFR-443-A now provides high speed transmission where once it was impossible because of the bulky and complicated equipment required to perforate tape. With this unit, accurate tapes can be prepared for transmission at speeds up to 300 words per minute.

The McElroy PFR-443-A consists of two units. **The Keying Unit**, which is silent in operation, comprises two keys, space bar and punching mechanism. **The Electronic Unit**, which relieves the keying contacts of high current and voltage, is designed so that the tube and relay are separated from the mechanical section. Thus, the delicate electronic components are not subjected to jolts and jars.

Although the transmission of dots and dashes is automatic, the operation is similar to a semi-automatic (bug) key. A light touch actuates the punching mechanism for as long as either the key or space bar is depressed. Experienced operators can maintain, with ease, speeds of between 30 and 40 words per minute in all Morse combinations assigned to the Russian, Turkish, Greek, Arabic and Japanese alphabets and languages. This is a McElroy advantage not found on the keyboards of standard perforators manufactured in the U. S. or Great Britain.

2 power sources

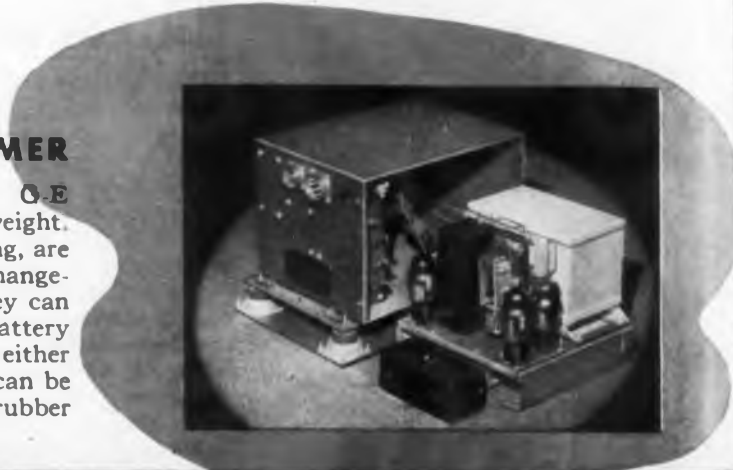


THE G-E DYNAMOTOR

Designed to deliver high output from small frame size, G-E dynamotors have earned a reputation for thoroughly dependable service under adverse conditions. Compactly constructed and light in weight, these units are available in outputs of 15 to 350 watts intermittent (15 to 200 continuous) and with output voltages ranging up to 1500 volts d-c when operated on a 12- or 24-volt battery source. Weights range from 3 to 31 lb. These dynamotors are specially designed to minimize objectionable a-c ripple and consequent need for radio filtering.

THE G-E INVERTER TRANSFORMER

Custom-designed for individual applications, G-E inverter transformers are compact and light in weight. They are specially designed for low internal heating, are quiet and efficient in operation, and readily interchangeable with correspondingly rated dynamotors. They can be designed for operation on a 6-, 12-, or 24-volt battery source, to supply wide range of output voltages—either a-c or d-c. Where conditions require, these units can be made dust-tight and can be shockmounted on rubber cushions.



to choose from . . .

Another example of how the variety of G-E components enables you to choose your own method of accomplishing a desired result.

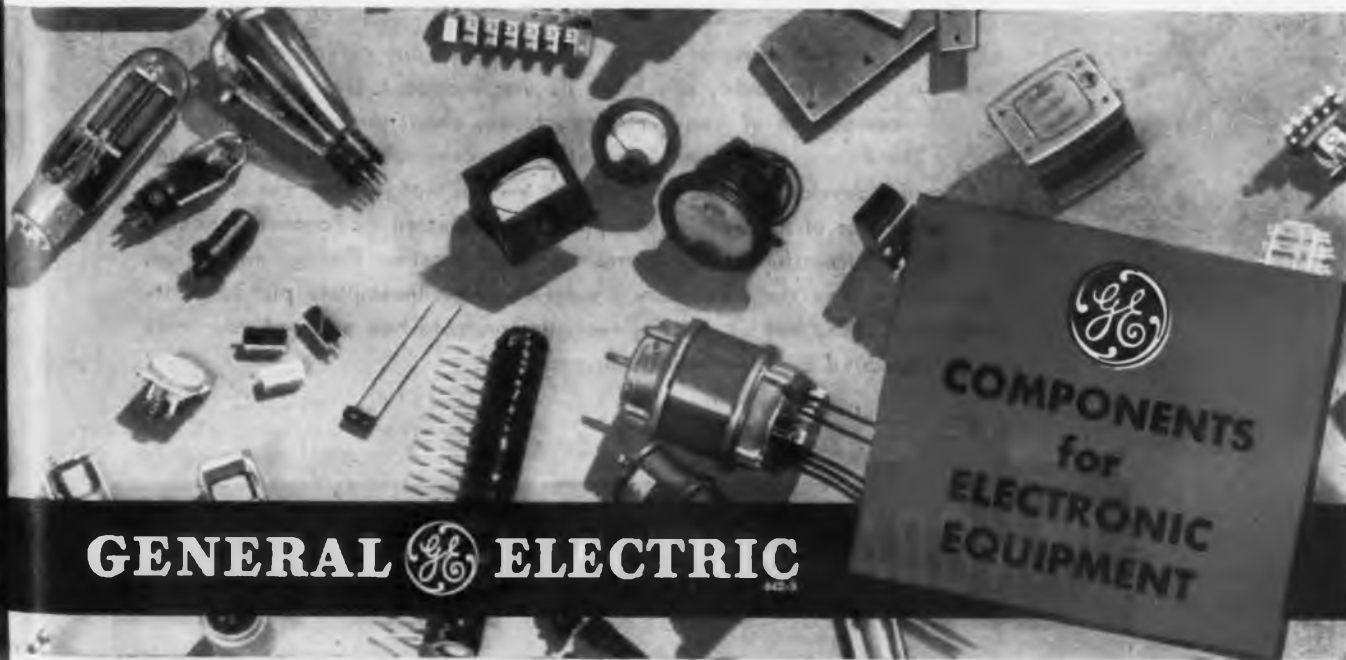
● If you have a problem involving a portable power supply for radio or allied electronic equipment, it will pay you to look into the merits of the dynamotor and inverter shown at the left. Similarly, if you have need for any of the many other components in the diversified G-E line, you can profit by discussing those needs with our engineers.

For every one of these G-E products has been worked out in close co-operation with designers in the electronic industries. All have been thoroughly tested—in our laboratories, in our customers' laboratories, and in labora-

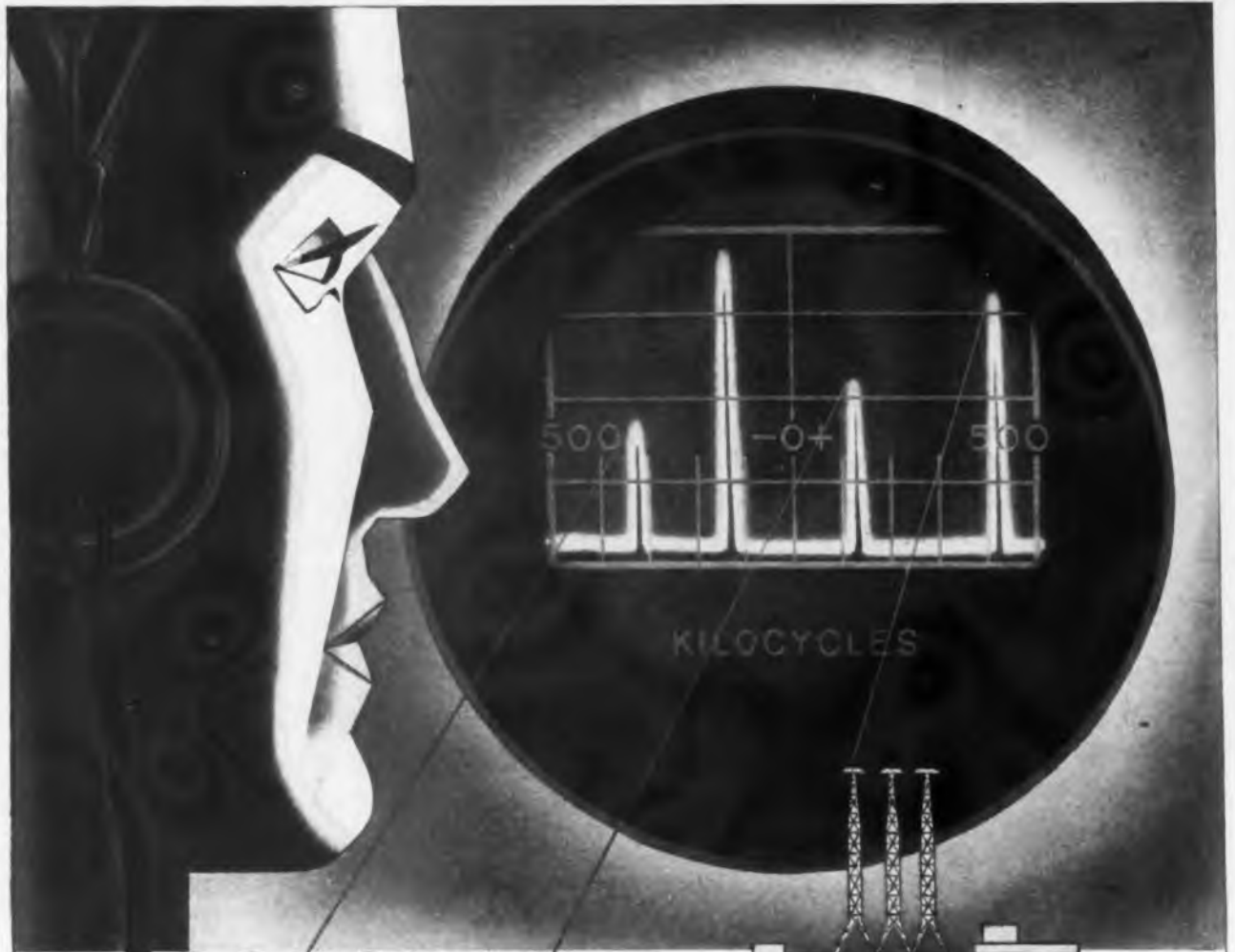
tories operated by the Armed Services. More impressive still, many have been tested on the field of combat, where their dependability has proved a contributing factor in the success of a variety of radio and allied equipment.

Whether you are designing new electronic equipment or improving old designs, take advantage of the extensive line of G-E components and G-E electronic "know-how." Whatever your objectives, find out how G.E. can help you achieve them more simply or more economically. The G-E office near you will gladly furnish details. *General Electric, Schenectady 5, N. Y.*

Buy all the Bonds you can—and KEEP ALL YOU BUY



GENERAL  ELECTRIC



PANORAMIC RECEPTION

SIMULTANEOUS VISUAL OBSERVATION OF SIGNALS OVER A BROAD BAND OF FREQUENCIES

Panoramic Reception is the technique of viewing simultaneously a multiplicity of signals received over any given portion of the radio frequency spectrum. Its uses include the measurement and comparison of frequency, inductance, capacitance, and resistance. The Panoramic Radio Corporation has conceived and pioneered the major developments in this field, yet we feel that we have but scratched the surface of the tremendous sphere encompassed by Panoramic Reception. Its successful use in communications, direction finding, navigation, production, and the laboratory presents only an incomplete picture of its possibilities. Why not let our engineers demonstrate how much of your work can be expedited by Panoramic equipment?

PANORAMIC



RADIO CORPORATION

242 250 WEST 55TH ST New York 19, N.Y.

forecast

Our ability to call all things, contact all planes, talk with every party on reconnoiter, forecasts the impact of electronics on future progress. Today's accomplishments in electronics are as nothing

compared to things to come. To current war time triumphs in this field Leland engineering has contributed a full share. To tomorrow's great strides Leland will also contribute in full measure.

THE LELAND ELECTRIC CO.

DAYTON 1, OHIO



Leland Carbon Pile Voltage Regulator—control device on air-borne electronic equipment component.

The Leland line includes motors, generators, motor generator sets, inverters and voltage regulators.

Consult Leland. They may be able to supply or design, exactly what you require.

Leland

ELECTRIC

**CREATIVE
ELECTRICAL
ENGINEERING**

YOUR MOST IMPORTANT OBLIGATION—THE PURCHASE OF WAR BONDS



RETAINING RINGS are being more and more widely used because they are inexpensive and yet so satisfactory on many varieties of mechanisms. Broadly described, a retaining ring is an artificial shoulder or collar on a circular shaft or in a housing. The shaft is grooved, and the ring is snapped on.

The former, and much more expensive method, was to turn the artificial shoulder—cutting down a larger shaft. Now, by simply grooving a smaller shaft and applying a retaining ring a like result is obtained in a vast number of cases.

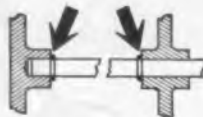
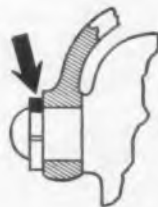
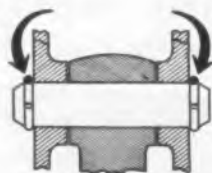
Furthermore, it has been found much more economical and far more effective to design the cutting tool so as to groove the

shaft at the same time that the shaft is cut to its required length—and then to use our steel retaining rings instead of going to the expense of drilling holes for other holding devices that have less strength.

National retaining rings provide an extra safety factor because of our special method of manufacture. They give service that assures economy.

National retaining rings are made of high grade spring steel which is heat treated after forming, rather than from pre-tempered spring wire. Our standard stock sizes will fill nearly all requirements; special sizes and cross sections made at small extra cost.

Write today for our descriptive folders on various types of retaining rings.



THE NATIONAL LOCK WASHER COMPANY
 NEWARK, N. J. MILWAUKEE, WIS. U. S. A.

IN MARINE WARFARE



Here's what the
BRUSH SURFACE ANALYZER

means to them...

● Speed, ruggedness, dependability—the basis of P. T. engine design. Accurate control of surface finish is one of the important factors facing the builder of P. T. motors.

Mated, moving parts must be precision made with surface finish accurately held to low microinch smoothness. The Brush Surface Analyzer provides charts which reveal surface irregularities to one millionth of an inch or less.

Should accurate control of surface finish be essential in your business, write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.

THE BRUSH DEVELOPMENT COMPANY

3 4 3 3 PERKINS AVE. • CLEVELAND 14, OHIO

ELECTRONIC INDUSTRIES • July, 1944



Relays
AND OTHER CONTROL DEVICES
by **AUTOMATIC
ELECTRIC**

BE SURE YOU HAVE THE RIGHT RELAY

The *right* relay, of course, is the one which will exactly fit your needs, and give you the longest, most dependable service at lowest cost. Here's how you can get it:

1. Write for the Automatic Electric catalog. It lists over forty basic types of relays, providing every combination needed for modern electrical control. All technical facts are clearly tabulated for your guidance.

2. If you want help in applying this information to your problem, call in our field engineer. He will be glad to put his experience to work for you.

Send today for your copy of the catalog—or simply ask our field engineer to bring one over.



AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren St., Chicago 7, Ill.

In Canada:

Automatic Electric (Canada) Limited, Toronto

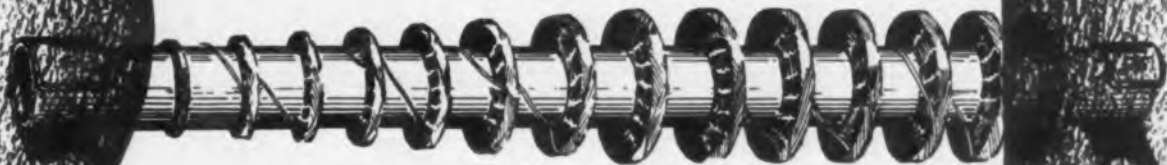
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GUTHMAN *Super-Made* CHOKES

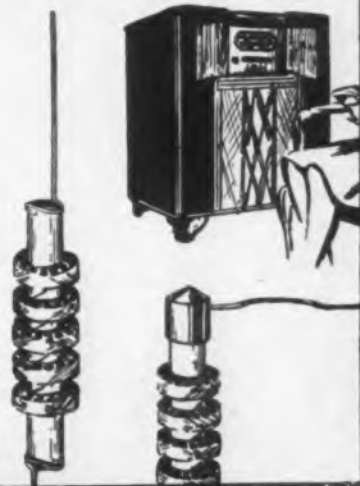
A Wide Range... from

TRANSMITTER CHOKES



to... **RECEIVER CHOKES**

Again, Guthman experience, engineering, skill and complete manufacturing facilities are coordinated to produce a wide variety of Guthman Super-Made Chokes. Universal Guthman Chokes are available in unlimited ranges of inductances. They are wound on ceramic or bakelite with pigtail connections or standard resistor mountings



EDWIN I. GUTHMAN & CO. INC.

PRECISION MANUFACTURERS AND ENGINEERS OF RADIO AND ELECTRICAL EQUIPMENT
15 SOUTH THROOP STREET - CHICAGO



1944 ELECTRONIC INDUSTRIES • July, 1944

"FEATHER" FROM A MOSQUITO WING, magnified 5000 times by the G. E. electron microscope. The "feathers" show only as a fringed edge along the wing through a light microscope.



They wanted a

"100,000 MAN-POWER EYE"



...and its power to see begins with Nickel

You're looking at a single feather from a mosquito's wing through the new G. E. electron microscope.

Even with a fine optical microscope which can see objects as small as 1/84,000 of an inch long and magnify them 2,000 times, you could only make out the feathers as a fringed edge along the wing.

But with an electron microscope you can look at submicroscopic objects 1/1,000,000 of an inch long and reproduce them by photographic blow-up at 100,000 times their true size.

The first electron microscope was taller than a man, powered by some four dozen tubes. Now General Electric Company has simplified it into a compact instrument for general use which plugs into a regular 110-volt A.C. outlet. A 2-tube power unit con-

verts the A.C. into 30,000 volt D.C. for the electron gun. And in both these tubes, the vital elements are nickel—because nickel combines all these advantages:

- High strength, at regular and elevated temperatures.
- Resistance to distortion and warpage.
- Freedom from rust... high corrosion resistance.
- High stiffness and damping capacity to lessen vibration.
- Ability to take strong spot welds... resist oxidation.
- Ability to give off absorbed gases readily.
- High electron emissivity... minimum back emission.

And nickel may be the answer to your problems, too. Write:

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

NEW, COMPACT, G. E. ELECTRON MICROSCOPE distinguishes objects as small as 1,000,000th of an inch... magnifies them directly to 5,000 or 10,000 times actual size. If photographic enlargements are wanted, blow-ups can be made to show objects at 100,000 times their true size. Can be plugged into a regular 110-volt A.C. line.

POWER CONVERTOR TUBE (above) used in G. E. microscope converts 110-volt A.C. to 30,000 volts D.C. Vital elements of tube are made of Nickel.

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL
Sheet... Strip... Rod... Tubing... Wire... Castings

ELECTRONIC INDUSTRIES • July, 1944



Did we hear
someone say
this was
impossible?

DOING what couldn't be done in glass has become a habit at Corning—and this is a good example. "You can't solder metal to glass"—they said. But Corning Research did it.

Now Corning has developed a metallizing method whereby the base for the solder becomes an inseparable part of the glass and so provides a permanent, airtight seal. The metallized layer solders almost as easily as brass or copper and is not harmed by normal soldering temperatures. Parts can be soldered to it by any ordinary soldering iron, soft-air-gas flame or induction heating.

Also important—Corning type metallizing can be applied to an extremely wide range of glasses. Where

extreme resistance to thermal or mechanical shock is required it can be applied to Corning's tempered glasses. Where electrical characteristics are of first importance it can be applied to Corning's special low-loss glasses.

This unique method of metallizing is just one of the ways that Corning's knowledge and experience may some day save you time and money. If you'd like to know more about us, we have a suggestion. Send for the study, "There Will Be More Glass Parts In Post-War Electrical Products." It's free. Just write to the Electronic Sales Department I-7, Bulb and Tubing Division, Corning Glass Works, Corning, N. Y.

CORNING
—means—
Research in Glass

Electronic Glassware



"PYREX" and "CORNING" are registered trade-marks of Corning Glass Works



Quality

TRANSFORMERS OF SPECIAL DESIGN

Illustrated above is one of the many types of special application transformers designed and manufactured by us. We at Langevin are interested solely in the manufacture of quality apparatus, both transformer components and complete electronic units. Your inquiries for either are solicited. Transformer capacity to 5 K. V. A.



The Langevin Company

INCORPORATED

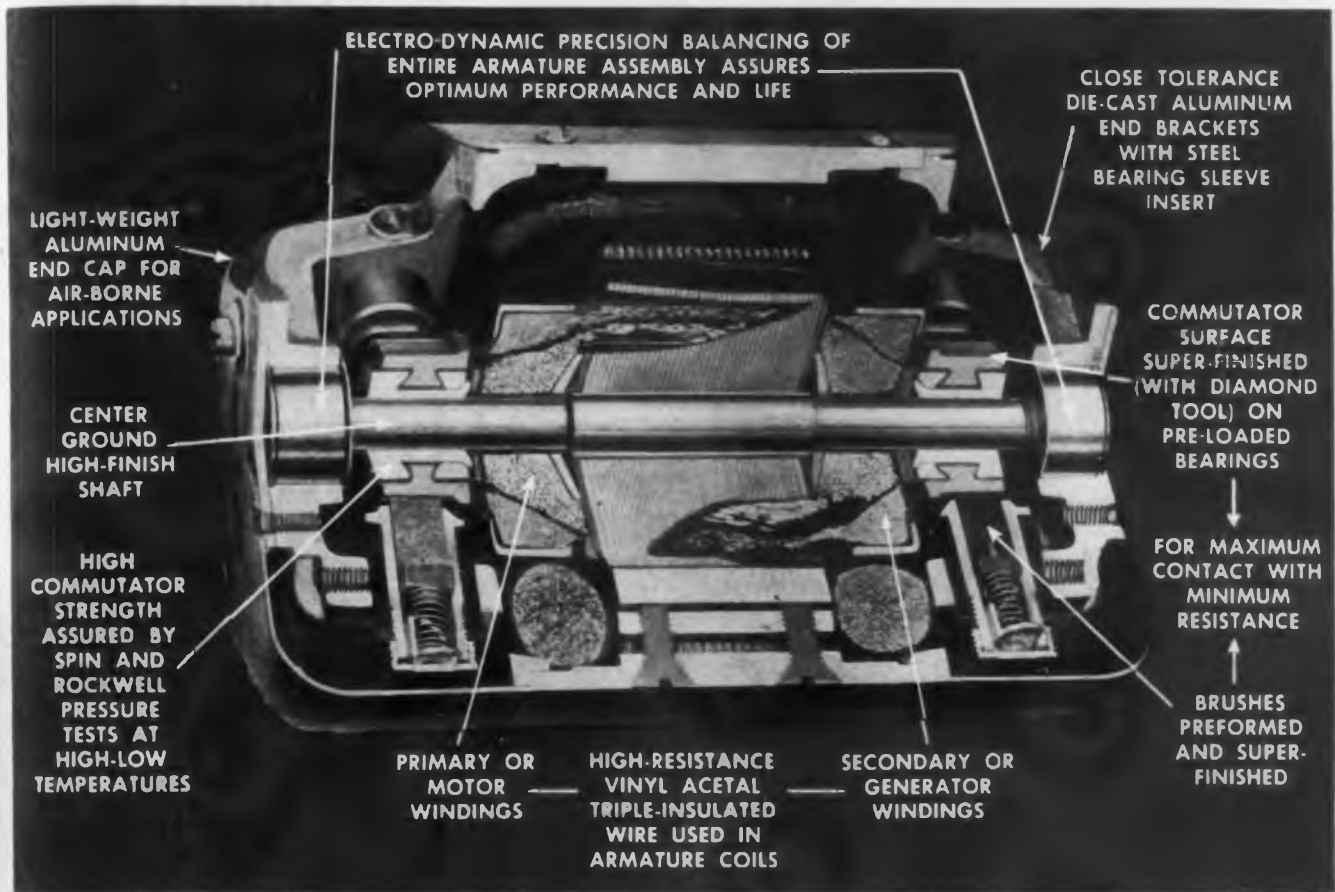
SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK
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1000 N. Seward St., 38

WEBSTER DYNAMOTORS



Improved Design and Manufacturing Processes Bring Measurable Superiority

LOOK TO WEBSTER PRODUCTS TODAY

Dynamotors and Voltage Regulators
TOMORROW
 World-Acclaimed Record Changers



Tests show Webster dynamotors far surpass Government requirements on leakage to ground, vibration, ripple, temperature rise, operation under extremes of temperature, operation in the presence of moisture and all other vital specifications. Reasonably prompt delivery in production quantities can be made on practically all dynamotors listed under frames Q, R and S on page 18 of the *American War Standards Bulletin* on dynamotors, No. C75. 13-1944. Within wattage limitations of these frame sizes, we can supply dynamotors of different input and output values. We will be glad to discuss your specific dynamotor problems with you.

WEBSTER PRODUCTS

3825 W. ARMITAGE AVE.  CHICAGO 47, ILLINOIS



Large or small

It can be economically and quickly made by one of the many processes available here at ceramic headquarters.

Not being restricted to a few processes, it may be that the pieces you use can be made better, faster and at less cost by our ability to select the right method.

Let us take a crack at that tough job.

Locke

INSULATOR CORPORATION

BALTIMORE, MARYLAND

"Leaders in Clayamics"

A COMPLETE "CLAY"RAMIC SERVICE

for every electrical, chemical and mechanical application.

Locke has unrivalled facilities for the production of fired clay pieces by every known method.

(1) **Dry Process — Porcelain and Steatite**

A process ideally suited to the production of certain pieces with reasonable tolerances and adequate mechanical and electrical strength.

(2) **Vacutite Process—Porcelain and Steatite**

A process developed by Locke for forming intricate pieces. Close tolerances. Mechanical and electrical strength almost equal to wet process.

(3) **Wet Process — Porcelain and Steatite**

The standard process for the production of high voltage insulators, and porcelain for mechanical and chemical applications. Exceptionally strong mechanically and electrically.

Locke Wet Process porcelain and Locketite is produced by the following methods, the selection of method depending upon the piece.

- | | |
|-------------------|-------------------|
| (1) Pugging | (5) Jiggering |
| (2) Ram Extrusion | (6) Plastic Press |
| (3) Wet and Dry | (7) Core Casting |
| Turning | (8) Drain Casting |
| (4) Plunging | (9) Throwing |

and certain other methods which at the present have only limited application.

Other clayramic products will be available in the future to meet special conditions. Whatever your problem, our experienced electrical, mechanical and ceramic engineers will be glad to help. Their services have resulted in material savings in money, time and critical materials to other manufacturers. Perhaps they can help you.



Television sees Democracy in Action

● AMERICANS have always been eager to share in the political life of our Democracy. This year, the two great political conventions will be filmed in Chicago and the reels will be rushed to New York for broadcasting over WNBT, NBC's pioneer television station.

Four years ago, in 1940, WNBT made television history, by directly telecasting the Republican Convention at Philadelphia and by broadcasting films of the Democratic conclave in Chicago.

When Peace comes, a greater and more widespread television audience—expanding into mil-

lions of homes equipped with RCA television—will see as well as hear Democracy in action . . . thanks to the new super-sensitive television camera, and other radio-electronic devices developed in RCA Laboratories.

Today, RCA research and engineering facilities are devoted to creating the best possible fighting equipment for the United Nations. Tomorrow, RCA—Pioneer in Progress—looks forward to supplying American broadcasters, and the American public, with still finer radio, television, and electronic instruments.



RADIO CORPORATION OF AMERICA

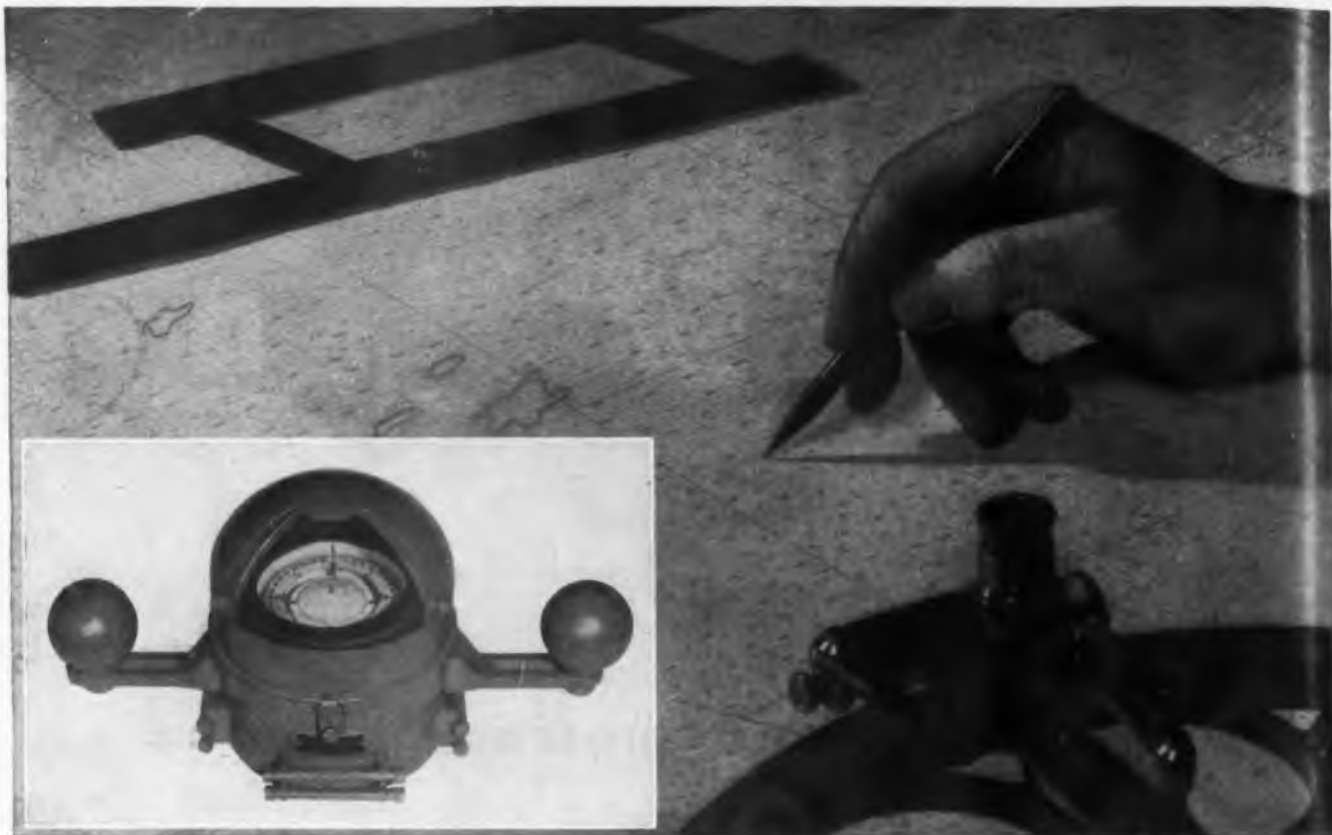
RCA LABORATORIES • PRINCETON • NEW JERSEY

RCA
leads the way in
radio—television—
phonographs—records
—tubes—electronics



Listen to RCA's "The Music America Loves Best"—Saturdays, 7:30 P.M., E.W.T., over the Blue Network ★ BUY WAR BONDS EVERY PAY DAY ★
ELECTRONIC INDUSTRIES • July, 1944

PERMANENT MAGNETS MAY DO IT BETTER



Rendezvous on a "Fly-Speck"

A PRECISION instrument used for guiding both large and small ships to their destinations is the magnetic compass, such as the one illustrated above. Unprecedented quantities are required for marine service. Many magnetic compasses are also used in planes and tanks.

Modern compasses are versions of the earliest known application of permanent magnets. Today the hundreds of uses for permanent magnets are

widely diversified and are expanding rapidly through aggressive engineering and research.

34 years of specialized experience in this field have enabled us to play a leading role in developing these new uses. Our large, modern plant is one of the nation's vital sources of supply.

Write us, on your letterhead, for the address of our office nearest you and a copy of our "Permanent Magnet Manual" containing valuable data.

Help Win the War in '44—
Buy War Bonds!

Copyright 1944—The Indiana Steel Products Co.

The
INDIANA STEEL PRODUCTS
Company

★ SPECIALISTS IN PERMANENT MAGNETS SINCE 1910 ★
6 NORTH MICHIGAN AVENUE • CHICAGO 2, ILLINOIS



IN ORDER to take full advantage of General Ceramics & Steatite Corporation's facilities for the production of high quality steatite insulators, we are offering a new booklet, "DESIGN CRITERIA". This booklet describes the various methods of manufacture and outlines in detail the characteristics peculiar to good steatite insulator designs. Adherence to the principles outlined in this booklet in the design of new insulators will result in lower costs, quicker delivery and improved quality.

WRITE FOR YOUR COPY TODAY



Ⓢ 8967

MAGNAVOX HAS MADE ELECTRONIC HISTORY FOR 30 YEARS

THIS GIANT SPEAKER was a Magnavox development of twenty years ago . . . an early example of the pioneering by which Magnavox has produced so many outstanding contributions to the radio industry. Among those contributions was the electro-dynamic speaker, the "voice" of all modern electronic sound reproduction.

Present wartime experience will enable Magnavox to serve the peacetime needs of the radio industry even better than before. With stepped-up efficiency and the excellent facilities of the modern six-acre plant, Magnavox will again supply components for radio manufacturers, and will figure prominently in the



Largest loud speaker ever built—heard 9 miles. Built for Idora Amusement Park, Oakland, Cal., in 1922. Standing in the speaker is E. S. Pridham, now a vice-president, one of the founders of Magnavox, and co-inventor of the electro-dynamic speaker.

coming peacetime developments of electronics. The Magnavox Company, Fort Wayne 4, Ind.

Magnavox craftsmanship won the first "E" award in this field (1941), now with 3 White Star Renewal Citations.



Magnavox



LOUD SPEAKERS • CAPACITORS • SOLENOIDS

COMMUNICATION & ELECTRONIC EQUIPMENT



They came to Machlett for the answer

Some time ago a group of distinguished scientists and engineers designed, on paper, a most remarkable new instrument that could be invaluable in a certain war activity. But when the final calculations had been completed, it was realized that the device required a tube that not only had never been made, but perhaps never could be in adequate numbers.

An impressive delegation of these gentlemen visited the Machlett Laboratories, and explained the situation. Would we study the matter? "If you conclude the problem cannot be solved," they said in substance, "we shall have to revise our design and be satisfied with only a fraction of the desired performance, because we know that if a

tube is too difficult for you, certainly no one in the world can make it."

This is the kind of challenge Machlett likes. Today that tube is produced in quantity and is serving our country at war.

Some day the full story of that extraordinary achievement can be told. Now it can only be referred to in general terms, as an example of the skill that makes Machlett the world's largest manufacturer of X-ray tubes for medical, dental and industrial uses. Today, Machlett, in addition, makes various electronic tubes for special purposes in those fields and in radio. Machlett does not make apparatus, but tubes only . . . Machlett Laboratories, Inc., Springdale, Connecticut.



Machlett x-ray tube with rotating anode. 100 kilovolts; 50 kilowatts.

MACHLETT

RAY TUBES SINCE 1898
TODAY THEIR LARGEST MAKER

This cab no longer



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KU-627	Thyratron	WL-672	Thyratron	WL-892	Pliotron
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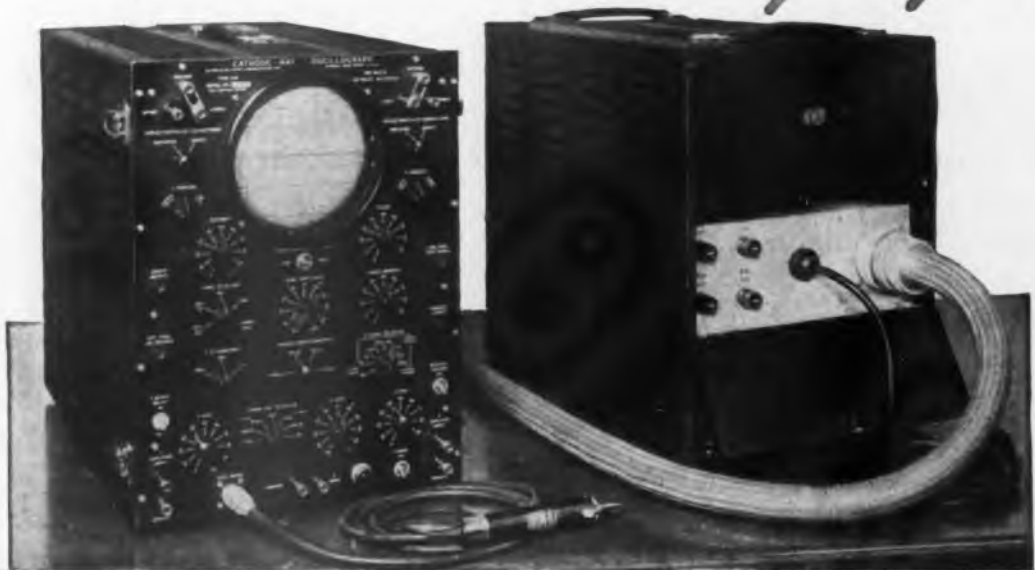
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ELECTRONIC INDUSTRIES • July, 1944

New! To facilitate the study of microsecond pulses containing frequency components as high as ten megacycles . . .
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Wide band vertical axis amplifier usable to 10 MC.

4000 volts accelerating potential applied to cathode-ray tube, allowing observation of fast-writing-rate phenomena.

Extremely flexible time-base generator to display signals which heretofore required special sweep circuits.

Delay network in vertical channel, permitting observation of entire wave shape of short duration phenomena.

Useful timing oscillator for quantitative analysis.

Trigger output signal useful for "synchroscope" applications.

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Convenient mechanical design which permits placing separate power supply on floor or shelf beneath lab bench.

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power unit.

Design is such that modifications to standard specs. can be accommodated to special order in the following respects: (1) Driven sweep durations; (2) Marker oscillator frequencies; (3) Trigger pulse rates.

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◆ Still another DuMont "first". Incorporating the most advanced features, this latest oscilloscope is now available at moderate cost as a standard commercial instrument. It will be especially welcomed by the investigator heretofore restricted in his work by the inadequate performance or the prohibitive cost of existing equipment.

Type 248 is a portable instrument. Two units facilitate handling and installation. Either transient or recurrent phenomena can be displayed. Also accommodates phenomena of inconstant repetition rate. The leading edge of short pulses is not

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for V.H.F.—U.H.F. APPLICATIONS

ERIE Type 370 Silver Button Mica Condensers have proven to be ideal components for V.H.F. and U.H.F. applications where short ribbon-type leads, low series inductance, and compactness are requisite factors. Their efficiency and quality have been thoroughly established through practical service, in large quantities since 1941.

These small condensers consist essentially of a stack of silvered mica sheets encased in a silver plated housing. The housing forms one terminal, the other terminal being connected to the center of the stack, thus providing the shortest possible electrical path to and from the capacitor.

A wide selection of terminal and mounting designs is available to provide both feed-through and by-pass connections. Capacity ranges and electrical characteristics are given above.

Complete technical information will be sent to interested engineers on request.

CHARACTERISTICS

CAPACITY RANGE:

15 to 500 MMF at 1 mc.

POWER FACTORS:

.08% max. for capacity tolerance $\pm 5\%$ or closer (for resonant circuit applications).

.12% max. for capacity tolerance over $\pm 5\%$ (for by-pass and blocking use).

MAX. WORKING VOLTAGE:

350 Volts A.C., 500 Volts D.C.

Flash Test (2 seconds) 1,000 Volts D.C.

Leakage Resistance, Over 10,000 megohms.

*PATENTED



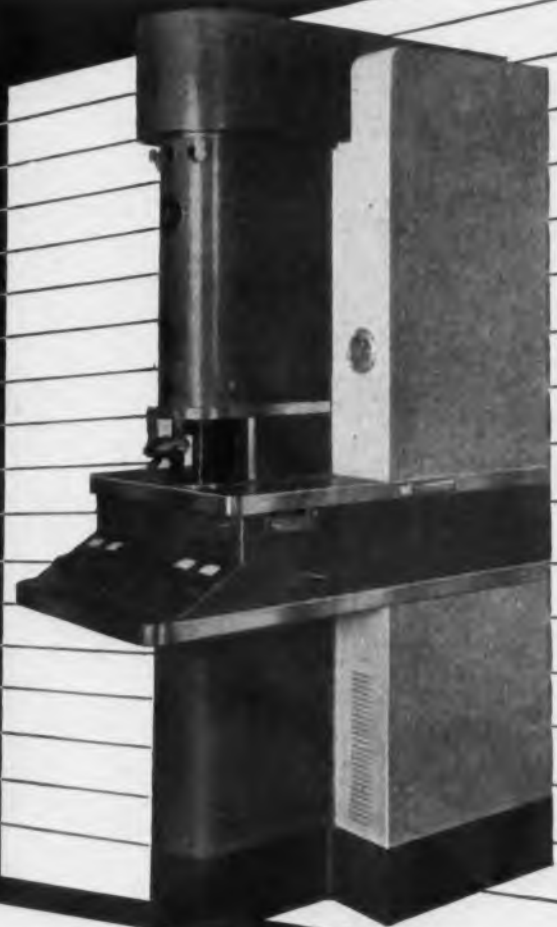
Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

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RCA ANNOUNCES *NEW MODELS* OF THE FAMOUS RCA ELECTRON MICROSCOPE



Today, many of the most successful industrial and research laboratories employ RCA Electron Microscopes in solving vitally important problems—problems relating to the processing and use of metals, chemicals, ceramics, plastics, synthetic rub-

bers, textiles and petroleum products—to name just a few.

Equally noteworthy is the fact that several industries at present are using this equipment for purposes of production or quality control. This is an application of the Electron Microscope which should be considered by every industry in which size or shape of small particles or fine details of surface structure are important in processing or manufacturing.

To further enlarge its utility and convenience to science and industry two new models of the RCA Electron Microscope are now offered. These new instruments . . . one a compact desk model, the other a de luxe Universal model incorporating an electron diffraction camera . . . are described in a bulletin "The RCA Electron Microscope." The coupon at the left will bring you this bulletin by return mail. Fill it out now.

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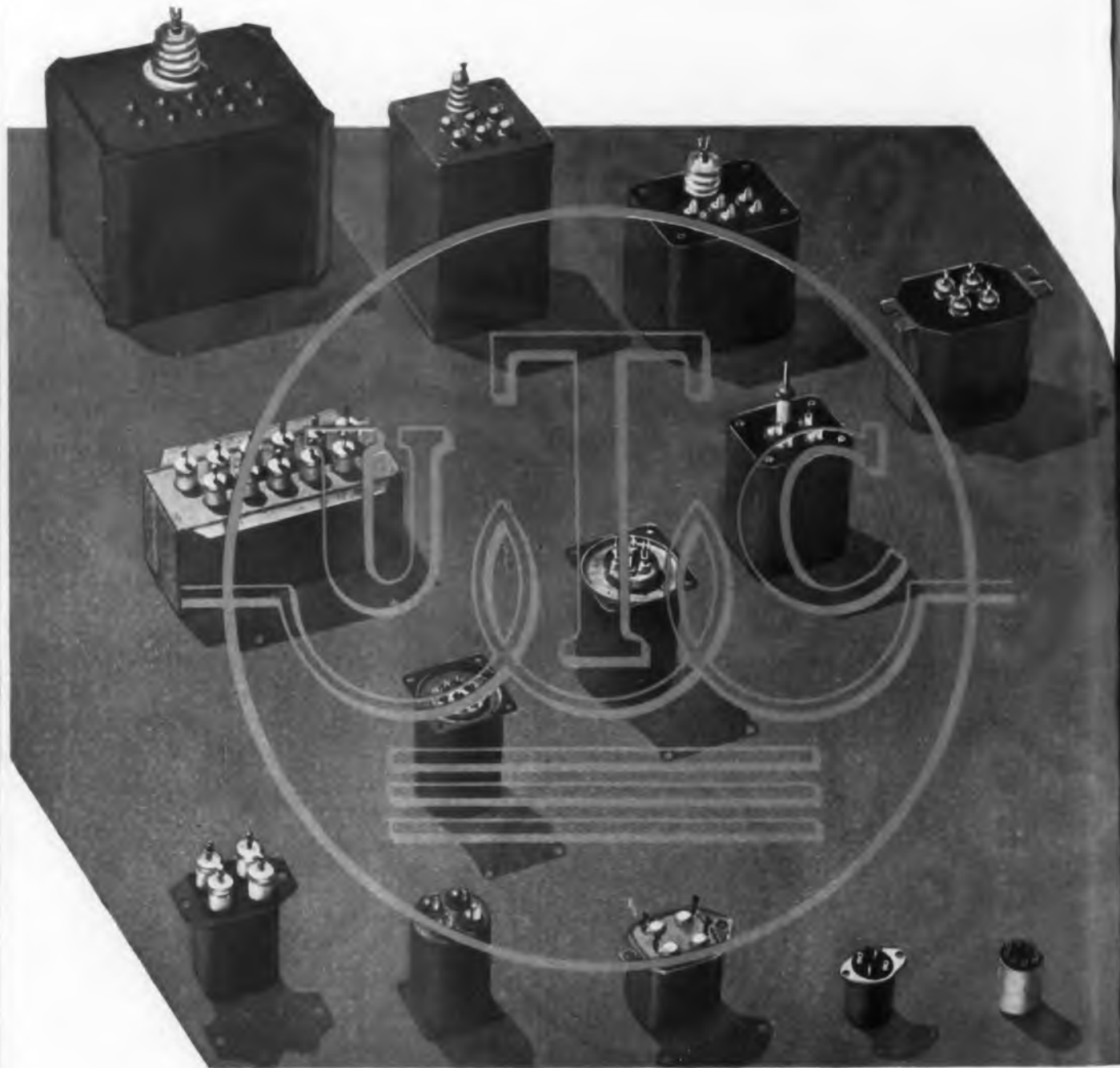
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O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

Invasion's Success Controls 1945 Radio

Progress of the Invasion is the key to future trends in radio production. If results are good, our present military-radio surplus will be ample, and civilian radios can be scheduled as 1945 opens. But if the Invasion slows down, another two billions of military radio may be immediately called for, deferring any civilian-radio schedules.

Revolutionizing Naval Strategy

Rapid radiophone communication is accountable for the revolutionary changes in naval operations and strategy that have occurred in this war, it now appears. Ability of fleet commanders to dispose ships at distant points, and yet to talk freely with their officers so as to bring about coordinated attacks, has put new effectiveness into our battle fleets.

"Equalization" as Step to Re-Conversion

In the emergency of getting military radio and electronic manufacturing schedules into production, heavy overloads were thrown on some factories. But now as re-conversion looms on the horizon, the first step of WPB will be to equalize these loads—to adjust contracts and sub-contracts so as to get the plants into the same relative positions as they were when civilian-set shutdown came in April, 1942. Then as they re-enter civilian production, they'll all "start even"!

Wanted—A Workable Reconversion Plan

From much thinking about it, and quite a bit of talk, sentiment of manufacturers, as it simmered to the top at the RMA Conference last month, is to seek now rather than later some basis upon which a blueprint for postwar production of civilian radio can be laid down. Most logical, and likely, plan would appear to be one in which war and peace production can be sort

of scarf-joined together, the one starting and growing as the other tapers off and eventually stops. The real problem, of course, is going to be to lay down a plan that will be eminently fair to all. That will call for brains—with a capital B.

Russia Models Her Radio on Ours

On his return from Russia, where he spent six weeks freely studying the radio industries of the Soviets, Ray Ellis, director Radio Division WPB, sees a great future for radio-electronic development in serving Russia's 190 millions. Already the Russians are designing their future civilian radios around U. S. tube and parts standards, indicating that, postwar, American radio methods will set the pace from Leningrad to Vladivostok.

Electrical Life Processes

Electronic applications are showing up more and more how electrical effects are the basic modus operandi of animal life. The many electrical conditions which form the means of coordinating muscular, nerve and mental activity, are now better known, thanks to amplifiers and oscillographs—and this research has hardly been started.

Rewiring Human Misfits!

One wonders what will be the nature of the electrical filters, frequency converters, bypass circuits and "rewiring jobs" that will be developed in the future to convert the mental processes of a would-be Hitler into those of a normal human. Once the electrical process of living and thinking is fully known, such reconversion methods will become automatic sequences. From then on, our law-makers will need to be engineers or scientists who can draw up the universal system of connections so that short-circuits causing criminal tendencies, will be avoided.

\$16,000,000,000 OF SECURITY

Leaving every other consideration aside—even the humanity represented by the shortening of the war it makes possible—the Fifth War Loan still represents a top-notch investment both for the funds of individuals and of every manufacturer as well!



RADIO IN RUSSIA

by RAY C. ELLIS

Director, Radio and Radar Division, War Production Board

Despite intense cold, with most factories moved to Siberia, engineering and production compare favorably with America's

● Several months ago my knowledge of Russia was probably as generalized as that of the average American reading the newspapers and magazines and listening to radio commentators.

It was with this vague background that I was told that the Soviet Government had approached our Government through Donald M. Nelson, chairman of the War Production Board, to have someone from this country meet in Moscow with Soviet engineers and factory managers to discuss their military electronic situation in relation to their production and our assistance, as well as to discuss plans for closer working arrangements in the radio field both now and after the war. Mr. Nelson asked me to make the trip.

In addition to making extensive technical preparations, I spent as much time as possible collecting information on Russia before I left.

Mr. Ellis has recently returned from Russia where at the invitation of the Soviet government he visited practically every important radio and electronic production plant, flying more than 7000 miles during the course of his stay. Photo was made in Moscow



I read many articles and reviews written by men who had been in Russia for some time, and made contact with radio engineers who had been there several years ago working on new plants. Much of this information was contradictory, and comparatively little was known in this country of the Russian radio and radar industry. There were wide differences of opinion between experts about future policies in the Soviet and its position among the nations of the postwar world.

As a result, it seemed to me most logical to make a frank, honest approach and begin with no preconceived opinions and prejudices. That type of approach contributed greatly to making the entire mission's success.

Multiple Installations

The radio industry in Russia prior to the war was quite small as compared with that of this country. Although the use of radios was not restricted until the beginning of the war, there were many installations in homes and apartments using loudspeakers with a volume control which were tied into a centrally operated receiver.

These sets and parts were produced in about fifteen factories. These fifteen factories did very little development work because the designs and development of new models, etc., originated with a central government planning agency. The development was largely set up separately from the factories, and was associated with the universities at Leningrad and Moscow and with the National Academy of Sciences located in Moscow.

The development programs consisted mostly of work on high-powered transmitters, television, and special tubes. They had two experimental television stations in operation. They did very little development work on receiving tubes, short wave sets, high fidelity, FM (Frequency Modulation), loudspeakers, or component parts.

Foreign contact by their engineers was kept to a minimum, and during the thirties very few out-

side radio men were allowed into Russia. These contacts seem to have been kept largely to RCA (Radio Corp. of America), some German assistance in Leningrad on tubes, and some English help on a loudspeaker plant.

During the middle and later thirties, even the small engineering work was still further minimized as the better engineers were put into radio war products and their contact from that time on, of course, ceased with anyone, including Russians, outside their particular job.

Because of the small production, lack of suitable transportation, hand methods, etc., most of the set factories made all of their own parts, except tubes and speakers. There was no standardization of parts, so when war started, Russia found herself with a small industry, as such, to build up and expand. It also found them with their laboratories and factories largely on the "front line," so to speak, and we will see later how this latter situation proved to be probably more of a handicap to their war radio production than anything else.

At the time when Germany invaded Russia in June, 1941, many of the latest factories as well as the research and development work were centered in the West. By October, 1941, all of the radio industry had been evacuated to Central Siberia, over 2,500 miles away. This evacuation was made under extremely adverse conditions, which was typical of the manner in which most of the industrial evacuations were carried out.

In the section of Siberia to which the radio industry was moved, the temperature varies more than in any other place in the world, changing from 100 deg. in summer to 50 deg. below in the winter. Originally the principal occupation revolved around agriculture. However, several years before the war the Soviets began a modernization program and began moving their industries into this area. The winter of 1941 was exceptionally cold.



Russian designed and built telemetering-recording equipment used for control in dispatcher's office in a large oil field



Final inspection of sound picture projectors coming off production line at State Optical and Mechanical Works in Leningrad

many employes dying because of insufficient heat in the buildings during the first year. Because of housing shortages a large portion of the people lived in the same building in which they worked. I was told that there were many days when the temperature stayed at zero in the plant and that individual stoves were set up next to machines both for heating and cooking purposes. In spite of that, the machines were kept going 18 hours every day. Ideal production layouts were impossible because of the unsuitable buildings in which the industries were established, and practically everything had to be improvised. Nevertheless, shipments began in January, 1942, four months after leaving their old location.

One tube plant employs 2,000 persons and is producing several types of metal tubes. A series of "G" glass tubes are made, as well as glass power tubes, acorn tubes, water-cooled power tubes up to 100 kilowatts, rectifiers, and X-ray tubes. All tubes except the receiver types are skillfully hand built, including the glass blowing. Test equipment of all types was lacking; lighting facilities were poor, and safety devices on their punch presses were inadequate. In spite of these conditions, I was greatly impressed with the enthusiasm of

the factory workers, both men and women. I have seen nothing to compare with this spirit in American plants, and I am not exaggerating when I say that it fringes on an emotional ambition to overproduce their quota. About 85 per cent of the employes are a serious-minded group of women, ranging from 14 to 55 years of age.

Radio-quota enthusiasm

Entire plants are on a quota basis and production results are posted every 10 days, every possible effort being made to have the employes feel that they are an important factor in the plants' operations. All radio factory employes are on an incentive basis with their total weekly pay check dependent upon their rate of production. Workers in departments other than production are awarded medals for outstanding performance, which they proudly wear and which also entitle them to additional food coupons, better seats at the opera, additional gasoline for their cars, and, in general, provide a basis for a higher standard of living. Frequently the plants operate farms, which supply one substantial meal per day to the workers for which food coupons are not required.

Recently some of the plants were moved back to the west into mod-

ern buildings which incorporated their latest production knowledge. Intense precautions against bombing and gas attacks were taken in the reconstruction of these buildings. Basements had been strengthened with concrete to provide bomb shelters and one section devoted to gas-proof shelters including medical facilities, extra clothing, showers, etc. A central telephone control room was also located in the factory basement in order to facilitate an orderly evacuation of the building in case of raids. The organization of one particular plant which I visited followed closely accepted American practices. They had one department responsible for the one meal supply of food, but they also had departments headed by capable men handling personnel, inspection, processing, planning, engineering, purchasing, accounting, production and sales. It is my opinion that the production and engineering departments are doing work which compares very favorably with some of our large American organizations. In their personnel and incentive departments they are more advanced than many of our American factories. The management is very much interested in the morale of the individual worker and the personnel department was in charge

(Continued on page 182)

Armour Research Foundation's

Research LABORATORIES

Illinois Institute of Technology

Founded to render a research and experimental engineering service to industry, the Armour laboratories in Chicago illustrate the modern trend, in their use of many electronic aids to measurement, analysis and control. In addition, the laboratories have played key parts in developing new applications for the electron art, such as the use of induction heating to brighten electrolytically deposited tinplate, saving half to two-thirds of the tin formerly used on tin cans.

Hammer's impact on storage tank under study (at right) using resistance type strain gages in a bridge circuit, amplifiers, and single-sweep oscillograph with 35mm camera to photograph vibration trace. Note special swing hammer used. For field work, the laboratories have a mobile trailer-laboratory with eleven strain gage recording channels for static and dynamic stress analysis and a complete photographic darkroom to check progress

Melting furnace in ceramic project (below, right). Operator sights down through pyrometer. Ceramics laboratory engages in many studies on insulators and insulating materials for electronic uses

Laminated lumber's resistance to bending studied (below) with strain gaging equipment. Bend is measured by noting displacement of 400,000 pound testing machine compression arm. A number of strain measurements are made simultaneously





Sound intensity study. Photo shows sound level meter, audio oscillator and a loud speaker. The sound being measured is from "confidential" equipment close by but purposely not shown in this photograph



Metallurgical test using back-reflection X-ray diffraction technic. The four port XRD unit itself was constructed in the laboratories' shops, using a few stock parts and tube. Specimen is metal research product



Diesel engine study, using Edgerton high speed motion picture camera to photograph combustion through special port. Many electronic aids for engine analysis are used in Armour's internal combustion research



Calibrating strain gages, using bridge, amplifiers, oscillograph, and camera. Strain gages are fixed to one suspended metal bar, struck with known force by other bar in foreground as gage's response is recorded

Metals and minerals research building (below) has photoelectrically controlled steel converter, tube and rotary induction heating units, and other electronic test and measurement equipment for research

Wheat technology laboratory (below) showing electrically heated, temperature-controlled oven for experimental bread baking. Postwar development may find many electronic devices suited to food industries



REDUCING RADIO NOISE

by **CARLTON WASMANSORFF**

Hoffman Radio Corp., Los Angeles

An analysis of various methods that may be used to help in the elimination of man-made and natural interference

● The reduction of noise in radio reception has long been one of the major problems in the communications field. Today, widespread use of receivers in unfavorable locations and under adverse conditions has highlighted the necessity of taking full advantage of the various methods of noise reduction.

In considering this problem there are in general three points of attack: (1) Elimination of noise at the source; (2) reduction of the pickup of noise by the antenna system; (3) reduction of the effect of the noise through the use of noise limiting and noise reducing circuits within the receiver.

The subject of source elimination has been rather thoroughly covered and the principles involved are generally understood; in addition, source filtering is obviously very often impractical. Therefore this point of attack does not seem to warrant further consideration at this time.

In considering the reduction of pickup of noise by the antenna system one important point is rather generally overlooked. Most systems of this type depend upon getting the antenna proper out in the clear and then feeding the antenna pickup in through some form of balanced line. At the line termination there will then appear a voltage across the line which represents the desired voltage and, in addition, in-phase voltages from each side of the line to ground. These voltages represent pickup by the line or by the line and antenna acting as a different type of antenna. Since these voltages are in-phase, the supposition is that they will cancel out. This would be true if the coupling to the input circuit were entirely magnetic. However, many receivers have considerable capacitive coupling between the antenna coil and the first tuned circuit. The net effect is that the noise is coupled into the first grid through this path. Receiver specifications and measurements seldom refer to this most important point.

A method of measurement and establishment of a figure of merit for receivers having the usual three terminal input coupling arrangement is shown in Fig. 1. The connections to the generator are made as at "A" and the generator level set to produce standard output from the receiver. The input is then connected as at "B" and the generator level increased until standard output is again obtained from the receiver. " V_2/V_1 " is the figure of merit for the receiver at the test frequency used. A series of measurements should be taken across the tuning range of the receiver.

Faraday screen used

Since it is generally conceded that the most desirable condition would be to reduce the noise voltage as much as possible in or ahead of the input circuit of the receiver, the ratio expressed by this figure of merit is important. Considerable improvement in this ratio can be obtained by the use of a Faraday screen between the primary and secondary of the input circuit. Improvement may also be effected by the use of a push-pull input stage or a push-pull line isolating stage as shown in Fig. 2. Capacitive coupling to the grids is effectively in parallel and may be accurately balanced by careful design. Thus, voltage fed to the grids through the capacitive path cancels in the push-pull plate circuit.

The question now arises as to what can be done about noise voltages that are picked up by the antenna and fed down the line, appearing at the line termination as a voltage across the line. Some use has been made in the past of so-called "noise antennas" which were designed to pick up noise which is fed to the coupling coil in-phase with the voltage from the antenna, the coupling coil being center-tapped and the noise voltage fed to the opposite end of the winding to provide cancellation. However, variable coupling for balance was difficult to

obtain, and sufficient stray capacitive coupling usually existed to provide a path where the noise voltages from the two antennas were effectively in parallel. If the input circuit is properly isolated and the noise antenna coupled in through a separate primary winding the coupling of which can be varied, a further improvement can be gained.

Since the trend is to the higher frequencies and the more extensive use of directional arrays, it becomes more practical to use a second directional antenna of the same general type as the signal antenna. Signal differential is maintained in the two antennas by orientation. The feed lines are connected to separate coupling coils with variable coupling.

If the noise is from the same direction as the signal, a signal differential may be maintained in the two antennas by altering the directivity characteristics in the vertical plane. At the higher frequencies the noise antenna or both antennas may conveniently be coupled to tuned lines to allow the use of stub arrangements for phasing and matching. The types of arrays which may be most desirable vary widely with the service required, the frequencies used, and the amount of complication economically justifiable. Worthwhile improvement can be secured by careful design and installation.

Limiting circuits

The next point of attack is the receiver proper. It has been observed that a given limiting circuit would give much more satisfactory operation in one receiver than in another. Before considering limiting circuits it should be ascertained that the receiver does not actually increase the effect of the noise, since noise pulses may be lengthened out before reaching the limiter to such an extent that the limiter cannot perform properly.

The various design factors influencing the signal-to-noise ratio in

the input stage are rather well known. Not so well appreciated is the fact that following stages are often bad offenders. Even in a well designed receiver it has been observed that individual receivers of the same design vary widely in this respect. Investigation has shown that the trouble is frequently a form of parasitic oscillation. The normal differences in resistor, condenser, and other component values in production runs, as well as slight differences in wiring capacities, are of sufficient magnitude to cause individual receivers to vary markedly.

The usual production tests do not show up a tendency toward parasitic oscillation unless the condition is severe enough to cause sustained oscillation. Under test conditions the receiver behaves normally, but under the impact effect of high amplitude, steep wave front, short time duration noise pulses, the parasitic oscillation may build up. The train following the actual pulse provides the time element which makes the effect of the noise greater than would normally be the case. This effect has often been commented on, but the blame has usually been attached to the normal resonant circuits. It is true that impact tends to cause momentary oscillation of the tuned circuits; it is also true that in many cases this is not the major cause of the lengthening of the effect of the pulse.

The receiver may be checked for this condition by feeding a radio frequency signal of relatively high amplitude, keyed by a square wave generator, to the input of the receiver or the stages under test. The keying speed should be varied over a wide range, observing the output wave on an oscilloscope. Care should be taken that the keying circuit is such that there is no direct current keying component contained in the keyed wave and that the keying is clean. This setup is quite satisfactory except that under these conditions, the mark-to-space ratio being unity, considerable automatic volume control voltage is developed which may reduce the gain of the receiver to the point where parasitics do not appear.

If the receiver is operated with the automatic volume control "Off," the test is accurate for the receiver operating in this condition. A better test may be made by keying the radio frequency signal with a pulse generator which produces a short duration pulse followed by a relatively long time interval. It is convenient to have the pulse length and recurrence rate variable over rather a wide range.

The method of elimination of the parasitics will usually be found to

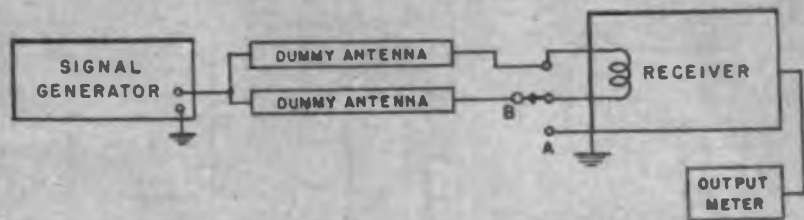


Fig. 1—Method of measurement and establishment of a figure of merit for receivers

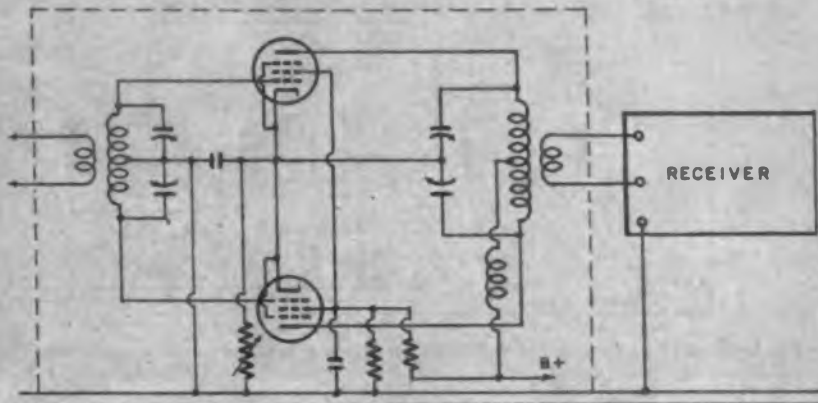


Fig. 2—Use of rf noise reducing circuit with push-pull input and line isolating

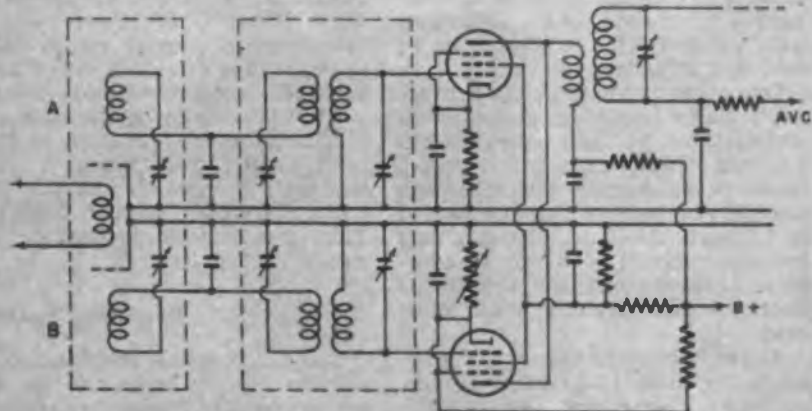


Fig. 3—Noise reduction through the use of cancellation system at input IF amplifier

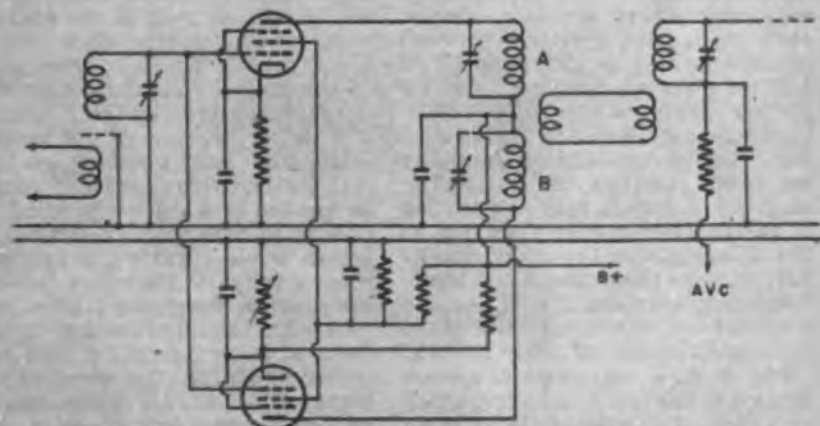


Fig. 4—Grids are connected in parallel and the plate circuits are in push-pull

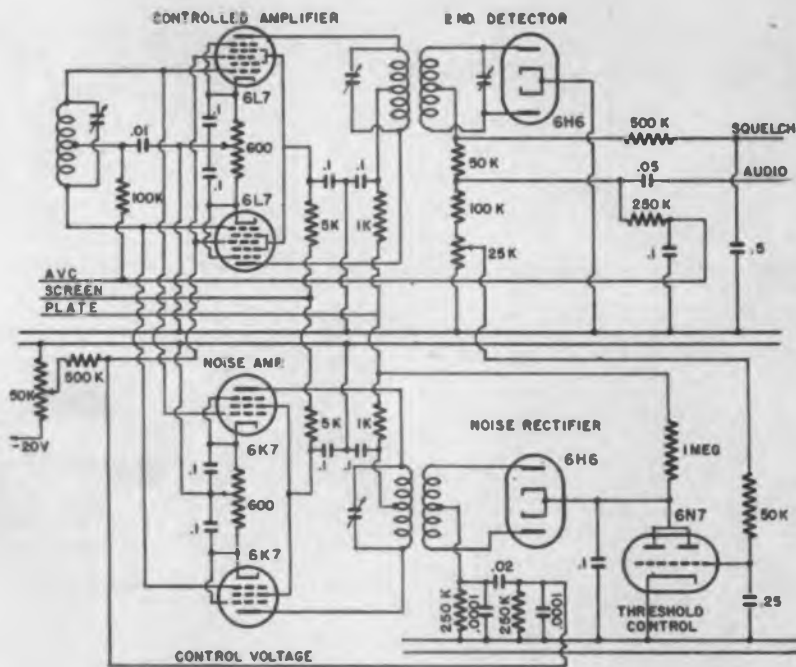


Fig. 5—Type of receiver circuit depending for noise reduction on counter modulation

be quite similar to common transmitter circuit practice. Automatic volume control circuits, screen circuits, and common cathode circuits used for manual radio frequency gain control will be found to be frequent offenders.

One other point to be considered, particularly in mobile and aircraft installations, is noise entering the receiver through remote control leads, power supply wiring, switch circuits—in fact, any conductor fed in through shielding. Bonding and shielding should of course be complete. Filters consisting of both inductance and capacity seem to be best.

At the higher frequencies the inductance filter is particularly important. Capacitors, where the capacity is to the chassis over a rather wide area, seem to be considerably more effective than lumped capacitors. Such a capacitor may have several sections, one for each lead, with capacity between sections as well as to ground.

Noise reducing circuits in general operate on one or more of five principles, namely, limitation, cancellation, counter modulation, blanking out, and variation of gain. The controlling action may be applied to the radio frequency amplifier, to the intermediate frequency amplifier, between the detector and audio frequency amplifier, to the audio amplifier or output circuit, or to some combination of these circuits.

Fig. 3 is a cancellation system applied to the input radio frequency amplifier. Cancellation is at radio frequency. Grid circuits are in push-pull and plate circuits are in

parallel. Circuit values are conventional for tubes and frequencies used. The signal channel "A" is resonated at signal frequency. Noise channel "B" is resonated off frequency to provide signal differential. This circuit is most useful for fixed frequency cw operation.

A circuit employing the same general principle of operation as Fig. 3 is given in Fig. 4. Signal is fed to the grids in parallel and the plate circuits are connected in push-pull. Tuning is similar to that for the circuit of Fig. 3.

Blanking systems

Radio frequency stage noise reduction circuits may also be used employing the counter modulation or the blanking out principle. Such a circuit would best employ the push-pull line isolating stage of Fig. 2 with counter modulating or blanking voltage applied to the grid circuit, suppressor grid circuit, or by using pentagrid tubes. The source of the control voltage must be from a separate amplifier and rectifier. The latter is true of all counter modulation and blanking systems.

If the controlling voltage were to be applied to a stage preceding the control voltage rectifier, the control action would remove the source of control voltage. Therefore the voltage must be developed from a non-controlled channel which is fed from a point preceding the controlled stage in the receiver. If blanking or counter modulation is applied to the first stage, a substantial portion of the receiver must be duplicated. Excepting this

consideration it is highly desirable to provide control in the first stage of the receiver.

The noise reducing systems applied to the intermediate frequency amplifier have usually been of the blanking type; that is, a noise pulse causes a temporary cut-off of the intermediate frequency amplifier, thereby punching a "hole" of short duration in the signal. Such circuits usually apply a negative voltage to one grid of a pentagrid tube causing a cutting-off of the plate current for a short period of time in response to a strong noise pulse, or reducing the gain for a short period of time in response to a weaker noise pulse.

This method is quite effective in reducing noise when no signal is present, and it is quite effective in keeping noise voltages from opening a following squelch circuit when there is no carrier present. However, when a carrier is being received the noise modulates the carrier downward as well as upward. The downward modulation by noise represents a hole in the signal for a duration of time, then on the upward noise peak another hole is punched by the biasing voltage. If the noise pulses follow in rapid succession, the net result is often worse than without any noise reducing circuit.

A method that somewhat overcomes this difficulty utilizes counter modulation applied to a pentagrid intermediate frequency amplifier. In such a system a pentagrid intermediate frequency amplifier is operated at less than full gain, then an audio voltage of the noise component rather than a unilateral voltage is applied to a gain controlling grid, the control action being applied out of phase with the noise modulation component of the carrier passing through the amplifier.

When no carrier is being received, the system should provide a unilateral control voltage since any noise then represents upward modulation. However, as carrier strength increases, the noise begins to modulate the signal downward.

At this point the control pulses should increase the gain of the controlled amplifier on one half of the cycle as much as it decreases it on the other half of the cycle. It is this shifting of the zero axis of the control voltage that is necessary with varying signal-to-noise ratios which causes many circuits that are satisfactory in other respects to fail to deliver maximum possible performance.

Either the blanking or the counter modulation intermediate frequency control stages require some form of automatic threshold control, if the system is to be automatic, in

order to keep signal modulation from appearing in the output of the noise rectifier when strong signals are being received.

A circuit using the counter modulation principle is shown in Fig. 5. The operating principle of this circuit is straightforward enough. Signal and noise voltage at the intermediate frequency of the receiver are fed to a push-pull controlled amplifier stage. In parallel with this stage is a push-pull am-

plifier stage whose plate circuit is tuned to a lower frequency than the intermediate frequency channel of the receiver. Thus the plate circuit radio frequency voltage developed contains more noise voltage and less signal voltage than the plate circuit of the pentagrid stage.

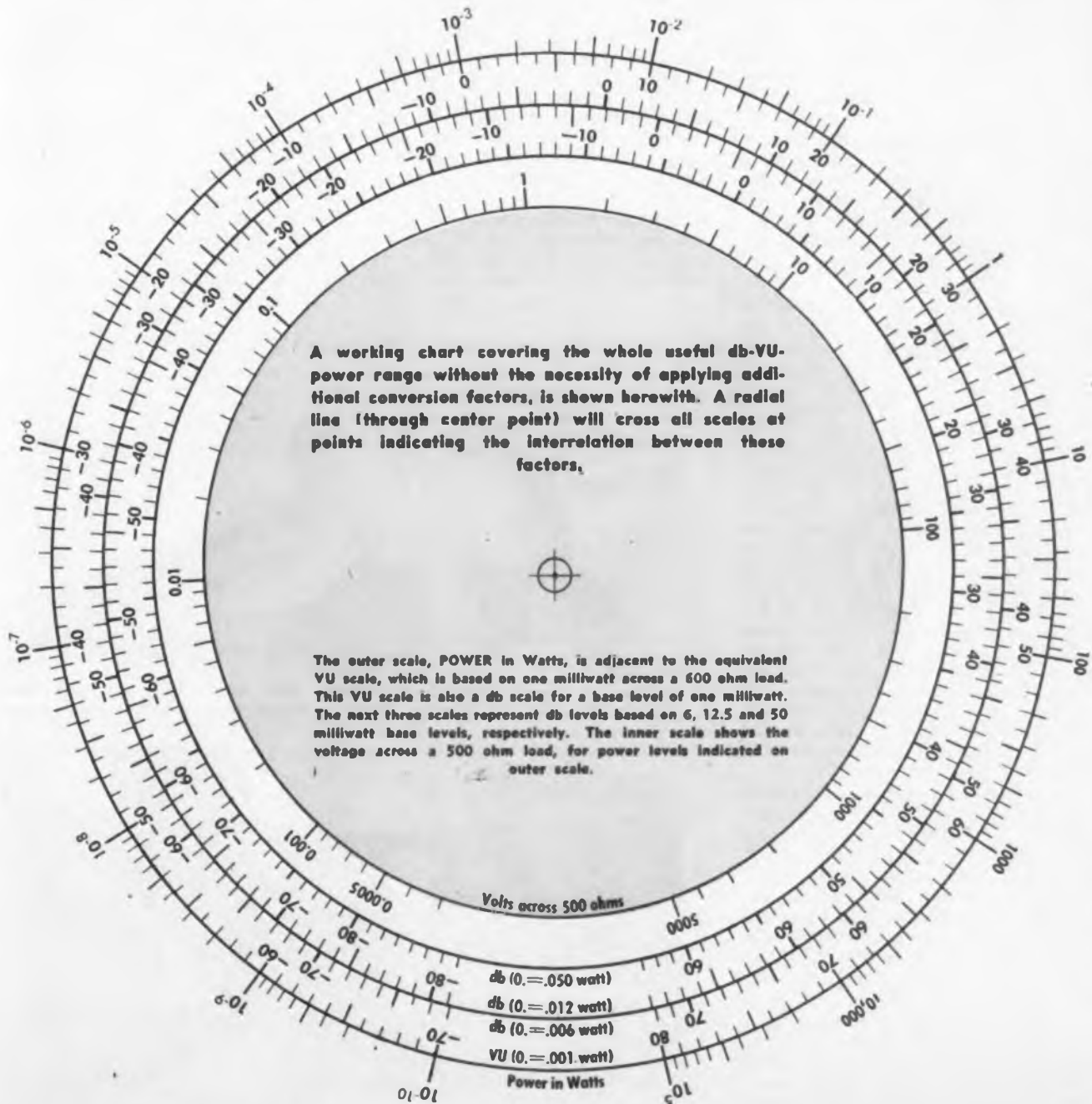
If the preceding stages are relatively broad, the noise amplifier plate circuit may be offset enough to eliminate substantially signal voltage in this circuit. Unless the

receiver is of a band-pass type so that this can be done, some signal voltage will be present in the plate circuit of the noise amplifier. This signal voltage is prevented from affecting the operation of the circuit by the action of the automatic threshold control tube.

The plate circuit of the noise amplifier consists of a tuned primary closely coupled to an untuned secondary which feeds a full wave de-

(Continued on page 170)

POWER-VU-db Relations



TORSIONAL VIBRATION

CAA develops sensitive electronic equipment for measuring vibration frequencies causing crankshaft failures

● When war training service began reporting fatigue failure on crankshafts of military planes, the Aircraft Engineering Division of CAA under the direction of E. Forest Critchlow, Chief of the Flutter and Vibration section, immediately began a study of this rather difficult problem. The need for a measuring and prediction device which was both more sensitive and capable of a much wider scope of measurement soon became apparent. It would have to cover vibration amplitudes beyond any conditions occurring in practice. A complete electronic system capable of studying all modes of crankshaft vibrations resulted from this need.

The problem of vibrational fatigue which causes operating failures, as is illustrated in Fig. 1, has been the latest and heretofore unpublicized vibration study of the CAA Laboratory in Washington. An internal combustion engine is an ideal exciter for vibrating systems, since the explosions that transfer the torque to the crankshaft are of a rhythmic nature, and the waveform of the pressure wave shows many harmonic relations. The crankshaft itself is a vibrating system and although the mass and resilience have a distribution, since the shaft has a wide variation in cross-section (and therefore stiffness to resist bending) and the mass is unequally distributed along the shaft. Therefore, the crankshaft bending period can be excited by the cylinder explosions. At critical speeds sufficient vibration amplitude results to fatigue the shaft if run long enough at that speed.

The failure of the crankshaft seemed a fairly general problem and was reported by several companies as their major complaint. The detailed analysis of the problem and possible solution was referred to the Flutter and Vibration Unit. Much special and unique equipment, which is part of CAA's laboratory, has proven of great value.

The same type of equipment is also well adapted for use in studying effects on vital structural parts of operations during violent maneuvers such as spins, power dives,

pulling out of dives and other operations essential in war. One of the most important results of this work is that it is possible to determine the operational range of safety, without going the limit of destruction, as was the usual procedure in earlier days.

Electronic equipment has offered invaluable assistance in the furthering of more efficient operation of the planes used in combat duty on all the fighting fronts. This equipment falls into four groups, according to the usable frequency range: 1 (a)—(zero to 100 cycles per second) for measuring structural vibration, dynamic loads, static measurements such as steady stresses, airspeed, control surface position indicators, control force indicators, etc. However, in order

to get around the use of modulated or dc amplifiers, certain forms of the equipment were designed to function in the frequency range of 1 to 100 cps instead of starting at zero frequency although this greatly reduces the utility of the equipment since only steady-state vibrations can be measured with it. 2—(5 to 1,000 cps) for measuring engine and propeller vibrations which usually involve a higher frequency range than structural modes of the aircraft. 3—(30 to 10,000 cps) for sound-proofing and general noise measurements. 4—(5,000 to 15,000 cps) for detonation indicators.

Many types of standard and special equipment are essential for different studies and for the more extensive studies an increasing

Fig. 1—Vibrations of hitherto unidentified frequency have caused fractures such as this



Fig. 2—One of several four-channel amplifiers with multi-channel oscillograph used by CAA in measuring and recording resonant vibration frequencies that cause fatigue



STUDY

number of aviation manufacturers are calling on the CAA for its co-operation in working out their specific problems in this field. Fig. 2 shows an eight channel amplifier with multichannel oscillograph which typifies the type of equipment needed for studying technical problems.

In studying torsional vibration as in a crankshaft, a suitable pickup is attached to the end of the crankshaft which produces a voltage proportional to the crankshaft vibrating amplitude and of same frequency, which is amplified and recorded for analysis. Since the shaft may be vibrating two or three different ways at the same time, there are several different frequencies usually present. Here an electronic analyzer makes it possible to study each frequency separately.

After the various natural frequencies of the crankshaft have been recorded, results are plotted to ascertain how the crankshaft may be redesigned so that it does not become excited by the cylinder explosions at critical speeds. Thus shaft fatigue is avoided. These computations have proven of invaluable help in assisting airplane designers to avoid mechanical resonance trouble.

At an early period during the tests, it became apparent that the mechanical exciter, such as is shown in Fig. 3 was inadequate for proper detailed study, principally

(Continued on page 192)

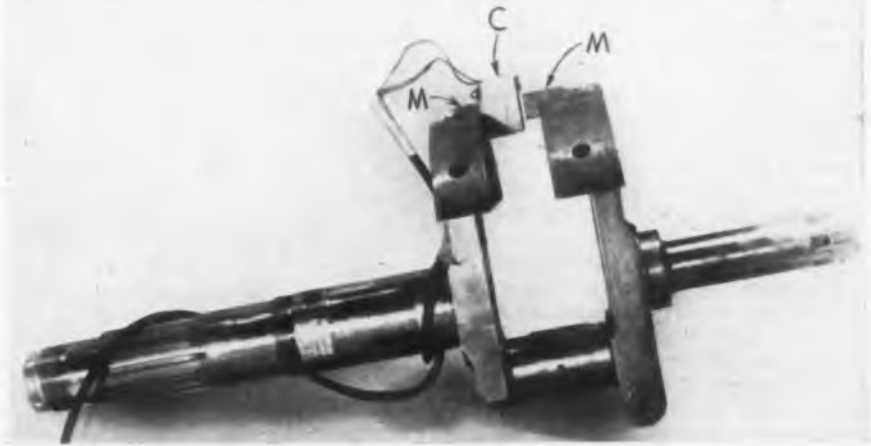
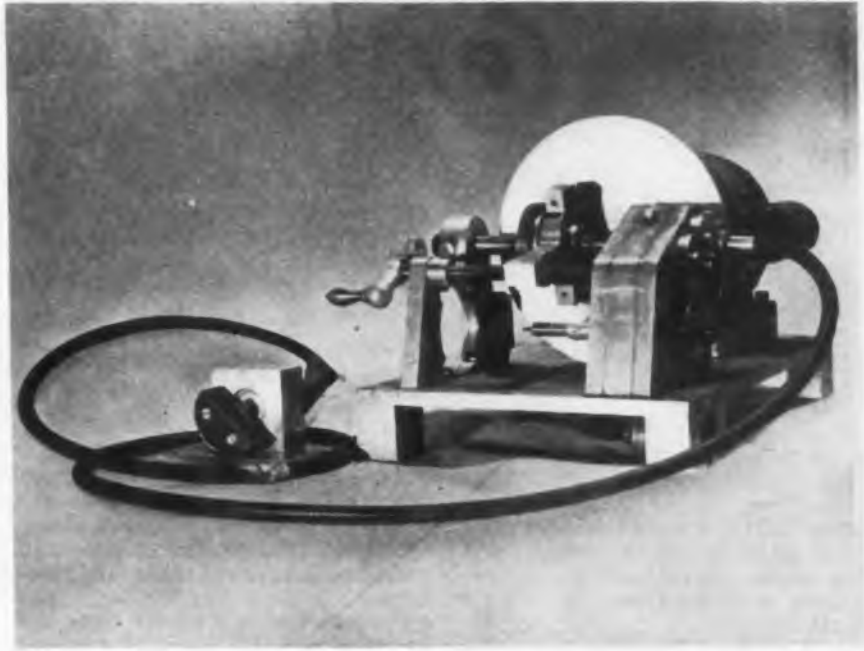


Fig. 3—(Top) Mechanical vibration exciters such as this have been found inadequate

Fig. 4—(Center) New magnetic exciter attached to crankshaft; two magnets and driving coil apply vibration forces to airgap shown

Fig. 5—Various types of vibration pickups: (A) Velocity; (B) Torsionmeter; (C) Wire gage; (D) Crystal (acceleration type); (E) Modulated magnetic (acceleration type)



Fig. 6—Complete equipment which includes the oscillograph, crankshaft with electronic vibration exciter and the audio oscillator with a special power amplifier

PANORAMIC PRINCIPLES

by W. E. MOULIC

Associate Editor, Electronic Industries

Cathode-ray oscillograph method for simultaneous observation of signal voltages of different frequencies

● There are numerous problems that require simultaneous indication of physical or electrical quantities. Multiple pen recorders and other technics are in common use. One oscillographic method for presenting simultaneously the interrelation of several factors is known as the Panoramic system.

The basic purpose of the Panoramic system is the apparent simultaneous presentation on an oscillograph screen of a group of narrow "V"-shaped traces representing voltages of different frequencies. These voltages may be radio carriers or any other group of signals in which it is desirable to compare by visual means the relative amplitudes and frequencies.

The conventional radio receiver is designed for maximum selectivity in most cases. Its purpose is to separate one desired signal from the large number of signals that are continuously present in the frequency spectrum. If it is necessary to count or otherwise locate all of the signals in a given band of frequencies, it would be necessary, with the usual receiver, to tune slowly from one extreme of the band to the other, recording the frequency and relative strength of each signal. This sort of monitoring is a necessary process in many cases and is also extremely tedious

where large bands must be covered. When the signals are intermittent, it is even more difficult to "be there" when transmission is taking place.

An improvement on this method would be to connect an oscillograph across the loud speaker voice coil and by means of a motor, tune the receiver rapidly back and forth across the band. Each signal within the band would then appear along a horizontal axis on the oscillograph screen as an inverted "V." The position along this axis can be

calibrated in frequency with respect to the center or either end. If the tuning were made rapid enough, all of the signals in that band above a certain minimum amplitude would appear on the screen at their respective frequency positions along the horizontal axis of the oscillograph. The relative amplitude of the inverted "V" (signals) would correspond to the strength of the signal at the point of reception. If all of the transmitters had identical power ratings and non-directional antennas, the amplitudes on the screen would correspond relatively to the distance from the receiver to each transmitter.

An unmodulated carrier will appear as an inverted "V" on the screen (see Fig. 1A). If the carrier is amplitude modulated by a single tone, three inverted "V" signals will appear (Fig. 1B), the center frequency being the carrier and the two smaller peaks being the upper and lower sidebands.

A carrier frequency-modulated by a single tone will appear as a group of peaks (Fig. 1C) above and below the central carrier, the magnitude and number of peaks depending upon the modulation index.

If the carrier is being keyed, the signal would appear and disappear from the screen in accordance with

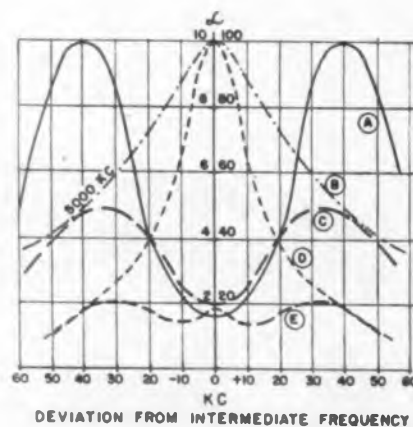


Fig. 2—General selectivity characteristics of communication receiver (B) and (D) characteristic of special amplifier (A) and combined curves (C) and (E)

Fig. 1—Typical patterns on the cathode-ray tube screen of a Panoramic system. (A) (at left) is pattern of two unmodulated signal voltages of different amplitude and different frequency as shown by horizontal displacement. (B) (at center) is carrier, upper and lower sidebands or 100 per cent amplitude modulation. (C) (at right) is frequency modulated carrier showing carrier and sidebands for single tone modulation

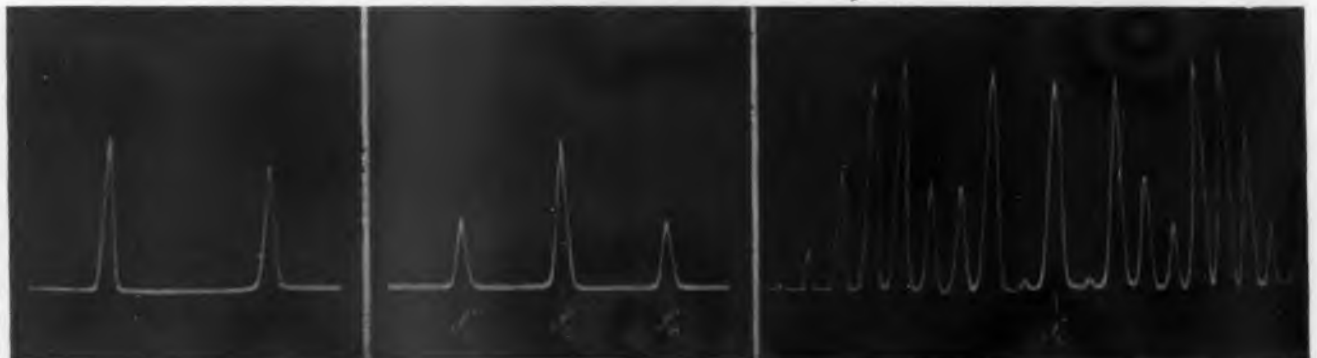




Fig. 6—One model of adapter designed for mobile installation uses 2-inch CRT in separate case

output of an early stage, a usable amplitude of signals that are as much as 100 kc on either side of the frequency to which the set is tuned. The amplification at these points is usually only 20 to 30 per cent as great as that at the resonant point. By feeding these signals, that is, all which fall in a band of minus 100 kc to plus 100 kc around the frequency to which the set is tuned, into a special amplifier which is designed to amplify the signals near the edge of the band pass more than those of the center, it is possible to compensate (approximately) for the selectivity characteristic of the receiver.

As an example, curves B and D of Fig. 2 show the selectivity characteristics of a typical receiver at two frequency ranges. Curve A in Fig. 2 is the characteristic of the special compensating amplifier in the adapter. This characteristic may be obtained by overcoupling of two resonant circuits. In curves C and E is shown the overall response of the special amplifier in combination with the receiver. The selectivity characteristic of a receiver is not the same for all frequency ranges and unless the special amplifier is adjusted to balance the selectivity characteristic, "flat" response will not be obtained over the band pass.

The block diagram of a typical Panoramic system is shown in Fig. 3. The output of the first detector in a superheterodyne receiver is connected to the input of the special compensated amplifier previously mentioned. The output of this amplifier is fed into a mixer stage. In the mixer stage, a signal from a local oscillator is injected and the output of the mixer, as in any superheterodyne, is the difference frequency (usually, but may be the sum). The frequency of this local oscillator is varied linearly

with time by means of a reactance tube modulator. The reactance of this tube is varied by means of a saw-tooth oscillator operating at 30 cycles per second.

The output of the mixer stage in the Panoramic adapter is connected to a highly selective intermediate frequency amplifier. This selective amplifier will respond to each of the signals in the spectrum to be surveyed as the frequency of the local oscillator in the adapter unit

is varied over the range to produce the necessary IF to pass through the amplifier. The output of this selective amplifier is connected to a conventional diode detector which in turn is connected to a low frequency resistance coupled amplifier. The output of this amplifier is connected to the vertical deflection plates of the cathode ray tube.

The saw-tooth oscillator is synchronized to 30 cycles by the power line frequency (usually 60 cycles). The output of this saw-tooth oscillator is amplified and connected to (1) the horizontal deflection plates of the CR tube; and (2) the grid circuit of the reactance tube modulator. Thus the frequency deviations of the local oscillator in the adapter unit are synchronized with the movement of the spot on the CR tube.

While the spot of light on the CR tube can trace only one signal at a time, the 30 horizontal "trips" made each second give the illusion of simultaneous presence of all of the signals within the spectrum being surveyed.

In Fig. 4, the circuit diagram for a portion of a typical Panoramic adapter unit is shown. This section includes the 6SA7 converter which is frequency-modulated by the 6AC7 reactance tube. A 6SL7
(Continued on page 206)

Fig. 7—Suggested applications of Panoramic system to industrial and other problems

To Indicate	Calibration of Horizontal Axis (Frequency)	Calibration of Vertical Axis (Amplitude)	Conversion Unit
Altitude or elevation.	Feet or meters.	Relative distance to position of transmitter.	Frequency of signal controlled by barometer.
Position with respect to fixed location transmitters.	Frequency or miles from reference position.	Relative position with respect to transmitters and to line of motion.	Transmitters along line of motion have frequencies proportional to distance from reference.
Temperatures of large number of objects.	Temperature.	Amplitudes may be scaled to identify each pickup unit.	Frequency of signal thermostatically controlled.
Pressure in large number of tanks.	Pressure.	Amplitudes may be scaled to identify each pickup element.	Frequency of signal controlled by pressure gage (etc.).
Strain in a number of sections of a structure.	Pounds.	Amplitudes may be scaled to identify each pickup element.	Frequency of signal controlled by strain gage.
Frequency drift of number of signals.	Frequency.	Amplitudes may be scaled to identify each pickup element.	None required.
Voltages or currents of number of sources.	Volts or amperes.	Amplitudes may be scaled to identify each pickup element.	Voltage controls frequency of oscillator.
RPM or linear speed.	RPM—Feet per minute or mph.	Amplitudes will also indicate speed.	Pilot alternators develop voltage and frequency proportional to RPM.

FEEDER WIRE LOSSES

by M. RETTINGER

RCA Victor Division, RCA, Hollywood, Calif.

• It is frequently necessary to connect a load to a source by means of a long pair of feed-wires or cable which, by its own resistance, represents a power loss. A typical illustration is afforded by a public address system loudspeaker connected to an amplifier at a considerable distance. Fig. 1 shows the insertion loss of a copper wire line (2 wires with negligible inductance and distributed capacity) as a function of the ratio of line length, in feet, to load impedance for wire of various sizes (American Wire Gauge). As an example consider a 15-ohm loudspeaker connected through a distance of 600 feet to an amplifier having an output impedance of 15 ohms. The insertion loss for a No. 20 wire therefore comes to 2.85 db.

Reducing loss

A reduction in insertion loss can be obtained by connecting the amplifier output transformer for a higher impedance. Fig. 2 shows the insertion loss for two cases—one where the amplifier output impedance is the same as the load impedance; and the other, where the output impedance of the amplifier is equal to the sum of the load impedance and cable resistance. The latter case represents the lowest possible insertion loss, since it obviously fulfills the condition of source impedance equal to total load impedance (total load impedance being the sum of all the loads).

Load impedance

In the above we have not concerned ourselves with the proper load impedance as required by the output tube so that it may be able to deliver maximum undistorted power, assuming that the "50 ohm" top, for instance, of an amplifier output transformer was merely a designative value, chosen to obtain maximum power transfer. Looking into the secondary of the output transformer, one might therefore have seen only 15 or 20 ohms, as in the case of a triode output tube, or 100 or more ohms, as in the case of a pentode output tube.

A family of curves could be drawn similar to that in Fig. 1 to

show the insertion loss for the case where the amplifier output impedance has been stepped up to a value equal to the sum of all the loads. On the other hand, this new insertion loss can be obtained almost as quickly by considering Fig.

2. For instance, if an insertion loss as secured from Fig. 1 comes to 6 db, examination of Fig. 2 will show that this corresponds to an insertion loss of 4.75 db for the case of the higher amplifier output impedance.

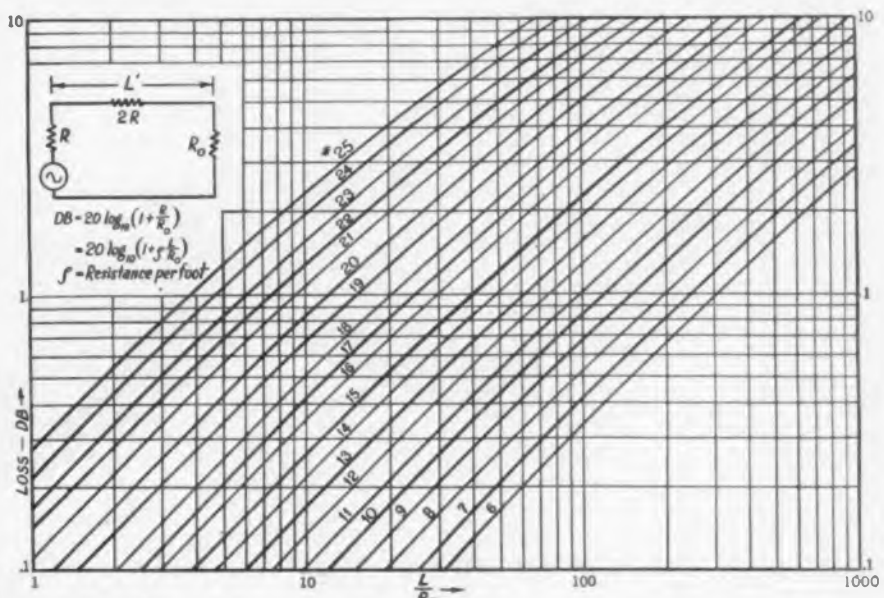


Fig. 1—Insertion loss of a copper wire line (2 wires with negligible inductance and distributed capacity) as a function of the ratio of length in feet to load impedance for wire of various sizes

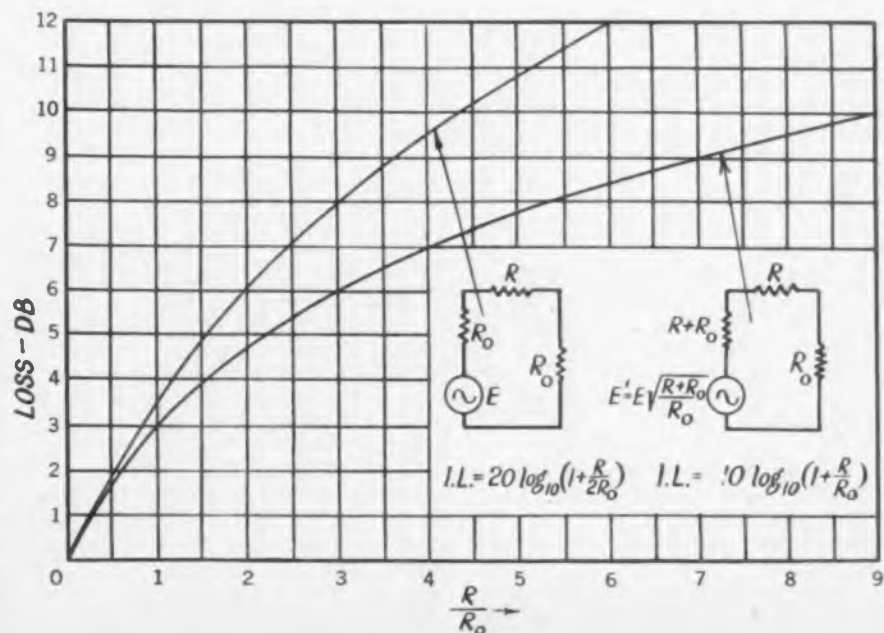
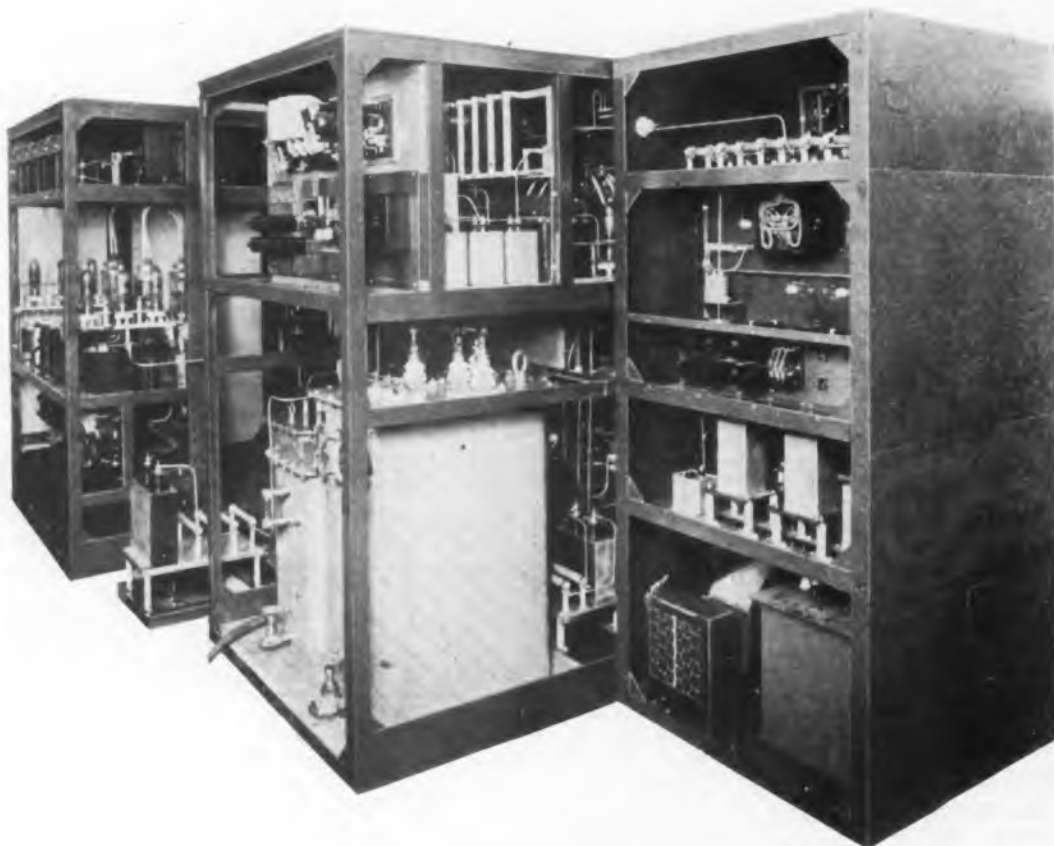


Fig. 2—Insertion loss for two cases: one where amplifier output impedance is the same as load impedance; the other where the output impedance of the amplifier is equal to the sum of the load impedance and cable resistance

200 KW HF TRANSMITTER



Three sections of the modulator for the 200 kw transmitter, units being the first three audio stages, fourth audio stage and 7000 volt rectifier and modulator tubes and 3000 volt bias rectifier

New units operated by OWI at two West Coast locations to augment existing facilities in covering Pacific area

● Short wave transmitters of 200-kilowatt capacity, almost twice as powerful as any existing transmitters in the United States, are being constructed for the Office of War Information by Federal Telephone and Radio Corp., Newark, N. J., manufacturing associate of International Telephone and Telegraph Corp. These units operating at two locations on the West Coast of the United States, will augment existing but inadequate radio coverage of the entire Pacific area, from Siberia to Australia and from Hawaii to India, and will guarantee reception of American broadcasts in Japanese occupied territories and in far-flung stations of the United Nations forces where heretofore it has been difficult to receive anything but Japanese propaganda broadcasts.

Designed to meet rigid specifications set up by the Office of War Information, these units incorporate the latest in technical developments. Emphasis in design was

placed not only on performance and reliability but the utmost stress was also placed on producing a high-fidelity unit. The transmitting equipment is now being tested before installation in the buildings for which the ground was broken this Spring. It is planned to have the buildings completed and both stations in operation early next Fall under the supervision of two of the major radio networks.

Each plant will be composed of three separate transmitters: One of 200 kilowatts and two of 50 kilowatts each. The equipment manufactured by Federal consists of the main units for a 200-kilowatt, high-frequency, broadcast transmitter, a rectifier power supply, a 150-kilowatt modulator, a water cooling system, radio control panels and other auxiliary components. This will be used with existing 50-kilowatt radio-frequency channels to provide single-program, dual-frequency broadcasting at 50-kilowatt output and single-program, single-

frequency broadcasting at 200-kilowatt output.

Peak input for the 200-kilowatt transmitter will be over 600 kva at 2300 volts, totaling more than 12,000 kilowatt-hours per day. 12,000 gallons of water per hour will be required to cool the tubes of the 200-kilowatt transmitter, enough to dissipate 1,260,000 BTU's per hour. Both stations will be equipped with two transmitter panels, each of which when completely installed will be 62 ft. long. The total weight of all the equipment for each station will be approximately 60 tons, requiring 6 freight cars to transport.

Each modulator will be used initially for modulating two 50-kilowatt power amplifiers (or 100-kilowatt rf output), which require about 75-kilowatts audio output, with a plate voltage of 10,000 volts. It is, however, capable of modulating the single 200-kilowatt power amplifier, requiring about 150-kilowatts audio output with a plate

voltage in the neighborhood of 12,000 volts. Eventually the 50-kilowatt transmitters may be replaced by a single 200-kilowatt broadcaster. This modulator stage uses six Federal Type 125A water-cooled vacuum tubes.

Two audio amplifiers provide four push-pull stages to supply audio driving power to the modulator grids. The driver stage ahead of the modulator is of the low-impedance type and the coupling between this stage and the modulator is so designed as to provide good regulation. Alternating current filament operation is used for all the tubes in the modulator unit, the starting current being limited by means of current-limiting reactors. The individual tubes of the modulator stage are operated from a single-phase filament supply from a three-phase source. The six filament transformers are connected to the three-phase source in a manner to minimize ripple.

Individual indicating overload relays have been provided for each of the tubes in the modulator. Meters for reading the plate current of each tube in the modulator unit and bias and plate voltmeters for the modulators are included. As a part of the modulator unit there is provided a bias rectifier using Federal Type 872A mercury-vapor tubes. Overload protection has been incorporated in the circuits of the bias and low-voltage plate rectifiers.

The plate supply rectifier is capable of delivering 600-kilowatts of direct current at 12,000 volts. A voltage regulator of the induction type is used in the primary supply to this rectifier so that the voltage may be varied from its maximum value to a value 35 per cent lower. Each of the plate supply rectifier racks mounts seven Federal Type 857 mercury-vapor rectifier tubes. Six of the tubes in each rack are used in a conventional three-phase, full wave circuit. The seventh tube on each rack serves as an installed pre-heated spare. A convenient switching system is provided to enable cutting it into service in place of any one of the six in the regular circuit. A blower is provided with a thermostat to regulate the temperature of the rectifier tubes.

Control system

Power is supplied to the rectifier through a high-speed oil circuit breaker with a 50,000 kva interrupting capacity. In addition to electrical remote operation, this circuit breaker is controlled by dc overload relays placed in the various units of the transmitter and so connected that they provide a maximum speed of interruption in case of overload in any part of the transmitter.

Centralization of the control system of the transmitter is accomplished by use of a transmitter control panel. In addition to the main

transmitter switches and a voltage control for the rectifier, there are located on the panel all control switches for starting auxiliary circuits such as pumps, blowers, tube filaments and low-voltage rectifiers.

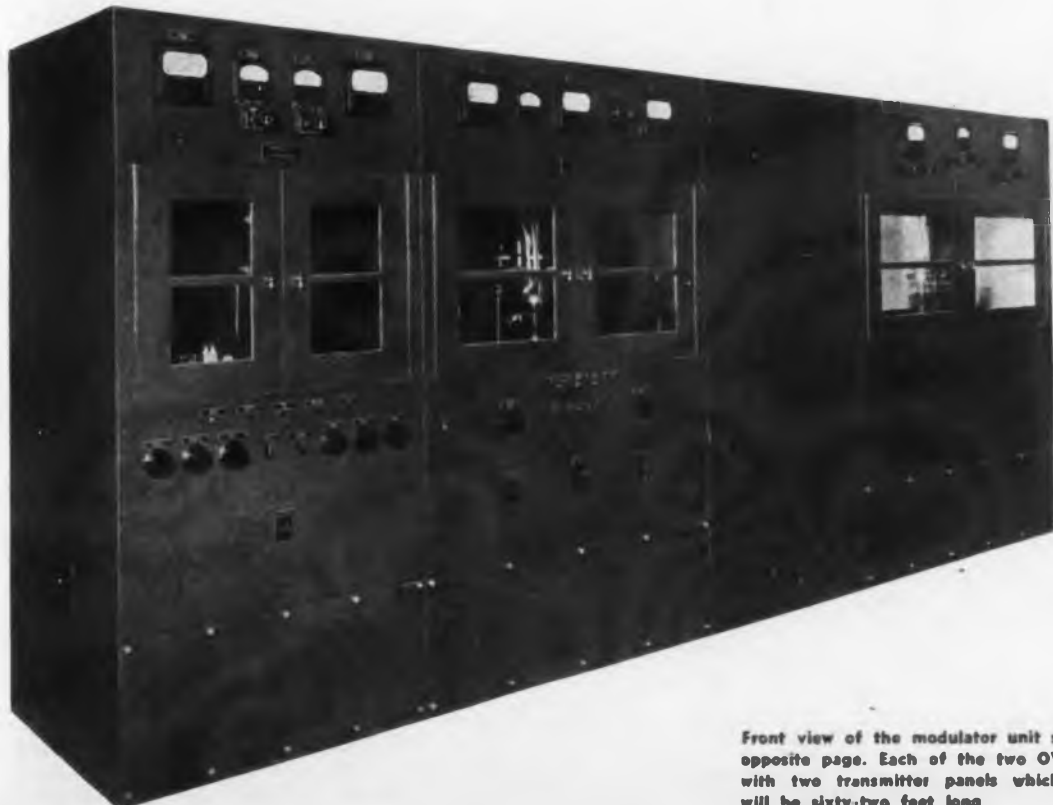
Sequence and protection relays are also included in the control equipment. The control circuit incorporates complete sequencing and interlocking so that voltages may not be applied in improper sequence and adequate protection for the equipment and personnel is assured. A system of supervisory lamps indicates the operation of the equipment controlled and enables speedy location of interruptions in the control sequence.

The water-cooling system consists of three complete units. The operation of any two units will give the desired cooling capacity while the third unit is used for standby service. Forced-air, radiator-type coolers are used.

Protective devices

A positive system of interlocking is provided for the protection of the tubes in case of water failure and immediate removal of plate voltages is assured when there is an insufficient flow, or if the temperature of the water is excessive. In addition, an alarm system, thermostatically operated, is included to warn the operator of abnormally high water temperature before the removal of the plate

voltages. A low-voltage primary distribution panel is located adjacent to the transmitter control panel. This is connected through a manually operated, thermal trip, air circuit breaker to a bank of three 75 kva transformers arranged to give 230 volts, three-phase current. Distribution circuits from the panel to the transmitter units are not fused but are provided with manually operated air-circuit breakers of suitable rating.



Front view of the modulator unit shown from the back on the opposite page. Each of the two OWI stations will be equipped with two transmitter panels which when completely installed will be sixty-two feet long

FM DETECTOR CIRCUIT

by JOHN GELZER

Engineering Dept., Crosley Corp., Cincinnati

Versatility of the Reid discriminator arrangement such that it may be used successfully at frequencies from 460 kc to 50 mc

● The recent opening of a commercial frequency modulated broadcasting service in the 42 to 50 megacycle range has greatly increased the interest which electronic engineers have taken in circuits suitable for FM reception.

Portable and mobile communication systems have used FM to advantage because of a saving in weight and size obtained. For a given permitted weight and size, it has been found possible to build FM equipment of somewhat higher

power than would otherwise be obtained.

Circuits suitable for FM reception seem to have one basic requirement, namely, an arrangement which gives a response directly proportional to the deviation in frequency of an applied ac voltage. A very useful circuit of this type has been developed by John D. Reid, Manager of Research, Engineering Department, The Crosley Corp. In addition to fulfilling the basic requirement, the circuit arrangement has many

advantages which make it adaptable to a variety of communication and allied electronic problems.

An understanding of the operation of the Reid circuit may be gained by reference to Fig. 1. A parallel resonant circuit LC is connected to an ac generator by means of capacitor C^1 as shown in the diagram. If the generator frequency is varied through the resonant frequency of the LC circuit, the impedance of the LC circuit will vary in accordance with the well-known curve shown in Fig. 2.

Fig. 1—The basic circuit is capable of both series and parallel resonance
Fig. 2—Variation of reactance & resistance near resonance parallel circuit

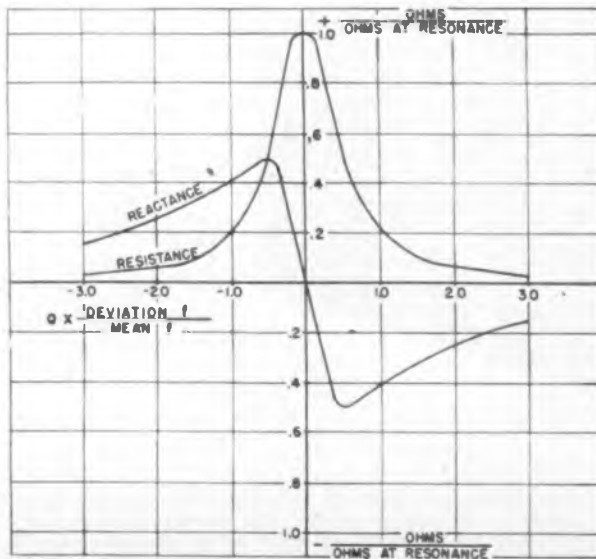
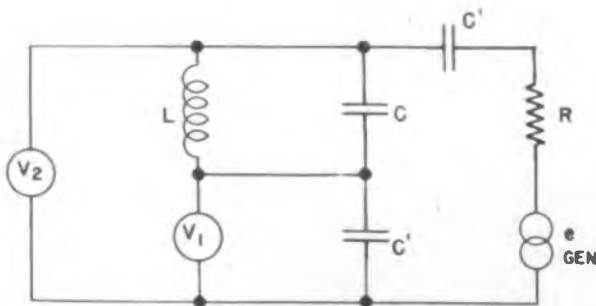
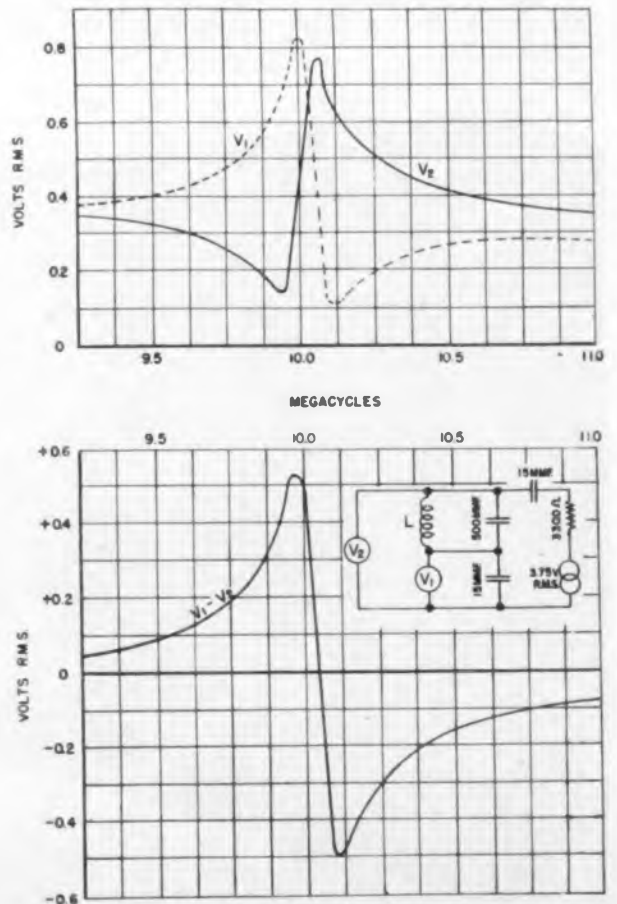


Fig. 3—Voltage curves resulting from series and parallel resonances. The subtraction of V_2 from V_1 gives an S-curve that is symmetrical



of WIDE ADAPTABILITY

An examination of this curve discloses that for frequencies below resonance, the circuit appears to be an inductive reactance having series resistance. As resonance is approached from the low frequency side, the apparent inductance rises very rapidly so that it is possible to obtain series resonance between this inductance and a relatively small capacitance C^1 . Fig. 3 is a plot of the voltage-frequency curve taken across two different points of the network. The voltage V_1 (see Fig. 1) exhibits a dip at the series resonance just described, while at some higher frequency, the voltage rises to a maximum determined by the resonance of LC. The voltage V_2 will, of course, exhibit a rise at the series resonant frequency and a dip at the parallel resonance of LC.

The sharpness of the series resonance depends on the effective Q of the virtual inductance obtained from LC. Fig. 2 shows that the ratio of reactance to resistance decreases very rapidly near resonance. In practice, it is desirable to place the series resonant peak far enough from resonance to be outside of the reactance peaks. Since the reactance peaks are within ± 0.5 per cent of the resonant frequency of LC if the Q is greater than 100, it is possible to place the series resonance as close as 99.0 per cent of the parallel resonance frequency. Practical applications of the circuit have been made in which the series resonance frequency has been as low as 95 per cent of the parallel resonance, although it should not be presumed that this is near the limit for wide spacing of the series and parallel resonance.

It has been found that this series resonance in Fig. 1 will occur at nearly the frequency which would be obtained if L and C are considered connected in series with the capacitor C^1 . The parallel resonance occurs at the resonant frequency of L and C. If C^1 is small compared to C, the following expression may be useful:

$$\frac{\Delta f}{f} = \frac{C^1}{2C} \times 100 \text{ per cent}$$

$$\Delta f = f \text{ series} - f \text{ parallel}$$

(peak to peak spacing)

For FM detector service the ideal frequency characteristic is shown in Fig. 4. Since the detector is to deliver a voltage proportional to the frequency deviation of a signal, it is rather obvious that the detector must have a uniformly sloping re-

sponse characteristic centered on the mean frequency of the signal. If the response of the detector is made zero at the mean frequency, it follows that all variations other than frequency deviation of the signal will have no effect on the detector output.

This important point is the basis of the noise reduction obtained in FM receivers on signals which would otherwise have an objectionable amount of amplitude modulation noise. The sloping central portion of the FM detector curve should extend linearly to a point 75 kilocycles above and below the mean frequency, since that is the limit of frequency deviation under the present broadcasting standards. The response of the detector should then return to zero within the allotted channel of 200 kilocycle width so that the circuit will not detect signals in the adjacent channel.

Ideal characteristic

Either curve V_1 or V_2 shown in Fig. 3 has a uniformly sloping center line and might be used for FM detection if the advantage of FM noise reduction in the detector were not required. A close approach to the ideal characteristic of Fig. 4 may be obtained with the Reid circuit by connecting diode rectifiers to both V_1 and V_2 and connecting their respective rectified outputs in opposition. Since the individual curves of V_1 and V_2 have the required S shape, it follows that the composite curve $V_1 - V_2$, shown in Fig. 3 will have this shape. It has been found, furthermore, that a high de-

gree of curvature correction is obtained in the composite curve and the linearity of the center slope is improved.

To make the composite detector curve of Fig. 3 approach the ideal it should be preceded by a band pass filter which has uniform response over a band of ± 75 kilocycles and cuts off at the edges of a band ± 100 kilocycles from the mean frequency.

Due to the relatively low impedance connecting V_1 and V_2 in the Reid circuit, it has been found that outside of the S curve region, the voltage V_1 and V_2 rapidly became equal. In the composite $V_1 - V_2$ curve, this results in rapid return lines of the S curve and materially aids in obtaining the ideal curve shape.

Controls symmetry

To obtain symmetry in the curve of Fig. 3, it is necessary that the effective Q of the series and parallel resonances be approximately equal. Ordinarily the proper matching of the generator impedance to the circuit impedances will bring about equality of the two peaks. In Fig. 3, if the circuit were operated from a generator of near zero ohms impedance, it is found that the lower frequency peak due to series resonance is about 50 per cent greater than the higher frequency peak. If the generator impedance is made higher than 3,300 ohms, the higher frequency peak will be greater than the lower frequency peak.

In practical FM receiver applications, the generator feeding the discriminator circuit will often be a

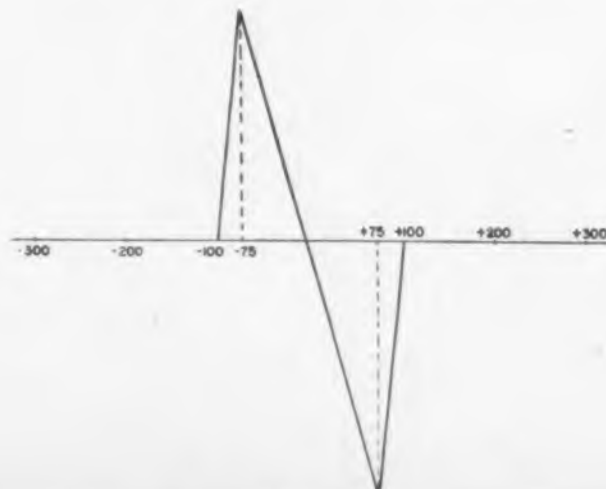


Fig. 4—The ideal response curve for FM is symmetrical about the cross over frequency, has a straight center line, and returns to zero response within the 200 kc FM channel

tuned circuit connected in the plate of the final IF amplifier or limiter. The impedance of this circuit must be adjusted by changing the LC ratio until the proper symmetry of the discriminator curve is obtained. Similarly, it may be found that in some applications, the diode load resistors must be arranged so as to impose such loading as will give equal peaks.

The sensitivity of the Reid circuit is proportional to the voltage gain from the generator to the diodes at the frequency of the peaks. This gain is determined largely by the effective Q at the peaks and the degree of coupling between generator and discriminator. It is apparent from Fig. 2 that the Q of the discriminator coil will have a considerable effect on the Q of the apparent inductance used for the series resonance. The higher this Q is made, the higher will be the impedance level of the discriminator circuit and as a result the gain will be higher.

Of even greater importance is the spacing between series and parallel resonances, since we have seen that the Q of the apparent inductance decreases rapidly as the two resonances approach each other. Generally, as the peak spacing is reduced, the impedance of the circuit and the gain will be reduced.

In every application of the Reid circuit, it is essential to see that the effective Q of the peaks is made as high as possible for a given peak to peak spacing in order to obtain maximum sensitivity. The coupling of the generator to the circuit is determined by the capacitors C^1 shown in Fig. 1. The selection of values for C^1 is usually based upon the peak to peak spacing desired as has previously been explained. Low values of C^1 as required for close peak to peak spacing will give less coupling and consequently less gain. For a given peak to peak spacing, however, the lowest possible value of C^1 should be used since the L/C ratio, impedance, and consequently

the gain of the circuit may then be made the highest for a given Q .

Fig. 5 illustrates a number of practical arrangements of the Reid discriminator for use as an FM detector. Each of these arrangements may be fed from a suitable IF or RF band pass amplifier system provided the output impedance is correctly matched to the discriminator. The frequency characteristic of the amplifier system must be sufficiently flat through the discriminator cross over region to allow a symmetrical over-all frequency characteristic.

If L is made adjustable for any of the circuits in Fig. 5, the discriminator cross over frequency may be varied over a relatively wide band without loss of symmetry of the discriminator curve. The convenience of having only a single discriminator adjustment is readily apparent.

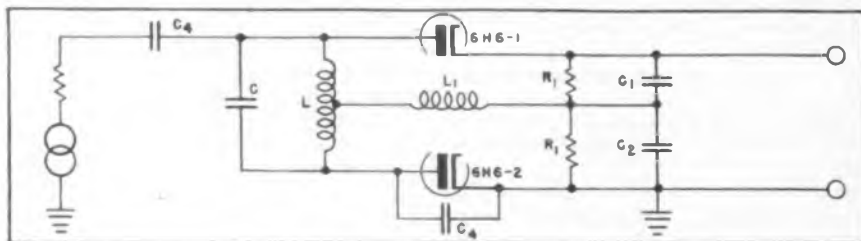
If C is made adjustable, the frequency of the lower peak will be varied without materially affecting the frequency of the higher peak or the symmetry of the curve. An increase in C reduces the frequency of the lower frequency peak. In this way, a single adjustment serves to change the peak to peak separation of the discriminator curve. Production variations in the capacity of the diodes does not affect the ability of the circuit to yield a symmetrical curve; only the peak to peak spacing will be slightly altered.

In Fig. 5B is shown a method of connection which supplies avc voltage from R_3-C_3 . The voltage obtained in this way is a maximum at the cross over frequency and is symmetrical with respect to frequency. The audio output of this detector arrangement is balanced with respect to ground and may be used to operate a push-pull amplifier system.

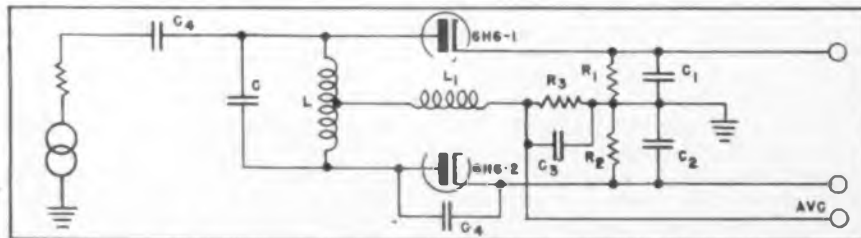
Circuits 5C and 5D are simplified arrangements which omit several parts, notably the choke coil L . Circuit 5C is suitable for higher frequency IF systems where the loading effect of R^1 and R^2 is small, due to the low impedance of the tuned circuits. Circuit 5D is arranged so that even for the lower frequencies, the loading effect of R_1 and R_2 does not destroy the symmetry of the peaks. The component values marked on 5C and 5D were used for a 13.7 megacycle, 75 kilocycle deviation system and a 460 kilocycle, 15 kilocycle deviation system respectively.

The versatility of the Reid discriminator circuit is illustrated by the fact that the circuit has so far been successfully applied at frequencies from 460 kilocycles to 50 megacycles without requiring critical shielding or circuit variations other than those discussed.

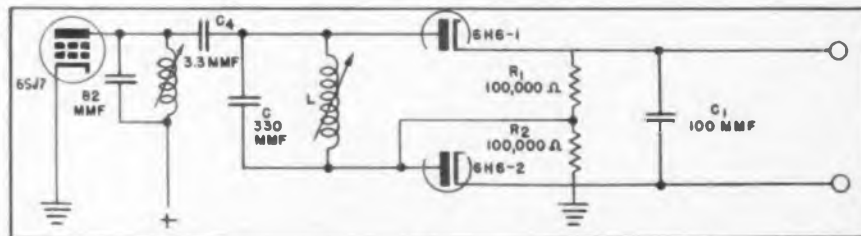
Fig. 5—Some typical arrangements of the Reid discriminator circuit



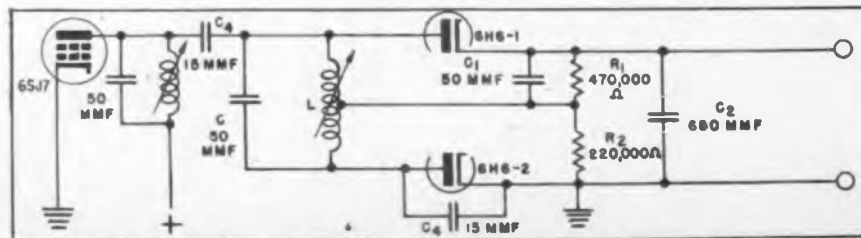
A. FUNDAMENTAL CIRCUIT.



B. PUSH-PULL OUTPUT WITH AVC VOLTAGE TAKE-OFF



C. SIMPLIFIED CIRCUIT AS USED AT 13.7 MEGACYCLES.



D. SIMPLIFIED ARRANGEMENT AS USED AT 460 KILOCYCLES.

HF HEATING OSCILLATORS

by W. C. RUDD

Chief Engineer, Induction Heating Corp., New York

Factors in equipment design include circuit choice, power requirements, cooling, output coupling and various mechanical considerations

● Applications of high frequency induction heating to various types of work have been discussed in considerable detail. Emphasis has been placed on the design of work coils and methods of coupling them to the oscillator. There has been little discussion of electrical and physical requirements of the vacuum tube oscillators themselves.

In general, two types of oscillator circuits are used for induction-heating work. One of these is the familiar Colpitts circuit, in which grid-excitation is obtained from a split capacitance. Fig. 1 is a diagram showing typical connections for this type of circuit.

The other circuit in general use is a modified Hartley type, somewhat simpler since the tank circuit contains only one capacitor. Grid power is obtained from a tickler coil electromagnetically coupled to the tank coil. Fig. 2 is a diagram showing typical connections for this type of circuit.

In both these oscillators the tank circuit consists of an inductance and a capacitance, the values of which are such as to give a resonant frequency corresponding to the desired output frequency. The tank condenser consists of an oil-filled, fixed capacitor, or a num-

ber of mica capacitors, in a series parallel arrangement. Industrial service has shown that the oil-filled capacitor operates more satisfactorily. The tank inductance consists of coils of copper tubing which may or may not be water cooled. As a rule, a portion of the total inductance is inside the oscillator and the balance of the tank inductance is a work coil or the primary of a radio frequency transformer. Of course, a large variety of capacitances and inductances may be selected for any given frequency, but operating considerations require that the L-C ratio must be of such magnitude as to give sufficient circulating kva in the tank circuit to feed properly the low power-factor loads generally encountered in induction heating. If the circulating current, or kva, in the tank is small it will be extremely difficult to extract energy from the oscillator. However, if the circulating current, or kva, is excessive, high I^2R losses will take place in the tank circuit resulting in a very low overall efficiency. Six hundred kva may circulate in the tank circuit in a typical 20 kw output oscillator under no-load conditions.

Since the ratio of inductance to capacitance is important, it is not too feasible to design an oscillator whose frequency has wide variations; i.e., to adjust simply the tank capacitance, or the tank inductance alone, for a change from 200 kc to 1 megacycle would seriously impair the loading ability of the oscillator since the circulating kva would change considerably. If both the inductance and the capacitance are changed keeping the same relative ratio, it is possible to have an oscillator with wide frequency variations. However, the latter usually necessitates a revamping of the tank circuit and should not be considered to be simply a case of dial adjustment. Additional changes

would also have to be made in the grid-feeding circuit to compensate for the change in frequency. In general, induction heating oscillators are therefore of a semi-fixed frequency type. Relatively small changes in frequency are easily made by varying the inductance of the work coils.

Two types of oscillator tubes are available for use in this type of equipment. Units of smaller capacities use air-cooled tubes while those of larger capacities use either water-cooled or air-cooled tubes; there being considerable physical difference in the construction of the oscillator depending upon the type used. Air-cooled tubes require an air-blast which means that large volumes of air must be circu-

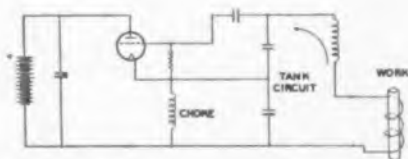


Fig. 1. Basic circuit of Colpitts oscillator

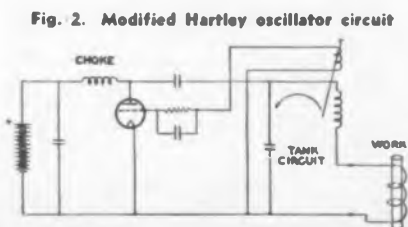


Fig. 2. Modified Hartley oscillator circuit

Fig. 3. Twenty kw power oscillator using city water to cool tubes, plate tank, and work coils



lated through the equipment. This is often objectionable in industrial equipment since the oscillator is usually installed in plants where there may be a great deal of dust and dirt, which must be kept from depositing on the high-voltage components of the oscillator and causing flash-overs. For this purpose, filters are usually installed on the suction side of the blowers to clean the air passing through the equipment. Frequently, these filters become plugged and a reduction in ventilation takes place which may be injurious to the equipment. It is therefore imperative that these filters be changed or cleaned regularly. As a rule, an airflow switch is installed in the duct system leading to the tubes which prevents the equipment from being operated if the blowers are not functioning.

The use of water-cooled tubes eliminates a large percentage of the difficulties caused by dust and dirt collection inasmuch as no large blowers are required. The tubes are mounted in water jackets which are fed with water through an insulating tube of rubber or porcelain. Since the plates of the tubes are at a high voltage above ground it is essential that the water supply be insulated from the water jackets. This is accomplished by having a long column of water passing through an insulated conduit. The electrical conductivity of the cooling water should be sufficiently low to make the leakage current from tube to ground negligible, thus preventing energy loss at this point. The average city water encountered in this country is satisfactory. There are, however, certain occasions when the impurities in the water are excessive, in which cases it is necessary to install some form of heat exchanger which recirculates pure water through the tubes' water jackets.

A water economizer for use with city water which permits a large volume of water to be circulated through the tubes but only requires a small quantity of water to be drawn from the supply, has been developed for use with this type of equipment. A 20 kw oscillator with water-cooled tubes is shown in the accompanying photograph, Fig. 3.

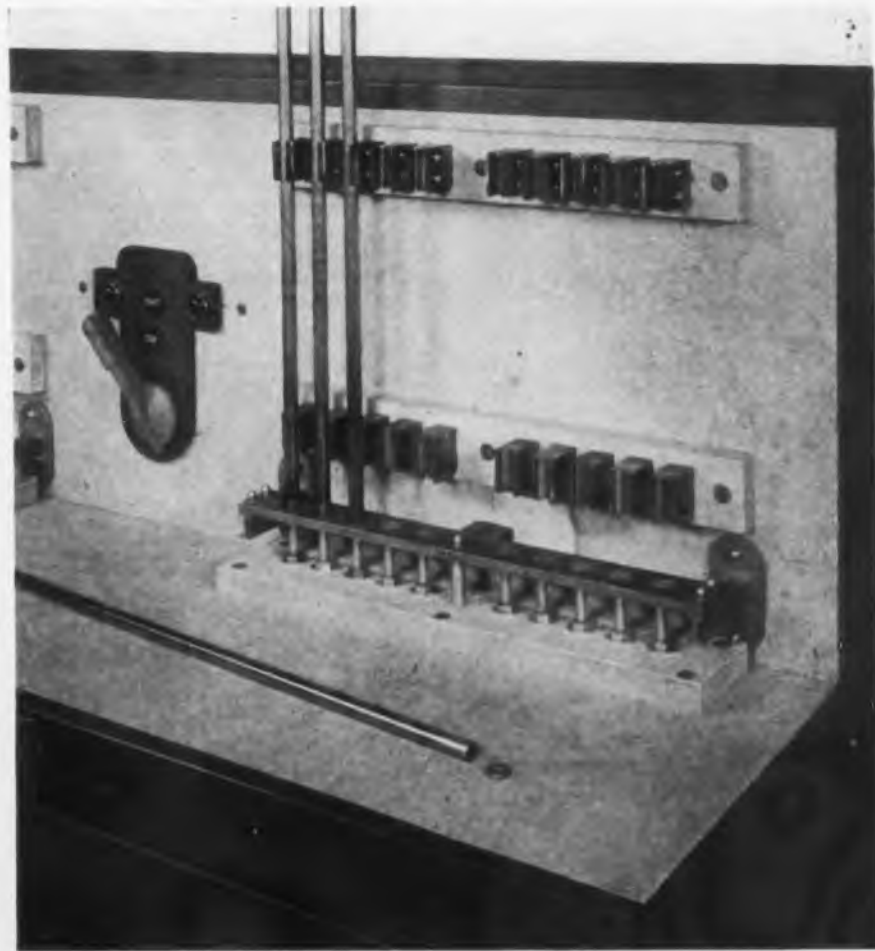
In all induction heating equipment, the radio-frequency current-carrying parts are water-cooled. On humid days there may be sweating or condensation on these various parts. It is therefore essential that this be taken into consideration when designing the equipment. Care must be taken to see that the water condensation which may drop from or run along these parts, cannot possibly cause short circuits or flash-overs in the equipment.



Fig. 4. Back view of switching unit which enables oscillator to be used continuously among three work-coil setups. Switching is in primary side of output transformers

In precise production heat-treating work attains is a function of time and the output of the oscillator, metallurgical properties of the work should not vary appreciably. Since the temperature which the output of the oscillator should be held uniform. Line voltage (Continued on page 202)

Fig. 5. Typical solid-inductor work coil, with fixtures for holding multiple pieces upright for heating. Coil is made of solid copper, channeled for water circulation



COLD CATHODE TIMING

by ASA H. MYLES

Electric Controller & Mfg. Co., Cleveland, O.

Applications of simple gas-filled cold cathode diodes to motor-starting, welding and other timing jobs

• In the necessarily gradual starting of large, heavily loaded electric motors, the most frequently used timing devices are dash-pot relays and motor-driven, cam-operated switches. Dash-pot relays require careful maintenance and, because of their limited range of adjustment, are not suited to many industrial control problems. Motor-driven timing devices are not easily adjusted in the field, are relatively expensive, and are subject to considerable wear. It is therefore desirable to use a timing device which operates on electrical principles only and which may be adjusted readily over a wide range.

As is well known, when a constant dc voltage V_0 is applied to a circuit consisting of a resistance R in series with a condenser of capacitance C , the voltage V across the condenser at any time t after closing the circuit is given by:

$$V = V_0(1 - e^{-t/RC}) \quad (1)$$

A cold-cathode gaseous discharge tube connected across the condenser will "fire" at the instant the voltage on the condenser reaches the ignition potential of the tube. The

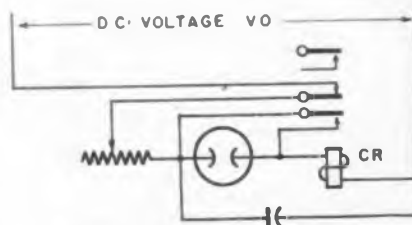


Fig. 1. Simplified cold cathode timing circuit for operation from dc voltage supply

time required for the voltage V to reach any definite potential depends on the product RC and for a fixed condenser on R only. Thus a simple and accurate method of timing is provided in which the time interval may be adjusted over any desired range.

Fig. 1 shows the coil of a control relay CR connected in series with the gaseous discharge tube in the circuit described above. The relay has normally open and normally closed contacts. At the instant the tube "fires," the relay opens its normally closed contact disconnecting the timing circuit from the charging voltage V_0 . The normally open contacts close to short-circuit the gaseous discharge tube and provide

a holding circuit for the relay against the extinction of the tube. By proper choice of the relay coil, it is possible to assure practically complete discharge of the condenser, a condition essential to consistent operation of the timer.

Assuming the extinction potential of the tube to be V_1 and its ignition potential V_2 , the amount of energy given up by the condenser in discharging from V_1 to V_2 is $\frac{1}{2}C(V_1 - V_2)^2$. This energy must be greater than that required to close the relay CR; otherwise positive operation will not be obtained. A 20 microfarad condenser used in conjunction with a gaseous discharge tube having an ignition potential of 160 volts and extinction potential of 80 volts will permit the use of a relay sufficiently rugged for mounting adjacent to standard industrial control apparatus.

If the voltage applied to the timing circuit is proportional to the line voltage, it is obvious from equation (1) that the time intervals will decrease or increase as the line voltage is higher or lower. This variation in "time" with applied voltage is in the desired direction in timing the sequence of motor ac-

Fig. 2. Basic diagram of three-step resistance-type starter for squirrel-cage motor, shown in radio-type relay symbols. Operations on ac line through cold cathode full wave rectifier

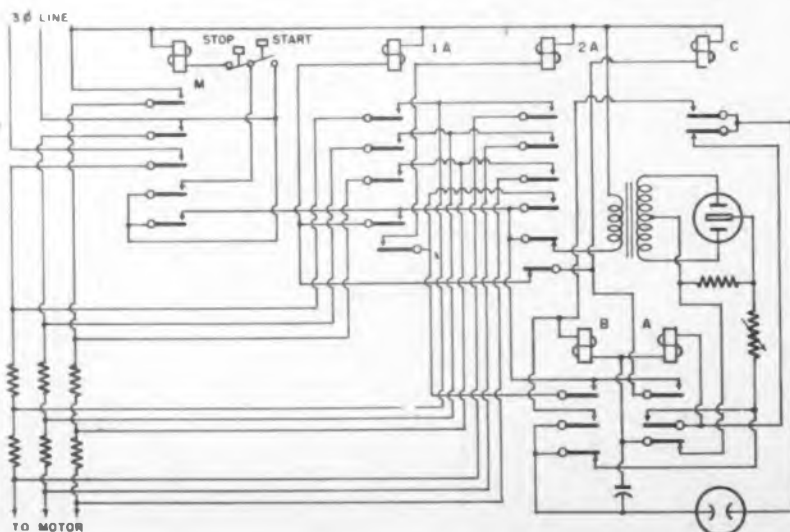
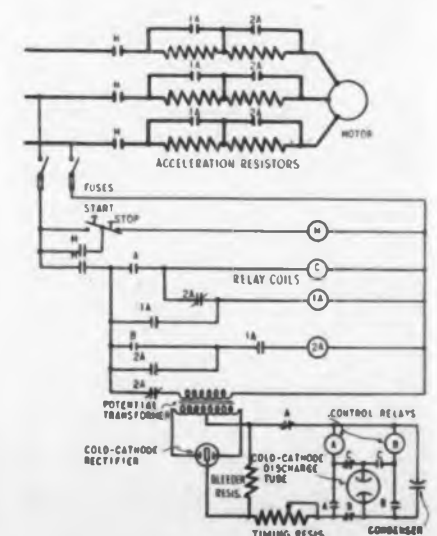


Fig. 2(A). Same as Fig. 2 but with industrial-type symbols for relays and contactors



DEVICES

celeration contactors since a motor operating on a lower voltage requires more time to accelerate.

When the source of potential is ac, it is necessary to employ a rectifying system of the hot or cold cathode type. The cold cathode type is preferable for industrial control work since less wiring is required and no filament heating time-lag exists.

In the equivalent timing circuit for operation on ac, the primary of the transformer is designed for the usual voltages 110, 220, 440 and 550 while the secondary is designed so that the dc output is approximately 400 volts. When very accurate timing is required for special applications, a constant voltage for the timer may be obtained by the use of voltage regulator tubes such as the VR90 or VR150.

Acceleration of ac motors

Throughout industry the ac polyphase induction motor is extensively applied. Whether the motor used is the squirrel-cage or wound-rotor (slipping) type depends upon the load requirements. Whenever possible the squirrel-cage type is selected because of its ruggedness and lower cost. To reduce the peak current demand on the power supply and to limit the stresses within the motor and the driven load, it is desirable to apply reduced voltage to the motor and to increase this voltage in successive steps as the motor accelerates. This reduced-voltage starting may be accomplished by several methods, the commonest employing primary resistors, primary reactors, or auto-transformers.

Fig. 2 is an overall, simplified diagram of a three-step resistance-type starter for a squirrel-cage motor using a cold-cathode timer. When the "start" button is pressed, the contactor "M" is energized and closes to apply a voltage to the motor which is reduced by the primary resistors. The timer is also energized and, after a definite time, the cold-cathode gaseous discharge tube "fires" to energize relay "A." The closure of relay A energizes re-

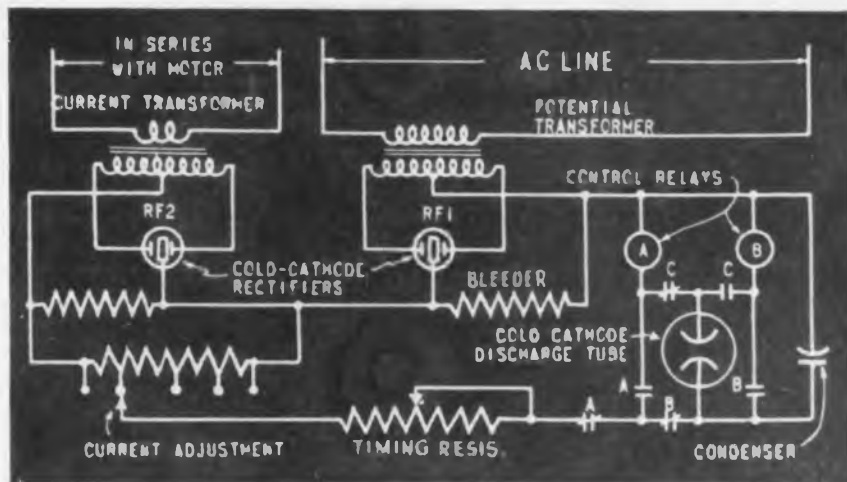


Fig. 3. Circuit for time-current timer on ac supply

lay "C" and contactor "1A." Contactor 1A short-circuits a portion of the primary resistor increasing the voltage on the motor.

An auxiliary contact on 1A provides a holding circuit for relay C and contactor 1A against the opening of relay A. Relay C has closed its normally open contacts and opened its normally closed contacts to transfer the second operation of the timer from relay A to relay B. After relay A opens, the timer repeats the timing cycle. When the timer operates a second time, relay B closes to close contactor 2A short-circuiting out the remaining resistance and putting full voltage on the motor.

Contactors 2A closes a normally open auxiliary contact to provide its own holding circuit and opens two normally closed auxiliary contacts to de-energize relay C and also remove potential from the timer transformer. If a greater number of acceleration steps are required, the circuit can be arranged for additional repeat operation of the timer for each additional acceleration contactor.

Various motor types

If the motor to be accelerated is a wound-rotor type, the starting resistance would be in the rotor circuit. Closure of the acceleration contactors would be identical in operation to that of the squirrel cage motor starter described.

A similar timing control system is readily applied to the acceleration and field application of synchronous motors. The time intervals may be made sufficiently long to allow the motor to attain the highest possible speed before dc power is applied to the field, a desirable condition in starting a synchronous motor.

In the acceleration of dc motors, resistance in series with the motor

armature circuit is excluded in steps in a similar manner to that for ac motors. The circuit for the timer is identical except for the omission of the rectifier tube and potential transformer required for ac operation. The timer may be adjusted to provide a very long time for each acceleration step to keep current peaks low, a condition often necessary where limited generator capacity is available, or when the load has high inertia.

Current limit acceleration

Electric motors are often required to accelerate mechanical loads which vary greatly in value and in their inertial and frictional characteristics. The frictional resistance of loads varies with temperature and often during cold weather the time intervals between closure of the acceleration contactors must be increased to prevent abuse to the motor and equipment. If the acceleration time is adjusted for heavy loads, excessive current peaks will be taken care of, but for light loads, the motor will be accelerated more slowly than necessary.

Numerous control schemes have been devised to overcome this disadvantage. The most common scheme interprets the load in terms of motor current by using series acceleration relays. This method is often referred to as "current-limit" acceleration. The acceleration relays operate when the motor current falls to some predetermined value, thus a heavily loaded motor will automatically be accelerated more slowly than a lightly loaded one. The main disadvantage of the "current-limit" method of acceleration is its failure to provide "forced acceleration" on heavy loads.

It is therefore desirable in some cases to vary the acceleration time intervals with variation in load and at the same time provide forced

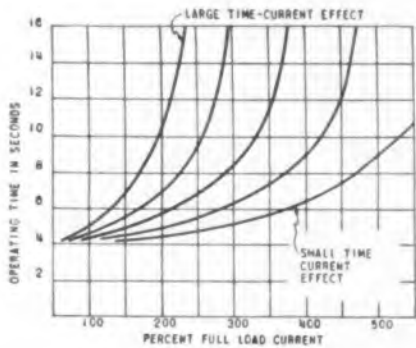


Fig. 4. Time vs. load for various settings of current adjustment potentiometer of Fig. 3

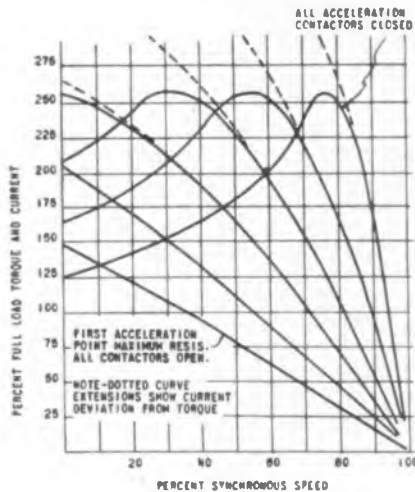


Fig. 5. Speed vs. torque or current for different values of secondary resistance in wound rotor induction motor

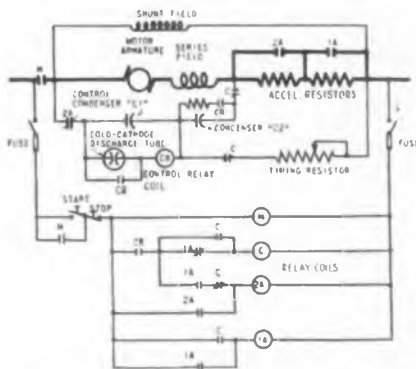


Fig. 6. Simplified circuit diagram of a dc motor starter with time-current acceleration

acceleration on very heavy loads. A method which provides these features is often referred to as "time-current" acceleration to distinguish it from "constant-time" and "current-limit" methods.

Fig. 3 shows a simplified circuit of a "time-current" timer for use with an ac motor. A potential transformer supplies voltage for the rectifier RF1 while a current transformer, whose primary is connected in one of the motor leads, supplies a voltage for the second rectifier RF2. The dc outputs from these

two rectifiers are connected in opposition through a potentiometer. With this connection the dc voltage applied to the timing circuit is increased or decreased with decrease or increase in motor current. The higher the motor current the longer the time interval. By adjusting the potentiometer, the "time-current" effect may be increased or decreased to meet conditions in the field.

Fig. 4 illustrates how the time-current effect is varied by adjustment of the potentiometer and how for any setting of the potentiometer, the time-interval varies with load on the motor.

The wound-rotor induction motor is often used when speed control is essential. Fig. 5 shows typical "speed-torque" curves for such a motor with various values of secondary resistance. As the motor increases in speed it is necessary to reduce the amount of resistance in the secondary by means of contactors. The resistance values are so chosen that, with all acceleration contactors open, the motor will exert 150 per cent full load torque at standstill, with the first acceleration contactor closed 200 per cent and approximately maximum torque with the second acceleration contactor closed.

If the motor is loaded to a point approaching maximum torque it will fail to start until the second acceleration contactor closes. If the motor is loaded beyond the maximum torque, acceleration will not be forced beyond the closure of the second contactor since further reduction of secondary resistance only results in greater motor currents with reduced torque developed. In such an event the motor will be removed from the power supply by operation of the overload relays.

With most dc motor applications, time-current acceleration is also desirable. However, with the dc motor circuit, it is apparent that current and potential transformers cannot be used in a system to obtain opposing voltages for operation of the timer as in the case of an ac motor drive.

Fig. 6 shows a simplified wiring diagram illustrating a time-current timing scheme for acceleration of

dc motors. In this circuit two condensers C_1 and C_2 are connected in series across the motor armature and series field. When contactor "M" closes, power is applied to the motor through the acceleration resistance. Condensers C_1 and C_2 charge up immediately (the starting resistance is low in ohmic value) to a combined voltage equal to that across the armature and field. This combined voltage is divided between C_1 and C_2 inversely proportional to their capacitances. Simultaneously a timing circuit is established through the timing resistance to condensers C_1 and C_2 . The potential across C_1 will increase while that across C_2 will decrease. If the back emf of the motor builds up rapidly, the voltage across C_1 will also build up rapidly and vice versa. In this way the time required for the voltage on C_1 to reach the ignition potential of the cold-cathode discharge tube across it will be increased with increase in load and decreased with decrease in load on the motor.

When the cold-cathode tube "fires" relay "CR" closes to close relay "C." Relay C opens its normally closed contacts to open the timing circuits and closes its normally open contacts to discharge condenser C_2 and close contactor "1A." Contactor 1A short-circuits a portion of the acceleration resistor to increase the voltage on the motor. Contactor 1A also closes one auxiliary holding contact to establish its own holding circuit and opens a second auxiliary contact to prevent relay C from being energized on successive operations of the timer relay CR.

After a short time interval relay CR opens to de-energize relay C and the control condenser C_1 starts to recharge for the second timing period. When the cold-cathode tube "fires" the second time, relay CR closes to energize contactor "2A." Contactor 2A short-circuits the remaining portion of the acceleration resistor to apply full voltage on the motor. Contactor 2A also closes an auxiliary contact to establish its own holding circuit and opens an auxiliary contact to prevent the timer from continuing to repeat the operation.

LOOKING TOWARD THE ELECTRONIC FUTURE

"Perhaps here we should take a glimpse into the future of this electronic fairland. Mail sorted and distributed by electronic automatans; automobiles protected from accidents at dangerous crossings by electric eyes; railroad train crews always in full communication with each other and with the dispatcher; airplane navigation and landings made safe by electronic tools; automatic automobile driving on main cross country highways by means of a master pilot;

electric eyes, which unfortunately for some of us, tell police stations far ahead just how fast the driver is going; facsimile newspapers and television newsreel scenes not only in the home but even in the automobile as we drive along; the transmission of electric power, not by wire, but by wireless; cooking and heating homes by radio; the processing of plastics and metals by heat induction through radio."—Senator Burton K. Wheeler, in Telegraph Centennial address.

REFLECTOR EFFICIENCY

by GROTE REBER
Wheaton, Illinois



Fig. 1—Mirror-cavity device for collecting cosmic static

● Various types of mirrors are being increasingly used with high frequency radio equipment. One such device for cosmic static experiments¹ is shown in Fig. 1, wherein both aperture and focal distance are several wavelengths long, having a cavity containing the antennas proper at the focus of the mirror and coaxial with it. The electromagnetic energy enters this cavity with an effectiveness depending upon the response pattern of the cavity. Energy arriving axially to the cavity is totally absorbed since the cavity appears as a black body to such rays. The effectiveness of this black body decreases as the ray angle differs from the axis of the cavity and finally reaches zero at a ray angle of 90 deg. The way in which this effectiveness of the cavity decreases depends upon the direction of the arrival of the ray in respect to the electric and magnetic axes of the cavity and the size of the cavity opening in the directions of these two axes.

In general the response in respectively the planes of the electric and magnetic vectors will be

$$R_e = R_0 (\cos \delta)^e \quad R_m = R_0 (\cos \delta)^m \quad (1)$$

Both e and m increase as the aperture increases in these directions. The approximations of equation (1) are quite accurate down to about one-quarter or one-third R_0 , which is the region of interest. For very small response and large ray angles at large apertures they obviously fail. However, these latter conditions are not important since they represent a design condition of low mirror efficiency.

¹ "Cosmic Static," by Grote Reber, Proc IRE, Vol. 30, Aug. 1942, p. 367.

Mirror efficiency in collecting electromagnetic energy

Fig. 2 shows the geometry of the response pattern at the mouth of the cavity. The electric axis is along Y , the magnetic axis along X and the axis of the cavity along Z . This figure is for a cavity turned up (opposite Fig. 1) with the opening in the XY plane. The antennas will have their long directions parallel to the electric axis.

Take an element of response along direction R at angles ϕ and θ to the coordinate system. The incremental response will be

$$dR = \int_0^{\theta} \int_0^{\phi} R_0 \cos^n \delta \sin \delta \, d\phi \, d\theta \quad (2)$$

(3) gives the response in one octant from axis out to an angle ϕ therefrom.

Integrating (3) from $\theta = 0$ to $\pi/2$ and $\phi = 0$ to ϕ gives the response in one octant as

$$R_0 \left[C_1 \int_0^{\phi} \cos^{(n+1)} \delta \, d\delta - \cos^{(n+2)} \delta (C_2 \sin \delta + C_3 \sin^3 \delta + C_4 \sin^5 \delta + C_5 \sin^7 \delta + \dots) \right]_0^{\phi} \quad (4)$$

Each of the constants is a series in itself as follows:

$$C_1 = \frac{1}{2} \left[\frac{1}{n+3} (K_A + K_C \frac{3}{n+5}) + K_D \frac{3}{n+5} \left(\frac{5}{n+7} \right) + K_E \frac{3}{n+5} \left(\frac{5}{n+7} \right) \frac{7}{n+9} + K_F \frac{3}{n+5} \left(\frac{5}{n+7} \right) \frac{7}{n+9} \frac{9}{n+11} + \dots \right]$$

$$C_2 = C_1 - \frac{1}{2}$$

$$C_3 = \frac{1}{2} \left[K_C + K_D \frac{5}{n+7} + K_E \frac{5}{n+7} \frac{7}{n+9} + K_F \frac{5}{n+7} \left(\frac{7}{n+9} \right) \frac{9}{n+11} + \dots \right]$$

$$C_4 = \frac{1}{2} \left[K_D + K_E \frac{7}{n+9} + K_F \frac{7}{n+9} \left(\frac{9}{n+11} \right) + \dots \right]$$

$$C_5 = \frac{1}{2} \left[K_E + K_F \frac{9}{n+11} + \dots \right]$$

$$C_6 = \frac{1}{2} \left[K_F + \dots \right]$$

$$K_A = \frac{5}{2} [(n+1) - (n-1)]$$

$$K_C = \frac{5}{2} \left[\frac{3}{2} (n+1)(n+3) + (n+1)(n+1) + \frac{3}{2} (n-1)(n-3) \right]$$

$$K_D = \frac{5}{2} \left[\frac{5}{3} (n+1)(n+3)(n+5) + (n+1)(n+3)(n+1) + (n+1)(n+1)(n+3) + \frac{5}{3} (n-1)(n-3)(n-5) \right]$$

$$K_E = \frac{5}{2} \left[\frac{35}{24} (n+1)(n+3)(n+5)(n+7) + \frac{5}{6} (n+1)(n+3)(n+5)(n+1) + \frac{3}{4} (n+1)(n+3)(n+1)(n+5) + \frac{5}{6} (n-1)(n-3)(n-5)(n-7) \right]$$

$$K_F = \frac{5}{2} \left[\frac{21}{20} (n+1)(n+3)(n+5)(n+7)(n+9) + \frac{7}{12} (n+1)(n+3)(n+5)(n+7)(n+1) + \frac{1}{2} (n+1)(n+3)(n+5)(n+1)(n+3) + \frac{1}{2} (n+1)(n+3)(n+1)(n+3)(n-5) + \frac{7}{12} (n-1)(n-3)(n-5)(n-7) + \frac{21}{20} (n-1)(n-3)(n-5)(n-7)(n-9) \right] \quad (5)$$

Equation (4) is useful only for ϕ out to a value of $\pi/2$, the region of convergence.

(Continued on page 214)

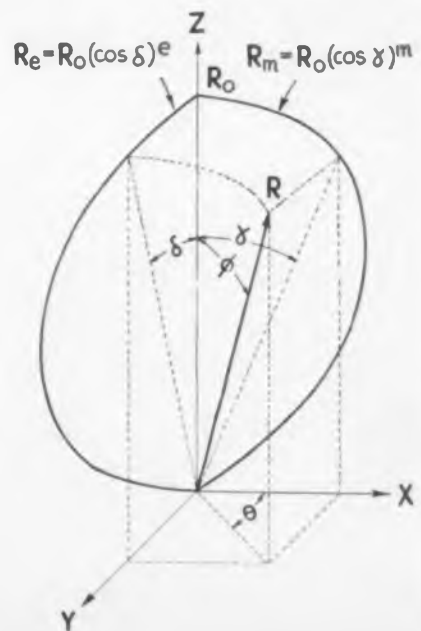


Fig. 2—Geometry of response pattern at mouth of cavity

SLOW ACTION RECORDING

by HERBERT S. REMNICK

Allen B. DuMont Laboratories, Inc., Passaic, N. J.

Simple form of converter permits delineation on an oscillograph of slow, irregular movements such as are found in biological experiments

● Operating methods whereby the amplitude and velocity of small vibrations may be recorded have been pretty well established. However, for larger movements, such as might be produced by slowly operating machines, the technic is more complicated. The method of analyzing the movements of a muscle in a biological experiment, described here, covers a rather special process for making oscillographic studies of irregular movements. It may suggest the means whereby many other experiments having similar requirements can be carried out. The method provides a way of recording slight, but rapid, movements of biological specimens more easily and more accurately than normally can be done on kymographs.

In general, by connecting between the signal and ground input terminals of the Y-axis amplifier of a cathode-ray oscillograph a coil of wire into which a bar magnet is inserted and withdrawn, there will be observed first a positive and then a negative deflection of the cathode-ray beam. This deflection can be plotted as a function of time

*These Laboratories provide a number of cathode-ray oscillographs with a self-contained single sweep, the periods of which may be varied: Type 247—2 seconds to 1/50,000 second; Type 248—1000 microsec. to 5 microsec.; Type 233—125 millisecc. to 33.3 microsec.; Type 215, Low Frequency linear base—2 seconds to 1/125 second.

when a linear time-base signal is introduced. If a single sweep time-base is available,* either self-contained in the instrument, or introduced externally, it can be tripped off externally under control of the operator.

One specific experiment, a record of the contraction and relaxation of a muscle, normally done on a kymograph, was carried out with the above generality in mind. The accessory parts were so constructed that they were versatile enough for other applications without undue modification. The leg muscle with sciatic nerve attached was excised from a pithed frog and suspended by a femur clamp above a coil of wire.

One end of the coil, grounded to the chassis which held the coil, went to the ground terminal of the oscillograph (Fig. 1). The other end of the coil went to the input of the Y-axis amplifier. The coil used had approximately 1,000 turns of No. 38 wire. The number of turns and the diameter of the wire used are not at all critical; however, an increase in the number of turns will increase the output.

Above this coil was placed another coil whose terminals were connected to a dc source (18 volts) and through whose center ran, also, the bar of iron. By having a direct current flow through the coil, the bar

of iron is always magnetized to the same extent, and the retentive properties of the bar become unimportant. To reduce the friction of the movement of the bar against the coil forms, a glass tube was inserted between them (Fig. 2).

Fig. 1—Oscillograph connections for studying artificially-stimulated muscular reaction effects

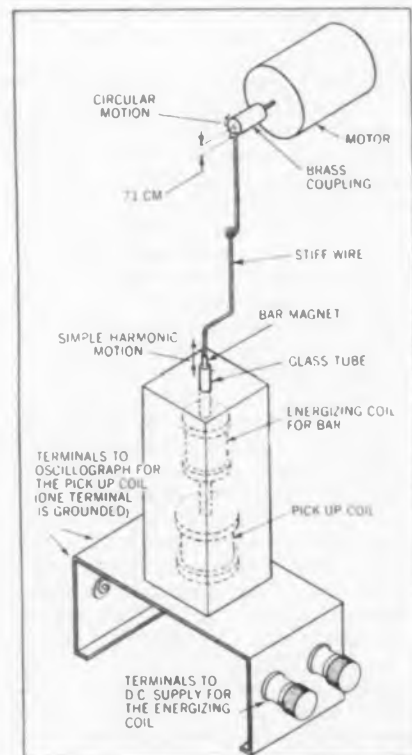
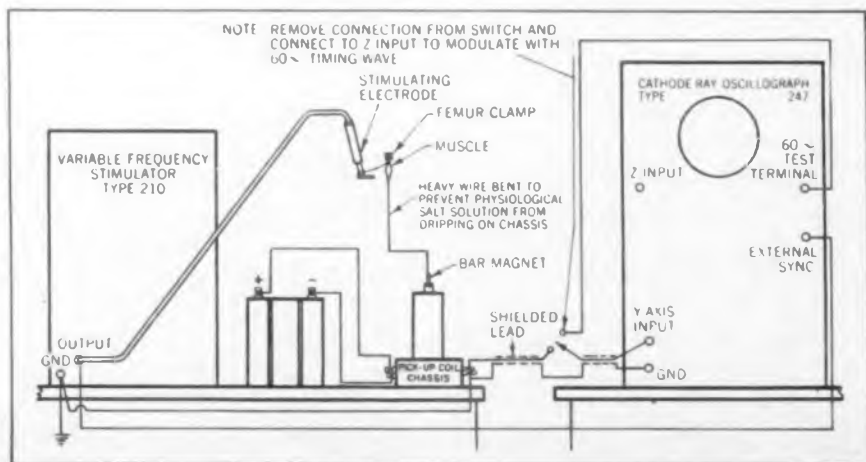


Fig. 2—Device for converting motions having known rates of change, into a potential to produce the deflection. Here the motion is produced by motor-driven actuator, to provide a calibration of converter unit displacements

One-fourth of an inch at one end of the iron bar was filed flat and a stiff piece of wire spot-welded to it. The upper end of this wire was firmly fastened with a piece of linen thread to the tendon of the muscle. Stiff wire was used instead of string to connect the muscle to the iron bar, to help reduce inertia of the moving parts. The sciatic nerve was stimulated once every three seconds in this case, by a Type 210 Variable-Frequency Stimulator (DuMont) and at each oper-

ation the single sweep was tripped.

A camera was placed before the oscillograph, set for time exposures, the space between the oscillograph and the camera being hooded by a black cloth. The three second pause between pulses gave ample time to open the shutter, wait for a pulse to occur, and close the shutter before the next pulse. By positioning the image in the upper part of the screen, room is left for a 60 cycle time wave. This is taken on the same film, the sweep being tripped by the stimulator.

In order to interpret the curves obtained correctly, certain facts must be observed. First, the curves are a resultant of two vectors, namely, time on the horizontal axis, and velocity—in this case, of muscle contraction—on the vertical axis. The curve rests on a base line, or line of zero velocity, at three points: the point of rest (at A, in Fig. 3), the point of maximum contraction (D through E), and the point of rest again (H). Somewhere between the points of rest and of maximum contraction is a point of maximum velocity of contraction (B through C), and another point of maximum velocity, smaller than the first, is reached as the muscle relaxes (F).

Fig. 3 is actually a triple exposure, composed of the timing wave and two curves of muscular movement. The second curve was taken two minutes after the first and seems to indicate the ability of the instrument to duplicate results.

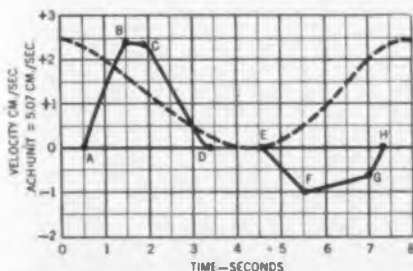


Fig. 5—Graphical comparison of actual oscillograms with calibration curve. In these velocity/time curves, the vertical ordinates correspond to a velocity of 5.07 cm/sec per unit of scale. Units on the time scale each represent 0.016 second, for the solid curves

Since the apparatus is so arranged that the sweep and the stimulation begin at the same time, the short line of zero velocity before A represents the time for the stimulation to travel along the nerve and to pass from the nerve endplates and excite the muscle. By comparison of the curve obtained with the 60 cycle timing wave, the duration of the different conditions of the stimulated muscle can be estimated. In Fig. 3, for example, the period of contraction (A through E) lasted .085 second; it taking .060 second (A

through D) for the muscle to become fully contracted.

It should be observed at this point that it is possible for one to read the velocity at which an object moves directly from the oscillogram. By differentiating, we can find the acceleration; and by integrating, we can find the distance the muscle fibers moved. However, on kymograms, we have a distance-time record and we must differentiate to find velocity.

It is also possible to determine the actual velocity of the muscle in centimeters/second. To do this, however, the pickup coil must be calibrated. A motor, giving two or three revolutions per second, is attached to the magnet in place of the nerve-muscle preparation in such a way (Fig. 2) that the magnet executes simple harmonic motion. A photograph of the output of the coil is taken with single sweep (Fig. 4), tripped off by the operator. The photograph obtained is traced on graph paper, Fig. 5. Then the maximum velocity of the rod is equal to the velocity of the point on the drum 0.71 cm from center, or $2 \times 3.14 \times .71 \times 1.4$ revolutions/second = 6.24 cm/sec.

From Fig. 5, distance peak-to-peak = 2.45 cm; so, distance base-to-peak = 1.23 cm.

$$6.24$$

$$\therefore V_{max} = \frac{6.24}{1.23} = 5.07 \text{ cm/sec/cm}$$

or each cm division represents a velocity of 5.07 cm/sec.

It is possible to use this figure for all measurements taken with a given oscillograph, providing the strength of the magnet, energized by the dry cell batteries, remains the same; and that the gain on the Y-axis remains the same. If it is necessary to increase the gain on the Y-axis for a particular experiment, then it is necessary to calibrate the instrument in terms of the deflection in cm per millivolt of signal in order that a correction factor can be introduced between

(Continued on page 226)

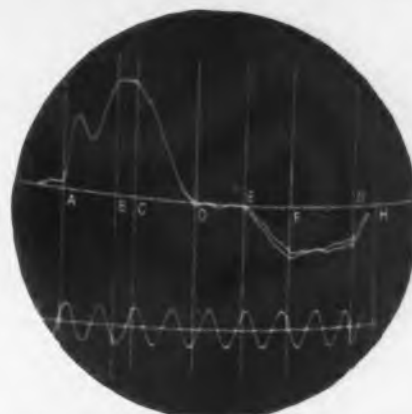


Fig. 3—Two superimposed reaction oscillograms, from which velocity of muscular activities can be computed. Timing wave (60 cycles) added by use of electronic switching equipment

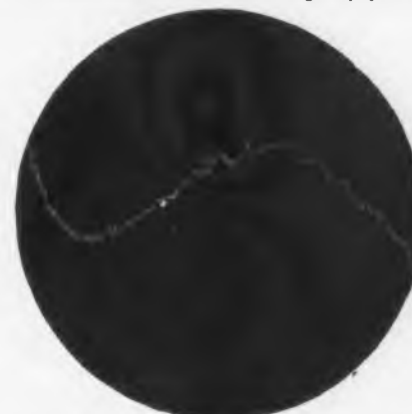


Fig. 4—Shows oscillographic record of the sinusoidal output of the pickup at calibration



Fig. 6—Shows the use of modulated cathode ray beam for timing purposes. Three repeated readings are shown here

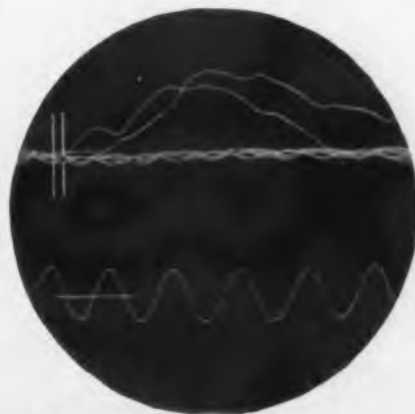


Fig. 8—Transmit time along nerve measured by double application of pulses

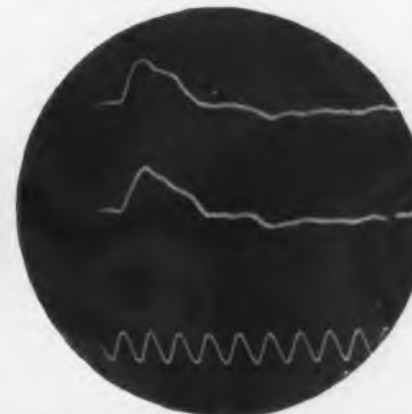


Fig. 7—Checks showing repeatability of records of nerve movements with artificial stimulation

PRODUCTION SHORT CUTS

More radio-electronic ideas, technics, and methods. Will one of them help you increase output, cut costs, improve employe morale?

● War Production Board Report gives much of credit for this year's increased output of radio-electronic products to suggestions and ideas the workers have made, usually through the local labor-management committees. The overwhelming response to the request for suggestions on doing a better job has been gratifying in most plants. It isn't hard for the average radio plant worker to evolve a new method or short cut, once he's given the green light to do his own independent thinking and has been told his ideas will be rewarded with a war bond or a percentage of the savings effected.

Magnetic wrench

It's an old wrinkle to magnetize a screwdriver. There are many screw-holding screwdrivers on the market. However, applying the same idea to a socket wrench for hard-to-get-at steel nuts and lock-washers seems to have been generally overlooked. J. R. Steen, of Harvey - Wells Communications, Inc., Southbridge, Mass., suggests one method of magnetizing: "Take

your socket wrench, ordinary or spin-type, wind a dozen turns of insulated wire around it, and touch the ends to a storage battery. One touch makes it strong enough to hold both nut and lock-washer."

Saving stock and time

Too often, little jobs are still being done the hard way, consuming valuable material and too much man and machine time. For example, as originally set up for a screw machine operation, a shaft for a radio dial was machined from a 3/4-in. stainless steel rod. By making the piece from two different diameters of stock, then pressing together and riveting, 2,754 hours on the screw machines and 2,970 pounds of stainless steel have so far been saved.

Cutbacks vs. employe morale

When a government contract is not renewed, several things are likely to happen. Inaccurate rumors may spread among the workers. The labor forces in departments not actually affected by the

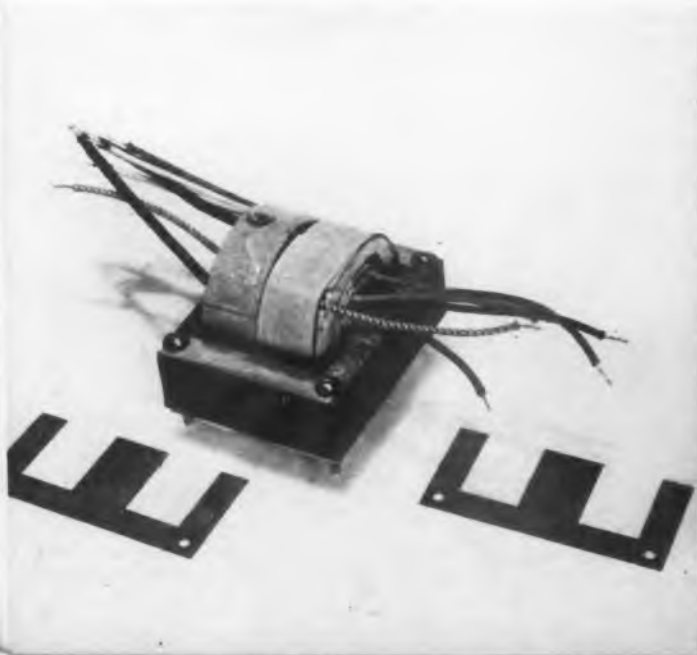
cutback will feel that the "squeeze" is off, and production may suffer. General employe morale may turn into general insecurity. One effective way to combat such evils, according to the Kollsman Division of the Square D Co., Elmhurst, N. Y., is to take the matter up before it happens, with the labor-management committee leaders, including the president and other officers of the union local. With the right kind of cooperative understanding formed in advance, cutbacks can be taken in stride, working hours can be reduced in an equitable manner, and there won't be any hard feelings left over.

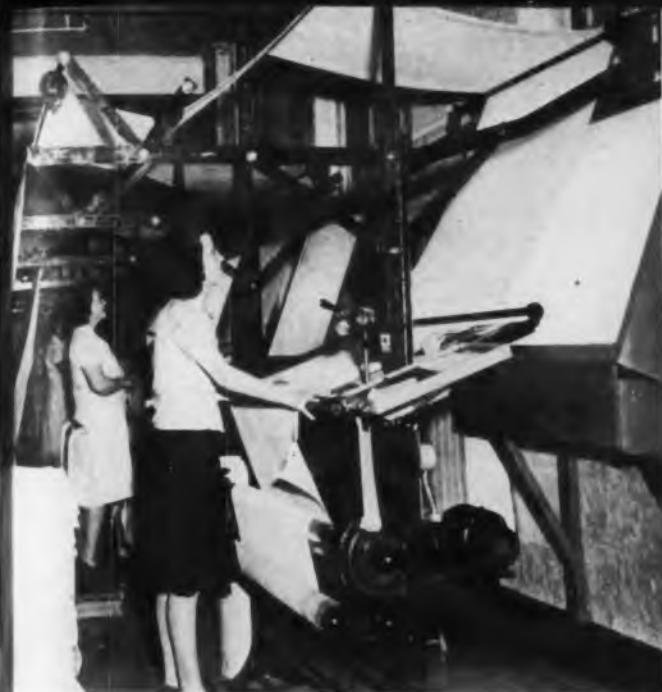
Summer labor source

With the vacation season upon us, thousands of public school and college instructors, as well as the students, are resting on their laurels. John Meck Industries, Plymouth, Indiana, have tapped this teacher supply for a training program for new recruits in soldering, assembling, and wiring cabling. Other plants have put vacationing teachers on production-line work.

1. GOOD, HARD LOOK at what you are doing may reveal that you are doing it "better" than need be. At RCA, Camden, N. J., this transformer was built up of laminations .007-in. thick. Suggestion to double thickness, halve labor, was tried. Result: transformer with .014-in. laminations easily passed all military specs

2. JIGS AND FIXTURES—are you using them wherever practicable? This jig at the Crosley Corporation, Cincinnati, Ohio, appreciably increases one girl's output. Sockets are first located, then fastened to chassis with help of "electric wrench" visible (on counterbalanced support) at upper left in the photograph





3. "TRANSLIGHTING" is the best inspection method for most translucent materials. Here, box at right holds 320 watts of fluorescents under sheet of opal glass, speeding cloth inspection in a New Hampshire mill 20 to 25 per cent. This special fixture (Sylvania type T-1) or a similar model might be useful in several radio-parts lines

4. XMAS TREE at upper right is strictly functional. Devised at Bendix Aviation Corp., North Hollywood, this generator test-stand gives a four-hour workout to Gibson Girl transmitter power supplies. On swivel base, the stand provides friction-drive takeoff from a central, revolving shaft. Each test cradle is provided with indicator lamp across the load resistor for quick indication of trouble or lack of output

5. ADD BOILING WATER. Tung-Sol, Newark, N. J., solved problem of frequent tube rejects due to internal leakage paths caused by dirt, dust, or lint, by sloshing all tube mounts in boiling running water before sealing and evacuating. Latest method includes automatic conveyor belts to wash-stand and into drying oven.

6. (!)g I SCREWDRIVERS have a way of disappearing every time they're put down. Housewife-worker at Douglas Aircraft, brought this clever idea right from her sewing basket. The small screwdriver she constantly needs on her job was fashioned into a thimble (insert at upper right) so the tool is always on the job





Fig. 1—Compress for compressing cotton for shipment. Densities as high as 35 lbs./cu. ft. are produced equal to that of the heaviest pine lumber

BALING PRESS RECORDER

by WALDO H. KLIEVER*

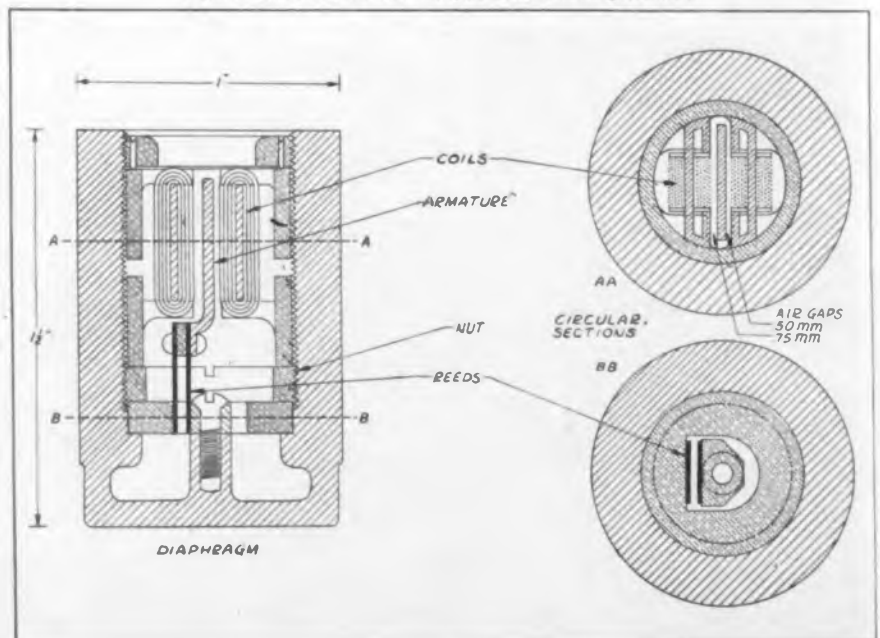
● In the high density compression of cotton baled for shipping, cuts frequently developed in the bales to an extent warranting the careful investigations conducted by the Agricultural Marketing Service, U. S. Department of Agriculture.¹ The instrument described here was built in 1939 at the U. S. Ginning Laboratory and has been used quite effectively for research on cotton packaging at the Ginning Laboratory since. It was found that uneven packing of the bale, with resultant concentrations in pressure, was responsible for the cutting. It was necessary to measure pressure simultaneously at six points of a compress platen, such as that shown in Fig. 1.

After considering various possibilities, including hydraulic methods, an electrical method appeared advantageous. Electric wires connecting the control units to the meter element give the greatest flexibility in setting up the equipment in various locations and elec-

tric outputs are readily adaptable to recording. The recording of the curves is practically a necessity because of the fact that on most commercial steam compresses, the pressure varies too rapidly to permit any one observer to read simultaneous pressures on six elements.

The requirements for the design of a pressure unit for this service were very restrictive, especially as to size, to permit its use in any of the tie-channels of a standard commercial compress, so that no modification of the press would be required. This placed the maxi-

Fig. 2—Cross-section views of pressure-measuring element



*Engineer-Physicist with U. S. Cotton Ginning Laboratory, Stoneville, Miss., at the time of the work reported here. Now Chief Physicist, Aeronautical Division of Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

¹By Francis L. Gerdes, Director, and Messrs. George Gaus, Charles S. Shaw, and Arvid Johnson, in cooperation with members of the Bureau of Agricultural Chemistry and Engineering, under the direction of Mr. Charles A. Bennett.

imum external dimensions at 1-in. diameter and 1½-in. length. The element was made round as shown in Fig. 2, for convenience in machining the element itself and the holders which could be applied to the presses of the Laboratory or in the field.

The elementary circuit of the pressure recorder contains essentially two magnet coils in the pressure element and the center-tapped primary of a push-pull transformer connected as an impedance bridge, as shown in Fig. 3b. The cotton pressure causes deflection of an iron armature between the reactance coils, changing their air gaps and consequently their magnetic reluctance. This disturbs the balance of the circuit, and the resultant current flowing in the transformer secondary is calibrated in pressure units.²

The pressure element has a single-piece body of tool steel turned as indicated in the cross-section in Fig. 2. The closed end and part of the adjacent sides are 1/10 in. thick, and serve as a diaphragm. All the other parts of the element are contained on the inside of this body in an opening 5/8 in. in diameter.

The armature of transformer iron is moved by means of reeds of phosphor bronze .011 in. thick (No. 30 gage) and .25 in. wide, seen from the edge in Fig. 2. One reed is soldered to a brass block attached by means of a 3/48 screw to the center of the diaphragm; the other

reed is soldered to a brass disk which is screwed down by means of a ring or nut to a shoulder in the stationary part of the pressure element. The opposite end of each reed is riveted and soldered to the armature.

When one reed is moved parallel to its length, the relative shifting causes them to bend, and the armature moves approximately as if it were mounted on a pivot at a distance from the end equal to its length plus half the length of the reed and actuated by a lever of length equal to the separation of the reeds. The ratio of these distances has been made equal to about 20. The use of reeds obviates the need for pivots, with their small parts, and resultant friction and backlash. The coils are wound with 400 turns of No. 40 enamel wire on cores of transformer iron shaped and bent as shown in Fig. 2, section AA. Forms for winding were made by wrapping the iron with thin paper and cementing ends of Bristol board with cellulose acetate. The ends of the No. 40 wire were attached to No. 36 DCC wire leads, and the entire coil and reeds dipped in insulating varnish. The varnish was then scraped from the clamp and pole faces.

The coils are clamped in place by two brass disks cut out to clear the armature and coil and pressed together against the core pieces by four 0/80 headless screws in a threaded nut. Small pieces of lead-foil are placed between the cores and clamp rings to produce uniform clamping pressure. The shielded lead wires from the pressure element are held in a small strap

clamp attached to the outer brass nut, and the leads from the coils are soldered to these wires in such a way that no strain on the coils can result from a pull on the external lead wires. Three conductors are required as shown in the circuit diagrams, Fig. 3, and they are contained in a shielded cable with shield grounded to the element body. About 18 in. of cable, ending in three telephone tips, are attached to the pressure element. Connection is then made by tip jacks and microphone plugs and sockets through 30 ft. of shielded cable to the control and reading unit.

Before clamping the coils in place, thickness gages were placed between the coil faces and armature, of a thickness of .050 millimeters, on that side in which the air gap increases with pressure, and .075 millimeters on the other side, these dimensions being as shown in the diagram. The coils were pressed against the thickness gages and armature, and the thickness gages were removed after the coils were clamped. In this way the air gaps are very simply standardized without the need for complicated adjustments and without requiring that the armature be perfectly centered with the meter, as this latter requirement was found to be rather difficult to meet.

The diaphragm deflects about .01 mm. (.0004 in.) for a pressure of 2,000 lbs. per square inch against the diaphragm, which is the full scale reading for which the instrument has been calibrated. The corresponding armature tip motion is about .2 mm. (.008 in.). The inductances of the coils average

²A variable-reluctance strain gage is described by Rusler and Mershon: *Electrical Engineering* 57 645-648, (1938).

Fig. 3—Electrical circuit of pressure recorder

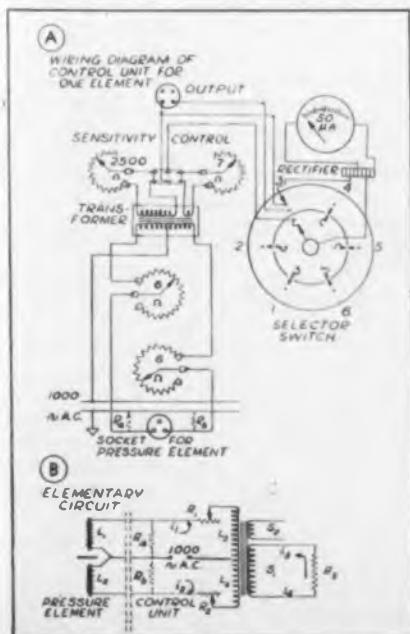


Fig. 4—Power supply unit showing 1,000-cycle tuning fork, lamp lenses, photoelectric cell, amplifier, and driving magnet. Form-fitting covers normally enclose the fork and optical system





Fig. 5—Cotton pressure recorder complete with chassis. The control and reading unit stands on the main table, with the power supply underneath, and the oscillograph on the shelf at the top. Provision is made for winding the leads to the measuring elements so that all of the instruments remain properly connected during transportation. One pressure element in V-block on lower shelf

about .006 henries, and the coil resistances about 25 ohms. Steel V-block adapters are provided for holding the pressure elements in the tie channels of commercial compresses.

The control panel and reading unit are visible in Fig. 5. It contains push-pull transformers for six pressure elements, sockets for the latter and for output circuits, rheostats, a voltmeter for the 1,000-cycle alternating current input, and a 50-microampere meter calibrated directly in pounds per square inch.

The center-tapped primary of a transformer (Fig. 3) is electrostatically shielded from the two secondary windings. Output readings are obtained on a high resistance, built-in microammeter with copper oxide rectifier, or on an external instrument of either high or low impedance. The primary has 200 turns with 1-ohm dc resistance; secondary No. 1 has 900 turns and 15-ohm dc resistance; secondary No. 2 has 45 turns and .07 ohm dc

resistance. A DPDT switch connects either secondary to the microammeter or output. Rheostats are provided in series with each secondary for the purpose of calibration.

A multiple contact closed circuit switch connects any pressure element, from any coupling socket, to the microammeter, at the same time disconnecting it from the output socket. This switch connects a meter into one circuit while leaving the other circuits closed, and is wired as shown in Fig. 3a.

The small size of the coils in the pressure element and their consequent small time constant, about .0002 second, make it necessary to use an alternating current for the bridge of a frequency higher than 60, and a 1,000-cycle power supply has been built for this purpose, as shown in Fig. 4. The construction and wiring of the circuit was considerably simplified by using a small factory-built, four-stage amplifier.

The frequency standard is a 1,000-cycle tuning fork of Elinvar 9/16 in. wide and 5/16 in. thick, with tines 2½ in. long. An unusual feature of this fork is the photoelectric pickup for the vibrations. The filament of a 6-volt pilot bulb is focused on a slit formed by one tine of the fork and a stationary knife edge. A lens at the slit images the first condenser on the photoelectric cell cathode. The vibration of the fork modulates the light beam intensity and the cell is connected to the input of the amplifier, which also supplies cell voltage. A cylindrical housing with a small opening to allow the light to pass, protects the fork from thermal effects due to the lamp. Other coverings enclose and shield the photoelectric cell, lamp, lenses, etc.

Following the first stage of amplification, an additional stage of amplification drives the magnet which maintains the fork. This magnet is placed at the end of the fork with poles between the tines, in such a way that the magnetic flux passes only through the end of the fork tines and not through the main body of the fork.

Another circuit following the first stage of amplification has two additional stages to supply 5 to 8 watts through an output transformer to the pressure meter. Thus the fork vibration is made independent of the output load. A capacitor in parallel with the driving magnet increases the efficiency of the drive and brings the magnetic current more nearly in phase with the vibration of the fork. Adjustment of the output is obtained by a volume control between the first and second stages driving the magnet and a rheostat control for the lamp. The fork and its optical accessories and driving magnet are mounted on a small chassis which attaches directly to the amplifier. Direct current for the lamp is obtained from a transformer and copper oxide rectifier with a large inductance between the rectifier and lamp to filter the lamp current. The complete power supply is mounted on rubber in a perforated carrying case shown in the lower part of Fig. 5. It is necessary to mount the fork and optical parts very securely, because any parasitic mechanical vibrations cause distortion and variations in output voltage.

As pressure is applied it will be assumed that the armature moves proportional to the pressure, the air gaps in one magnet decreasing with an increase in its inductance (L_1); the air gaps in the other increase, with a decrease in inductance (L_2). If in the pressure element, the magnetic reluctance is considered to exist principally in the air gaps between the coil and

armature, then the magnetic flux through each coil and its inductance are approximately inversely proportional to the combined length of the air gaps for that coil and can be expressed by

$$i_1 = \frac{p}{k_1 + kp} = \frac{k}{k_1 + kp} \quad (1)$$

$$i_2 = \frac{p}{k_2 + kp} = \frac{k}{k_2 + kp}$$

Here it is assumed in the second expression that the pressure is measured from the point where both air gaps are equal to X and the inductances both equal ωL , and that p is the pressure and k is the proportionality constant between the armature movement and pressure. Using the symbols indicated in the diagram Fig. 3b, and using Kirchhoff's law for closed circuits we can write the following equations for the three circuits:

$$\begin{aligned} (Z_1 + i_1) i_1 - m i_2 - m i_3 &= E \\ -m i_1 + (Z_2 + i_2) i_2 + m i_3 &= 0 \\ -m i_1 + m i_2 + (Z_3 + i_3) i_3 &= 0 \quad (2) \end{aligned}$$

where $i_3 = j\omega L_3$, $i_1 = j\omega L_1$, and $m = j\omega M$, etc.

The solution of this gives us for the value of i_3

$$i_3 = \frac{E(Z_1 + i_1)(Z_2 + i_2) - m^2 i_1 i_2}{Z_1 Z_2 + i_1 Z_2 + i_2 Z_1 - 2m^2} \quad (3)$$

In order to simplify this expression, we will assume 100 per cent coupling of the transformer and symmetry in the two parts of the transformer secondary, we can then substitute the following conditions:

$$Z_1 = Z_2 = Z$$

and

$$i_1 = i_2 = i$$

Then

$$i_3 = \frac{E(Z + i_3)}{Z^2 + i_3 Z - 2m^2} \quad (4)$$

A vector diagram for the potentials around the circuit Fig. 3b (i.e., the output circuit in which i_3 flows) is shown in Fig. 6b. Equation (4) shows that the value of i_3 is very nearly proportional to the difference in the inductances L_1 and L_2 near the balance point where for equal increases and decreases in Z_1 and Z_2 respectively the denominator remains approximately constant. The curve in Fig. 7 was computed from equation (4). The proportionality holds fairly well for changes in air gap up to 30 per cent and we take further advantage of this, as noted previously, by starting with one air gap larger than the other and passing through the point of equality.

These results are in agreement with the outputs of the bridge as measured on the oscillograph. This is over a range of 2,000 lb./sq.in. in which the air gap of L_1 changes from about .5 mm. to .75 mm. and the air gap of L_2 from .75 mm. to .5 mm. However, the characteris-

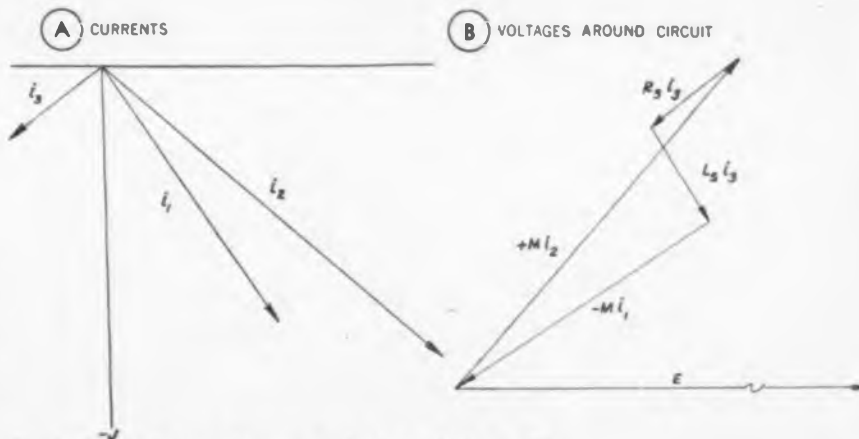


Fig. 6—Vector diagram of currents and voltages for $kp = .5X$

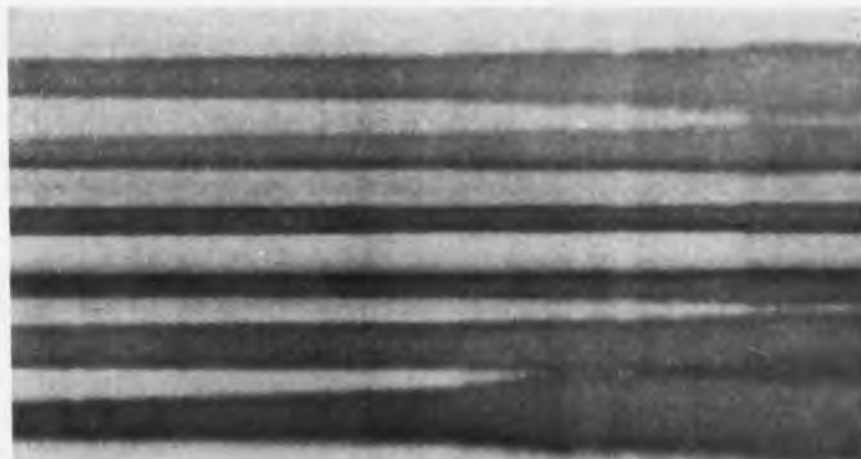


Fig. 8—Pressuregram showing pressures at various points of the compress platen during compression of a bale

tics of the copper oxide rectifier cause the pressure scale on the microammeter to be badly contracted in the lower pressures. If a suitable electrodynamic instrument could be used, the scale would be much improved.

It is interesting to note that when the bridge is balanced the mutual inductance in coils L_2 and L_1 counteracts the self-inductances, and therefore, there is no voltage drop across the complete primary of the transformer except that due to resistance. This is obvious from the fact that when the bridge is

balanced there is no output in circuit 3; hence, there can be no magnetic flux set up in the transformer and, therefore, there can be no voltage drop due to inductance. Therefore, at balance most of the voltage drop E takes place across the coils of L_1 and L_2 . This characteristic of the circuit is conducive to good efficiency. At balance, therefore, the currents flowing in the two circuits of the bridge are almost entirely controlled by the inductances of the pressure element coils and the resistances of the circuit.

In balancing of the bridge, one rheostat is placed in each arm of the bridge, the two mounted on a common shaft so that the resistance of one is increased while the other is decreased. It was helpful in some cases to shunt one of the pressure element coils with a permanent small resistor as shown in dotted lines by R_1 and R_2 in Fig. 3b. This was done to improve the balance by bringing both phase and magnitude of the currents into coincidence. These auxiliary resistances have values around 2,000 ohms or larger and, therefore, do not affect the sensitivity or other characteristics appreciably.

(Continued on page 208)



Fig. 7—Curve showing output reading against pressure. The straight dotted line is introduced for comparison only

7000 HOURS EXPERIENCE

by HARRY R. LUBCKE

Director of Television, Don Lee Broadcasting System, Hollywood

Many new technics have grown out of pioneering West Coast station during the past 14 years of operation

● Television research using cathode ray tube methods was started by the Don Lee Broadcasting System in November, 1930, and by May 10, 1931, the first image from motion picture film was transmitted in the laboratory, from one side of the room to the other. On September 11, 1931, the construction permit for W6XAO was granted and the transmitter was on the air before December, using grid modulation and a frequency of 44.5 megacycles, making W6XAO one of the first, if not the first, television broadcasting station of the type known today to go on the air. A schedule of one hour daily, except

Sunday, from six to seven p.m., was inaugurated on Dec. 23, 1931.

By May, 1932, a self-synchronized cathode ray tube television receiver had been completed. This, it will be recalled, was in the days of the scanning disk receivers with their whirling disks and electric motors invariably connected to a common electric power system for synchronization. In order to demonstrate that the Don Lee receiver synchronized on incoming television energy alone, it was taken aloft and images were received from W6XAO while flying over the city of Los Angeles. This is believed to be the first observance of a televi-

sion image while traveling at the speed of airplane flight.¹

It was demonstrated that a cathode ray tube and its electronic circuits could withstand the shocks of takeoff, landing, and bumpy air. Varying field strength with flight was noted, something unknown at ordinary frequencies. The signal often varied from a small value to overload. Invariably the image remained in synchronization, indicating a high order of synchronization.

¹Lubcke, H. R., "Television Image Reception in an Airplane," Proceedings of the Institute of Radio Engineers, Vol. 20, No. 11, November, 1932.

W6XAO's radiator is atop a 200-foot tower on Mt. Lee, elevation of which is 1700 feet



Construction of the iconoscope camera used 1937 to 1940 for live studio shows. Case below the iconoscope contains a preamplifier using three acorn pentode tubes



in TELEVISION SERVICE

Soon after this work the W6XAO transmitter was developed to operate on 44.5, 49.4 and 66.75 mc, the latter being about the upper frequency limit of the transmitter, and this three-frequency schedule was inaugurated in August, 1932. The now well-known approach to rectilinear propagation as the frequency increased was determined and the desirability of using a "low" ultra-high frequency for television broadcasting established.

In April, 1933, eight representative video frequencies were transmitted successively at constant output, as determined by means of a linear rectifier associated with the transmitter. The receiver response was consequently its frequency characteristic.

It is submitted that similar frequency characteristic transmissions would be of value today. A triple purpose would be served: First, the need for servicing of a commercial television receiver would be evident; second, home constructors would have an opportunity to check the excellence of their product and

The 324 mc beam relay receiving antenna has 16 half wave elements in four groups



to take steps to improve it; third, the effects of multipath transmission at any location could be ascertained in relation to the video frequency characteristic and used as a means of interpreting and eliminating undesirable results.

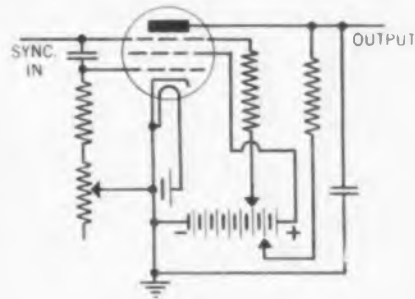
In 1934 an interesting device which we called our "single tube source" was perfected.^{2,3} It is a complete saw-tooth wave scanning device utilizing only one triple-grid vacuum tube. It has the unique property of working substantially at cut-off during the working cycle rather than at cathode current saturation. This allows a simplified receiver of low current drain to be built; the vacuum tube draws approximately half what it would when operating as a voltage amplifier. The middle grid has the highest potential in the system, the plate has approximately two-thirds this potential, while the third grid has somewhat over one-third of the highest potential. In the accompanying circuit diagram batteries have been shown but any voltage source may, of course, be used, such as the cathode-ray tube power supply itself. When this is used the single tube gives sufficient output to electrostatically deflect the electron beam for television purposes. In the operating cycle the current flows away from rather than to the third grid.

During 1935 considerable attention was given to ultra-high frequency propagation. The field-strength of W6XAO was determined up to distances of sixty miles. Some interesting readings were made on the apparent attenuation of California hills. In an ideal location in the Hollywood Hills, it was possible to set up test equipment both with a clear line of sight to the transmitter and with 180 ft. of sedimentary rock as an obstruction. Reflections from adjacent terrain were less than 1 per cent and diffraction was well-nigh impossible since the obstruction measurements were made in locations which would call for an 85 deg. diffraction angle.

Jones⁴ evolved an empirical equation for an attenuation constant for downtown New York buildings as follows:

$$a = \frac{\log_e \frac{E_1 R_1}{E_2 R_2}}{1/\lambda (S_2 - S_1)}$$

Substituting our California values in the above, a value of $a = 0.28$ was obtained. This is approxi-



"Single tube source" saw-tooth wave scanning device using single triple grid tube

mately ten times the average value found by Jones. Thus it can be generalized that sedimentary rock attenuates ultra-high frequency waves ten times as much as large city buildings.

Our receiver design had certain advantages not carried through by others in commercial receivers designed to operate in stronger field strengths. Multivibrator type scanning oscillators were used and the synchronization feed sufficiently filtered to reduce the effects of interference.

During 1938 and early 1939, a number of "deluxe" television receivers were constructed for the use of Don Lee executives. They included several innovations. A tuned radio frequency amplifier circuit was used which accepted both sight and sound carriers and tuned over several channels as well by inductance variation alone.^{5,6}

In the schematic circuit of the receiver, two or more radio frequency amplifier stages are used with the band-pass filter inductors just described to simultaneously amplify the sight and sound energy. The separation of the two is accomplished in a compound detector circuit. A diode detector fed from an inductively coupled band-pass filter passing sight energy is utilized for the visual channel, whereas a cathode output infinite-impedance high gain detector fed from a sharply tuned circuit (which is capacitatively coupled to the common circuit) transfers the

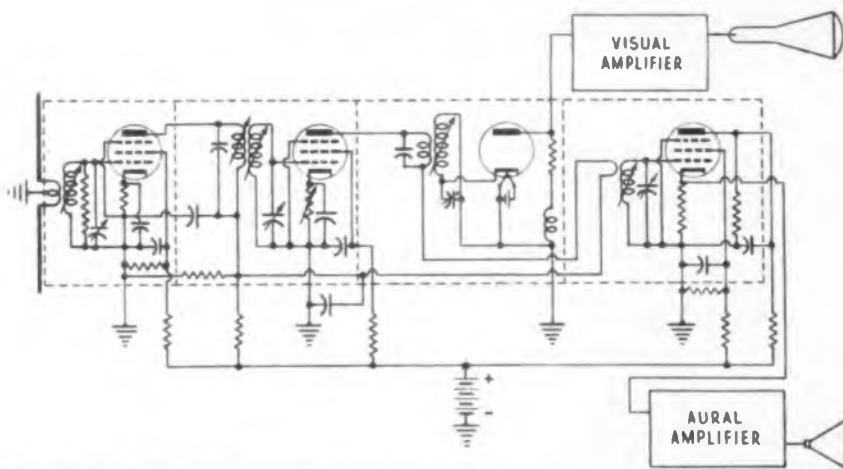
²U. S. patent 2,047,277, July 14, 1936, H. R. Lubcke, "Relaxation Oscillator."

³British patent 471,337, May 25, 1936, H. R. Lubcke, "Improvements in Thermionic Valve Relaxation Oscillation Generator Circuits."

⁴Jones, "Propagation of Wavelengths Between Three and Eight Meters," Proc. I.R.E., Vol. 21, No. 3, March, 1933.

⁵U. S. patent 2,240,849, May 6, 1941, H. R. Lubcke, "Band-Pass Filter."

⁶U. S. patent 2,282,487, May 12, 1942, H. R. Lubcke, "Television Receiver."



TRF television receiver using bandpass filters for separation of video and audio signal components, with permeability tuning used in the rf tuned circuits



The 25-watt 324 mc transmitter used for televising sports and other local events

The first unit built in 1939, is still in regular operation over W6XAO, having exhibited several million feet of motion picture film.

A portable television pickup equipment having a visual transmitter-receiver link operating on 324 megacycles was first put into operation in connection with the Pasadena Tournament of Roses Parade, January 1, 1940. The transmitting path was 9 miles with structures atop two hills in the line of sight. The transmitter having a peak power of 25 watts and the receiver gain reaching its inherent noise level the technical operations required unusual attention to antenna design and placement in order to secure the best results.

Although the day was overcast and rainy during the latter part of the parade, the image clarity was far greater than might have been expected. At 14 miles from the main W6XAO transmitter it was reported that the names on all floats and relatively small items of detail were discernible.

Here, for the first time, an empirical rule of portable television pickup work was discovered. It was found that each time the antenna height above the supporting structure was doubled the field strength at the receiver was doubled. This has been verified by a number of subsequent pickups, one as unusual as where the antenna was atop the wood roof of a seventy foot auditorium pointing away from the same and an increase of from 12 to 24 ft. in the mast height doubled the signal strength at the receiving location 7 miles away. In the present instance the antenna height at the transmitter, atop the Elks Building in Pasadena was successively increased from 12 to 43 feet and the receiving antenna from 12 to 100 ft. above the Don Lee Building in Los Angeles.

It is to be noted that these increases increase the length of feeder connecting the antenna to the transmitter or receiver, as the case may be. However, this loss is absorbed in the gain in height effect giving the linear ratio set forth. In our work the feeders have been two No. 12 B&S gage wires spaced two inches and supported every three feet by Victron insulators attached without metallic means.

During 1940, and the spring of 1941, the Mt. Lee television plant of the Don Lee Broadcasting System was planned, constructed and put into operation. Thus far, this is the largest, highest and perhaps most complete television plant in the country. Mount Lee, 2,000 ft. elevation at antenna top, is only 2½ miles airline from the heart of Hollywood. It is surrounded by greater Los Angeles and contiguous towns embracing a population of 2,000,000 persons in the direct service area.

The building and technical plant were especially designed and constructed with only television use in mind. The building is sheathed in copper, with the transmitter room again sheathed from the remainder of the building. It is one hundred ft. square and two stories high. Stage 1 is 100 ft. long, 60 ft. wide and 30 ft. high, exceeding in size some of the smaller sound stages in the Hollywood studios, and having the capacity of containing a regulation basketball, tennis, volleyball, badminton or similar sport as well as providing ample room for multiple life-size and miniature sets. Stage 2 is 46 ft. long, 26 ft. wide and 16 ft. high. This is sufficiently large for many types of television programs, although in the Mt. Lee plant its function is to provide a second stage so that continuous live television may be produced.

Monitor rooms, one for each stage, are located on a mezzanine floor between the stages, affording an unobstructed view thereof. A properties storage room is below and a 45 foot square transmitter room above. Complete facilities for handling all technical and program problems are provided.

The building is equipped with a 900 kva substation which brings 4600 volt power to the premises and distributes it through generous raceways and conduits for adequate lighting and equipment power needs. Three-phase lighting circuits are provided to eliminate any artificial illumination flicker.

The visual antenna is of unusual design in that it gives a gain of six over the standard dipole and provides a uniform pass band over

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sound energy to the aural channel.

This technic evolved lends itself to the design of inexpensive television receivers postwar. The sensitivity of these receivers equals that of contemporary twelve inch commercial television receivers. The receivers utilize multivibrator type sweep circuits coupled through push-pull amplifiers to an electrostatically deflected cathode ray tube of twelve or fourteen inch size. Some receivers were built for direct viewing, others for indirect.

In 1939, a new continuous-intermittent type of motion picture film projector for television was developed.⁷ This device employs a rapid pull-down of the film, a translucent shutter and operation of a storage-type camera tube in a manner which integrates the picture impressions to give a continuous projection effect with intermittent film motion. Once the proper light and electrical values have been established by design the operation of the device is simple and reliable.

⁷U. S. patent 2,288,096, June 30, 1942, H. Lubcke, W. Brown and W. Klein, "Television Film Projector."

TROPICALIZING PROBLEMS

Study of the effect of moisture and fungus growth in radio reveals importance of choice of metals and their finishes

● The necessity for moisture-proofing and fungus-proofing radio and electronic parts, especially those intended for the Southwest Pacific war theater, has become one of the most important problems confronting manufacturers of military equipment. In the case of radio equipment, temperature, humidity, corrosion-proofing, and tropicalization against active fungus growths, the prescribed methods must not only prevent corrosion and physical surface changes but also the electrical characteristic must remain unaltered.

In order to forestall delays in production necessitated by research in these problems, most of which are entirely new ones for the designer and processor, the P. R. Mallory Co. have organized a cooperative standardization program among manufacturers and published a booklet from which these facts are abstracted and which gives the result of tests and experience on a wide variety of radio circuit components. The knowledge thus gained is of value to radio equipment producers in the selection of the proper finishes to meet any service, either in purchased components or those fabricated and assembled in their own lines.

In order to get started quickly on the testing of anti-fungus treated materials and parts, the bacteriological laboratory of Butler University, in Indianapolis, was engaged to carry out the research. Two types of fungi, *Aspergillus Niger* and *Chaetomium Glogosum* were obtained from the American type culture collection maintained by the Georgetown University. Exhaustive tests were conducted on various materials. The tests indicated that fibre, hard rubber, cotton-covered wire (waxed) and practically all grades of bakelite will support the growth of fungus. It was also found that porous materials such as unglazed ceramics readily support the growth of fungus.

Many different types of commercially available fungus-resistant coatings have been tested, in accordance with the Signal Corps Specification No. 71-22202A, in an effort to determine the resistant coating material best suited for a

given application. It has been found through experiment that there is much more to obtaining a fungus-resisting coating than merely using an approved fungicidal varnish. There are definite technics involved in the application of the coating material that are just as important as the coating itself. Many methods of treating were tried on the various types of materials used in Mallory switches and other components, and their effectiveness tabulated.

It is practically impossible to construct a component in such a manner that there will be no visible discoloration of surfaces at the end of the salt spray test. It is necessary, therefore, to disregard appearance unless corrosion is excessive, and judge the unit in the light of its ability to function mechanically and electrically.

In the assembly of such a component as a switch, jack or variable resistor, the design often requires the use of dissimilar metals in contact with one another. When wet with salt solution these dissimilar metals, which individually would withstand the salt spray test with-

out showing corrosion, constitute a battery. The galvanic action which occurs may cause one of the metals to corrode at the expense of the other. It is possible to so choose the metals in contact with one another as to reduce the tendency of electrolytic corrosion to such a point that satisfactory performance is obtained. Unless all parts are of the same metal, plated with the same metal, or protected by the application of Glyptal or lacquer, some evidence of electrolytic corrosion will be evident after salt spray test.

Some pertinent facts regarding the use of stainless steels have been noted: The "stainless" properties of these steels are due to a very thin invisible film or skin of oxide which completely covers the part and prevents further oxidation. A freshly machined or punched part will eventually acquire this film by contact with the atmosphere. A stronger and better film can be produced quickly by dipping the parts in a solution of nitric acid. This process is known as passivation.

(Continued on page 200)

This Signal Corps photo, made from an abandoned Japanese pillbox somewhere in New Guinea, indicates the conditions under which military communications equipment must be used



DEFINITE POSTWAR PLAN

Industry and WPB must soon agree on blueprint for orderly transition from war to civilian production

by Paul Galvin

● Tracing the history of the Radio Manufacturers Association back to that day in 1924 when the original group of nine manufacturers formed the "Associated Radio Manufacturers," President Paul V. Galvin made a strong plea for (1) an orderly transition from war to civilian production; (2) talk in the terms of "improved radio" rather than revolutionary radio; (3) elimination of all attempts to gag the television industry with monopolistic patent control.

"We all know that some day we will go back to civilian production," he said, in addressing the 20th annual meeting of RMA in Chicago June 6 and 7, "and when we resume civilian production we will then take on just as important a responsibility to our civilian economy as we now bear to our war economy. Up to now, the industry has done very little postwar planning. We have been too busy with our war job. I think we can again take our cue from President Roosevelt, who has made some recent public utterances pointing up postwar planning. I can see where we can do some work in this direction without being distracted from our war job.

"Although it does not seem likely that we will be shipping any civilian radio sets until some time in 1945, nevertheless, I think it is well in order that the industry, in conjunction with officials of WPB, work out an orderly program setting forth just how the WPB Limitation Order will be altered—after the German war has been concluded—permitting our re-entry into some civilian production while we are still continuing our military production requirement for the Japanese war. We all know this will result in some form of an allocation. It will be "X" numbers of sets in total that will be allocated to be built by "Y" numbers of manufacturers, starting on "Z" day.

"The development of such a program is not only important to the industry, but it is important to the public. A lot of detailed work is involved and a lot of policy determination must be resolved. The parts and tube manufacturers have a real problem of planning to properly integrate war and civilian

production. It is therefore of the greatest importance that they have factual information from set manufacturers. This is only possible after we have a program.

"I think the time is at hand when we and WPB should institute specific activity which will complete the plans so that we will have this program determined and thoroughly understood by all the parties in the industry, the services, and WPB. Then we can enter into our civilian activity without the confusion we will certainly have if we let this go too long and act too late.

"We in the radio industry know that when we resume civilian production of radio sets we are not going to put out any fantastic gadgets—we are going to have a set with improved tubes, improved components, circuit modification—but the fundamentals will be the same. We must be very sure that this is what the buying public expects. Let's think and talk in terms of 'improved radio.'

Electronic discoveries

"The application of most of the discoveries made in connection with our secret devices will be related to industry, transportation, and medicine. These electronic discoveries will revolutionize navigation and control in land, air and sea travel.

"Television, of course, is in the back of the minds of all of us, and some day we will have another industry as big or bigger than the radio industry.

"It is quite reasonable for us in the radio manufacturing business to assume that we will be the ones who will develop, produce and merchandise television sets. There is some variance of opinion as to just when and how television will take hold after the war. This is no time to pre-judge the situation.

"A very orderly effort is in process for a thorough technical appraisal. A study is in progress by the Radio Technical Planning Board to develop facts as to if, and to what degree, and when any alterations should be made in the television systems standard and/or

television frequency allocation we now have. I believe proper technical appraisals will be made in due time, and sober consideration will be given to this entire problem by the FCC.

"FM is going to be in the picture in postwar radio. FM has a lot of merit, and will play a very important part as a factor in postwar radio merchandising. Out of television and FM will arise new patent situations in our industry which look very cloudy at this time—particularly those involving television; and no one has the solution.

"I don't believe it is out of order to sound a warning from the industry to anybody or anybodies to whom it might apply. We in the industry will not tolerate any attempts to gag our industry with monopolistic patent control of television. In the interest of the public and the industry, the television patent situation must be resolved with long-view forethought and common sense. There is no

MANUFACTURERS ELEVATED

● Winding up their Third War Production Conference and their 20th Annual Membership Meeting in Chicago June 7 after two days of committee meetings, members of the Radio Manufacturers Association elevated Raymond C. Cosgrove, vice-president and a director of the Crosley Corp., Cincinnati, to the presidency, seated more than 1650 people at the final luncheon.

Mr. Cosgrove, who has been chairman of the Set Division of the Executive Committee, will have associated with him as vice-presidents: E. A. Nicholas (Farnsworth), David T. Schultz (Raytheon), Walter A. Evans (Westinghouse), Robert C. Sprague and Thomas A. White (Jensen). Bond Geddes was re-elected executive vice-president, general manager and secretary; Leslie F. Muter remains treasurer. Directors elected were: Set Division—Frank Folsom (RCA-Victor), Herbert Bell (Packard-Bell), Joseph Gerl (Sonora). Tube Division—R. E. Carlson (Tung-Sol), Fred Lack (Western Electric), Transmitter Division—George E. Lewis (Federal Telephone and Radio). Parts Division—Monte Cohen (Sickles), Ernest Searing (IRC), Samuel Cole (Aerovox).

At a business session, the Board

Urged at RMA CONFERENCE



Paul Galvin turns over to Raymond C. Cosgrove the gavel emblematic of RMA presidency

monopoly on brains and research, and the radio industry has a lot of both, along with stout vigor in top management."

OSGROVE TO PRESIDENCY

of Directors authorized the appropriation of a \$5,000 fund for a series of tests on the problems arising from automobile interference with television and Frequency Modulation reception. The tests will be conducted jointly by the RMA and the Society of Automotive Engineers, which then will recommend ways of eliminating such interference.

On the problem of reconversion of radio industry plants from war to peace production, the board recommended appointment of a committee of five to develop an industry plan for submission to the radio and radar industry advisory committee of the War Production Board. The five are Chairman A. S. Wells, E. A. Nicholas, Max F. Balcom, P. L. Schoenen, and Fred D. Williams.

A program for the future offered by the employment and personnel committee, under the chairmanship of A. H. Gardner, was approved by the board to cover questions of reemployment of veterans, layoffs and seniority, job classifications, labor legislation, sick benefits, pensions, recreation, and incentive pay. The board authorized a \$25,000 subscription to the Fifth War Loan.

Two billion war job, with half billion not yet in initial production, still major operation for '44

by Major General Wm. H. Harrison

● Although today the United States armies all are adequately equipped with the most modern signal equipment—"equipment that outstrips that of the enemies' in dependability, flexibility, range, resolution and general performance"—the immediate production job is far from done, emphasized Major General W. H. Harrison.

"You know our 1944 program totals more than 3 billion dollars—about 25 percent greater than 1943. For the five months—with 40 percent of the year elapsed 40 percent of the program has been completed. The monthly trend of production takes a definite pattern—for the first six months of last year—levelled off at 175 million dollars—for the last six months a sharp—steady increase to a level of 280 million—where, with slight changes, it has been for the past five months, and where, in all likelihood, it will remain through the balance of the year.

"While the overall program has levelled off, there is a marked shift within the various classes of equipment—certain airborne types rapidly expanding, with sharp contraction in other air and ground requirements.

"Significant in this, is the fact that roughly one-half a billion dollars of the year's requirements are involved in items not yet in initial production. So that while the figures have levelled off—the complexities continue to multiply.

Requirements in '45

"So much for 1944. 1945 presents a different picture—the pattern is anything but clear. Procurement plans must be on the basis of a continuation of the war in all theaters. This basis in itself is uncertain. Barring the blessing of early victory, our best picture of first half 1945 is a level of production some 15 to 20 per cent under present going rate. I would rather not hazard any guess as to the level the last half of 1945. Even a prediction might be misleading.

"Before the turn of the year is reached, initial issue of equipment to combat units broadly should have been completed—these re-

quirements have been stable—could be calculated with some degree of reasonableness as to time and volume. After initial issue, requirements are for maintenance and for combat losses—these are difficult to predict. On the whole, I think the present figures are on the high side. My view is that experience will point to reduction rather than increases.

"You need no reminder that the immediate production job is far from done. Two billion yet to produce in 1944 is quite a job—it is still more exacting when you consider nearly a half billion is not yet in initial production.

"In addition to the overall situation, we need immediate help on certain specific matters. Here they are: Tropicalization treatment is essential—water proofing is essential—technical manuals are essential—water-proof and shock-proof packing is essential—Signal Corps stock numbers for replacement parts are essential."

Contract Termination Problems Being Solved

by Col. Wm. M. Mack

● Contract termination matters are moving along much more smoothly now than they have in the past, reported Colonel Wm. M. Mack, and will move even more smoothly, and more quickly, in the future. Since Pearl Harbor, he pointed out, "the contract cost of items cancelled by the Signal Corps is approximately one-half billion dollars."

"The first official score keeping was in July, 1943," he said, "at which time we determined that since Pearl Harbor, the Signal Corps had had occasion to terminate in whole or in part seventy-three contracts of which three had been rescinded following termination, making a net total for the period from December 7, 1941, until July 1, 1943, of seventy.

"The contract cost of the items cancelled of these seventy cases amounted approximately to fifty

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TUBES ON THE JOB

Partly-Filled Tin Cans Detected by PE-Tube

Recent research has developed a number of new PE-cell applications, but wartime restrictions make most of them confidential. A good many PE cells, for example, are going into gunnery trainers, air trainers, etc., details of which cannot be released at present.

"A rather interesting application," reports R. E. Smiley of Continental Electric Co., Geneva, Ill., "involves determination of the contents of cans in a fish cannery. It seems that this fish cannery had quite a bit of trouble in that every so often a can would be only half or three-quarters full and would get out for distribution. The only way they could catch these cans would be to weigh every can, which would be too laborious.

"It was found, however, that that part of the can which did not contain fish would oxidize severely when put through the boiler. A PE-cell equipment was set up which operated on the basis of reflected light. Obviously, those cans which were partially or entirely oxidized reflected substantially less light, and by means of the PE-cell equipment these partly-filled cans were automatically kicked off the conveyor belt.

Thickness-Gage without Contact

In accepting the Franklin Medal of the Franklin Institute, Dr. W. D. Coolidge, director of the General Electric Laboratories, said:

"X-rays may be used as a thickness gage without the necessity of making mechanical contact with the work, as, for example, in the rolling of sheet steel where the sheet metal may be coming through the mill at the rate of over twenty miles an hour and at temperatures up to 2,000 degrees F, and where through adjustment of the mill, the thickness of the sheet must be kept within certain narrow limits."

Industrial Applications for Television—Beal

Potentialities of television as a new and effective aid in industry after the war were outlined by Ralph R. Beal, of RCA Laboratories, Princeton, N. J., to members of the Engineering Society of Detroit.

Mr. Beal envisioned television as the coming "eyes" of factories, the "means of coordinating activities in giant manufacturing plants, such as those in Detroit, and the means also of peering into places and situations that might be inaccessible or extremely hazardous to man."

Mr. Beal said that those like himself who are close to television foresee the day after fighting ceases when this type of television application may be in "wide" use.

"We know now," the research engineer declared, "how it can be used to extend the eyesight of the plant manager to critical operations that ordinarily would require much time and effort to reach for personal inspection or which might even be inaccessible—how television can aid immeasurably in plant control.

Factory process aids

"Television cameras at strategic points can be connected by wire to receivers where production experts, foremen and supervisors can follow the flow of fabricated or raw materials and watch the progress of the work. Such set-ups will be particularly valuable in mass-production assembly lines, and they may be extended to include loading platforms and shipping rooms."

According to Mr. Beal, television cameras may be used in connection with chemical reaction chambers, making visible to the operator without personal risk the chain of events occurring in complicated

chemical production units, and thus enable him to control the process with optimum results. He said specially-built cameras may be used in furnaces to observe steps in the formation of alloys, and others may solve vital problems of analysis in important industrial processes.

"In addition," Mr. Beal declared, "television equipment may facilitate port movements of ships. The cameras located fore and aft, and on port and starboard sides of vessels, could lessen the hazards of docking and insure safety in crowded shipping lanes.

"We likewise foresee the use of television in metropolitan traffic control and along congested motor routes. Cameras may be installed permanently at busy intersections to flash to traffic headquarters running, up-to-the-minute picture accounts that should greatly aid traffic experts in easing congestion."

Mr. Beal said that it is "reasonable to assume" that television tubes and associated electronic devices together with photoelectric cells, may "facilitate increasingly the development of new industrial processes and methods seemingly far removed from the usual sphere of radio science."

The ultimate aim of RCA in television is to match the perfection of the human eye, Mr. Beal said, and added: "The significance of that is obvious. We hope, in years to come, not only to televise the world's still life and action in three-dimensional views, but to transmit scenes in their exact color."

Police Radio "Shock Test"



Driver of this Mission State Patrol car, wrecked 40 miles from headquarters, "came to" to find car on its side with all doors jammed. Despite that fact that the Motorola two-way FM radio equipment was torn from its mounting and the car's antenna lay flat against the body, the set made contact with the headquarters station and promptly brought rescuers to the scene

WHAT'S NEW

Devices, products and materials the manufacturers offer

Grid Control Tube

Continental Electric Co., Geneva, Ill., has added the CE-306, which is a gas-filled grid control tube or thyratron designed to give high efficiency with a long life. It is rated at 6 amperes continuous load. Peak forward volts (max.) 750; peak inverse volts (max.) 1250. Mechanical dimensions: height 9½, diameter 2 in. The tube is designed for general industrial electronic use, such as motor control for various uses, resistance welder control, controlled rectifiers, etc.

Portable Disk Recorder

A new model portable recorder and reproducer (Model C-7) has been developed by Memovox, Inc., Beverly Hills, Calif. It records by the embossing process on 7-in. thin, plastic disks which will accept 15 minutes recording on each side. The equip-



ment, completely self-contained except for the microphone, weighs 87½ lb. and operates from any 115 volt 50-60 cycle source. The unit may be used for either individual or conference recording and provision is made to connect two instruments together to provide for continuous recording. An induction type pickup is supplied for recording both sides of telephone conversations. Recording and transcribing heads are crystal actuated and equipped with sapphire styli. Recordings may be monitored through head phones. A foot-operated control switch permits stopping and starting the unit and repeating any part of recordings.

Battery Connector

A new development in quick disconnect battery connectors particularly adapted to G-1 standard batteries conforming to AN-W-B-141 specifications has been designed by Cannon Electric Development Co., 3209 Humboldt St., Los Angeles. Based on the screw jack principle found in many Cannon connectors, this new fitting speeds removal of batteries and banishes shorting and fire hazards. The large handwheel which turns a gear and disengages the battery is notched and easily operated by a gloved hand in subzero temperatures. The pin contacts in the receptacle are so enclosed by its shell that the contacts cannot touch any outside metal surfaces during removal and hence will not short.

Receptacle No. 11749, also called the "Battery Kit" because it is affixed to the case, is made of aluminum alloy, finished with black acid-proof lacquer. The two pin contacts are leaded copper for 12-24 volt rating, 600 amperes continuous duty. The Plug No. 11751 shell material is molded phenolic, and the handwheel aluminum alloy, has an acid-proof black lacquer finish. Cable outlets of 5/8 in. diameter are on both ends of the connector, with possible alternate arrangements of cables, if desired.

Moderate Cost Oscilloscope

Those heretofore restricted in their oscillographic studies by the inadequate performance or the prohibitive cost of existing equipment will be especially interested in the new Type 248 oscilloscope just announced by Allen B. Du Mont Laboratories, Inc., Passaic, N. J. The designers claim that this instrument removes the obvious deficiencies in commercial test equipment performance as brought to light by recent advances in electronic equipment, and yet is made available at moderate cost.

Du Mont Type 248 oscilloscope and the power supply are connected by a 6-ft. plug-in shielded cable. A removable cover protects the oscilloscope panel when instrument is not in use. The power supply weighs 80 lbs.; oscilloscope, 30 lbs. Units each measure 14 x 18 x 21 in. deep. This instrument produces either transient or recurrent phenomena and also accommodates phenomena of inconstant repetition rate. Leading edge of short pulses is not obliterated. The accelerating potential applied to the cathode-ray tube is great enough to permit study of extremely short pulses with low repetition rates, usually observed only with specialized and costly oscillographic equipment. Timing markers are available for quantitative or calibration purposes.



Among features of this oscillograph are: wide band vertical axis amplifier usable to 10 mc. 4000 volts accelerating potential applied to cathode-ray tube, allowing observations of fast writing rate phenomena. Extremely flexible time base generator to display signals which heretofore required special sweep circuits. Delay network in vertical channel, permitting observation of entire wave shape of short-duration phenomena. Useful timing oscillator for quantitative analysis. Trigger output signal useful for "synchroscope" applications. Design is such that modifications to standard specs. can be accommodated to special order in the following respects: (1) Driven sweep durations; (2) Marker oscillator frequencies; and (3) Trigger pulse rates.

Fastener Stud

A new all-purpose fastener stud with an adjustable range of nearly one-half inch, and replaceable with all snap or spring type fasteners now in use, has been developed by Nigg Engineering Co., of Covina, Calif. The new fastener stud ac-




commodates total sheet thicknesses from .021 in. to .500 in., yet locks and unlocks with only a quarter turn. The adjustment is controlled by a central screw which moves a sliding crosspin sleeve through a range of .471 in. The adjustment is made from the outside to any desired tension and locking torque. All outside measurements of the fastener stud conform to standard dimensions. In addition, the Nigg stud fits all existing pin type receptacles including United-Carr, Shakeproof, Right Way and Chicago.

Plastic Preheating Equipment

Time is reduced to a matter of seconds with Illitron manufactured by Illinois Tool works, 2501 N. Keeler Ave., Chicago, Ill. This plastic preheating high frequency equipment is designed specially for preheating plastic preforms, e. g., wood flour, rag and mica-filled phenolic. The heating is done between plates which are self-adjusting to accommodate preforms of various thicknesses. The movable plate has a heat retainer to maintain the temperature in the preform after the high frequency heating is off, so that greater time is permissible between the pre-heating and loading of the press. An automatic timer cuts off the current after a predetermined time and simultaneously turns off a light on the panel board. A meter indicates in watts the amount of heat per second that is generated in the preforms, so that a close temperature control can be maintained.

(Continued on page 230)



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WASHINGTON

Latest Electronic News Developments Summarized
by Electronic Industries' Washington Bureau

ELECTRONIC-RADIO-RADAR LIFELINE — From beachheads to inland France, the performance of the apparatus and equipment, produced by the American electronics industry, achieved and exceeded all expectations of the Army and Navy leadership. The vital role of command communications in the shore landings against the vaunted Nazi Atlantic Westwall, in the paratrooper and airborne glider operations and in the drives inland of the divisions of the British and American forces saved many, many lives and casualties among our troops.

AMERICAN EQUIPMENT SUPERIOR—It cannot be fully disclosed, but it is known that the secret communications and radar devices, shrouded completely up to now, were invaluable especially against the airborne attacks. The handie-talkies and walkie-talkies on the ships of the invasion fleet and in the hands of the assault troops again came to the forefront as indispensable weapons of the attacks. American soldiers, sailors and airmen were superior to the Nazis. So was the U. S. communications—radio-radar equipment.

STILL KEEP PLUGGING—The military production job (2,000 per cent greater than peacetime output) still is the No. 1 task—that was the keynote of the Radio Manufacturers Association conference. After the European phase is won, reconversion steps and limited civilian production may be considered as there will be a diminution of military requirements by about 15 or 20 per cent. By early July, WPB Radio and Radar Division Director Ray Ellis and Deputy Director John Timmons are hopeful, after thorough consultations with the industry, of completing a blueprint for its reconversion.

ARMY ASSIGNMENT—The Signal Corps as outlined by Major General Harry C. Ingles, Chief Signal Officer, has a \$2,130,000,000 procurement task for the electronics-radio-radar manufacturing industry for the next governmental fiscal year (July 1, 1944 to June 30, 1945). This is 83.7 per cent of the total appropriation for the Corps. Of this amount \$1,070,000,000 will be for airborne equipment deliveries to be completed about March 31, 1946; of the remaining \$1,060,000,000, equipment for the Army Ground Forces will aggregate \$805,000,000, ground apparatus for Air Forces \$51,000,000 and \$305,000,000 for international aid (Lend-Lease). All the ground equipment is slated to be delivered by Dec. 31, 1945. Radio and radar equipment are major Lend-Lease items, going principally to England and Russia.

EVEN START FOR ALL—WPB Radio and Radar Division with the backing of the Army and Navy has been successfully bringing about the redistribution of the military production loads among prime contractors who received in recent months huge schedules of airborne electronic and radar equipment to subcontract their volumes as far as possible among their competitors. The WPB Division leadership is pressing for this levelling off of the loads of military production

on a voluntary basis by the industry so that when the starting gun for civilian reconversion is fired all the 55 major companies will be toeing the mark on the same line.

ARMY REWARDS FOR NOTED INVENTORS—Dr. Edwin H. Armstrong was the Number One recipient of the new award of the Chief Signal Officer's Certificate of Application for the donation to the Army of his patents for his Frequency Modulation system for use in manufacturing the invaluable radio equipment. Another inventor receiving this honor is Samuel Ruben of New Rochelle, N. Y., who enabled, through research and patents, great improvements in the size and durability of dry-cell batteries.

COMPONENTS SURPLUS BEING CARVED DOWN—The Component Control Section of WPB's Radio and Radar Division, the clearing house for surplus critical electronic components for industry and the armed services, during May and June averaged over \$1,500,000 worth of these items plowed back into military production channels. This will be most important when "Reconversion Day" comes because in the components field are the newcomers into the electronics-radio field during the war.

SIGNAL CORPS FIGHTING ACCUMULATION OF SURPLUSES—Major General Ingles, Chief Signal Officer, has offered the comforting thought that his branch of the Army is fighting the accumulation of surpluses rather than trying to dispose of one coming up. Procurement schedules are being cut back to actual requirements; a survey of vacuum tubes in stock in Philadelphia Signal Depot was made with that objective. Potential surpluses of equipment and components are being reported by the Signal Corps to Treasury's Procurement Division. Corps only has about \$50,000,000 worth of obsolete apparatus, with little resale value and mainly available only for salvage.

MISCELLANY—Navy's Radio Division (Bureau of Ships) has just been reorganized with new chiefs of branches and sections to replace officers sent to sea or to key Navy Yards. . . . Important for aviation radio, Radio Technical Committee for Aeronautics, interdepartmental agency in that field and headed by Bureau of Standards radio chief Dr. Dellinger, recently was reactivated and is studying airways beam and range equipment types and problems and airport frequency and apparatus needs. . . . Even though key officials have returned to private industry, WPB Radio and Radar Division is not being shelved; because of its vital reconversion task it had its peak staff June 30—some 240 personnel—and by next Dec. 31 will have estimated 233 on staff. . . . Due to broadcasters' opposition, new radio legislation, White-Wheeler bill to revamp FCC and to revise broadcasting regulation, is doomed for pigeonholing by Chairman Wheeler of Senate Interstate Commerce Committee.

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ROLAND C. DAVIES
Washington Editor

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A recently designed automatic calibrator for frequency meters used in conjunction with adding machines largely eliminates tedious hand calibration, saves man hours, reduces element of human error, speeds production.



Photo Courtesy Philco Corporation

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The Philco 126-tube Electronic Calibrator employs a system of fast and slow-acting relays and solenoids to bring about desired end actions. One application is the transferring of readings from the storage bank (shown above) to the keyboard of the adding machine. Operated by the plate current of OA4G tubes the relays on the storage bank energize the adding machine solenoids which press the proper number key of the adding machine.

The Guardian Series 120 relay used in this application is a small, sensitive unit having a minimum power requirement of 0.5 VA and an average of 2 VA. Coils are available in resistances from .01 to 6,000 ohms. Contact combinations up to single pole, double throw with 12.5 amp. points. Send for Bulletin 120.

The solenoid is Guardian Series 4 available for either A.C. or D.C. use. Series 4 A.C. at a maximum stroke of 1" permits a pull of 14 oz. intermittent duty, 3 oz. continuous duty. Series 4 D.C. at a maximum stroke of 1" permits a pull of 6 oz. intermittent duty, 1 oz. continuous duty. Send for information.



Series 120 Relay



Series 4 Solenoid

Consult Guardian whenever a tube is used—however—Relays by Guardian are NOT limited to tube applications but are used wherever automatic control is desired for making, breaking, or changing the characteristics of electrical circuits.

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Loss-Less Transmission Lines

A. Bloch (Wireless Engineer, London, April, 1944)

A graphical analysis of a system of loss-less transmission lines, including sections of different characteristic impedances, inductances and capacitances, is described. The method is based on the equation $Z_i = Z_o \cot \psi$, where Z_i is the input impedance, Z_o the characteristic impedance and ψ the electrical length of the line section reckoned from the end of the line.

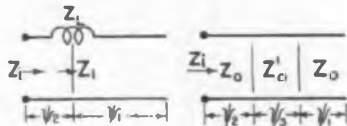


Fig. 1—Types of transmission lines discussed

As an example, the line shown at the left of Fig. 1, which consists of an inductance between two line sections, is treated. Starting from the open end of the line, the input impedance DA of the section between the inductance and the end of the line is found from Z_o and ψ_1 in a conventional way, as indicated in the second figure. DB is the combination of DA and Z_i . $Z_i = BA$, the value of the inductance. The final input impedance of the complete arrangement, $Z_i = DC$, is computed by plotting ray OC enclosing the angle ψ_2 with ray OB.

The determination of the input impedance of a line, which contains an intermediate section of different characteristic impedance, is carried out in a similar way. A second parallel to the X-axis is drawn at the distance Z_o' , where Z_o' is the characteristic impedance of the intermediate line section;

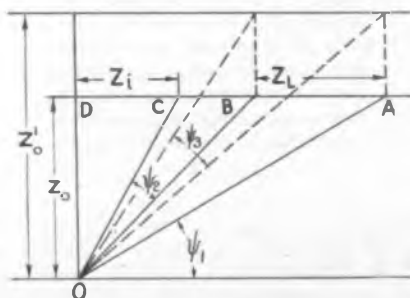


Fig. 2—Computation of input impedance

the dashed lines in Fig. 2 indicate the construction of the input impedance DC for the case illustrated at the right hand side of Fig. 1.

In some instances it will be preferable to use an admittance scale, which will be at right angles to the impedance scale, or both scales simultaneously. The input admittance of a line shunted by a condenser is used as an example to illustrate this type of diagram.

Fig. 3 illustrates a method to compute the current and voltage distribution in a loss-less line, consisting of several sections of different characteristic impedances and possibly loaded with some shunt or series reactances; it is based on the equations

$$U = U_o \cos \psi \text{ and} \\ I = I_o \sin \psi.$$

The current and voltage scales are so chosen that U_o is equal to I_o so that the two equations represent a circle.

To evaluate the voltages and currents for the line with the in-

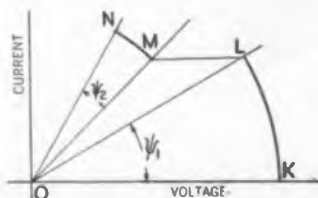


Fig. 3—Computation of currents and voltages

intermediate inductance, the corresponding web of rays is replotted, and the circular arc KL drawn; the abscissa and coordinate of the arc are the currents and voltages in the terminating section of the line. As the current through both terminals of the inductance Z_L must be the same, the horizontal line starting at L and ending at its intersection M with the second ray will give the current and voltages within the inductance. The input line section will be represented by another circular arc between M and the next ray.

A diagram for the line consisting of sections of different characteristic impedances is also shown and explained, as well as the graphical solution to the problem of finding the length of a short-circuited line which tunes exactly to anti-resonance with a given capacitance.

On the Virtual Cathode

A. Haug (Zeitschrift fuer technische Physik, Berlin, No. 6, 1943)

Experiments have been carried out to check the results of the space charge theory for electrons with the same, arbitrary, initial velocity in a plane diode. The theory describes the formation and the disappearance of the virtual cathode as a discontinuous process. An increase in the cathode current and the consequent increase in negative space charge, causes the potential minimum—previously established between the two electrodes,—to change suddenly from a minimum value larger than zero to zero with a simultaneous jump in the value of the plate current. The formation of the zero-potential negative space charge which constitutes the virtual cathode, takes place at definite values for cathode current and plate voltage. If, subsequently, the negative space charge is reduced, e.g. by a decrease in cathode current, the virtual cathode disappears suddenly at a cathode current value different from the one at which it had been formed. The resultant theoretical plate current curve as a function of the cathode current is shaped similarly to a magnetic hysteresis loop.

(Continued on page 220)

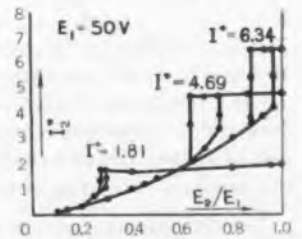


Fig. 1—Plate current as function of voltage ratio

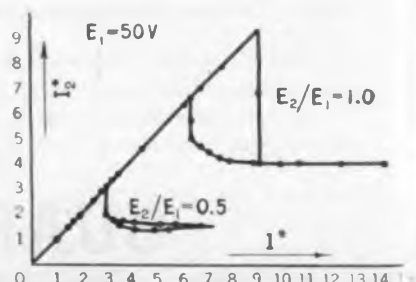
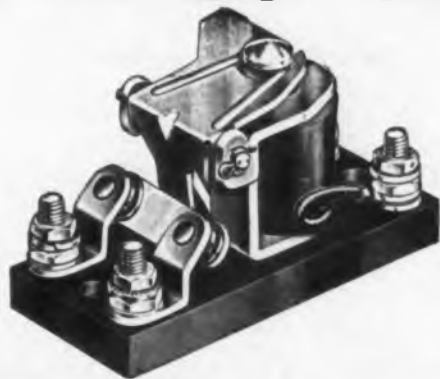


Fig. 2—Plate current as function of grid current

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★ TELEVISION TODAY* ★

News Developments in the Video Field

Laying Television Ghosts

The reflections of television signals by buildings and other objects produce "ghost" images. The elimination of these unwanted reflections is a big problem in the congested city areas where a number of tall buildings surround the receiving antenna.

The object causing reflection of a television signal may be located at any point on an ellipse formed about the transmitter and receiver locations as foci.

In order to determine the object or objects producing a given ghost, measure the distance from the main image to the ghost pattern on the cathode ray screen and let this distance be G inches. The extra distance $2X$, over which the signal is traveling can be determined from the following relationship:

$$\frac{G}{W} \times 11.7 \text{ miles} = 2X$$

where W is width of picture in inches (+ 15 per cent).

Referring to the diagram, a reflecting surface might be located directly back of the receiving antenna as at some point Z . In this case the signal would travel from the transmitter, T , to the receiver, R , a distance of D plus twice the distance X . This distance X is one-half of the value as calculated above from the original ghost pattern. If an ellipse is described through the point Z with T and R as foci, reflections producing the observed ghost can take place from any point on this ellipse, as for example a building at B or A .

In order to locate the source of reflection by this method, use a map of the area surrounding the transmitter and receiver and place pins at the transmitter antenna and receiver antenna locations. With a loop of string placed over the pins of such a length that a pencil placed in the loop will pass through the point Z , draw the ellipse. The minor axis can also be determined by drawing a line perpendicular to the line between T and R as at O . With a compass and either T or R as a center, swing an arc with a radius of $D/2 + X$. Where this arc crosses the perpendicular is the minor axis ordinant and a point through which the ellipse passes.

Reflecting objects located near the transmitter are more difficult

to eliminate by means of directional receiving antennas since the angle between the desired direction and the undesired reflection is small. However, when the reflecting surface is near the receiver as at A the directional characteristics of the receiving antenna are usually adequate and will separate the desired signal from the undesired.

The reflection problem B to R can be solved by placing a reflector between the dipole and the building B . As long as all stations to be received are in the same general direction from the receiving location, the problem of reflections from behind the antenna are usually easily solved by a reflector element

(Continued on page 130)

ATS Makes Television Station Awards

The second annual awards of the American Television Society for 1943 to 1944 will be made to WABD, DuMont tele outlet in New York, and WRGB, General Electric Co. station at Schenectady, N. Y.

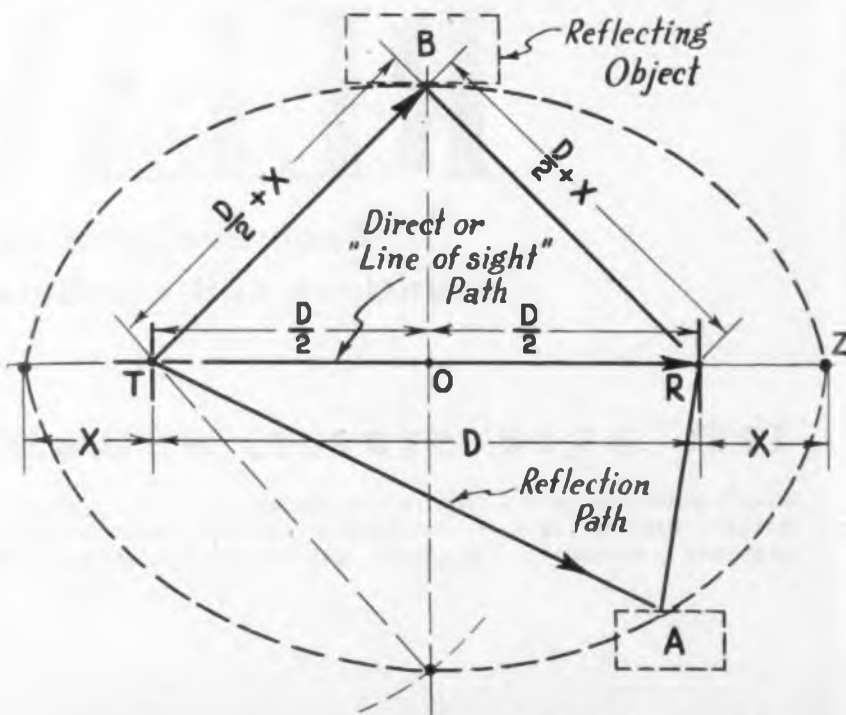
Plaques have been recommended by the awards committee of ATS to WABD for the year's "outstanding contribution to the art of commercial television" and to WRGB

"in recognition of the year's outstanding contribution to the art of television programming."

Appreciation is expressed in the committee's report of the work of W6XYS, sight-and-sound station of Television Productions, Inc., Paramount Pictures' subsidiary on the studio lot in Hollywood, "for the advance in techniques, such as improved lighting and shadowing, process screen, and other advances contributed by the motion picture art."

CBS Orders UHF Television Transmitter

The filing of an order with the General Electric Co. for a television transmitter to operate in the 400-500 megacycle region was announced by Paul Kesten, vice-president of CBS. The new transmitter is to have a rating of approximately 1 kw and will be used to demonstrate wide band black and white and full color television systems of CBS. CBS officials explained that they expect improved performance with regard to signal reflection problems producing "ghosts." This is based on the wider use of directional antennas which are physically more practical at the shorter wavelengths.



Plan of possible positions of a reflecting object producing a given "ghost" picture. Distance from transmitter T to receiver R is $D + 2X$ over path producing ghost

* Title registered U. S. Patent Office.



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ASSOCIATION NEWS

Electronic Conference

Sponsored by Illinois Institute of Technology, Northwestern University, Chicago section of IRE and the Chicago section of AIEE, a National Electronics Conference is scheduled for October 5, 6 and 7 at the Medinah Club, Chicago. Described as "a national forum for electronic developments and their engineering applications" by Dr. J. E. Hobson, Head of the Engineering Department of the Illinois Institute of Technology, and Chairman of the National Electronics Conference Executive Committee, the Conference has as its aim a means of providing free discussions of the application of electronics in various fields of technical endeavor.

The program for the Conference is under the direction of Professor A. B. Bronwell, Technological Institute, Northwestern University, Evanston, Ill. While the general plan of the program has been reasonably well outlined, those desiring to submit papers are invited to communicate with Prof. Bronwell, Chairman of the Program Committee. Advance registrations may be made with Professor P. G. Andres, Illinois Institute of Technology, 3300 Federal St., Chicago, Ill., Chairman of the Arrangements Committee.

RTPB RR Committee

Panel No. 13 of the Radio Technical Planning Board, charged with study of the needs of portable, mobile, and emergency radio communications services, embraces the problems of postwar use of radio equipment by the nation's railroads. The Panel's Committee No. 7, Railroads Radio Communications Services, now include the following men:

- J. L. Niesse (Chairman), Assistant Superintendent Telegraph, New York Central R.R., 718 Big Four Building, Indianapolis 4, Ind.
- L. J. Priendergast (Vice-chairman), Superintendent of Communications, Baltimore and Ohio R.R., Baltimore 1, Md.
- D. F. Dunsmore, Road Electrical Foreman, Chesapeake & Ohio Railway, Richmond 10, Va. (Representing the Electrical Section, Mechanical Division.)
- F. B. Hank, Assistant to Vice-president and General Manager, New York Central System, 466 Lexington Avenue, New York 17, N. Y. (Representing the Operating Section, Operating-Transportation Division.)
- W. M. Vandersluis, General Superintendent Telegraph and Signals, Illinois Central System, 135 East 11th Place, Chicago 5, Ill. (Representing the Signal Section, Engineering Division.)
- Alternate:—P. B. Burley, Electronics Engineer, Illinois Central System, 135 East 11th Pl., Chicago 5, Ill.
- S. M. Viele, Assistant Engineer, Electrical Department, Pennsylvania R.R., Philadelphia, Pa. (Representing the Electrical Section, Engineering Division.)

- G. W. Baughman, Engineer, Union Switch & Signal Co., Swissvale, Pa.
- R. A. Clark, Jr., President, Communication Equipment & Engineering Company, 504 N. Parkside Ave., Chicago, Ill.
- F. C. Collings, Engineer, Radio Corp. of America, Camden 2, N. J.
- L. W. Goostree, Engineer, General Electric Co., Schenectady, N. Y.
- S. J. Holland, Sales Engineer Radio Division, Bendix Aviation Corp., Baltimore, Md.
- F. S. Mabry, Section Engineer, Westinghouse Electric & Manufacturing Co., 2519 Wilkens Ave., Baltimore, Md.
- Alternate:—S. G. Little, Consulting Engineer, Westinghouse Electric & Manufacturing Co., 2519 Wilkens Ave., Baltimore, Md.
- J. O. Mauborgne (Maj. Gen. U.S.A., Retired), Consultant, General Railway Signal Co., 1 Alston Court, Red Bank, N. J.
- Alternate:—V. C. Chappell, Engineer, General Railway Signal Co., Rochester 2, N. Y.
- J. A. Parrott, Engineer of Special Services, Department of Operation and Engineering, American Telephone and Telegraph Co., 195 Broadway, New York 7, N. Y.

Conventions and Meetings Ahead

American Physical Society (K. K. Darrow, Columbia University, New York), July 22, Berkeley, Calif.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York), Pacific Coast Technical Meeting, Aug. 29-Sept. 1, Los Angeles.

Institute of Radio Engineers (330 West 42nd Street, New York City), September 6, October 4, New York.

Radio Club of America (11 West 42nd Street, New York City), September 14, New York.

American Society of Mechanical Engineers (Ernest Hartford, 29 West 39th Street, New York), Fall Meeting, October 2-5, Cincinnati, Ohio.

Electronic Parts and Equipment Industry Conference (H. Clough, Belden Mfg. Co., Chicago), Oct. 6-9, Edgewater Beach Hotel, Chicago.

Electrochemical Society (Colin G. Fink, Columbia University, New York City), Fall Meeting, October 13-14, Hotel Statler, Buffalo, N. Y.

Society of Motion Picture Engineers (J. Haber, Hotel Pennsylvania, New York), Semi-annual Fall Conference, October 16-18, Hotel Pennsylvania, New York.

National Electronic Distributors Association (George Barbey, P. O. Box 2, Reading, Pa.), Electronic Parts and Equipment Industry Conference, October 19-21, Stevens Hotel, Chicago, Ill.

American Mathematical Society (531 West 116th Street, New York), October 28, New York.

AIEE Summer Meeting

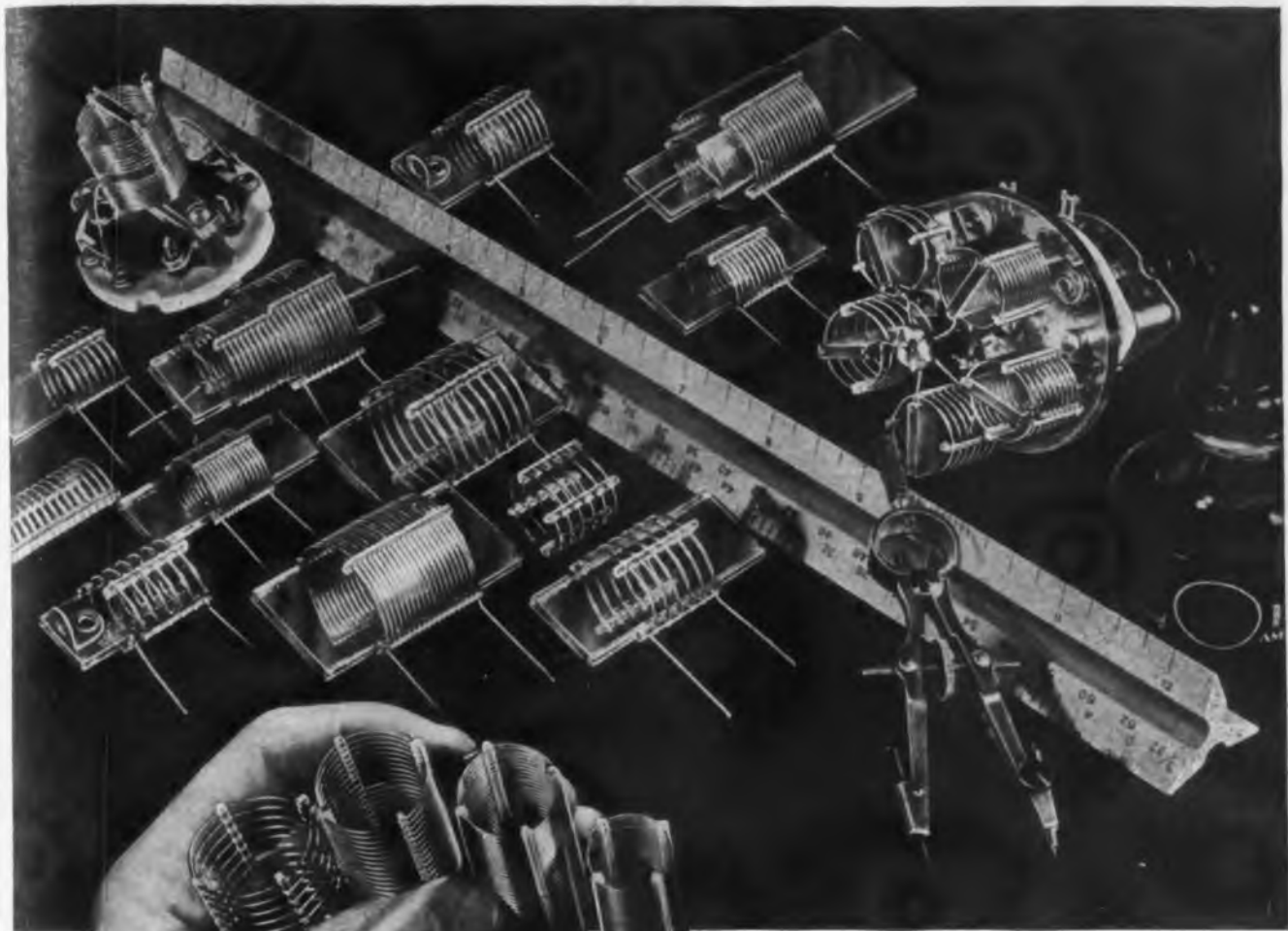
Several of the papers read at the AIEE Summer Technical Meeting in St. Louis, Mo., on June 26-30, 1944, are of possible interest to electronic engineers. Copies may be obtained by mail from the AIEE order department, 33 West 39th St., New York 18, N. Y.

Fundamentals of Hearing-Aid Design; W. D. Penn. **An Improved Electronic Control for Capacitor-Discharge Resistance Welding**; H. J. Bichsel and E. T. Hughes. **Electronic Regulator for Arc Furnaces**; J. E. Reilly, C. E. Valentine. **Induction Heating—Selection of Frequency**; N. R. Stansel. **Application of Industrial Radio-Frequency Generators to Induction Heating**; E. H. Browning. **Surface Heating by Induction**; H. F. Storm. **Analysis of Rectifier Circuits**; E. F. Christensen, C. H. Willis, C. C. Herskind. **Design of an Electronic Frequency Changer**; C. H. Willis, R. W. Kuenning, E. F. Christensen, B. D. Bedford. **Pentode Ignitrons for Electronic Power Converters**; H. C. Steiner, J. L. Zehner, H. E. Zuvers. **Operation of Rectifiers Under Unbalanced Conditions**; E. F. Christensen, M. M. Morack. **The Electronic Converter for Exchange of Power**; F. W. Cramer, L. W. Morton, A. G. Darling. **Switchgear and Control for Electronic Power Converter**; W. N. Gittings, A. W. Bate-man. **A Resonant-Cavity Method for Measuring Dielectric Properties at Ultra-high Frequencies**; C. N. Works, T. W. Dakin, F. W. Boggs.

Medal to Dr. Rentschler

The Frank P. Brown Medal, awarded annually by The Franklin Institute, has been presented to Dr. Harvey C. Rentschler, director of research of the Westinghouse Lamp Division, for his work in development and application of an ultraviolet lamp that kills bacteria. Dr. Rentschler, physicist under whose supervision was developed the germ-killing ultraviolet lamp known as the Sterilamp, was selected as this year's winner of the Brown award "in consideration of his application of a source of bactericidal ultraviolet radiation in air conditioning systems in a scientific and practical manner." In 1942, Dr. Rentschler completed 25 years as director of lamp research for Westinghouse. In addition to ultraviolet research, his work with rare metals such as thorium, titanium and tantalum has helped to make possible new photoelectric cells.

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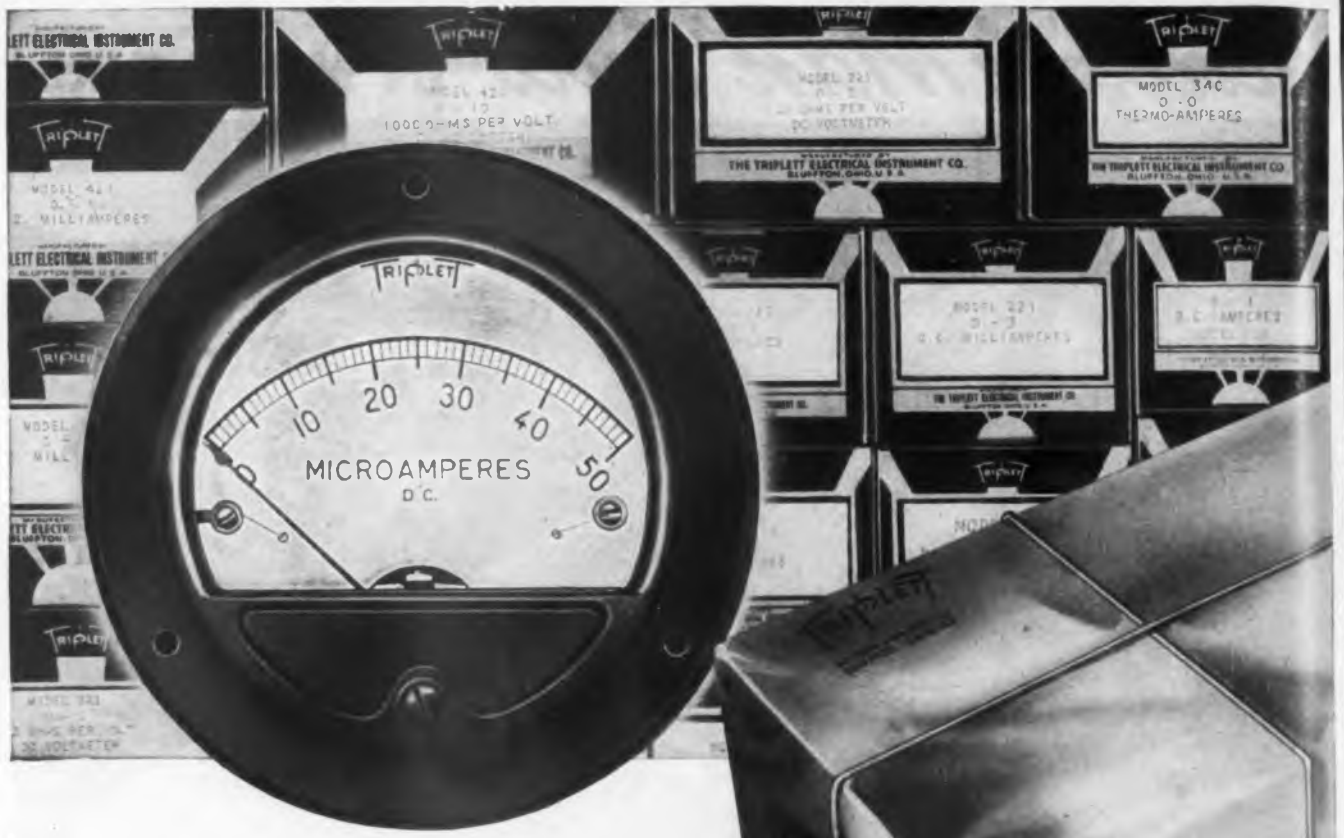
The coils have a high Q, due to the almost total absence of insulating material in the electrical field. They are exceptionally light in weight and extremely rigid. Normally wound with tinned copper wire in sizes from #28 to #14, they can also be supplied with coin silver, coin silver jacketed, bare copper, or phosphor bronze wire. All types may be equipped with either fixed or variable internal or external coupling links, or other non-standard features. Samples on request to quantity users. Send us your specifications!

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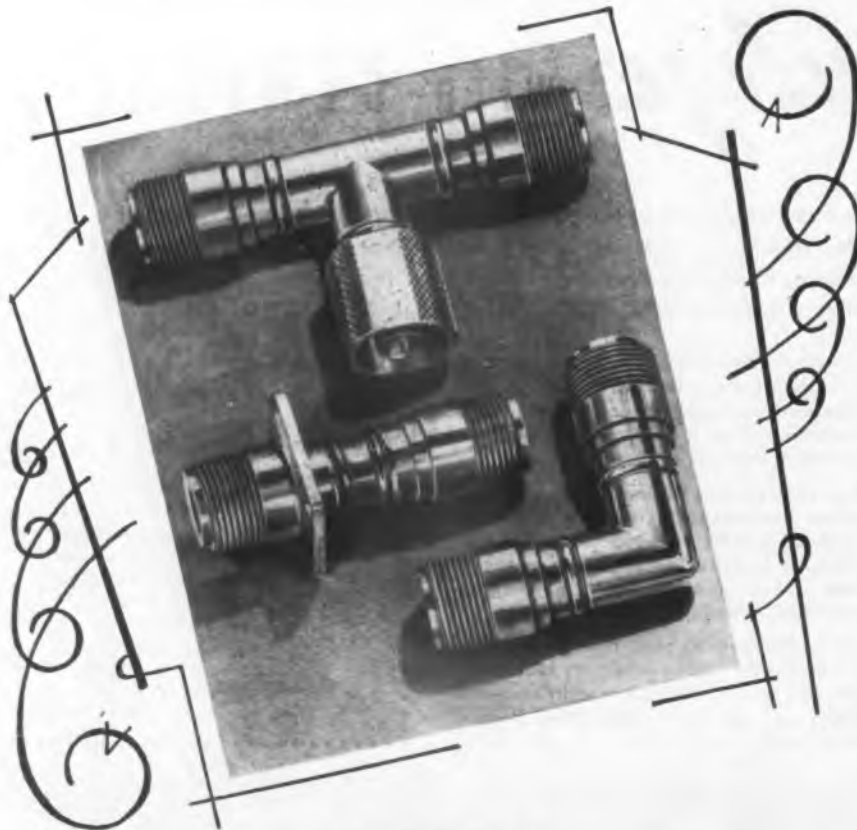


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YOUNGSTOWN, OHIO

TELEVISION GHOSTS

(Continued from page 124)

added to reduce the pickup from the undesirable direction. Where stations to be received are not in the same general direction from the receiver location, it may be necessary to resort to two or more separate dipoles and reflectors if necessary. The separate antennas can usually be connected into a mixing transformer and the same lead-in cable used without switching. A good "ground" should always be used on television receivers. It will improve performance and is a safety measure.

Line of sight

The high frequencies used in television have some of the characteristics of light waves. The waves tend to travel in straight lines and will bend only slightly. This characteristic leads to the "line of sight" phrase applied to television. In general, the high frequency waves (50 megacycles and up) will travel to the horizon. The higher the transmitting antenna, the greater the range of the station. Elevation of the receiving antenna is also important. The total line of sight distance between two antennas can be calculated easily.

Television signals are being received satisfactorily beyond the horizon limit in many cases. With transmitting antennas located on tall buildings or nearby mountains, an area with a 40 to 50 miles radius can be easily served.

Television Organizations

American Television Society, 1140 Broadway, New York (CAledonia 5-7430).
President—Dan D. Halpin, RCA, Camden, N. J.; Vice-president—Ray Nelson; Treasurer—Don McClure; Secretary—Kay Reynolds; Directors: Norman D. Waters, George T. Shupert, David H. Halpern, Prof. E. C. Cole, Lela Swift, Charles Kleinman, J. R. Hutchinson.

Television Broadcasters Assn., Inc., 500 Fifth Ave., New York 18, N. Y. (Lackawanna 4-4788).
President—Allen B. DuMont, Passaic, N. J.; Vice-president—Louis Allen Weiss, Los Angeles, Calif.; Secretary—Will Balfin; Provisional Assistant Secretary—Jack R. Poppele, 1440 Broadway, New York City.

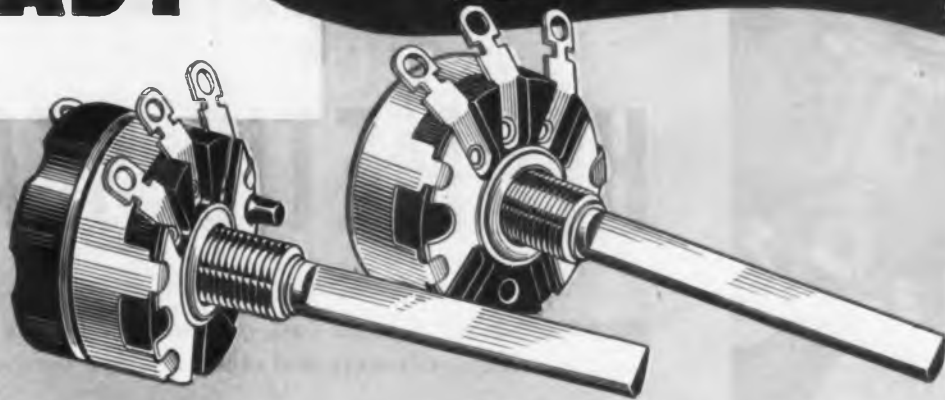
Society of Television Engineers (Pacific Coast)
Secretary-Treasurer—Curtis W. Mason, c/o Earle C. Anthony, Inc., 141 No. Vermont Ave., Los Angeles 4, Calif.; RTPB Representatives: Frederic C. Wolcott, chief engineer, Gilfillan Bros., Los Angeles, Calif.; Frederick Ireland, General Radio Co., Hollywood, Calif.

Television Producers Assn., 1425 Broadway, Room 70, New York, N. Y.
Acting President—Bud Gamble, Farnsworth Tel. & Radio Corp.; Acting Vice-president—Edwin Woodruff, DuMont Labs.; Acting Secretary—Jay Strong; Acting Treasurer—Roger Caelos.

Television Press Club
Board of Governors—A. W. Bernsohn (Click Magazine), Richard W. Hubbell (author, editor Television Review), T. R. Kennedy, Jr. (N. Y. Times), Ben Kaufman (Radio Daily), Stanley Kempner (Retailing-Fairchild's), Hermine Isaacs (Theatre Arts), Wanda Marvin (Billboard), Mike Wear (Variety), Louis Winner (Communications Mag.)

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How to Read a VIBRATING REED FREQUENCY METER

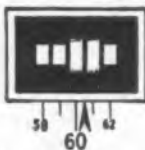
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1

Easy Lesson!

for example:



ON THE NOSE! Model 21-FX, full cycle increment, shown indicating a frequency of 60 cycles. The 60 cycle reed is vibrating to full amplitude with the adjacent 59 and 61 cycle reeds practically at a stand still.



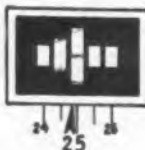
60.5 cycles. The 60 and 61 cycle reeds are vibrating equally, but to less than full amplitude. Side reeds are quiet.



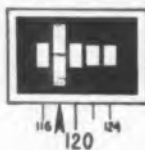
60.75 cycles. The 60 cycle reed is vibrating a little, and the 61 cycle reed is vibrating to almost full amplitude. Other reeds are quiet.



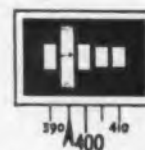
60.75 cycles. Note this is a half-cycle instrument. The 60.5 and the 61 cycle reeds are vibrating equally.



24.85. Watch the scale! Each division is one half cycle. Frequency lies between 24.5 cycles and 25 cycles and closer to 25 than 24.5.

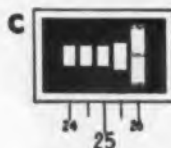
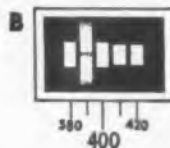
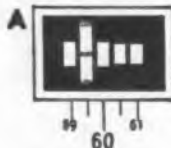


118.0. This one is easy. Each division represents a full cycle. The 118 cycle reed has no competition in this example.



395. This is a cinch, too. How many cycles per division? Five—right. The 395 cycle reed has everything its own way, here.

Now, how good are you? Watch your Scales!



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Bulletin VF-43 with supplements gives detailed descriptions of the complete line of J-B-T Frequency Meters. Your copy is waiting for you.

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0'9E = 3
0'06C = 4
5'6S = 5

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J-B-T INSTRUMENTS, INC.

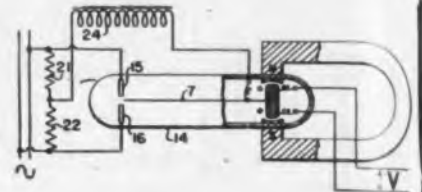
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7-JBT-3

NEW PATENTS ISSUED

Galvanometer-Bridge Tube

The tube 14 is designed as a measuring or regulating device. The voltage V is a function of the quantity to be measured or regulated—for instance the output of a thermocouple—; it is zero for the desired or mid-value of the quantity. Upon any deviation from this value, current will flow through the galvanometer coil and the pointer 7 will be deflected. This will, in turn, unbalance the bridge network having two fixed resistances 21 and 22 in two arms and the space paths resistances between pointer 7 and anodes 15 and 16, re-

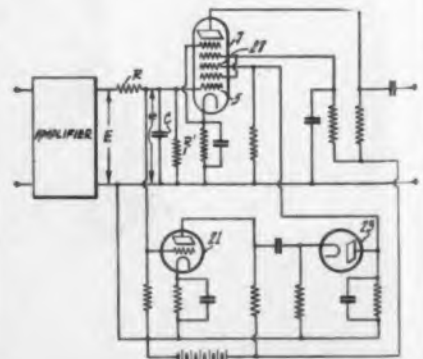


spectively, as the other two arms. Unbalancing of this bridge causes current to flow through coil 24 which current controls a reversible electrical motor. It will be seen that the motor may be used to either register any deviation of the voltage V from a mid-value—and consequently of the quantity to be measured—or to regulate the quantity until the voltage V is equal to zero and the bridge is balanced. In another embodiment the two fixed resistors 21, 22 are replaced by three additional electrodes suitably arranged in the tube; it is also possible to use only one pair of electrodes, with a fixed electrode and the movable pointer between them. E. A. Keeler, The Brown Instrument Co., (F) Jan. 17, 1939, (I) Jan. 25, 1944, No. 2,389,861.

Phase Shifter

A phase shifter is described which provides constant amplitudes and a 90 deg. phase shift over a frequency band; its output may be applied to one pair of plates in a cathode ray tube for circular scanning. The amplifier compensates for the attenuation introduced by the phase shifter. In the phase-shifting network, the resistance of R and R' considerably exceeds the reactance of C so that $e = -jE/2\pi fRC$, introducing a 90 deg. phase shift. It will be seen that the voltage e is inversely proportional to the frequency f , which is undesirable. To maintain a constant output voltage over a certain frequency band, voltage e is amplified in tube 21, rectified in tube 23, and applied to grid 27, regulating the amplification factor of tube 7. A decrease in voltage e will be compensated by

(Continued on page 138)



WELDING CAPACITORS

*for capacitor
discharge-type equipment*



- Uniform voltage stress
- Low max. voltage gradient
- Contacts **SOLDERED** to foil
— internal arcs avoided

Working closely with leading welding equipment manufacturers in the rapid development of Capacitor-Discharge units, Sprague has produced a line of specially-designed capacitors that have proved eminently successful in this exacting application. The dielectric of these Sprague Welding Capacitors is a high-quality

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For the latest developments in this field—whether for original capacitor-discharge welding equipment or replacement purposes—*write Sprague.*

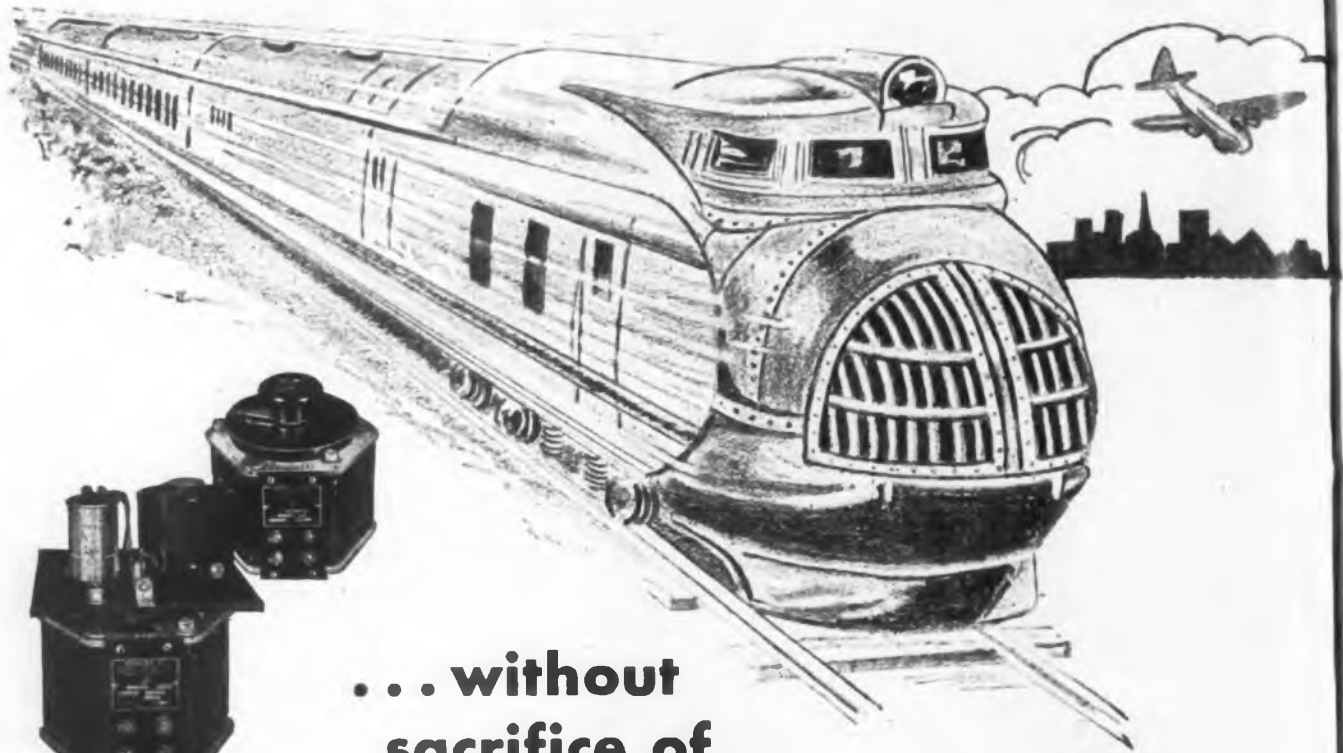
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Consult SECO engineers for equipment to control voltages from 115, 230, and 440 volt single or polyphase circuits and be assured of a quality controller.

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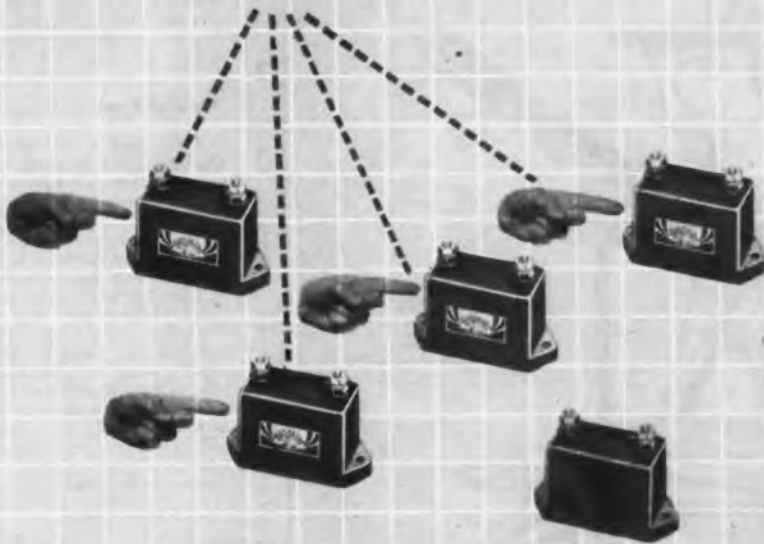
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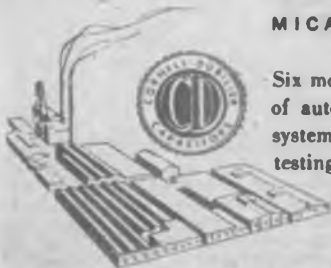
TYPE 6K ideal for high stability tuned circuits where constant capacity is required.

A compensated unit which can be made having any temperature coefficient between the limits of +.003% to -.005% per degree C. (tolerance $\pm .001\%$ per degree C.) over a temperature range of from -40°C . to $+70^{\circ}\text{C}$., made in a wide variety of capacity and voltage ratings.



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THE ARMY BUILDS MEN, SAVES MONEY WITH

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OPERADIO PLANT BROADCASTING FOR MUSIC AND VOICE-PAGING
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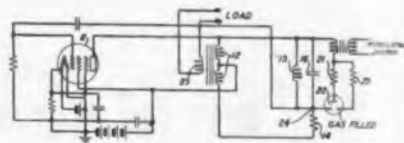
NEW PATENTS ISSUED

(Continued from page 134)

a simultaneous increase in amplification factor so that the output voltage of tube 7 will be independent of frequency. L. N. Norton, RCA, (F) Sept. 30, 1942, (I) Feb. 8, 1944, No. 2,341,232.

Modulator

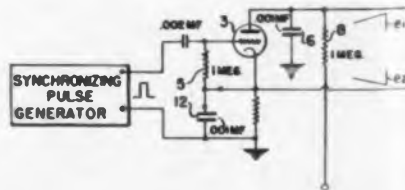
Amplitude modulation is obtained by applying the modulating voltage in series with a non-linear amplitude stabilizer (cold-cathode gas-filled tube, contact rectifier, etc.) in one arm of a bridge-stabilized oscillator. In the embodiment shown, feedback to the control grid of oscillator tube 11 is taken off junction point 24 of the bridge, 12 (two arms across which the input is connected), 14, and the fourth arm including 15, 16, 21, 22, 23. At low oscillation amplitudes, tube 22 is an open circuit and the impedance of the fourth bridge arm is substantially higher than the value of resistance 14; there will be considerable feedback. The oscillation amplitudes will increase until the ionizing potential of tube 22 is reached and it will conduct current. The impedance of the



fourth bridge arm will then only slightly exceed the resistance 14 and the feedback will be considerably reduced. This process will stabilize the oscillation amplitude. Modulation is effected by causing tube 22 to ionize or restore at a higher or lower point with respect to the oscillator output. M. E. Mohr, Bell Telephone Laboratories, (F) Feb. 18, 1943, (I) April 4, 1944, No. 2,345,712.

Saw-Tooth Wave Generator

It is desired to generate two trains of saw-tooth waves having equal amplitudes but opposite polarity, as indicated by e_1 and e_2 ; these wave shapes are useful in television scanning as input signals for balanced push-pull modulator circuits. The saw-tooth waves may be synchronized by square wave pulses supplied by any type of generator. Two equal time-constant circuits, 6, 8 and 12, 13 are inserted into the plate and cathode leads of tube 3, respectively. At the beginning of a cycle tube 3 will not conduct, capacitor 6 will charge through resistor 8 and capacitor 12 will discharge



through resistor 13; the gradually sloping first parts of e_1 and e_2 will be produced. The charging and discharging will continue until the square wave pulse renders tube 3 conductive and the current through the tube rapidly discharges capacitor 6 and charges capacitor 12 to the same voltage—if the voltage drop across the tube is neglected—providing the second, steep parts in e_1 and e_2 . C. E. Hallmark Farnsworth Television and Radio Corp., (F) March 14, 1942, (I) April 4, 1944, No. 2,345,668.

(Continued on page 142)



Electro-Voice MICROPHONES

The extent of our line is but partially illustrated in this advertisement. Our current production is now being utilized in essential services. Soon, however, there will be Electro-Voice Microphones available for civilian use . . . and these will be described fully in subsequent advertisements.

In our South Bend laboratory, we have complete facilities for accurate frequency checking, harmonic wave analysis, measurement of ambient noise, etc. Electro-Voice Microphones reflect painstaking care in design and construction by superior performance in the field. They serve you better . . . for longer periods of time.

If your present limited quantity needs can be filled by any of our Standard Model Microphones, with or without minor modifications, we suggest that you contact your nearest radio parts distributor.

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Let THEM do the Talking

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HOW TO AVOID WAR CONTRACT "STYMIES" ON POST-WAR PRODUCTION

Lewyt offers a solution of this problem to a manufacturer who "fits" into our schedule. Perhaps we can *plan now* to assist with your electronic, electrical and mechanical parts production, or complete assembly, chassis and housings. Write for 48-page illustrated book, "Let Lewyt Do It". No cost or obligation. Consult Thomas Register for Lewyt listings.

LEWYT CORPORATION
80 BROADWAY, BROOKLYN 11, N. Y.



'Twice we've experienced readjustments from peace to war and back again. We've carried on through lush times and lean times, booms and depressions and every kind of business cycle. 194-? will be our third re-conversion.

American Industry drafted us by their own *selective service act* to fight their parts-production battles 53 years before Pearl Harbor. We've been in thousands of engagements . . . we've employed every known strategy . . . and some secret devices of our own . . . to defeat high production costs.

War-born companies of the 1940's have had no experience with peacetime invasions on competitive-cost strongholds. When "C-Day" comes the Conversion Casualty List will be high among sub-contractors brought up in the "Cost-Plus School" of production.

Lewyt is *not* a war baby. Lewyt is a "Manufacturer's Manufacturer" with 56 years' experience devising less costly methods of making things better. Lewyt has the *peacetime* production ability you need. Maybe we can't figure on your re-conversion manufacturing problems *now*. But we can quote on WAR BONDS. They start at \$18.75.

Lewyt

LET LEWYT DO IT

experience Counts!

Here at Conant Laboratories, we're old timers in a new business. Eleven years ago, we began the manufacture of Conant Instrument Rectifiers to fill a definite need. Today our production is more than 200 times as great as during our first year, and we've learned a lot. We've gone far toward making rectifier type instruments dependable.

By concentrating strictly on the manufacture of rectifiers for electrical measuring and indicating instruments, we have gained the experience so necessary to precision production.

Conant Instrument Rectifiers are not adaptations of power supply rectifiers, but were, from the beginning of our company, developed exclusively for meters.

Yes, indeed, we've gained a lot of "know-how" in our eleven years of research and production. If you have need of a rectifier-instrument application, you'll want to avail yourself of our practical experience.



Instrument Rectifiers

ELECTRICAL LABORATORIES

6500 O STREET, LINCOLN 5, NEBRASKA, U. S. A.

20 Vesey St., New York 7, New York
85 E. Gay St., Columbus, Ohio
600 S. Michigan Ave., Chicago 5, Ill.
1215 Harmon Pl., Minneapolis, Minn.

2017 Grand Ave., Kansas City, Mo.
7935 Eustis St., Dallas, Texas
4018 Greer Ave., St. Louis, Mo.
1526 Ivy St., Denver, Colo.

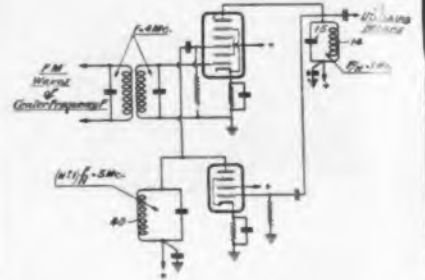
4214 Country Club Dr., Long Beach, Calif.
4205 N.E. 22nd Ave., Portland, Ore.
Caixa Postal 930, Sao Paulo, Brazil
50 Yarmouth Rd., Toronto, Canada

NEW PATENTS

(Continued from page 138)

Frequency Divider Network

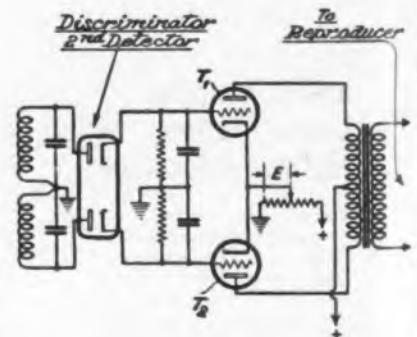
The frequency division network shown will be located between the intermediate frequency amplifier and the discriminator of an FM receiver; the bandwidth of the output will be reduced in the same proportion as the center frequency, i.e. by the factor N . Converter tube 4, resonant circuit 14, 15 frequency multiplier 20 and resonant circuit 40, 41 operate as a re-entrant network and, consequently, there will be no output unless the signal input exceeds a



certain amplitude which is made to be higher than the noise level. Noise will be eliminated from the receiver in the absence of signal. Additionally, the network may have its constants adjusted so as to provide the characteristics of a limiter stage. Further, the device if tuned to a desired center frequency, will reject interfering signals which do not have the same frequency M. G. Crosby, RCA, (F) March 29, 1941, (I) March 21, 1944, No. 2,344,678.

Discriminator Circuit

The output of an adjustable limiter is coupled to the discriminator transformer. The bias E is made sufficiently high so as to insure operation of tubes T_1 and T_2 as a class B push-pull amplifier, only one tube carrying current at any instant of time while the other is biased beyond cut-off; negligible distortion and comparatively



small plate current requirements are insured. Both tubes are operated in the negative grid-voltage region of their characteristic so that they do not draw grid current. As the tubes T_1 and T_2 are biased to, or beyond, cut-off for no-signal input, there will be no noise during these periods. J. A. Rankin, RCA, (F) Nov. 13, 1940, (I) March 21, 1944, No. 2,844,781.

Radio Beacon

One of two comparison frequencies is rated on a short wavelength, e.g., 80 mc, and gives a square law pattern, the other comparison frequency is transmitted on a relatively long wavelength, e.g., 100 to 400 kc, the field strength contour lines of this

(Continued on page 146)



PHILO T. FARNSWORTH
Originator of Electronic Television



E. M. MARTIN
Secretary and Counsel



E. H. VOGEL
Vice President Sales



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Purchasing



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Service



J. H. PRESSLEY
Chief Engineer Marion



A. E. SIBLEY
Credit

They were veterans when they joined Farnsworth 5 years ago! These 21 men in the Farnsworth headquarters organization today are all in the same important positions they took in 1939 when Farnsworth expanded its research and entered into radio production.

This intact staff is a true indication of the sound planning and development within the Farnsworth organization.

These men are planning post-war products and services and policies now — natural developments of our 19 years

of research in the electronics field . . . in television, radio and phonographic reproduction.

After the war, Farnsworth will be in a strong position to work with you in all phases of radio and television transmission and reception. Farnsworth accomplishments have received high recognition. Farnsworth possibilities in the future are unlimited.

★ **FIRST POPULAR INTERPRETATION OF TELEVISION** ★
Write for copies of "The Story of Electronic Television." Prepared for the public, it should be useful to you.

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Farnsworth Television & Radio Corporation, Fort Wayne 1, Indiana • Farnsworth Radio and Television Transmitters and Receivers • Aircraft Radio Equipment • Farnsworth Television Tubes • The Farnsworth Phonograph-Radio • The Capehart

" WE'LL NEVER ATTRACT THEIR ATTENTION
AS LONG AS THEY'RE DISCUSSING THE
ECHOPHONE EC-1"



Echophone Model EC-1

(Illustrated) a compact communications receiver with every necessary feature for good reception. Covers from 550 kc. to 30 mc. on three bands. Electrical bandspread on all bands. Six tubes. Self-contained speaker. 115-125 volts AC or DC.



Echophone Radio Co., 540 N. Michigan Ave., Chicago 11, Illinois



Here's important radio equipment powered by Ray-O-Vac batteries and used in establishing beachheads as at Attu, in Africa and Europe.

The Manufacture Of Dry Batteries For War Has Shown Us How To Make Batteries For Peace

The Handie- and Walkie-Talkies, mine detectors, and other war-important electronic developments call for dry batteries. A large proportion of these batteries on the fighting fronts are made by Ray-O-Vac, in close cooperation with the U.S. Signal Corps.

If your products require dry batteries, there are many ways in which Ray-O-Vac engineers may help you. Check with them before you "freeze" your post-war designs—and insure the advantages of "the batteries of the future."

Write Dept. E., Ray-O-Vac Co., Madison 4, Wis. Other factories, Clinton, Lancaster, Sioux City, Milwaukee, Fond du Lac.



BUY WAR BONDS

RAY-O-VAC

BUY WAR STAMPS

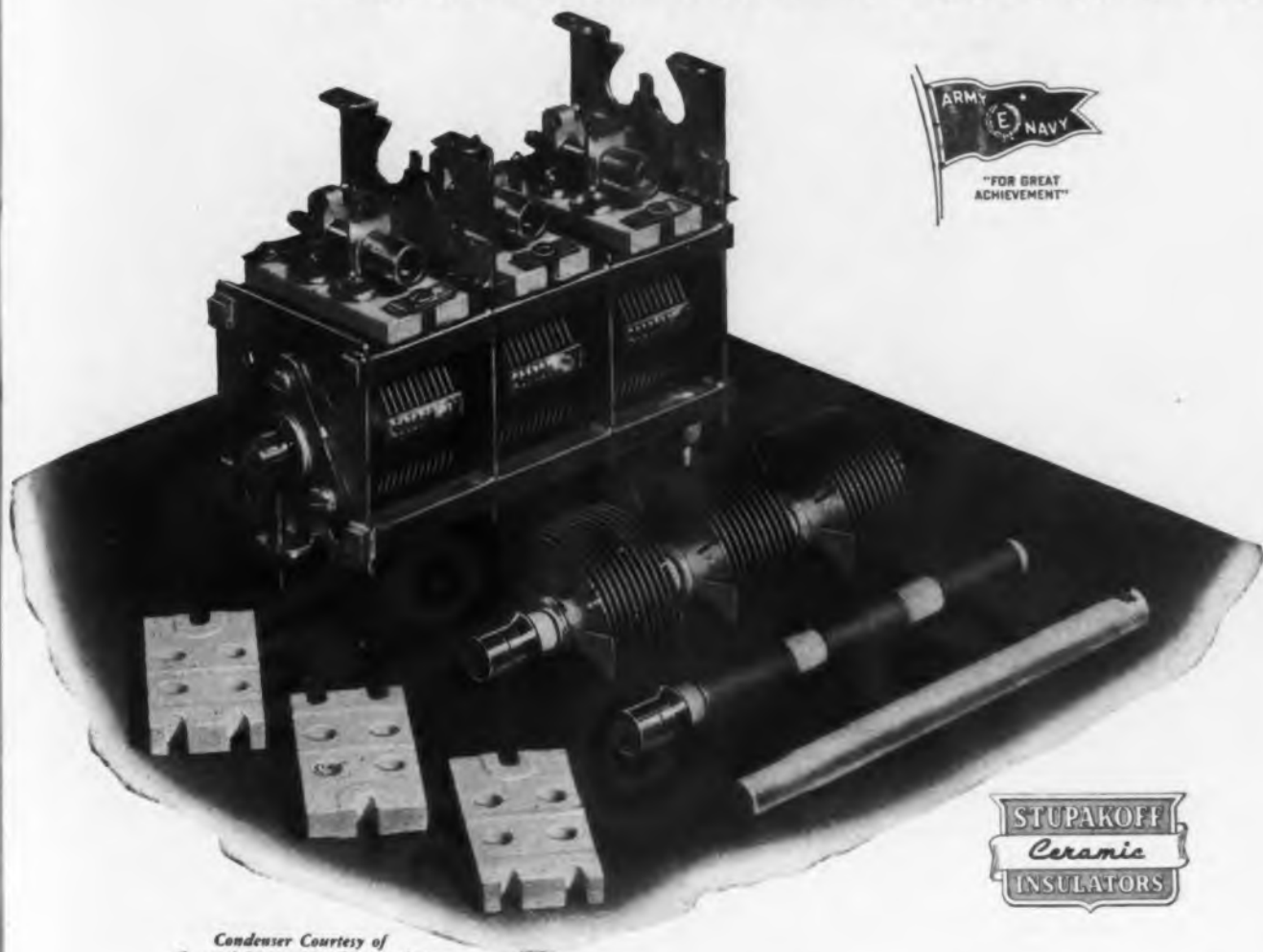
Guaranteed
BATTERIES



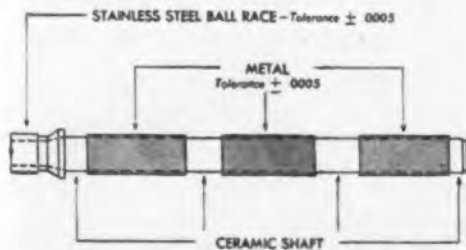
TELEPHONE • LANTERN • HEARING AID • RADIO • IGNITION • MULTIPLE

The Trend is to . . .

CERAMIC-METAL SUB ASSEMBLIES



Condenser Courtesy of
General Instrument Corporation



ILLUSTRATED is a "precision condenser" equipped with Stupakoff insulators and metallized ceramic sub-assembly.

This metallized ceramic rotor shaft is only one of many extremely accurate sub-assemblies produced by Stupakoff.

Correctly engineered, laboratory perfected and converted to large scale production, such parts offer optimum electrical and mechanical characteristics.

Use our experience to solve your special problems. Write, wire or phone—our engineering and production facilities are ready to serve you promptly.

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Products for the World of Electronics

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

electricity comes of age



In the radio and electronic equipment serving the armed forces, electricity is performing new functions, and performing old functions more efficiently, through the application of electronic principles.

There is more than a military significance in this accomplishment. For electronics is essentially a means of *controlling and disciplining* electricity to serve man better, and, as such, it will enrich the peace it is helping to win.

Whatever electronic developments the future may hold in store, this much is sure: Delco Radio will build good, dependable products

that make the most of electronic knowledge. They will be characterized by the same precision workmanship and progressive engineering that earned Delco auto radios a place on millions of cars, and that now safeguard the performance of Delco Radio equipment for America's land, sea and air forces.

**Make Your Dollars Fight
BUY MORE WAR BONDS**

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DIVISION OF
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Machined to Specifications

GLASS BONDED MICA has long been known as a dependable, all-purpose electrical insulation. Likewise, as specialists in the fabrication of this material, we have long been known as a dependable source for all types of fabricated parts—machined to specifications with the ability to produce them better . . . faster and at lower cost!

Let us prove this to you. Send us the specifications for your next requirements. Our large stock of Glass Bonded Mica is available in all thicknesses and meets Army, Navy and Air Corps specifications.

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ELECTRONIC INDUSTRIES • July, 1944

"FRAHM" FREQUENCY METERS

... IN 1910

the wood engraving at the right appeared in our first bulletin on Frahm Resonance Frequency Meters.

AND TODAY...

the Frahm instruments shown below are typical of the thousands we build each year.



In the 34 years that have passed since Mr. James G. Biddle introduced Resonant Reed Frequency Meters to American industry, the basic principle of these instruments has not changed. Countless refinements and improvements have been made since that date, and the range of application is being constantly broadened. Frahm Resonant Reed Instruments were unique and outstanding in 1910. And today, through Biddle experience, research and development, the same simple resonant reed principle is being applied to the solution of an amazing number of measurement problems.

Write today for Bulletin 1695-EI

James G. Biddle Co.

1211-13 ARCH STREET Electrical and Scientific Instruments PHILADELPHIA, PA.

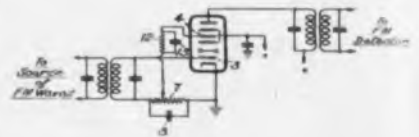
NEW PATENTS

(Continued from page 146)

of the sound-modulated carrier wave, so that the gate voltage follows the signal intensity. The RC network should have a cut-off just above the highest modulating frequency, i.e., the time constant of this network should be such that the gate voltage will follow the highest modulating frequency. C. C. Martinelli, RCA, (F) May 27, 1941, (I) April 4, 1944, No. 2,345,742.

Limiter

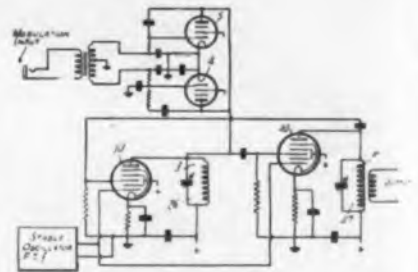
The circuit acts as an amplitude limiter and is inserted between the intermediate frequency stages and the discriminator in an FM or phase modulation receiver. Networks 7, 8 and 12, 13 have a time constant short compared to the shortest audio period and long compared to the wave period. Cathode, control grid 3 and plate act like a low mu section, while cathode, control grid 4 and plate act as a high mu section. Accordingly, the limiter voltage developed across resistor 7 is applied at a predetermined magnitude to the control grid 4 so as to produce a limiter characteristic which is substantially flat above a relatively small carrier input level. The fast-acting AVC



voltage across network 7, 8 is applied to grids 3 and 4. By providing a dual control over the electron stream within a single tube, it is possible to use only one tube and to secure more efficient limiting action which can function at relatively low carrier input levels. Alternatively, the modulated carrier waves may be applied to both control grids and the limiter voltage to only one of them. S. Hunt, RCA, (F) Aug. 22, 1941, (I) March 21, 1944, No. 2,344,699.

Frequency Modulator

Low frequency circuit 26 and high frequency circuit 47 are arranged in a self-oscillating pair of converters 10,40 so that generation of the high frequency is dependent upon the re-entrance through the low frequency circuit. This gives the high frequency circuit a stability equal to that of the low frequency circuit which is the more stable one. For frequency modulation, the tuning of the low frequency circuit is modu-



lated by push-pull reactance tubes 4, 5, or, alternatively, by a balanced off-tuned system arranged for differential modulation. The selectivity of tuned circuit 47 is broad compared to the degree of frequency variation obtained. M. G. Crosby, RCA, (F) March 27, 1942, (I) March 28, 1944, No. 2,345,101.

BUY BONDS

ELECTRONIC INDUSTRIES • July, 1944

High Dielectric Strength

High Mechanical Strength

Low Power Factor

Heat Resistance

High Arc Resistance

They
all
point
to



MYCALEX

THESE important properties are only part of the 21-year success story of G-E mycalex.

In addition, G-E mycalex is easily subjected to all machining operations—drilling, filing, sawing, grinding, polishing—and its stability permits closely held tolerances.

It has high imperviousness to moisture, oils and gases, making it ideal when these conditions are present.

It's unique as a ceramic product . . . because metal parts can be inserted and securely anchored right in it during the process of molding.

Radio, electronic and electrical engineers have found that G-E mycalex

meets many of their specialized insulation needs. Let this outstanding all-purpose insulating material help you solve your insulation problems. And help yourself to General Electric's unequalled experience in the application of this amazing material.

For a list of specialists in the fabrication of G-E mycalex—for a free sample of this material and a copy of the data bulletin, "G-E Compression-Molded Mycalex"—please fill out the coupon. . . . *General Electric, Schenectady, N. Y.*

• Tune in General Electric's "The World Today" and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday evening listen to the G-E "All-Girl Orchestra" at 10 E.W.T. over NBC.

FREE—
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Section 3-D
ELECTRONICS
DEPARTMENT

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Please send me a free sample of G-E mycalex and your descriptive bulletin explaining the methods and tools to use in machining G-E mycalex.

(If you wish a list of fabricators of G-E mycalex, check here _____.)

Name _____
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Over 21 Years of Mycalex Experience—Your Assurance of Quality

GENERAL  ELECTRIC

177-M-C3-0010

ELECTRONIC INDUSTRIES • July, 1944

151



Instead of the silvery Seine — the murky Congo. Instead of well-tended fields and spotless villages — African jungle. Instead of a nation of Frenchmen — a handful of over-worked technicians and hundreds of African natives.

Yet here, three hundred miles up the Congo, is the true voice of France. Here at Brazzaville a gallant group of Free French brought in American equipment and erected one of the most powerful short-wave transmitters in the world. Every hour of the day, the voice of Free France thunders from Brazzaville, speaking in twenty different languages—spreading truth among the conquered peoples of the world—sending bulletins to the Free French fleet.

This tiny outpost is one of the most important voices of France —and Freedom—in the world.

H.R.O. receivers are standard equipment used exclusively in this station for monitoring and rebroadcasting. Brazzaville is the Voice of France, and these receivers are the Ears of Brazzaville.



152

NATIONAL COMPANY

MALDEN



MASS, U. S. A.

ELECTRONIC INDUSTRIES

July, 1944

THREE OF THESE PLASTICS COULD FAIL ON YOUR PRODUCT!



— do you know which one is right?

Only one of the above four widely known plastic materials is suited to your product. The other three, while ideal for other uses, might be costly failures to you. Creative uses all four of these plastics — and many others. We have no interest in pushing any of them.

When you decide that you might like a plastic material on your product, don't worry yourself searching through lists of plastics manufacturers, and then trying to judge between materials. Instead, *call on Creative*

and let an expert, with no particular material to sell, study your problem and advise you which type of plastic, *if any*, will do your job best.

What is more, you may be pleasantly surprised to learn that your product can be produced by us without the cost and delays of molds. Possibly the very item that you want is carried in our stock for immediate delivery.

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Where Listening calls for Courage

For Europe's enslaved millions, listening to radios today involves *danger*—and will so continue until after Victory, when free broadcasts can again be heard without fear.

Even in America, listening today involves *difficulty*—because, due to the priority of radio and electronic devices for military service, Americans are still using the same equipment that has served us since 1941.

And yet the amazing thing is how

well—and how many—of America's 59 million radio receivers are still functioning . . . kept in operation by servicemen who are performing miracles to keep 'em listening. Their testimonials to Jackson's INTEGRITY OF DESIGN—that "hidden plus" of all Jackson Testing Instruments—are based on excellence of performance under most severe handicaps.

Buy War Bonds and Stamps today



New Jackson Instruments, incorporating the advances of military experiences, will be available for the vast post-war radio market. Until then, maintaining Jackson products is a responsibility we shall fulfill as promptly as wartime conditions permit.

Model 652 Audio Oscillator

JACKSON

Fine Electrical Testing Instruments

JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO

154

NEW BOOKS

Communication Circuits. Second Edition

By L. A. Ware and H. R. Reed.
Published by John Wiley & Sons,
Inc., New York, N. Y.

The second edition of this well-known book includes an extensive treatment of ultra-high frequency transmission lines both of the wave guide and conventional coaxial cable types. The development and application of Maxwell's equations to uhf transmission and propagation problems are emphasized and illustrated throughout the text.

The second edition retains the useful chapters on transmission line parameters, T and π networks, network theorems, transmission lines infinitely long, matched, shorted, and open are considered from a mathematical and practical standpoint.

Constant-K and M-derived filters along with composite types are treated in separate chapters. Transmission of uhf waves through wave guides is discussed in Chapter 13 for rectangular guides and Chapter 14 for cylindrical guides. A chapter on transmission line experiments outlines the procedure required to demonstrate important points described in the text.

An appendix contains 9 chapters including an introduction to Fourier series, loop equations, hyperbolic functions, Maxwell's equations, Bessel's functions, and a table of natural hyperbolic functions. The price of this volume is \$3.50.

Electrical Essentials of Radio

By Morris Slurzberg, B.S., M.A., and William Osterheld, B.S., M.A., published by McGraw-Hill Book Company, Inc., New York, 1944. 529 pages, \$4.00.

This book provides a text for a preparatory course for the study of radio and electronics. Basic electrical principles are explained and where possible illustrated by diagrams or photographs.

The electrical principles particularly used in communications are explained in a comparatively simple manner for classes of high school or trade school level.

Symposium on Radiography

Published by American Society for Testing Materials, Philadelphia, Pa.

This 256-page book is the result of the 1943 ASTM symposium on radiographic technic. The book contains all of the papers of the

(Continued on page 158)



E Extra hands

KARP facilities and men, skillful in engineering and fabricating metal parts and products of simple or complex design, are your extra hands. In design, our engineering department has helped solve the knot-tiest of problems. In production and deliveries, our facilities have been praised for maintaining and beating standards and schedules. In cost, KARP extensive stocks of dies have saved thousands of dollars for customers.

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SUPPORT THE 5TH WAR LOAN DRIVE

ANY QUANTITIES — ANY METAL — ANY SIZE — ANY FINISH

KARP METAL PRODUCTS CO., INC.

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CABINETS
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BUY MORE WAR BONDS

For the
EXTRA
Element of
Safety



Type PM (NAF-1131)
Circuit Breaker



Type B-3120 Thermostat
and Heater. Crystal Dew
Point Control



Type C-6363
Switch Circuit Breaker



Type C-4351 Thermostat. Used
for Tube Warming, Tube Cool-
ing, High Limit Controls, etc.



Type RT Thermostat. Adjustable
Crystal Temp. Oven Control



Type ER Series.
Ambient Compensated Time
Delayed Relays



Type C-2851 Thermostat. For
such use as Roughing Controls
on Outer Crystal Ovens

... Use **KLIXON**

Disc-Operated Controls

No matter what the control problem . . . motor and transformer overheat protection, electrical circuit overload protection, thermal time delays or temperature control for radio equipment . . . you get an extra element of safety when you use Klixon snap-acting controls. The reason lies in the actuating element . . . the scientifically calibrated Spencer thermostatic disc. This disc does away with complicated relays, toggles, magnets and other fussy parts. It "snaps" to a solid make or a quick, clean break. And because it has no complicated moving parts, it keeps on providing protection for years on end.

Klixon Snap-Acting Controls are small, compact, light in weight and are unaffected by altitude, motion, shock or vibration. They are available in many standard types to meet most control requirements. Write for complete information.



SPENCER THERMOSTAT COMPANY, ATTLEBORO, MASS.
ELECTRONIC INDUSTRIES • July, 1944

Here's The Precision Factor in Radio Frequency Control



Crystal

PRODUCTS COMPANY

1519 McGee Street, Kansas City, Mo.

Producers of Approved Precision Crystals for Radio Frequency Control

For the inside facts about precise radio frequency control, look *inside* the holder!

Crystal Holder Units are made in many types, but each depends upon the quartz-crystal blank for its accuracy in final performance.

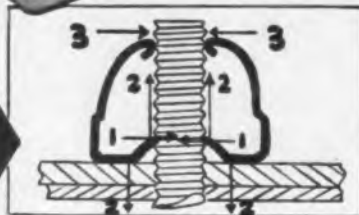
This is why more and more electronic engineers specify quartz oscillator plates made by Crystal Products Company. Here they get crystals made under the most exacting methods of control. Here, too, they find valuable cooperation in engineering the crystal and its holder for any specific circuits.

Our products and our services are available to you. Use them—and be sure of satisfaction.

NEW TYPE NO. 6NAO SELF-LOCKING PALNUTS



With the
TRIPLE GRIP



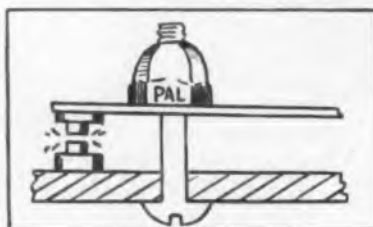
When the Type 6NAO Palnut is tightened, its arched, slotted jaws grip the bolt like a chuck (1-1), while spring tension is exerted upward on the bolt threads and downward on the part (2-2), securely locking both. A third grip is exerted around the top of the bolt by spring tension at 3-3.

The new Type 6NAO Self-Locking Palnut may be used as a one-piece locknut to securely fasten parts—or as an adjusting nut to maintain accurate settings anywhere on the screw. (See typical uses herewith.)

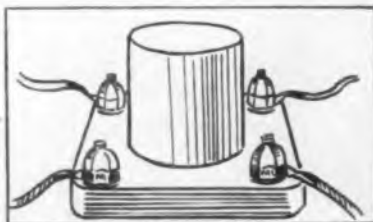
When used as a fastening, the full triple grip is utilized to keep parts tight under vibration, without need of lockwashers. When used as an adjusting nut, the third gripping action (3-3) locks it firmly in position.

Type 6NAO Palnuts are single thread locknuts, made of tempered spring steel. Light in weight, low in cost, easily, speedily applied. Send details of your assembly for samples and suggestions. Write for new data sheet and copy of Palnut Manual No. 2, giving information on all types of Self-Locking Palnuts.

THE PALNUT COMPANY
83 CORDIER ST. IRVINGTON 11, N. J.



As adjusting nut on contact switch.



As fastening to hold electrical terminals.



NEW BOOKS

(Continued from page 154)

1942 annual meeting plus selected papers from the first symposium and other sources. Some of the papers included in this volume are the Principles of the Radiographic Process — Norton; Gamma-Ray Radiography and its Relation to X-Ray Radiography — Mochel; Foundry Applications of Radiography — Cook; Radiography of Welds and Weldments — Lorentz; Precision Radiography—III—Schier and Doan. The price of the book with cloth cover is \$3.00 to ASTM members and \$4.00 to non-members.

Shop Job Sheets in Radio, Book 1, Fundamentals

By Robert Neil Auble. Published by The MacMillan Co., 60 Fifth Avenue, New York City, \$1.50.

This handbook contains experiment or job sheets designed to assist the beginner in radio to obtain a practical working knowledge of the electrical fundamentals of radio. The book is designed for use in well-equipped radio work shops and offers 30 problems from electrical fundamentals to construction of simple receivers and simple test equipment.

Each job sheet is laid out stating the objectives of the experiment, references to text books, the procedure to follow plus other information required to do the jobs. Space is given to answer the questions printed on the sheets.

Basic Mathematics for Engineers

By P. G. Andres, H. J. Miser, and H. Reingold. All of Illinois Institute of Technology. Published by John Wiley and Sons, Inc., New York, 1944. 736 pages, \$4.00.

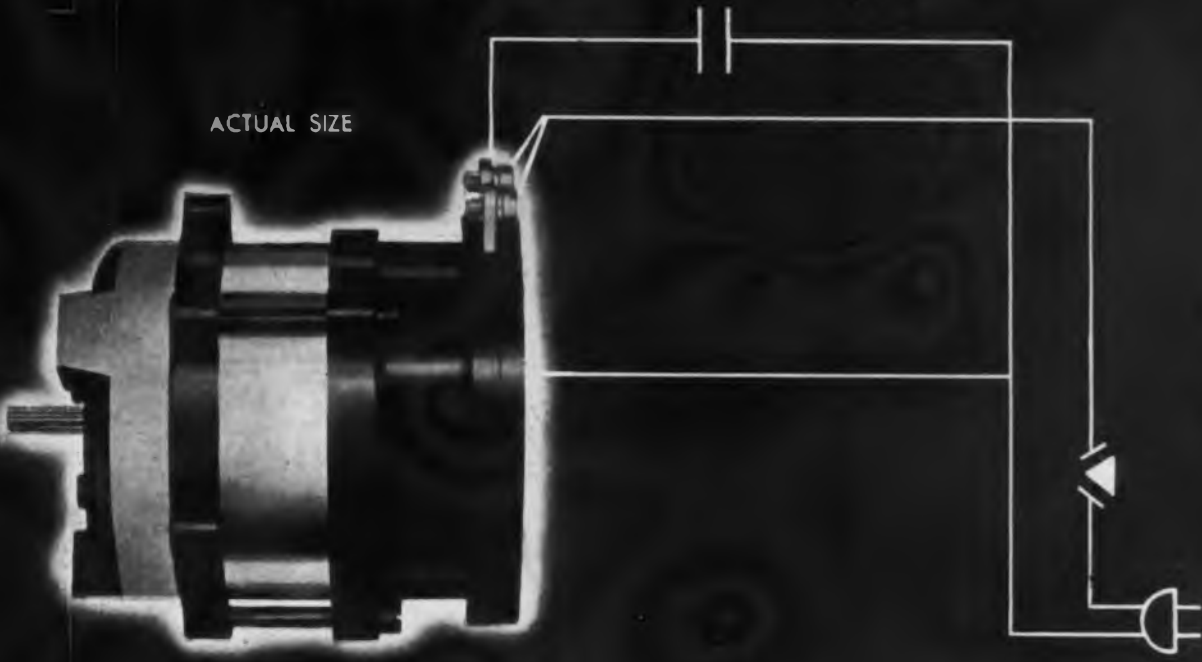
This book can be used as a text for technical and science courses, for home study or as a review or reference for those to whom mathematics has become hazy by non-use. Assuming only a knowledge of basic arithmetic, it takes up algebra, trigonometry, vectors, exponents, radicals, logarithms, imaginary numbers, quadratic equations, analytic geometry (plane and solid) and an introduction to the principles of differential and integral calculus.

The plan of this text, to make each section self-explanatory, is well executed. The illustrations, problems and subject matter are on engineering applications, and any intelligent technical worker should find no trouble in understanding these subjects by determined home study.

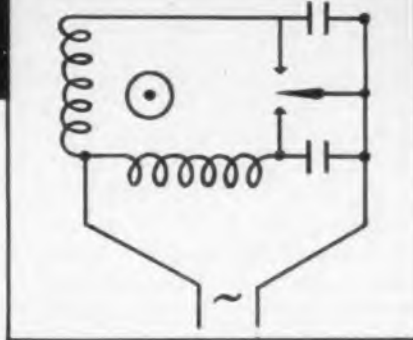
(Continued on page 164)

Design Engineers! ... KOLLSMAN NOW OFFERS

many new types of low-inertia Drag Cup Motors including an adaptable 115 volt 60 cycle unit



DRAG CUP MOTOR SIMPLE REVERSING CIRCUIT



Design Engineers requiring a low-inertia, quick-reversing unit will be interested in the many new types of Kollsman Drag Cup Motors—particularly the new 115 volt 60 cycle units which can be run directly from a regular single-phase outlet with the addition of a capacitor as shown in the main illustration.

The low-inertia, quick reversing characteristics are obtained by a special light aluminum cup, used in place of the usual solid metal rotor. Speed of rotation is varied by controlling voltage input to one or both windings or by varying one phase angle. Direction of rotation may be changed by reversing the leads or phase of either winding.

Where additional torque is needed, and a slight

increase in inertia is not undesirable, copper cups may be substituted for aluminum cups.

In addition to applications as motors, Kollsman Drag Cup Units are sometimes used as induction generators.

OPERATING CHARACTERISTICS--115 VOLT 60 CYCLE DRAG CUP MOTORS

Type	Rotor	Speed	Reversing Time	Stopping Time	Stall Torque
776-05	Aluminum	2930 RPM	.12 sec.	.2 sec.	.50 in/oz.
776-015	Copper	2930 RPM	.20 sec.	.4 sec.	.656 in/oz.

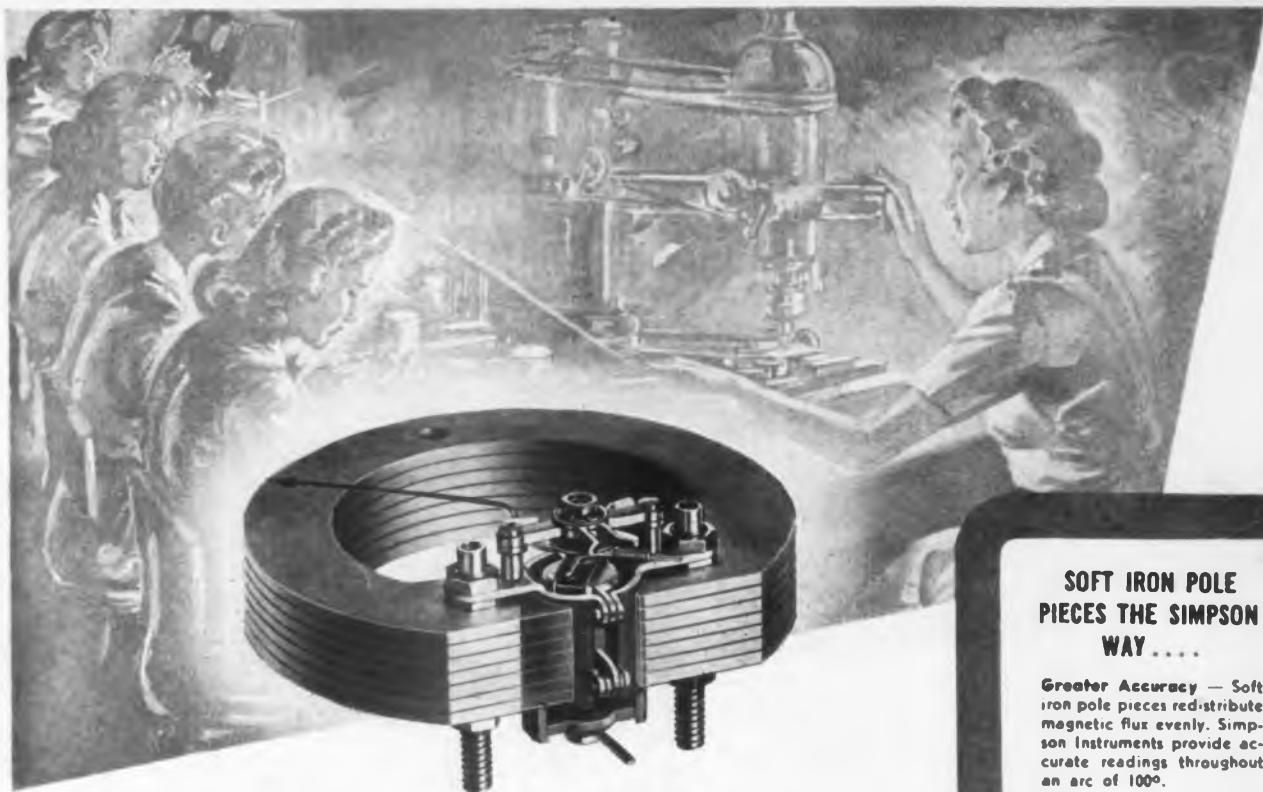
For latest information about Kollsman Drag Cup Motors write to Kollsman Instrument Division of Square D Company, 80-12 45th Avenue, Elmhurst, New York.



ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

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These soft iron pole pieces tell the story—

EXPERIENCE is a much used, and too often abused, word. Yet in any field experience is the only source of practical knowledge—the only sound basis for further advance.

Measured in terms of time alone, the experience of the Simpson organization is impressive enough. For more than 30 years this name has been associated with the design and manufacture of electrical instruments and testing equipment. But the real value of this experience is to be found in the many fundamental contributions Simpson has made to instrument quality.

The use of soft iron pole pieces in the patented Simpson movement serves as an example. An admittedly finer type of design, these soft iron pole pieces have been employed by Simpson to provide maximum strength as well as accuracy, and to achieve a simpler assembly that permits faster, more economical manufacture.

For today's vital needs, this experience enables Simpson to build "instruments that stay accurate" in greater volume than ever before. For your postwar requirements it will insure the correct interpretation of today's big advances.

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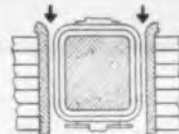


SOFT IRON POLE PIECES THE SIMPSON WAY

Greater Accuracy — Soft iron pole pieces redistribute magnetic flux evenly. Simpson Instruments provide accurate readings throughout an arc of 100°.

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No cracks or irregularities to invite dust or other foreign particles, which might interfere with movement of armature. Reamed to accurate dimensions after assembly.



Speed and Economy—Pole pieces are stamped, not machined. This is one of many ways Simpson has speeded construction, and lowered costs, of this basically better movement.

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Factors with

SHERRON TEST EQUIPMENT

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- ★ Ultra High Frequency Loss
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- ★ Characteristic Impedance
- ★ Power Factor
- ★ Capacitance



Users of Sherron test units are equipped to find the answer to the knotty problem of reduced cable production. They rely on Sherron equipment to help achieve and maintain quality control. Sherron's complete laboratory facilities, practical engineering skill and years of manufacturing experience are available to coaxial cable manufacturers for design, development and production of appropriate testing equipment.

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**"Where The Ideal is the Standard
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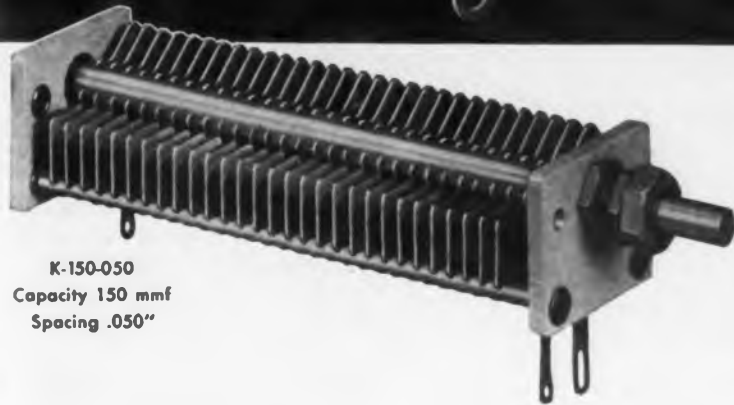
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 Has 29 plates spaced .022"
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MOBILE RECEIVERS—Crystal controlled superheterodynes for medium and high frequencies. Easy to service.



CRYSTALS—Low-drift quartz plates. Fundamental and harmonic types available in various holders.



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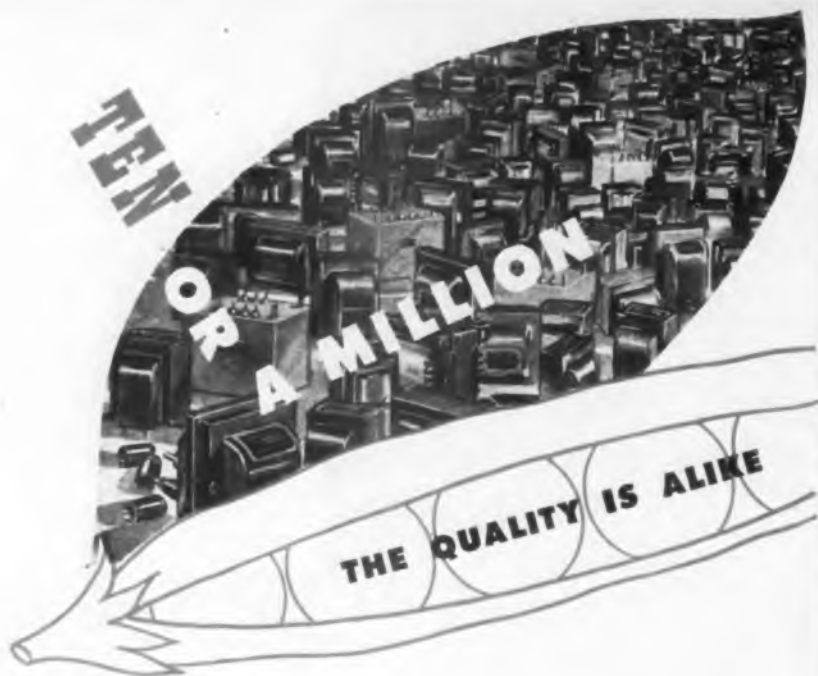


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TRANSFORMERS



NEW BOOKS

(Continued from page 158)

The Oxy-Acetylene Handbook

Published by The Linde Air Products Co., and available at any of their sales offices, 600 pages, cloth, fully illustrated. Price \$1.50, 1944.

This is a complete and comprehensive textbook and operating manual on basic oxy-acetylene welding and cutting procedures. It should fill a need as a guide for self-instruction and also as a standard classroom textbook in vocational and trade schools, technical high schools, and engineering colleges. It is a how-to-do-it book and covers the entire range of the oxy-acetylene process applied to all common commercial metals, together with simple explanations of the fundamental principles of the various methods of depositing and controlling molten metal. It also describes the operating principles of oxy-acetylene equipment and instructions for its care and maintenance.

Basic Radio

By C. L. Boltz. Published by the Ronald Press Co. New York, N. Y., \$2.25.

This book on basic radio is an elementary text book covering basic knowledge required for radio. The author is English and the subject matter follows the syllabus for British Air Training Cadets. The book contains 288 pages, is well illustrated with drawings, and numerous sample problems are used to emphasize the application of the information presented. The subject matter includes fundamental electric and magnetic theory at the beginning and follows through generation and transmission of radio signals. Receivers, oscillators and antenna systems are described.

Basic Radio Principles

By Maurice G. Suffern, Lieutenant, U.S.A. Published 1943 by McGraw-Hill Book Company, Inc., New York and London. About 260 pages. Price \$3.00.

This is a new basic training study-book designed to prepare radio repairmen and technicians on a vocational level in 200 hours of work. The book is novel in that it omits all mathematics, formulas, and complex graphs while attempting to prepare the student for serious work in the radio field. A good deal of practical, down-to-earth advice regarding servicing is scattered throughout and each of the thirteen chapters is followed by a recap quiz. Study assumes basic electricity knowledge.

(Continued on page 168)

Vitrotex Magnet Wire



upped the capacity of this generator **20%**

IT'S A TYPICAL EXAMPLE of results from Vitrotex. When this generator—which was connected to a water wheel of larger capacity—began to overheat, it was rewound with Vitrotex. Result: capacity was increased from 75 KW to 85-90 KW.

Vitrotex pure spun-glass insulation is fire-resistant . . . moisture-proof . . . highly resistant to corrosion. Anaconda Vitrotex Magnet Wires retain sufficiently high dielectric strength to operate satisfactorily at temperatures consider-

ably above the destruction point of cotton, silk, paper and similar insulation.

Excellent space factors, too

And with all their exceptional thermal and dielectric properties—Vitrotex Magnet Wires possess excellent space factors. The design advantages are obvious.

Especially at high operating temperatures, use of Vitrotex wire permits reduction in size of the device in which the wire is used, without danger of fail-

ure due to heat. In the same size, Vitrotex can replace other insulations and thereby increase output.

The Vitrotex covering is bonded to the wire (either bare or enameled) resulting in a smooth surface resistant to abrasion. The covering is extremely flexible and compares favorably with steel in tensile strength.

Vitrotex Magnet Wires are one of the many fine *engineered* products of Anaconda. Any of our sales offices will be glad to supply additional data. ⁴⁴²⁸⁵



Magnet wire and coils



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All pieces can be furnished in any desired finish.

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Every Stewart Stamping, small or large, must conform to specifications. Badly formed, out-of-true, defective stampings simply can't get by. Under our rigorous system of constant checking, the password is "Precision."

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 $\frac{1}{10,000}$ *of an inch?*

Small things are often of major importance—and mean the difference between success and failure. Utah Parts, for instance, must be accurate to the most minute detail. Even an error so small as one ten-thousandth of an inch could result in faulty operation.

This marvelous instrument, the measuring microscope, makes it possible for Utah engineers to spot errors in workmanship—no matter how slight. They are able to make infallible measurements to the ten-thousandths of an inch—just one reason for the split-hair accuracy

of Utah Parts wherever they are used.

Utah's outstanding name for dependability and long life is due to the painstaking inspection, ever watchful surveillance and complete testing. These "traits" in Utah's character have been of prime importance in adapting the many war-born miracles of radio and electronics to today's military needs. They will be just as important in transforming them to commercial uses tomorrow.

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At high altitudes and under all temperature and humidity variations, Permoflux Dynamic Headphones meet pounding battle requirements with rugged mechanical strength and the utmost in communication intelligibility. The same engineering principles that set the pace for improved headphone performance under adverse noise conditions are making their contribution to the superior line of Permoflux Speakers, Microphones, Transformers and other electronic apparatus.

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PRINCIPAL MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

NEW BOOKS

(Continued from page 164)

How to Pass Radio License Examinations. Second Edition

By Charles E. Drew. Published by John Wiley & Sons, Inc., New York, N. Y., \$3.00.

This 320-page volume contains a series of questions and answers on basic radio regulations, theory and principles of radiotelephone and radiotelegraph equipment. An appendix includes rules governing commercial radio operators, extracts from radio laws, Q signals plus miscellaneous useful engineering data.

The subject matter is divided into six elements, namely: Basic Radio Laws, Basic Theory and Practice, Radio-telephone, Advanced Radiotelephone, Radiotelegraph, Advanced Radiotelegraph.

Radio Direction Finders

By Donald S. Bond. Published by McGraw-Hill Book Co. Inc. New York, N. Y., \$3.00.

This new 280-page book covers the theoretical problems of direction-finding in addition to circuits and other features of common



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USE THE "RH" TRANSTAT

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FREQUENCY, VOLTAGES UP TO 480

The type "RH" Transtat was developed for electronic applications where voltage must be continuously adjustable in minute fractional-volt increments, or line fluctuations must have instant and accurate compensation. In achieving such results, these regulators sacrifice neither high electrical efficiency nor extreme compactness.

Like other Transtats, this is a highly efficient transformer type regulator that does not distort wave form or interfere with radio reception. The velvety smooth Transtat system that con-

trols without circuit interruption is further refined by Vernier type actuation and innovations in the core, coil and commutator construction.

If you wish improved efficiency and wider latitude in designing your electrical apparatus, consider the advantages of the compact, lightweight "RH" Transtat as a component. Write for Bulletin 51-2E.

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Great Metal offers you the ideal source of supply for stampings and deep drawings, pierced and hot-tinned as required, in *any* quantity and *when* you need them.

When it comes to cans and brackets, we are bottleneck busters. You can bank on Great Metal to keep your production going.

We have the finest types of automatic equipment. We use electronic control of production and high frequency heat in soldering. We are tooled up for continuous service, now and in the postwar period. We have ample capacity *and* *experience* to meet your needs.

GREAT METAL PRODUCTS ARE NOW BEING SUPPLIED TO THE FOREMOST MANUFACTURERS IN THE RADIO-ELECTRONIC FIELD

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Sales Office—Pittsburgh, 5730 Melvin St.	Jackson 2720
<i>Manager—Harold Friedman</i>	

types of equipment now in use. Aircraft, shipboard and fixed station apparatus and systems are covered in this volume. Particular attention has been paid to current trends such as the use of ultra-high frequencies, the employment of visual and automatic direction finders. Some of the chapters include: General Considerations, Wave Propagation, Directive Antenna Systems, Oral Null Direction Finders, Visual Direction Finders, Radio Navigation.

A number of complete circuit diagrams of modern direction finding apparatus are included.

REDUCING RADIO NOISE

(Continued from page 83)

sector. This detector has a variable delay bias regulated by the threshold control tube. The delay is adjusted so that rectification only occurs above the level of the signal component in the radio frequency voltage being rectified. Once this adjustment is made for the characteristics of the particular set-up involved, no further adjustment should be necessary.

The automatic volume control voltage fed to the grids of the

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When transmitting tubes go into action, there is little to be seen of the forces that make it possible to carry out the vital commands of America's Fighting Men. Like other weapons of war, their efficiency and dependability is a direct reflection of engineering improvements — advanced technical developments that provide our Armed Forces with the world's finest communications. Taylor improved custom-built tubes are today helping defeat the enemy in every battle area. After Victory, these Taylor improvements will be ready for peacetime applications.

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threshold control regulates the delay level with change of signal strength. Audio voltage representing the noise component is taken from the noise rectifier load resistor through a blocking condenser and fed to the gain controlling grids of the pentagrid tubes, these tubes being connected in push-pull with the controlling voltage fed in parallel.

This method provides much smoother control than where a single ended stage is used. A direct current biasing voltage is applied to the gain controlling grids to set the level of the zero axis for the counter modulating voltage. Once set for best performance this level need not be changed.

This circuit is not a particularly simple one; however, it is very effective and is fully automatic, requiring no adjustment with varying signal level. One important advantage of this circuit is the fact that noise voltages are reduced before rectification. This provides several desirable features. Noise voltages do not cause an increase in the automatic volume control voltage; therefore the gain of the receiver is controlled only by signal strength.

Since the same automatic volume control voltage is also used for regulating the noise rectifier delay and the noise amplifier gain, these

(Continued on page 176)

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The Legion of Life...

An army within an army... the 75,000 doctors and nurses of the Army Medical Department have the job of saving, rather than taking life. The victory they are winning is magnificent beyond praise. Want facts?

In the last war, eight of every hundred wounded men died. Today, ninety-seven of every hundred wounded recover. And that is not the whole story, either... the tragic toll of men suffering amputation, prolonged hospitalization, recurrent operations and permanent disability is being drastically reduced.

The wartime products of Connecticut Telephone & Electric Division (field telephone equipment, electronic devices, and aircraft ignition components) are helping the Army Medical Department to practice its skill and devotion with greater promptness than ever before.

Here at home, Connecticut Telephone & Electric hospital communicating and signalling equipment (installed before the war) is also lending a helping hand. Civilian doctors, nurses, and volunteer aides in understaffed institutions are doing a job under trying conditions which too few of us appreciate. "Connecticut" equipment adds to their efficiency in hundreds of American hospitals.

After the war, needed hospital construction will be one of the most active and important elements of the nation's building program. "Connecticut" engineers are planning even now to return to the hospital field with new and better systems for communications, signalling, paging and "electronic supervision".



CONNECTICUT TELEPHONE & ELECTRIC DIVISION
GREAT AMERICAN INDUSTRIES, INC. • MERIDEN, CONNECTICUT





Mallory Standardization Program for Electronic Components *Breaks a Production "Log-Jam"*

Cooperation is a reality in wartime. Mallory engineers have just provided another striking example of practical cooperation with a research program for standardization that assures speedier production and improved construction of components vital to the war effort... conserves valuable engineering time for you.

For the first time, a manufacturer of electronic parts has thoroughly studied the effects of various salt spray conditions on combinations of metals, alloys and platings. One result has been Mallory's development of two *standard* types of construction for radio components:

Type A—most parts: stainless steel and nickel-plated brass.

Type B—most parts: cold rolled steel and brass, cadmium-plated.

Extensive Mallory research has proved what metals do the best job in each part of a switch, variable resistor or jack assembly—what plating thickness is required—what combination of materials will withstand rigorous salt spray tests. Until now, production of rotary circuit switches and other components has been delayed by dozens of specifications—often conflicting—for materials, plating finishes and special construc-

tions. Mallory's new standards are helping to break this "log-jam", with

- Specifications and ordering vastly simplified.
- Production speeded and made much easier.
- Deliveries to customers made more promptly.

Also, the new Mallory constructions are obvious improvements because the materials selected for each part have been proved best.

Mallory cooperation isn't limited to producing better switches, jacks and volume controls, faster. Normally, the salt spray data would be kept secret and used only by Mallory. But throughout the war, Mallory's policy has been to provide useful information to anyone in American industry who can put it to work for victory. Now Mallory offers complete data on the materials and platings, chosen on the basis of thorough salt spray tests, for various parts of Mallory switches, variable resistors and jacks. Valuable data on fungicidal protection has also been compiled.

Collected in a 20-page booklet, this useful information is yours for the asking. Write us on your business letterhead today.

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 - Two Mount in Octal Socket
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TYPE 200

- 1,000 KC to 10,000 KC
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 - Banana Plugs Spaced .750"
- Shown Actual Size*



TYPE 300

- 2,000 KC to 10,000 KC
 - Tolerance .005% — .01% — .02%
 - Plugs in 5 Prong Socket
- Shown Actual Size*



TYPE 400

- 4,000 KC to 10,000 KC
- Tolerance .005% — .01% — .02%
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These crystals are manufactured to the highest standard of quality by the most modern equipment and precise means known to the art. All units are scientifically adjusted by X-Ray and, before shipment, are thoroughly tested for frequency, drift, and activity, throughout your specified temperature range.

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You have known of Sperti, Inc. as a pioneer in the field of selective radiation.

Sperti lamps for the irradiation of food, to increase vitamin D content, are widely applied. So also is the Spertifier, an ultraviolet source radiating in a selected band. For some time it has been standard equipment in many packing plants, locker plants and meat markets where it inhibits the growth of mold. It allows tenderizing enzymes to act in the meat without mold and without spoilage.

The Sperti ultraviolet lamp combining ultraviolet and infrared rays has been accepted by the medical profession and domestic users.



While Sperti is engaged in war work, these products of selective radiation have necessarily given way to more urgent military demands.

But in the laboratories beyond Sperti, engaged in pure research, work on selective radiation has continued with developments that may have wide postwar applications in broadly diversified fields.

It is suggested that you maintain a contact with Sperti, Inc. so that you may be kept informed of these later developments.

Sperti
INCORPORATED



RESEARCH, DEVELOPMENT, MANUFACTURING • CINCINNATI, OHIO

(Continued from page 172)

stages are also controlled by the carrier strength only. If a squelch circuit is used in the receiver, the fact that the automatic volume control voltage is not substantially increased by noise makes it possible to set the squelch much closer to the opening point without noise bursts opening the squelch. Thus the squelch is actuated primarily by signal strength and can be set to be very sensitive and positive in its operation.

If a series limiter is used following this counter modulation circuit as a final cleanup circuit, a further improvement can be gained. This is due to the fact that such a limiter can be set to cut very sharply at a predetermined level. Inasmuch as the automatic volume control voltage is now dependent primarily upon signal strength, this voltage can be used to control the series limiter so that a very precise control is obtained.

For communications work it is often advantageous to limit at less than the one hundred per cent modulation level. The best overall performance attained under any conditions has been obtained using a counter modulation circuit removing noise voltages almost to the modulation level and then using a series limiter controlled by the automatic volume control voltage so produced and setting this limiter

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WIDE RANGE VACUUM TUBE VOLTMETERS



- High input impedance for both AC and DC measurements.
- Convenient, low capacity "Probe" especially adapted to high frequency radio use—100 megacycles and over.
- Self-regulating operation from power line; no batteries.
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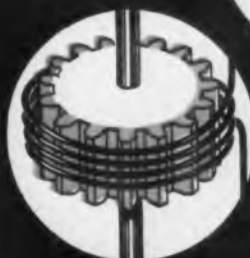
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IS YOUR HEATER A POWER-WASTER?

Whether your heating operations require large or small units, we can give you the **RIGHT** unit for your applications. You need not use a "misfit" that gives you an incorrect power and frequency selection. Scientific Electronic units usually pay for themselves many times over in *savings*.

Note the wide range of power-and-frequency combinations our equipment offers. Before you buy an Electronic heater, investigate the advantages our units afford. *Write today for detailed information.*



Scientific Electric



DIVISION OF "S" CORRUGATED QUENCHED GAP COMPANY
119 Monroe Street Garfield, New Jersey

Manufacturers of Vacuum Tube and Spark Gap Converters since 1921.

Our equipment offers you a selection of frequencies up to 300 megacycles — and the following power range, with stepless control from zero to full load:

3 Kw
5 Kw
7½ Kw
10 Kw
12½ Kw
15 Kw
18 Kw
25 Kw
40 Kw
100 Kw

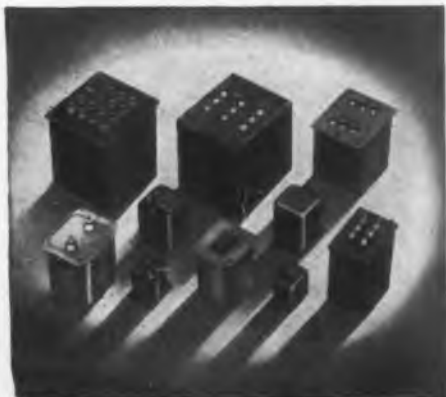


*Magnets
made by
Lightning Flashes*

Distant flashes of lightning were used to magnetize needles by Joseph Henry during his experiments at Princeton in the 1840's. The needles were placed in coils attached to a metal roof and grounded. This little-known incident demonstrated to Henry that electromagnetic force was propagated — "wave-fashion."

Electronic research is an ever-unfolding drama that often magically turns into real-life factors—as Stancor engineers discover almost daily—and the values of which they build into the devices now being perfected for better coordination and control of communication.

SEND FOR NEW COMPLETE CATALOG



STANCOR

Transformers

STANDARD TRANSFORMER CORPORATION
1500 NORTH HALSTED ST. • CHICAGO 22



Manufacturers of quality transformers,
reactors, power packs and allied products
for the electronic industries.

to cut at less than the one hundred per cent modulation level.

The series limiter, its advantages and disadvantages, is rather well known, so no extended discussion of this type of circuit should be necessary. The same may be said for the shunt type limiter. These limiters are usually operated between the second detector and the first audio stage. Both types can be made fully automatic in their operation.

One other type of circuit not so well known is a limiter controlled by average audio level. For certain purposes this is highly desirable. The circuit may be used in addition to other noise reducing circuits which are controlled by the strength of the signal. Such circuits allow noise up to a predetermined modulation level to pass through the circuit. If the carrier is unmodulated or modulated at a low percentage, the noise allowed

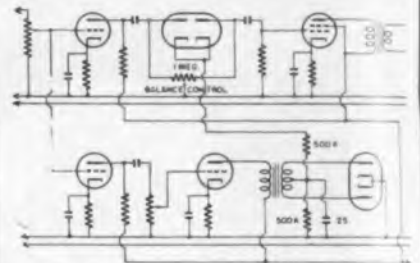


Fig. 6—In this circuit there is a limiter controlled by average audio level

KIRKLAND Pioneer

INDICATING LAMPS



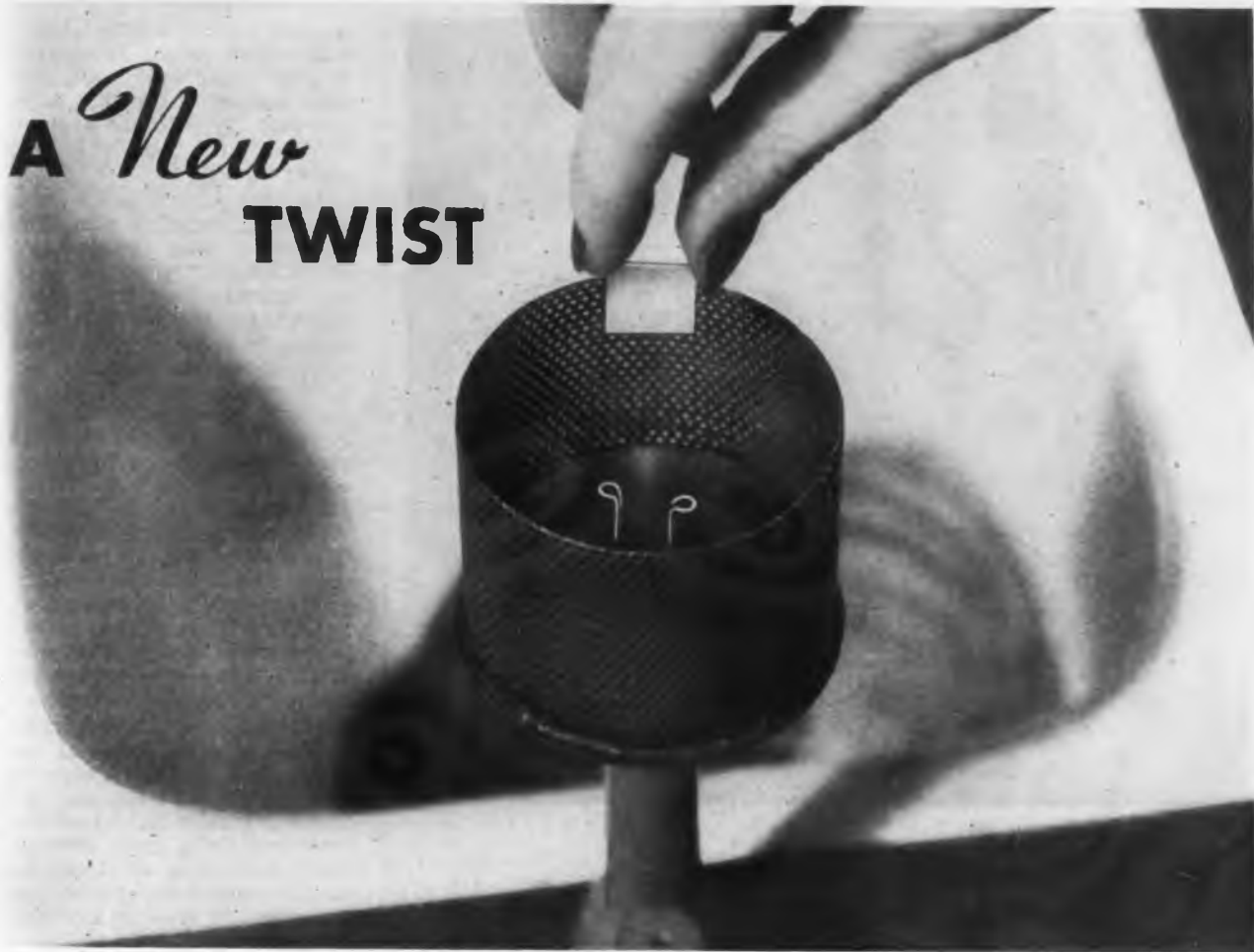
No. 600 . . . Molded Bakelite socket with special lamp gripping features, 6/32 terminal screws and 1/4" insulation barrier; high arched lens for side visibility; correct interior diameter to control lamp heat and to permit easy lamp removal without tools. Increased diameter flange for positive coverage of mounting hole; chromium plated; Underwriters Approved for 120 V. (S6 type bulb). Patented 1931. (U.S. No. 185-8994).

KIRKLAND HEAVY DUTY UNITS, standard since 1931 on the products of America's finest manufacturers. All units feature: single hole mounting; easy lamp removal from the front; screw terminals in husky sockets; longer threaded area for thicker panels; and most important; NON-TURN lug to prevent the unit from turning in the mounting hole.

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Write for
Catalogue

THE H. R. KIRKLAND CO.
MORRISTOWN, N. J.

A New TWIST



... to CRYSTAL CLEANING



THIS is an actual photograph of the centrifugal air drier, or "spinner," used in Bliley production to facilitate clean handling of crystals during finishing and testing operations. Quartz blanks are dried in 5 seconds in this device which is powered with an air motor and spins at 15,000 r.p.m.

Little things like lint or microscopic amounts of foreign material can have a serious effect on crystal performance. The "spinner" eliminates the hazards encountered when crystals are dried with towels

and makes certain that the finished product has the long range reliability required and expected in Bliley crystals.

This technique is only one small example of the methods and tests devised by Bliley Engineers over a long period of years. Our experience in every phase of quartz piezoelectric application is your assurance of dependable and accurate crystals that meet the test of time.



BLILEY ELECTRIC COMPANY - - - ERIE, PA.



Bliley Crystals





IN *Crystals* IT'S THE *Cutting* THAT Counts



To insure constant frequency and high activity, Crystals must be cut at the correct angles to the crystallographic axes. That's why C.T.C. Crystals are X-RAY ORIENTED. This process predetermines the axes of the Crystals, making it possible to cut each slice with extreme accuracy.

Next time you need Crystals send your specifications to us. You'll find C.T.C.'s "correctly cut" Crystals will meet your most exacting standards of quality and performance.

For delivery estimates, quotations, etc., get in touch with

CAMBRIDGE *Thermionic* CORPORATION
441 CONCORD AVE. • CAMBRIDGE 38, MASS.

to pass can be appreciable. If the additional limiter is controlled by average audio level at a syllabic rate, this additional limiting action will rise and fall with the average modulation level. Such a circuit is shown in Fig. 6.

In this circuit audio voltage is amplified, rectified, and filtered to produce a bias voltage for a full wave limiter. When the audio voltage impressed on the limiter input exceeds the bias voltage, the limiter ceases to conduct. The time constant of the bias level is determined by the value of capacitance across the full wave rectifier load resistor. A variation of this circuit uses the bias voltage to control the gain of an audio frequency amplifier rather than straight limiting action. Somewhat better control is obtained by this method as the wave shape is not altered, although the circuit now operates as an expander rather than as a limiter. A pentagrid first audio stage may well be controlled in this manner to reduce the gain when the modulation level is low.

All of the foregoing circuits have definite practical uses; as has been pointed out, it is often advantageous to employ more than one circuit to attain maximum possible performance for a given service. It is really surprising what can be done in the reduction of noise if circuits are carefully selected and designed.

PREMAX



ANTENNAS In Standard and Special Designs to meet every need in maintaining communications for the Armed Forces . . . on land or on sea. Write for Bulletin.

Premax Products

Division Chisholm-Ryder Co., Inc.
4408 Highland Avenue, Niagara Falls, N. Y.

ELECTRONIC INDUSTRIES • July, 1944



**Lumarith* insulation...
guards against**

**HUMIDITY'S
BLACK HAND OF CORROSION**

LUMARITH (cellulose acetate) insulation is especially effective in resisting electro-chemical oxidation whenever electrical equipment must operate in a highly humidified atmosphere. A textile mill spinning-room provides an excellent example. Here humidity must be adequate to keep down static electricity, and contactor coils especially have been known to burn out prematurely due to moisture-induced corrosion. The use of Lumarith insulation guards against this trouble.

Lumarith films for moisture-resisting wrappers and layer insulation, and Lumarith dip coats have excellent dielectric and physical strength and are low in moisture absorption. The films are furnished plain or with

a special mat finish which is easy to see and prevents slipping of wires—important winding advantages.

"Lumarith for the Electrical Industry" is a booklet worth studying. Send for your copy. Celanese Celluloid Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off.

LUMARITH*
A Celanese Plastic



PULSE

Commutation is the heartbeat of a motor or dynamotor. A schoolboy might define this important function as: "conducting the right voltage to the right place at the right time." That description is simplicity itself, but not so simple are the design calculations upon which commutator manufacture and performance are based.

In d.c. machines, such as Eicor motors and dynamotors, commutation reverses current direction thousands of times per second, each reversal involving the making and breaking of a momentary contact. To provide years of unflinching service, the commutators must be large enough to carry the current and dissipate the heat but still be of a diameter small enough to afford moderate peripheral speed and long brush life. Division of the commutator into segments of proper number is based on such factors as voltage, composition and size of brushes, and on performance requirements.

The individually formed copper and mica segments are hydraulically swaged into permanent position on the mica lined steel core. After heat treating, high potential tests are made between segments and from each segment to ground to prove insulation. When the commutator is mounted and connected as part of a complete armature, it is finished by turning and undercutting (illustrated), and then by machining to concentric limits measured in "tenths."

Good commutation, so vital to the fine performance of an Eicor unit, can be consistently achieved only by men with specialized knowledge and experience.



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RADIO IN RUSSIA

(Continued from page 77)

of a most capable individual who had in operation many interesting ideas to increase production.

Factory morale

I shall mention a few of these plans which were in operation in these newer plants. Some of these will be familiar to you as they are carried out in your own plants. However, such morale-increasing programs are much more strongly stressed in Russia than in America.

1. Painted signs were placed over machines when the individuals had pledged to better their quotas. Upon being introduced to these outstanding employees, I found them very interested in their work and eager to excel in their work.

2. Progress reports in the form of easily read graphs were posted in each department showing what they had agreed to do and the production percentages to date.

3. Suggestion boxes were placed throughout the factory. Bonuses were given and the individual's

(Continued on page 184)

RADIO and ELECTRONIC ENGINEERS

Project and design engineers experienced in the field of communications equipment and radar.

Also openings for junior engineers to serve as assistants to senior project men.

Positions available for engineering inspectors, draftsmen, and tracing checkers.

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DIRT-

INSIDE ELECTRONIC TUBES CAN CAUSE TROUBLE TOO

Foreign matter within an Electronic Tube was always a hazard. Now, with the tendency toward miniature tubes and smaller parts with less distances between them, even a tiny thread of lint free in the glass enclosure can prove very damaging.

The TUNG-SOL regular procedure of washing and baking all mounts and glass enclosures just before sealing has proven a more than worth while precaution. It not only removes all dirt and dust and lint from component parts but at the same time removes any deposit of harmful salts that might poison the emission

of electrons from the filament.

This final cleaning is just one of the innumerable practices instituted by TUNG-SOL research and development engineers, who have given TUNG-SOL Electronic Tubes their ruggedness, long life, efficiency and uniformity. These characteristics are important to both manufacturers and users of electronic devices. These engineers are available to you to assist in the designing of circuits and in the selection of the tubes that will do your job most efficiently.



EVERY DAY IS WASH DAY...



A continuous flow of hot water is introduced through the bottom of the washing tank and is discharged out the top floating the lint and foreign matter out with it. This prevents contamination of water. After washing, both mounts and enclosures travel through a high temperature oven, thoroughly clean and ready for exhaust.

TUNG-SOL

vibration-tested

ELECTRONIC TUBES



TUNG-SOL LAMP WORKS INC., NEWARK 4, NEW JERSEY

ALSO MANUFACTURERS OF MINIATURE INCANDESCENT LAMPS. ALL-GLASS SEALED BEAM HEADLIGHT LAMPS AND CURRENT INTERMITTORS

ELECTRONIC INDUSTRIES • July, 1944

183

ANDREW

No. 83

3/8" COAXIAL TRANSMISSION LINE

QUICK DELIVERY can be made on this extremely low loss transmission line. Especially suited for RF transmission at high or ultra-high frequencies, it has wide application (1) as a connector between transmitter and antenna, (2) for interconnecting RF circuits in transmitter and television apparatus, (3) for transmitting standard frequencies from generator to test positions, and (4) for phase sampling purposes.

Andrew type 83 is a 3/8" diameter, air-insulated, coaxial transmission line. The outer conductor material is soft-temper copper tubing, easily bent to shape by hand and strong enough to withstand crushing. Spacers providing adequate mechanical support are made of best available steatite and contribute negligibly to power loss.

Accessory equipment for Coaxial Transmission Line, illustrated:

Type 853 Junction Box: Right angle box required where very sharp right angle turn is necessary.

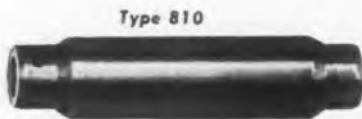
Type 825 Junction Box: Three way T box for joining three lines at right angles.

Type 1601R Terminal: Gas tight end terminal with exclusive Andrew glass to metal seal. Incorporates small, relief needle valve for discharging gas.

Type 810 Connector: Cast bronze outer connector with copper sleeve for inner conductor.

Andrew Company manufactures all sizes in coaxial transmission lines and all necessary accessories.

Write for Descriptive Catalog



Type 810



Type 1601R



Andrew Type 83 (3/8" diameter) coaxial transmission line is manufactured in 100 foot lengths and may be purchased in coils of this length or in factory spliced coils of any length up to 1/2 mile.

ANDREW CO.



363 EAST 75th STREET
CHICAGO 19, ILLINOIS

picture was placed on the bulletin board when a suggestion was accepted.

4. At the main entrance to the plant were several large bulletin boards in a small courtyard. The bulletin boards covered the following subjects:

a. Cartoons showing various humorous incidents that have occurred in the plants—all well sketched.

b. Pictures of the 20 workers who made the highest percentage of quota for the preceding month.

c. List of 14 to 16-year-old children working in the plant who have shown the best in their factory work and at their industrial school.

d. Daily copy of the "Moscow News."

e. War Map—which is changed daily to show the location of the Red Armies and the cities captured.

f. Display of letters written from the front by previous employes of the plant.

g. Notice of daily pep talk by some soldier. The day I was there, a guerrilla fighter who had operated behind the

"Urgent Equipment"

Builders of—

SPECIALLY DESIGNED

INCANDESCENT LAMP

RADIO TUBE

ELECTRONIC TESTING and

PRECISION MACHINERY

For the past 25 years!

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NEWARK, N. J.

Bigelow 3-0234 and 0235

Now a
NEW BLUE SENSITIVE

CETRON Phototube

The CE-29 is of short, sturdy construction and is particularly sensitive to blue and violet light. It is, therefore, particularly useful with light sources rich in violet, blue and green light. In many applications this tube will possess advantages even with light sources which produce considerable red and infra-red light. Though the CE-29 is not sensitive to red and infra-red light, its basic sensitivity on an energy basis is at least ten times that of conventional red sensitive phototubes.

RMA spectral sensitivity designation is S-4. CE-29 uses octal 5-pin base, interchangeable with other similar tubes. Send for bulletin PC-15 giving complete technical data.



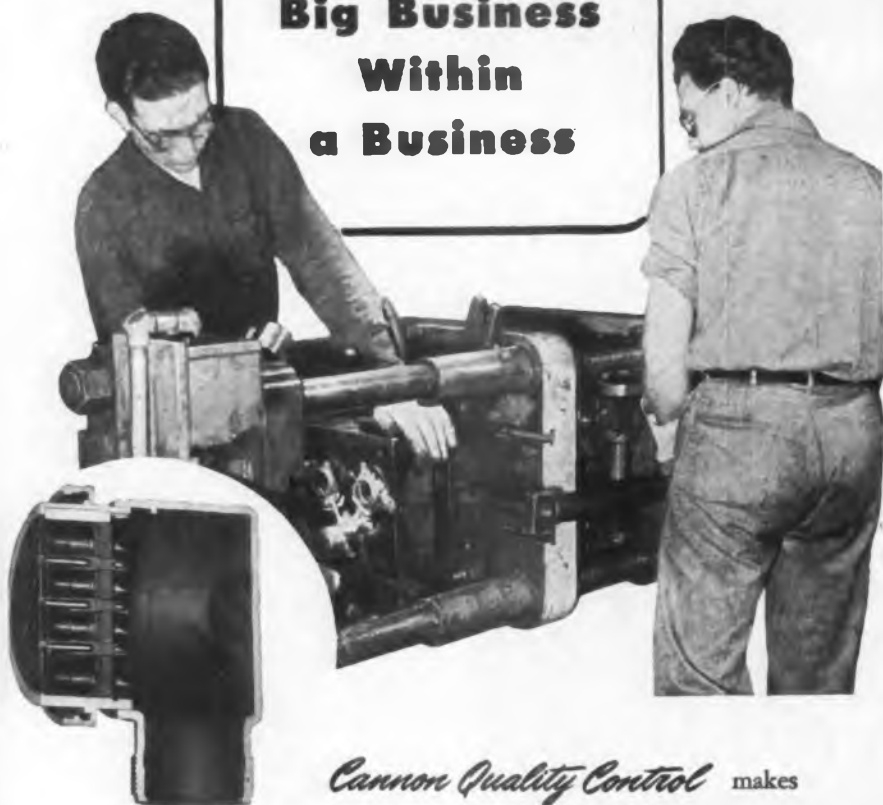
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GENEVA, ILL.

NEW YORK OFFICE
265 W 14th ST.

Big Business Within a Business



Cannon Quality Control makes some exacting demands—for instance die castings so intricate and precise that ordinary sources

can't supply them profitably and in quantity.

So we built, equipped and staffed our own die casting department.

It's a big one—rates among the five largest aluminum alloy die cast plants in the country. It has a huge capacity—much more than even we need. But its size assures our customers

prompt delivery of almost any quantity of Cannon Connectors, on short notice without the slightest sacrifice of the well-known Cannon qualities—easier assembly, better fit, greater strength with less weight, longer trouble-free life.



Cannon slide films with sound covering assembly and soldering techniques are available on request. Address Department A-122, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

CANNON ELECTRIC

Cannon Electric Development Co. Los Angeles 31, California

Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto

REPRESENTATIVES IN PRINCIPAL CITIES — CONSULT YOUR LOCAL TELEPHONE BOOK



German lines was to speak.

h. Pictures and lists of the employes operating the best "Victory gardens."

i. Thermometer type chart showing the over-all requirements of the plant as specified by the central planning group in Moscow and the percentage to date for the month.

News is broadcast throughout the plant over loudspeaker systems and the employes are kept up to date on both war news and the over-all requirements and production in their own departments, as well as for the entire factory.

In several of the plants I visited many American machine tools were being used. However, it is quite definite that the Russians do possess the "know-how" to properly put into operation plants comparable in operating efficiency to our own radio factories. They had functioning all the elements of a modern plant, and in the hands of a capable man.

Traveled 7,000 miles by plane

As stated before, I tried to read the most highly recommended books regarding the Soviet before taking the trip. There are not many points on which you can get

THERE'S A DRAKE SOLDERING IRON FOR EVERY TYPE OF ELECTRONIC WORK

From that mighty mite



the Drake No. 400 to the high-speed production "honey"



the Drake No. 600-10 there is a high quality Drake Soldering Iron "just right" for the job.

Drake Heat Controls and the Drake "Magic Cup" Stand are important soldering aids.



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PARTS JOBBER

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"BOILED-DOWN" PRODUCT INFORMATION for Engineers

Here are the "quick facts" about S. S. White Flexible Shafts, Fixed Resistors and Plastics Specialties — all of which are widely used in electronic applications. Note and keep this information handy.

FLEXIBLE SHAFTS

S. S. White offers the widest selection of flexible shafts for power transmission and for remote control, each type specially engineered and constructed for its particular function.

POWER DRIVE SHAFTS range in diameter from .095" to .750" with a selection of different characteristics of torsional strength, torsional deflection, transverse flexibility, etc., in each diameter. Table of engineering data in **BULLETIN 43**.

REMOTE CONTROL SHAFTS come in diameters from .130" to .437"; also in a wide selection of characteristics. Basic data table in **BULLETIN 43**.

FLEXIBLE CASINGS — A wide range of Metallic, Fabric and Rubber Covered Casings for light and heavy duty use with flexible shafts. Basic data on all types included in **BULLETIN 43**.

END FITTINGS for shafts and casings in a comprehensive selection of designs. Illustrations with dimensions in **BULLETIN 43**.

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Write for yours.

FIXED RESISTORS

The "all-weather" resistors, featured by noiseless operation, retention of values, durability and excellent performance in all climates.

STANDARD RANGE—1000 ohms to 10 megohms.
HIGH VALUES—15 megohms to 1,000,000 megohms.
BULLETIN 37 with full details mailed on request.

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S. S. White offers a complete line of plastic dummy shipping plugs and caps designed to provide inexpensive protection for products with threaded openings during shipment. Full details in **BULLETIN P-4305**—copy on request.

S. S. White also offers a complete plastics molding service equipped to provide the best in molding in any thermoplastic or thermosetting material to your specifications. Quotations on your requirements furnished on request.

The name "S. S. White" on any product is your guarantee of highest standards of engineering, material quality and craftsmanship.

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INDUSTRIAL

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FLEXIBLE SHAFTS

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MOLDED PLASTICS

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FLEXIBLE SHAFT TOOLS





**New Development Increases
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From the time they are wound and assembled with all insulation material in their own metal containers — throughout the entire impregnation cycle, sealing operations and final tests — Oil Type BC Capacitrons remain untouched by human hands — safe from the possibility of body acid contamination, physical damage, moisture or injurious foreign matter.

The development of this method of processing large section capacitors assures a tangible increase in the life expectancy of these units and is one more reason for using Type BC Capacitrons in your equipment. Our prompt delivery of these uniformly high-quality capacitors, which meet both Army and Navy specifications, can mean increased production for you.

IMMEDIATE DELIVERY on these Oil Type EC CAPACITRONS

Controlled production on just a few basic Capacitron types means quick delivery to many customers. Type EC units can be supplied in many capacities and voltage ratings to suit your need. Write or wire today for information covering your requirements.

Telephone: MICHigan 9656



The CAPACITRON Company

318 West Schiller St., Chicago 10, Illinois

unanimous opinions, even from people who have been there for many years. I was in Russia only six weeks, but I was unrestricted in my plant visits, traveling some 7,000 miles by air within the country. I was also free to observe and talk with as many people as I wished, and tried to form some opinions which may be of interest.

The Russian people have an unextinguishable love for the soil of their country. This tremendous feeling for the soil united the republics at the time of the German invasion as nothing else could have. The love for the soil is intensified by the fact that before science and industry were started in Russia, the people's livelihood was almost entirely dependent upon the crops and the forests.

The Russians have a fierce hatred of the Germans because Russian losses have been so tremendous, and because of the treatment of their people in occupied territories. In my discussions with the Russian people, there were very few with whom I talked that had not lost an immediate relative.

Throughout the entire country I found the people very enthusiastic about good music, drama, opera and the ballet. The movies are primarily composed of news reels and historical pictures. At Leningrad and Moscow the ballet and opera were kept operating even

110-VOLTS A.C. from DIRECT CURRENT

with KatoLight Rotary Converters for operating radio and electronic equipment, moving picture projectors, sound apparatus, A.C. appliances, etc.



225 WATT CONVERTER

Available in sizes 110 through 2500 watts, 1800 and 3600 r.p.m. ball bearing designs. Furnish standard 110-volt, 60-cycle, A.C. from 32, 110 or 220-volts direct current. Quiet in operation. Can be furnished with special filtering equipment for sensitive radio work.

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At present Kato's entire production must be directed to furnishing converters on high priority orders. Write us if you need this kind of equipment for orders.

Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; frequency changers; high frequency generators; and motor-generator sets.

KATO ENGINEERING CO.
150 SPRING ST. MANKATO, MINN.

SIMPLICITY OF APPLICATION

... and High Degree of
Vibration Isolation are
Basic Features of → → →



MILLIONS of Lord Mountings are in use today, providing protection against the harmful effects of shock and vibration on all types of industrial, military, and naval equipment, from light, delicate instruments to heavy, massive machinery.

Providing such protection in modern equipment designs may well be termed "Protective Engineering". To engineers confronted with a problem of vibration control, Lord offers a wide variety of bonded rubber, shear type mountings from the standpoint of function, size, shape, load ratings, and methods of application.

The accompanying photographs show Lord Plate Form Holder Type Mountings being used to float electric generators within the transmitter housing of a marine radio unit manufactured by Federal Telephone and Radio Corporation, at Newark, New Jersey. Simplicity of application is well illustrated. The generators weigh 110 pounds each, and the mountings serve to isolate component equipment from any disturbing forces emanating from this source.

Through proper mounting selection, isolation efficiencies ranging from 75% to 85% reduction of disturbing forces may be expected, although reductions up to 97% are not unusual in equipment operating at very high frequencies. The remarkable efficiency of Lord Mountings is due to the accuracy, precision, and uniform quality of manufacture.

Lord Mountings are made in two main types, Plate Form and Tube Form, with variations to suit special conditions. Load ratings of standard sizes range from a few ounces to 1500 pounds. They absorb shock, control vibration, and minimize all noise transmitted through solid conduction.

For complete information covering all Lord Mountings, as well as engineering discussion on vibration control, write for Bulletins 103 and 104, or call in a Lord Vibration Engineer for consultation on your vibration problems. There is no obligation.

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Designers and Manufacturers of
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Chicago Transformer is an organization specializing exclusively in the design and manufacture of all types of small transformers and reactors.

Housed in our modern daylight plant are complete laboratory and plant facilities for the handling of every operation in the manufacture of fine transformers.



**CHICAGO TRANSFORMER
 CORPORATION**

DIVISION OF ESSEX WIRE CORPORATION

3501 WEST ADDISON STREET • CHICAGO, 18

while the Germans were a very few miles away. The Russian people are very eager to learn, are energetic, hard working, resourceful and ingenious. This has been shown in their ability to adapt themselves quickly to changing fighting conditions such as they were up against with the mechanized German armies. As individuals, their habits, temperaments, likes and dislikes are almost identical with those of the average American.

Both Russia and the United States have many fundamental and basic things in common. Both countries are generally self-sufficient so far as their basic requirements are concerned. Neither country has had any ambitious colonization program. Neither country should have any difficulty in the future from an immigration standpoint.

I feel that the friendly relations of the United Nations will continue to develop. Russia's big problem is raising the standard of living in her own country, which will require all of the products that they can produce. As for postwar radio problems, it would seem to me that if they are handled on a business basis, the United States and Russia can be of great mutual help to one another.

BIRD & CO.
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GLASS "V" BEARINGS
made to your specifications

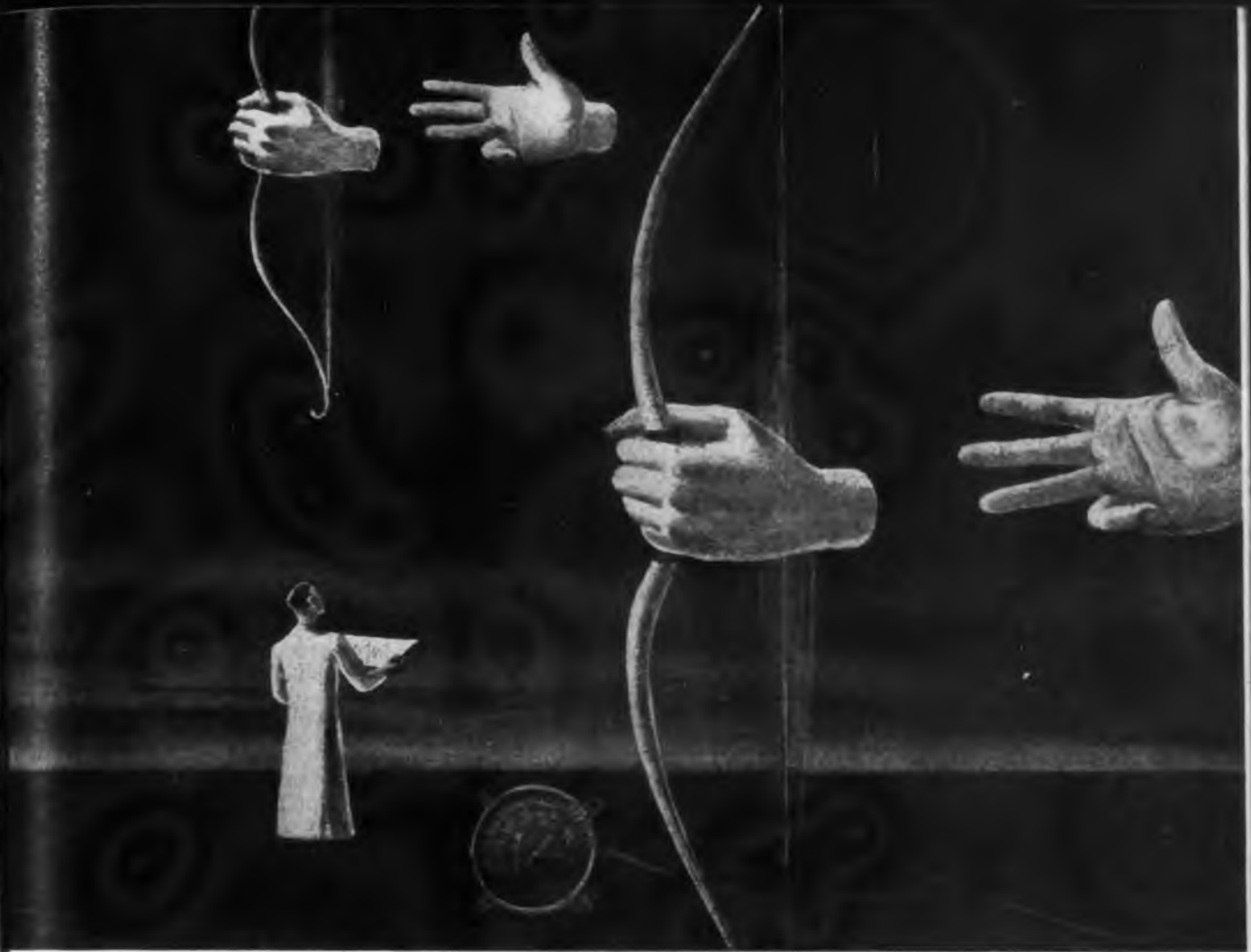


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Write for details of
Vibration machine VMJ-4VF.



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descriptive
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Waugh Laboratories presents a new Waugh-Johnson vibration machine, for high frequency vibration of loads up to 500 lbs. Amplitude 0 to 1.5 inches with frequencies of 600 to 6,000 C.P.M. Automatic electric control of amplitude, frequency and acceleration over entire range while in operation. Table dimension 4' x 4'. This is one of a series of Waugh-Johnson high-frequency vibration machines designed to test equipment of all types which must meet Army and Navy specifications.





Designers and Manufacturers of
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made to your specifications



We welcome your inquiries

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A NEW STRING—A BIGGER BOW

Write for details of
vibration machine VMJ-4VF.



Send for
descriptive
literature.

Waugh Laboratories presents a new Waugh-Johnson vibration machine, for high frequency vibration of loads up to 500 lbs. Amplitude 0 to 1.5 inches with frequencies of 600 to 6,000 C.P.M. Automatic electric control of amplitude, frequency and acceleration over entire range while in operation. Table dimension 4' x 4'. This is one of a series of Waugh-Johnson high-frequency vibration machines designed to test equipment of all types which must meet Army and Navy specifications.



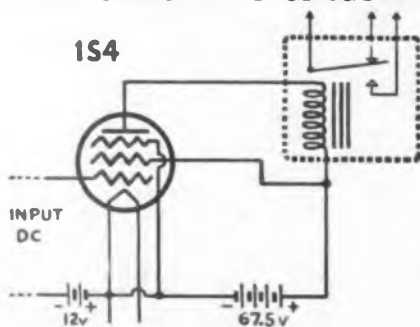


Matching a Relay

to an output tube circuit involves unusual considerations which are sometimes overlooked. While the results are not strictly like the above picture, they are often nearly as unfortunate!

WHAT RESISTANCE WOULD YOU SPECIFY FOR THE RELAY COIL IN THE FOLLOWING CIRCUIT?

★ Assume it is desired to energize the relay from a 2 volt D. C. signal (positive).



★ The book says a 1S4 should operate into a 5,000 ohms plate load when used with a 67.5 volt plate supply. Bear in mind that we wish to put as much power as possible into the relay under conditions of minimum signal.

If the relay resistance is 5,000 ohms the plate current will be about 1.5 Ma with no signal, and about 3 Ma with a 2 volt signal. The corresponding power values are .011 watt and .045 watt. How good is the match?

A 67.5 volt circuit passing 3 Ma has a total resistance of about 22,500 ohms. If less than 25% of this is in the relay coil, it is easy to see that power is being wasted.

Now suppose we try a resistance of about 16,000 ohms. The plate currents with and without signal will be around 2.5 and 1.25 Ma., corresponding to power values of .100 watt and .025 watt. Since a 67.5 volt circuit with 2.5 Ma flowing has a resistance of 27,000 ohms and we have about 16,000 in the relay coil, our match, although apparently not perfect, is a great deal better than before, and accounts for the large increase in relay power. The optimum match is not necessarily at the point where $\frac{1}{2}$ the circuit resistance is in the relay, because of the non linear tube plate current characteristic. Usually the relay resistance should be enough to drop the plate voltage somewhere near the knee of the plate current curve for minimum useful input signal, with due allowance for all circuit variations.

We are anxious to help you on Relay Problems. Send us the details.



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SIGMA
RELAY
TYPE 4A



SIGMA
RELAY
TYPE 4R

CAA

(Continued from page 85)

because of the limited range of the resulting vibrational frequencies. This mechanical exciter, which consists mainly of a rotating unbalanced weight, will provide vibrational excursions only up to 5000 cycles per minute. Since certain tests require frequencies up to 20,000 cycles per minute, the mechanical exciter was inadequate.

To develop an electronically controlled exciter which would adequately cover the necessary scope for testing, Mr. Critchlow designed an electronic vibration exciter which consists of a combination of two magnets and a coil. It is attached to the crankshaft, as shown in Fig. 4, and actuated by the audio oscillator and power amplifier at the right in Fig. 6.

Examples of typical pickups will be found in Fig. 5, depending on whether response to strain, position, pressure, acceleration, velocity, or displacement is wanted and whether linear or angular motion is encountered. The output of the pickup can in some cases be put directly into a recording or measuring device, but in most cases it is amplified to operate the recording device as in Fig. 2. In Fig. 6 the crankshaft in the center has been the main problem under study and the electronic vibration ex-

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NEW radio developments are being worked out behind these new doors. ¶On the success of its past achievements Pacific Division's Radio Engineering Laboratory has earned for itself a greatly expanded workshop. ¶The same engineers who developed the Gibson Girl Emergency Transmitter . . . who pioneered in radio remote control equipment, now have the full facilities to accelerate their development work. Principally they are working on a new interpretation of simplified UHF for aircraft and other uses. The doors of this new laboratory will open tomorrow when this development is perfected.



Pacific Division
Bendix Aviation Corporation
 NORTH HOLLYWOOD, CALIF.

Before Pearl Harbor Pacific Division developed the famous Gibson Girl Emergency Transmitter, which is now standard equipment on every A.A.F. and A.T.C. airplane making overwater flights.

citer can be seen attached to the crankshaft.

In connection with aircraft structures containing large discontinuities in mass and stiffness properties, it will be found in many cases that simple uncoupled modes of vibration do not represent the structural behavior with the degree of accuracy necessary to be used in conducting a satisfactory flutter analysis. With this in mind, CAA has been conducting ground vibration tests on a number of aircraft structures to determine the coupled modes of vibration with a view toward investigating the possibilities of predicting these coupled modes of vibration from design data. This would enable a complete flutter analysis to be conducted while the design is still in the drafting room stage. This, of course, required close correlation between test data and analysis, with a method of analysis that is capable of yielding coupled modes of vibration.

In studying the modes of vibration, equipment capable of recording a number of stations simultaneously was used, so that the frequency and relative phase and amplitude of various points on the structure could be obtained to define the deflection curves of the vibrating structure. An example of oscillograms obtained with the electronic recording equipment is

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 Larger Type '89: 400 v., .015 to .5 mfd.; 600 v., .015 to .25 mfd.; 1000 v., .006 to .1 mfd.; and 2000 v., .006 to .05 mfd.
 Unless otherwise specified, units are supplied with Aérovox Hyvol oil impregnant and fill. Available also with mineral oil.
 Type '38 tolerances up to but not including .01 mfd., minus 20% plus 50%; .01 mfd., minus 10% plus 40%.
 Type '89 tolerances up to .009 mfd., inclusive, minus 20% plus 50%; .01 to .09 mfd., minus 10% plus 40%; higher than .09 mfd., minus 10% plus 20%.



• Aérovox tubular oil-filled capacitors combine top performance with extreme compactness. Smaller Type '38 units serve as mica-capacitor alternates, meeting all standard test specifications as such.
 These capacitors are hermetically sealed in tiny metal cans or tubes. The Aérovox double-rubber gasket material, depending on impregnant and fill). Case normally insulated from section, but grounded cases are available. Smaller Type '89 normally supplied without insulating outer tube and center mounting strap. Larger Type '89 normally supplied with insulating outer tube and center mounting strap.
 Covering a wide range of working voltages and capacitance values, these oil-filled tubulars are contributing notably to still better radio and electronic assemblies.

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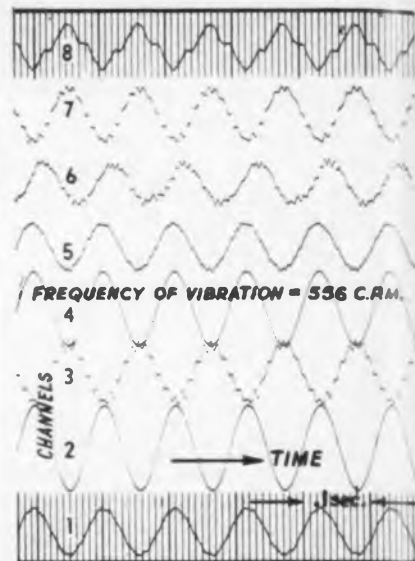


Fig. 7—Record from multichannel oscillograph

shown by Fig. 7 where a number of test points have been recorded.

Since available methods for calculating coupled modes of aircraft vibration sometimes are long and tedious, this group in the Aircraft Engineering Division has initiated a study aimed at devising an additional tool for the engineer to expedite such calculations. After considerable exploratory work, methods of utilizing the punch card calculating machines were



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successfully developed to perform the laborious calculations involved in solving matrix equations, so effective in obtaining the coupled modes of vibration of the aircraft structure. Conventional calculating machines presented an extremely tedious process for this analysis.

After procedures were developed for utilizing the punch card calculating machines for performing routine calculations of aircraft modes of vibration at zero airspeed the machine procedures were then extended to permit computation of aircraft modes of vibration at various airspeeds and to solve the basic flutter equations which are involved in the determination of critical flutter speeds. A search to find the proper place to undertake such a development resulted in the interest of the Bureau of Census, and the work has progressed under the direction of Everett Kimball. After noting the pattern which the iteration of a matrix takes, he applied it to the machines successfully.

Since the punch card calculating machines take care of complex numbers, it also became possible to solve the flutter stability equations. With machines capable of iterating complex numbers, the coefficients were put in the form of a matrix rather than a determinant and the matrix solved by iteration. The iteration process has been set up on the machines so that several values and different values of frequency ratio can be computed simultaneously, so that the complete curves defining the stability of the aircraft modes being analyzed can be plotted for the speed range being studied.

The government agencies controlling the air-worthiness of aircraft equipment set up rigid specifications, which have to be met on new products before they are released. The manufacturer has to take all precautions possible to insure that his product meets these specifications and is proven air-worthy. Even then the obligation of the manufacturer is still unfinished and the ceaseless vigil for continued improvement often appears to be the bigger problem of the two. To this end the laboratory of the CAA is proving its value, both to the armed forces indirectly in this critical wartime and to the potential expansion of civilian flying post war.

CAA has already cooperated on problems for the Grumman Aircraft Engineering Corp., at Long Island, Brewster Aeronautical Corp., Pa., Aircooled Motors, New York, and Continental Aviation and Engineering Corp., Detroit. The facilities of this laboratory are available whenever possible, for the improvement of all airplane engineering problems.—Carol Pray Ryan, Washington Bureau.

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1859: The world was spellbound when the first telegraphic message was sent across the Atlantic by cable. But in three months that first cable was broken. Seven long years elapsed before a new Atlantic cable was laid. And in the meantime, news had to travel the old slow way . . . by ship.

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at present we have a nice little set-up in a cave. It's really nice & I'll tell you - it's just 4AM in the morning and I'm writing this by light of a lantern -

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TROPICALIZATION PROBLEMS

(Continued from page 113)

Another function of this process is the removal of minute particles of foreign metals that may have become lodged in the surface as a result of contact with the tools in machining, punching, milling or grinding operations. These particles will act as corrosion centers during salt spray if not removed. All of the parts made from stainless steel should be passivated before assembly into a switch, variable resistor or other component.

In assembly it is frequently necessary to stake or rivet stainless steel parts. This not only destroys the film on the surface of the steel but it may also change the grain structure of the metal in such a way as to reduce its corrosion resistance. Microscopic amounts of the tool metal may be left on the surface. Small rust spots which are not detrimental to function or operation and are not cumulative may appear as the result of the salt spray test. Appearance of the part should be judged in the light of function and performance at the termination of the test.

Electrolytic action

When stainless steel is placed in contact with another metal and wet with an electrolyte such as a salt solution, a small galvanic voltage is set up that tends to attack one of the metals and protect the other. Aluminum, zinc, cadmium and ordinary iron or steel all tend to protect the stainless steel and the attack goes to the other metal. Nickel, lead, copper, brass and silver throw the attack on the stainless steel.

As the result of numerous tests, it has been determined that the galvanic action between nickel and stainless steel is less severe than any of the other combinations. Wherever the plating is broken by staking or spinning operations, the exposed brass can cause attack of the stainless steel. If such areas represent critical points in the operation of the switch they may be protected from contact with the salt spray by a covering of Glyptal varnish.

Brass and phosphor bronze

Copper and copper base alloys such as brass and phosphor bronze have a negative electrode potential with respect to the other metals with which they may be in contact. If not plated, very rapid and severe corrosion of the other metal, such as cadmium-plated steel, will occur in the salt spray test with little or no corrosion of the brass part itself.



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of experience in every phase of Plastics production pool their knowledge in advance—to insure on-schedule production of precision parts under accurate cost control. Backed by the facilities of one of the largest, best equipped exclusive custom molding plants in the country, Kurz-Kasch is *planning today* for a great deal of *production tomorrow*. Ask for a Kurz-Kasch representative.



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"CABDA"

was "some-
where in the neighborhood of $3\frac{1}{4}$ inches."

What a contrast to the modern fields of Radio and Electronics, where accuracy in calibrating is a fetish with engineers and a "must" with production and maintenance men! Little wonder that

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HF HEATING

(Continued from page 97)

variations will cause the oscillator to vary its output for two reasons; first, the filament voltage varies with line voltage and thus the emission characteristics of the oscillator tube are changed and second, the plate voltage varies with the line voltage which also changes the output. It is not considered practical nor economical to install regulating equipment on the supply side of the oscillator, and therefore, line voltage variations at the location where the oscillator is to be installed must be kept at a minimum. The variation should not exceed plus or minus 3 per cent for hardening jobs, and for work in which wider latitudes of temperature may be allowed, such as brazing, this variation should not exceed plus or minus 6 per cent.

Oscillator ratings

Induction heating oscillator ratings are usually given in output. They may be rated in btu per minute or kw. The rating can be converted from btu per minute to kw since 56.9 btu per minute equal 1 kw. It should be borne in mind that the output rating of an oscillator is based on the heating of an object which has sufficient volume, surface area, and resistivity to absorb the full output of the equipment. If the objects to be heated are small it may be very difficult to extract the full power from the oscillator due to coupling difficulties. The same may hold true in the heating of non-magnetic materials such as brass and copper. In the latter case, little over 50 per cent of the rated output of the oscillator can be counted on since the electrical resistivity of these materials is so low that it is difficult to create large energy losses within the material. Industrial oscillators should not be expected to deliver energy at much over 50 per cent efficiency. Under certain optimum conditions, efficiencies as high as 65 per cent to 70 per cent may be realized, but they are uncommon in practice.

In performing induction heating operations in an industrial plant, it is often desirable to have several working positions available to the operator. This eliminates loss of time in the operation of the oscillator while the operator is unloading and loading the work coils. With a switching arrangement, one position may be heating while the other is unloaded and loaded in preparation for the next heating cycle. The switching is usually accomplished with a high voltage, manually operated, throw-over switch, conveniently located to the operator. This switch acts as a disconnect only and is never operated



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and the design of new, superior products. These new devices have been credited with helping to turn the tide of battle. ★ ★ ★ We find double satisfaction in the task performed today. Developing and producing advanced equipment assures us that our boys are adequately equipped with superior military devices. It also means these responsibilities have greatly added to our abilities to serve industry as designers and builders of electronic equipment and tubes when peace comes.



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Available, or quickly made to specifications, are either single or dual section models . . . furnished with airgaps up to one-half inch between rotor and stator plates, and with your required capacities.

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while the equipment is on. Since the work coils and radio frequency transformers are water-cooled, some problems are encountered in switching both the water and the radio frequency current from one set-up to the other.

Work coil problems

This can be side-stepped by merely switching the radio frequency current and keeping the water circulating in both set-ups at all times. It is general practice, when using radio-frequency transformers, to do the switching on the high-voltage primary side of the transformer, since the currents are smaller and the inductance introduced in this circuit by the switch is negligible. If the switching were to be done on the work coil or secondary side of the transformer, currents on the order of 1,000 amperes would have to be handled and the inductance of the switch would be an appreciable portion of the total inductance of the coil, thus limiting the current circulating in the coil, which is undesirable. Fig. 4 shows the switching arrangements of a radio-frequency transformer set-up.

Work coils may be made of copper tubing or machined from water-channeled blocks of copper. The latter are usually called solid inductors. Copper tubing coils are satisfactory for experimental or not highly productive jobs. They are usually fragile and subject to mechanical damage, and also are of a relatively high impedance. The latter means that, for a given circulating current, the voltage drop across them may be high. With a comparatively high voltage existing across the work coil, accidental contact of the work with the coil may cause flash-over, damaging the coil, the work, or both. In order to prevent this, it is essential to insulate the coil with a heat-resisting material which has electrical insulating properties and high mechanical strength.

Solid inductors

Solid inductor coils eliminate most of the difficulties encountered with copper tubing coils. They are usually of a single turn type and therefore have low impedance. The voltage is so low that brazing flux collecting on the coil does not interfere with its operation. Solid inductors are not connected directly into the tank circuit of the oscillator, but are coupled to the tank circuit by means of a radio frequency transformer which steps down the tank circuit voltage to a very low value and, at the same time, causes higher currents to flow in the work coil than are flowing in the tank circuit. A typical solid inductor coil with work-holding fixtures is shown in Fig. 5.



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Whether or not this special-purpose gadget has application to anything you build or propose to build, there's a moral in it for you. In this case, as in hundreds of others, an original and impractical design was modified by Lapp engineers—to provide a part that meets all electrical and mechanical requirements, and that Lapp can build economically and efficiently.

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the requirements are and how you think it might be made; Lapp will tell you how it can best be made—and will make it." Our right to that claim has been proved over and over in military electronic production; it's going to be a competitive advantage to smart post-war electronic producers. *Lapp Insulator Co., Inc., LeRoy, N. Y.*



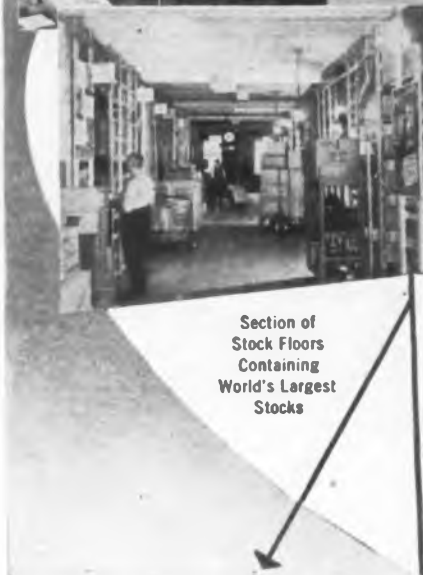
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IRC	Hallicrafters	Meissner	Dumont
Centralab	Hammarlund	Amphenol	Bussman

PANORAMIC PRINCIPLES

(Continued from page 88)

serves as a blocking saw-tooth oscillator and amplifier to drive both the horizontal deflection plates of the CR tube and the reactance tube modulator.

A number of controls are provided to regulate performance of the circuit. In the cathode of the 6AC7 is a 500-ohm variable resistor which regulates the point on the characteristic curve where the tube is to operate in order to give symmetrical frequency deviations.

The second detector, video amplifier, and cathode ray tube connections are shown in Fig. 5. The input to the diode detector comes from the selective IF amplifier which follows the 6SA7 mixer shown in Fig. 4.

The cathode ray tube receives its operating voltages from a separate rectifier system and bleeder network. The normal B supply voltage is used for centering purposes as the positive end of the high voltage power supply is grounded.

The Panoramic system is not limited to surveying the radio frequency spectrum in order to locate particular stations. The system has many possible applications to industry, communication, navigation and special services.

As an example of the utility of such a system, Fig. 6 is a tabulation of several of the possible applications. Since most physical quantities, temperature, humidity, distance, pressure, etc., may be converted into a voltage whose frequency is relative to the magnitude of the fundamental quantity, a large number of these fundamental quantities may be observed simultaneously on a cathode ray screen. As an example, the pressure of a number of tanks or cylinders can be connected to an aneroid barometer in order to control the frequency of a low power self-excited oscillator. Each of these oscillators would produce a signal whose frequency depends upon the pressure. A receiver and Panoramic adapter unit could then "survey" this spectrum of frequencies and give visual indication on the cathode ray tube of the pressures in each of the units as well as changes in the pressures. In order to identify one cylinder from another, it would be possible to scale down the output of each of the oscillators so that the largest signal on the screen would be tank No. 1, the next tank No. 2, etc. Keying or other modulation could also be used for identification purposes.

Where other quantities must be observed simultaneously, similar conversions from the fundamental quantity to frequency can be made and the Panoramic method used to show the relationships.

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208



BALING PRESS RECORDER

(Continued from page 109)

The bridge is normally placed out of balance at zero position by about the equivalent of 200 lbs. pressure in the positive direction by adjusting the rheostats. This insures immediate response and partially overcomes the lag in the rectifier, in the iron excitation, etc. The pressure scale is then drawn with the zero removed that amount from the zero reading of the microammeter. On the oscillograph record this results in a band .4 in. wide for zero pressure.

It is possible without difficulty or excessive heating to apply sufficient voltage to the bridge circuit so that a full scale reading on the microammeter is obtained with a pressure of 400 lbs. per sq. in. The lower sensitivity of 2,000 lbs. full scale reading is obtained by lowering the voltage to about 0.15 volts and adjusting the sensitivity with the rheostat.

Recording facilities

The control and reading unit with its pressure elements and power supply constitutes a complete instrument for measuring pressures at points where it is possible to make the six readings successively. Usually, however, it is preferable to record the results. A Duddell oscillograph with seven elements was used for this purpose. It offers in a compact instrument the opportunity of recording seven independent currents. Although the high frequency response available was not required for this application, the oscillograph has many other applications about the laboratory.

Because of the undesirable characteristics of rectifiers, none are used with the oscillograph. The alternating current from the low impedance of the secondary bridge transformer is used directly on the oscillograph galvanometer. Sensitized recording paper is moved at a rate of about 3 in. per minute. This does not resolve the 1,000-cycle wave, but gives a band the width of which is a measure of the cotton pressure. A specimen pressuregram is shown in Fig. 8.

Identifying records

The seventh galvanometer, which is not used for recording cotton pressures, serves as a convenient means of identifying the records and marking other quantities such as time, or the platen separation of the press. A single-cell pencil flashlight with push-button switch has been connected by wires of convenient length to the oscillograph to deflect the galvanometer. Bales can be numbered by producing a

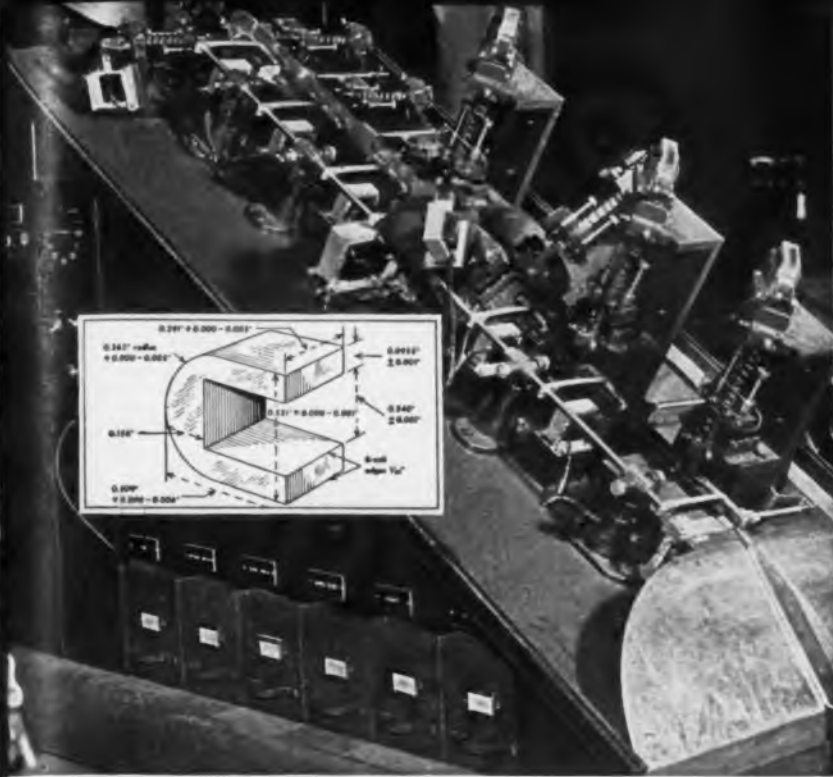
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The Micro Switch equipped "Gage-O-Matic" machine uses two Micro Switches at each of seven stations through which the parts are passed automatically. The Micro Switches energize solenoids to either discard the piece or pass it for the next measurement. Pieces which pass all seven tests arrive in the "OK" drawer. Those which have been discarded, go to their respective drawers, depending upon the defect.

This use of Micro Switch by Hamilton Standard Propellers is just one example of the way in which this tiny, accurate, dependable, snap-acting electric switch is enabling all industry to do old jobs better . . . often to accomplish results not possible with earlier types of switches.

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number of short deflections equal to the number of the bale up to 9, while for higher numbers long dashes are used to represent figures in the tenth place.

Calibration

The pressure elements are calibrated against hydraulic pressures. A holder maintains the elements with their diaphragms flush with its surface. A thin diaphragm of phosphor bronze (.011 in.) is placed over this surface and a head is bolted securely over this diaphragm with a copper wire gasket. Oil under pressure is forced into this head with a small hand pump which is part of a standard five-ton truck jack and is measured with a standard hydraulic gage of $\frac{1}{2}$ per cent accuracy.

No correction has been made for the rigidity of the phosphor bronze diaphragm which is very small compared to the 1/10 in. tool-steel diaphragm. The calibration holder is six inches in diameter, made of steel shafting and has openings for seven elements. Any openings not in use are filled with dummy bodies to support the bronze diaphragm when in use. This apparatus has been used successfully up to 2,000 psi.

Results

The instrument has had sufficient use both at the laboratory and at commercial presses to prove its usefulness and convenience. Rubber mountings between the instruments and the pneumatic tired truck on which they are carried give sufficient protection against vibration so that the entire apparatus may be moved around on motor trucks without undue precautions.

The microammeter has been fitted with a hand-drawn scale reading directly in lbs. per sq. in. Response characteristics are sufficiently similar so that the same scale can be used for all elements, provided they are consistently plugged into the same bridge circuits, and the sensitivity controls are properly adjusted for each one.

Pressure elements for measuring pressure of cotton against the saws and ribs of the seed roll box of a gin have been considered and it is expected that many other uses will be found for this equipment. The fact that such an exceedingly small diaphragm deflection is required to give full scale readings is advantageous for problems in which a large deflection of the diaphragm would result in deformation or change in pressure of the material under observation. It could also be used for measuring small displacements and flexures.

The author acknowledges his indebtedness to Mr. Charles A. Bennett, Engineer-in-Charge, and to Messrs. R. G. McWhirter, R. C. Young and G. W. Franks, principal Laboratory mechanics, all of the U. S. Cotton Ginning Laboratory.

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CONTRACT PROBLEMS

(Continued from page 115)

million dollars. From July 1, 1943, to the end of December, we cancelled six hundred sixty-seven cases, of which twelve were later rescinded, making a net of six hundred fifty-five with a dollar value of approximately ninety-five million dollars. From the first of January of this year to the first of June, twelve hundred forty-nine additional cases have been found necessary, the contract cost on the items cancelled is also almost double that of the preceding twenty-four months.

“Starting the fifth of July we plan to hold sixteen one day meetings in the various parts of the country in an effort to get over to the contractors and suppliers some of the basic practical considerations on contract terminations; to recommend some steps which should be taken and to run a short clinic on particular problems. The cities which we plan to visit are Baltimore, Boston, Hartford, New York, Philadelphia, Buffalo, Detroit, Ft. Wayne, Chicago, Milwaukee, Kansas City, Los Angeles.

“Property Disposal Advisory officers and Field Accounting representatives have been placed in twenty-nine plants by the War Department. The Signal Corps having three—Western Electric, Philco and Zenith. We recently authorized our contracting officers, in proper cases to delegate authority to prime contractors to settle cases of sub-contractors not to exceed ten thousand dollars and formulated a comprehensive policy on property disposition.

“The backlog of unsettled cases in the Signal Corps has increased from one hundred eighty-four at the end of January, 1944, to eight hundred fifty-one at the end of May. The cases over six months old have increased from sixteen at the end of January to thirty-seven at the end of May. The number of cases in the two to six months old group has increased from ninety-six at the end of January to 275 at the end of May.

“Although cases are getting closed, we are not moving sufficiently fast. In January we closed one hundred forty contracts of a value of about nineteen million dollars as against two hundred fifty-five contracts of a value of \$50,000,000, for the month of May. The best indication that we have not yet hit the necessary stride is that a very high percentage, over 80 per cent, are no cost cases. It takes contractors, in cases where claims in excess of ten thousand dollars are filed, an average of about six months in which to come up with the claim. It takes the Signal Corps about 2.7 months to settle such a claim. This time must be radically reduced.”

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Electrical and Mechanical Engineering

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Designers and Manufacturers of Electrical and Mechanical Devices

REFLECTOR EFFICIENCY

(Continued from page 101)

The response of a unit sphere in one octant would be that of a non-directional black body and will serve as a reference in regard to the effectiveness of combined cavity-mirror system. In this case $m = e = 0$. The response $R_{\phi,0}$ out to ϕ versus ϕ is plotted in Fig. 3 for one octant in arbitrary units. When the dimensions of the cavity opening are small compared to a wavelength in directions of both magnetic and electric vectors then $m = 2.0$ and $e = 1.5$. The response $R_{\phi,0.15}$ out to ϕ versus ϕ for same arbitrary units is also plotted in Fig. 3.

(Continued on page 216)

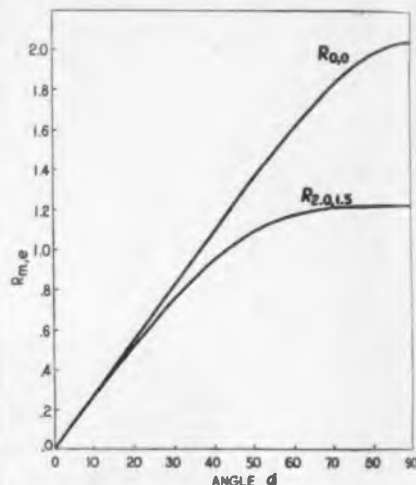


Fig. 3—Response curves for unit sphere and for small opening

$R_{0,0}$ = Response of cavity along axis of cavity

R = Response of cavity in direction of angle ϕ to axis of cavity at angle θ in plane of cavity opening

δ = Angle R makes with axis of cavity in plane of electric vector

α = Angle R makes with axis of cavity in plane of magnetic vector

R_e = Response function of cavity in plane of electric vector

e = Exponent determining sharpness of response pattern in plane of electric vector

R_m = Response function of cavity in plane of magnetic vector

m = Exponent determining sharpness of response pattern in plane of magnetic vector

Δ = Denotes increment

R_ϕ = Integrated response in one octant from $\theta=0$ to $\theta=\pi/2$, and from the axis of cavity out to angle ϕ

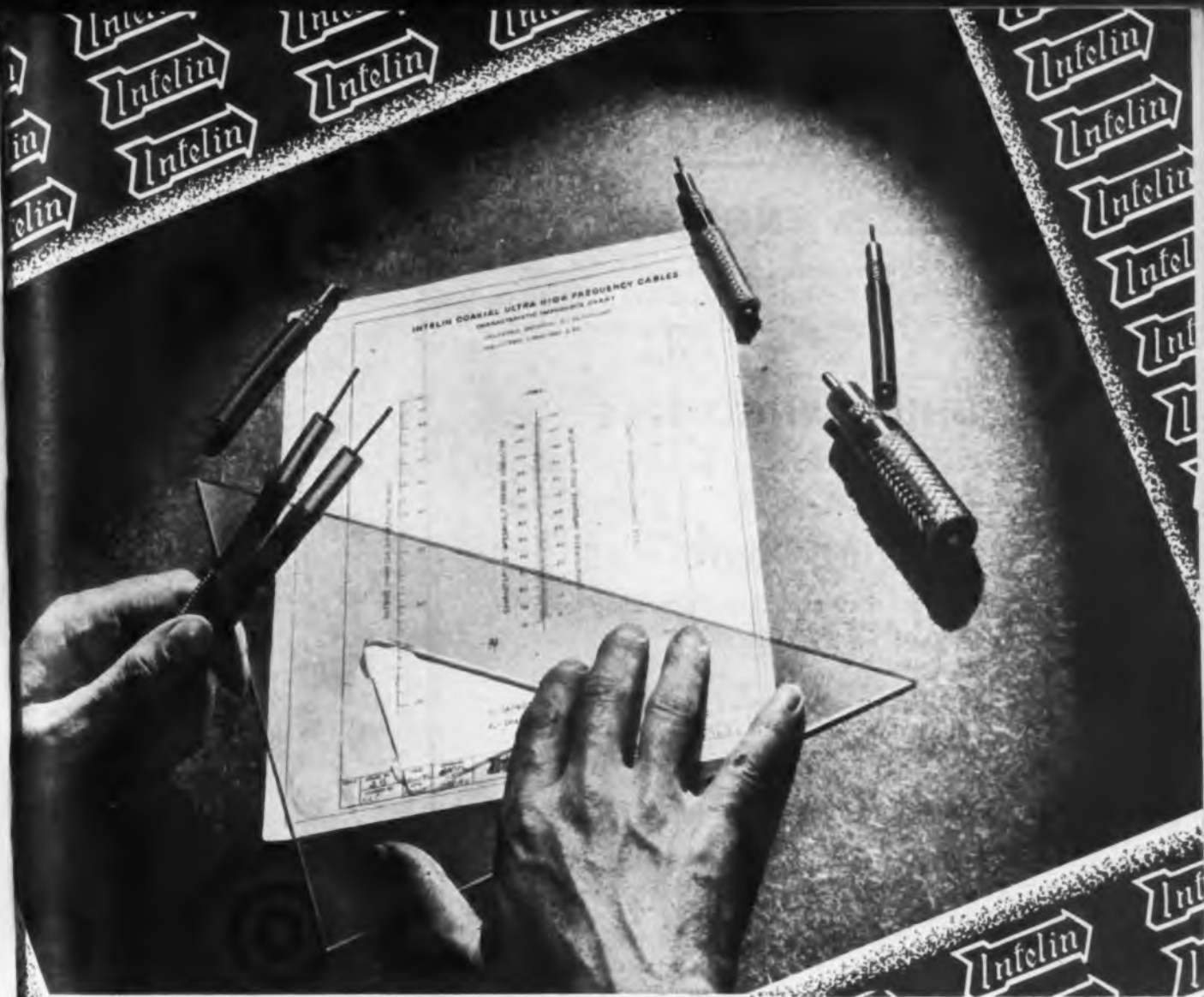
E_r = Receiver efficiency of mirror cavity system

E_t = Transmitter efficiency of mirror cavity system

$R_{m,e}$ = R_ϕ for particular values of m and e

$R_{0,0}$ = R_ϕ when both m and e are zero

$R_{\pi/2}$ = R_ϕ for any values of m and e integrated out to angle $\phi = \pi/2$



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42 YEARS' EXPERIENCE

(Continued from page 214)

Now the efficiency of the mirror-cavity system when used for reception is

$$E_r = \frac{R_{a,e}}{R_{o,n}} \quad (6)$$

where both responses are integrated out to same angle ϕ . The efficiency of the system when used as a sender is

$$E_s = \frac{R_p}{R_{n/2}} \quad (7)$$

where both responses are integrated over the same function of $R_{m,e}$. These two efficiencies E_r and E_s for response function $R_{a,e,1s}$ are shown in Fig. 4 from $\phi = 0$ to 90° . The mirror of Fig. 1 has $\phi = 43$ deg. Therefore its efficiency as a receiver is 85 percent.

Other values of m and e for cavities with openings large compared to a wavelength may be obtained from a previous publication.² When

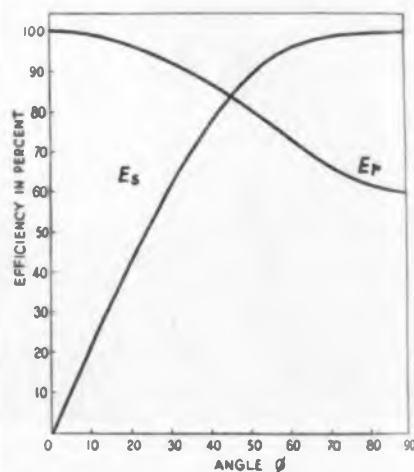


Fig. 4—Transmitter and receiver efficiency versus acceptance angle for values of $m = 2.0$ and $e = 1.5$

the aperture of the cavity is increased to two wavelengths in directions of both magnetic and electric vectors by a suitable horn we have $m = 8$ and $e = 12$. These can be inserted into equation (4) with good results for E_r out to $\phi = 40$ deg. Beyond $\phi = 40^\circ$ the response pattern exhibits great complexity with minor maxima and nul points. The useful angle of ϕ will continue to decrease as the aperture increases. The transmitter efficiency cannot be obtained without integrating out to $\phi = 90$ deg. which is impossible in this case because of minor maxima which have not been taken into account. In any case E_r for $R_{a,1s}$ will rise more steeply for small values of ϕ and flatten more quickly than curve for $R_{a,e,1s}$. Likewise E_s will drop more quickly and end at lower values in the former case than the latter.

² "Electromagnetic Horns," by Grote Reber Communications, Vol. 19, Feb. 1939, p. 13.

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TELEVISION

(Continued from page 112)

a six megacycle channel with a reasonably sharp cut-off beyond. Half wave dipoles are stacked a half wave apart vertically and backed by reflectors. By skewing the elements a field pattern reasonably well suited to many configurations of service areas can be achieved⁹. At Mt. Lee this has been checked by numerous field strength surveys and adjusted to give maximum coverage over Southern California. The strongest field strength is directed southeasterly and has a value of over 100 millivolts at 5 miles.

The Mount Lee plant was opened in 1941 with a double remote pickup telecast of the Easter Sunrise Services from the Hollywood Bowl. This was a return engagement from the year before, although the direction of the beam relay path was nearly 90 degrees different. The 1940 telecast was accomplished with the transmitter on the rim of the Bowl with the beam pointing Southeast. In 1941 the transmitter was placed in the audience with the beam pointing Northeast. Although the distance from the Bowl to Mount Lee is two miles and much of the path is hundreds of feet above the ground it was found impossible to make the pickup with a slight hill in the line of sight about a half mile from the Bowl.

This is an important consideration in contemplating frequencies of the order of 300 megacycles for television broadcasting service. In this instance, a video line was run over the heads of the audience until a line of sight was accomplished, but householders who reside behind hills are not as mobile.

During 1943 and at present, Orthicon cameras are being used for studio work. Several important engineering advantages are realized. The incident light intensity, measured on several televised scenes, of 250-ft. candles or less is satisfactory as compared to the value of 1000 required for an iconoscope. This is with a lens setting of f6.3 rather than f2.7, respectively, so that the depth of focus of the Orthicon pictures is relatively great and therefore pleasing. The 250-ft. candle value represents a Weston exposure meter reading of 15 on average objects having a reflection factor of 50 per cent. The elimination of shading effect gives a "roundness" of rendition to all objects and a fidelity of tone which cannot be achieved with the iconoscope.

At the end of 1943 the station had been on the air 6,899 hours. In a period of twelve years. Post-war, numerous projects will be completed which were interrupted by the war. A sister station in San Francisco has been applied for

⁹U. S. patent 2,274,149, Feb. 24, 1942, H. R. Lubcke, "Television Antennas."

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SURVEY OF WIDE READING

(Continued from page 122)

The measurements were taken with a plane electrode system consisting of an oxide cathode, a grid and a plate. A portion I of the emitted electron current is accelerated by the grid, which in this case constitutes the cathode of the diode under investigation, and enters the space between grid and plate. To determine I , the emitted electron current value is reduced by a grid absorption factor computed from the grid currents before the formation of the virtual cathode.

In the following: E_g is the grid potential, E_p the plate potential, $I^* = I/I_g$ and $I_p^* = I_p/I_g$, I_p being the plate current and I_g the saturation current for a diode having the dimensions of the cathode-grid system for electrons of zero initial velocity; this factor is introduced in connection with the theory.

Fig. 1 demonstrates that before the formation of the virtual cathode, grid and plate currents are approximately equal, indicating that all electrons passing through the grid reach the plate. While the virtual cathode is formed, a sudden change occurs in the current distribution; the plate current remains almost constant when its formation is completed. The hysteresis loop may be readily seen for the $E_p/E_g = 1.0$ curve, but it is hardly noticeable for $E_p/E_g = 0.5$. Fig. 2 shows the plate current as a function of the voltage ratio with the grid potential as parameter.

The shapes of the curves in both figures agree with those expected by the theory; particularly, the sudden changes in plate current at the formation and disappearance of the virtual cathode are proved, as well as the fact that these two processes occur at different values of grid current and of voltage ratio.

The numerical agreement, however, is less satisfactory and to obtain a survey of the conditions, theoretical and measured grid current values at the points of the formation and the disappearance of the virtual cathode were investigated. The probable effects of edges, of the electrons repulsed by the virtual cathode and returning through the grid, of the initial velocity distribution of the electrons when leaving the cathode, and of the deviation imparted to the electrons by the grid are discussed. If the last two factors are considered, the virtual cathode would be formed for smaller grid current values or for greater voltage ratios, as both effects cause unequal velocities of the electrons which favor the formation of the virtual cathode. Better numerical agreement between theory and

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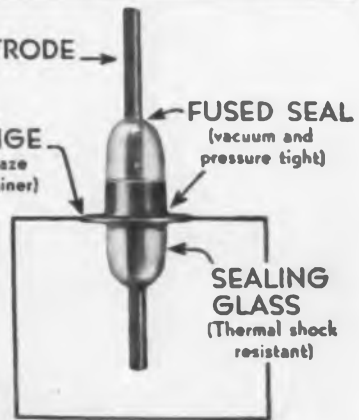
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WIDE READING

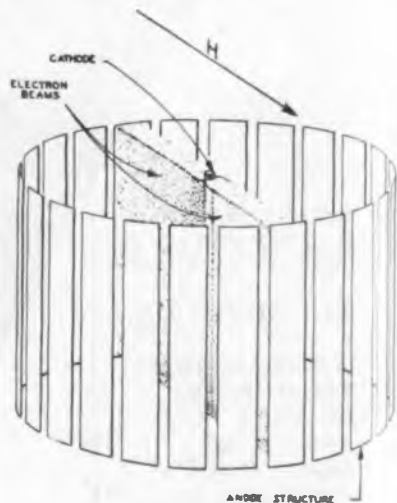
experiments results from these considerations.

The deviations of the measured values from the theoretical values increase with increasing grid current. There is also a dependency on the grid potential and not only on the voltage ratio, as would be required by the theory; these deviations increase with increasing grid potential. An attempt is made to explain these discrepancies by the spreading out of the electron beam as it approaches the virtual cathode; preliminary experimental evidence of this assumption is given.

Cylindrical Tube with Radial Beam

A. M. Skellett (Bell System Technical Journal, April, 1944)

In the new type of vacuum tube described, the electrons emitted by the cylindrical cathode are subjected to the influence of a cylindrical electric field and focused into two diametrically opposite, flat, radial beams by a uniform magnetic field H . The beams are parallel to the lines of magnetic force, and as the magnetic field is rotated the beams move around with it. The stator of a two-pole polyphase alternating-current motor furnishes an excellent rotating magnetic field for use with these tubes.



In addition to the elements shown in the figure, the tube may contain a negatively biased control grid for modulation of the beam current density. Farther away from the cathode may be mounted a cylindrical element with as many windows as there are anodes, it is maintained at a positive potential and is called a screen. Immediately behind each window may be a pair of paraxial wires which, because of their similarity in function to the fourth element of a

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MACHINE
GROUND

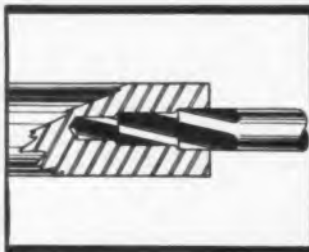
New Precision Step Drill Grinder Simplifies Production and Maintenance of Step Drills

The quality of a step drill produced by common methods depends almost entirely on the skill and attention of the individual tool maker. However, with the development of the precision step drill grinder, the human element has been entirely eliminated, the characteristics of the step being completely controlled by the grinding machine without adjustments during the course of grinding. This automatic feature insures absolute uniformity, regardless of quantity, and permits large-volume production of step drills.

The apparent advantages gained through the use of the step drill grinder are: Permits mass production of drills ground to exact specifications, entirely independent of the human element. Maintenance, too, is no longer an obstacle as step drills produced by this method are quickly sharpened by the same uniform machine-controlled operation. With the step drill grinder step drills can now be made from standard drills. These advantages result in a wider application of step drills which provide a definite saving of machine tools, man-hours and cost; this in turn results in greater production.

You know there are plenty of benefits in chewing gum, too. That's why all of the Wrigley's Spearmint we're able to make from our available stocks is going overseas to our fighting men and women. You know what a lift it's been on the job and we wish we could supply everybody, because we have pride, too, in our workmanship and productivity. But there just aren't enough available top quality raw materials right now to do it. When we can produce it in sufficient quantity, it will be back to you with the same fine flavor and chewing satisfaction... Wrigley's Spearmint has never been changed!

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The above illustration shows mechanical design which requires a hole having diameters diminishing in steps. This is an operation for step drills which has often been neglected due to difficulty in obtaining and maintaining step drills.



Step drills produced by our method are quickly sharpened by the same uniform, machine-controlled method.

Y-125



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OHIO

WIDE READING

pentode, are called a suppressor grid. In back of each suppressor grid is the anode.

If ordinary commercial cathodes are used with anode structures an inch or two in diameter, 100 volts or less on the anode will draw the full space current for which the cathode was designed. The application of the magnetic field will then focus from 85 to 90 per cent of this electron current into the two beams, the remaining 10 or 15 per cent being lost at the cathode due to an increase in the space charge which the magnetic field produces. Some of the smaller tubes produce beam currents of more than 5 milliamperes with only 50 volts on the anode structure, and in some of the tubes with larger cathodes beam currents of 50 milliamperes or more are easily obtainable. The magnetic field strengths range from 50 to 300 gauss.

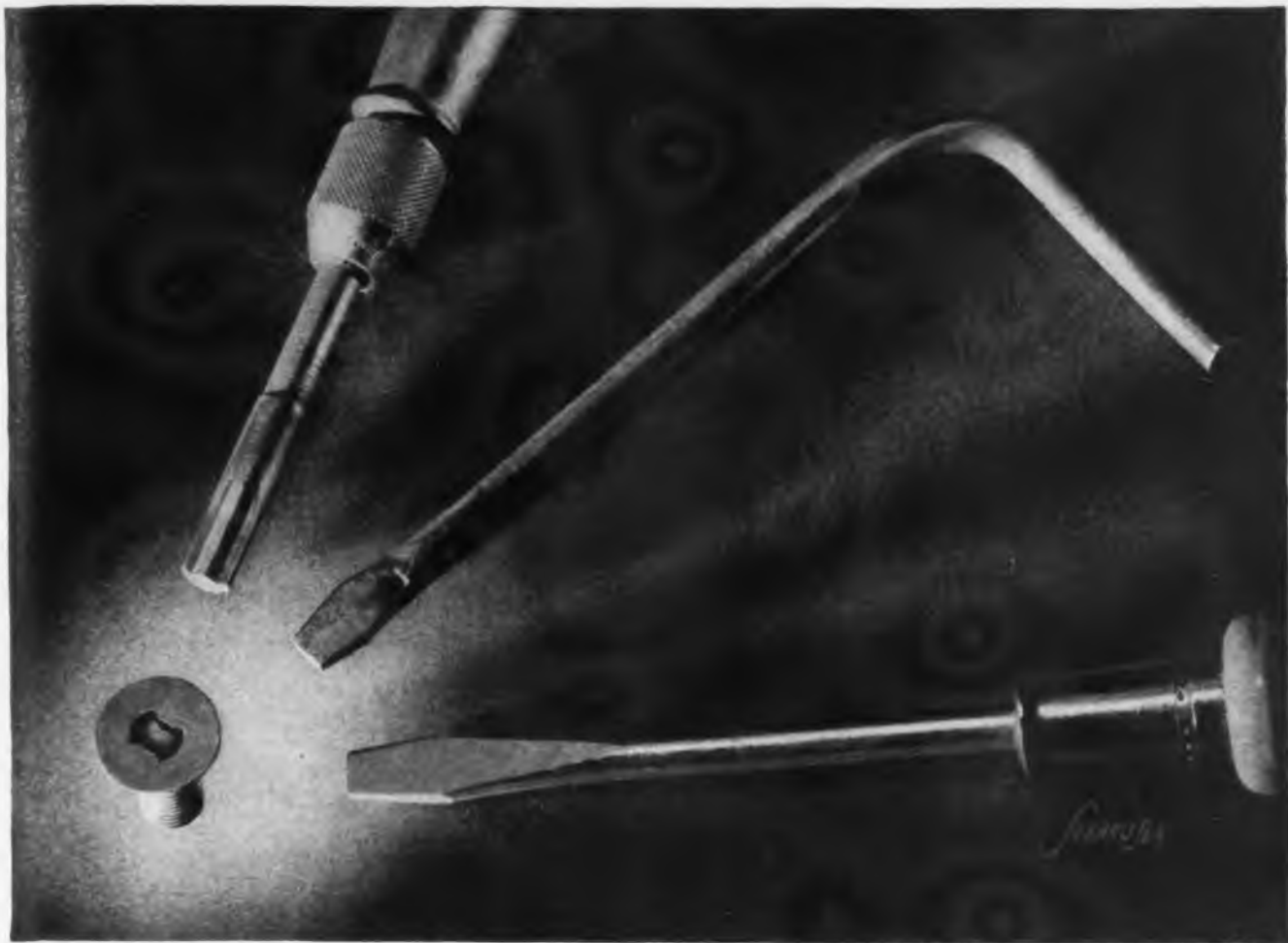
For some of the applications it is desirable to eliminate one of the two beams, this may be accomplished by substituting a uniform electrical field at the anodes of the tube for the cylindrical one, by having an odd number of anodes, or, alternatively, the screen or the suppressor grid may be used to reject the unwanted beam.

If the tube is used as an amplifier, modulating signals are supplied either to the control grid or to the suppressor grids. One of the simplest and most obvious of the various possible applications of this tube is that of an electronic commutator, the individual signals being applied to the individual suppressor grids. Its speed limit is estimated to be in the neighborhood of 10,000 cycles per second for ordinary stator and tube designs. A 30-channel multiplex telegraphic system using two 30-anode tubes has been successfully tested over short distances in New York City.

Measuring Turntable Speed Variations

C. R. Miner (General Electric Review, April, 1944)

The instrument was developed for measurement of the instantaneous speed variations of phonographic turntables. If a test record is used, on which is recorded a constant 1000 cycle tone, then minute speed variations of the turntable will cause the tone to be frequency modulated. This modulated wave is then fed in turn to an amplifier, a discriminator, a rectifier and finally applied to a direct current reading instrument which can be calibrated in rpm. The average speed of the turntable may be determined either by a stroboscopic disk or by calibrating a microammeter in the discrim-



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This is the only modern Assembly Line screw so designed that it also operates with an ordinary type screwdriver . . . even with a piece of flattened steel rod in emergency. The only requirement is that the screwdriver or flattened rod be reasonably accurate *in width*. The thickness of the blade, so important with other screws, is a secondary consideration with CLUTCH HEAD because its roomy recess allows great latitude in this respect. Obviously, a broad tolerance like this is invaluable in field service where the Type "A" Drivers (used for the fast tempo of Assembly Line work) may not be immediately available. This logical simplified design applies to all sizes and styles of CLUTCH HEAD Screws . . . an exclusive feature that is daily proving its worth in the War effort by keeping men and machines in motion when time is vital.

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WIDE READING

inator diode circuit to read rpm average. Details of the construction and operation of the instrument are given.

Differential Analyzer

H. P. Kuchni and H. A. Peterson, (Electrical Engineering, May, 1944)

A system transferring the rotation of the integrator wheel to the output shaft which does not require any work to be done by the integrator wheel is described. This system operates photoelectrically making use of polarized light, phototubes, an amplifier unit, and a thyatron tube controlling the motor which rotates the output shaft.

Portable Carrier Telegraph

C. A. Dahlbom (Bell Laboratories Record, May, 1944)

A portable, four-channel, voice-frequency carrier telegraph for simultaneous two-way operation has been designed to operate over one channel of a carrier telephone system. The local side of each telegraph channel may be connected to outlying teletypewriter stations, telegraph repeaters, or switchboards.

Cathode Follower Output Stage

C. J. Mitchell (Wireless World, London, April, 1944)

The use of the cathode follower in the output stage of a receiver is suggested, because the low output impedance provides excellent damping for the loudspeaker, while the large negative feedback renders the stage practically distortionless. A circuit with suitable dimensions is shown and its performance discussed in detail.

SLOW ACTION RECORDING

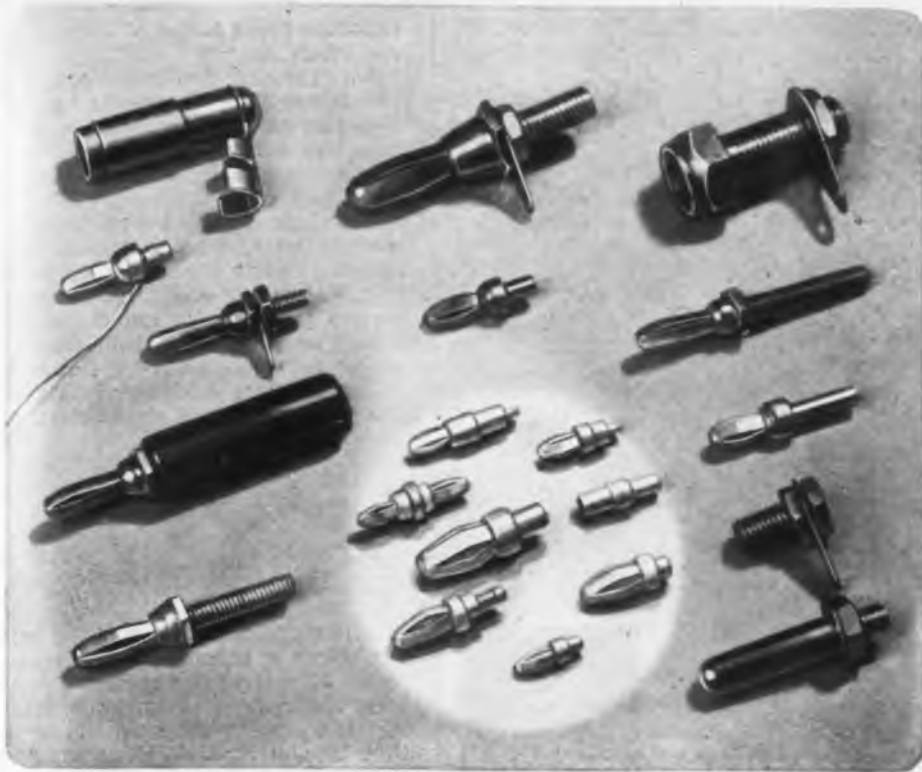
(Continued from page 103)

the gain used in calibration and that used for the experiment.

Plotting Fig. 3 in the same way on the graph as shown in Fig. 5, we can read directly velocity in centimeters per second. For example, the maximum velocity which the muscle reached was, at B, 11.91 cm. per second. Also, at F, the muscle reached a maximum relaxation velocity of 5.07 cm. per second.

With many oscillographs it is possible to modulate the curve obtained from the pickup coil with the 60 cycle timing wave by the Z-axis control of the oscillograph. The result obtained (Fig. 8) illustrates the difference of the velocity of the muscle during contraction and during relaxation.

Fig 7 and Fig. 8 are oscillograms illustrating the ability of the apparatus to reproduce results, each



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That is the plus element you get at no extra cost.* Many manufacturers are producing plugs and jacks, some are very clever copies and some are not so clever. Some of these manufacturers are experienced in making electrical parts and many are not.

In Johnson you get the benefit of a quarter of a century of experience in manufacturing radio transmitter components and assemblies—a manufacturer who knows transmitter parts requirements and in fact, to assist the war effort, is actually building transmitters for the armed forces. Johnson engineers are therefore thoroughly familiar with the applications and functional requirements of all transmitter parts and these parts become more than mere mechanical assemblies. Many products are original Johnson designs and considered standard for comparison by the industry.

Whether the new "miniature" plugs featured above, the "standard" plugs manufactured by Johnson for years, or "specials" for particular applications, Johnson plugs and jacks are designed by the same engineers, produced by the same skilled hands, and carry the same Johnson guarantee of quality.

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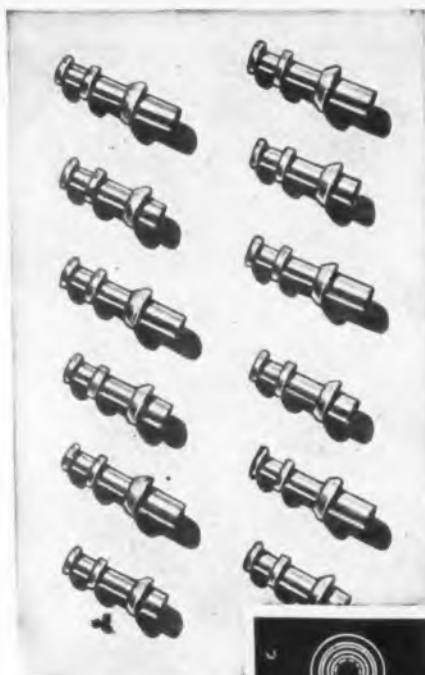
FIRST—they're easy to use. Just swage them to the board, and in a jiffy you have good firm Turret Terminals.

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THIRD—they're readily available. Turret Lugs to meet a wide range of terminal board thicknesses are in stock.

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exposure being taken at three minute intervals.

For further demonstration, the velocity of a nerve impulse was determined. A nerve-muscle preparation was arranged as above. The muscle was stimulated twice by electrodes placed in two different positions along the nerve, 75 millimeters apart. The additional time elapsing before the second contraction was due to the 75 extra millimeters the impulse had to travel. It is seen from Fig. 9 that the distance between the two curves is 1.5 millimeters and the length of one time-wave is 9 millimeters.

Then:

$$\frac{1.5}{9} \times \frac{1}{60} = .00277 \text{ second}$$

$$\frac{75}{.00277} \times \frac{1}{1000} = 27 \text{ meters per sec.}$$

The impulse traveled over the sciatic nerve of the frog with a velocity of 27 meters per second.

By observation of the procedures and the results obtained, it seems that this method of recording the movements of biological specimens has some advantages. Extreme accuracy is possible, with refined technics, since it is inherent in the nature of the apparatus used. There is some amount of inertia introduced into the system by the bar magnet which is, nevertheless, of lesser degree than that of a kymograph's accompanying system of levers and pulleys.

The sensitivity of the cathode-ray oscillograph used was 0.029 volt dc per centimeter deflection, ample for a number of investigations.

Although cathode-ray oscillographs have been used in conjunction with this type of work before, the majority of the pickup apparatus is dc amplified. The apparatus used in this investigation, however, is ac amplified and there may be introduced a certain amount of distortion due to the characteristics of the amplifier on the down-sweep of the curves. Nevertheless, this is almost negligible on the low frequencies used. An ac amplifier system also eliminates much of the delicate apparatus used formerly.

The apparatus used is rugged and has withstood much abuse, both electrical and mechanical. The technic needed to set up and operate the apparatus is simple and should be contrasted with that needed to line up a number of levers parallel to a kymograph drum.

In some laboratories, bio-physics laboratories, for example, a more versatile recording instrument than a kymograph is needed. A cathode-ray oscillograph, with the specifications mentioned above, could not only be used for almost all duties a kymograph is put to, but also for its more normal functions.

Designed for

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**THE 45000 SERIES
 MIDGET COIL FORMS**

are a good illustration of our slogan, "Designed for Application." Coil forms of this general type (evolved from use of discarded tube bases) have long been used by electronic research workers and radio amateurs. The shortcomings of previous types were overcome four years ago when we designed and put into production the first of the No. 45000 Series.

The "Designed for Application" features include:

1. The guide "funnel" (easier to thread leads into pins)
2. The longer-than-normal length
3. Made in 5-pin as well as 4-pin and blank bases.

The material, of course, is low loss mica-filled bakelite.

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WHAT'S NEW

(Continued from page 118)

Cam Lever Switch

General Control Co., 1200 Soldiers Field Rd., Boston, Mass., has a new rotary cam lever switch designed for one to six index positions. Any combination of spring leaf contact assemblies is available for each of



the six positions. It is adaptable to open or close practically any number of circuits in sequence (or repeat) with the convenience of a single control knob. A single hole is required in the panel for mounting, and contact assemblies in any section can be removed from frame by removing a single bolt. Its construction provides such features as circular cams for locating up to 12 low-friction, spring type actuators, cast aluminum frame, Bakelite cams and rollers, static shielding nickel plated phosphor bronze contact springs, solid silver contacts, and contact build-ups assembled under pressure. The switch is rated at 10 amperes, 125 volts ac, and is built to meet Government specifications.

Cockpit Lamp

The X-244 cockpit lamp produced by Electronic Laboratories, Inc., Indianapolis, Ind., has an ultra-violet lens, is equipped with control switches and rheostat which enable the operator to control the amount of light diffused. Covering the lens is a shutter which, when closed, shuts off light. Immediately back of the lens is an iris which permits focusing of the light to a spot or a flood. An important feature of this lamp is its retractable, rubber-jacketed, electrical cord made by Cordage, Inc., an affiliate of Kellogg Switchboard & Supply Co., Chicago. Through a special process in permanently molding into a spiral shape the rubber outer covering containing the



conductor this cord can be stretched to approximately seven times its contracted length. Originally developed as a commercial telephone instrument cord these Coiled Kords now have many applications and have found wide acceptance by our Armed Forces. They are available with different conductor combinations and in various diameters.

Multi-Contact Timer

A new multi-contact timer for remote control has just been placed on the market by the R. W. Cramer Co., Inc., Centerbrook, Conn. It is used to control a series of machine operations in definite order—to automatically reverse or alternate in operation a group of motors, machines or devices—to operate in a predetermined sequence a series of signals, valves or solenoids, as well as numerous other applications where se-



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**Oil Impregnated—Oil Filled
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CLARE "CUSTOM-BUILT" RELAYS

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FORM B FORM E
FORM C FORM F

Contact springs employing any of these basic forms can be furnished.

Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly are of magnetic metal.

High voltage spring pile-up insulators of special heat-treated Bakelite. Has minimum cold flow properties, low moisture absorption content and permits punching without cracks or checks.

Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard or special types and sizes.

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This flexibility of Clare Type "C" Relays permits any combination of five basic contact forms; provides twelve different standard, or other special, types and sizes of contacts.

Electrical and Production engineers have found this rugged, multiple contact relay of exceptional value in such operations as sequence control of machine tools, for counting equipment, in electric eye controls, in radio and radar and

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All Clare relays are carefully designed, well manufactured from best materials and precisely adjusted. These factors result in a relay which reduces overall relay cost, simplifies installation and insures better and more dependable performance.

Clare engineers are ready at all times to assist you in developing a relay specifically "custom-built" to meet your requirements. Send for the Clare catalog and data book. C. P. Clare & Company, 4719 Sunnyside Avenue, Chicago (30), Illinois. Sales engineers in all principal cities. Cable address: CLARELAY.

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ELECTRONIC INDUSTRIES • July, 1944

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This detail-contact model is only one of a series of mountings and indicates only one of the complete range of Luxtron[®] cell shapes and sizes available.

Circuit simplicity contributes to a constant flow of power. The ability of Luxtron Photocells to operate instruments and instrument relays, without amplification, removes the hazards of complex circuits.

This fact alone recommends their application to precision control problems. Another quality is their exceptional resistance to vibration, shock and general mechanical violence. These factors assure long service and unusual adherence to calibrated accuracy.

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Illustrated data sent on request.
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WHAT'S NEW

quence operations are of prime importance. Its solenoid starting mechanism is operated from a remote control momentary start button, so that the timer will go through its complete cycle or any part of its cycle of operation and stop. Reclosing the momentary start button will either continue or repeat the cycle as the case may be. They can be arranged so that in the event of a power interruption it is necessary to again press the remote control start button to continue the cycle, or, after power is restored to automatically continue the cycle of operation.

Snap-Switch

Reported to be the smallest fully enclosed snap-action switch ever built, the new Miniac is 17/64 in. thick, 13/16 in. high, and 1-3/16 in. long. Engineered on the well-known rolling spring principle, but with a new design and smaller size it is fully enclosed in a bakelite case with four



mounting holes. Actuation is with a stainless steel pin plunger. All parts are non-corrosive and contacts are of fine silver. Main blade, contact blade, and rolling spring are made of beryllium copper. Rated at 15 amps., 115 volts ac. Furnished in single pole, normally open and normally closed, double throw. Designed to permit leaf type or overtravel plunger type actuators to be attached to the case. Manufactured by the Aero Electric Co., 1308 Superior Ave., Cleveland, O.

Disconnect Fittings

The Sta-Kon disconnect fittings are designed to connect, disconnect and reconnect in a straight line at will. Almost limitless



combinations can be made with the T&B tips and coupler because the tips are identical and interchangeable. These disconnects are members of the Sta-Kon family of pressure (solderless) connectors and are installed with Standard Sta-Kon pressure tools, manual or power. Manufacturer is the Thomas & Betts Co., Inc., 36 Butler St., Elizabeth 1, N. J.

Duralon

The U. S. Stoneware Co., Akron, O., has made available for limited commercial and experimental use a new basic resin having widespread applications. The new resin, named Duralon, a furane derivative, is characterized by the lowest water absorption of any organic resin, insolubility (after activation) in any solvent or combination of solvents, high electrical resistivity, absolute stability in storage and handling, and by ease of workability. Duralon resin, in its pure form, is a heavy, viscous liquid, dark maroon in color. On incorporation of catalysts and application of mild heat

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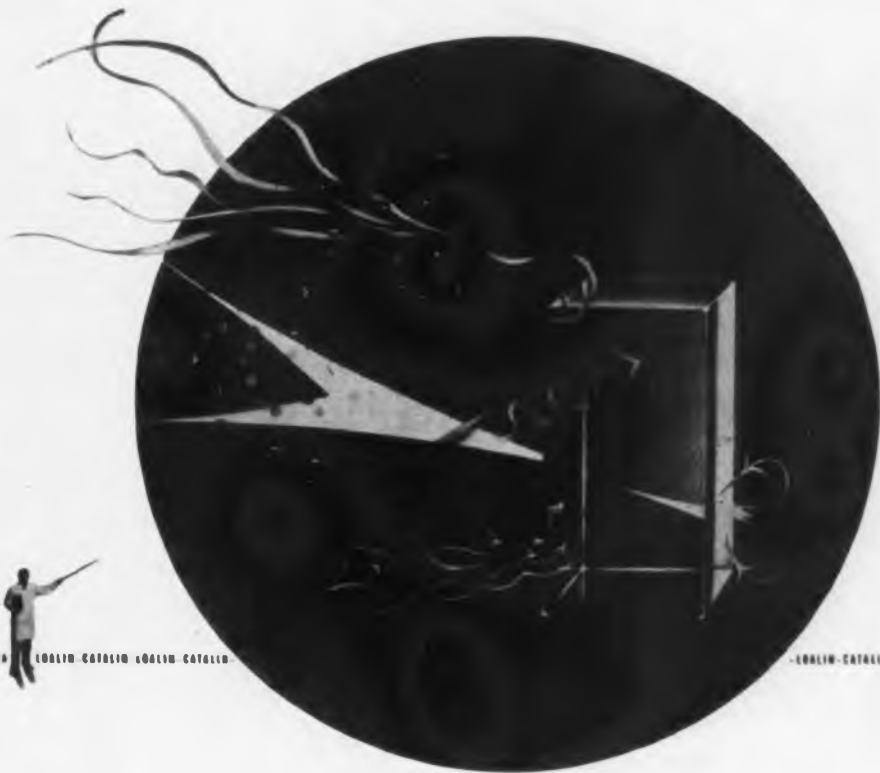
Molding Compounds

Loalin polystyrene thermoplastic injection molding compounds enjoy a unique position among plastics. It possesses outstanding electrical, chemical and mechanical properties. It has a "zero" water absorption and is unrivalled in dimensional stability. Loalin is the lightest weight of all the plastics and one of the least costly. It is available in a limitless range of brilliant colors.



Liquid Resins

Catoband, Colavar and Loaband identify a wide variety of liquid resin formulations employed for coating, laminating, gluing, impregnating and banding wood, plywood, abrasives, paper, cork, brake linings, brushes, etc. Several of these formulations now make possible low cost techniques for the fabrication of aluminum sheets. They can be economically cast at your own plant and excel as drill and saw jigs, router, shaper and hydroform blanks, chocking fixtures, stretch press molds and dies.



LOALIN-CATALIN LOALIN-CATALIN LOALIN-CATALIN

LOALIN-CATALIN

Chemical Resistance

"Chemical Warfare" is not confined to the battlefield. Under conditions imposed by modern industrial applications, Plastics, along with other materials, are subjected to constant chemical "attack" as they perform their allotted tasks in military and essential civilian uses.

"CATALIN" Cast Resin in the "Chemical Resistant" grade is especially formulated to withstand the effects of most acids, alkalis and lubricants. In addition to this desirable quality, it has a low percentage of water-absorption and the other physical, mechanical and machining characteristics usually associated with all Catalin Cast Resins.

"LOALIN" - Catalin's polystyrene molding compound - offers excellent resistance to all acids, alkalis and alcohols, being soluble only in esters and the aromatic hydrocarbons. Its water-absorption is 0.00% (24 hours immersion at 25° C.) and its reaction

to mineral, animal or vegetable oils ranges from excellent to poor, depending upon the particular oil.

Our chemists and engineers have made exhaustive tests of both Catalin and Loalin under various conditions and covering chemical, electrical, thermal, mechanical, physical and "working" properties. The results of their inquiries and the experience and testimony of fabricators, molders and users in many fields are available to your own technical staff for immediate application or for guidance in "blue-printing" the products of tomorrow.



Cast Resins
Molding Compounds
Liquid Resins

CATALIN
CORPORATION

ONE PARK AVENUE • NEW YORK 10, N. Y.

BROADCASTING STATIONS!

RECORDING STUDIOS!

SCHOOLS!

You Can Get Them
Without Delay!



GOULD-MOODY
"Black Seal"
**GLASS BASE
INSTANTANEOUS
RECORDING BLANKS**

The tributes paid to "Black Seal" discs by many leading engineers have been earned by distinguished service on the turntable. Your ears will recognize the difference in quality of reproduction, and the longer play-back life will prove the superiority of "Black Seal" construction. Choice of two weights—thin, flexible, interchangeable with aluminum, or medium weight—both with four holes.

An AA-2X rating is automatically available to broadcasting stations, recording studios and schools. Enclosure of your priority rating will facilitate delivery. Old Aluminum Blanks Re-coated with "Black Seal" Formula on Short Notice



**THE
GOULD-MOODY
COMPANY**

RECORDING BLANK DIVISION
395 BROADWAY • NEW YORK 13, N. Y.
EXPORT DEPT. ROYAL NATIONAL COMPANY, INC.
87 BROAD STREET, N. Y.

WHAT'S NEW

Duralon reverts to an extremely hard, dense, black substance. Varying physical, chemical and electrical properties can be developed in the base resin by incorporation of the usual fillers and lubricants. In certain stages Duralon can be readily machined by drilling, milling, turning, sanding, grinding, etc.

Electronic Relay

A new electronic relay for amplifying the limited current transmitted by delicate control contacts or high resistance circuits, has been developed by the Industrial Control Division of the General Electric Co. Operated by any material having a resistance of from 0 to 500,000 ohms, or even greater if necessary, the new relay is especially suitable for controlling liquid levels in tanks and boilers, sorting metallic parts by size, detecting broken threads in textile machines, and as a limit switch requiring extremely light pressure to operate. The new relay consists of a standard type electronic tube, a supply transformer, and an electromagnetic relay, mounted in a weather-resistant enclosure suitable for wall or machine mounting. In operation, the electromagnetic relay in the device is kept energized as long as the controls connected to the input grid circuit of the electronic tube remain open. The instant these con-



tacts close, the relay is de-energized. A built-in time delay feature prevents chattering when the contacts in the input circuit are momentarily closed. A contact arrangement on the electromagnetic relay permits the device to be used either to make or break a load circuit when the actuating contacts connected to the input circuit on the electronic relay are closed.

New Oscillograph

To facilitate the investigation of transient as well as recurrent phenomena over a wide frequency range, Allen B. Du Mont Laboratories, Inc., Passaic, N. J., has developed a new (Type 247) oscillograph. This instrument utilizes the new Army-Navy preferred Type 5CP1 cathode-ray tube with intensifier electrode, operated at an overall accelerating potential of 8000 v. High-intensity patterns are obtained on the 6 in. screen. The medium-persistence green screen is standard. If a permanent record of transient phenomena is required, the instrument may be supplied with short-persistence blue screen for high-speed photographic recording, or with the long-persistence green screen for visual observation of low-speed phenomena.

The sweep frequency range has been extended down to one-half cycle per second, providing a wider range of sweep operation. Thus it may be used for observations on low-speed machinery and for other low-frequency functions. The time-base provides recurrent, single or repetitive sweep operation. An unusual beam control circuit is used with single sweep operation, to darken the screen except during the actual sweep cycle, providing a reduction of background illumination and resulting in



CONVERTS MECHANICAL INTO ELECTRONIC CONTROLLED WELDERS

A new and compact self-contained timer and tube contactor 'package' unit which quickly converts any foot or mechanically operated spot welder is now available from Weltronic (Model No. 120-75). It automatically controls spot welder operation providing the accurate, uniform welding production made possible by electronic control.

It is adaptable to a wide range of welding operations by virtue of its interchangeable panel construction. Any NEMA type timer may be plugged in as desired, or any standard ignitron tube panel inserted for the weld current required.

Ask for Bulletin No. 120-75

Weltronic
COMPANY
DETROIT 19, MICH.

Only



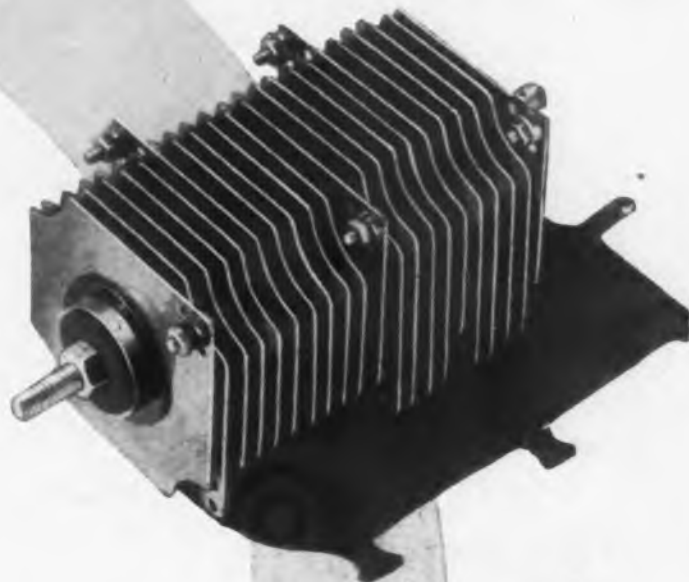
Offers All Three

Low-voltage Rectifiers

Where other manufacturers offer one or two of the three standard types of low-voltage rectifiers, General Electric is alone in supplying all three—an important fact to remember when next you need a rectifying unit. The reason: The most efficient type in one application may be least efficient on the very next application. It is in determining which type to use in each instance that G.E. can help you most—having all three types it can give impartial engineering advice on which one you should use. Full details from Section A748-124, Tungar & Metallic Rectifier Division, General Electric Co., Bridgeport, Conn.

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news, every weekday 6.45 P.M. EWT, CBS.

GENERAL  **ELECTRIC**



COPPER-OXIDE



SELENIUM

TUNGAR





Type "C" D.C. Generator
Permanent Magnet Field, ball-bearing equipped; 1 3/4" outside diameter, 3 3/8" in length . . . weighs 16 ounces.

THE
ALL-IMPORTANT
Plus
IS
PROMPT DELIVERY

Elinco fractional — h.p. motors and generators combine compactness and small size with utmost precision and accuracy, the result of long experience and extreme manufacturing care and testing . . . plus adequate production to assure the most prompt delivery possible.



Type "B" A.C. Generator
Permanent Magnet Field wound for one, two or three phase A.C. Ball-bearing equipped; flange or base mounted. 2 1/4" outside diameter . . . weighs 16 ounces.

Elinco

Can supply quantity production on standard items, or produce experimental or production machines built to your own specifications.

ELECTRIC INDICATOR CO.
STAMFORD U.S.A. CONN.

WHAT'S NEW



photographs of greater contrast. Exceptionally uniform response over a very wide frequency range for both the vertical and horizontal axes; a distortionless, continuously-variable low-impedance attenuator or gain control; a Z amplifier channel for applying external timing signal to the grid of the modulating electrode; and other features and refinements, mark this instrument. Dimensions: 14 in. x 19 in. x 26 in.; Weight 180 lbs.

Midget Transformer

A transformer that compares in size with an ordinary cigarette is being manufactured by the Acme Electric & Mfg. Co. of Cuba, N. Y. for certain electronic applications. This transformer in an aluminum case is only one inch in diameter and 1-7/16 in. in height overall. The weight is approximately 2 ounces. It is rated at 1.4 henries at .025 amperes direct current, with a resistance value of 100 ohms.

Navy Speaker

The demand by the Navy for a loud-speaker, that could satisfy the rigid requirements of today's great naval battles, has been met in a new speaker designed by Bell Telephone Laboratories and now being produced by the Western Electric Co. Designed for speech reproduction, the speaker has an outside diameter of 12 1/2 in. and weighs approximately 25 lbs. The unit is composed of three principal sections: the base, which provides space for a transformer, and a terminal strip, and provisions for the lead-in cable; the horn, which is of the folded exponential type; and the magnetic unit which is fitted with a two-piece permanent magnet, and diaphragm. The loudspeaker is constructed principally from



as **DEPENDABLE**
as the **PLANETS**

Haydon
TIMING MOTORS
and
DEVICES
AC — DC

AS regular, as precise as the movements of planets . . . such are Haydon Timing Motors and Devices. Equipped with special motors to fit your particular requirements and geared up or down to any speed from 450 RPM or faster, to one revolution a month.

Let our Engineering Service help you with your timing problem!

Send for illustrated catalog!



Haydon motors can have brakes for instant stop . . . are reversible and possess shift devices for any automatic reset.



As makers of the most complete line of Synchronous Timing Motors, Haydon Manufacturing Company offers a complete **TIMING ENGINEERING SERVICE**. Why not write for our new catalog!



DC MOTOR
Reversible — Compact — light in weight — seven segment commutator — low reactance rotor winding — alnico magnet field — totally enclosed. Sealed-in lubrication.



AC MOTOR
Available 450 RPM to 1 REV. per month; manufactured to your specific voltage, frequency, speed and torque requirements. The smallest 110 volt, 60 cycle 1-RPM units consume only 2 watts.



ADDRESS
DEPT. 21

Haydon

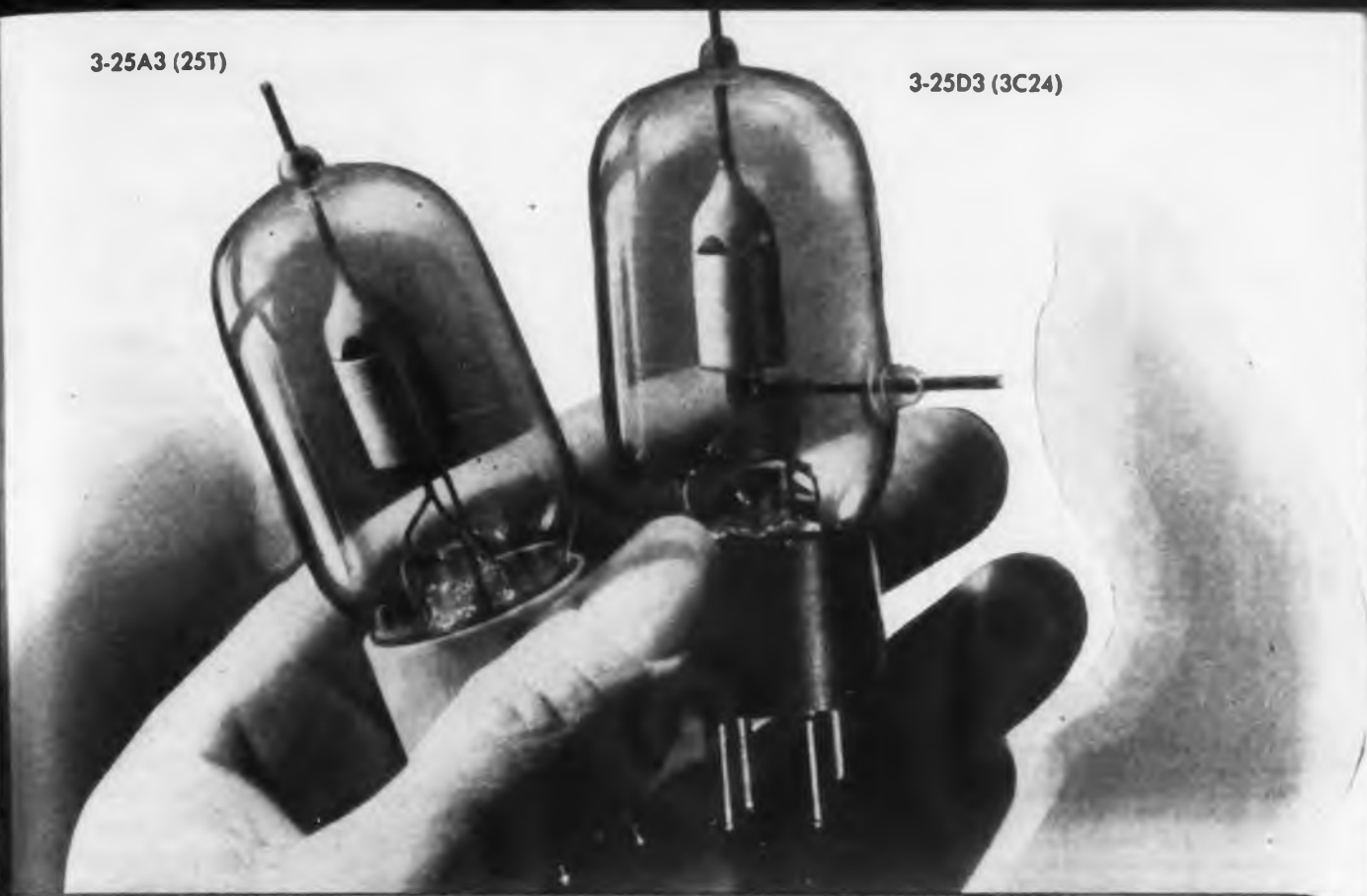
MANUFACTURING COMPANY
INCORPORATED

Forestville, Connecticut

ELECTRONIC INDUSTRIES • July, 1944

3-25A3 (25T)

3-25D3 (3C24)



Here are TWO NEW TUBES in the Eimac line

Plate Dissipation (watts)	20	25
Amplification Factor	100	100
Filament Volts	6.3	6.3
Filament Current (amps)	0.15	0.15
Inter-electrode Capacitance		
Grid to Plate	1.0	1.0
Grid to Filament	1.0	1.0
Plate to Filament	1.0	1.0
Maximum Rating		
(Class C Amplifier)		
Plate Voltage (DC)	200 volts	200 volts
Plate Current (DC)	75 milli	75 milli
Grid Current (DC)	20 milli	20 milli
Maximum Plate Dissipation (watts)	20	25

Smaller brothers of the Eimac 35T and 35TG, these two triodes are filling a need in high-frequency equipment of relatively low-powered class. They attain a high order of efficiency on frequency in the VHF range and perform equally well at lower frequencies.

In every way these two are worthy additions to the Eimac family... embodying all the Eimac features including complete freedom from premature emission failures due to gas released internally.

Complete data is available without obligation. Write for it today. Also ask for your complimentary copy of *Electronic Telesis*, a sixty-four page booklet which gives the fundamentals of Electronics and many of its applications. Written in layman's language, this booklet will assist engineers in explaining the art to novices.

Follow the leaders to



EITEL-McCULLOUGH, INC., 893 San Mateo Avenue, San Bruno, California

Plants located at: San Bruno, California

and Salt Lake City, Utah



Export Agents: **FRAZAR & HANSEN, 301 Clay Street, San Francisco 11, Calif., U.S.A.**



INTELLIGENTLY SPEEDILY...

The Lafayette Radio Corp. organization, built soundly over a period of 25 years, functions in two "key" shipping centers — Atlanta and Chicago. Yes, we maintain tremendous stocks of radio and electronic components and equipment. But, equally important, there are "brains" to go with them. Our men are truly appreciative of what you are up against these days...whether you're a giant of industry, the little service man around the corner, or represent a military agency or training school.

Because we are well versed in all fields utilizing electronics, your orders are handled intelligently. At our fingertips is complete data on shipping routes, priorities, effective substitutes...all things a purchasing agent wants to know. Write, wire, telephone or teletype — get to know the superior service of Lafayette Radio Corp.



NEW — 8-Page CIRCULAR, listing merchandise available for immediate delivery, will be rushed to you on request. All items are subject to prior sale. Write or wire Dept. J-7

P. S. We specialize in equipment for laboratory and experimental use. Such equipment built to your specifications if you desire.

Lafayette Radio Corp.

901 W. Jackson Blvd. CHICAGO 7, ILLINOIS
765 Peachtree Street ATLANTA 3, GEORGIA

238

WHAT'S NEW

formed sheet steel and molded plastic. The voice coil impedance of the unit is approximately 7.5 ohms. The speaker develops the high sound pressure of 60 dynes per square centimeter when operated at the rated electrical input and measured at 10 ft. from the speaker on the sound axis in open air; it is resistant to shock, vibration, salt spray, gun blast, and is readily accessible for servicing due to its simple construction.

Fungicidal Concentrate

A new fungicidal concentrate has been added to the line of Insl-x products and is to be used in various insulation and sealing waxes for the elimination of fungus growths. The product does not volatilize nor lose potency at bath temperatures and is non-toxic; it does not precipitate upon cooling. Manufacturer is Insl-x Co., 857 Meeker Avenue, Brooklyn, N. Y.

Electronic Speed Programmer

A system of program control developed by The Reliance Electric & Engineering Co., Cleveland, Ohio, provides any number of speeds covering the entire range of the machine to which applied. Speeds are set up on a series of dials. Speed selections can be handled with limit switches or other devices for opening and closing circuits. A simple electronic grid-controlled rectifier,



the unit is arranged for the conventional control with a fixed displaced ac rider voltage in the control grid circuit, superimposed on a dc voltage which is the sum of an adjustable positive voltage, and a negative feed-back voltage from the generator armature of the electronic variable speed drive. When running at a steady speed, a balance of control voltages is established which maintains the required voltage output from the generator. Although this type of control can be applied to all types of adjustable voltage drives, it is particularly adaptable to applications requiring a series of adjustable pre-set speeds with automatic or manual selection of these speeds.

Sealed Relay

A new type of explosion-proof, sealed relay is being made by Electrical Products Supply Co., 1140 Venice Blvd., Los Angeles. The standard model, which weighs 4.7 oz., is rated at 25 amps. The instrument is sealed at the factory but has reversible contacts which may be reversed in the field when worn, providing new surfaces without disturbing adjustment.

Portable Tester

The RCP Model 422 Supertester is for general circuit testing and trouble shooting, and combines many important measurements in one small case. Features are: Current measurements in both ac and dc up to 25 amperes; voltage measurements in both ac and dc up to 5,000 volts; high voltage not applied to selector switch nor to general test circuits. 3-in. square meter with movement of 200 microamperes or 5,000 ohms per volt sensitivity on dc voltage measurements. Resistance measure-

For Uninterrupted
Service Specify
DOLPH'S
INSULATING VARNISHES

ADDED
PROTECTION



Today, it is most essential that power transformers, voltage regulators, etc., deliver uninterrupted service. The presence of moisture, oil and corrosive chemicals will tend to lessen the useful service of your equipment. Such deteriorating factors can be curtailed by specifying DOLPH'S Insulating Varnish for extra protection to coil windings.

When in need of insulating varnishes specify DOLPH'S for extra protection. They are formulated to meet the most rigid specifications.

Write for
the free folder
on SYNTHITE PG-4 Clear Baking
Varnish.

JOHN C. DOLPH COMPANY

Insulating Varnish Specialists

173-C Emmet St., Newark, New Jersey

ELECTRONIC INDUSTRIES • July, 1944

HOW MUCH LESS PAPER CAN YOU USE IN YOUR PLANT?

That's a mighty important question. Paper stocks are seriously low this year, and every time another shipload of paper-wrapped war supplies leaves an American port, the problem gets tougher • The voluntary cuts, the simple economies you have put into operation up to now, won't be half enough in 1944 • The only answer is honest, convincing *paper-pinching* by every one who uses paper • Organize a Paper Conservation Committee in your company. Pick only the best men for this job, and give them a green light so that they can work effectively • From envelopes to heavy cartons, have this Committee see to it that functional packaging is the order of the day—every day • In the panel are suggested many ways your plant can use less paper. But you know your own business best! Go to it *NOW!*

Use Less Paper Because

Multiwall paper bags are used extensively in shipping flour and dehydrated foods.

All openings and exposed surfaces of tanks are sealed with paper for shipping.

Submachine guns are not only paper-wrapped but boxed in paper board. Shell grommets, bomb rings and practice bomb fins are made of paper to save needed steel.

Gas-mask canisters and hand-grenade containers are made of paper.

Paper is used in camouflage strips and netting and parachutes.

All Army clothing and equipment are shipped in waterproof paper wrappers.

Use Less Paper These Ways

Condense letters and memoranda by (a) keeping margins as narrow as possible; (b) sticking to single-space forms; (c) using reverse side of incoming letters as first carbon copy of replies; (d) using reverse side of second sheets for carbon copies; (e) using both sides of all mimeographed sheets.

Check carefully to determine whether your shipping container exceeds the requirements of Rule 41 of "consolidated freight classification requirements."

Eliminate individual cartons in every practical instance.

When individual cartons are indispensable, pack in bulk whenever possible.

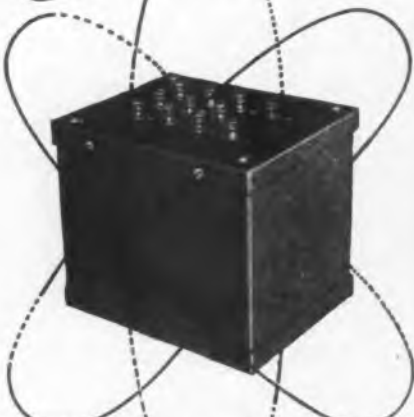
Control disbursement of paper supplies to employees so that excessive quantities do not accumulate in desks and departmental supply closets.

This advertisement prepared under the auspices of the War Advertising Council in co-operation with the Office of War Information and the War Production Board.

LET'S ALL USE LESS PAPER

Space for this advertisement contributed by **ELECTRONIC INDUSTRIES**

Electronic



PERFORMANCE

Imagine splitting an ampere into thousandths. But, that's our business, for electronic performance depends upon controlling electrical impulses to close limitations. If you use transformers with micrometer-type specifications, better talk with an Acme Engineer. We know how to build Plate Supply transformers, Power transformers, Filament transformers, Chokes, etc., and for all electronic applications.



Maybe you need something like this. 2½ KVA. Auto transformer, 115 volts primary, 90/100/110/120/130/200/210/220/230/240 secondary.



BREAKDOWN TESTER

A compact, portable testing unit ideal for laboratory or production-line use, 115 volt, 60 cycle primary. Adjustable secondary voltage of 500/1000/1250/1500/1750/2000/2500 volts. Many safety features combined with typical Acme high quality construction . . . Write for Bulletin 140.

THE ACME ELECTRIC & MFG. CO.
CUBA, N. Y. • CLYDE, N. Y.

Acme Electric
TRANSFORMERS

WHAT'S NEW



ments up to 10 megohms. Batteries are replaceable without a soldering iron. Supplied complete with batteries in natural wood case—6½ x 7 x 2¼ in.—with carrying strap handle, manufacturer is Radio City Products Co., 127 West 26th St., New York.

Miniature Inductors

Miniature air inductor coils added by Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa., are supplied in diameters from ½ to 1¼ in. Air wound construction assures maximum rigidity and accuracy, with lightest possible weight. Q characteristic is high due to the almost



total absence of insulating material in the electrical field. Any type of mounting can be supplied, and the coils can be equipped with fixed or variable, internal or external coupling links, and many other features to match practically any specification. There are 5 standard diameters and each diameter is available in any winding pitch from 44 to 4 turns per inch, or less if required. Wire sizes range from No. 14 to No. 28 and almost any desired type of wire can be supplied.

Direct-Reading Megohmmeter

Designed for checking condenser dielectric, but equally applicable to other high megohm testing, the TAC Model 404-E Megohmmeter permits rapid measurement of resistance from 400 megohms to 100,000 megohms. Resistance values are measured under an applied dc potential of 90 volts and are indicated on an individually calibrated scale. With an accuracy of 5 per cent, the instrument is stable enough to allow its use in production testing. An important feature is the built-in current limiter which prevents damage to the instrument if the test terminals are accidentally shorted. The controls—which are master switch, range selector, and zero

A STRONGER FACTOR in TODAY'S NEW COMPLETE CIRCUIT PROTECTION



EXTRACTOR POSTS

WITH WELDED ANTI-VIBRATION
SIDE TERMINALS

NOW UNDERWRITERS' APPROVED

Resistance to extremes of shock, vibration and temperatures is provided by the new Littelfuse Extractor Posts with electrically welded side terminals. By Littelfuse process, terminals are made integral with inside metal shell. Maximum conductivity is insured. Other Littelfuse improvements for dependability, durability, and convenience make these extractor posts outstanding examples of Littelfuse complete circuit protection.

EXTRACTOR POST No. 342001 for 3 A G Fuses

Finger-operated. Welded side terminals. Knob and body black bakelite. Positive fuse grip. Full visual shock-proof inspection. Spring-activated cup. Specially designed grip prevents fuse from dropping out.



Also furnished screwdriver-operated (341001), meeting Underwriters' specifications.

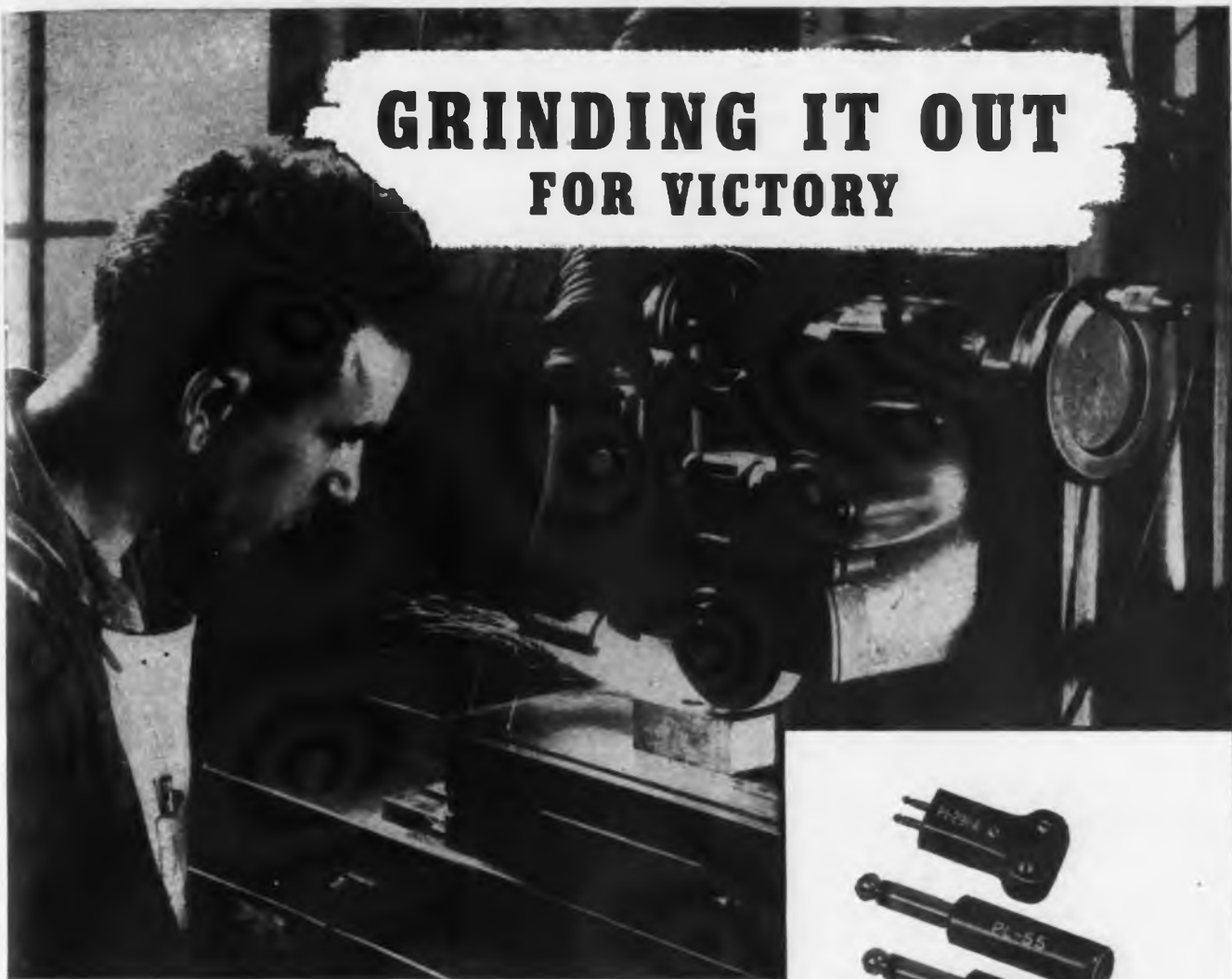
Send for B/P and ENGINEERING DATA
Ask for Samples

Safeguard new equipment, or irreplaceable present equipment. Fuses, Fuse Clips, Fuse Panels, Circuit Breakers, Thermocouples, Fine Wire Products, Indicators, etc.

LITTELFUSE INCORPORATED

4737 Ravenswood Ave., Chicago 40, Ill.
200 Ong St., El Monte, Calif.

GRINDING IT OUT FOR VICTORY



Precision grinder—a "cog" in the Remler tool room which is equipped with complete facilities

THE SUM OF SMALL JOBS well done adds up to the mighty effort necessary to achieve the long hard march to victory. Remler's contribution to the common task is the manufacture of complete sound transmitting systems, radio . . . plugs and connectors. Twenty-five years of experience in electronics and plastics plus complete modern facilities for planning, design and manufacture are at the disposal of prime contractors. Further assignments welcome.

Wire or telephone if we can be of assistance

REMLER COMPANY, LTD. • 2101 Bryant St. - San Francisco, 10, Calif.

REMLER

SINCE 1918

Announcing & Communication Equipment



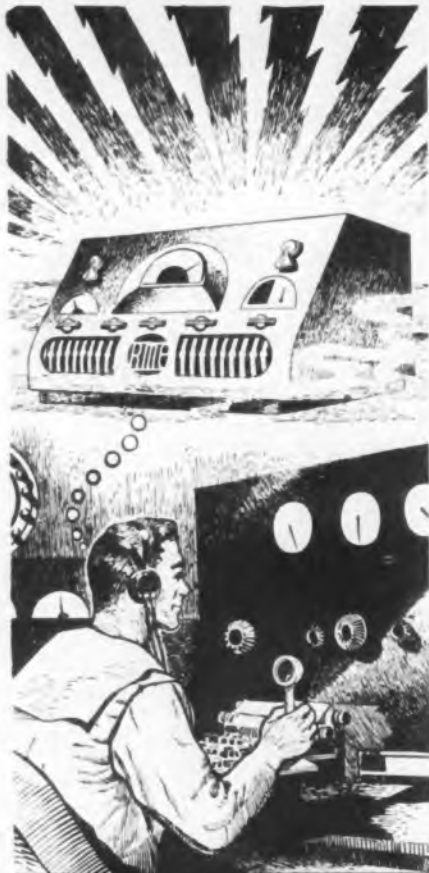
PLUGS & CONNECTORS

Signal Corps • Navy Specifications

Types :		PL			NAF	
50-A	61	74	114	150		
54	62	76	119	159		
55	63	77	120	160		1136-1
56	64	104	124	291-A		
58	65	108	125	354		No.
59	67	109	127			212938-1
60	68	112	149			

PLP		PLQ		PLS	
56	65	56	65	56	64
59	67	59	67	59	65
60	74	60	74	60	74
61	76	61	76	61	76
62	77	62	77	62	77
63	104	63	104	63	104
64		64			

OTHER DESIGNS TO ORDER



Your **R. M. E.**
for Tomorrow

Yes, tomorrow's R.M.E. radio equipment is in blueprint stage. Surprises are in store for you. We've made fast forward steps because of the demands of war on our equipment. New design, better performance, same strict adherence to "extra values". Stand by for R.M.E. Radio Equipment.

"R.M.E.—Since 1933"

R M E • 
FINE COMMUNICATIONS EQUIPMENT
RADIO MFG. ENGINEERS, INC.
Provia 6, Illinois U. S. A.



WHAT'S NEW

adjustor—are conveniently grouped on the front panel, which also carries the resistance indicating meter, the pilot lamp, and the terminal strip. The latter is made of an extremely high resistance, non-hygroscopic material. The measuring circuit, including its 110 volt, 60 cycle power supply and the test battery, is contained in a steel housing 8 x 10 x 8 in.; a hinged top panel gives access to the interior for replacement of batteries or tubes. Manufactured by Technical Apparatus Company, 1171 Tremont Street, Boston 20, Mass.

High Voltage Capacitors

A new line of rectangular oil-type capacitors has recently been added by the Capacitron Co., 318 W. Schiller St., Chicago. Capacitors are made in standard container sizes and in voltage ratings up to 6000 volts dc.

Vibration Tester

A new vibration tester operating on the tuning fork principle and permitting vibration testing in any direction through 360 deg. has been developed by Kurman Electric Co., 35-18 37th St., Long Island City, N. Y. The instrument has no moving cranks, gears or bearings, amplitude is visible, vibration acceleration is provided to 30G plus, frequency change is motor operated and the instrument can be mounted on any bench. Two models are available, the other providing for only up and down vibrations.

Tube Rectifier

Designed for heavy duty service, No. 869B tube rectifier, made by Arpin Mfg. Co., 422 Alden St., Orange, N. J., has a rugged edgewise-wound ribbon filament, carbon anode and an oversize cathode shield. Maximum peak inverse current is 10 amperes; anode current is 2.5 amperes.

Surge Resistors

Developed for X-ray and other high-voltage applications, Shallcross Type 290 wire-wound surge resistors are wound on high-grade non-hygroscopic ceramic forms with insulated nicrome wire, single layer space-wound. The wire is protected with a special finish which reinsulates, resists heat and can assure operation at 450° F. Any resistance from 1,000 to 3,000,000 ohms is available. Maker is Shallcross Mfg. Co., Jackson and Pusey Ave., Collingdale, Penn.

Power Supply Units

Selenium rectifier power supply units of 1, 5 and 10 amperes at 115 volts, dc, designed for use in the operation of magnetic equipment, dc motors, relays, circuit breakers, carbon arc lamps, battery chargers, and other applications have been added to the line of power supply equipment manufactured by Federal Telephone and Radio Corp., Newark, N. J. The new units are designed for wall or bench mounting with no special connections needed. The 10-ampere unit is furnished with an 11-point selector switch for maintaining 115 volts from no load to full load. Powered by convection-cooled Federal selenium rectifiers, these 1, 5 and 10 ampere units are conservatively rated.

Vinyl Tubing

A newly developed vinyl tubing, with the same electrical properties as conventional tubings, heat endurance characteristics, resistance to oil embrittlement and resistance to gasoline-benzol, is being produced by The National Varnished Products Corp., Wood-

for **TODAY** or
TOMORROW



It's **WINCO ROTARY**
ELECTRICAL EQUIPMENT
for Your **TOUGH**
POWER PROBLEMS

Whether you need rugged, sturdy dependability for today's battle conditions—or designing foresight for tomorrow's sales markets—Winco can help you with special rotary Electrical Equipment. Our engineers are at your service. Consult them when you have a problem involving—

- Built-in and Shell Type Motors
- Adjustable Speed Motors
- Synchronous Motors
- Rotary Electrical Equipment for Aviation
- Dynamotors and Inverters
- Motor Generator Sets
- Railroad Car Lighting Generators



WINCO ROTARY
ELECTRICAL EQUIPMENT
WINCHARGER CORPORATION... SIOUX CITY, IOWA

WHAT'S NEW

bridge, N. J. Designated as Natvar 400 Series, this new tubing is chemically inert and is suitable for oil lines, sheathing and other protective coverings in applications where adverse oil, solvent or acid conditions are severe, and where protection from chemicals or vibration is required over a wide temperature range. Has tensile strength in excess of 3000 psi, with elongation from 175 per cent to 410 per cent, depending on type of tubing, and remains flexible down to -80 deg. F.

Tare Compensator

It is a new method of tare compensation scale for use in hand filling directly into containers whose weight is known to vary to an extent that would impair the accuracy unless the scale is balanced before each weighing operation. A conveniently located balancing knob provides for precise adjustment of weighing mechanism to exact balance point after empty container is placed on the scale. Accuracy and speed—rotation of the control knob through approximately 270 degrees compensates for



variations in container weight through any reasonable range specified by purchaser—from a few grains to several pounds. Accuracy of balance point is unaffected by normal variations in supply line voltage. Supplied only for use on 110 volt 50-60 cycle alternating current. Available from the Exact Weight Scale Co., 957 Fifth Ave., Columbus, Ohio.

Circuit Breaker

Supplementing their present line of aircraft electrical control devices, the Square D Company, Regulator Division, Detroit, Mich., now offers a new line of push type circuit breakers. The Class 9310 manual reset circuit breaker has been developed to provide an improved unit for use in the protection of low voltage circuits not requiring switching. Although especially designed for aircraft use, these devices are also suitable for boats, tanks and other mobile units having power sources up to 80 volts dc. The bimetallic trip element gives time limit protection against small momentary overloads as well as instantaneous protection on heavy overloads and short circuits. Each breaker is calibrated and factory sealed. After tripping it is



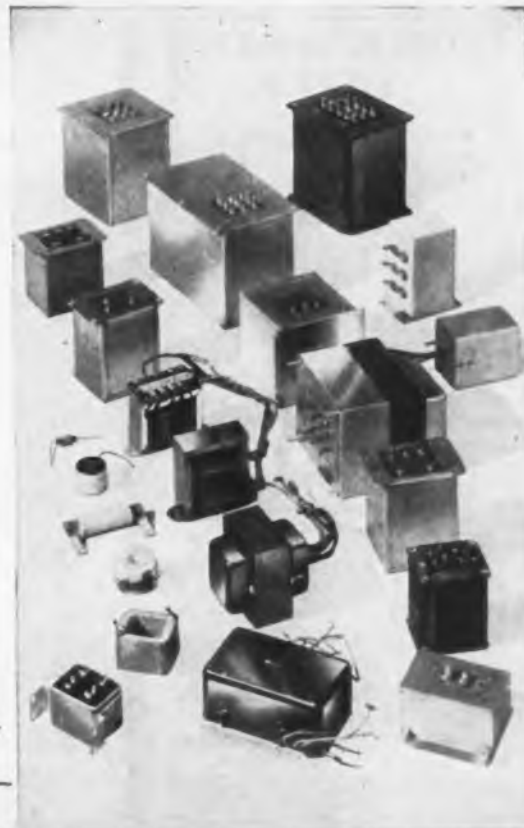
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of

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EACH issue of this magazine is closed, published and mailed on a definite time table.

When there was no manpower problem ... no transportation delays ... no paper shortage ... we had some flexibility in our schedules. We liked to be accommodating. Today we have no leeway for granting extensions, holding forms or handling late advertising copy.

Of necessity, eight advertisements were left out of this issue because they reached us too late. Future omissions can be averted only by a strict adherence to the published closing dates as follows:

CLOSING DATE—For composition, proofs, corrections, plate changes, etc., in black and white, color and preferred positions.

1ST OF MONTH preceding month of issue, i.e.: August issue closes on July 1st.

FINAL FORM—For complete plates, ready to print, in last form in back of book. No setting, proofs, key changes, foundry work, etc.

10TH OF MONTH preceding month of issue.

CALDWELL-CLEMENTS, INC., 480 Lexington Ave., New York 17, N. Y.

TECHNICAL NOTES

Excerpts from *New Home Study Lessons Being Prepared under the Direction of the CREI Director of Engineering Texts*

The Iconoscope

This month CREI is publishing the third and final article of a series on the iconoscope. This is one of a series of interesting technical articles appearing each month in the CREI NEWS, official organ of the Capitol Radio Engineering Institute.

This final article analyzes the action of the iconoscope when a scene is optically focused on it, together with a discussion of the advantages and disadvantages of this type of pickup device. Altogether, the reader will have a good physical picture of the action of the iconoscope from these articles.

At some later date, the technical staff of CREI intends to present an analysis of the action of the orthicon.

Since the appearance of these technical articles in the CREI NEWS, copies have been very much in demand. Write at once for the July issue which includes this final article on the iconoscope. Also indicate if you would like to be placed on our mailing list to receive the CREI NEWS each month. There is no charge or obligation.

Those who are already receiving this monthly magazine can further benefit from it by writing to The Editor and suggesting technical topics they would like to have discussed. We are anxious to make the CREI NEWS interesting and of service to you.

★ ★ ★

The subject of "The Iconoscope" is but one of many that are being constantly revised and added to CREI lessons by A. Preisman, Director of Engineering Texts, under the personal supervision of CREI President, E. H. Rietzke. CREI home study courses are of college calibre for the professional engineer and technician who recognize CREI training as a proven program for personal advancement in the field of Radio-Electronics. Complete details of the home study courses sent on request. . . . Ask for 36-page booklet.

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WHAT'S NEW

only necessary to push the reset button down to its farthest position. The Class 9810 circuit breaker is available in sizes 5 to 50 amperes. The unit is built in accordance with Navy specification and bears approval. The unit is of non-trip-free construction and all devices are equipped with luminous indicating rings visible on trip in darkness and with a red indicating ring for daylight indication.

Time Delay Relay

The new Cramer Type TDSA and TDSB time delay relay has been designed to provide a definitely varied operation of one circuit in relation to the second circuit. It is arranged for surface mounting for either front or rear connections and withstands momentary shock conditions. It is made by The R. W. Cramer Co., Inc., Centerbrook, Conn.

Alternate for Varnished Silk

A seamless bias alternate for varnished silk obtainable in continuous length rolls of 86 or 72 yards, is being manufactured by the Irvington Varnish and Insulator Company, Irvington 11, N. J. The new material has been introduced to eliminate the need for splicing 51 in. bias cut strips. Whereas the sewed or cemented seams of spliced fabric often prove bulky or mechanically weak, the new alternate offers freedom from seams or splices permitting uniformly tight, compact taping. The product is a thin cotton cloth varnished to specified thicknesses—and is obtainable in either a slightly tacky or mica dusted finish. Dielectric strength is stated as 1200 VPM and tensile strength as 42 lb. per 1 in. width.

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FILE IN YOUR NOTEBOOK

PUNCH IN HOLES INDICATED

NEW BULLETINS

Arc Welders

Herco arc welders, made by Hercules Electric Mfg. Co., 2418 Atlantic Ave., Brooklyn, N. Y., are illustrated and described in a new four-page catalog bulletin giving essential engineering data. Capacity of the equipment varies in the five models available from 6.6 to 40 kva.

Fractional HP Motors

"Control Devices" is the title of a file envelope of catalog sheets just issued by Eastern Air Devices, Inc., 585 Dean St., Brooklyn. Physical dimensions, characteristics and engineering data are given on a large number of fractional horsepower motors developed for special purposes. They include 28 volt dc motors and ac motors for both 60 and 400 cycles.

Industrial Densitometers

Densitometers for industrial applications are covered pretty fully in a four-page catalog insert published by Photoswitch, Inc., Cambridge, Mass. The instrument measures the optical density of liquids, gases, films, filters, plastics and similar products. Density, relative to a standard, is indicated on a single four-inch meter with a one millimeter movement.

Plastic Preheater

Illitron, high frequency plastic preheating equipment is illustrated and described in an eight-page folder which gives considerable engineering information about the product. Models varying in size from one to 20 kw are covered. The maker is Illinois Tool Works, 2501 North Keeler Ave., Chicago, Ill.

Low Voltage X-ray

A new 50 kv industrial X-ray unit has been developed by Picker X-Ray Corp., 300 Fourth Ave., New York, and is quite fully described in an eight-page bulletin. The bulletin points out the many industrial uses for low voltage long wavelength X-radiation and includes complete technical and engineering data on the equipment.

Testing Laboratories

A trip through the eight-story plant of Electrical Testing Laboratories, Inc., 2 East End Ave., New York, has been put between the covers of 20-page illustrated book-

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SIMPLE AS A. B. C.

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NEW BULLETINS

let that outlines the services this independent laboratory makes available to industry. ETL engages in research, testing analysis, inspection, surveys, statistics and technical promotion covering practically anything electrical or allied. Facilities also are available for optical, physical, mechanical and chemical investigations.

Insulation Tester

The Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y., has issued a new bulletin describing the model B-5 Megohmer, battery-vibrator type insulation tester. It shows the triple color scale, the various models available, and contains a chapter on the value of periodic insulation resistance measurements as recorded on megographs.

Jobber's Micro Topics

Universal Microphone Co., Inglewood, Calif., with a May date-line, has issued the first jobbers' edition of Micro Topics as an eight-page issue, well illustrated with photos of its factory representatives, company executives and factory supervisors.

News material contains information on Universal and also general



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Plug-in capacitors with a wide range of voltages and capacities are one of the many different paper and electrolytic capacitors manufactured by the Illinois Condenser Company. This unit is hermetically sealed and built to operate under the severest conditions. We also manufacture condensers for special applications with a wide temperature range of from -50°C to +85°C and which are one volt to 500 D. C. working on the electrolytic types.

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NEW BULLETINS

material for the trade. It will be issued at frequent intervals. Micro Topics is now on its second year of publication as a bi-weekly employees' journal. The jobbers' edition will be separate and distinct from the house organ.

The Story of Phillips

A handsome new booklet has been issued by North American Phillips Co., 100 E. 42nd St., New York, N. Y., which is to serve as a general introduction for the company and its products to its American friends. In attractive color plates, the book shows the worldwide experience and scientific achievements behind the organization, its affiliates, its present activities in war production, and its continued service after the war in the manufacture of specialized electronic equipment.

Luminescent Principles

An absorbingly interesting booklet (24 pages, 2 colors) has been prepared by New Jersey Zinc Co., 160 Front St., New York, that lets in a lot of light on the subject of luminescence and fluorescence. The title "The ABC of Luminescence," very nicely describes the contents — an easy-to-understand explanation of the principles of luminescence and a discussion of the practical applications of these principles in the form of activated fluorescent and phosphorescent pigments. A great deal of interest has attached to various forms of night-visible paints though few understand how and why they function the way they do. The book effectively answers any question and so clearly describes technical terms that it should prove a valuable teaching medium. It is profusely illustrated with diagrams.

Silver Mica Capacitors

Bulletin No. 586 which includes engineering data on part numbers 830 to 834 inclusive, has recently been published by Centralab, 900 East Keefe Ave., Milwaukee 1, Wis.

This bulletin on silver mica capacitors takes into account new expanded capacity ranges from 6 to 2,400 mmf and various types of terminals now in production. It introduces a center terminal rivet capacitor that permits wire threading, and a new three-leg shell construction.

Welding Safety

Publication of an attractive 32-page booklet entitled "Safety in Electric and Gas Welding and Cutting Operations," represents another in the series of American war standards developed by the American Standards Association. Its preparation was initiated by the International Acetylene Association, the American Welding Society,

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NEW BULLETINS

the National Electrical Manufacturers Association, and the Division of Labor Standards of the U. S. Department of Labor.

The booklet is designed to serve as a guide for the protection of the individual operator from injury or illness, and for the protection of property from fire or other damage arising out of improper methods in the installation, operation, or maintenance of welding and cutting equipment. It covers every phase of safety applicable to all ordinary welding, cutting, brazing, lead burning, and flame-treating operations.

UHF Insulating Material

Continental-Diamond Fibre Co., Newark, Del., has issued a new bulletin, DN-50 on Dilectene, a uhf insulating material. Briefly, this synthetic resin has exceptionally low loss properties which change very little over the commercial and high-frequency range and are practically unaffected by surrounding moisture conditions since the resin itself is practically non-absorbent. Its dielectric strength is high, and its cold flow and tendency to warp is slight. The folder gives a description of the material, its fabrication, uses and physical data and its properties are presented in four tables.

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The names, addresses and telephone numbers of the chief radio and radar specialists in the WPB regional offices are:

- I—BOSTON, Michael Scott, 17 Court St. (Lafayette 7500).
- II—NEW YORK, F. S. Mysterly, Empire State Bldg. (Murray Hill 3-6800).
- III—PHILADELPHIA, D. B. Miller, 1617 Penn. Blvd. (Locust 3400).
- IV—ATLANTA, T. W. Sumpter, 1506 Candler Bldg. (Walnut 4121).
- V—CLEVELAND, H. J. Shartle, 1325 Union Com. Bldg. (Cherry 7900).
- VI—CHICAGO, C. C. Wood, 226 W. Jackson Blvd. (Andover 3800).
- VII—KANSAS CITY, F. H. Larrabee, Mutual Interstate Bldg. (Harrison 6464).
- VIII—DALLAS, O. T. Neitzel, 1221 Mercantile Bank Bldg. (Riverside 5711).
- IX—DENVER, George Joslyn, Continental Oil Bldg. (Tabor 3137).
- X—SAN FRANCISCO, H. S. Ayers, 1355 Market St. (Klondike 2-2300).
- X—LOS ANGELES, H. G. Schmieler, 1031 South Bway. (Prospect 4971).
- XI—DETROIT, L. A. Kreis, 7310 Woodward Ave. (Trinity 2-4900).
- XII—MINNEAPOLIS, H. M. Richardson, 300 Midland Bank Bldg. (Main 3244).
- XIII—SEATTLE, W. A. Biesmen, White-Henry-Stewart Bldg. (Elliott 0200).

FCC Studies "Bursts"

Some observations on "bursts" which cause interference on high-frequency bands long under study by the Federal Communications Commission, have been made public.

A "burst" is defined as a sharp increase of signal strength of very short duration (seldom more than a spoken word or a note of music) from an FM station located at a considerable distance. Since February, 1943, FCC engineers have been recording reception from certain FM stations to determine the nature and extent of the interference.

Amplitudes of such bursts have varied from the lowest levels which can be measured up to levels well in excess of those required to render satisfactory FM broadcast service. During periods of maximum activity they may occur at the rate of several hundred per hour.

Bursts have been heard at distances up to 1,400 miles from certain FM stations, but are neither so intense nor so numerous at the longer distances as they are at distances of 300 to 700 miles. Systematic variations in the relative number of bursts occur from hour to hour during the day, the highest

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CD-307-A	PL-47	"A" Plug
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JK-26	PL-55	BC-347-C
	PE-86	SW-141
	JB-47	TO-3



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Plate-Modulated R-F Power Amplifier— Class C Telephony

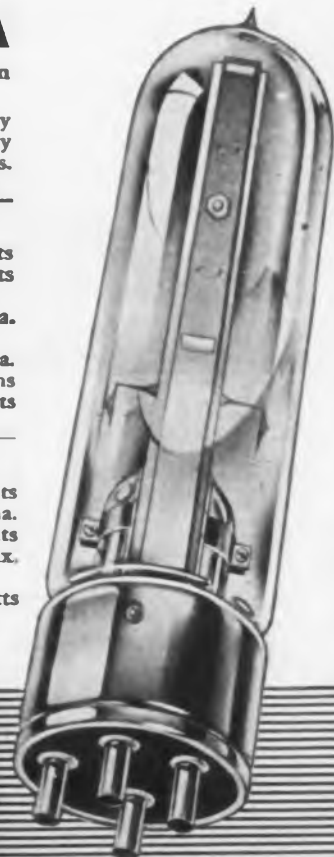
D-C Plate Voltage	1500 volts
D-C Plate Current	300 ma.
D-C Grid Voltage	-200 volts
D-C Grid Current	75 ma. max.
Carrier output for mod. factor of 1.0	300 watts

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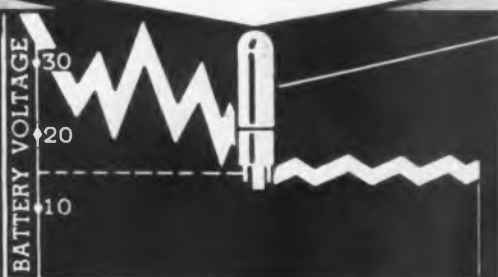
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AMPERITE CO., 561 Broadway, New York (12), N. Y.

In Canada: Atlas Radio Corp., Ltd., 560 King St., W. Toronto

number occurring near sunrise and the fewest near sunset.

These bursts may be related to bursts of somewhat longer duration and greater frequency of occurrence on frequencies below 20 megacycles. The distances over which the FM bursts are received, as well as certain measurements of signal path length, indicate they are ionospheric in origin. Bursts were also observed on certain television stations at 72 megacycles. The Commission has made a preliminary report on bursts in the FM band to the RTPB.

Occasionally a normally unheard vhf station will come in with sufficient strength to operate a receiver for a considerable length of time. This effect, easily distinguishable from the burst phenomenon by its duration, can be produced by transmitters of low power. The cause has been traced to abnormal, "patchy" ionic densities in the lowest of the ionospheric layers, and is known as "sporadic E transmission." Both effects are being studied by the appropriate Panels of the RTPB.

Potential Tube Demand

As a guide in planning civilian production of home receiver radio tubes and radio batteries, the WPB Office of Civilian Requirements on June 14 issued an analysis of its consumer goods survey of miscel-

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aneous household items, based on responses by about 4500 representative families which showed a fairly substantial consumer interest in tubes and a less marked potential market for radio batteries.

For radio tubes it was estimated that if they were plentiful, 16 per cent of the nation's households or 6,092,000 families would be purchasers. Of the households who have been trying to buy tubes since Jan. 1, 1944 and were successful the survey showed 39 per cent, but 41 per cent of the families had been unsuccessful. For radio batteries, the survey estimated 6 per cent of the country's households, or 2,181,000 families—34 per cent of the households had been able to buy batteries since Jan. 1, but 49 per cent had been unsuccessful.

Mexican Electronic Markets

Mexico has between 650,000 and 700,000 radio receivers, 70 per cent of them equipped for short wave reception, produces about 2000 receivers a year almost all assembled from American parts in four assembling factories, and, according to the U. S. Department of Commerce Foreign Reports, imported 123,639 receivers in 1941, all from the United States. Considerable possibilities are thought to exist in the field of sound equipment and there appears to be a good market for electronic control apparatus, X-ray equipment, etc.

Thermador Elec. Mfg. Co. Organization

From information supplied by W. E. Cranston, vice-president and general manager, following are the members of the executive and engineering organization of the Thermador Electrical Mfg. Co., 5119 S. Riverside Drive, Los Angeles 22, Calif.: President, H. H. Fogwell; Vice-Pres. and Gen. Mgr., W. E. Cranston; Treas., J. W. Toland; Superintendent, C. I. Harding; Chief Engr., F. M. Pence; Chief Radio Engr., J. W. Wardell; Asst. Radio Engr., J. Jauch; Engineers, R. Harding and A. P. Sullivan; Sales, H. P. Balderson.

Eclipse on Coast

Eclipse-Pioneer division of Bendix Aviation Corp. has opened a West Coast branch office in Los Angeles. Address is 5655 Wilshire Blvd.

Carburundum Branches

Carburundum Co., Niagara Falls, N. Y., has opened new branch offices in Buffalo (G. S. Rogers), St. Louis (Gordon O. Watson) and San Francisco (W. T. McCargo).



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It's Now Cartwright & Son

J. M. Cartwright, 1276 Peabody Ave., Memphis, Tenn., announced that his son, Wm. C. Cartwright, joined him as an associate on May 1st. "Jim" Cartwright has been a manufacturers' agent in the mid-south territory for the past fourteen years, representing many of the leading electronic and electrical manufacturers of the country.

Bill Cartwright, as he is known to many of the manufacturers whom Mr. Cartwright represents, as well as to many of the jobbers of the South, attended Tennessee State College, where he majored in Chemistry, Gulf Radio, at New Orleans, and California Institute of Technology, at Pasadena, Calif. Prior to the war he was radio officer on luxury liners to South America, leaving this field to become radio officer in the Merchant Marine early in 1941, having been rejected by all Navy and Air force recruiting offices from Nova Scotia to Houston, because of physical disability. He left the Merchant Marine in 1942 to join the Pan-American African Ferry Command at Miami, Fla., becoming Radio Officer and Navigator in this Command. He became disabled in this work, and after several months in hospitals, was advised by his physicians to go to a semi-tropical climate to recover. It was then

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that he went to California and attended Cal Tech. He left Cal Tech to go back to sea as Lt. (sg) on a tanker to the South Pacific, from which he has just returned to California.

Raytheon Rechristened

Raytheon Production Corp. has changed its corporate style to Raytheon Mfg. Co., Radio Receiving Tube Division. No change has been made in the company's factory address, 55 Chapel Street, Newton, Mass.

Rehfeldt and Holubow Head New "Electronic Engineering Co."

Electronic Engineering Co., a new concern specializing in the manufacture of electronic equipment such as intricate and complex transformers, chokes and wave filters, has opened a factory and main office at 735 W. Ohio St., Chicago 10, Ill., and a branch office at 5200 W. Chicago Ave., same city. The new firm also offers a consulting service for the testing and checking of proposed electronic equipment, and for writers of technical papers. Already the recipient of several wartime production contracts, Electronic Eng. Co. is anticipating a tremendous demand for specialized equipment in the postwar expansion of the new electronics industry.

Planning and production manager of Electronic Engineering Co. is E. J. Rehfeldt. "Ed," as he is well known to the electrical manufacturing industry, had 10 years' experience with Thordarson Electrical Mfg. Co. as manager of the export sales, and as advertising and sales promotion manager.

Harry Holubow, chief engineer, comes to Electronic Eng. Co. after seven years' experience as design and research engineer at Thordarson Electrical Mfg. Co. Mr. Holubow holds degrees in electrical engineering from Lewis Institute and Armour Institute and is the author of several well known technical books.

Sales Manager is J. S. Cislak and K. C. Hawkins is credit manager.



E. J. Rehfeldt

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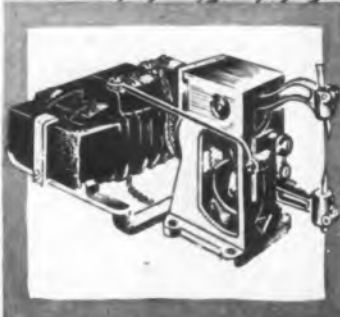
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"E" Awards

Emerson Radio & Phonograph Corp., 111 Eighth Ave., New York, N. Y.

Espey Mfg. Co., 305 E. 63rd St., New York, N. Y. (white star added).

Farnsworth Telev. & Radio Corp., Fort Wayne, Ind. (Marion plant—2nd white star).

Galvin Mfg. Corp., Motorola Div., 4545 Augusta Blvd., Chicago, Ill. (third white star).

The Hallicrafters Company, 2611 Indian Ave., Chicago 16, Ill. (third white star).

Picker X-Ray Corp., 300 Fourth Ave., New York, N. Y. (second star).

Solar Mfg. Corp., Bayonne, N. J. and West New York, N. J. (white star added).

Sprague Electric Co., North Adams, Mass. (second star).

Crowe Name Plate & Mfg. Co., 3701 N. Ravenswood Ave., Chicago 13, Ill.

Fansteel Metallurgical Corp. and Tantalum Defense Corp., N. Chicago, Ill. (white star added).

Lewyt Corp., 60 Broadway, Brooklyn 11, N. Y.

Meissner Mfg. Co., Chicago & Mt. Carmel, Ill. (second star added).

Sylvania Elec. Products, Inc., Emporium, Pa. (third star added).

Utah Radio Products Co., 320 W. Ohio St., Chicago, Ill. (white star added).

The Insuline Corp. of America, Long Island City, New York.

Bell Sound Systems, Inc., 1183 Essex Ave., Columbus 3, Ohio (star added).

15 Years for Goat

Goat Metal Stampings, Inc., Brooklyn, N. Y., which since the late 20's has specialized in the production of tube parts, is celebrating its 15th anniversary. Goat supplies nearly all tube manufacturers with a wide variety of parts such as shields, tubes, plates, grids, etc.

WE Radio Division Changes

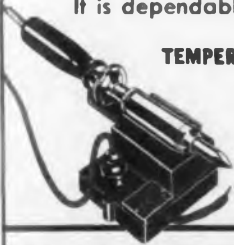
F. R. Lack, vice-president in charge of Western Electric's Radio Division, has made public the following organization changes: P. L. Palmerton, formerly radio merchandise manager, is advanced to the position of assistant manager of the Radio Division. D. C. Hickson, manager of the Division's office in Washington, D. C., is transferred to Headquarters in New York as staff assistant. J. W. Sprague, as Division comptroller, and H. N. Willets, commercial contract service manager, will also report to Mr. Lack.

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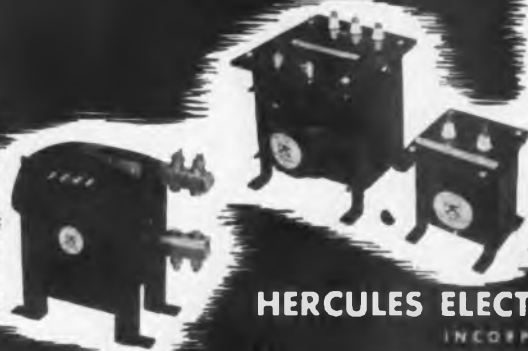
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Standard Molding Expands

Standard Molding Corp., Dayton, O., has opened offices: R. S. Christie & Co., 175 Fifth Ave., New York; Standard Molding Corp., 6452 Cass Ave., Detroit, Mich.; and Standard Molding Corp., 324 Chattanooga Bank Bldg., Chattanooga, Tenn.

"E" Award

Commercial Radio Equipment Co., Kansas City, Mo., was awarded the Army-Navy "E" on June 15.

The company, with branches in Silver Springs, Md., and in Hollywood, has been producing quartz crystals since the late 'twenties, and is one of the few companies whose product is approved by the FCC for broadcast station use.

Chrome-Plating Dodge

When polished steel parts have been chrome plated and finish-ground or polished, it is often difficult to detect with the naked eye whether the chrome has been inadvertently removed in spots, exposing the steel. A better method has been devised, at the St. Louis plant of Curtiss-Wright Corp., utilizing the light-diffusing characteristics of .04-in. translucent plastic sheeting. A hood consisting of top and three sides is used as an inspection chamber. Natural or artificial light is so evenly diffused on the part that any deficiencies in the chrome plating are immediately discernible. Such a diffusing hood might have additional applications in inspection, wherever highly finished surfaces reflect overhead or other light sources into the eyes.

Army Releases Ken-Rad



Back in his office again after the Army moved out on May 25, Roy Burlew, president of the Ken-Rad Tube and Lamp Corp., Owensboro, Ky., is greeted by Mrs. Naomi Turley, his secretary. The Army seized Ken-Rad on April 14 but returned the plant to its officials after WLB had approved an agreement reached by the company and the United Automobile Workers.

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This book presents a complete explanation of the various types of cathode-ray tubes and what role each element within the device plays in making visible the voltages and currents encountered in various kinds of tests.

More than half the book is devoted to the practical applications of the cathode-ray tube oscillograph. Oscillograms, made in the Laboratory maintained by the author, have been used to illustrate this section of the



book, so that the reader may know just what image he should see under any given circumstances.

This volume is not an engineering text. There is, however, contained in the volume a complete and elaborate explanation of the theory of the tube. It is this information plus the practical applications, which make this book so valuable.

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ORCHARD PARK NEW YORK

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the
Attack



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Bonds

PERSONNEL

T. R. Porter, eight years with Westinghouse, has joined North American Philips Co. and will specialize on high frequency heating applications.

Donald M. Campbell, formerly with Wurlitzer and Bell Aircraft Corp., and Jay L. Taylor, 15 years with Colonial Radio Corp., have joined Hoffman Radio Corp., Los Angeles, as senior engineers.

Philip Lauter, executive partner of the Electro Motive Mfg. Co., Willimantic, Conn., has returned to his desk.

Henry A. Hutchins, National Union Radio Corp. sales executive who has been serving with the U. S. Navy for 20 months has resumed his National Union activities.

C. G. Steinbicker, for the past ten years president and general manager of the National Tile Co., Anderson, Ind., has resigned. After a rest he will announce future plans.

Walter L. Tesch, formerly manager of the Record Engineering Department of RCA, has joined the staff of RCA's Electronic Apparatus Section as an application engineer on electronic power heating equipment. Tesch, who was chief electrical engineer with RCA's Japanese subsidiary, Victor Talking Machine Co. of Japan, Ltd., in Yokohama, from 1929 to 1939, has been associated with RCA for nearly 22 years.

Thomas F. Kenna has been added to the staff of RCA's Electronic Apparatus Section as a commercial engineer on high-frequency induction heating equipment. He formerly was Middlewestern sales representative for induction heating equipment of the Van Norman Machine Tool Co., and earlier for that of the Lepel Laboratories.

K. P. Haywood, district manager for the RCA Service Co. in the Philadelphia area for several years, has been transferred to Camden, N. J., headquarters on special assignment. Appointed to succeed him in the Philadelphia district managership is M. E. Wheaton, formerly assistant district manager at Scranton, Pa., who in turn has been succeeded by R. L. Carnis.

Tweeddale to W.E.

J. E. Tweeddale, until recently on special leave of absence from Bell Telephone Laboratories to Columbia University's War Research Division, has taken over coordination and production programming of thermistors, varistors, glass-sealed switches and carbon-deposited resistors in the Radio Division of the Western Electric Co. under the direction of H. N. Willets, commercial contract service manager.



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1025-10	18	12	6
1025-11	18	15	12
1025-12	18	12	12
1025-13	18	18	12
1025-15	24	15	12
1025-16	24	15	15
1025-17	24	18	12
1025-18	24	18	15
1025-19	24	18	18
1025-20	24	12	9
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Donley Heads Westinghouse Home Radio

Walter Evans, vice-president in charge of the Westinghouse Electric and Manufacturing Company's radio activities, has announced appointment of Harold B. Donley as manager of the new Westinghouse radio-receiver division, which will turn out home receivers as soon as they can be made again. Mr. Donley has been with Westinghouse twenty-two years.

N. A. Philips Appoints Lloyd

North American Philips Co., Inc., 100 E. 42nd St., New York, has appointed Warren D. Lloyd commercial manager of its Medical Division, which manufactures X-ray apparatus, X-ray tubes and accessories. Mr. Lloyd has had over 18 years' experience in the medical X-ray field, the last 14 as New York office manager of the General Electric X-Ray Corp.

Dryer to Amperex

John F. Dryer, Jr., has joined the engineering staff of Amperex Electronic Products, Inc., Brooklyn, N. Y. He will specialize in the development of power and control tubes for industrial applications.

Rote on V. T. Committee

Major George A. Rote, of the Engineer Board at Fort Belvoir, Va., has been appointed a member of the American Standards Association's committee on standardization of vacuum tubes for industrial purposes. The scope of the committee's work covers definitions, class-

ifications, methods of rating and testing, dimensions, and interchangeability of vacuum tubes for power and industrial applications.

Invasion Broadcasts

By far the most spectacular of the invasion broadcasts were the combat recordings of the U. S. Naval actions in the English Channel, which were transcribed by network radio reporters on film recording equipment loaned by the Navy. There are four crews, each composed of a commentator and a recording engineer, presently attached to the U. S. Naval Forces in European waters. Under a pooling arrangement reached by the four American broadcasting networks all recordings are available to each. The recordings are delivered by plane or courier from the scene of operations to London where they are rapidly processed for network programs.

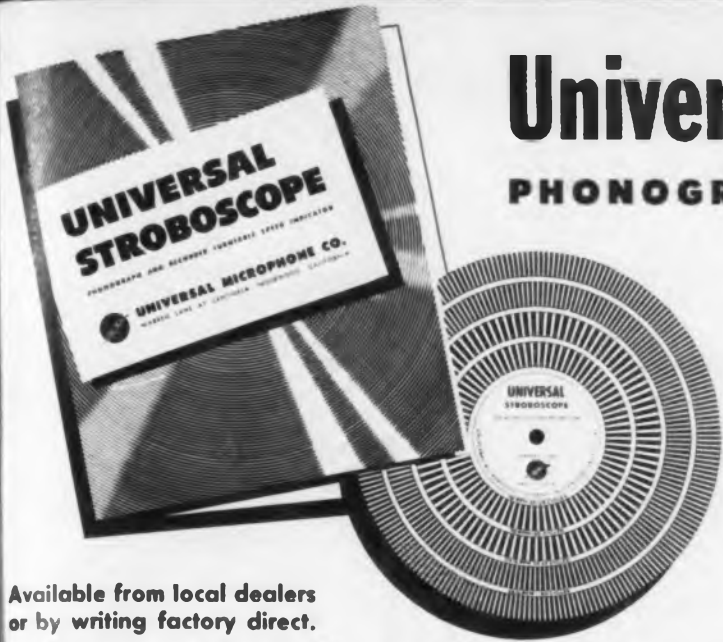
The recorded coverage of U. S. Naval participation in the invasion is the outgrowth of experiments conducted by the Navy with various methods of recording since the days of the Neutrality Patrol prior to Pearl Harbor. Early in 1944 a recording of a carrier task force engagement with a U boat in the Atlantic was made as an experiment. It was released by the Navy to the broadcasting chains. The recorder, known as the Recordgraph, Commando Model, is manufactured by Amertype Recordgraph Corp. of New York. Coordinating the technical operations for the sound recordings is Lt. Marvin F. Royston, former engineer of the Blue and NBC networks, who went with the Radio Section of the Navy Public Relations Office in April, 1943.



U. S. Navy recording equipment of the type now being operated on a pool basis by the four major radio networks to provide eyewitness accounts of invasion action

Universal Stroboscope

PHONOGRAPH AND RECORDER AID



Available from local dealers or by writing factory direct.

Yours for the asking!

This handy phonograph turntable speed indicator, complete with instructive folder, is now available gratis to all phonograph and recorder owners through their local dealers and jobbers. As a recorder aid the Universal Stroboscope will assist in maintaining pre-war quality of recording and reproducing equipment in true pitch and tempo.

Universal Microphone Co., pioneer manufacturers of microphones and home recording components as well as Professional Recording Studio Equipment, takes this means of rendering a service to the owners of phonograph and recording equipment. After victory is ours—dealer shelves will again stock the many new Universal recording components you have been waiting for.



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SPOT SOLDERING MACHINE

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prevent overheating of soldering irons between soldering operations. Irons do not deteriorate when being used. The idle period causes oxidation and shortens life.

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**BELL
SOUND
SYSTEMS**

Like a trained attack force striking swiftly and surely at new objectives, Bell Sound Systems forged ahead with fast action in taking over wartime needs for electronic equipment. As pioneers in the development of improved systems for inter-communication, amplifying, recording, and other purposes, BELL has always adhered to a policy of progressive experiment and research. This habit of looking and thinking ahead gives BELL engineers a head start on new requirements. Because still further knowledge of how electronics can serve a peacetime world is being gained from this wartime production, you can look to BELL Sound Systems, Inc. for leadership after Victory.

BELL VOICE-PAGING EQUIPMENT!

For efficient vocal-paging and plant-wide broadcasting of announcements, signals, recorded music—the first, complete system of standard units designed for industrial needs. Quick, easy expansion or rearrangement; adjustable to any variety of noise levels; standard units combine to fill needs of any type or extent. Write!



BELL SOUND SYSTEMS
Incorporated
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RCA Names Winters

Harold M. Winters has been named manager of a newly-created sales region for the RCA Victor Division of the Radio Corp. of America, covering the eastern central states, with headquarters at Cleveland. The boundaries of the new region will include Ohio, Michigan, Kentucky, West Virginia and the western portion of Pennsylvania.

Edison Elevates Two

Thomas A. Edison, Inc., East Orange, N. J., has two new vice-presidents. They are K. G. Berggren, manager of the special products division, and C. D. Geer, who served the company as chief engineer for eight years and latterly has been general manager of the instrument division.

Gerstenberger Now V.-President

H. Leigh Gerstenberger, formerly general sales manager of the Weston Electrical Instrument Corp., Newark, N. J., recently has been made vice-president in charge of sales of that company, succeeding Mr. Caxton Brown who now is president. Mr. Gerstenberger has been associated with the Weston organization since 1917, shortly after his graduation from Stevens Institute of Technology. He served in both export and sales departments prior to his appointment as general manager in 1932. He is a member of the National Electrical Manufacturers' Association and the Industry Advisory Committee of the War Production Board.



H. Leigh Gerstenberger, who has been made a Weston vice-president

Matched MIDGET CONTROLS



★ They look, measure and operate the same

—these Clarostat wire-wound and composition-element midget controls. Fully interchangeable, mechanically. Can be made up in various tandem assemblies.

Clarostat Type 37 midget composition-element controls have been available for several years past. Their stabilized element has established new standards for accurate resistance values, exceptional immunity to humidity and other climatic conditions, and long trouble-free service. 1 watt. 500 ohms to 5 megohms.

And now the Clarostat Type 43 midget wire-wound is also available, to match Type 37—matched in appearance, dimensions, rotation, switch. 2 watts. 1 to 10,000 ohms.

For neatness, compactness, convenience, trouble-free operation—just specify Clarostat matched midget controls.

★ Write for literature ...



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ELECTRONIC INDUSTRIES • July, 1944

★ The second Army-Navy "E" Award citation for high achievement in war production, continuing a long record of war service is a source of justifiable pride to the management and personnel of The Arnold Engineering Company.

The star will serve as an incentive to The Arnold Engineering Company to continue with the same high devotion, energy and skill to turn out products for the war effort.

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On Production or Laboratory basis

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ELECTRONIC ENGINEER (PERMANENT)

The Brush Development Company requires, for one of its research and development programs, the services of an electronic engineer, preferably with acoustic or vibration experience, including a working knowledge of electrical-mechanical analogies. The project has immediate War applications and will continue as an important postwar activity. Write Personnel Director, The Brush Development Company, 3311 Perkins Avenue, Cleveland 14, Ohio.

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- RELAYS**
- RESISTORS**
- CAPACITORS**
- TRANSFORMERS**
- TEST EQUIPMENT**

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RADIO AND ELECTRONIC COMPONENTS

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Industrial Condenser Builds for Postwar

Construction of a handsome and modern condenser factory was started during March in Chicago by the Industrial Condenser Corp. Built on 75,000 sq. ft., the plant is expected to house a million-volt research laboratory. H. Lee Sklar, president, said: "The starting of this new building is another indication of our faith in the future. We have utmost confidence in what the postwar era will bring. Our new plant also will permit doubling the output of condensers to help relieve present bottlenecks in capacitors for military application."

The new building, which will be finished in July, will be the corporation's eighth plant.

IT&T Smith to Brazil

Captain Henry E. J. Smith, Signal Corps, has returned from North Africa, Sicily and Italy, where he has been stationed with the Armed Forces since 1942, to resume his duties as managing director of one of the International Telephone and Telegraph Corp's. South American subsidiaries. He has been discharged from the Army because of physical disabilities, and leaves shortly to take up a new permanent post in Rio de Janeiro, Brazil.

General Aniline Appoints McKenna

General Aniline & Film Corp., 230 Park Ave., New York, N. Y., has appointed Charles F. McKenna, Jr., manager of its Special Products sales division, to succeed Roger Coleman.

Among the strategic products Mr. McKenna will handle in his new post are the carbonyl iron powders, important in electronics, and the "Poelectron" products. General Aniline Works are the original producers of carbonyl iron powders in this country.

Mr. McKenna takes over the management of this division after a long and varied experience in many branches of the chemical and allied industries, his most recent work having been in the development department of General Aniline & Film Corp.

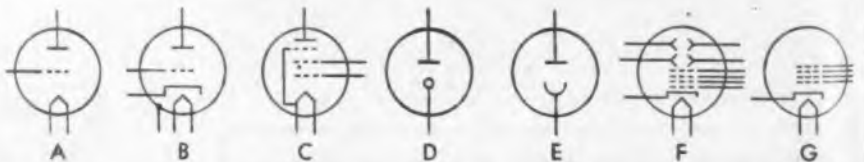
Sprague Electric Company

Without changing ownership or management, Sprague Electric Company is now the official name of the former Sprague Specialties Co., North Adams, Mass., nationally known designers and manufacturers of Sprague condensers, Koolohm resistors, power-factor control equipment and other electrical components. Believing that the word "Specialties" has not adequately indicated the nature of its business, the company has made this change and sent formal notification to suppliers, customers and others.

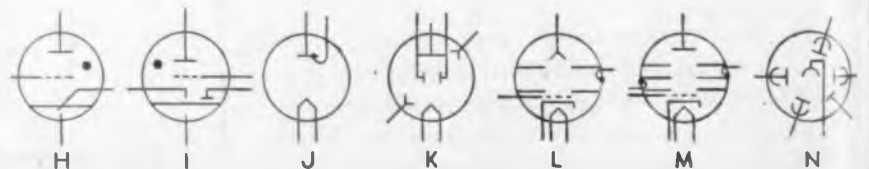
Beginning in 1926 in Quincy, Mass., the business founded by President R. R. Sprague, grew rapidly from the start and in 1930 moved to North Adams. After weathering successfully the depression years, the company was prepared when war loomed on the horizon to accomplish a rapid conversion and expansion capable of handling the large volume of war orders received.

Its three plants in North Adams have received the Army-Navy "E".

GRAPHICAL SYMBOLS FOR VACUUM TUBES



A—Triode with filament; B—Triode with heater; C—Pentode; D—Cold cathode diode; E—Phototube; F—Cathode Ray tube (Electrostatic); G—Cathode Ray tube (Magnetic)



H—Mercury Pool tube with Ignitor; I—Mercury Pool tube with Excitor; J—Magnetron; K—Transit-time tube with Split Plate; L—Velocity Modulation tube (Single Cavity); M—Velocity Modulation Tube (Double Cavity); N—Multiplier Phototube

These standards, approved by American Standards Association (Z32.10-1944) are intended to replace tentative standards published in July 1929. Lines outside the envelope are not part of the symbol but are electrical connections and need not be brought into the symbol as shown

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Ideas

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4. Armature is mica insulated; is suitable for keying a 50 Mega-cycle R.F. signal.
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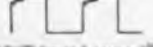


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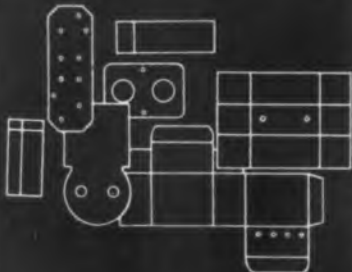
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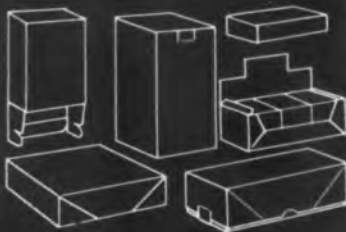
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Famous Californian Visits the East



When Dr. Lee De Forest, whose home is in Los Angeles, recently visited in the East he went to inspect the modern miniature tube plant of the Sonotone Corp., in Elmsford, N. Y., and was greeted by these people: Dr. E. H. Greibach, president, and L. G. Pacent, consulting engineer, I. I. Schachtel, and Dr. F. W. Kranz, vice-presidents, Dean Babbitt, president, and Paul Schwerin, plant manager (next to Dr. De Forest)

Made 67,000 Radios in 1943

Reports from the RCA License Bureau on the number of home-type radio receivers built by American manufacturers during 1943, indicate a mere trickle of some 67,000 sets.

This figure compares with preceding years as follows:

1934.....	4,084,000
1935.....	6,026,000
1936.....	8,248,000
1937.....	8,064,000
1938.....	6,000,000
1939.....	10,500,000
1940.....	11,800,000
1941.....	13,000,000
1942.....	4,400,000
1943.....	67,000

450,000 Juke Boxes

In answer to frequent inquiries which reach this office regarding the number of coin-operated phonographs or "juke boxes" in the United States, we find that the figure most generally accepted in the industry is 450,000. This figure is within 25,000, plus or minus, of estimates given by industry leaders.

Since no juke boxes have been manufactured since 1942, it is reasonable to deduct at least 10 per cent for those not in use.

In addition to these 450,000 juke boxes, the total home phonograph and pickup units of all kinds in the U. S. is estimated at 6 million—about 10 per cent of the total number of radios in use (58,000,000) at the start of the war.

California Reps Honor Easterner



When Dan Bittan, chairman of the board of governors of The Representatives of Radio Parts Mfrs., Inc., visited the West Coast, a special meeting of the Los Angeles Chapter honored him. Pictured are: W. Bert Knight, Charles Silvey, J. T. Hill, Lewis E. Sperry, Frank Emmet, David N. Marshank, D. R. Bittan, Harry A. Lasura, Carl Stone, James C. Pope, Jr., and V. T. Rupp. Dan Wallace took the picture

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Actual Size

RCA-6AQ6 DUPLEX-DIODE TRIODE \$1.50

A multi-purpose miniature electrically similar to the metal 6SQ7, but with half the heater-power requirement. Primarily for use as a combined detector, amplifier, and AVC tube. Diode biasing of the triode unit is not suitable. Diode capacitances are low. Heater: Volts, 6.3; Amp., 0.15. Max. overall length, 2 1/8 in.; seated, 1 7/8 in. Triode Characteristics (class A1 Amplifier): Plate volts, 250; Grid resistance, 58,000 ohms; Transconductance, 1200 micromhos; Plate current, 1.0 ma.



Actual Size

RCA-6AL5 HIGH-PERVAANCE DOUBLE DIODE \$.75

A heater-cathode type of miniature twin-diode. Its low tube-drop, 10 volts at 60 ma. per plate, permits the design of high-efficiency broad-band circuits. Diodes can be used separately or in parallel. Heater: Volts, 6.3; Amp., 0.3. Max. Ratings (Design center values): Peak inverse plate volts, 420; Peak current per plate, 54 ma. D-C output potential, 330 volts. Max. overall length, 1-13/16 in.; seated, 1-9/16 in.



Actual Size

RCA-6J4 HIGH-MU TRIODE MAX. FREQ.—500 Mc \$8.35

A heater-cathode type of miniature triode. Excellent as a grounded-grid u-h-f amplifier (up to 500 Mc); provides high signal-to-noise ratio. Amplification factor, 55. Transconductance, 12,000 micromhos at plate current of 15 ma. Useful in conventional circuits with ungrounded grid. Heater: Volts, 6.3 (a-c or d-c); Amp., 0.4. Max. overall length, 2 1/8 in.; seated, 1 7/8 in. Max. Ratings (Design center values): Plate volts, 150; Plate dissipation, 2.25 watts; Plate current, 20 ma. Mounts in any position.

EACH of these 3 new tubes meets an important need in the miniature field:

- RCA-6J4** as a high-gain triode for frequencies up to 500 Mc
- RCA-6AL5** as a high-perveance double-diode for efficient broad-band circuits
- RCA-6AQ6** as a duplex-diode/triode to combine several functions in one miniature envelope

All 3 combine sturdy construction with small size and high performance.

All 3 are on the Army/Navy Preferred Type List!

All 3 were completely engineered by RCA!

Additional technical data is available on request. Ask for it by tube type number.

If you have an application involving these or other RCA tubes, get in touch with us. Our tube application engineers will be glad to help you. Radio Corporation of America, Tube & Equipment Department, Harrison, N. J.

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