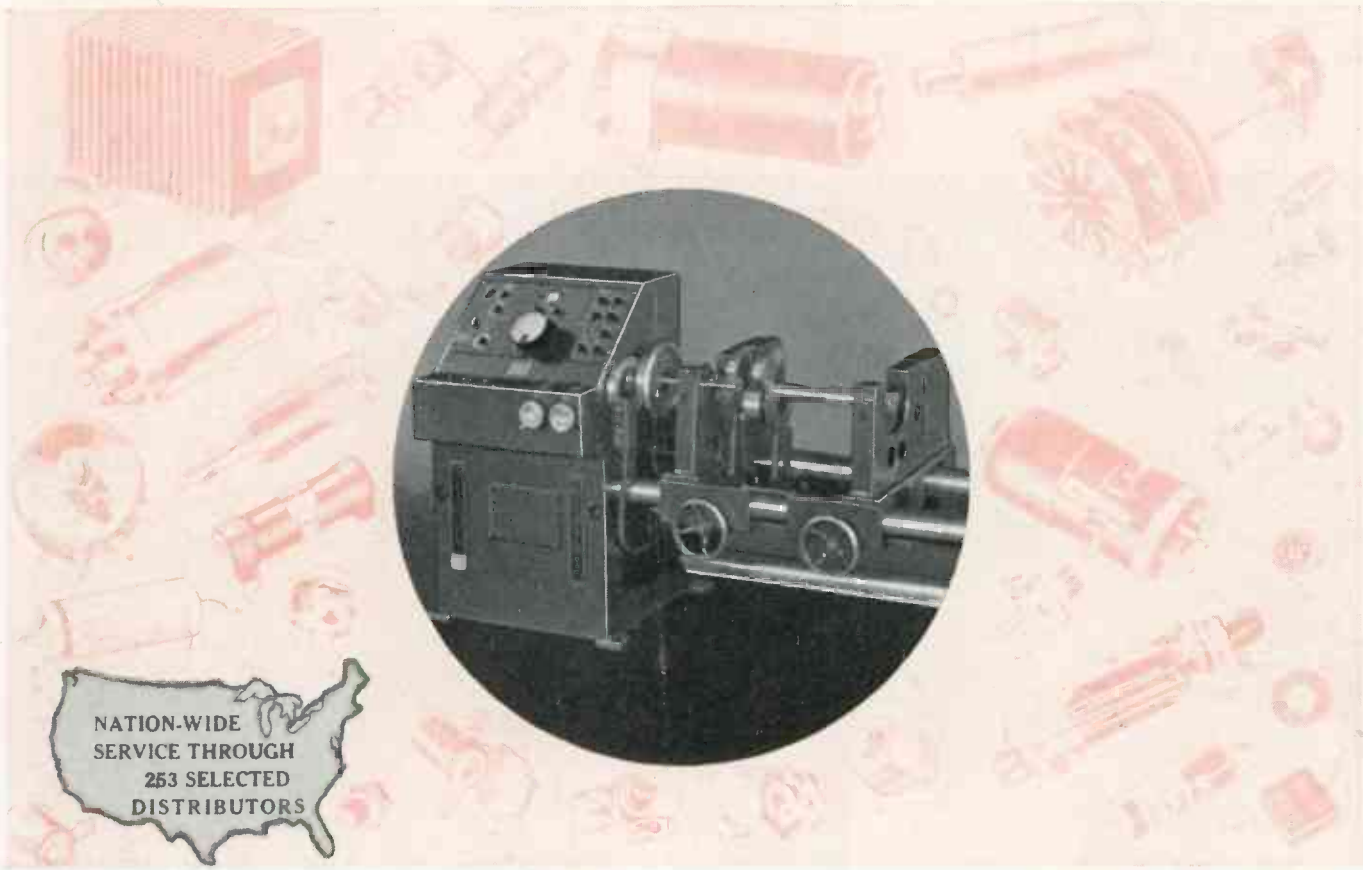
ELECTRONIC INDUSTRIES

- Radio-Electronic Warplane Production Speedup. Factory Short Cuts
- Military Radio Standards—WPB, RMA, IRE, ASA
- Newest Broadcasting Installations and Methods

In Two Parts—Part One

DECEMBER

Aircraft Engines Get Their Balance of Power . . . Thanks to Mallory Approved Precision Products



Balancing crankshafts of airplane engines assures longer motor life and less vibration . . . makes fighter planes easier to handle in the air. Thus many airplane engine manufacturers are using Gisholt Dynetric Balancing Machines to help attain more perfect operation and a smoother flow of power from the multi-horsepower engines they make.

Balancing machines made by Gisholt also improve the performance of many other products . . . from tiny motor armatures and small ventilating fans to heavy turbine rotors . . . used in many industries. To control these Dynetric Balancers, ultra-precise electronic parts are needed . . . such parts as the electrical switches supplied by Mallory.

Similarly, a large manufacturer of aircraft engines for both American and British warplanes utilizes many Dynamometer engine test cells . . . equipped with standard Mallory jack switches . . . a Mallory Approved Precision Product obtained in quantity, promptly, through the local Mallory Distributor.

Do you need electronic hardware, condensers, rectifiers, resistors or volume controls? For testing or experimental work? Or perhaps for plane replacements? Or as an integral part of some electrically operated device you plan to manufacture? See your nearest Mallory Distributor.

There are 253 Mallory Distributors from coast to coast, carefully selected by Mallory, technically trained and ready to give *your* needs their prompt attention. Ask your Mallory Distributor, or write to us, for your free copy of the Mallory catalog . . . used as a buying guide every day in the aeronautical, automotive, electrical, geophysical, radio and other industries.

Write today for free catalog covering entire line of Mallory Approved Precision Products.

P.R. MALLORY & CO. Inc
MALLORY
APPROVED
PRECISION PRODUCTS

P. R. MALLORY & CO., Inc. **INDIANAPOLIS, INDIANA** • *Cable Address*—PELMALLO

. . . don't disturb urgent radio communication!

"KEEP 'EM HEARING!" is the new, vital slogan of the war. For today's battles are sprawling battles of movement, *directed by Radio*. Headquarter commands by radio must be heard clearly, easily, without fail.

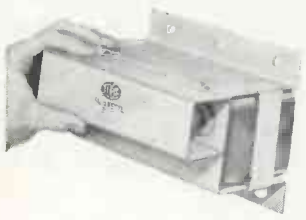
But can they be heard in the midst of swarms of electrically-controlled vehicles? Isn't radio reception blurred by static interference caused by generators, motors, and high tension ignition on the vehicles themselves? The answer *was*—Yes. But now it is No—emphatically NO!

Man Made Static Beaten On All Fronts

Tobe Filterettes are ingenious, compact units incorporated in the vehicle's ignition system. They *blot up* interference, absorb "self-made" static. Result:—noise-free radio operation!

Tobe Helps to "Keep 'Em Hearing!"

Command Cars (as illustrated), Jeeps, Tanks, Half-Tracks, Weapons Carriers and many other U. S. Army vehicles are now Tobe-equipped. And so are many proud vessels of the Navy and Coast Guard. When Peace is won, Tobe will "keep 'em hearing" at home, in pleasure cars and aboard boats. Again you'll say, "No Noise Please! Thanks to Tobe Filterettes!"



THE COMPACT, EFFICIENT TOBE FILTERETTE

Every Tobe Filterette is individually designed for a specific need. Furthermore, its effective operation is assured by the Tobe Capacitor—famous for unusually long life under all conditions. The quality of this condenser is a direct result of *persistence* in research, *soundness* in engineering design, *perfection* in production—*plus* 15 years of condenser experience. For all electrical and electronic applications, be sure to insist on the Tobe Capacitor—accepted by industry as *the* capacitor of the future.

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

What do THEY think of FM?

This new antenna by G. E., with circular bays, eliminates the usual complex, costly structure, yet radiates energy uniformly. It is an example of General Electric engineering leadership in FM equipment.

G.E. WENT TO THEM AND FOUND OUT!

AMONG owners of frequency-modulation receivers, a large majority like the quality of FM reception. For example, 85 per cent say it is better than regular broadcast reception, and 91 per cent would recommend it to their friends!

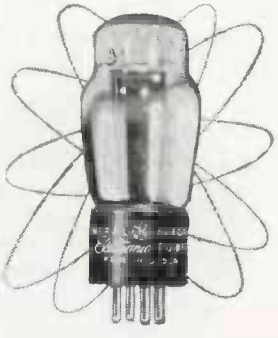
These are facts and figures taken directly from a survey made for General Electric in 14 cities by an independent research organization. Among owners of General Electric FM receivers, the approval registered was even greater.

FM Receivers
NO OTHER

The research organization went directly to private homes for its findings. It sought and obtained answers from both FM and non-FM owners of high, medium, and low cost sets. The answers took on a pattern of telling significance.

Seventy-eight per cent of the non-FM owners rated virtual freedom from static and better tone quality as the outstanding FM advantages. Eighty per cent of FM owners emphasized these same advantages also.

Today G. E. is building FM transmitting and receiving equipment for war purposes only, with the same precision and skill that characterize all of its electronic devices. When peace comes, General Electric FM equipment will be more than ever the best that money can buy! . . . For detailed information on the FM survey, write for booklet, entitled "What the Consumer Thinks of FM," to Radio, Television, and Electronics Department, General Electric, Schenectady, N. Y.



FM Broadcast Apparatus • FM Broadcasting • FM Police Radio • FM Military Radio

MANUFACTURER OFFERS SO MUCH FM EXPERIENCE

GENERAL ELECTRIC

160-A2-6918

FM

ELECTRONIC INDUSTRIES

DECEMBER 1942

In this Issue

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Make accurate tests

of Delicate Precision Instruments

the AMCOIL way

KNOW IN ADVANCE how instruments will perform under service conditions. Amcoil Chambers test accurately and automatically under extremes of cold and heat. In addition to the mechanical refrigeration and dry ice models illustrated, there are Amcoil Test Chambers for other uses, including humidity and altitude testing.

Information on these types as well as further details on those shown here will be furnished on request. Address Dept. EI-12

AMCOIL

Low and High Temperature Test Chamber Model RTC3

- Mechanical Refrigeration (Quick Pull Down)
- Range: −55°C. to +70°C. (−67°F. to +160°F.)
- Exterior: 50" wide x 41" high x 36" deep, Stand: 34" high
- Usable interior: 27" wide x 19" high x 26" deep
- Interior Content: 7.7 cu. ft.

AMCOIL

Low and High Temperature Test Chamber Model RTC1

- Mechanical Refrigeration (Quick Pull Down)
- Range: −55°C. to +70°C. (−67°F. to +160°F.)
- Exterior: 71" wide x 56½" high x 42" deep, Stand, 35¾" high
- Usable interior: 59" wide x 28½" high x 39" deep
- Interior Content: 28.7 cu. ft.

AMCOIL

Low and High Temperature Test Chamber Model RTC-1A

- Mechanical Refrigeration (Quick Pull Down)
- Range: −70°C. to +70°C. (−95°F. to +160°F.)
- Exterior: 71" wide x 56½" high x 42" deep
- Usable interior: 52" wide x 27½" high x 39" deep
- Interior Content: 25 cu. ft.

AMCOIL

Low and High Temperature Test Chamber Model M50TC-1

- Dry Ice Refrigeration (Quick Pull Down)
- Range: −55°C. to +70°C. (−67°F. to +160°F.)
- Exterior: 40" wide x 43" high x 40" deep
- Usable interior: 21" wide x 21" high x 28" deep
- Interior Content: 7 cu. ft.

Our line is 100% converted to war-needed test cabinets

AMCOIL

AMERICAN COILS INC.

25-27 LEXINGTON STREET • NEWARK, N. J.

3130

YOUR FUTURE - IN PICTURES

THE future of the radio business is already deeply involved in pictures — *the magic pictures of the television screen.*

BIG MONEY IN TELEVISION

Informed people expect television to be the country's next great industry, duplicating the success of the automobile business after the last war.

As a leading manufacturer, Farnsworth recognizes its responsibility to today's radio dealers, who will be the television dealers of tomorrow. We can't make sets today — our whole output is precision equipment for the armed forces . . . but we can build a ready and enthusiastic market — a nation-wide demand for television that will carry today's radio dealers into this great new field.

ADVERTISING BUILDS THE MARKET

Farnsworth advertising carries the exciting story of television to all America, arousing interest, stimulating desire for sets, creating demand that the trade must fill tomorrow.

As it did for the automobile, the radio, the electric refrigerator and other outstanding successes, advertising is opening the market for television, laying the foundation for business and for new jobs for countless thousands.

For tomorrow's dealers, Farnsworth Television promises a future as bright as television's own!

●

YOU HAVE probably seen Farnsworth Television ads in the magazines. If not, see October 19 *Life* and *Newsweek,* October 10 *New Yorker* and *Business Week,* October *Fortune,* October 5 *Time,* October 2 *U. S. News.*

FARNSWORTH TELEVISION

FARNSWORTH TELEVISION & RADIO CORPORATION, FORT WAYNE, INDIANA. MANUFACTURERS OF RADIO AND TELEVISION TRANSMITTERS AND RECEIVERS; AIRCRAFT RADIO EQUIPMENT; THE FARNSWORTH DISSECTOR TUBE; THE CAPEHART, THE CAPEHART-PANAMUSE, AND THE FARNSWORTH PHONOGRAPH-RADIOS.

C-Ds FIGHT WITH THE CONVOYS

TODAY'S C-D Capacitors Speed Victory . . .
TOMORROW'S C-D Capacitors assure more hours of use per dollar for American industry

A flying boat, bounced from a warship's catapult, does its tour of patrol ahead of a convoy. Suddenly a sub is sighted! The radio flashes warning to the convoy leader. Destroyers, eager for the kill, plunge forward, Y guns ready . . .

Victory demands split-second teamwork of planes and ships, men and equipment. The "impossible" of the last war has become routine. We are proud that the *finer* performance of C-D Capacitors is successfully meeting the Axis challenge wherever radio and a hundred other electrical and electronic devices serve on critical war duty.

Today's C-Ds speed Victory. Tomorrow's C-Ds assure *more hours of capacitor use per dollar* for American industry. Cornell Dubilier Electric Corporation, South Plainfield, New Jersey; New England Division: New Bedford, Mass.

copied • imitated
but never duplicated

Type DY Capacitors are filled and impregnated with non-inflammable Dykanol and hermetically sealed. They will operate under all climatic conditions and at temperatures up to 80°C. Particularly designed for marine applications. Ideally suited for r.f. and a.f. bypass and a.f. coupling.

Described in Catalog No. 160T free on request.

Cornell Dubilier Capacitors

MICA • PAPER • DYKANOL • WET & DRY ELECTROLYTIC CAPACITORS

MORE IN USE TODAY THAN ANY OTHER MAKE

WHY OHMITE RESISTANCE UNITS MEET TODAY'S CRITICAL REQUIREMENTS


Controlled High Humidity Chamber for all types of Humidity Tests


Machine for Rotation Life Tests of Rheostat And Tap Switches


Measuring Inductance with A Radio Frequency Bridge


Pyrometer Measurement of the Temperature of a Rheostat in a New Device

Extra quality and *extra* dependability have always been an integral part of Ohmite Resistance Units. Electrical and physical fitness for heavy-duty service in exacting applications are built-in from the very beginning. Research, engineering, testing, production and inspection all work together to make Ohmite Products always a little better.

As a result Ohmite Rheostats, Resistors, Chokes, Tap Switches readily meet today's requirements. They are widely used for military, electronic, scientific and industrial purposes.

The wide range of types and sizes makes it easier to meet each need. Many stock items. Units produced to government specifications or specially engineered for you. Let Ohmite engineers help you.

Engineers' and Buyers' Guide

SEND FOR 96-PAGE CATALOG AND ENGINEERING MANUAL No. 40

Write on company letterhead for complete guide in the selection and application of Rheostats, Resistors, Tap Switches, Chokes, Attenuators. Especially helpful today to engineers, production executives and purchasing departments. Contains useful engineering data, reference tables, dimension drawings, illustrations and a manual of resistance measurements.

OHMITE MANUFACTURING CO., 4984 Flournoy St. ★ Chicago, U. S. A.

Foremost Manufacturers of Power Rheostats, Resistors, Tap Switches

BE RIGHT WITH ★ OHMITE Rheostats·Resistors Tap Switches

Near technical perfection is achieved through use of scientific instruments but the trained eyes of skilled workmen inspect completed units before they are passed along to the pumps

An important reason why Eimac tubes set the modern pace in communications

In the fabrication of plates, sealing of stems and leads, winding of grids... every tiny part must pass the rigid inspection of trained individuals, precision testing devices. At the end of each production line sits a group of hardboiled inspectors. All this checking and testing takes place before Eimac tubes reach the vacuum pumps. That's one of many reasons why Eimac tubes possess such uniformity of characteristics . . . why their performance records have made them first choice among world's leading engineers.

Follow the leaders to

Eimac TUBES

Manufactured by **EITEL-McCULLOUGH, INC., SAN BRUNO, CALIFORNIA, U. S. A.**

Export Agents: Frazar & Co., 301 Clay St., San Francisco, California, U. S. A.

Bead tester utilizes polarized light in search for stress points in glass beads which seal leads to bulbs

Polariscope is here used to inspect glass bulbs for flaws or strain which may occur during the shaping operations

General inspection bench where completed filamen stems and assemblies are thoroughly checked for faulty construction

FREEZE 'EM OR FRY 'EM

• Global war means airplanes in the Arctic. It means tanks in the tropics. For fighting machines of all kinds, combat conditions call for freezing or frying — and sometimes both!

Solar is building capacitors which meet these extreme conditions. If "freezing or frying" is part of your capacitor problems — call on Solar's "temperature-engineering" services.

Facts and more facts. Complete capacitor data describing and illustrating the entire Solar line is now available to design engineers on request.

Solar

SOLAR MANUFACTURING CORP. BAYONNE, N. J.

CAPACITORS

MAKERS OF CAPACITORS ELECTRO

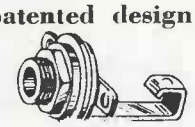
A LOT OF JACK . . . FOR THE JOB ON HAND!

Utah Long Jack

• The success of many an operation may depend upon a jack. With Utah Jacks you can be sure of dependable performance. Utah-Carter Short Jacks, for instance, are small and compact, but do a full size job. Utah-Carter Long Jacks take minimum panel mounting space.

Short and long jacks fit all plugs in two and three conductor types. All contacts between springs are fine silver, giving minimum contact resistance.

Utah-Carter Imp Short Jacks are popular because they combine compact size, highest quality and economical price. Unique patented design makes them the smallest jack fitting standard plugs. Write today for full information—there is a Utah Jack to meet your requirements.



Utah Open Circuit Jack

UTAH VITREOUS ENAMELED RESISTORS—From 5 to 200 watts, they are available either as fixed—tapped or adjustable. Also non-inductive types.

UTAH JACK SWITCHES—Long and Short Frame and Imp Type Switches to meet the circuit and space requirements you need.

UTAH PHONE PLUGS—Two or three conductor types—for practically every type of application.

UTAH TRANSFORMERS are fully guaranteed. Able to meet the requirements in choke, input, output and smaller capacity power transformers.

Write for full details

UTAH RADIO PRODUCTS COMPANY

General Offices and Factory • 850 Orleans Street • Chicago, Illinois

utah SPEAKERS

VIBRATORS • TRANSFORMERS • UTAH-CARTER PARTS

Pressed—for time AND TIME SAVED BY PRESSING

A customer needed a large quantity of these 7½-inch coil forms — in a hurry. The normal processing called for extruding, cutting-off, threading, drilling and other machining that would have made "on time" delivery impossible as all equipment necessary for these processes was tied up for months ahead.

We could have thrown up our hands and said "Sorry" We could have found plenty of alibis. But that is not our way.

Our Engineering Department went to work. "What about pressing?" asked someone. Pressing? A piece 7½ inches long with 52 holes and eight flutes and 52 threads on each flute? A stiff problem. It had not, to our knowledge, been done before.

"All right, let's try it!"

The die was probably the most complicated one that ever came out of our tool shop.

To make a long story short — we did it, and, pardon us for saying so, we are rather proud of this achievement.

It *you* have any special steatite problems, we would like to have a shot at them.

GENERAL CERAMICS AND STEATITE CORPORATION

KEASBEY, NEW JERSEY

GENERAL
CERAMICS AND STEATITE CORPORATION
STEATITE INSULATORS

3330

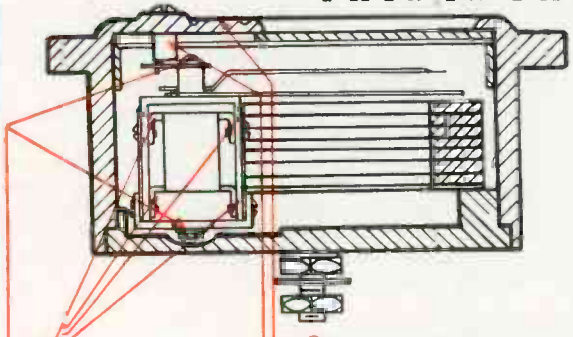
When Space is at a Premium

TRIPLETT Thin Line INSTRUMENTS

Full size of Instrument. Note deep shroud for glass protection—and "Quick-Look" Scale.

This molded case contains *full size* Triplett Mechanism. Rugged Construction—Compact Convenience.

THIS IS THE INSIDE STORY

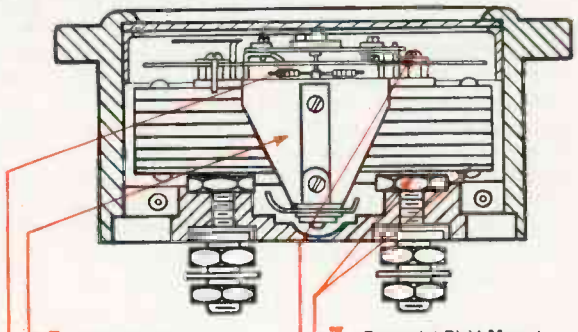


1 Four-point Core Support

2 Full Metal Bridges on Top and Bottom

3 Bezel Shroud Eliminates Unwanted Glare

4 One-piece Formed Spring Zero Adjustment



5 Balanced Frame Construction

6 Solid Balance Cross with Screw-type Balance Weights

7 Four-point Rigid Magnet Clamping

8 Separate Dial Mounting Independent of Top Bridge

Thin-Line Instruments also have Standard Large Coil Triplett Movements. Furnished with Osmium pivots for special requirements. All these features make for greater rigidity under vibration; greater permanence of calibration; greater user satisfaction.

TRIPLETT Thin-Line

memo

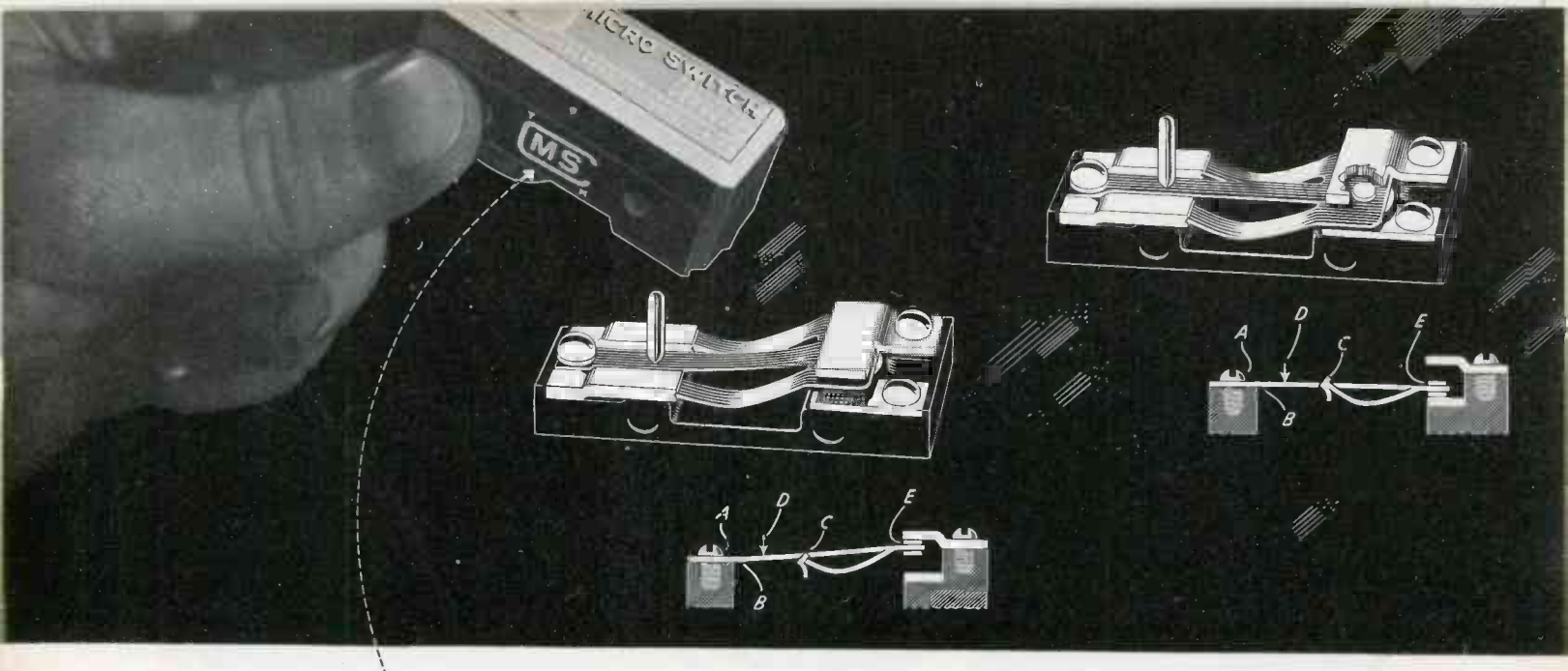
PLEASE INSERT INITIALS OF YOUR EXECUTIVES

FOR CIRCULATION TO... ✓

Triplett Thin-Line Instruments meet rigid requirements for dependable performance. Though occupying minimum space they are *not* miniatures. Mechanisms are standard size with emphasis on excellent performance over long periods. Standardized installation. Made in three styles of cases — Molded, Metal Wide Rim and Metal Narrow Rim.

Triplett Thin-Line Instruments, available for many industrial applications, can be depended upon for precision performance in limited space. For full details write for "Triplett Thin-Line Bulletin".

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



Without This Mark TRADE MS MARK It Isn't a Micro Switch

There is only one micro switch—the MICRO SWITCH—manufactured by this company. When you buy a precision snap-action switch, it is not a MICRO SWITCH unless it has the now familiar trademark shown on the side of the switch as illustrated above.

The MICRO SWITCH is thumb-size, feather-light, and operates precisely at the same point for millions of operations with lightning-fast contact action. It is accurately built to exact standards from precisely made parts. Its performance characteristics can be changed to meet functional requirements. It can be furnished with many types of actuating mechanisms and protective housings.

The MICRO SWITCH is the only precision snap-action switch available to you which employs the principles of design illustrated above and described below.

The MICRO SWITCH principle is different. It involves no reverse bends—no buckling "oilcan" action. The long member of the one piece, three bladed, beryllium copper leaf spring "B" is supported in cantilever at "A". The two short members are curved in compression to rest in the notches at "C." These two strut-like springs exert an upward force to hold the electrical contacts "E" together with a force of 40 to 100 grams, depending on the type of switch. The operating force applied at "D" deflects the longer tension member downward in a gentle curve until the upward force of the bowed members is overcome and the contact end of the spring moves downward with the sharp, snap-action which makes clean cut electrical switching. The distance the contacts are separated is controlled to suit the particular problem at hand, and may be as much as .070 inches for high altitude aircraft use. Removal of the force at "D" allows equally fast snap-return to the original position... The electrical contact moves in the same direction as the operating force. This direct action not only provides accurate performance, time after time, for millions of operations, but should there be a welding or sticking of contacts due to overload, the direct-acting force acts as insurance to break the weld and to put the switch back into service.

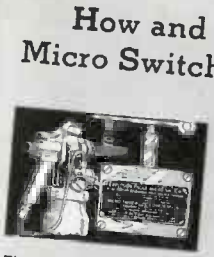
On present or future designs it will pay you to consider the many advantages in space saving, accuracy, precision performance, and the dependability of a snap-action switch. But when you do, be sure that you select a MICRO SWITCH for the reasons enumerated above. Shown below are typical applications, and the two catalogs illustrated in the lower left hand corner of these pages will be highly advantageous to you in incorporating the MICRO SWITCH into your design.

SEND FOR THESE CATALOGS

Your up-to-the-minute engineers will thank you for keeping them informed about the Micro Switch. Send for as many of the Handbook-Catalogs illustrated here as you think necessary. No. 60 covers Micro Switches in general; and No. 70 deals with specific Micro Switches for use in aircraft.

Micro Switch is a trade name indicating manufacture by Micro Switch Corporation

How and For What Micro Switches Are Used

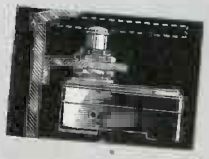


This shows an explosion proof Micro Switch used with a spray gun which automatically cuts out the entire operation of the spraying booth when the gun is shut off.

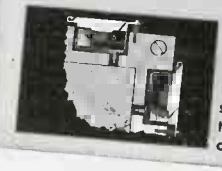
This illustration shows the Micro Switch with a spring leaf actuator serving as a break indicator as used in textile mills or paper mills.

This illustration shows Micro Switch enclosed a die cast housing with synthetic rubber seal, an Is being used as a lath carriage stop.

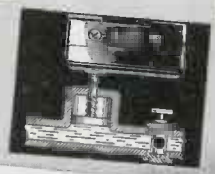
This illustration shows a Micro Switch with a pushbutton actuator being used as a safety switch in a high tension cabinet door. It is a normally open switch in which the circuit is opened as the door is opened.



This illustration shows two steel enclosed Micro Switches which serve as overrun limit switches on a machine tool.



This illustration shows the use of two Micro Switches with spring type plungers to insure safe positioning of material in a punch press or a similar tool.



This illustration shows use of a Micro Switch with a spring plunger which is actuated by the pressure of a liquid in a line as the actuating medium.

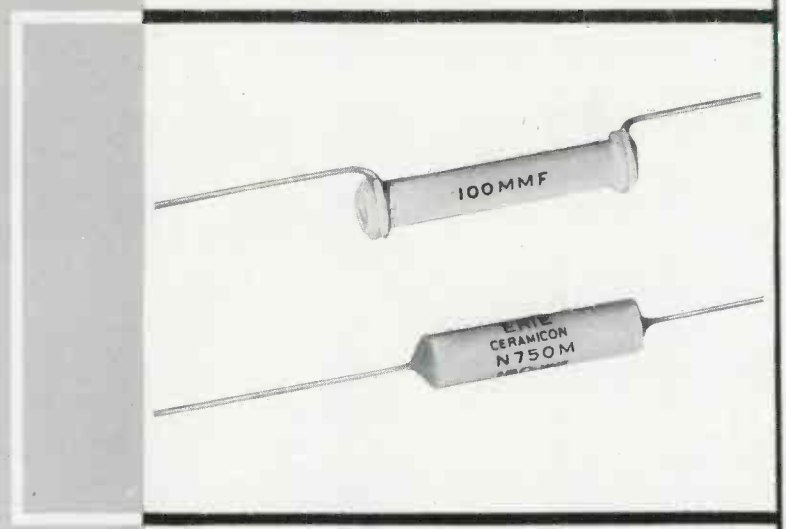
MICRO TRADE MS MARK SWITCH

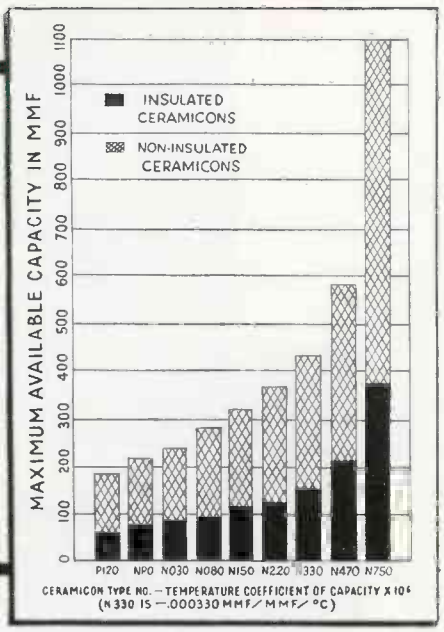
Manufactured in FREEPORT, Illinois, by Micro Switch Corporation

USE *Erie Ceramicons*

REG. U.S. PAT. OFF.

FOR MICA CONDENSER REPLACEMENTS





THE scarcity of high grade mica makes it essential for manufacturers of electronic equipment to switch to other types of condensers.

The dependability of the silvered-ceramic construction of Erie Ceramicons has been definitely proved by their use in many types of installations over 6 years.

In using Ceramicons for mica replacements, the function of the capacitor in question should be considered in selecting the proper type. When practically no change of capacity with temperature is permissible, zero coefficient (type NPO) should be specified. Where moderate variations are allowable, maximum negative coefficient (type N750) or some intermediate value should be used to take advantage of the smaller size of Ceramicons available in the higher negative coefficients.

Where rather large variations are allowable, and where power factor is not critical, a new series of high dielectric constant Ceramicons, which will be available shortly, should be specified, since very high capacities will be available in this type of unit.

The chart reproduced above shows the range of standard Ceramicons. The new high dielectric constant Ceramicons will be available up to approximately 5,600MMF in the insulated style and to approximately 16,000MMF in the non-insulated style.

Write for literature that fully describes the operating characteristics of standard Erie Ceramicons.

ERIE RESISTOR CORP., ERIE, PA. LONDON, ENGLAND · TORONTO, CANADA.

SPEEDS PRODUCTION LOWERS COSTS

SPRAGUE KOOLOHM RESISTORS Free You From MOUNTING Limitations

The unique construction of Koolohm resistors allows them to be mounted directly to (and flat against) metal or grounded parts with complete resistor circuit insulation. This offers a flexibility in designing and manufacturing that is invaluable under today's changed — and changing — conditions.

Koolohms are doubly protected. The wire itself is insulated before being wound AND — all types are sealed in sturdy, chip-proof, ceramic or tempered shock-proof glass casings.

Therefore, they operate safely and dependably even when mounted directly to grounded parts with the simple attachments illustrated above. All of these methods of mounting are today being used by prime- and sub-contractors who are meeting exacting specifications with Koolohms.

Meter multipliers — high resistance, high-power units, truly non-inductive resistors — ferrule type resistors that withstand the most severe salt water immersion test and other features are found in Koolohms — the answer to practically all your resistor problems.

Write for further particulars, samples and catalog

SPRAGUE SPECIALTIES COMPANY
(Resistor Division) North Adams, Mass.

THE ONLY RESISTORS WOUND WITH CERAMIC-INSULATED WIRE

FOR *Better* RESULTS USE TUBES WITH GENERAL CERAMICS STEATITE INSULATORS

For long tube life at high frequency and temperatures, depend on tubes with

GENERAL CERAMICS STEATITE INSULATORS

Two major advantages over ordinary commercial steatites are:

1. **Low surface conductivity and contamination.**
2. **Good insulating quality at high operating temperatures.**

As vacuum tubes increase in power, more and better insulation becomes necessary. Glass insulation is unsatisfactory at high temperatures and high frequencies. Natural lava from Sicily has the essential insulating qualities but is unobtainable.

General Ceramics has succeeded in producing a steatite that, as an insulator, is equal to natural lava, but requires no expensive Carboloy tools for machining. In addition, these insulators are made of domestic materials and therefore are available in quantities.

Outstanding electronic tube manufacturers have tested General Ceramic's Steatite Insulators and are using them with marked success. These insulators can be supplied in pressed or extruded shapes for every type of vacuum tube requirement.

GENERAL CERAMICS AND STEATITE CORPORATION

KEASBEY NEW JERSEY

GENERAL CERAMICS & STEATITE CORPORATION
STEATITE INSULATORS

3346

Breaking INSULATION BOTTLENECKS

Top left — Connector plug with insert and engraving
Top center — Compression-molded end seal for high voltage and high pressure
Top right—Sample of intricate Mycalite machined part
Center — Antenna insulator with Mycalite-to-metal seal
Bottom — Molded part—Mycalite inside metal rings

BOTTLENECK No. 1 . . . BROKEN BY:

The customer's urgent need of improvement in insulation characteristics.

Mycalite's creative engineering, viz: the development of a new, vitally-needed ceramic insulation for (CENSORED) —a material of high insulating efficiency; nearly as strong in rupture as cast iron; machinable to high precision.

BOTTLENECK No. 2 . . . BROKEN BY:

The customer's requirement of speed.

Mycalite's 4,000 per cent. expansion in the past two years. Whatever has been needed has been produced and delivered quickly. There has never been a bottleneck in this material.

BOTTLENECK No. 3 . . . BROKEN BY:

The customer's need of quantities to safeguard production schedules.

Mycalite's unusual capacity and flexibility accruing from a two-year expansion of production and engineering facilities.

Characteristics

As Shown in Reports of Independent Testing Laboratories

		No. 4	No. 8
Dielectric Constant	(Dry)	6.68	6.75
Dielectric Constant	(Wet)	6.73	6.70
Power Factor	(Dry)	.00240	.00164
Power Factor	(Wet)	.00241	.00231
Loss Factor	(Dry)	1.60	1.11
Loss Factor	(Wet)	1.62	1.54
Dielectric Strength		630 Volts Per Mil.	660 Volts Per Mil.
Mechanical Strength		22,000 lbs. per sq.in. rupture	16,000 lbs. per sq.in. rupture

Parts like these are playing a dramatic role in the war effort. Can they help you? They are available in ample quantities.

MYCALITE today is in a position to meet insulation problems with a minimum of time for planning. Ever since Pearl Harbor we have been breaking bottlenecks. We can continue to break them if you will tell us what your problem is.

Mycalite

INSULATING MATERIAL

can be supplied in sheets 6"x24" and 19"x14" from 1/8" thick to 1" thick, or machined to your specifications—or can also be molded.

Manufactured exclusively and machined to specifications by

ELECTRONIC MECHANICS INC.

70 Clifton Boulevard
CLIFTON
NEW JERSEY

In over 200 newspapers from coast to coast, PHILCO made this report to your customers of the past and future.

Battle Flags

for Philco Soldiers of Production

AMONG the far-flung manufacturing facilities of Philco Corporation, devoted 100% to the manufacture of war equipment, *four* Army-Navy "E" Flags now fly from the Philco plants. And each of their soldiers of production wears the official Army-Navy "E" Pin as a badge of honor for "*distinguished service to America*".

On four separate occasions . . . in Philadelphia, Pa., Trenton, N. J., Sandusky, Ohio and Chicago, Ill. . . . distinguished officers of the Army and Navy have presented the Army-Navy Production Award Flag to the men and women of Philco for, in the words of the Under Secretary of War, "*accomplishing today what yesterday seemed impossible*".

Of course, Philco is proud of its soldiers of production who have turned their knowledge and their skill so effectively to the service of the nation: In the manufacture of intricate communications equipment, powerful radios for tanks, airplanes and ships, artillery fuzes, shells and storage batteries, Philco's war production activities serve every branch of our fighting forces, on land, at sea and in the air.

The Army-Navy "E" Flags that now fly above the Philco plants are *battle flags* for Philco soldiers of production. For they realize that if America's might is to strike the decisive blow for Victory, what they have done today must be but an inspiration for greater deeds tomorrow. In this spirit, Philco soldiers of production have made their pledge, "*More — Better — Sooner!*"

Buy War Bonds and Stamps

PHILCO CORPORATION

This announcement, published in the nation's newspapers, is a report to *your customers* of what the men and women who produced over 17 million Philco products are doing for the duration.

In its Electronic laboratories, Philco engineers have achieved untold miracles for war which wait only for Victory to blossom into new blessings for all . . . and new opportunities for Philco dealers everywhere.

PHILCO CORPORATION

Product of

UNITED

Skills in Electronics

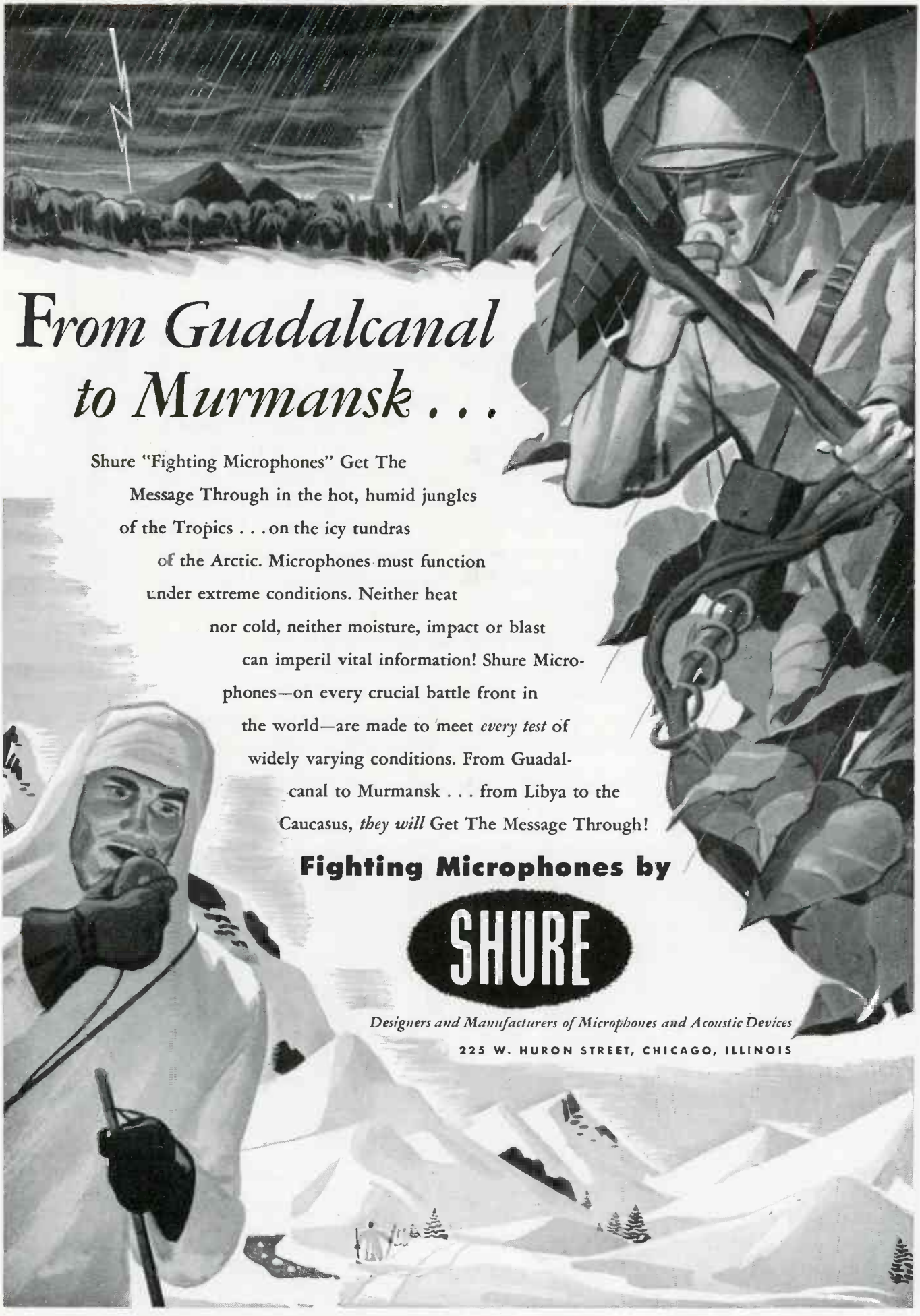
"UNITED" electronic power tubes cannot be spun out on swift, automatic assembly lines. The painstaking manufacturing of these sensitive devices requires the skill of human hands.

Here at the "United" Plant, incredibly accurate hands perform under a system of personal supervision by electronic engineers. One by one, the steps of forming and fitting the stems, leads, plates, grids, wires and rods combine to produce transmitting tubes of such flawless precision that they consistently win top rating for performance. Never before were the hands of craftsmen and the brains of scientists so superbly "United" in advancing the scope and purpose of electronics.

Consistent technical advances in tubes, now required for war, some day will be more readily available to you for radio communication, physiotherapy and industrial electronics. Remember to look for "United" on the tubes.

UNITED ELECTRONICS COMPANY

NEWARK, NEW JERSEY



From Guadalcanal to Murmansk . . .

Shure "Fighting Microphones" Get The Message Through in the hot, humid jungles of the Tropics . . . on the icy tundras of the Arctic. Microphones must function under extreme conditions. Neither heat nor cold, neither moisture, impact or blast can imperil vital information! Shure Microphones—on every crucial battle front in the world—are made to meet *every test* of widely varying conditions. From Guadalcanal to Murmansk . . . from Libya to the Caucasus, *they will* Get The Message Through!

Fighting Microphones by

SHURE

Designers and Manufacturers of Microphones and Acoustic Devices

225 W. HURON STREET, CHICAGO, ILLINOIS

Centralab now Serves Itself and the Industry with STEATITE

CENTRALAB has added a new plant of large capacity for the production of glazed and unglazed STEATITE.

This highly critical, strategic material is an important factor in the operation of ultra high frequency equipment.

Centralab's STEATITE plant is in a position to furnish coil forms up to 5 inches diameter and pressed pieces to approximately 6 inches square. The same high standards of excellence will be maintained in this department that have characterized every other Centralab product during the past decades. The Centralab Ceramic department that has been in existence since 1930 has built up an extensive engineering, production and laboratory background to ensure a product of the highest quality that fully meets military specifications.

STEATITE is an extremely dense non-porous ceramic of high mechanical strength with low loss factor and low dielectric constant. It can be fabricated in various cylindrical and flat shapes by extrusion or pressing. Centralab is also equipped to engineer and manufacture other grades of ceramics.

CENTRALAB — Division of Globe-Union Inc., Milwaukee, Wis.

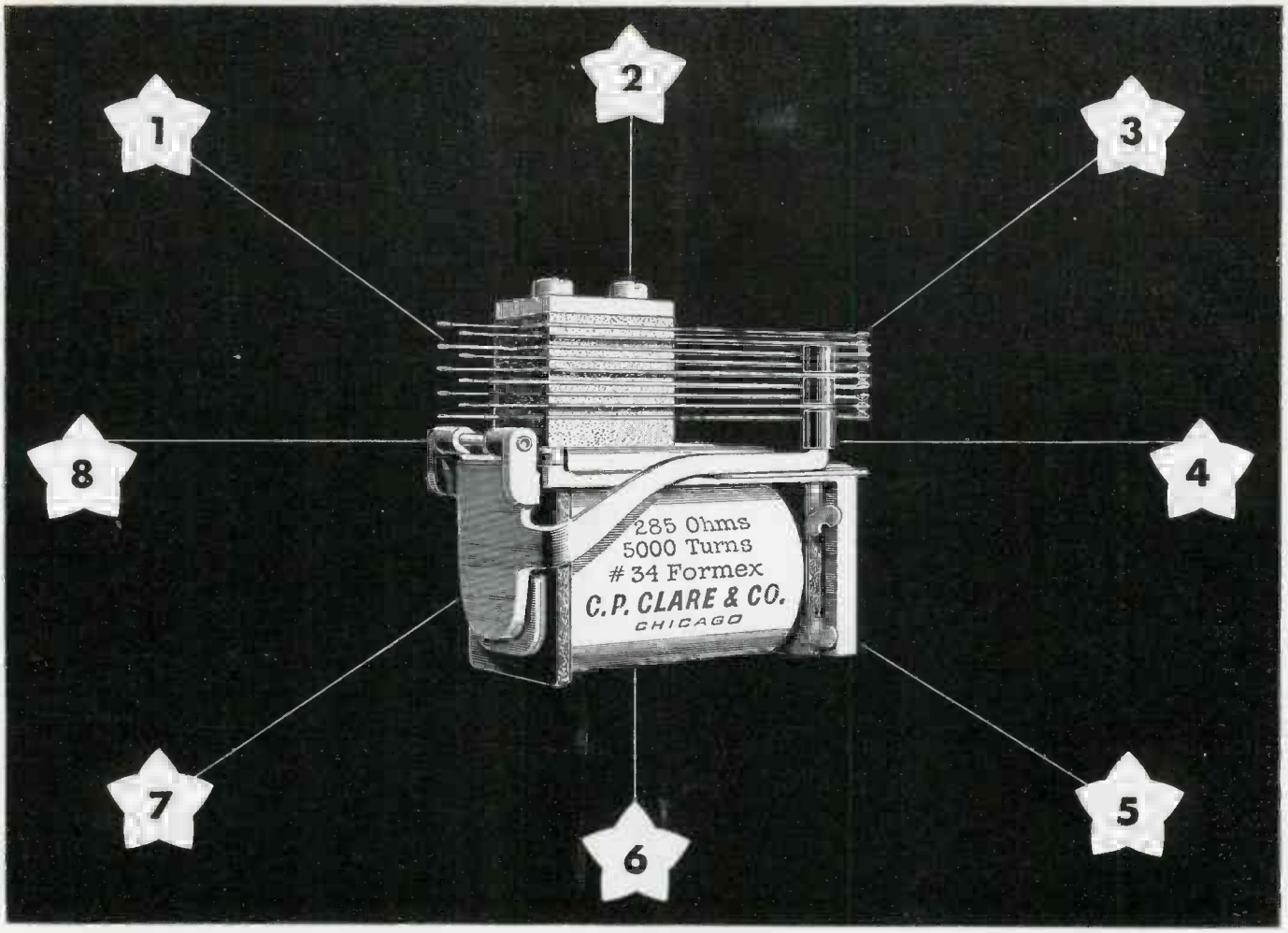
1930 Centralab pioneered a fixed resistor of "hard-as-stone" ceramic material.

1936 Centralab added a temperature compensating fixed condenser of ceramic material.

1940 Centralab added a trimmer condenser with temperature compensating characteristics

Ceramics by Centralab

1942 Centralab added a STEATITE plant to take care of its own needs and those of the industry.



☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ An Eight Star Feature Relay "Custom-Built" for Absolute Dependability

This Clare Type G a. c. Relay is designed to insure absolute dependability in service . . . It measures only 2½" long by 2¼" high by 1¼" wide, and weighs only 6½ ounces . . . It is replete with features that insure dependability, and has a wide range of application. It has the following outstanding features:

1 Clare Relay illustrated shows pile-up of nine springs. Relay can be supplied with as many as twelve springs in a single pile-up.

2 Spring pile-up insulators of special heat treated Bakelite provide more favorable characteristics than triple "X" Bakelite and permits punching without cracks or checks. It has minimum cold flow properties and low moisture absorption content. The pile-up assembly is locked together under hydraulic pressure. Insulators are held in place with two flat or filister headed screws of high tension steel.

3 Contacts of rare metals or special alloys are available in sizes from .062" to .1875" diameter, flat or hemispherical. These contacts are "overall" welded to nickel silver springs by a special process, making them an integral part of the spring, thereby reducing contact pressure to the minimum and providing for rapid heat dissipation. Long contact life is assured.

4 Spring bushing insulators are made of Bakelite rod under a patented process. Hard rubber bushings generally employed are similar in appearance, but inferior in wearing qualities and will not pass heat cycle requirements on many applications. Strong, hard, long-wearing Bakelite bushings are essential where heavy contact pressures are employed or where vibration exists.

5 The heel piece is made of magnetic metal carefully annealed and cadmium plated, and is so constructed that it is adaptable for plug-in mounting, thereby permitting easy servicing and replacement.

6 Coil core laminations are made of low loss silicon iron. Copper shading piece is securely fastened in the square, slotted armature end of coil core. Coils are carefully wound to exact turns on precision machines. Lead-out wires are securely soldered; entire coil is impregnated with Glyptol.

7 Armature of this relay is made of magnetic metal carefully annealed in precision ovens, and is cadmium plated to withstand a 200-hour salt spray test.

8 Armature bearing consists of a stainless steel rod operating in a hard brass yoke with great bearing area.

This relay, like all Clare "custom-built" relays, is recommended for specific applications where hard service, long life, and dependability are absolute "musts." Regardless of what your relay problem may be, Clare can supply a relay to solve that problem. The "custom-built" idea enables you to reduce your over-all relay cost and simplify your designing. It insures better and more dependable performance. Clare engineers will gladly assist you. And we will be glad to send you our catalog and handbook. Address: C. P. Clare & Co., 4719 West Sunnyside Ave., Chicago, Ill. Sales engineers in all principal cities. Cable address: CLARELAY.

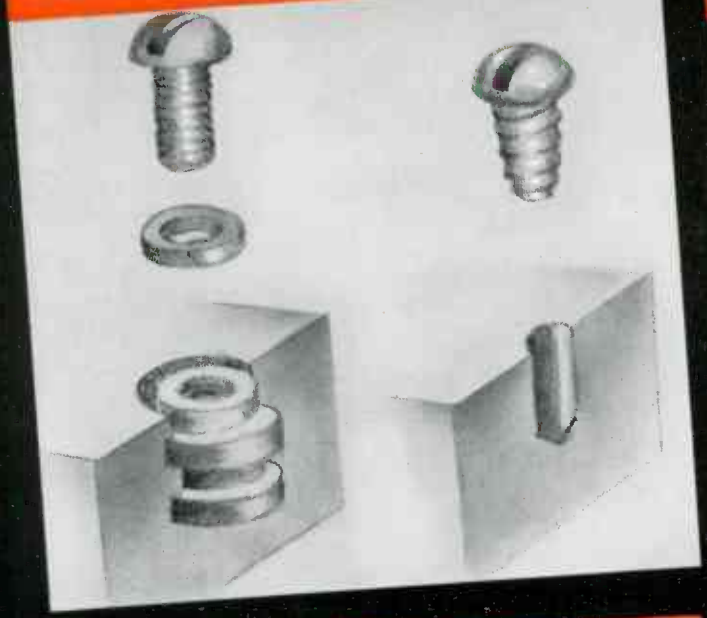
C L A R E R E L A Y S

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

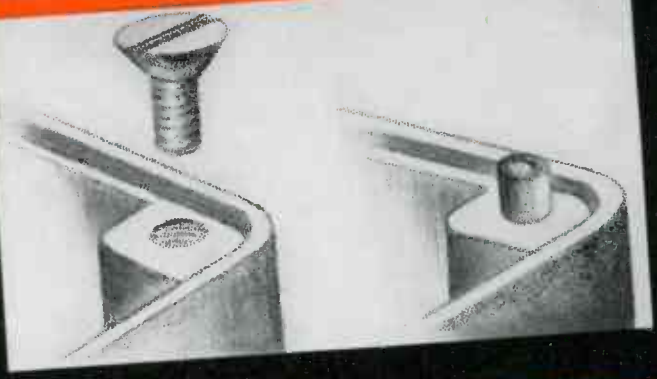
In the Battle of Design

A waste of material or machine time in engineering design today is as damnable as sabotage. The battle of design will be won by refinements in existing components as well as by new inventions. Savings in small things add up . . . to big things. Here are some examples:

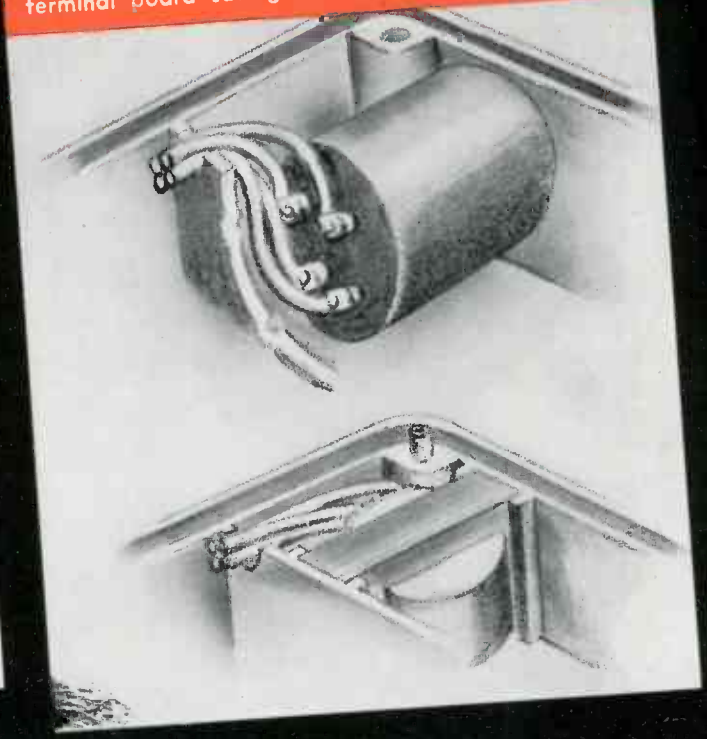
One of our engineers changed the construction of a plastic assembly from brass insert + lockwasher + brass screw to steel PK screw only. Approved by the Army, the savings represented 1,000,000 inserts and lockwashers.



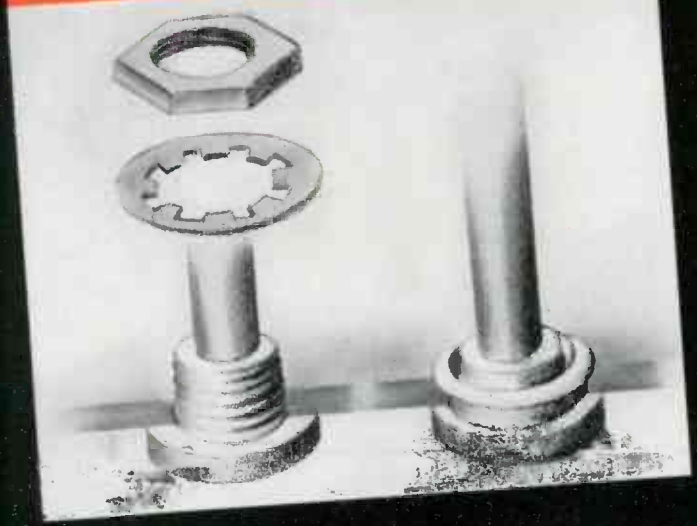
In die cast structures, covers and nameplates were held on by screws. A UTC design modification added a round projection in the casting, which is spun over to hold the plate or cover. Saving: over 2,000,000 screws and lockwashers . . . over 2,000,000 tapping operations.



This structure employed a cased transformer fastened to a compartment wall with screws. A changed design permitted potting the transformer directly in the compartment. Saving . . . 1,000,000 terminals . . . 300,000 screws . . . 400,000 aluminum cans . . . plus terminal board saving and reduction in overall size.



One UTC design eliminated a threaded shank, lockwasher and nut by changing to a spun-over shoulder on the shank. Saving . . . 150,000 lockwashers and nuts . . . 150,000 threading operations.



These savings *added up*. Small in themselves . . . slight for each individual unit . . . their total is impressive. Today we need all possible savings . . . even those which seem impossible at first. Review your designs for Savings for Victory.

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK, N. Y.

ELECTRONIC INDUSTRIES

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

Wanted: More Speed-Up

Every last man in research, engineering, and production,——and each and every worker on the nation's assembly lines—must have the firm conviction that he or she is a vital part of America's war effort,—and act accordingly,— before we will begin to win this war. In radio production, **we need more speed!**

"United we stand" was never truer than it is today. In this issue, we present a number of new ideas and methods which have stepped up production for somebody. You, we hope, may find among them an idea you can use. However, only by a "free trade" in new ideas and methods can we hope to achieve total production for a total war. What's new in **your** plant? Why not tell "Electronic Industries" how a suggestion by an engineer or worker helped you speed production. EI—and Uncle Sam—will be grateful.

You Wouldn't Believe It!

The terrific punishment which military radio apparatus must take, can hardly be appreciated by the engineer who has concerned himself only with civilian radio.

Some English radio men recently exhibited a radio transformer that had been sheared in two, by a bomb fragment, as cleanly as if cut by a hacksaw.

Explosive bombs are made of hardened steel cast into sections which break up with razorlike edges. Speeding and spinning through the air with terrific velocity, such a deadly instrument can sever almost anything. In this instance, striking the transformer case, the heavy laminations were sheared and the whole top of the transformer cut squarely away,—without even ripping the core from its chassis mountings!

"Physicists" and "Radio Engineers"

American radio engineers have been wondering why our big radar program has been handled largely by "physicists" and "scientists," while experienced radio engineers have had a decidedly secondary role in its conduct.

The explanation is simple. Radar is of course an American invention. But after radar equipment performed so strikingly in England, it was decided to expand the radar work going on here and to adopt the English plan of organization for the expansion. The English organization plan called for "physicists." So, physicists were called upon, here.

Well, as you may have guessed, dear radio reader, what we call a service man, the British call a "radio engineer." And the radio engineer to whom we give professional standing, they term a "radio physicist!"

But in building the American organization, the imported "labels" were used. And ever since, a lot of puzzled physicists and college professors have been wondering why they suddenly got yanked out of pure science and into applied radio development, design and production,—which experienced radio engineers could have done better!

Drops Machine-Gun on Jap Zero!

The feat of an Army Air Forces radioman in "knocking out" a Japanese Zero fighter over New Guinea, was related by General Henry H. Arnold at Miami.

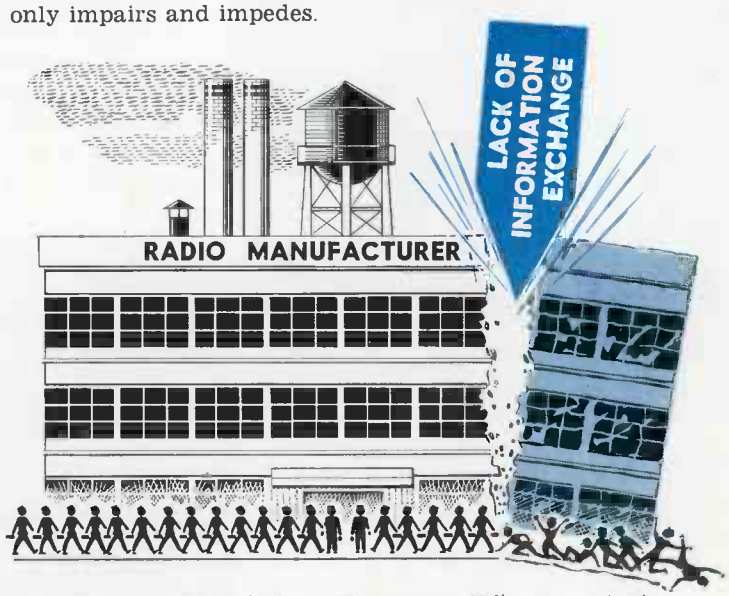
This is the story:—The radioman on a B-17 plane took over during a fight with Jap Zeros after the floor gunner was wounded. The gun mounting had been shot loose from the plane's floor and the radioman in his endeavors to train the gun on the Zero yanked it completely loose. The gun fell overboard through the hole in the plane's floor and by luck it hit the Zero below which was knocked to pieces by the impact.

Secrecy Makes Radio Plants 25% Useless!

One quarter of our present radio factory equipment and workers might just as well be non-existent or wiped out by bombs. For that large fraction of our productive power is kept useless and non-effective by the senseless secrecy which now blocks exchange of information on improved manufacturing methods.

The War Production Board itself has been making radio-factory surveys which bear this out. Indeed, "Electronic Industries" has it on the authority of men high in WPB that 20 per cent to 30 per cent increase in radio output could be expected with present equipment and personnel, if only information on factory shortcuts and best methods could be freely exchanged and slow processes speeded up to the productiveness of the best.

It's time to realize that we are paying a terrific price for secrecy at points where, instead, free information is needed. Such needless secrecy doesn't protect. It only impairs and impedes.



Our existing radio factories could produce 25% more output, WPB officials estimate, if by free exchange of factory information we could make similar processes in all plants as good as the best

★ *Radio-Electronic WAR PRODUCTION*

ELECTRON SPEED-UP of Aircraft Output

by GILBERT SONBERGH

Increasing production of better, more efficient aircraft and engines testifies to the growing utilization of electronic tubes and devices throughout the entire aviation industry. An inspection tour of any aircraft plant reveals a host of electronic research, engineering, and production tools, performing heretofore impossible tasks.

Perhaps the most spectacular field of activity for electronic devices is in the production of aircraft engines. Superior strength- and power-to-weight ratios have been one important result of the use of devices which amplify, measure, and record data on features of engine performance that are either inaccessible or too rapid to permit measurement in any other way.

Knowing exactly what happens in a cylinder as the high-octane mixture is fired, is of inestimable value to design engineers.

Graphing power-stroke

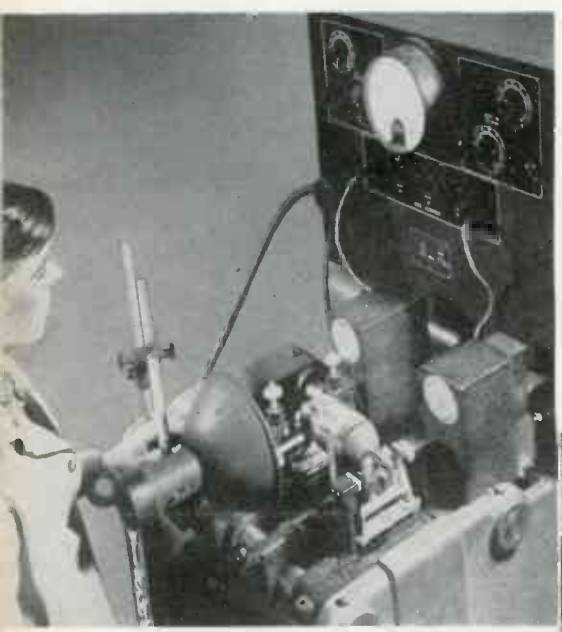
Measuring equipment which automatically graphs a curve showing pressure rise in time, in the split second following ignition, is in wide use. A sensitive piezo-electric pressure pickup is inserted into the test cylinder, either through an extra spark plug hole or a special hole drilled and tapped for it. This crystal pickup reports the pressure rise to the input grid circuit of an amplifier which controls a cathode-ray oscillograph, and the pressure-vs.-time curve is recorded on photographic film.

Measuring vibration

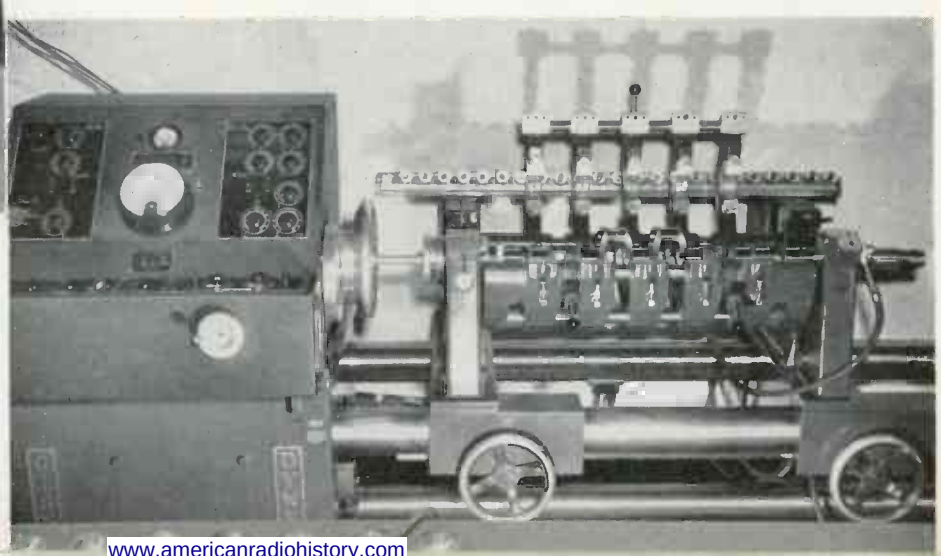
Increasingly powerful engines demand more and more freedom from vibration. Sperry M.I.T. electronic equipment to measure vibration makes use of various types of pickups which generate a weak emf in response to linear or torsional movement of vibrating parts. The pickups are attached to the engine base or other part and to rotating shafts, and the output is amplified to excite a cathode-ray tube in an oscilloscope, or oscillograph using sensitized film for a permanent record. In addition to oscilloscope "seeing" of vibration qualities, a visual metering device provides direct quantitative readings.

Crankshaft vibrator

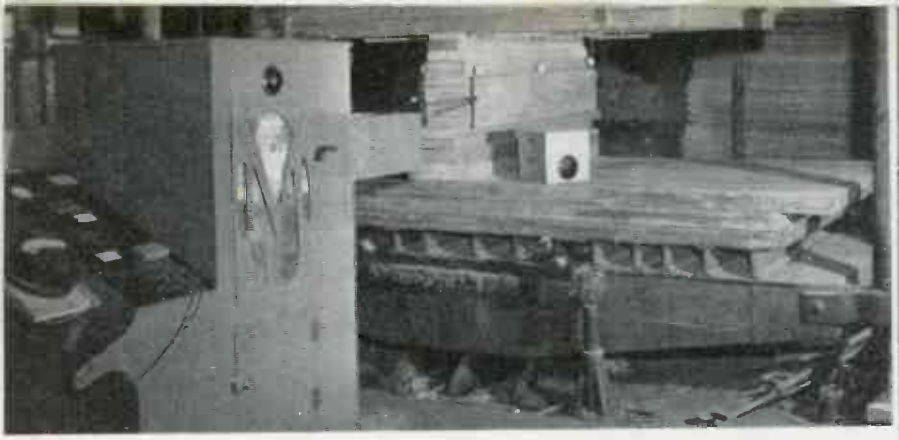
In a unique device designed by engineers of the Ranger Aircraft Engines Division at Farmingdale, N. Y., and built for them by Andrews and Perillo, Long Island City, N. Y., the output of up to one kilowatt of audio from an audio oscillator-amplifier system is fed into a special electromagnetic device to change the audio power into torsional motion for testing crankshafts. An in-line crankshaft which is designed to transmit over five hundred horsepower from cylinders to propeller can be shattered by less than one horsepower of improperly applied torsional force, as has been demonstrated by this apparatus. A crankshaft to be vibrated is mounted in its crankcase. One end of the shaft carries a fairly heavy flywheel, while the other end is coupled to an electric motor through the special equipment which converts the amplified audio to an alternating advancing and retarding force which actually varies the shaft's angular velocity



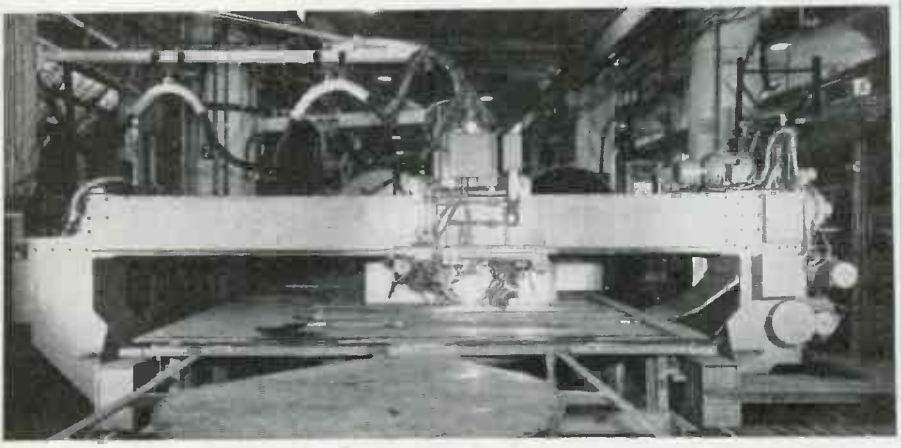
▲ **UNBALANCE vibrations as small as .000025 inch in high-speed aircraft motor armature are amplified, measured, and located for correction by Gisholt equipment**



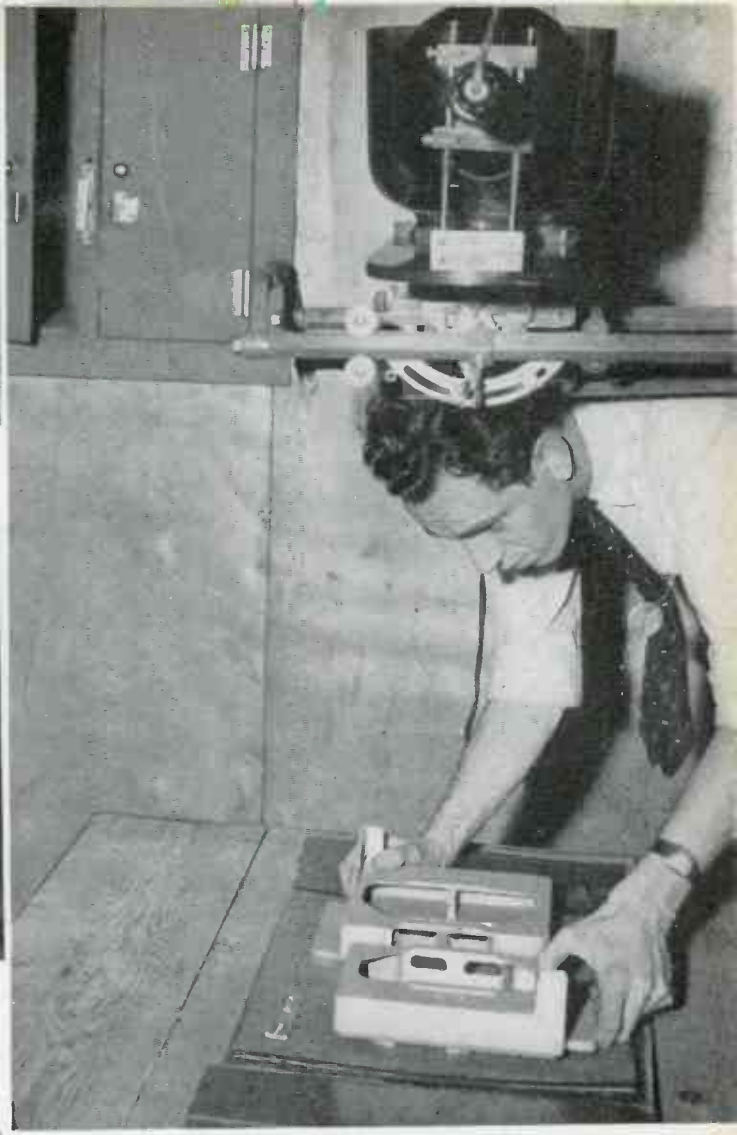
CRANKSHAFT balancing apparatus, in use at Ranger Aircraft Engines Division of Fairchild Aircraft and Engine Corp., on six and twelve cylinder crankshafts ➔



▲ EDGE-GLUING plywood propeller blanks with 12 mc electrostatic heating by Mann and Russell "parallel bonding" process in which lines of force follow glue layers in Wheeler Osgood Co. plant at Tacoma, Wash.



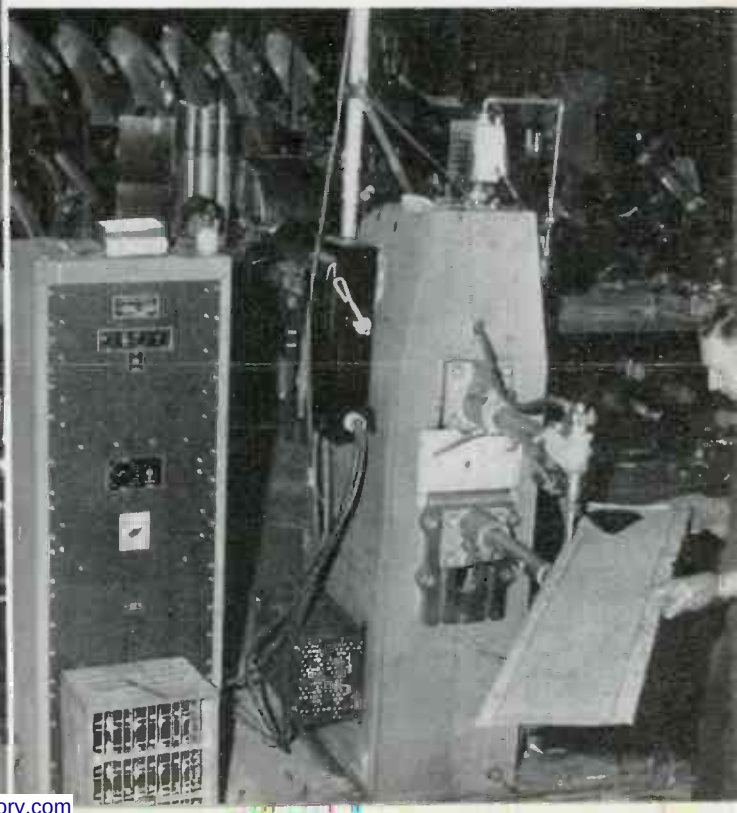
▲ BRIDGE-WELDER in Edward G. Budd Company plant, Philadelphia, in use to make all-welded stainless steel plane wings, in minutes where older processes took weeks. Developed by Budd and General Electric, this electronically controlled welder makes 480 "shotwelds" per min. for seam welding

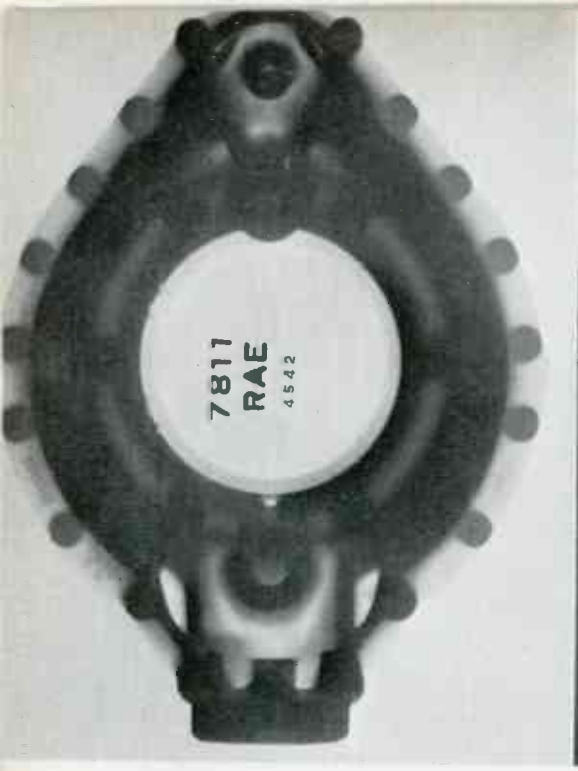


▲ LIGHT-TIGHT double doors lead to dark room from Westinghouse-equipped X-ray room at Republic Aviation plant

▼ PROPELLER at high speed studied in "slow motion" with General Radio stroboscope

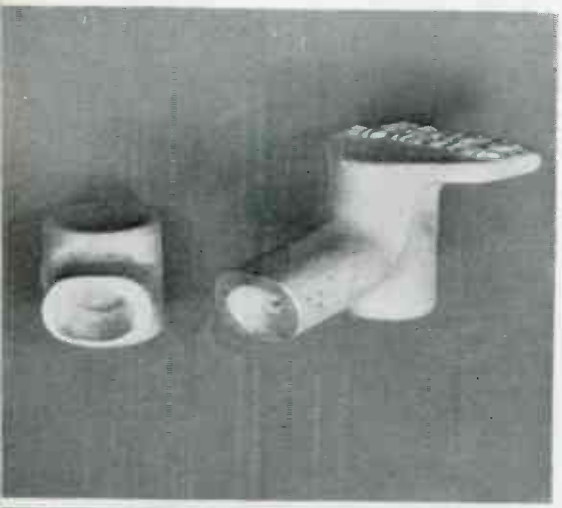
▼ PROGRESSIVE spot welder, with synchronous timer and phase-shifting, used in production of P-47 "Thunderbolts"

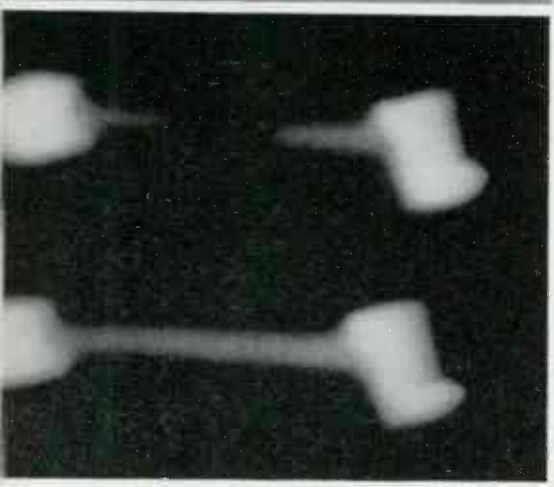




↑ RADIOGRAPH of nose section of Ranger six-cylinder in-line, air-cooled engine, and view of nose section under 200,000 v General Electric unit in lead-lined room

CASTINGS, one satisfactory and one defective, x-rayed at Republic plant, and photo of sectioned piece to show defect ↓





at any desired frequency and to any degree up to the maximum output of one kilowatt. The driving shaft carries an electrostatic pickup to give a direct reading of the degrees of torsion. Uses of the equipment include determination of a crankshaft's natural vibration frequency, and breakdown tests in connection with various design problems.

Stroboscopic viewing

A number of aircraft and engine manufacturers and field maintenance workers have found a valuable supplementary device for the study of vibration in the latest type of stroboscopic equipment. Any cyclic vibration of rotating or reciprocating parts can be viewed conveniently under a light source periodically interrupted at or near the frequency of the cyclic motion, or at some harmonic or sub-harmonic of it. The familiar still or cinematic photographs "freezing" action in an exposure of a few millionths of a second are easily made with this equipment, of either cyclic or non-cyclic motions of moving parts. An accurately calibrated stroboscope also makes an excellent tachometer for use in special circumstances or when rotating parts or shafts are mechanically inaccessible. In addition, the stroboscope as a tachometer has the obvious advantage of placing no additional load on the shaft or other device being checked.

taken apart, examined, reassembled, then given a final test-run before it is ready for shipment or installation. Unlike automobile engines, which can be "broken in" by a few hundred miles of driving at reduced speeds, aircraft engines must be ready to deliver maximum speed and power on the first take-off. Most manufacturers use some kind of electronic control in connection with this final testing. Instead of a dummy propeller, the engine is direct coupled to an alternator or dynamometer.

Several electronic controls are in daily use in the test rooms of the Ranger Aircraft Engines plant. Various test stands accommodate single cylinders under study, six-cylinder 225-horsepower trainer engines, and 12-cylinder 500-plus-hp air-cooled V-type engines. The largest test stand will fully load engines of up to 1000 hp.

Thyratron speed-load controls

In a sound-absorbing concrete and brick room equipped with heavy, double safety-glass observation window, the engine is mounted on the dynamometer stand and direct-coupled to the ac dynamometer, essentially an ac generator equipped with water cooling to dissipate the heat developed by its short-circuit load. The mechanical energy is converted to electrical energy, then heat, by resistance or eddy current losses. The drag or

X-RAY jig to photograph 20 cylindrical aircraft engine connecting rod bearings in 10 min. instead of previous 5 hrs. ↓

SOME TYPICAL ELECTRONIC APPLICATIONS IN AVIATION:

- X-ray radiographic inspection of castings
- Induction and high frequency heating (hardening, bonding)
- Rapid dynamic balancing of rotating parts
- Speed-load control in aircraft engine test-runs
- Vibration and detonation measuring and graphing
- Strain, temperature, pressure recording in test flying
- Controlled welding of steel, aluminum

load of the dynamometer on the engine under test can be varied by increasing or decreasing the externally supplied field excitation current. This current is controlled by thyratrons in response to variations in a grid control voltage produced by a magneto-type tachometer, a permanent-magnet dc generator in which the voltage is a direct function of the speed. The tachometer is belt-driven from the shaft of the dynamometer. Its output voltage is filtered and fed to a one or two stage amplifier. The output of the amplifier is impressed on the thyratron grids, causing the tubes to fire at any preselected speed of the engine and dynamometer. The electronic control keeps the engine at this constant speed regardless of throttle or manifold pressure setting, by automatically increasing or decreasing the load. If more mixture is fed to the engine, its tendency to speed up instantly causes an increase in the voltage developed by the tachometer. The amplified voltage fires the thyratrons to deliver heavier excitation current to the dynamometer field and a greater load to the engine propeller shaft. By means of a simple adjustment, this automatic control can be made to function to hold the load constant while the aircraft engine's speed is varied by changing the manifold pressure.

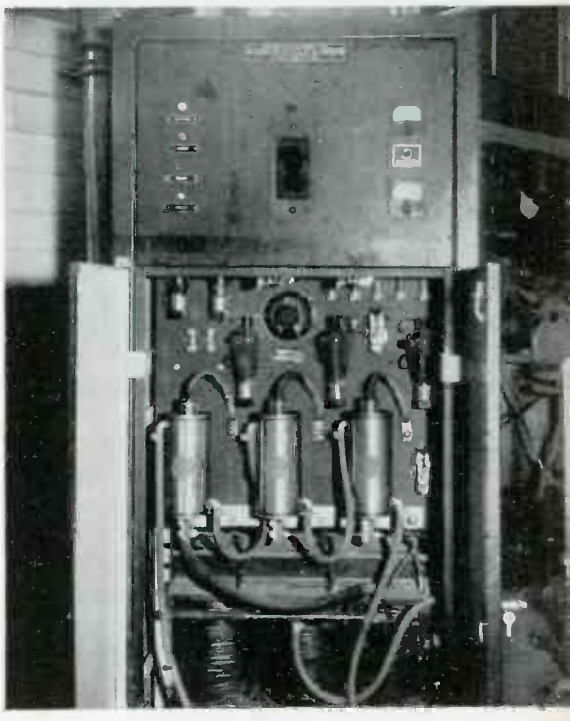
Several aircraft engine plants, in an attempt to get something back for the quite considerable value of the large quantities of aviation gasoline used, have engineered entirely satisfactory installations for power recovery where an alternator takes all or part of the load and converts it to ac energy to be fed back into the power lines, using an electronically-controlled feed-back system.

Controlled welding

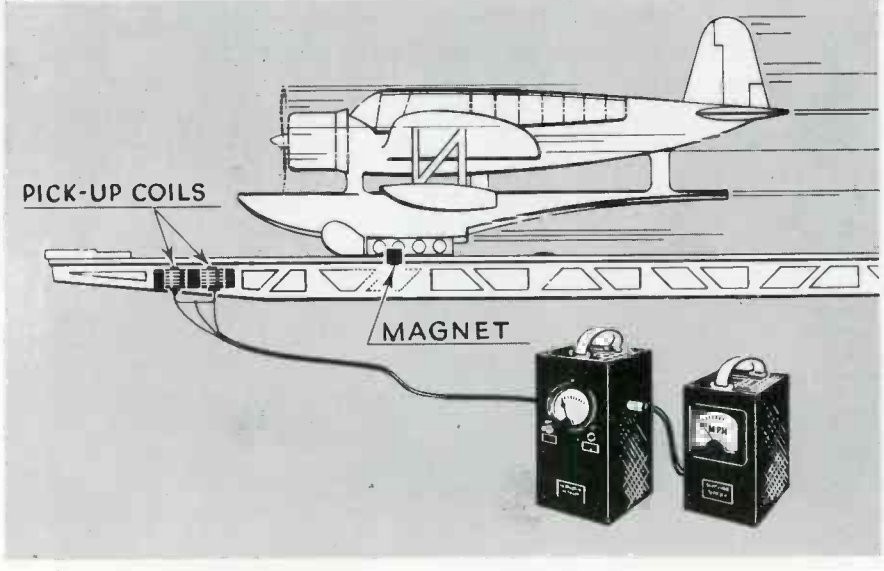
With the advent of electronic control, resistance welding has assumed major importance in the aircraft industry. Spot, butt, projection, or seam welding units in the past have consisted of a set of pressure-operated electrodes, the welding transformer to step down voltage and provide the tremendous current for the welding, a mechanical timing device to standardize the length of the weld, and mechanical contactors to make and break

▲ MAGNETIC type of stored energy welder This Sciaky dc unit spot welds aluminum

INTERIOR of control cabinet, showing ignitrons for rectification of 3-phase ac ▼



SPEED INDICATOR for catapult launching, developed by General Electric, gives direct reading in mph at end of "run," to study launching-charges for various planes ▼



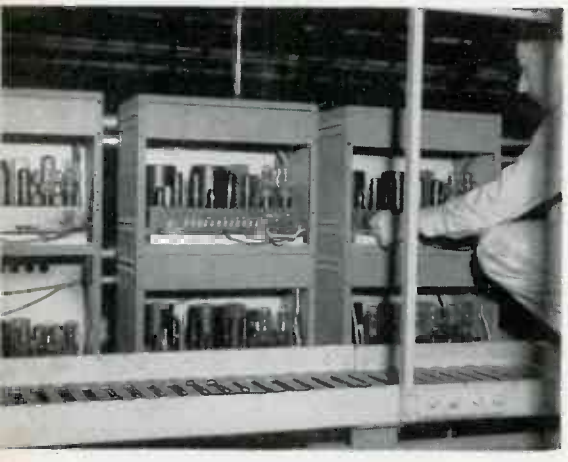
the heavy current in the primary of the transformer.

Precision control of the whole welding cycle—squeeze, weld, hold, and release—by thyratrons, with heavy-duty ignitrons used as contactors in ac welding and as both contactors and rectifiers in dc welding, has vastly stepped up aircraft production. The most obvious illustration is in the elimination of thousands of rivets in the aluminum or stainless steel skins of fighting planes.

The modern single-phase ac electronic welding control unit includes two ignitrons back-to-back to pass current on both halves of the cycle,

▲ TACHOMETER testing with General Radio stroboscope calibrated in flashes per min.

AMPLIFIER units in the public address system at the Republic plant. Fourteen RCA 40-50 watt amplifiers feed plant's speakers ▼



acting as a single-pole switch or contactor to make and break the welding current, a synchronous timer to fire and hold the ignitrons for a preset welding interval, always making and breaking the main circuit at a fixed point on the ac voltage curve, and a phase-shifting circuit for stepless adjustment of welding current.

Stored energy welders

Stored energy welders of the magnetic or capacitor type provide dc welding current where it is desired, and have the advantage of using three-phase power without unbalancing the power line, sometimes a real problem when using single phase ac welders, whose load is at very low power factor. Both types make use of a three-phase ignitron rectifier. In the magnetic type, the high voltage dc is fed to the primary of the welding transformer for a set interval. The initial surge of current causes an induced emf in the secondary, and the work between the electrodes is preheated. At the end of the transformer charging interval, the primary circuit is broken, the familiar effect of energy storage in an inductance induces a heavy current in the low voltage secondary, and the weld is made. The Republic Aviation Corp., Farmingdale, N. Y., uses five Sciaky spot welders of this type.

The capacitor type also utilizes a three-phase rectifier, the output of which is fed into a large bank of condensers to a preselected voltage level, usually between one and three thousand volts. This charge is guarded against leakage by a trickle charger, until the energy stored in the capacitors is used in the welding transformer primary. The primary circuit is completed by an ignitron or other mercury-pool cathode rectifier. The tendency for the capacity of the storage bank and the inductance of the transformer primary to form an oscillating circuit with a frequency of about two cycles per second has made necessary, in some instances, an additional mercury rectifier in shunt to fire after the initial welding surge has gone through the primary.

Numerous special types and arrangements of electronically controlled welding units are employed in the various aircraft factories. Two magnetic stored energy welders, for instance, are sometimes operated from the same rectifier equipment. A safety circuit prevents both of them from loading the rectifier at the same instant. The only noticeable effect is an occasional fractional-second pause in the operation of whichever welder tries to "cut in."

Electronically controlled welding has resulted in production of many plane structures in less than half the time required by previous methods.

X-Ray radiography

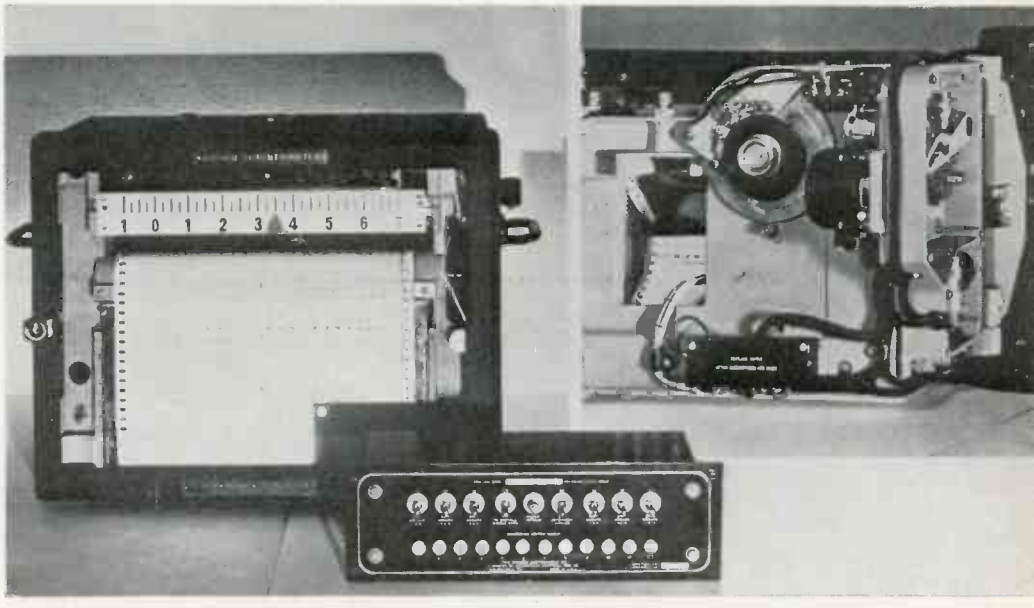
In all aircraft and engine plants, castings are divided into several classes, depending on their nature and the exact use to which they are to be put. Ordinarily, a certain percentage of some less critical classes is subjected to X-ray radiographic examination for internal cracks, blow holes, and other casting defects. If the developed films reveal any slight defect in any of the castings radiographed, the whole batch is automatically subjected to examination.

New techniques of casting, new alloys, and other variable factors make the X-ray a blessing to the aircraft industry. Each internally defective part shown up means saving machining hours, money, a plane, a pilot's life, or all four.

Industrial X-ray units as used by engine and plane manufacturers generally operate at voltages ranging from 140,000 to 400,000 volts. At least one of the "million-volt" units is now in use. A recent development

(*Continued on page* 100)

RECORDING potentiometer developed by Brown Instrument Co. to graph up to 144 temperatures in aircraft engines in flight. At right, reversible motors set and print readings ▼



WAR STANDARDS for MILITARY RADIO

Army, Navy, WPB, RMA, IRE and ASA cooperating to simplify war radio requirements. New specifications will speed production, conserve materials

A tremendous program for the standardization and simplification of radio parts used in military and naval radio and electronic equipment, is now under way, under the direction of S. K. Wolf of the War Production Board, at the assignment of Ray Ellis, Director Radio and Radar Division, WPB.

This great project to set up emergency standards for all military radio, has the cooperation of the Army and Navy, the RMA, the IRE, the American Standards Association, and the prime and sub-contractors for military radio.

Its purposes and accomplishments include the following:

1. Speed production of radio equipment.
2. Make replacements of parts easier.
3. Keep standards of quality high.
4. Conserve materials.
5. Provide interchangeability between Army and Navy.
6. Provide uniform type numbers for equivalent equipment.
7. Consider substitutes for critical materials.
8. Omit items uneconomical to manufacture.
9. Rationalize range of sizes, materials and usefulness.
10. Draft specifications for approved items.
11. Give consideration to present testing conditions which must use inexperienced personnel. This involves simplified statements of essential requirements including, where possible, use of familiar everyday terms (inches, ounces, Fahrenheit, etc.).

"In setting up standards for radio components to be used in equipment for the armed forces, there are two factors which must receive constant attention," explains H. P. Westman, secretary of the general committee working under ASA auspices.

Parts may be priceless!

"If the requirements are made so severe that no conceivable failure may occur in service, production will suffer or disappear. On the other hand, if production only is considered and quality ignored, the product will not be worth having. A balance must be reached which will reduce, to a reasonable minimum, losses in manufacturing time and materials and yet produce components which will operate satisfactorily under all conditions.

"Above all," Secretary Westman continues, "the consideration given to any component must not be based on its monetary cost at the time of its production. Its failure in the field may contribute substantially to the loss of a bomber, a tank, a ship, or a battle—involve the lives of trained men, on which no price can ever be put."

Mica capacitors first

Because of the complexity of the situation it was decided to select the field of mica capacitors as a trial assignment before undertaking work on the entire field. After a series of meetings, a draft standard was prepared covering all the various performance characteristics required by the armed services. This has necessitated the unification of the requirements of the services and of the prime contractors and parts manufacturers. Specifications have been developed for each size and grade of capacitor which indicates the form of case, the capacitance, the tolerance,

S. K. Wolf, WPB components chief, and chairman War Committee on Radio

working voltage, and loss characteristics. One of the valuable charts developed by the committee is reproduced herewith.

As a result of the mica-condenser experience it was decided to use the emergency procedure of the American Standards Asociation to organize for a thoroughgoing job on the whole problem of radio materials and parts. The work heads up in the American Standards Association War Committee on Radio, with S. K. Wolf of the War Production Board as chairman, and H. P. Westman of the ASA Sectional Committee on Radio (C16) as secretary. New York headquarters are at 29 W. 39th Street.

Committee organization

The functions of the Emergency Committee are to decide what jobs shall be done; outline the scope of each job; assign responsibility for each job to a Secretariat; keep the various jobs moving and obtain periodic progress reports; review all draft standards submitted to it from whatever source; circulate revised drafts for criticism; have the responsibility of securing approval of the military services; recommend formal approval of standards by ASA.

The following subcommittees have been organized:

WAR COMMITTEE ON RADIO

S. K. Wolf, War Production Board, (Chairman)
H. P. Westman, American Standards Association, (Secretary)
R. P. Bennett, Bendix Radio
Major Theodore Bishoff, U. S. Army, Signal Corps
Lt. G. C. Anderson, alternate
H. C. Bonfig, RCA Mfg. Company
D. F. Schmit, alternate
Lt. Comdr. A. B. Chamberlain, Navy Dept., Bureau of Ships
Dr. L. A. DuBridge, National Defense Research Council
M. D. McFarlane, alternate
J. J. Farrell, General Electric Company
C. H. Crawford; R. J. Biele, alternates
Dr. Alfred N. Goldsmith, Institute of Radio Engineers
D. G. Little, Westinghouse Electric & Mfg. Co.
Col. T. C. Rives, U. S. Army, Radar Division
H. N. Willets, Western Electric Co.
Marvin Hobb, WPB Radio Division

1. Insulating materials: a. Steatite b. Plastics c. Others.
2. Insulating Forms: a. Steatite b. Plastics c. Others.
3. Capacitors—Fixed: a. Mica b. Paper c. Electrolytic d. Ceramic.
4. Capacitors—Variable: a. Receiver b. Transmitter c. Trimmer.
5. Dynamotors and Similar Power Units.
6. Crystals and Holders.
7. Resistors—Fixed: a. Composition b. Wire Wound.
8. Resistors—Variable: a. Composition b. Wire Wound.
9. Transformers: a. Power b. Audio Frequency c. Radio Frequency.
10. Tube Sockets: a. Receiving b. Transmitting c. Cathode Ray.
11. Connectors: a. Plugs and Jacks b. Multicontact Plugs and Receptacles.
12. Dry Batteries: a. Single Cell b. Multicell.
13. Vibrators.

"Task Groups" do initial work

Each subcommittee is directly responsible to the War Committee on Radio. However, the personnel of subcommittees is not limited to that of the War Committee. Such committee members are drawn chiefly from the armed forces and from prime contractors and subcontractors. In most cases small "task committees" prepare draft standards which are then distributed for criticism, and after judicious revision are placed before the War Committee on Radio for final action.

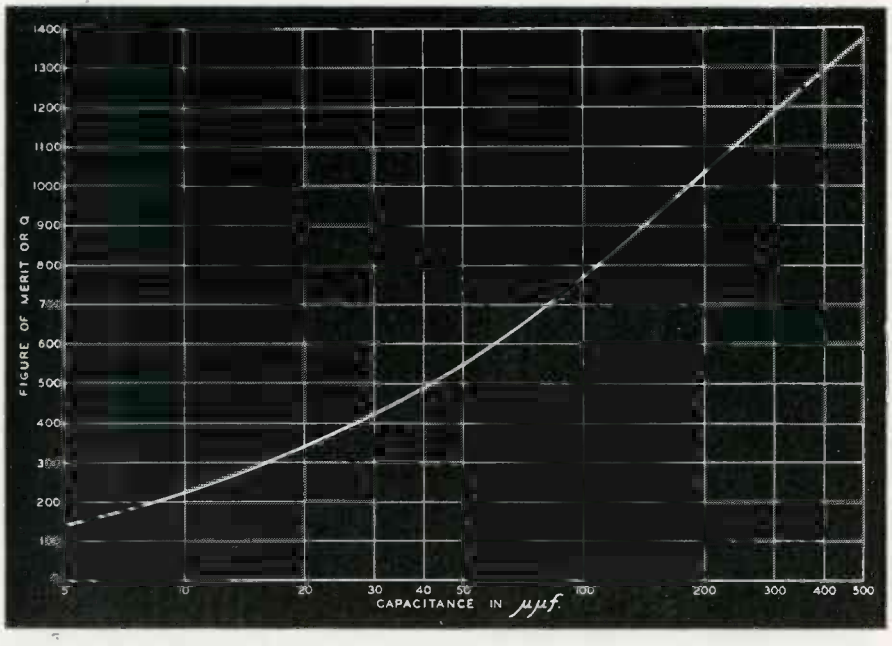
Above all, it should be emphasized that this military standardization job is a revision and unification of existing standards now in use by the Army, Navy, RMA, IRE, and individual companies, with such additions and corrections as are necessary to make a consistent and thoroughly workable series of standard parts and material requirements.

Some lessons

For example, in the work on capacitors it was found possible to eliminate many items now in use and varying only insignificantly from each other, while at the same time a few types were added in order to make the series sufficiently complete for all practical requirements.

Also it has been shown that while the requirements of Army and Navy are in general the same, the necessities imposed by our present far-flung global war effort present wide ranges of conditions. For example, a radio set on a plane in the tropics may have to withstand ground conditions of high humidity and 70°C. (158°F.) and then a few minutes later may be flying at upper sky temperatures of —40°C. (—40°F.) with low barometric pressures.

Already the specifications on fixed mica capacitors have been completed and approved, and are now being made available in printed form to all concerned.



Minimum permissible values of Q for capacitors when measured at 1 megacycle. Q is a factor of merit of any reactance component. The larger its value, the lower the losses in relation to the ability to store and release energy to the circuit

Immediately following will come the committee reports on ceramic materials, steatite products, vibrators, and resistors. Other reports soon to appear will be paper and ceramic capacitors, so that Chairman Wolf expects to have at least twelve sets of military radio standards well outlined and set up by the end of the year.

Sub-Committees and Task Groups

Insulating Materials

Dr. Alfred N. Goldsmith, Institute of Radio Engineers, (Chairman)
H. R. Wilsey, American Standards Association, (Secretary)
Rollin S. Baldwin, Navy Dept., Bureau of Ships
R. B. McDowell, alternate
R. S. Bicknell, American Lava Corporation
Kristian H. Brandt, Signal Corps, GDL
Dr. Carl J. Christensen, Bell Telephone Labs.
C. H. Crawford, General Electric Company
I. A. Meriwether, alternate
H. L. Crowley, Crowley & Company
Harord I. Danziger, alternate
Major Robert F. Cunningham, U. S. Army, Signal Corps, ARL
E. A. Domber, Isolantite, Inc.
G. Milton Ehlers, Centralab Div. of Globe-Union, Inc.
W. S. Parsons, alternate
Lt. Glenn N. Howatt, General Ceramics & Steatite Corporation
Louis Scheib, alternate
Dr. O. C. Ralston, U. S. Bureau of Mines
Major Richard Stanforth, Army & Navy Munitions Board
Capt. R. S. Grubmeyer, U. S. Army, alternate
R. E. Stark, Stupakoff Ceramic & Mfg. Company
S. H. Stupakoff, alternate
Frank J. Stevens, American Lava Corporation
Dr. Hans Thurnauer, alternate
A. F. Greaves-Walker, WPB

Task Group on Steatite (Physical & Chemical Specifications)

Dr. Carl J. Christensen, Bell Telephone Labs., (Chairman)
Rollin S. Baldwin, Navy Dept., Bureau of Ships
Robert B. McDowell, alternate
Kristian H. Brandt, Signal Corps, GDL
S. DeVita, alternate
Charles E. Butler, Signal Corps, Radar Lab.
L. J. Cavanaugh, General Electric Company
Major Robert F. Cunningham, U. S. Army, Signal Corps, ARL
Harold Miller, alternate
H. L. Curtis, National Bureau of Standards
G. M. Ehlers, Centralab Div. of Globe-Union, Inc.
Dr. R. F. Field, General Radio Company
R. F. Geller, National Bureau of Standards
J. D. Heibel, Erie Resistor Corporation
Lt. Glenn N. Howatt, General Ceramics & Steatite Corporation
Herbert S. Lyon, Signal Corps, Radar Laboratory
Trever M. Caven, alternate
Robert W. Orr, RCA Mfg. Company
F. Potter, Isolantite, Inc.
H. H. Race, General Electric Research Lab.
Dr. Hans Thurnauer, American Lava Corporation
Eugene Wainer, Titanium Alloy Mfg. Co.
K. B. Thews, alternate
J. S. White, Stupakoff Ceramic & Mfg. Co.
W. A. Yager, Bell Telephone Labs.

Task Group on Steatite Forms, Dimension and Tolerances

E. A. Domber, Isolantite, Inc., (Chairman)
Kristian H. Brandt, Signal Corps, GDL
Major L. H. Hitchcock, alternate
Bernard R. Boymel, U. S. Navy, Bureau of Ships
John N. Hall, alternate
Trevor M. Caven, Signal Corps, Radar Lab.
Herbert S. Lyon, alternate
C. H. Crawford, General Electric Company
F. E. Hanson, Western Electric Company
V. E. Heaton, National Bureau of Standards
D. G. Little, Westinghouse Electric & Mfg. Company
William H. Siesel, Lenox, Inc.
C. L. Snyder, General Ceramics & Steatite Corporation
R. E. Stark, Stupakoff Ceramic & Mfg. Co.
Frank J. Stevens, American Lava Corporation
H. R. Terhune, RCA Mfg. Company
H. J. Turpin, Signal Corps, GDL
Harold Miller, Signal Corps, ARL

Fixed Capacitors

H. P. Westman, American Standards Association, (Chairman)
H. R. Wilsey, American Standards Association, (Secretary)
A. R. G. Albright, U. S. Navy, Bureau of Ships
L. E. Anderson, RCA Mfg. Company
S. C. Starr, alternate
William Bailey, Cornell-Dubilier Electric Corporation
A. J. Christopher, Bell Telephone Labs.
J. I. Cornell, Solar Mfg. Corporation
A. DiGiacomo, Micamold Radio Corporation
Major William H. Edwards, U. S. Army, Signal Corps, GDL
G. Milton Ehlers, Centralab Div. of Globe Union, Inc.
J. A. Flanzer, Electro-Motive Mfg. Co.
Capt. R. J. Framme, Aircraft Radio Lab.
B. V. K. French, P. R. Mallory & Company, Inc.
C. A. Gunther, RCA Mfg. Company
J. D. Heibel, Erie Resistor Corporation
R. R. J. Johnson, Signal Corps, Radio Lab.
Louis Kahn, Aerovox Corporation
H. L. Kunz, Sangamo Electric Company
C. W. Metcalf, Tobe Deutschmann
F. K. Priebe, Signal Corps, GDL
R. Sprague, Sprague Specialties Company
Hans Thurnauer, American Lava Corporation

Task Group on Fixed Mica-Dielectric Capacitors

H. P. Westman, American Standards Association, (Chairman)
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C. A. Gunther, RCA Mfg. Company
Louis Kahn, Aerovox Corporation
F. K. Priebe, Signal Corps, GDL

Task Group on Fixed Paper-Dielectric Capacitors

H. P. Westman, American Standards Association, (Chairman)
A. R. G. Albright, U. S. Navy, Bureau of Ships
William Bailey, Cornell-Dubilier Electric Corporation
W. W. Clark, Sprague Specialties Company
D. D. Cole, RCA Mfg. Company
J. I. Cornell, Solar Mfg. Corp.
William Dubilier, Cornell-Dubilier Electric Corporation
Major William H. Edwards, U. S. Army, Signal Corps
William Frear, Philco Corporation

Signals from the Bush

This official U. S. Army Signal Corps photo shows how the new walkie-talkie and its user can conceal themselves in a foliage-covered observation post

W. Henry Fryling, Erie Resistor Corporation
F. J. Given, Bell Telephone Labs.
J. D. Stacy, General Electric Co.
K. E. Hassel, Zenith Radio Corp.
Louis Kahn, Aerovox Corp.
A. Maibauer, Halowax Products, Div. of Union Carbide & Carbon Co.
A. M. Okun, Aircraft Radio Lab.
F. W. Schor, Hallicrafters
J. R. Tozer, Signal Corps, Radar Lab.
E. B. Tyler, Micamold Radio Corp.
H. Walker, Bendix Radio
A. P. Williams, Galvin Mfg. Corp.

Task Group on Fixed Ceramic-Dielectric Capacitors

J. D. Heibel, Erie Resistor Corp., (Chairman)
A. R. G. Albright, Navy Dept., Bureau of Ships
L. E. Anderson, RCA Mfg. Co.
S. C. Starr, alternate
Major W. H. Edwards, U. S. Army, Signal Corps, GDL
G. M. Ehlers, Centralab, Div. of Globe Union, Inc.
C. A. Gunther, RCA Mfg. Company
Louis Kahn, Aerovox Corp.
K. E. Rollefson, The Muter Company

Dynamotors and Power Units

Lt. Comdr. W. G. Ellis, U. S. Navy, Bureau of Ships, (Chairman)
H. R. Wilsey, American Standards Association, (Secretary)
A. E. Abel, Bendix Radio
D. L. Beam, Aircraft Radio Lab.
Harris C. Haines, alternate
D. E. Bright, Pioneer Gen-E-Motor
H. E. Argue, alternate
W. F. Fryburg, Black & Decker Electric Co.
R. D. Jones, General Electric Company
P. O. Noble, alternate
J. Nader, Eicor, Inc.
F. J. Mailander, alternate
H. C. Newman, Army-Navy Electronics Production Agency
H. A. Poole, Bendix Radio
J. M. Shulman, Westinghouse Electric & Mfg. Co.
John Gammell, WPB
Robert Hanna, alternate

Crystals and Holders

D. K. Martin, Bell Telephone Labs., (Chairman)
I. E. Fair, alternate
R. S. Bailey, Bendix Radio
E. L. Minnich, alternate
C. F. Baldwin, General Electric Company
H. E. Blasier, Monitor Piezo Products Company
Lt. Comdr. P. V. Colmar, U. S. Coast Guard
L. A. Gagne, Standard Piezo Company
H. G. Johnstone, Western Electric Company
T. W. Keller, Howard Mfg. Company
W. C. Anderson, alternate
Robert B. McDowell, Radio & Sound Branch, Bureau of Ships
V. E. Trouant, RCA Mfg. Company
Major H. M. Wood, Signal Corps, GDL
Herman L. Gordon, alternate
John M. Ziegler, Crystal Products Company
H. P. Westman, American Standards Association, (Secretary)

Dry Batteries

Dr. G. W. Vinal, National Bureau of Standards, (Chairman)
Charles G. Birdsall, General Dry Batteries, Inc.
C. A. Gillingham, National Carbon Co., Inc.
J. L. King, Signal Corps, GDL
Ralph E. Ramsay, Ray-O-Vac Company
V. G. Reel, Burgess Battery Company
E. R. Roswell, General Electric Company
G. W. Duckworth, alternate
Ensign I. M. Vann, U. S. Navy, Bureau of Ships
W. F. Satterthwaite, WPB

Vibrator Power Supplies

B. V. K. French, P. R. Mallory & Co., Inc. (Chairman)
H. P. Westman, American Standards Association, (Secretary)
D. L. Beam, Aircraft Radio Laboratory
P. V. Galvin, Galvin Mfg. Company
W. W. Garstang, Electronics Lab., Inc.
Fred Gluck, U. S. Navy Dept., Bureau of Ships
F. D. Gray, Oak Mfg. Company
A. A. Guffsteln, American Television & Radio Co.
Billie Thomas, Radiart Corporation
L. O. Vladimer, General Electric Company
J. S. Comins, alternate
C. L. Walker, Utah Radio Products Company
H. C. Haines, Aircraft Radio Laboratory
George N. Scheer, Jr., Aircraft Radio Laboratory

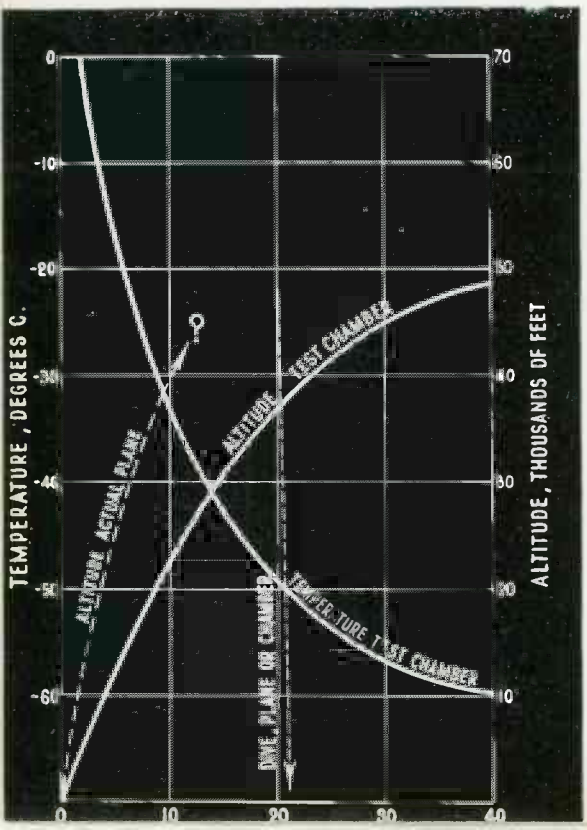
HIGH ALTITUDE TEST
for Aircraft Radio Equipment

Low temperature and low pressure in upper air change characteristics of many electronic components. Freezing and condensation of water vapor causes temporary inoperation or permanent damage

"High altitude chambers" producing simulated flight conditions of low temperature, low pressure and low humidity are being widely used in design and production testing of aircraft radio and other electronic equipment. Exacting demands of modern military aircraft operation have complicated radio design problems considerably.

Where pre-war radio apparatus had been designed to operate at high or at low temperatures, mili-

TEMPERATURE and pressure curves against time, in average test. Almost any set of conditions met in actual flight can be matched in a cold-chamber. For comparison, fast plane climbing and diving curves are indicated. Compiled with assistance of Mobile Refrigeration, Inc.



TEST-ROOM in the laboratory of the Sperry Gyroscope Company, Brooklyn, N. Y., used for simulated flight testing of a variety of electronic equipment for aircraft. The room is eleven feet square, ten feet high, and consists of a "floating" shell of stainless steel to resist fresh and salt-water simulated fogs, powerful ultra-violet light radiation, or simulated rain. The Tenney steel room is suspended at the center of the ceiling and floats in eight-inch insulation, with sliding fits at observation windows and doors. The shell is anchored at a central drain in the floor. A five ton refrigerating system maintains room at zero; temperatures to —40°F. are achieved with dry ice. Chamber can be heated to 150°F. Humidity may be controlled from apparatus dew point to 95%

tary radio must be able to do both within a matter of minutes. Instead of operation at moderate altitudes, in airline operation, military electronic equipment has to perform satisfactorily at or near the existing airplane ceiling.

Extremes of temperature and pressure, and rapid changes of temperature and humidity, account for most of these design problems.

Stratosphere temperature table

Altitude in Feet	Pressure, Inches of Mercury	Northern U.S. Winter	Northern U.S. Summer	Southern U.S. Winter	Southern U.S. Summer
5,000	24.89	—34	21	—2	38
10,000	20.58	—38	6	—9	21
15,000	16.88	—46.5	—12.5	—23.5	2.5
20,000	13.75	—58	—35	—40.5	—18
25,000	11.10	—73	—55	—57	—39
30,000	8.88	—87	—72	—74	—58
35,000	7.04	—99	—88	—90	—75
40,000	5.54	—107	—101	—104	—92
45,000	4.36	—111	—110	—115	—107
50,000	3.43	—110	—110	—122	—122

Average upper air temperature over the United States, in degrees Fahrenheit. Degrees C = 5/9 (°F —32). Compiled by Tenney Engineering, Inc.

Low temperatures

Oil in oil-impregnated condensers congeals on reaching a critical low temperature. The exact point depends, of course, on the composition of the oil impregnating compound. The capacity of such a condenser may decrease as much as 25 per cent. The power factor may increase, from a normal of less than 1 per cent, to 4 or 5 per cent.

Electrolytic condensers, in general, perform satisfactorily down to —30° C, if increased power factor of up to 30 per cent can be tolerated. In the neighborhood of —40° C, the capacity may decrease to one half or one third of the original value.

The lower the ambient temperature, the higher the ionization potential of the vapor in vapor-filled tubes. Increased voltage drop, or inoperation due to failure to reach ionization temperature at the available potential, must be considered in aircraft radio design.

Gas-filled tubes are not affected.

Serious change in the capacitance of variable condensers is experienced when the ambient temperature varies over a wide range. This is due, of course to expansion and contraction of the framework and other parts.

Humidity problems

A rapid descent from high altitude, into 80 or 90 degree air at normal pressure and normal or high humidity, brings considerable trouble because of frosting and wetting due to condensation of water vapor on the radio components, which may still be at or near zero. In addition, increasing air pressure during the descent may cause some components to "breath in" high humidity air. Because of the high dielectric constant of water, droplets on inductances and condenser plates greatly increase the capacity of the tuned circuits, an important factor if the apparatus is expected to function again within a short period. Deposition of water on most carbon resistors and potentiometers causes a considerable change in resistance, especially if there is dust present. In addition to the conductivity of dirty water, an electrolysis effect is noted where the voltages involved are high. As a result, components are hermetically sealed wherever possible. Another humidity problem is encountered where equipment ascends to a low temperature region from one of high humidity. Trapped moisture freezes.

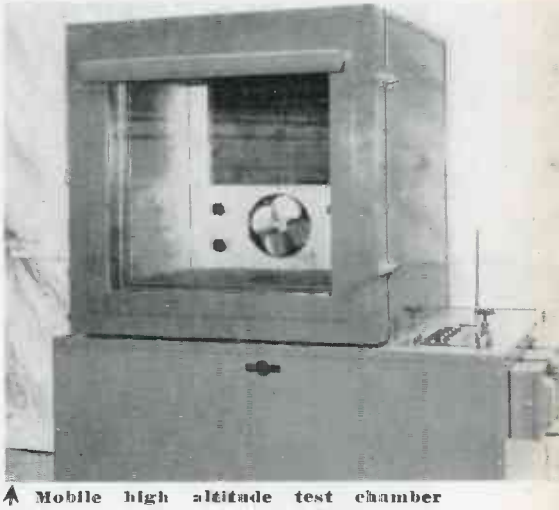
Low pressure problems

Sparking and corona potentials are cut to one fourth in the reduced pressure near the airplane ceiling. Five hundred volts may be sufficient to jump ⅛" under certain conditions. Above 2½ kilovolts, no practicable separation of .04" (No. 18 wire) conductors is sufficient to prevent corona discharge. Any solder points or other sharp edges make the condition worse. Larger diameter conductors, careful rounding of all edges, and globular soldering technique must be employed.

Materials problems

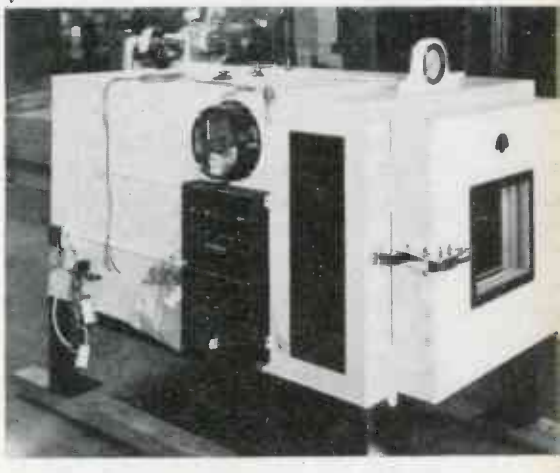
Most aircraft equipment must be shock-mounted, on rubber. Natural rubber becomes hard and quite brittle at extremely low temperattures. Various types of synthetic rubber are superior in this kind of service. Certain plastics flow and tend to disintegrate and can not be used. With the aid of stratosphere chambers, these and other problems are being studied.

Cabinet made by American Coils, Inc.

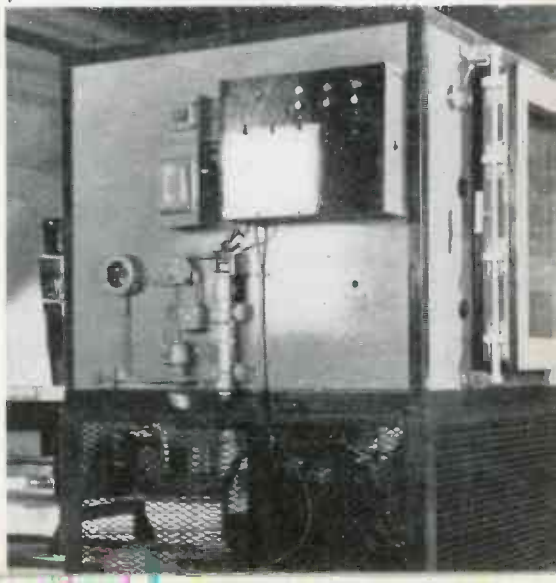


Mobile high altitude test chamber

Tenney unit at Belmar radar lab.



A cold chamber made by Dougherty



SUBSTITUTES for War Radio

Mr. Farrell compares some of the new components and parts developed to save critical materials

There are about 23 materials in Group 1 of the WPB critical-metals list, and about 14 of these are used in radio apparatus. But the requirements for two or three of them are almost insignificant, explained J. J. Farrell, designing engineer, GE electronics department, Schenectady, N. Y., addressing the Nov. 9 Rochester (N. Y.) War Production Conference of RMA and IRE.

For the remaining 11 or 12 materials, it is impracticable to obtain an authoritative listing of these in their order of scarcity. Even if this were feasible it is probable the list would be subject to frequent revisions due to unpredictable conditions. The knowledge of what materials cannot be obtained in sufficient quantities, all too often, comes the hard way—through notification that the requirements for a given period cannot be filled. The problem to be solved by industry, if military-radio output is to increase or hold its own, is the material problem.

The obvious way to relieve the critical material situation is by a program of substitution. However, because of the uncertainty of forecasts, it should not be a program of outright substitution. Rather it should be the provision of "alternates" or the establishment of flexibility to the greatest feasible extent. In lieu of drawing changes, the designer should provide an alternate list and allow his production and planning departments a free choice, dependent upon their current knowledge of material availability. They can then use the optional material, the original, if conditions change, or use both.

Choice of alternates

In considering alternate materials the designer must keep a few fundamentals in mind. The apparatus must be reliable and perform satisfactorily under severe conditions. The requirements written into the specifications on temperature range, altitude, humidity, etc., can be checked any day in the newspapers. The vital necessity of reliable equipment for fighting a war is self-evident. Much is heard about "20 to 40 hours combat life", but who has seen a directive or specification change to this effect? Every departure from post practice which is authorized by a military agency is with the reservation that it must not cause any degradation in performance or reliability. Authorizations for alternate materials or components cannot be lightly given. Thorough engineering consideration, and perhaps a trial run or lot, must first provide the assurance that reliability and performance will be maintained.

In selecting alternate materials the obvious thing to do is apply Group III and Group II materials if possible. Of some eight metals in Group III, we find only two, gold and lead, with possibilities. Among 17 in Group II we find cast iron, platinum, silver, and paradoxically, (because copper is in Group I), we find beryllium-copper. Three of the seven mentioned possibilities in Group II and III; cast iron, lead and silver, are finding increasing

applications. It does not require great consideration, however, to determine that much relief cannot be obtained from the less critical groups. Likewise there is some, but inadequate, relief in the less critical miscellaneous materials such as: some plastics, glass, ceramics, plywood, etc.

Unfortunately, the best substitutes for critical materials are other critical materials and the indicated action is to allow, insofar as feasible, a free choice dependent upon conditions at any given time.

Zinc, steel, aluminum sheet

Considering the Group 1 critical list, it appears, from current procurement experience, that zinc is more plentiful than nickel or cadmium, common steel can be obtained more readily than the alloy steels or aluminum, and aluminum sheet is more readily obtainable than aluminum bar, rod or extruded stock. Although we do not have any guarantee that the situation will be the same several months from now, the course of action for the present is clear. The samples shown will serve to illustrate flexibility of design, and illustrate how 2,088,740 lb. or 1044 tons of material can be saved.

Many more samples could have been provided to illustrate alternate designs involving other metals than steel and aluminum. These would be parts made of beryllium copper, spring steel and phosphor bronze; aluminum, zinc and plastics; copper and copper-weld; brass and steel; and others. Likewise many samples could be shown of aluminum parts made from extrusions and sheet, from rod and sheet, and from rod or by die casting. In all cases tools are provided for the alternates and the selection of the material is by the production and planning groups.

Component flexibility

To be fully effective, the plan for flexibility must include certain manufactured components. It is well known that the supply of some components is so inadequate as to subject them to allocation. In these cases the difficulty may be due to raw materials or insufficient facilities.

Let us consider two of these—steatite and mica capacitors. Although the supply of steatite has been greatly increased during the past months, there are still numerous instances where insulators of this material are a definite bottleneck. While the major increase in the steatite output was due to new facilities, the generous application of alternates has helped considerably. Plastics, mycalex, porcelain and glass have been applied where feasible. In most instances the application of these materials involved some loss, inasmuch as none of them is equivalent to steatite, but it was a loss which could be tolerated. The most satisfactory answer to the steatite problem is more steatite. If this answer requires more facilities than now operated by the ten or more suppliers of the material that outlook would not be encouraging, because it is probable that the Army, Navy and WPB would not support further expansion.

What is needed is an equivalent body or material which can be produced without new facilities.

Steatite characteristics

Here are some samples of a new material. By talc content it is a steatite. Its electrical and physical properties are slightly better than average of the materials in use. Its shrinkage is the same as a steatite in general use; these parts having been pressed in the same molds. However, this body contains no felspar. The frit is a synthetic compound which is subject to precise control and is therefore uniform.

The most important characteristic of the body is that it matures at Cone 10, the porcelain firing temperature. This opens up possibilities for the use of porcelain facilities, particularly the tunnel kilns, few of which are presently being used to full capacity. Tools—molds and dies—must be provided for porcelain makers but the facilities and technique are available. At this time, the material is in the proving grounds. A production run has been made and the parts are in various stages of subassembly, final assembly and test. If this double and triple checking bears out the results obtained with test specimens, steatite will be definitely on the way out of the highly critical list of components.

Mica equivalent

Probably the current No. 1 critical component is the mica capacitor. The need for developing alternates for this item is evident to the Government and to industry as well. A WPB sponsored program on the application of oil-impregnated hermetically-sealed paper capacitors is well under way. This undoubtedly will provide some relief but the limitations of the paper capacitors of the types now being manufactured will greatly restrict their application. A better answer is needed and, in particular, one which meets the requirements for flexibility by providing a capacitor which is strictly interchangeable—mechanically and electrically—with its mica counterpart, and one which includes a mica substitute so that it will make no difference to the assembler in the factory or to the maintenance man in the field

(*Continued on page* 103)

INTERCHANGE OF IDEAS NEEDED!

Would avoid duplication of effort

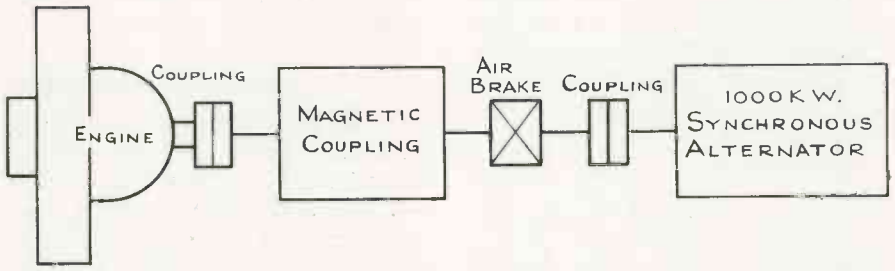
It seems definite that the most good can be accomplished in the shortest time by a coordinated plan between industry and the Government laboratories, which will provide for a free interchange of ideas and avoid duplication of effort.

It would be well if such a plan were adopted promptly, and followed aggressively,

For if we do not make the most strategic use of critical materials and components, one war which will not be won is the war of radio production.

—J. J. FARRELL
Member War Committee on Radio

AIRCRAFT ENGINE Power



Aircraft engine drives alternator through electronically controlled magnetic coupling

At the Melrose Park, Illinois, plant of the Buick Motor Company, an electronically controlled system feeds back to the power lines energy developed by aircraft engines under test. The system uses a 1000 kva alternator and a magnetic type coupling.

Low speed test

After the alternator has been used as a synchronous motor to start the aircraft engine, it is shut down and held by a large, air operated brake. The rotor of the magnetic coupling, attached to the alternator rotor, is also held stationary. In this position the magnetic coupling is used as a water-cooled absorption or eddy current dynamometer. The aircraft engine is loaded to any desired value by exciting the field of the coupling. The engine may be run at any speed up to and including the synchronous speed of the alternator. During this part of the test, which is a relatively short portion of the total test time, all power is absorbed by the magnetic coupling and dissipated in heat. When the speed at which it is desired to test-run the engine equals or exceeds the synchronous speed of the alternator, the air brake is released and the alternator is connected to the power line, as a power recovery unit.

Power recovery

At all engine propeller shaft speeds above the synchronous speed of the alternator, the magnetic coupling acts as a slip coupling, to transmit the power of the engine to the alternator. The alternator and magnetic coupling load the engine by delivering 1,000 kva of generated energy to the utility power lines, and by absorbing in the coupling the lesser amount of energy created by the slip speed differential between the engine and the alternator.

Electronic control

The excitation of the magnetic coupling is obtained from an electronic direct current supply. The field of the coupling is in the output circuit of a pair of gas filled, grid controlled tubes, so connected that full wave rectification of the ac source is effected. These two tubes furnish the basic field excitation to the magnetic coupling.

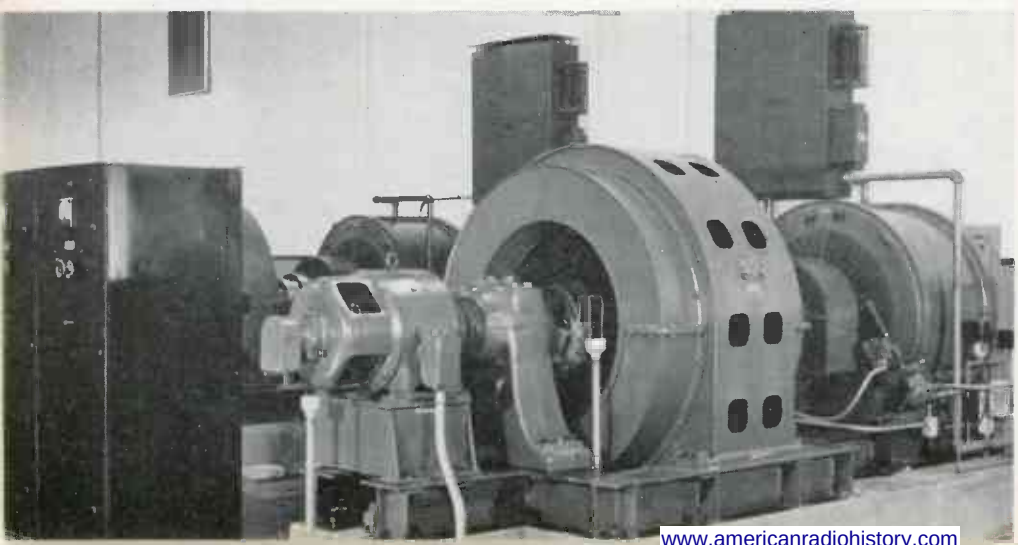
With engine throttle set slightly below any given engine test speed, a basic control potentiometer is adjusted to keep these tubes firing. This potentiometer, across the filtered output of a smaller rectifier circuit, is connected in the grid circuit of these tubes and keeps a basic amount of field excitation on the coupling. This is not critical but serves to keep the engine and alternator coupled.

Similar tubes placed in parallel with basic current tubes function as speed control tubes. They obtain an adjustable grid control potential from a second potentiometer across the output of the small rectifier. This potentiometer can be adjusted to bring the speed control tubes into control, or keep them inoperative when the basic field excitation is first applied to the coupling.

With the speed control potentiometer adjusted to raise this negative grid potential to any point where it crosses the critical grid potential of the tube, each tube will fire during the last quarter cycle of positive anode voltage. Any point on the first quarter cycle can be selected to begin firing. However, no point on the last quarter cycle can be selected to start firing the tube, as the controlled dc grid potential will cross the critical grid at the half way point in the half cycle.

Grid bias rider wave

By superimposing a rider wave on the potentiometer - controlled grid bias, it is possible to start the tube firing at any point on the half cycle wave of anode voltage. This low voltage ac rider wave lags the anode voltage by 90° and is obtained from a Scott Tee connected transformer arrangement.



◄ ELECTRONIC constant speed control, in wall-panels, controls magnetic coupling at extreme right. About 63% of the engine test-run power is fed back, supplying more than half the total power used by the Buick plant. The aircraft engine is in the next room. Small unit at left excites alternator

Recovery

The speed tubes have a second source of grid potential, obtained from the Alnico speed governing generator, which is connected to the input shaft of the magnetic coupling. This ac generator has a wide, direct variation of voltage within a narrow range of speed variation. The output is stepped up, rectified, and filtered, before introduction into the grid circuit of the speed tubes.

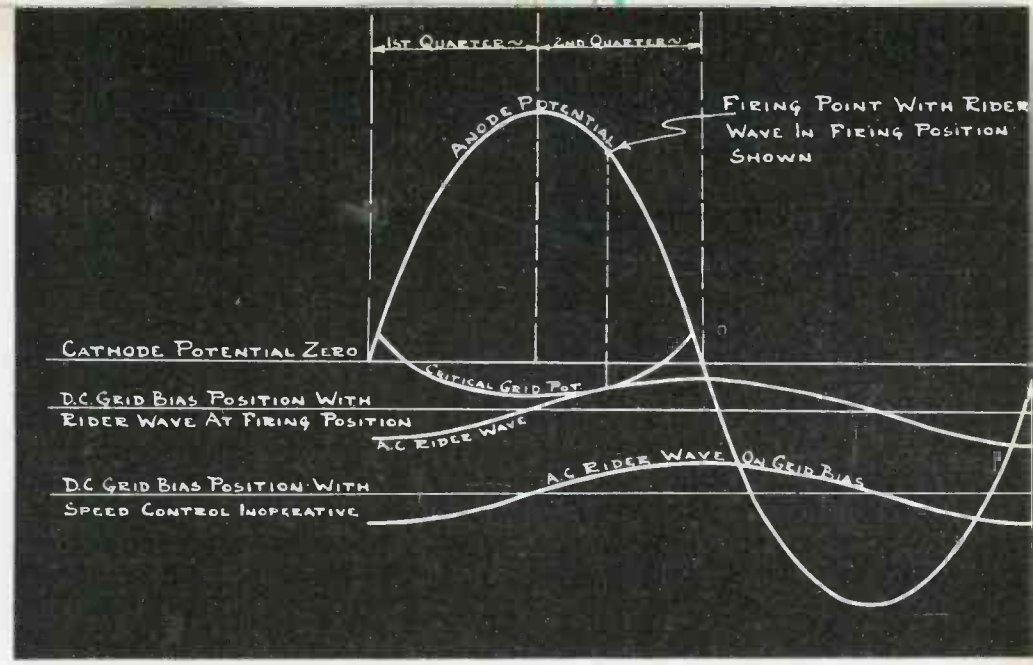
Constant speed control

With the potentiometer adjusted to bring the speed control tubes into operation, an increase of a few rpm of the engine shaft increases the positive dc grid potential obtained from the speed governing generator output. This has the effect of automatically raising the constant negative grid bias, as determined by the setting of the speed control potentiometer, toward zero cathode or positive grid potential, and causes the tube to fire. This tends to increase excitation of the coupling and "stiffen" the clutch, putting a heavier load on the engine. In like manner a decrease of engine speed with the governor operating will decrease excitation of the coupling and lighten the loading.

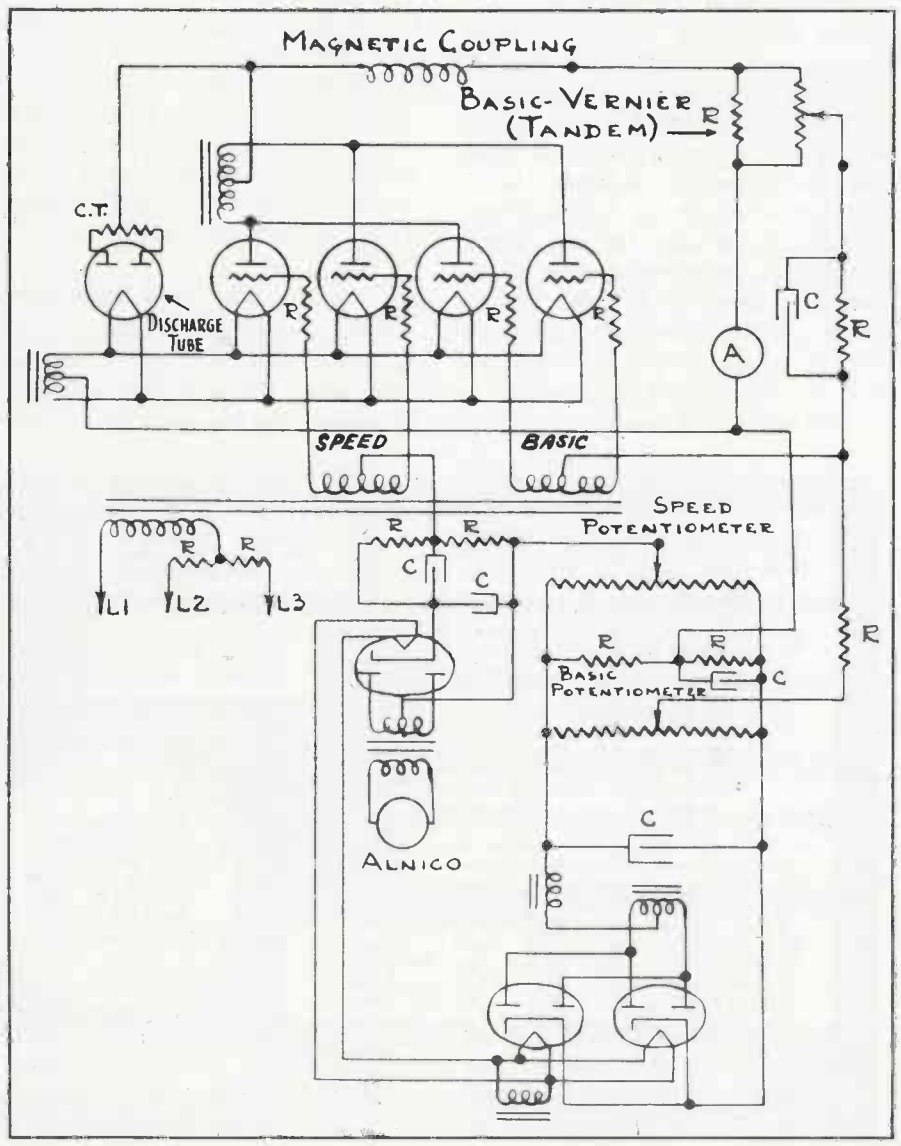
After the speed control potentiometer is adjusted to any pre-determined engine crankshaft speed, it is possible greatly to reduce the basic excitation control. The governor will still automatically hold the engine speed constant because of the extremely sensitive, rapid response of the control circuit.

After setting the speed control at a given point the operator can adjust the throttle to any setting he wishes. The engine will hold its pre-determined speed regardless of the throttle or manifold pressure setting chosen, and the varying power output will be dissipated in the water cooled magnetic coupling.

A discharge tube, connected between the anodes and cathodes of the basic and speed control tubes, serves to prevent short tube life which might result from the high inverse anode potentials.



TOTAL VALUE of grid bias with superimposed ac rider wave is moved up or down in negative region by speed control potentiometer. Alnico speed governing generator can move whole grid bias up or down instantly. Any point on either quarter cycle where dc grid bias or ac rider cuts critical grid curve determines point on half cycle where tube begins to fire. Tube then fires until end of half cycle. Schematic diagram below



★ *Radio-Electronic WAR PRODUCTION*

MANUFACTURING TESTS

Methods which Sperry electronics plant has developed to use present-day unskilled help in factory check-ups

The change to wartime radio and electronic production has brought new problems that have resulted in fundamental departures from accepted production-line testing methods. In a talk before the Rochester IRE-RMA meeting, Nov. 9, Harry E. Rice, test engineer of the electronics plant of the Sperry Gyroscope Company, Garden City, N. Y., discussed basic principles involved in the shift from skilled to unskilled labor in test methods.

Conflicting requirements

While skilled radio test men were being withdrawn from the labor supply, stringent military radio specifications and other apparently incompatible demands made themselves felt. Production runs have become generally smaller, on a greater variety of higher quality apparatus. At the same time, of course, constantly faster production is essential. These and other factors have made necessary a new approach to the problems of production line testing, Mr. Rice said.

Test procedure has been divided into three fairly clear-cut classifications: (1) Incoming parts tests, (2) Sub-assembly tests, and (3) Final production tests. The need for using unskilled labor has changed the emphasis from alignment, testing, and trouble-shooting of the complete unit, to relatively foolproof single-function or two-function tests at many points along the production line. The emphasis is placed on thorough tests of all components and of the various sub-assemblies before they have become too complicated to permit a simple, standardized test.

For the most part, test positions are carefully jigged. No tester is called upon to make diagnoses. A clear-cut accept-or-reject procedure passes faulty components or assemblies to a smaller force of skilled testers, who decide to repair, rework, reject, or junk the faulty part.

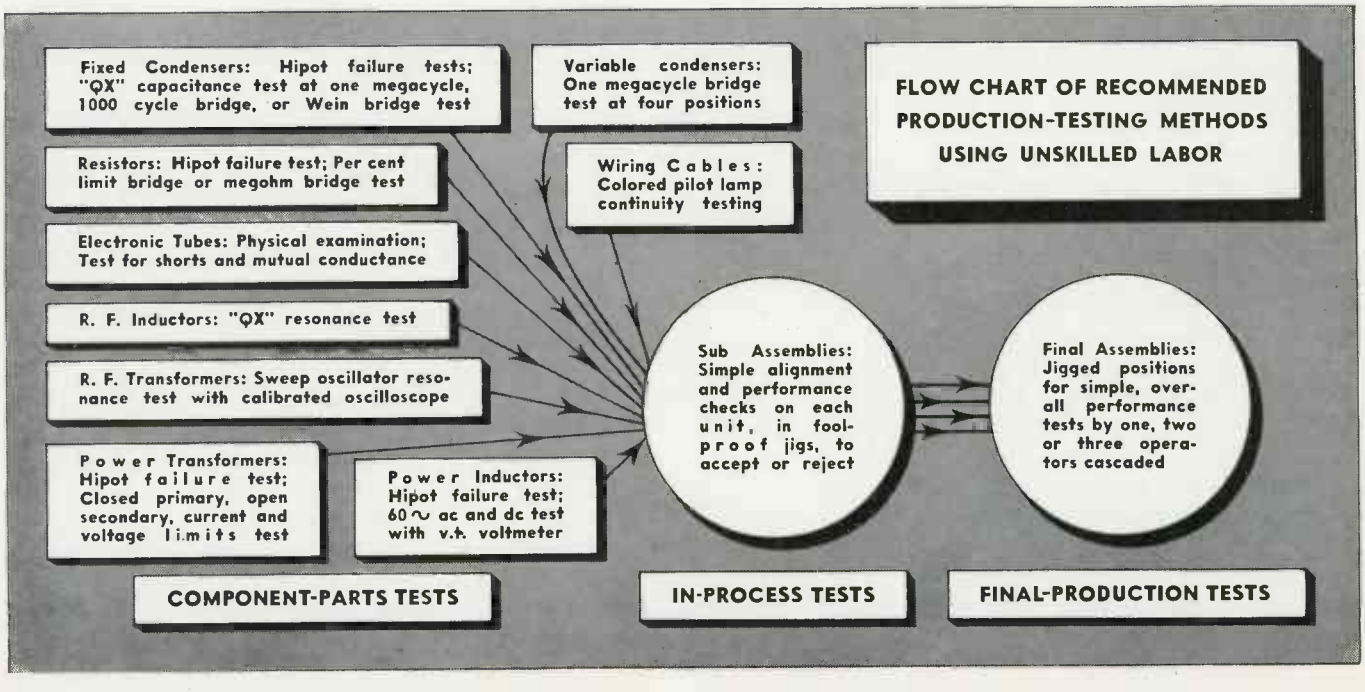
The test equipment

No unreasonable limitations are placed on the designers of the test equipment, beyond the specifications that the fixures or jigs be safe, be simple to use, and that a clear, positive indication be given concerning the tested part's acceptability. The fixtures, however complicated in themselves, must be simple to operate, must be rugged enough to give reasonable assurance that they will not fail in operation, and, if possible, should be adaptable or modifiable to more than just one highly specialized testing function.

It is obviously impossible, Mr. Rice said, to describe in great detail many of the test fixtures required on military production. However, a number of general observations can be made, concerning the changed test procedures.

Resistor testing

All resistors under 100,000 ohms are checked on a standard percent limit bridge, giving a clear indication as to whether the resistance lies within acceptable high and low tolerances. The bridge, jigged with spring holding clips, is very rapid. The meter and bridge are marked with a slip-on scale to indicate the permissible tolerances. Resistors



over 100,000 ohms are checked on a megohm bridge in a similar way. Some resistors are "hipotted" from case to leads, at least twenty units being loaded into a clip jig arrangement and covered with a protecting cage. The operator then slides a selector switch to check them one at a time. A neon lamp gives indication of high potential failure.

Capacitor testing

All condensers are "hipotted," or given a high-potential test,—the particular method depending on type, capacitance, and voltage rating. Wherever possible, a switching arrangement is used which enables the capacitance test to be made without removing the unit from the hipot test jig. Capacitance of mica condensers under 1,000 mmfd is measured on a "QX" oscillator checker at one megacycle. Values over 1,000 mmfd are checked on a one-megacycle bridge to tolerances indicated by two red marks on the controlling dial.

Paper condensers are hipotted and checked on a 1,000-cycle bridge in the same jig. Electrolytic condensers are checked on a Wein bridge for power factor and capacitance. Variable capacitors are placed in a jig with a long control arm for indexing to four positions in 180° rotation. The indexing arm rides on a scale marked to show acceptable tolerances. The one-megacycle bridge used is push-button controlled for the four settings. Visual indication is given with an eye tube.

Tube testing

After visual inspection for loose bases, broken glass, bent pins, and other physical defects, all tubes are inserted in warm up racks, then transferred to a simple tube bridge which is pre-set for shorts and mutual conductance. The only purpose of this gain check is to show up damage from shipment or other causes beyond the tube manufacturers' control.

All rf coils used by Sperry are tested on a QX checker. The frequency and capacity combination to form a resonant circuit with each type of coil is specified on its blueprint. Tolerances are indicated on the capacity control. In some cases, coils are adjusted for inductance on this same fixture.

A Vanishing American! Such keen, highly trained test-experts of peace times are no longer available. Test methods must therefore be modified and simplified so that routine check-ups can be handled by average man or woman employee

R. F. transformer testing

With the transformer as the plate load of a tube type with which it is ultimately to be used, voltage from a sweep oscillator is swept about the center point of the resonant characteristic. An amplitude detector is connected across the secondary of the transformer and feeds a cathode-ray oscilloscope equipped with a calibration chart. The check shows voltage gain, a function of coil "Q", and band width, or function of the coupling, and gives a good indication of common assembly errors such as crossed connections and shorts.

Power inductor testing

Low-frequency inductors are all tested at 60 cycles, with the proper direct current, if any, flowing through. Measurement is made with a vacuum-tube voltmeter at 10 volts rms applied across the choke. This arbitrary parameter has been standardized for checks on five or more different chokes, each held in a special fixture which plugs into the common unit. The chokes are hipotted in the same fixture.

In jigs similar to those used for the chokes, transformer primaries are fed with the proper voltage and frequency. Open-circuit secondary voltages and primary exciting currents are noted to tolerance limits. To make the high potential test, the operator uses two probes, one in each hand.

Cable testing

Most military equipment uses cabling rather than point-to-point wiring. In a cable consisting of 122 wires, laid in by eight operators, testing is carried out by eight groups of colored lights arranged across the top of the cable board. Each operator lays in his or her wires, clipping the ends into contacts which light up the corresponding lamps. When the board reaches the lacing position, every light must be on.

Sub assembly testing

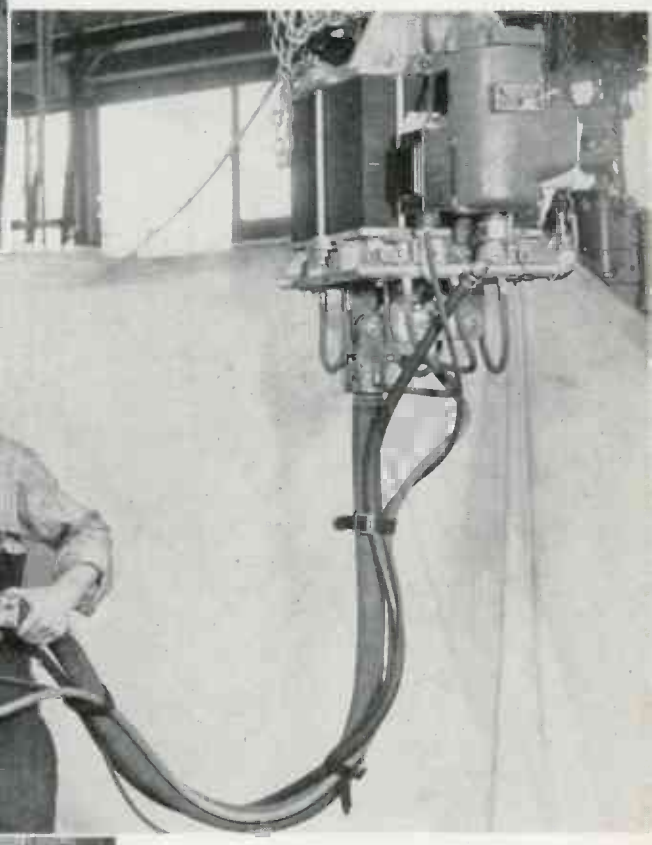
A number of tests are performed on sub assemblies before insertion in the final assembly. The emphasis in the sub assembly check is on performance rather than on parts. The main purpose of the sub assembly checks is to insure that the units, still in a reasonably simple form, have been correctly wired and assembled.

Final testing

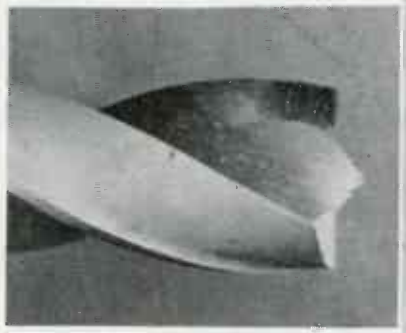
With so much emphasis on component parts and sub assembly testing, trouble in the final check is practically eliminated. Final test is merely a place where the finished product is checked for overall performance. Suitably jigged positions are provided. In certain cases, tests are broken up into single-function tests performed by two or three operators cascaded.

☆ *Radio-Electronic WAR PRODUCTION*

FACTORY SHORT CUTS



↑ AIR at 80 lbs. pressure blowing through upper die of Westinghouse punch press, supports stamped part in stream by pressure-velocity principle. Easy removal doubled output

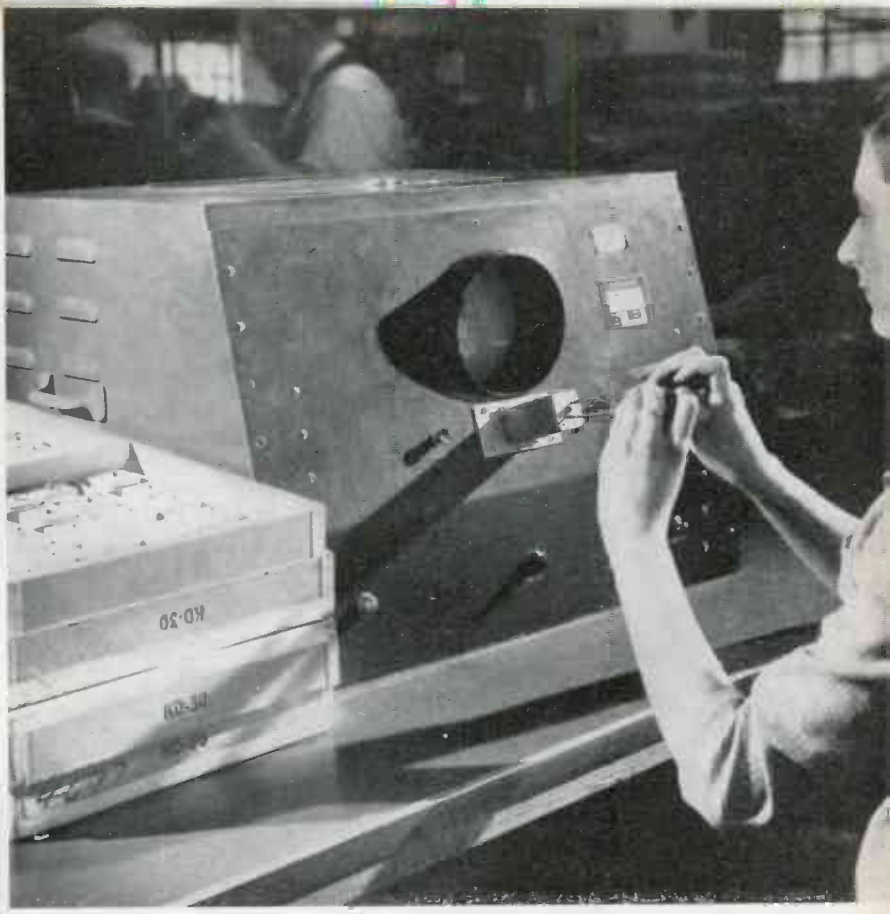


↑ DRILLS ground with this flat spur point cut thin sheet with less burr and improved chip clearance, according to Westinghouse engineers

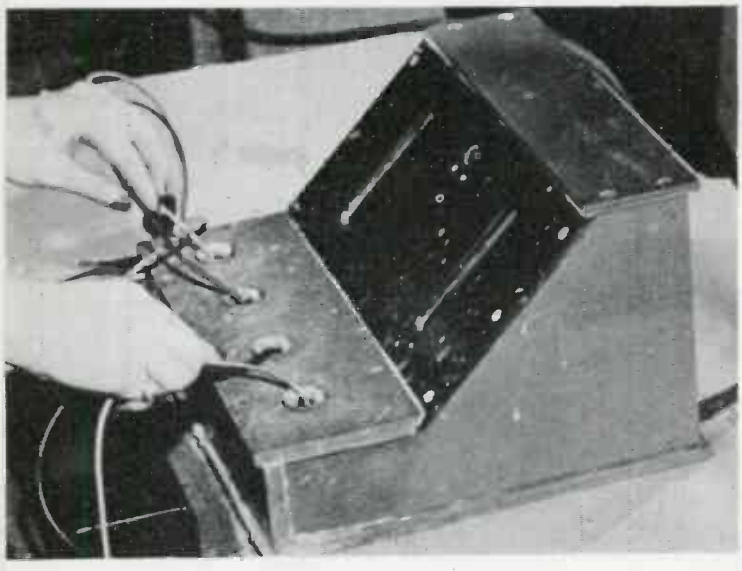
↑ RESISTANCE WELDING gun with knife-edge electrodes speeds production of certain types of electronic tubes in a General Electric plant by "pinching off" metal exhausting tube and welding the end shut. Air-hydraulic operated electrodes of this Progressive Welder Company unit are designed for parallel movement. Gun can swivel through 360°

← TRIAL ASSEMBLY on a limited scale of super light-weight aircraft transmitting-receiving units, preparatory to instituting conveyor belt production lines, in the Specialty Products Division of Western Electric's Kearny, N. J., plant system

↑ BLIND workers' nimble, Braille-trained fingers sort mica sheets in West New York, N. J., plant of the Solar Mfg. Co., to within a few thousandths of an inch. Sheets from .002-.005 in. are accepted; others rejected



↑ I.F. TRANSFORMERS are tuned and checked at this cathode ray oscilloscope in one of the Kearny plants of the Western Electric Company. Correct resonance characteristics are indicated by predetermined curve pattern



← MERCURY or electrolytic salt solution in small wells completes circuits, in short, open, or other testing, and cuts operating costs 30 per cent in a Westinghouse plant. Pools eliminate need for stripping ends of test wires

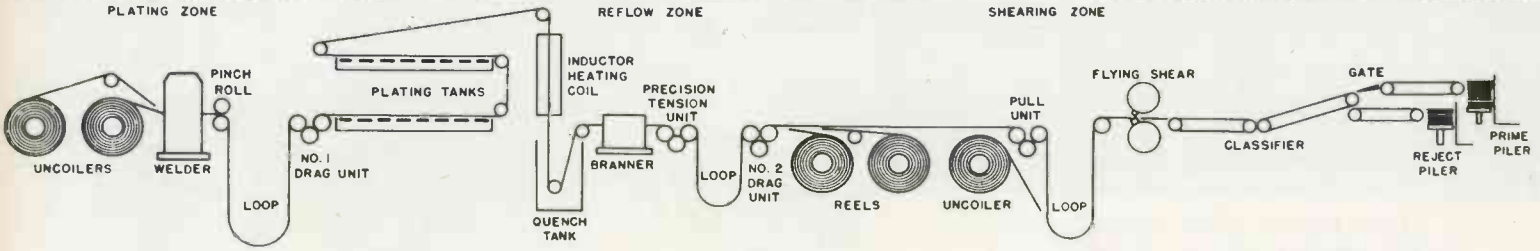
CALIPER for determining wall thickness and relation of cored interior to surface prevents waste of man-hours machining defective castings. New caliper is demonstrated by Stanley Crawford, of RCA's Camden plant ↓

SOLDERING small, delicate parts is facilitated with this Photobell Corp. stand used by General Electric and other manufacturers. The unit consists of a holder for any standard size electric solder iron, hood and chimney to remove fumes, lamps and magnifying glass ↓ in hood to view work while held against solder iron

★ *Radio-Electronic WAR PRODUCTION*

INDUCTION HEATING

Speeds Tin-Plate Output



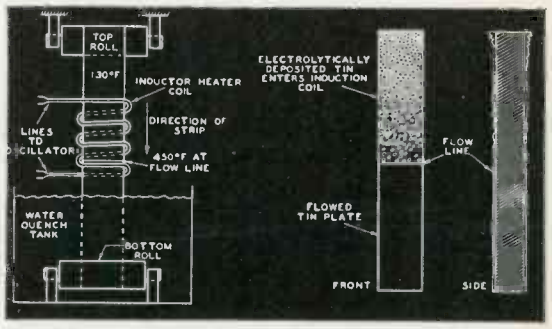
In an electronically controlled method of tin-plate production developed by the Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa., high power induction heating equipment continuously melts the .00003″ electrolytically deposited tin coating into an even, corrosion-resistant surface. Four or five times faster than gas furnaces or hot oil baths, the equipment treats three foot wide steel sheet at speeds up to 650 feet per minute. Design of equipment to handle over 1000 feet per minute is under way.

Since electroplating tin on steel requires one third the amount of tin used in hot-dip methods of coating, vast quantities of this critical material will be saved.

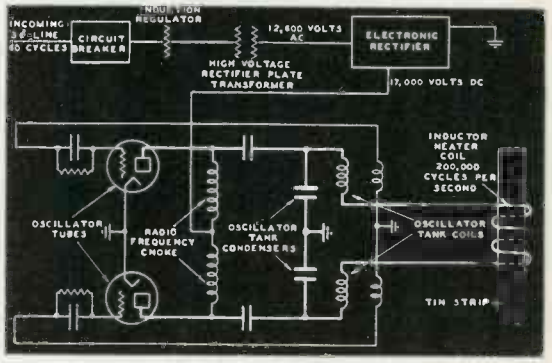
One of 36 100 kw power oscillator tubes

Diagrammed at top of page is a variable speed line with horizontal plating tanks. Horizontal tanks permit tinning the two sides of the sheet to different thicknesses or coating with different kinds of metal. Coils of steel sheet between .005 and .015″ thick, five and a half feet in diameter, and weighing about fifteen tons each, are mounted on the uncoilers at the extreme left. In operation, the uncoiler motor acts as a drag generator. The pinch roll pulls the sheet through to the first loop. The No. 1 drag roll is a belt-driven generator that maintains a constant tension on the sheet as it passes through the electrolytic baths. The .00003″ tin coating is flowed, in the induction heating work coil, the sheet is then cooled in the quench, is oiled and pulled through the branner to remove the excess, then through another drag or tension unit, another pull unit, loop, and the flying shear. Photoelectric controls maintain the loops automatically, at both ends of the line. A pinhole detector and a flying micrometer ahead of the flying shear operate a classification gate after a defective strip has been cut, throwing it to the off-gage piler.

The line must be slowed down to weld on each new coil. All the motor drives and drags must therefore operate in synchronism at all speeds. The driving motors have a flat speed characteristic. Some of them are equipped with IR drop boosters in order not to stall at the extremely low "threading" speed. In addition, an electronic



Work coil "flows" granular tin deposit



Schematic diagram of 200 kc oscillator

regulator is employed to reduce the 60,000 ampere electroplating current in proportion to any speed below the present maximum of 650 feet per minute. Another photoelectric device scans the tinned strip as it passes the heating coil, controlling the induction heating as required by any change in line speed.

The line uses 25 dc motors from one to 125 horsepower and 75 ac motors ranging from one-half to sixty horsepower. The plating unit requires 60,000 amperes at 12 volts, while the power input to the induction heating oscillators is in excess of 1,000 kilowatts at normal speed.

PHASE INVERTER ANALYSIS and DESIGN

by HENRY JACOBOWITZ

Computing output voltage unbalances in the self-balancing phase inverter

While phase inverters are widely recognized as an inexpensive and efficient method of obtaining push-pull operation, there are still certain unbalancing effects, which present a problem to the designer. This paper derives by the analysis of one popular circuit the design procedures to be followed for trouble-free performance.

Equipment of average fidelity is not likely to show up the eventual faults of some phase inverters such as unbalances due to aging of tubes, resistors, inaccurate adjustment etc.—as badly, as high fidelity equipment, nor are the purchasers of low prized apparatus as critical as those of high prized so-called "custom-built" receivers and amplifiers. The difficulty for the designer of high fidelity apparatus partly arises through the impossibility of accurate adjustment of each individual unit in mass production partly through the inherent weaknesses of some circuits. Figure 1 shows one of the most widely used phase inverter circuits.

The resistor R_f is common to both the plate circuit of tube 1 and the plate and grid circuit of tube 2, and as we can readily see, the ac voltage across it depends on the difference between the ac output currents of tube 1 and 2. There is also negative current feedback from resistor R_f to the grid of tube 2. These two factors, the differential action and the degenerative action guarantee very high stability. However due to the feedback in the circuit of tube 2, its output voltage cannot be made equal to the output voltage of tube 1, so that the exciting voltages for the push-pull stage are unbalanced.

The effect of a fixed relative unbalance in the exciting voltages of a push-pull stage is of course a deviation from pure push-pull operation and introduction of even harmonic amplitude distortion. It is also apparent that the unbalance in the load currents of the push-pull stage with its resultant distortion will be directly proportional to the transconductance of the power tubes, so that unfortunately just those tubes best suited for the output stage will be hardest hit by the differential in excitation voltage. The frequent complaints that 2A3's and similar high g_m tubes "do not respond well" to the self-balancing phase inverter point out the desirability of correct design in the inverter stage.

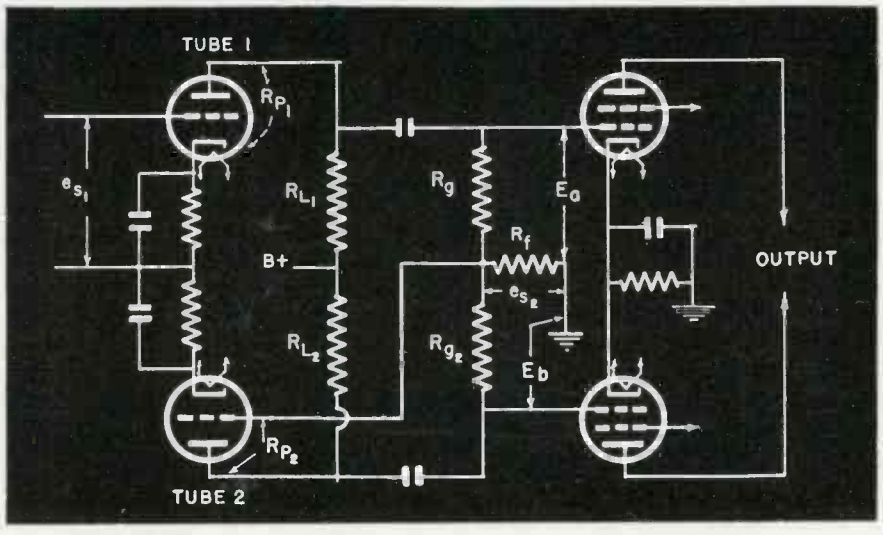


Fig. 1. Circuit for the self-balancing phase inverter

It will be interesting to see just what unbalance in the excitation voltages of the push-pull stage can be tolerated. The following table (Fig. 2) shows the distortion products for various excitation voltage unbalances for a pair of 2A3's operated Class A_1.

The values in the table have been arrived at by applying the 12-ordinate Fourier distortion analysis to the load current curves of the push-pull performance characteristics obtained through Kilgour's well-known sliding rule method. They are meant to indicate the relative effect of unbalancing the exciting voltages rather than to be taken as true values. In practice they are apt to be higher. It appears, that a slight unbalance (10 per cent) of the excitation voltage, while introducing an appreciable 2nd Harmonic, actually decreases the odd harmonics considerably, so that one has the choice in design, which ones he likes better. Larger unbalances (20 per cent) show the even harmonics increasing fast, and the odd ones slowly. The total harmonics seem to increase almost directly with the excitation voltage unbalance, for very large unbalance (over 20 per cent) increasing still faster. One can therefore work backwards from the output stage,—knowing the

Harmonic	*Balanced case*	*10% unbalance*	*20% unbalance*
2nd Harmonic	0	2.03%	3.95%
3rd Harmonic	1.29%	.94%	1.22%
4th Harmonic	0	.20%	.26%
5th Harmonic	.53%	.12%	.16%
Total Harmonic	1.39%	2.25%	4.15%

Fig. 2. Harmonic Distortion for a pair of 2A3's, push-pull Class A_1, Plate voltage = 250 V., Bias = −45 V., Load Resistance = 5,000 Ohms

total allowable harmonic distortion, assuming a likely value of excitation voltage unbalance and checking by graphical analysis, whether the assumed value will be within the allowable distortion limits. The phase inverter stage may then be designed to meet the allowable unbalance in excitation voltage.

Figure 3 shows the equivalent circuit of the self balancing phase inverter the actual circuit of which is presented in Figure 1. All capacities such as input and output tube capacities, coupling condensers, stray capacities etc. have been neglected. This is justified, since the frequency characteristic of a correctly designed resistance coupled stage generally is flat for the band of frequencies one is interested in. Also possible unbalances arising at the extremes of the pass band will be taken care of by slightly overdesigning the values for the middle frequencies.

The equations of the network are:

$$-\mu_1 e_{s1} = I_1(R_{p1} + R_{L1}) - I_2 R_{L1} \quad (1)$$

$$0 = -I_1 R_{L1} + I_2(R_{L1} + R_{g1} + R_f) + I_4 R_f \quad (2)$$

$$-\mu_2 e_{s2} = I_3(R_{p2} + R_{L2}) - I_4 R_{L2} \quad (3)$$

$$0 = I_2 R_f - I_3 R_{L2} + I_4(R_{L2} + R_f + R_{g2}) \quad (4)$$

$$e_{s2} = I_2 R_f + I_4 R_f = R_f(I_2 + I_4) \quad (5)$$

where: μ_1, μ_2 and R_{p1}, R_{p2} are the amplification factor and plate resistance of tube 1 and tube 2 respectively.

Substituting (5) for e_{s2} in (3) and rearranging, we obtain

$$0 = I_2\mu_2 R_f + I_3(R_{p2} + R_{L2}) + I_4(\mu_2 R_f - R_{L2}) \quad (5a)$$

The general expression for any mesh current

$$I_k = \sum_{y=1}^{y=n} E_y \frac{M_{yk}}{D} (-1)^{y+k} \quad (6)$$

where

y = any row; k = any column
M_{yk} = the minor of the y-row and k-column
D = the "denominator" of the determinant common to all mesh currents.

For the determination of the output voltages E_a and E_b we are only interested in the mesh currents I_2 and I_4

$$\text{from (6)} \quad I_2 = \sum_{y=1}^{y=4} E_y \frac{M_{y2}}{D} (-1)^{y+2} \quad (7)$$

$$\text{and} \quad I_4 = \sum_{y=1}^{y=4} E_y \frac{M_{y4}}{D} (-1)^{y+4} \quad (8)$$

written in determinant form:

$$D = \begin{vmatrix} (R_{p1} + R_{L1}) & -R_{L1} & 0 & 0 \\ -R_{L1} & (R_{L1} + R_{g1} + R_f) & \mu_2 R_f & R_f \\ 0 & \mu_2 R_f & (R_{p2} + R_{L2}) & (\mu_2 R_f - R_{L2}) \\ 0 & R_f & -R_{L2} & (R_{L2} + R_f + R_{g2}) \end{vmatrix} \quad (9)$$

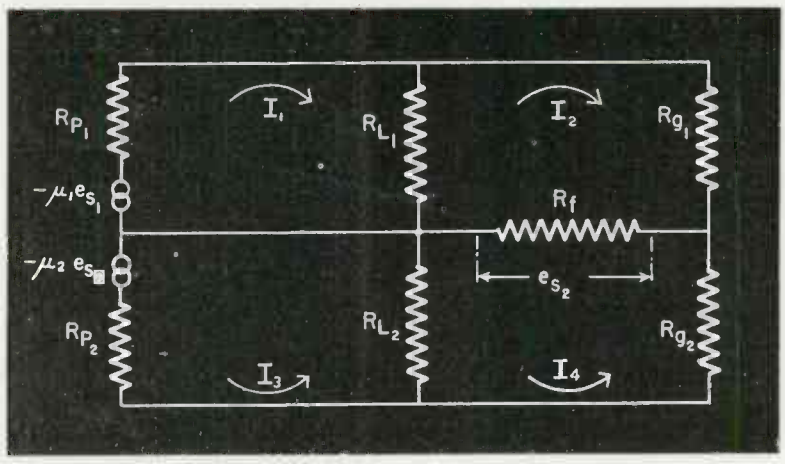


Fig. 3. Equivalent circuit of phase inverter shown in Fig. 1

$$I_2 = \frac{\begin{vmatrix} (R_{p1} + R_{L1}) & -\mu_1 e_{s1} & 0 & 0 \\ -R_{L1} & 0 & 0 & R_f \\ 0 & 0 & (R_{p2} + R_{L2}) & (\mu_2 R_f - R_{L2}) \\ 0 & 0 & -R_{L2} & (R_{L2} + R_f + R_{g2}) \end{vmatrix}}{D} \quad (10)$$

$$I_4 = \frac{\begin{vmatrix} (R_{p1} + R_{L1}) & -R_{L1} & 0 & -\mu_1 e_{s1} \\ -R_{L1} & (R_{L1} + R_{g1} + R_f) & 0 & 0 \\ 0 & \mu_2 R_f & (R_{p2} + R_{L2}) & 0 \\ 0 & R_f & -R_{L2} & 0 \end{vmatrix}}{D} \quad (11)$$

$$\text{from (7)} : I_2 = \mu_1 e_{s1} \frac{M_{12}}{D} (-1)^{1+2} \quad (12)$$

$$\text{from (8)} : I_4 = \mu_1 e_{s1} \frac{M_{12}}{D} (-1)^{1+4} \quad (13)$$

Evaluating the minors "M_{12}" and "M_{14}", we obtain

$$I_2 = -\mu_1 e_{s1} R_{L1}(R_{L2} R_{p2} + R_{p2} R_f + R_{p2} R_{g2} + R_{L2} R_f + \mu_2 R_{L2} R_f + R_{L2} R_{g2})/D \quad (14)$$

$$I_4 = \mu_1 e_{s1} R_f R_{L1} [R_{L2}(1 + \mu_2) + R_{p2}]/D \quad (15)$$

From Kirchhoff's laws (see Figure 3)

$$E_a = I_2 R_{g1} + e_{s2} = I_2 R_{g1} + R_f(I_2 + I_4) \quad (16)$$

$$E_b = I_4 R_{g2} + e_{s2} = I_4 R_{g2} + R_f(I_2 + I_4) \quad (17)$$

When the output voltage ratio $\left|\frac{E_a}{E_b}\right|$ is taken, we can readily see, that all the "D's", the "denominators", of the currents I_2 and I_4 will cancel out, and therefore do not have to be evaluated.

The deviation of the output voltage ratio from unity represents the relative unbalance, i.e.

$$U = \left|\frac{E_a}{E_b}\right| - 1 \quad (18)$$

Solving equations (16) and (17) we derive the complete general expression for the unbalance;

$$U = \{[(R_{g1} + R_f)(R_{p2} R_{L2} + R_{p2} R_{g2} + R_{L2} R_{g2}) + R_{g1} R_f(R_{p2} + R_{L2} + \mu_2 R_{L2})] \div R_f R_{L2}(\mu_2 R_{g2} - R_{p2})\} - 1 \quad (19)$$

This expression accounts for all possible unbalances in the circuit, such as maximum unbalance due to tolerance of resistors, variations in parts and in the amplification actor of tubes due to aging. However it is not practical for the most common case of identical tube types and component parts. We shall try to simplify (19), so that it may be used as a design formula. For the case of symmetrical operation:

$\mu_1 = \mu_2 = \mu$; $R_{p1} = R_{p2} = R_p$; $R_{L1} = R_{L2} = R_L$; $R_{g1} = R_{g2} = R_g$ and (19) reduces to:

$$U = \frac{2R_f + R_g}{R_f R_L(\mu R_g - R_p)}(R_p R_L + R_g R_p + R_g R_L) \quad (20)$$

or in terms of gm:

$$U = \frac{2R_f + R_g}{R_f R_L(G_m R_g - 1)}\left(R_L + R_g + \frac{R_g R_L}{R_p}\right) \quad (20)$$

if $G_m R_g >> 1$, then

$$U \cong \frac{2R_f + R_g}{G_m R_g R_f R_L}\left(R_L + R_g + \frac{R_g R_L}{R_p}\right) \quad (21)$$

From these expressions it is apparent that the unbalance is smaller for high G_m tubes in the phase inverter stage and high values of R_f. Since the values of $G_m = \mu/R_p$, R_L and R_g are fixed by gain and fidelity considerations for the resistance coupled stage, the only remaining variable after choosing the tube is R_f, which is then used as controlling

factor. Solving for R_f in (21) we derive

$$R_f = R_g \div \left[\frac{U R_L R_p (G_m R_g - 1)}{(R_p R_L + R_g R_p + R_g R_L)} - 2 \right] \quad (22)$$

When the unbalance is plotted as a function of R_f, for a chosen setup, the curve approaches a definite minimum value asymptotically, as R_f approaches infinity. This value is approximately

$$U_{min} = \frac{2}{a_1} \quad (23)$$

where

a_1 = the normal stage gain neglecting R_f

$$a_1 = \frac{\mu R_L R_g}{R_p R_g + R_L R_g + R_p R_L} \quad (24)$$

The gain of tube 1 is approximately equal to (24) for all values of R_f, while the gain of tube 2

$$a_2 = \frac{a_1}{1 + U} \quad (25)$$

and becomes very nearly equal to a_1 as R_f is increased and "U" is made small. In choosing the tube, the value of $2/\mu$ may be used as a guide to determine its suitability for balanced phase inverter service. As an example a 6N7 tube has been chosen, and the value of "U" has been calculated for a wide range of R_f. The constants of the tube are:

R_p = 11,000 Ohms; g_m = 3,200 micromohos; μ = 35

Plate load and grid coupling resistors have been made equal: $R_g = R_L$ = .25 megohm. The gain of the stage is about 32 and it is seen from the graph, that "U" approaches 2/32 or 6.25% as R_f is made large. R_f should be made larger or equal to about .2 megohm (U=10%), since below this value the unbalance increases very fast.

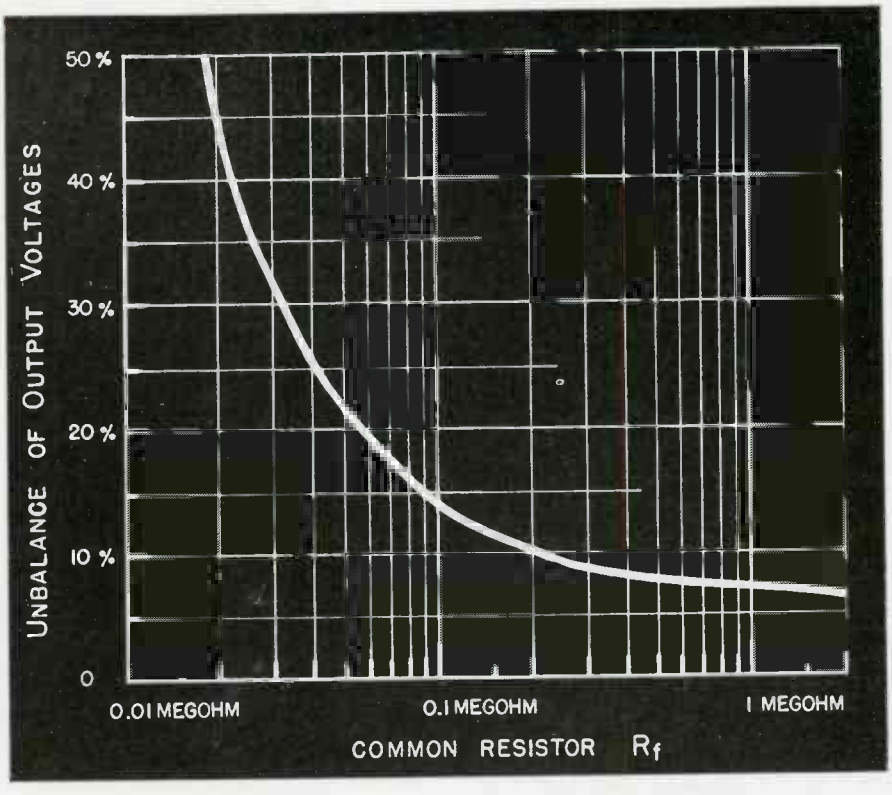


Fig. 4. Unbalance as a function of the common resistor for 6N7 tube

Fly Visions Radio Future; Lauds Jett, Wheeler

A prediction that in the post-war period the United States will become the world's principal supplier of radio equipment and that American radio engineers and manufacturers should be thinking of these potentialities, was made by FCC-BWC Chairman James Lawrence Fly in his address, Nov. 9, before the IRE-RMA meeting at Rochester, N. Y.

Mr. Fly paid high tribute to FCC Chief Engineer Ewell K. Jett whom he characterized as "a man of effective personality and untiring devotion to duty." He stated that Mr. Jett has been of great assistance in the Commission's problems of administration and is "the spark plug of the Board of War Communications." He said that "search as you may through Government, the Army and the Navy and the industry you cannot find another man of such broad competence in the field of world communications." He urged the radio industry to work with Mr. Jett.

Chairman Fly also complimented the I.R.E. for the election of Dr. L. P. Wheeler, FCC Technical Information Division Chief, as its 1943 president. Dr. Wheeler, he said, had brought the Commission his experience from teaching at Yale and from research work with the Navy's laboratories and has a notable background in electronics. He related how Dr. Wheeler, while with the Navy, had conducted electronics research over long periods inside a submarine as it lay on the bottom in Hawaiian waters.

Conventions and Meetings Ahead

American Society of Mechanical Engineers (Ernest Hartford, 29 West 39th Street, New York), Nov. 30-Dec. 4, Astor Hotel, New York.

National Association of Manufacturers (G. G. Geddis, 14 West 49th Street, New York), Nov. 30-Dec. 4, Waldorf-Astoria Hotel, New York.

Institute of Radio Engineers (H. P. Westman, 330 West 42nd Street, New York), Dec. 2, 29 West 39th Street, New York.

American Welding Society (M. M. Kelly, 29 West 39th Street, New York), Dec. 8, 29 West 39th Street, New York.

American Standards Association (P. G. Agnew, 29 West 39th Street, New York), Dec. 11, Hotel Astor, New York.

American Physical Society, Dec. 28-31, New York.

American Association for the Advancement of Science (27 Washington Square, New York), Dec. 28-Jan. 2, New York.

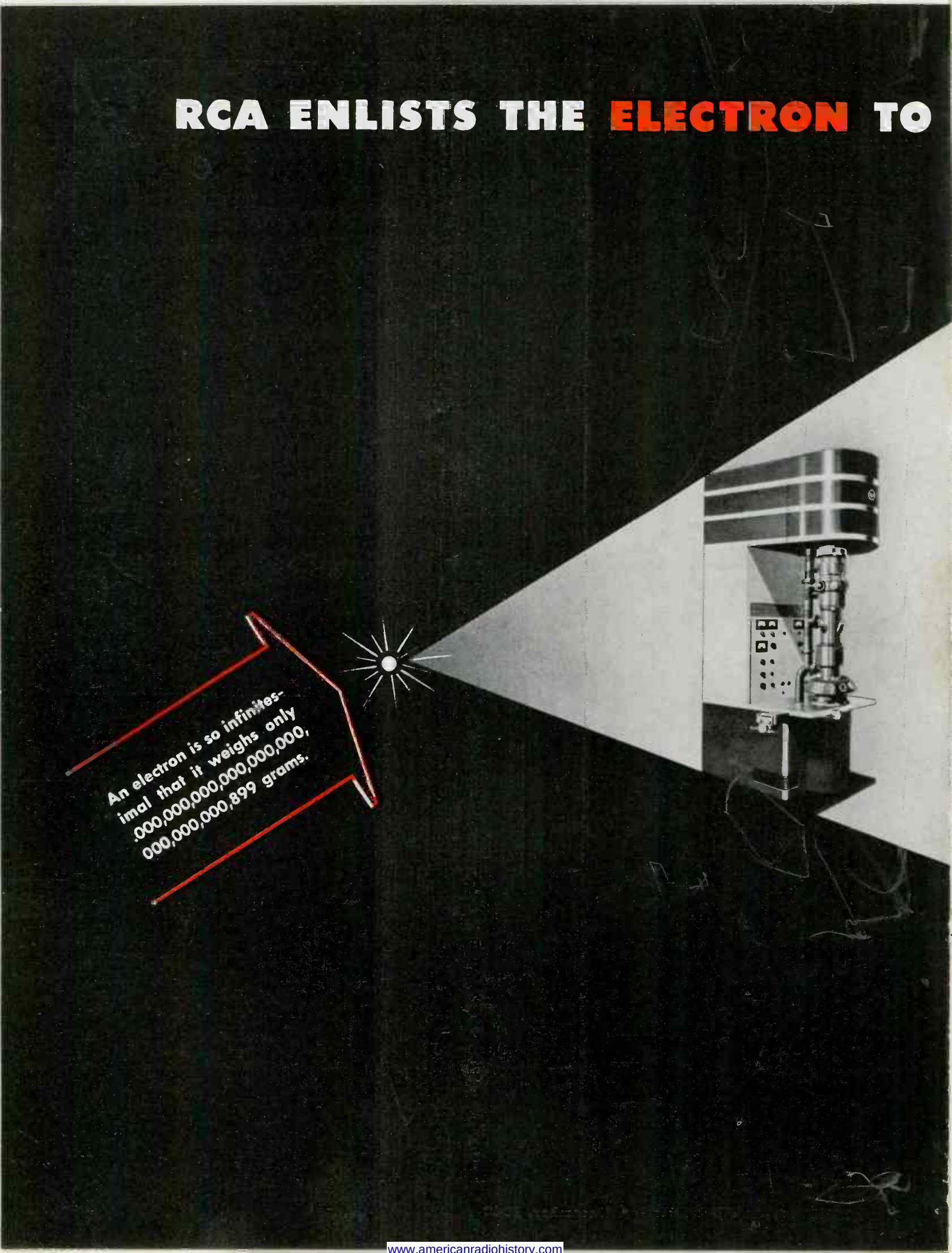
American Institute of Electrical Engineers, Electronics Conference, (H. H. Henline, 29 West 39th Street, New York), Jan. 25-29, New York.

Electrochemical Society (Colin G. Fink, Columbia University, New York), April 7-10, Hotel Roosevelt, Pittsburgh, Pa.

American Chemical Society (Alden H. Emery, 1155 Sixteenth Street, N.W., Washington), April 12-16, Indianapolis, Ind.

Acoustical Society of America (Wallace Waterfall, 120 South LaSalle Street, Chicago), May, 1943, New York.

RCA ENLISTS THE ELECTRON TO



OPEN NEW DOORS OF RESEARCH!

An example of how RCA electronic research is leading to new progress in science and industry

The RCA Electron Microscope is one of the hundreds of practical tools for progress that RCA electronic research has developed. Using electrons instead of rays of light, and electro-magnetic fields instead of lenses, the RCA Electron Microscope enables man to peer deeper into the hidden, sub-microscopic world than ever seemed possible before. Magnification as high as 100,000 diameters can be easily obtained—*fifty times* greater than is possible with the best optical oil-immersion microscope.

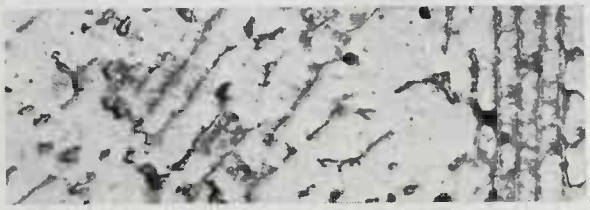
For industry it has meant closer insight into many processes, a better understanding of the methods for making, treating, and preserving materials.

For chemistry it has meant the opportunity to study, for the first time, details of molecular design and structure, so that there can be a continued advance in the creation of such products as nylon, rayon, synthetic rubber, and plastics.

For medical science it will mean the opportunity to observe, for the first time, how the body fights bacterial and virus diseases—such as infantile paralysis, smallpox, influenza, the common cold and many others.

For all America—and when peace returns, for all the world,—this product of RCA electronic research will lead the way to a richer and fuller life.

Micrograph showing Vinylite in one of its many stages of polymerization. The study of plastics is aided by the RCA Electron Microscope, which enables observation of the polymerization process, typical of the plastics.



Micrograph of Pearlite steel, a carbon steel formed by controlled annealing. By using very thin replicas of the surface, the structure of practically all metals can be studied with the RCA Electron Microscope.

Tobacco mosaic virus, seen for the first time by the human eye through the RCA Electron Microscope. The virus represents a large protein molecule, very injurious to tobacco. These observations may lead to the development of an anti-virus serum or antibody.

Micrograph of staphylococcus bacteria,—pus producing organisms which can attack any part of the body and cause painful and dangerous infections. The RCA Electron Microscope enables scientists to observe their actual structure, thus leading to important work in protecting man against this bacteria.

RCA

RCA LEADS THE WAY

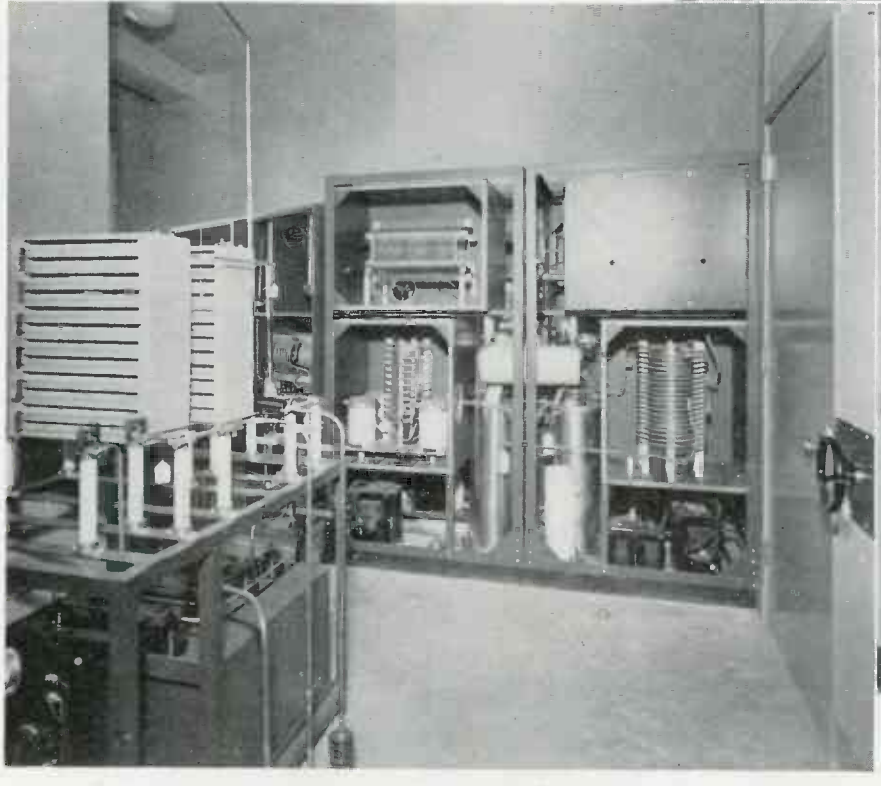
IN RADIO — IN ELECTRONICS — IN TELEVISION

RCA Manufacturing Co., Inc., Camden, N. J.

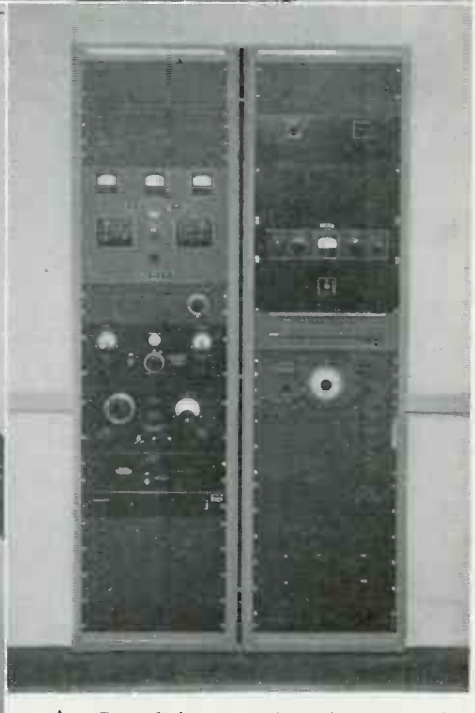
Newest in 50 KW

↑ Transmitter building with main tower in the right background. Another tower (not shown) is at left of the building

Control desk. The desk contains a set of control switches and indicating lamps in duplicate to those on the transmitter →



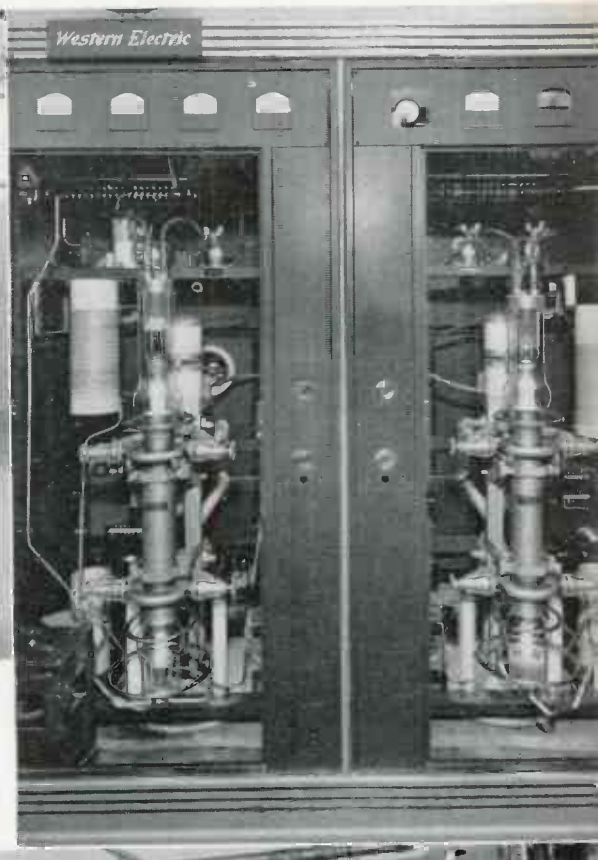
↑ Final amplifier, showing coil compartments and gas-filled tuning condensers in center of picture. On the left is the high-voltage filter-condenser assembly



↑ Speech-input test equipment racks. The rack at the left contains a phase monitor for checking the directional antenna, a General Radio modulation monitor, and noise and distortion measuring equipment. At right, monitoring amplifier

Transmitters—WLAC, Nashville, Tenn.

↑ The high-voltage transformers for plate supply of final amplifier in the basement of the transmitter house



Doherty final amplifier. Tube on left is peak tube, tube on right is the → carrier tube. The output of the amplifier feeding the antenna system, is 50 kw

↑ Pump room in the basement. Picture shows the water-cooling equipment for some of the larger tubes on floor above

← In the background are the bias rectifiers. The high-voltage rectifiers are on left

Calculating Charging Time in RC CIRCUITS

by EDISON WILLIAMS

A graphical calculator for determining voltages in grid circuits with suddenly applied potentials, and selecting coupling condensers and resistors

The wide use of the condenser-resistor type of coupling between stages of amplification is due to its simplicity, low cost and good performance.

The performance of audio amplifiers and similar low and medium frequency circuits has been long compared on an amplitude gain vs. frequency basis. These tests of "flatness" of response do not always indicate the presence of other distortion, particularly phase distortion.

The complex wave which distinguishes the sound of a violin from a piano consists of a fundamental and its harmonics. Each instrument produces its particular group of harmonics and their particular phase relation with the fundamental.

If the amplifier reproduces the harmonics in their correct amplitude relation with the fundamental, it may not maintain the proper phase relations.

Effect of R-C coupling

The coupling condenser and grid circuit resistor of the amplifier cause a phase shift of the components of a complex wave. The steep wave front signals of the so-called square wave type are not reproduced with their original wave shape if phase distortion occurs in the amplifier.

The coupling condenser and grid circuit resistor have a charging time which makes it impossible for a suddenly applied voltage to appear across the grid resistor at the same amplitude the instant the voltage is applied to the circuit. This fact is due to the action of the condenser which begins to charge the moment the voltage is applied. The charging current flowing through the grid resistor produces the voltage applied to the grid-cathode circuit of the tube.

The voltage across the condenser at any time t is given by: $ec = E\left(1 - \epsilon^{\frac{-t}{RC}}\right)$ (1) The voltage across the resistor is E — ec = e_R. E is the suddenly applied voltage such as a square wave.

Voltage relationships

Several relations between t and the product R (ohms) × C (farads) are common. If t = RC seconds, then ec = 63. 2 per cent of E. If t = 69.3 per cent of RC seconds, then e_c = .5E, or the voltage across the condenser or the resistor will reach 50 per cent of the applied voltage on 0.693 × RC seconds. For a 1 megohm resistor and 1 micro-farad condenser the time will be 0.693 x 1 x 10^6 x 1 x 10^{-6} = .693 seconds.

These and similar relations can be plotted against the percentage of E that will appear across either the capacitor or the resistor, and they are shown in the accompanying calculator chart.

This calculator can be used to figure the voltage across either the resistor or the condenser at an instant of time.

Using the calculator

For example, consider a 0.01 mfd. coupling condenser in series with a 1 meg grid resistor. A 60-cycle square wave of 10 volts is fed into the amplifier. The voltage impressed between grid and cathode (the voltage across Rg) at the instant (t = 0) the voltage is applied will be 10 volts as the voltage across the condenser is 0. These values can be read from the calculator at t = 0. As the condenser begins to charge, the voltage across R decreases because the current flowing in the circuit is decreasing. The half-cycle of the square wave lasts for 1/120 second. During this time the condenser voltage will increase from 0 to 5.73 volts, and the voltage across R will decrease from 10 to 4.27 volts.

Exponent of ϵ

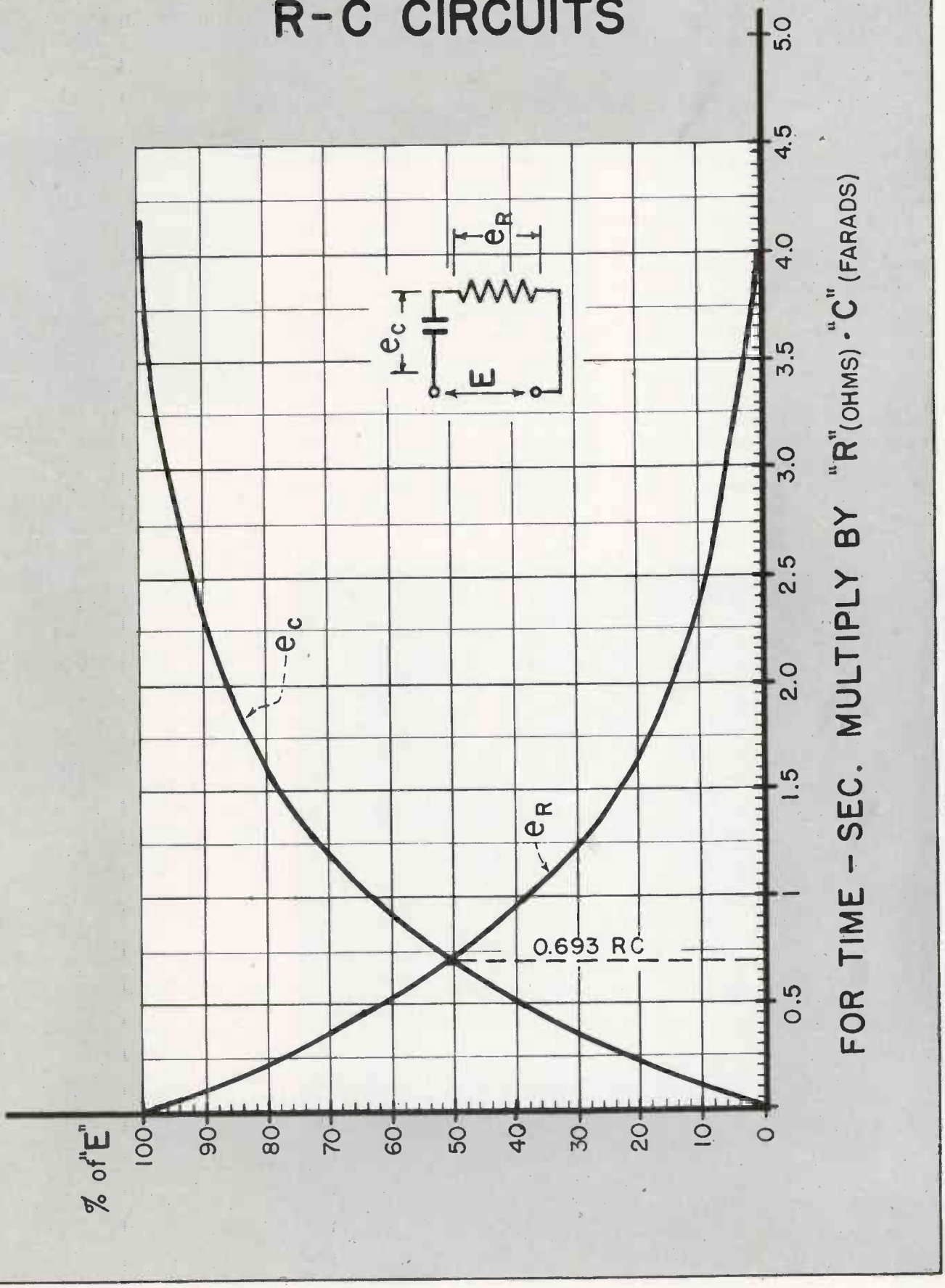
These values can be obtained from the calculator in the following manner. Multiply R ohms x C farads = 1 x 10^6 x 0.01 10^{-6} = 0.01. Since the scale along the bottom of the chart gives the time in seconds when multiplied by RC, t/RC = the number to be located on this scale. 1/120 = 0.00833. 0.00833/ .01 = 0.833. This number is the exponent of ϵ in equation 1. Reading directly off the curves, vertically above 0.833, ec = 57.3 per cent of E and e_R = 42.7 per cent of E.

Finding R-C values

Another problem might be to select a value of resistance and capacity which would give not less than 95 per cent of the applied voltage across R at the end of 1/60 sec. (a 30-cycle square wave.)

Find the intersection of the 95 per cent value with the e_R curve and read the number N directly below this point on the axis. The number is 0.0460. This is t/RC or RC = 1/60 sec/.0460 = 0.363. If R is to be 1 megohm, C should be 0.363 mfd.

VOLTAGE VS. TIME IN R-C CIRCUITS



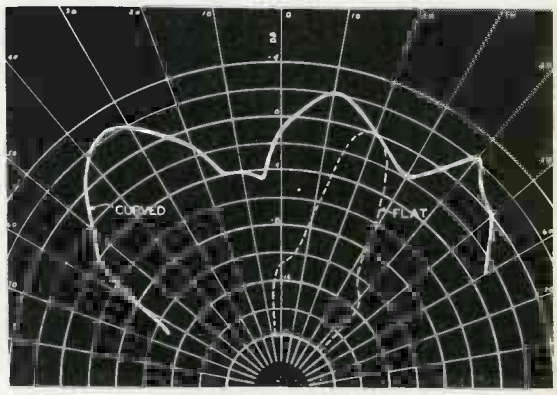
WSPD'S NEW STUDIOS

Revolutionary acoustic design makes possible "live studios" without excessive reverberation. Cylindrical panel surfaces. How panels are constructed

Apparently we have at last found a practical solution of the problem of properly dispersing sound in a broadcasting studio, to obtain, in some degree, the desirable effect of "out-of-doors" quality of sound radiation. The old practice of padding walls with acoustic material (for the purpose of deadening sound and destroying reverberation) has long been recognized by many engineers as impractical and unsatisfactory, yet very little constructive thought or effort has been expended toward making any radical change in wall or interior design that would produce an improvement.

Sound of any kind produced or introduced into any sort of a chamber, large or small, delivers the unwanted ill effects of confined resonance, which designers of broadcasting studios have looked upon as a drawback.

If we can forget for a while some of our "standard practice" customs and go back to fundamental examples, we shall find, for instance, that the human head, which likewise is a chamber, is a good example to start with. Here, the vibrations created at the larynx, after being amplified within the head and mouth, deliver an output of sound at the mouth opening which in no way is associated with the dreaded ills of "confined resonance". Instead, the sounds delivered possess all the beauty, fulness, and clarity of acoustical excellence. The walls of the mouth are resilient, soft cartilages, shaped into channels and cavities, and combined with the skull and teeth, from all of which we receive a combination of sound components, all functioning 100 per cent and in perfect co-ordination. Of course, in sound apparatus we cannot follow the structural scheme of the mouth, but we certainly can learn something of importance here which will help in the solution of acoustical problems.



▲ **Polar distribution characteristics of reflected waves for convex and flat panels**

No padding used

There are no straight lines inside the mouth but there are curves and cavities, and no corners. There are teeth and bone for brilliance of tone. There is no attempt at "padding". Hence in the design of the interior of a broadcasting studio it would seem proper to utilize the value of curved surfaces and the complexities of parabolic reflex and convex structures on the walls of the room,

← **One of the main studios showing use of special cylindrical panels on walls and ceiling**

at Toledo

using hard surfaces instead of deadening ones, in order to sustain the true dimensions of the sound. In this way we should retain the values of adequate,—yet not too much—reverberation, without incurring objectionable echoes. Reverberation should be controlled by proper radiation instead of by absorption, because the manner in which these after-sounds are controlled, distributed and dispersed has more to do with the acoustical excellence of a studio than the actual time of sound decay which most engineers worry so much about.

It is a well known law of physics that when sound strikes a wall a part of its energy will be absorbed, a part transmitted and the remainder of the energy reflected throughout the room. The absorption co-efficient of a wall material depends upon three factors, namely: the **nature** of the material itself; the **frequency** of the sound, and the **angle** at which the sound wave strikes the surface of the material. The objective is to control these three basic factors. The material, if padding or drapes are used will have the effect of absorption or deadening, whereas the use of hard, flat walls will cause a sharp increase of reverberation. The results of either of these are not desired. But "changing the angle" of the surface to a properly curved convex form and size, will cause the greater portion of the wave energy to be diffused at ideal decay proportions throughout the studio, with a minimum of reverberation.

Absorption energy losses

Practically all sound-absorbing materials are highly porous and owe whatever efficiency they possess to this fact. The air is set into vibratory motion by the incident sound waves, and the friction of this motion against the walls of the pores, generates heat. Thus a fraction of the total energy of the incident sound wave is sacrificed into useless heat energy. By changing the walls from flat to elongated, convex-curved panels, and from soft, porous substances to hard and polished surfaces the wave energy striking such a wall of changeable curved lines, instead of being absorbed or changed into heat energy is diffused into properly graduated energy uniformly covering the wide area of the studio.

It is common procedure for sound enginers to take measurements of reverberation only up to about 5000 cycles. Above this limit, measurements have been difficult to obtain. Experience, however has proved that in order to determine the quality of a studio the frequencies above 5000 cps. must be seriously considered and dealt with.

With the new system of curved hard walls the upper harmonics of musical instruments are not attenuated to the extent of making each instrument sound unnatural, thus enabling presentation of various instruments with realism.

Polycylindrical panels

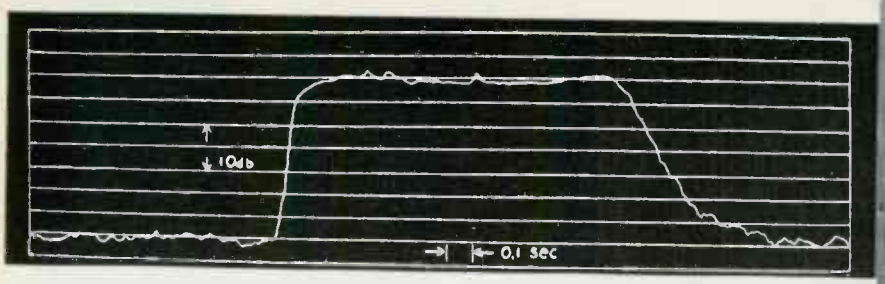
The nearest approach to the perfect broadcasting studio and one of the pioneers in this new and revolutionary system of sound dispersion and control, is the recent installation of "polycylindrical panels" placed on the walls in the five modern studios in Station WSPD located in their own building in downtown Toledo.

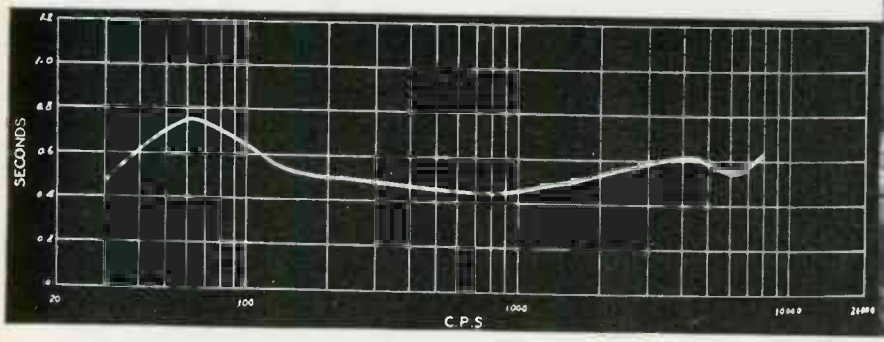
The installation consists of a series of convex wood panels of

End view of studio, with control room in the background. The backwall shows clearly the curved convex panels of different sizes, which disperse the sound. Note also shelf-enclosed microphone, which is non-directional, and is held at a convenient distance from speakers

Above—View of controlroom. Recording and playback turntables in foreground, the control desk in the back

Below—Close-up view of control desk. Monitor speaker is mounted above. Note the convenient layout and broad view of the studio





At top—Growth and decay curve of vibrating convex panel. Below—Reverberation time in studio

Construction of convex panels. Plywood sheet on the left is just in process of being bent

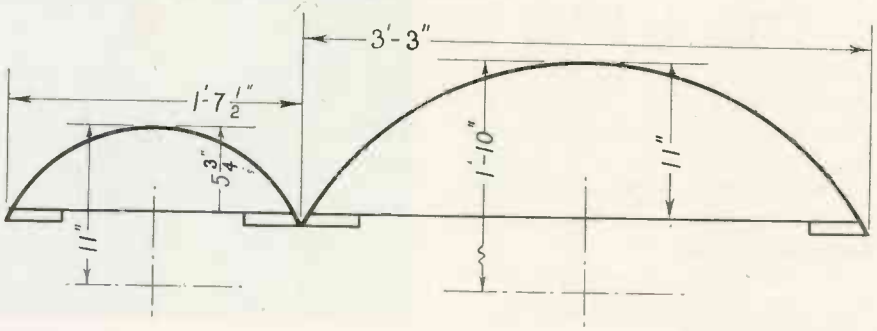
three definite sizes and curvatures. Because these groups of panels are of different sizes and curvatures and are placed in different planes, the panel resonance frequencies are not selective and each panel has a decay time of its own. The diffusion of sound and distribution of energy coming from so many random directions, and from many small convex sources of sound in the room gives both a uniform distribution and decay but also a marked degree of body or depth to the sounds. The energy incident on the surface of the convex panels which is not absorbed is re-radiated and due to curved panel vibration is dispersed over a wide angle. This kind of sound diffusion does not lessen the total energy radiated, but rather, it increases the number of reflections per unit time and lessens the intensity level of each individual reflection. These small increments of energy and random phases of diffused sound produce a smoother decay with an absence of echoes.

Reinforcement by resonance

This type of convex panelling disperses sound energy not only by reflection from its curved surfaces but also by radiation due to its resonance action. Dispersion by reflection depends on the size and curvature of the panel and its relation to the wave length. The resonance frequencies and response of a panel depend upon several factors such as the damping co-efficient of the material used, its thickness and surface, spacing of braces and the way it is made. The decay time of a typical panel is shown in accompanying drawing.

Wherever possible the size of WSPD studio rooms was made to conform to the established rules of unit ratio—ceiling height, two; width, three; and length, five. In a couple of the studios, however this type of arrangement has been modified slightly and in some cases to the betterment of acoustic results. The ceilings are acoustically treated and the flooring arrangements are altered as required by individual broadcasting,—such as the use of rugs or the omission of them on the lineoleum-covered floor. The two sizes of panels are formed over curved segment braces, the large arc straddling a distance of 3 ft.-3 in. and 11 in. in the middle, made from a circle with a radius of 1 ft.-10 in. The smaller arc reaches 1 ft. 7½ in. across and 5 ¾ in. high in center, made from radii of 11 in. These segment braces are placed at random. The space between the upright studding is filled with insulation pads of fibre glass. The material used for the curved reflectors is plywood and masonite of suitable thickness to withstand the bend and remain stable.

Dimensions of the two curved surfaces of panels



Practical experience

Without exception, visiting orchestras, singers, pianists and other radio entertainers who have used these new WSPD studios are unanimous in their praise of the way in which their renditions sound to them. They call attention also to the pleasing reinforcement of har-

(*Continued on page 99*)

When ENGINEER is MANAGER

by J. ALBERT STOBBE
Electronic Consultant, 63 Wall St., New York

A check-up on the many things the executive must keep thinking about, if the business is to go ahead

The present national emergency has required the production of large quantities of what should be called scientific electronic instruments. The mass producers and the specialists are now combining their respective talents to accomplish the immediate objective. Vast sums of money have been poured into the undertaking of reconstituting our existing cost-minded production organizations as quantity manufacturers of precision devices.

Sound policies forgotten

During this phase many of the ordinary landmarks and guide posts of sound management have been temporarily abandoned. However, we are now at the turning point where the industry, in order to fulfill its obligation, must recognize that it has a duty to produce the best that it can, as quickly and at as low a cost as is possible.

In addition, with the certain recognition of the electronic method bound to result from the intensive development work of this emergency period, the dependence of industry in general and the public at large on our ability to produce efficiently and economically that which will be required, necessitates careful scrutiny of management's obligation.

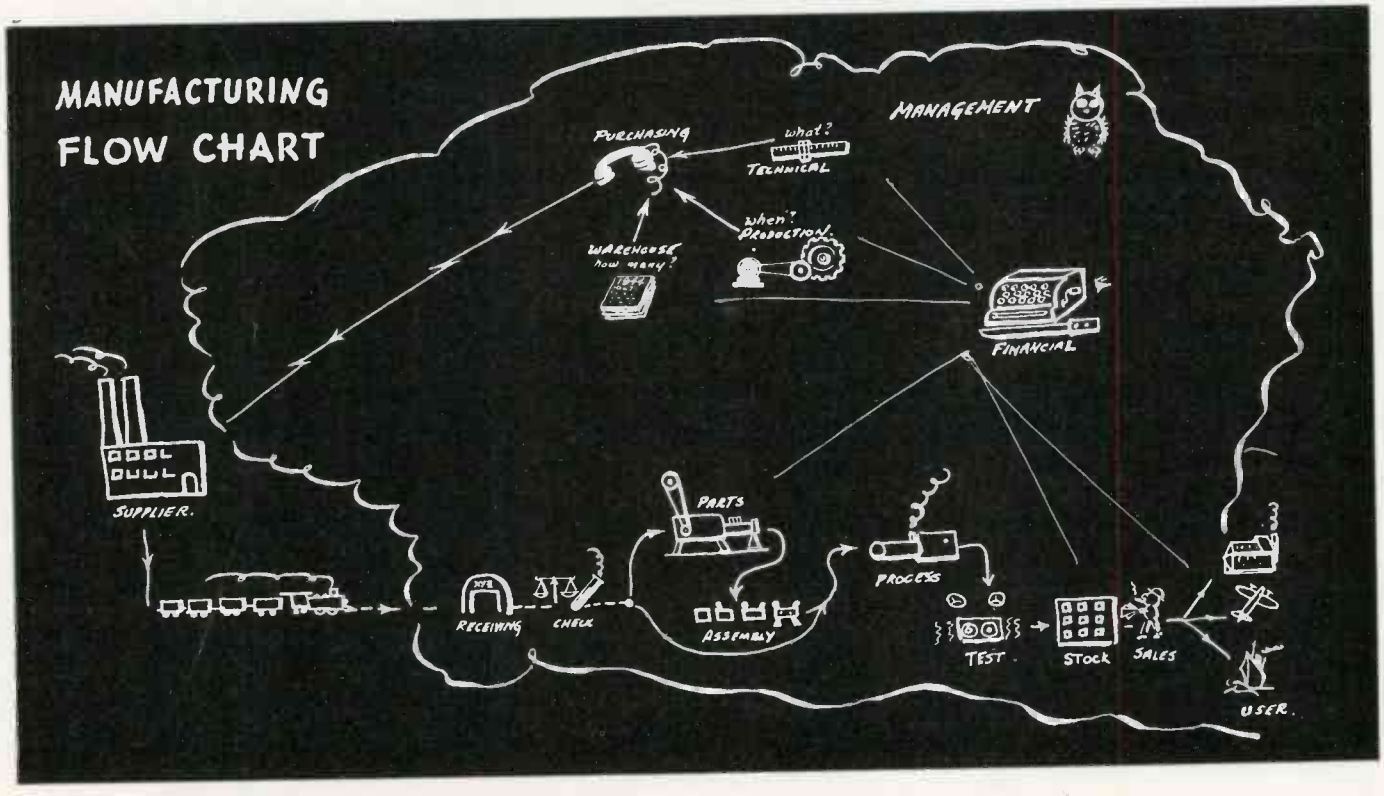
With this in mind a check list has been prepared against which the factory executive engaged in electronic manufacturing can quickly measure how well he is doing and how he has prepared himself and his organization to meet changing conditions.

Problem of people

Personnel organization, of course, is the primary consideration whether the group is large or small. It is necessary that confidence, loyalty and a feeling of participation should exist generally throughout. Whether each subdivided section of the organization contains several persons, or whether a number of functions are combined in one person, it is necessary that each separate requirement be fulfilled.

Research normally should be free to work on new problems, whether new in the sense of leading to a future product or new in the sense of solving an existing deep rooted difficulty. The person responsible for this work should have sound technical training and the ability to conceive and execute original ideas.

The development classification normally includes the technical and cost improvement of existing products. The general production organization should include not only people skilled in actually manufacturing the product, but also group leaders and foremen who have a basic conception of the industry and its problems. Often it is wise



to provide coordinators who are familiar with both the production and engineering aspects of the product involved.

Coordinating factor

It must be observed that the person responsible for the general direction of each section of the factory organization should have a mutually confidential relationship with the selling and policy-making members of the company. Above all the ability to work and think together and to solve each problem on a community basis should be the guiding thought throughout the entire enterprise. By measuring a present or future organization by these few simple tests, an excellent conception of its strong points or deficiencies can be obtained.

Equipment should be available in proportion to budgetary allowances It is of utmost importance not to allow pressed exigencies to distort the long-range viewpoint in this regard. Expecting change in methods, it may be wise in one case to get along on what is presently available, plus a little patching here and there. In another case, even though the scrapping of presently usable machinery is involved, it may be wise to embark on a program of building new high-speed production equipment.

Study special conditions

Each organization must measure its equipment position after a careful determination of present and projected future conditions. It is obvious that expenditures for scientific and measurement equipment for use in research work on new products or development work on existing products must be provided. The only real question is how much the budget should provide.

An analysis of the product or products currently being manufactured should be made periodically with a view to improving or supplementing the line. Its necessity, its suitability to the market and possible profit margins should be thoroughly studied as a regular duty of the organization's keymen. The responsibility for seeing that this reviewing and planning is done periodically may be placed on one person or a committee, but this cen-

CHECK LIST for GEN'L MANAGERS of ELECTRONIC BUSINESSES

Ask yourself these questions about the way you are carrying on your job.

PERSONNEL ORGANIZATION:

1. **Research:** Are we spending enough time finding useful new products?
2. **Development:** Are we properly improving what we are now making?
3. **Production:** Are we manufacturing as well and as economically as possible?
4. **Coordination:** Do we understand each other's problems?

LABORATORY EQUIPMENT:

5. **Scientific:** Have we equipment to tell us what we want to do?
6. **Measurement:** Do we know when we have accomplished what we want?

PRODUCT:

7. **Market suitability:** Does our product fill an existing or future need?
8. **Profit margin:** Can we make and sell our product economically?
9. **New developments:** Do needs exist that we should be attempting to fill?

RAW MATERIALS:

10. **Availability:** Can we get materials when we need them?
11. **Dependability:** Are we sure that we can continue to get materials?
12. **Uniformity:** Will our materials always be usable?
13. **Interchangeability:** Can we use other materials equally well?
14. **Cost:** Are they most economical for our use?

PRODUCTION EQUIPMENT:

15. **Fabrication:** Are we ourselves making enough of our parts?
16. **Assembly:** Are we putting them together well enough and economically enough?
17. **Testing:** Do we know that our product is always right?

OPERATIONAL MANUFACTURING:

18. **Uniformity:** Does our processing vary from day to day?
19. **Dependability:** Do troubles develop when we least expect them?
20. **Flexibility:** Can we adapt ourselves quickly to change?
21. **Speed:** Are we producing rapidly without confusion?

PRODUCTION REGULATION:

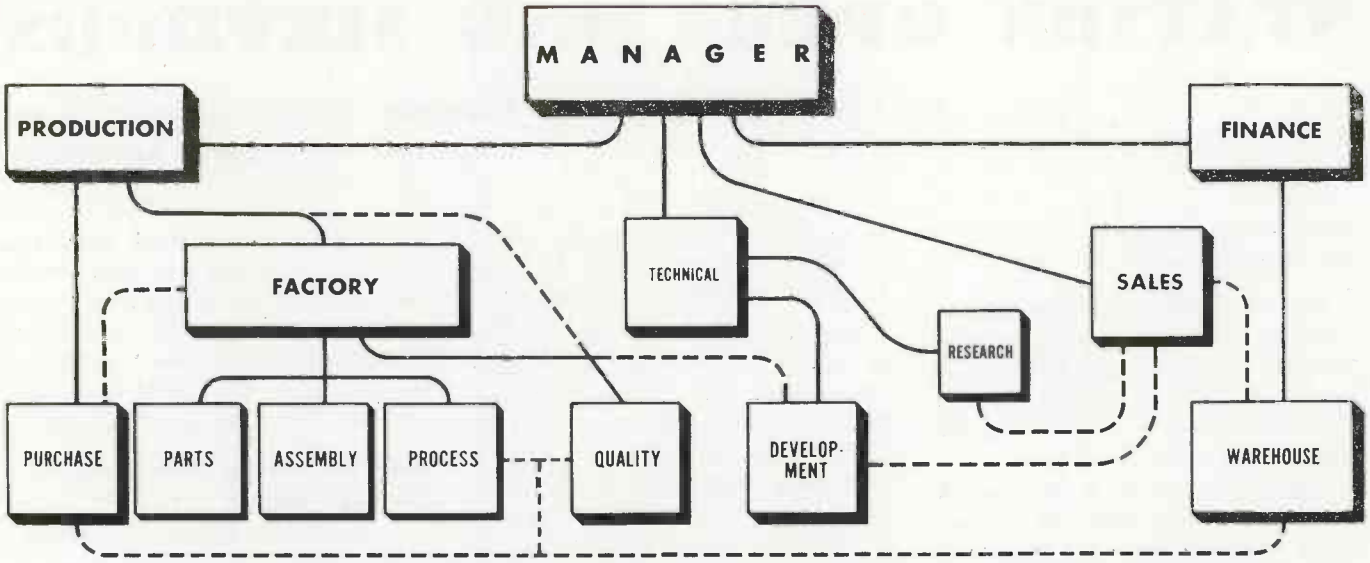
22. **Sales coordination:** Do our sales and manufacturing people understand each other?
23. **Warehousing:** Have we too much or too little in stock?
24. **Scope limitation:** Are we making too many or too few different items?

LOCATION:

25. **City:** Are our local relations mutually satisfactory?
26. **Suppliers:** Are the sources of our materials convenient?
27. **Customers:** Are we available to those who purchase our products?
28. **Personnel:** Are the right kind of people available to help us?
29. **Building:** Is it satisfactory now and have we room to grow?

FINANCIAL:

30. **Backing:** Is our bank account adequate and can we get more money?
31. **Inventory:** Does the factory, warehouse or our distribution freeze our assets?
32. **Credit:** Do our customers owe us more than they can pay?



In this organization chart the solid lines represent definite channels of authority and control. The dotted lines indicate some of the important informal relationships which must exist between units

tral planning group should be accorded the cooperation of the entire organization. Too often this phase has been put off until trouble is encountered either from the inability of the Sales Department to continue merchandising existing products successfully or from the inability of the Manufacturing Department to produce the product competitively. Planned programs of product analysis will do much to stabilize the industry and to keep it in the enviable position of high esteem that it now enjoys among its customers.

Working together

In the factory proper certain factors must be continually reviewed. The relations between the employer and employees will not be dwelt on at length. It is sufficient to say that the success of any organization depends on the quality and cooperation of the people comprising that organization. A regular personnel program with well-defined policies is vital. The expenditure of time and effort in formulating these policies and in adhering to them after they are formulated is often repaid in many unexpected ways.

The production organization should know its raw materials and constantly compare its thoughts and findings with those of the purchasing agent and the various engineering groups. It is necessary to consider all of the points listed in the check list and often many others. Which factor is most important depends on the conditions existing at any particular time. Cost must be understood to include not only the actual price paid for the material but also the cost of its use. It must be regarded as an all-embracing term since the lack of dependability, uniformity, availability or some other consideration may at a future time cause difficulties that are far more serious than any original saving could justify.

Stress broad outlook

Successful processing of the products depends on the equipment available and the use the organization makes of it. Generally speaking, uniformity, speed, dependability and flexibility of equipment should be constantly borne in mind. No day should pass when those responsible for actual production have not considered these points broadly. Spending hours attempting to increase the production of a certain part from 100 to 120 an hour may or may not be justified. Whether the effort is proper must be tested not so much as a single specific achievement to be vaunted, but more in its relation to the functioning of the entire business. The development of a broad outlook on the part of each member of the organization is probably the greatest single factor that is required to achieve successfully the desired result.

Production should be scheduled and regulated as far in advance as possible. Complete coordination between the sales, warehousing and financial policies of the company is required. Shortsighted or uninformed decisions result in continual hysterical conditions throughout an organization. Too optimistic long-term policies may result in over-production and subsequent "dumping."

Material supply essential

Under present conditions where the need for many items is great and future conditions cannot be too well ascertained, it is difficult to set up an absolutely successful production schedule. However, it is worth noting that those who have done so successfully have been those who, from skillful application of a combination of broad and intimate knowledge, were able to anticipate the problems of production and material supply. By properly scheduling and providing the right material, the right number of subassemblies and the right number of perfectly finished articles at the promised time of delivery, a smoothly functioning enterprise becomes possible.

Small-run items

The concentration of certain related types of product has always tended to result in a more satisfactory condition. Unless the organi-

(*Continued on page* 103)

STATION OPERATING METHODS

Wartime economies when men, materials and supplies are scarce

Training Women BC Operators

Several significant trends are already indicated by partial tabulation of the early replies to the NAB Manpower Survey, reports Howard Frazier, director of engineering for the Broadcasters' body.

The Survey shows a pronounced decrease in the number of technicians now employed holding first-class radiotelephone licenses. This is offset by a corresponding increase in the number of technicians holding restricted licenses or no licenses. On the basis of the incomplete figures, there has been an increase of more than 1200 per cent in the number of women employed as technicians since October, 1940. Even though this large increase is very significant, it appears that the average number of women technicans as of Sept. 15, 1942, is only about 2½ per cent of the total number of technicians employed.

With the present announced intention to establish a U. S. army in excess of ten million men and the large expansion of other branches of the armed services, it seems obvious that the major portion of the broadcast industry's male technical personnel is going to be lost.

Mr. Frazier believes the training of female replacements is the safest method of maintaining the necessary technical personnel for the duration of the war. Women have long been used in the radio manufacturing industry in the performance of many manufacturing operations. It has been well said, —"Women have made more radio tubes and radio sets than men ever will."

In order to avoid unnecessary delay in the training of unsatisfactory students, it is important that women replacements be selected with the utmost care and skill. The training of women for work of this type will require the development of a specialized training technique.

If the candidates for training are properly selected, a substantial number can be made available as studio and transmitter operators holding restricted licenses, in a period of from six to thirteen weeks. The emphasis during this preliminary training period should be entirely on creating **good operators.** Technical training and background necessary to do maintenance and repair work may be provided later, for those students already employed as operators who show a natural aptitude for radio fundamentals.

Safeguarding Broadcast Transmitters

Orders of the Board of War Communications restrict admittance to vital centers of all communication facilities, to persons actually employed or properly certified by the Board.

Many stations are now employing armed guards to patrol the area surrounding transmitters located in rural regions. Naturally it is impractical to patrol the entire route of power and telephone circuits, so whenever possible, emergency fall-back circuits have been provided along an alternate route. In some instances designation strips have been removed from control panels. Emergency microphones have also been concealed in order to make it difficult, if not impossible, for unauthorized persons to operate or use the transmitters for sabotage.

WOR's New Recording Studios with Latest in Acoustical Features

Scully recording lathe so located that engineer can look into control room and studio beyond

Reference recording room contains ten channels, for "recording off the line" or "off the air"

NBC's Electronic Clock Control System

A highly accurate time system is now in operation in vital NBC studios and control rooms at Radio City, New York. Electric clocks connected to this system will not vary more than one-third second a day. Similiar installations are being made at NBC divisional headquarters in Chicago, Hollywood, San Francisco, Washington, Cleveland and Denver. Affiliated stations may compare their own clocks with the Radio City precision system by using the time signal which is transmitted twice daily over the regular program lines.

War-time conditions created the need for the system. Most electrical power stations throughout the country have been affected by heavy power demands of the war industries and as a result of overloaded conditions, many divisions have encountered deviations in frequency of the ac supply lines, which may amount to as much as a twenty-second time delay. However, any lack of synchronization becomes a serious problem and may confuse the switching operations of an entire coast-to-coast network.

Uses tuning forks

The new precision clock control system, as perfected under the direction of O. B. Hanson, NBC vice-president, is based on the use of a special tuning fork in a vacuum chamber. The 60-cycle vibrations of the fork are amplified by a number of amplifiers, until sufficient power is generated to operate the 200 clocks in the Radio City headquarters. As a check on absolute accuracy the master clock in eacn divisional headquarter is compared daily with the accurate time signals transmitted by radio from the U. S. Naval Observatory at Washington, D. C.

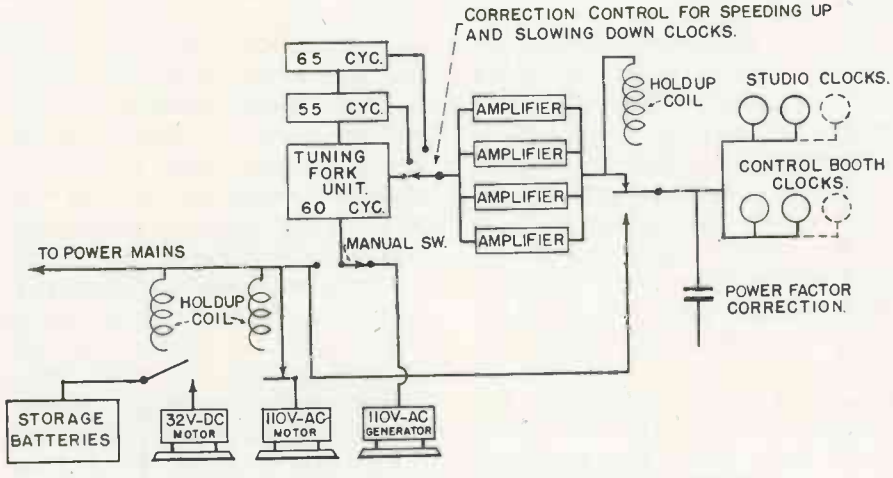
Precautions are also taken to prevent interruptions due to power-line failures. The system is claimed to be completely fool-proof. Normally the power required is drawn from the city ac supply lines, but in case of failure, the clock control equipment is automatically connected to an emergency power source derived from storage batteries. It is claimed that the changeover will not affect the operation of the clocks.

Chief Engineer O. B. Hanson at the controls of NBC's new clock system

The racks of vacuum-enclosed forks and associated amplifying tubes

Technically the system is not complicated. The tuning fork vibrations are amplified by eight 50-watt amplifiers connected in parallel to provide a total power output of 400 watts. A 110-volt ac motor is on the same shaft with a 60-cycle ac generator, which drives the tuning forks and other equipment. Normally the ac motor, which is connected to the city mains, drives the generator, but in case of failure, a direct-current motor, fed from batteries, assumes the load instantaneously.

The clocks in all studios are placed on one circuit, and those in all studio control booths on another separate circuit. Thus if trouble develops in one circuit, recourse may be made to the clocks in the remaining circuit. In checking the master clock with Naval Observatory time, the entire time system may be sped up or retarded for correction purposes by bringing into play either one of two secondary tuning forks, one vibrating at 55 cps, the other at 65 cps. Actually the correction is done automatically, the proper correction frequency being applied for the required period of time by an auxiliary clock arrangement. Time signals to the whole NBC network are transmitted at 9 am and 5 pm, EWT. Each pulse consists of a 750-cycle tone of approximately one-half second transmitted at about one-third of the volume of that of the programs carried on the same lines. The reduced volume minimizes objections by listeners, if the signal should occur during a broadcast.



Block diagram showing power sources and frequency adjustment

Electronic Tubes ON THE JOB

Exposing unit area of baked product to photocell measures oven efficiency

Wired-radio for Civilian Defense

Use of radiotelephone calls over power lines for emergency communications service, handled by amateur radio operators, has been tested successfully by the Communications Control Division of the Office of Civilian Defense and the Maryland Civilian Defense authorities in Prince Georges County near Washington, and may be extended into other parts of Maryland.

This "wired"-radio system may be an emergency civilian defense communications medium, if the tests prove completely satisfactory, for other sections of the country, particularly along the coast where the use of radio would be dangerous in event of enemy air raids. However, such "wired"-radio communications systems would only be valuable, it was noted, for local networks and not any national system.

In Prince Georges County, a master control center and six report centers have been established with radiotelephone circuits, using two frequencies in the 150 and 160 kc bands and power of between 10 and 25 watts, superimposed on the regular electric power lines. Voice transmission passes from the power lines into the low-voltage power outlets in residences and business offices. The tests have been good from the standpoint of stability and successful emergency communications, and show no difference between day and night transmission.

Transmission of "wired" broadcasting over power lines also presents a potentiality to be used for broadcasting stations when they have to be "blacked out" in case of enemy airplane raids.

Baked Goods Tested by Photocell

The amount of material available for domestic cooking appliances is limited by war needs, but certain requirements have to be met by every range. A method for testing gas ranges was developed by the A. G. A. Testing Laboratories, and an apparatus was designed which eliminates the human factor completely by measuring the reflection of the goods baked by means of a photoelectric reflectometer.

Provision is made for simultaneously exposing one square inch of the surface of a cake or cooky and of a magnesium carbonate block, used as reflectance standard, to a common light source. The light beams reflected from the cake and from the reflectance standard are focused on two barrier-layer cells, respectively, the reflectance being a measure of the color of the cake and, consequently, of the performance of the range. Currents proportional to the incident light are generated in the two cells and the corresponding voltages developed across two resistors by these currents are balanced against one another by variation of one of the resistors, until a galvanometer connected across both resistors indicates no current.

Electronic Gun Detector

Comprising a number of coils surrounding the doorway to be protected, an easily constructed electronic device has been designed to sound an alarm when a person carries a concealed weapon into a prison camp. It should perform equally well for a defense plant, detecting any small tools and parts which workers neglect to take out of their pockets before going home. Although the circuit does not make use of high frequencies, the apparatus is sensitive enough to detect even non-ferrous metal objects if of sufficient size.

Mounted on or concealed beneath the woodwork of a door, small Alnico magnets wound with a few

turns of wire are connected in series. Blunt, soft-iron pole faces attached to each magnet point up the fields. The faint emf induced in the coils by a moving iron or steel object is fed to an amplifier and stepped up 1,000,000 times. To avoid interference from the 60-cycle line, the amplifier is tuned to 20 cycles and below.

A mechanical relay in the plate circuit of the last stage operates a bell or other warning device.

PE-Cells Control Auto Tunnel Traffic

Recently at Bingham, Utah, it was decided to construct a vehicular tunnel, approximately 6,000 feet long through a mountain, to allow abandoning the highway across a valuable ore body.

At first it was thought necessary to make this tunnel wide enough for an expensive two-lane highway, unless equipment could be obtained to automatically control the traffic through a single-lane tunnel. Contractors' estimates indicated an appreciable sum could be saved by constructing the single-lane tunnel.

The automatic traffic control had to meet the following cycle:

1. Prohibit all vehicles from entering the tunnel until it is clear of traffic.
2. Allow traffic to enter only at one end for three minutes.
3. Prohibit all vehicles from entering either end of tunnel until it is clear of vehicles.
4. Allow traffic to enter only at the other end for three minutes.
5. Prohibit all vehicles from entering either end of tunnel until it is clear of traffic.
6. Begin with (1) and repeat.

If the tunnel is not cleared of traffic within 5 minutes after the last vehicle was allowed to enter, an alarm is sounded and all traffic is prohibited from entering the tunnel until the tunnel is clear.

If the carbon monoxide content of the air in the tunnel rises above a predetermined value all traffic is prohibited from entering the tunnel and the ventilating fan starts and continues to run until the carbon monoxide content falls to a predetermined minimum at which time the fan stops and traffic is again allowed to flow. All this supervision is fully automatic and is basically done by electronic tubes.

In foreground is housing photocell operated by beam across back

The watchmen of the tunnel are photo-cell electronic relays which count the vehicles as they go into the tunnel and again as they go out of the tunnel. When the same number of vehicles have left the tunnel as have gone into it, during any one cycle, it is known that the tunnel is clear. If the outgoing count is one less than the ingoing count it is evident that a lost sheep remains in the tunnel. Practice has shown it may be a boy and his girl friend, or more often a car out of gasoline or having motor trouble.

A patrolman stays within hearing of the alarm bell and when it rings, he rides through the tunnel to scare out the laggard. He then resets the equipment to allow it to again take up its duty as an electronic watchman.

When the G-E automatic traffic control was first placed in service, trouble was encountered due to boys placing boards in front of the photoelectric relays to give extra counts and thus tie up traffic. A few hours in the Bingham jail for these boys eliminated this source of trouble.

Aside from the usual small troubles, the automatic traffic control has worked quite satisfactorily.

After three years of continuous service, with hundreds of thousands of operations, only minor repair parts have been required.

Approximately 600 cars go through the tunnel every twenty-four hours, each one causing two operations of the equipment.

Phototube Guard in Coal Plant

Loaded coal cars are emptied at the New Piney Fork preparation plant of the Hanna Coal Company, in Ohio, by being rolled onto a rotary dump, fastened to the rails by a mechanical device, and then rolled upside down over a chute. After the car has been righted again, it moves off the dump by gravity.

It is essential that the dump does not revolve the next full car until the preceding empty one has moved off. Otherwise, the empty car will be turned over onto the floor.

At intervals, however, the plant experienced difficulty with this arrangement. The dump would revolve before the empty car had cleared. This usually happened because a particular car took too long to move off.

This difficulty was remedied when a photoelectric relay and light source were installed on opposite sides of the track at the "empty" end of the dump. Now the dump cannot revolve as long as the light beam between the light source and the phototube in the photoelectric relay is blacked out by the body of the empty car.

Stroboscopic Vision

At Hoosic Mills, New Bedford, Mass., a General Radio Strobolux is used to observe an experimental loom operating at 180 picks per minute. The five-foot throw of the shuttle can be "stopped" and watched at any point

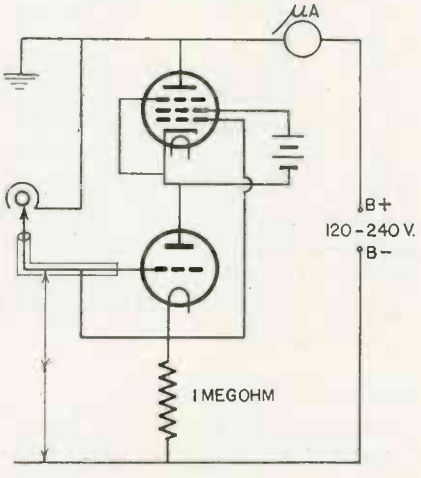
SURVEY Of WIDE READING

Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

Tube Voltmeter

F. T. Farmer (Proceedings of Physical Society, London, Sept. 1942)

A small capacity voltmeter is needed in connection with ionization chambers, used extensively for measuring gamma-ray intensities and having a capacity of one micro-micro farad or less. As shown in the figure, a tube voltmeter is used for the determination of these voltages of about 100 to 200 volts. The anode voltage should not exceed 4 to 5 volts and, therefore, another tube of high impedance is included providing negative feedback. The two tubes function in the manner of a cathode follower. The capacity of the grid and lead are reduced by a screen surrounding the lead. The ionization chamber must be charged negatively relatively to its case.

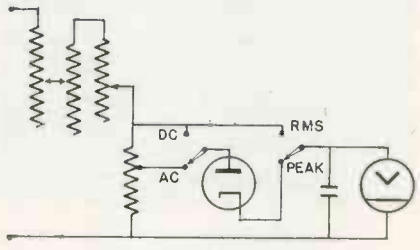


Tube voltmeter

Peak-Factor Meter for AC and DC

E. H. W. Banner (Journal Institution of Electrical Engineers, London, Part 2)

The author describes a simple arrangement for obtaining the peak factor of impure a-c or d-c and proposes the use of the term peak factor for rectified and filtered current as being better defined and more useful than the generally employed "ripple." An electrostatic voltmeter gives readings proportional to the rms voltage, and by means of a push button introduces a diode tube rectifier into the circuit for peak voltage readings. In the case of d-c the peak factor is 1.0 and no movement of the pointer occurs; with impure d-c any pointer movement is directly proportional to the peak factor. In the case of a-c the peak factor is 1.41 and by tapping 1/1.41 times the applied voltage of a voltage divider, the



Peak-factor meter

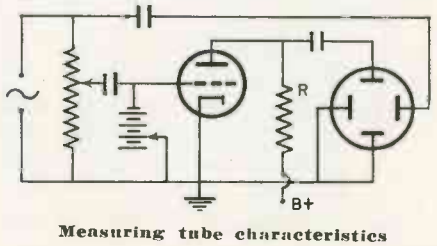
reading can be made the same as for the rms position for sinusoidal waveform. Again any pointer movement is directly indicative of the peak-factor deviation from 1.41. The voltage range of electrostatic voltmeters is unlimited in the upward direction, but is limited in the downward direction to about 150 volts for commercially obtainable instruments.

Cathode-Ray Oscillographs in Industry

W. Wilson (Beama Journal for the British Electrical Industry)

Tests involving independent bases other than time are described in this article, one of a series of similar articles dealing with the application of cathode-ray oscillographs in industry.

The natural frequencies of a circuit can easily be determined by applying current and voltage to each pair of deflecting plates. Power factor and impedance also can be measured by the same arrangement. The advantage of this method is that the determinations can be made under working conditions. Another voltage current curve shows the performance of a thermionic tube. An example for a device making visible the dependency of the anode current on the grid voltage is shown in the accompanying sketch. Similar arrangements may be used for obtaining other tube characteristics. The mysteries of iron can be investigated by connecting magnetizing force with resultant flux. Several arrangements are shown and discussed, one of them being applicable to direct transformer testing. The article describes also methods in general practice in receiver alignment.

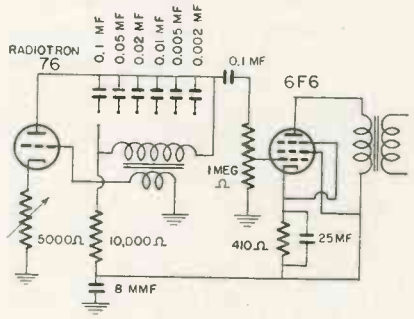


Measuring tube characteristics

2537 Angstrom for Raman Effect

Roop Kishore (Proceedings of Indian Academy of Sciences, Calcutta, July, 1942)

Most Raman spectra of crystals have been made with 4047 and 4358 A radiations of the mercury arc. The method employed for the present investigation, developed by Rosetti in 1931, uses 2537 A. The high intensity and large scattering power of this radiation coupled with its elimination from the scattered light permit the investigation of small crystals. Quartz, alumina, wikerite, barite, celestite and gypsum were investigated, and the results are tabulated and discussed.



Sine-wave oscillator

Sine-Wave Oscillator

W. G. Whittleston (New Zealand Journal of Science and Technology, Sept. 1942)

A simple audio frequency oscillator capable of giving a pure sine wave over the range of 300 to 3.500 cycles is described. The accompanying sketch shows the construction and dimensions of the arrangement. To obtain the best wave form the variable resistor between cathode and ground, providing negative feed-back, has to be adjusted for varying frequency.

Square Mesh Grids

C. C. Eaglesfield (Wireless Engineer, London, Oct. 1942)

The object of the article is determination of the amplification factor of a triode having a square mesh grid. For simplification, the electrostatic charge density at the cathode is taken as equivalent of the plate current. This procedure, ignoring space charges in the system, reduces the problem to an electrostatic one which can be solved, and the amplification factor computed, for a grid consisting of parallel circular wires.

The difficulties of calculating the amplification factor of mesh grids are pointed out, and three experimental methods are proposed: Investigating a set of actual tubes, conduction measurements in an electrolytic tank, and determining the electrostatic screening effect of such a grid. Experiments based on the last method have been carried out for gratings of parallel circular wires as well as for square meshes of circular wires.

It was found that the square mesh is equivalent to a grating of parallel wire with a pitch equal to approximately 0.60 of that of the square mesh. Theoretical formulas are discussed in connection with the experimental results.

Transient Response of Television Apparatus

A. V. Bedford and G. L. Fredendall (I. R. E. Proceedings, Oct. 1942)

In an excellent 30-page original paper the authors develop original methods for the analysis, synthesis and evaluation of the transient response of television apparatus. Since the sharpness of detail of a television picture is directly dependent on the response of the circuits to a square wave of sufficiently long period, the analysis of the square wave response becomes very important. The paper gives in convenient chart form, (1) the analysis of square-wave output into sine-wave amplitude and phase response and (2) the synthesis of a square-wave response from a given set of amplitude and phase characteristics. The measurement, analysis, synthesis and evaluation of square-wave response are presented as a basis for a unified and complete technique.

U.H.F. Wavemeters

A. G. Clavier (Electrical Communications, 1942, Number 4)

The formula for the selectivity of circuits with distributed constants is introduced and the use of two parallel wires as circuits for measurements of decimetric wavelengths is described.

A coaxial-line wavemeter, designed by the author and Mr. Rene Darbord, comprises essentially an adjustable test line connected by means of quarter-wave lines to an antenna at the one end and to a thermocouple at the other end. The accuracy of the device is computed. In the models constructed, one part in 2,000 of the wavelength could be measured. By a special arrangement a measuring line, the characteristic impedance of which does not depend on its length, may be obtained.

For wavelengths of a few centimeters or below one centimeter, dielectric guides, such as metallic pipes, are used. An expression equivalent to magnification is introduced and its variation with the wavelength, indicating the selectivity, is discussed.

Elastic Constants of Beta-Quartz

E. W. Kammer and J. V. Atanasoff (Physical Review, Oct. 1942)

There are two principally different methods of computing the elastic constants of a solid: From its deformation under load, and from the frequencies of standing waves that can be set up in the material. The latter method is described for beta-quartz, a modification existing between 573°C and 870°C.

The device used is shown in the figure. An oscillator is modulated to cause its frequency to vary periodically over a predetermined range, and the output is applied to the quartz plate under investigation. If a resonance point of the crystal lies within the range of frequencies attained by the modulated carrier, the quartz will absorb some energy and vibrate at its natural harmonic frequency for some time, while the carrier frequency continually changes. Upon demodulation, a single varying-pitch audio-beat note is obtained, amplified and applied to one pair of plates of a cathode-ray tube, the other deflection of which is controlled by the modulating frequency. For comparison, a standard frequency may be introduced and tuned until response of crystal and standard oscillation coincide on the screen.

Phase Modulation and FM

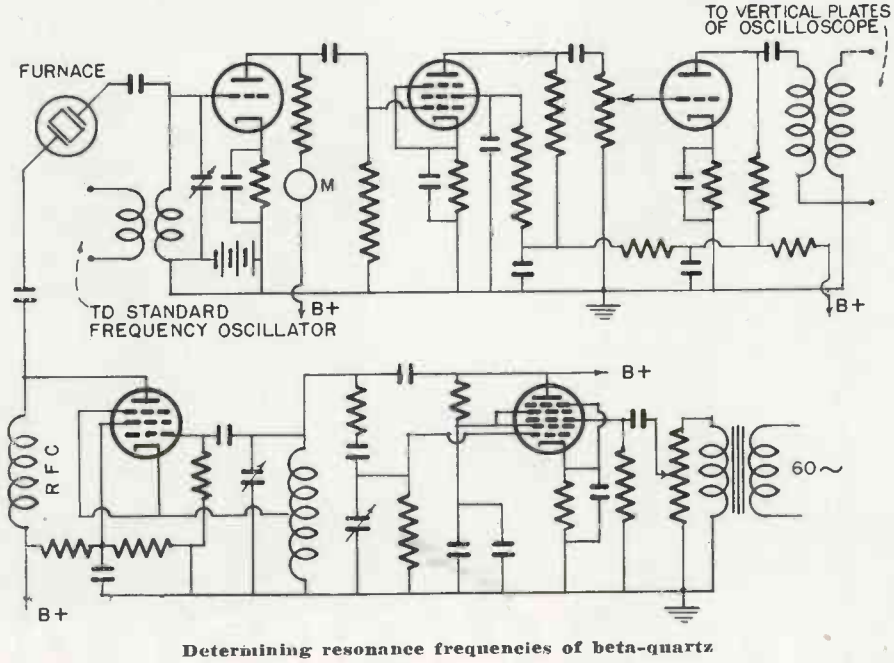
Christopher Tibbs (Wireless World, England, Sept. 1942)

The article gives non-mathematical definitions of phase and frequency modulation and explains their nature in simple terms. Based on these definitions it is shown why phase modulation is of necessity produced simultaneously with frequency modulation, and vice-versa. Conditions for phase modulation are derived and it is pointed out that the reference frequency must be held within close tolerance. Methods of obtaining phase modulation and demodulation are illustrated and discussed.

Testing Magnetic Materials

K. Kreielsheimer (Journal of Scientific Instruments, London, Sept. 1942)

Magnetic properties may be investigated by means of electrostatic deflection of a cathode-ray electron beam. However, the phase relation between the voltages of the transformer to be tested and the induction has to be taken into account. An arrangement providing for a compensating phase shift is shown and explained, and curves obtained from a standard radio receiver power transformer are given.



Determining resonance frequencies of beta-quartz

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PROVEN BY TWO YEARS UNDER THE FIRE OF EXPERIENCE
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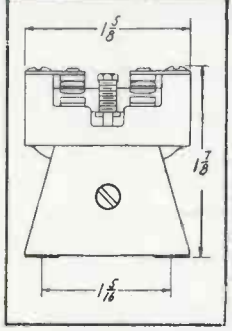
BO and BJ power relays meet every known requirement for light, firing and communication control.

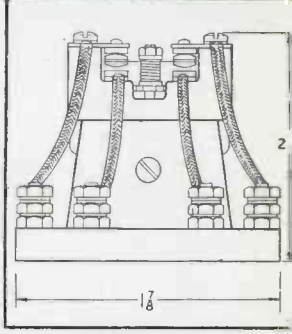
BO and BJ are Relay Veterans. They have seen two years on the firing line of experience . . . on the sea . . . in the air . . . and on land. They have proven themselves durable and completely dependable.

BO and BJ have semi-balanced armatures which require minimum wattage to withstand shock and vibration up to 12 G . . . they operate at temperatures of 120 plus or 60 minus . . . they are corrosion resistant beyond specifications . . . their weights are significantly low . . . their dimensions are minute . . . their double pole double throw design permits abundant contact arrangements . . .

In Bakelite Mounting Model BOB

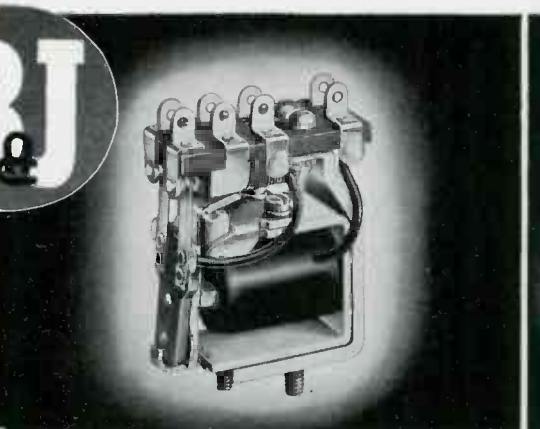


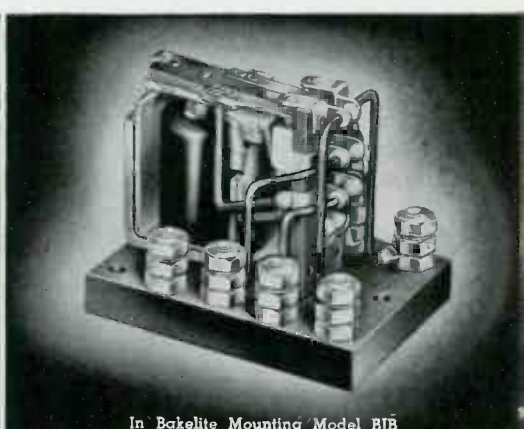
Coil Number	Nominal Volts	Amperes	Resistance	Watts
28	5.0	.500	10.0	2.5
29	6.0	.422	14.2	2.5
30	7.8	.319	24.5	2.5
32	13.2	.190	70.0	2.5
33	15.4	.162	95.0	2.5
34	20.	.125	160.	2.5
35	24.	.106	230.	2.5
36	32.	.078	415.	2.5
38	50.	.049	1024.	2.5
42	112.	.022	5000.	2.5



The above coil data is based on continuous duty at nominal operating voltages. Coils are impregnated to withstand humidity and salt spray. Bakelite parts are molded. Contact arrangement D.P.S.T. Double break normally open or closed and D.P.D.T. Contact rating non-inductive 15 amperes for 12 and 24 volts D.C. and 110 volts A.C.

B.J



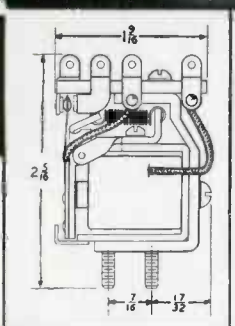


In Bakelite Mounting Model BJB

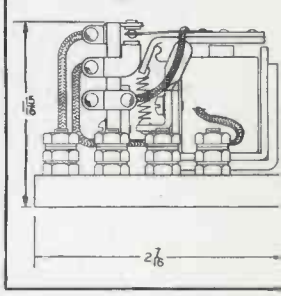
***. . . and they are* INTERCHANGEABLE**

. . . variations in the mounting base can be made to make this relay widely interchangeable

BO and BJ are *Accepted* and *Approved* RELAYS



Coil Number	Nominal Volts	Amperes	Resistance	Watts
24	1.61	1.243	1.293	2
26	2.56	.8003	3.270	2
28	4.07	.4918	8.267	2
30	6.47	.3093	20.90	2
32	9.92	.2017	49.16	2
34	15.0	.1332	112.6	2
36	25.4	.0786	323.5	2
38	39.5	.0506	780.6	2
40	59.6	.0339	1738.	2
42	86.3	.0232	3725.	2



The above coil data is based on continuous duty at nominal operating voltages. Coils are impregnated to withstand humidity and salt spray. Bakelite parts are XXXP laminated wax impregnated. Contact arrangement D.P.S.T. Double break normally open or closed and D.P.D.T. Contact rating non-inductive 5 amperes for 12 and 24 volts D.C. and 110 volts A.C.

ALLIED CONTROL COMPANY, INC. ★ 227 FUL[illegible] NEW YORK CITY • LONG ISLAND CITY • CHICAGO • PLANTSVILLE, CONN

Selectivity and Its Problems

M. I. Kobilsky (Revista Telegraphica, Buenos Aires, Sept. 1942)

This article, on which was based a discussion led by the author in the Buenos Aires section of the IRE on Sept. 4, details the general problems of selectivity in radio receivers.

After defining "interference", its causes and effects are analyzed. A general definition of selectivity is given, covering all possible types of interference, taking note of the difficulties which such a definition implies, in order to establish a method of measurement. The author then limits the term selectivity for the case where the interference is by a modulated signal. Audible effects of this type of interference are studied, and causes which condition selectivity are analyzed in detail, with special attention to the study of cross-modulation and to the effect of apparant demodulation. Finally, the possible errors that can be made in the evaluation of selectivity from a resonance curve with only one signal, are discussed. A satisfactory method using two signals is described.

Measuring Strong HF Fields

Kurt S. Lion (Review of Scientific Instruments)

The article discusses earlier methods of field strength measurements and their shortcomings. The requirements for a satisfactory instrument are stated and it is pointed out that an electrodeless tube containing gas under low pressure is the ideal instrument. A discharge arises, the brightness of which depends on the field strength and, if the tube is not spherical, also on its orientation with respect to the electric field. The brightness is measured by means of a photoelectric cell, an amplifier tube and a milliammeter. The physical dimensions and the electrical values of the arrangement are discussed in detail and results obtained by the method are given.

New Type of Microphotometer

R. Furth, Department of Mathematical Physics, University of Edinburgh (Nature)

This instrument is designed to produce instantaneously a visual picture of the distribution of transparency of an object under investigation, for instance, a photographic plate.

A reduced image of a lighted slit is focused on the photographic plate, the intensity of the light passing through the plate being recorded by means of a photoelectric cell and a cathode-ray oscillograph. A two-stage amplifier connects the photoelectric cell to the vertical deflection plates of the oscillograph.

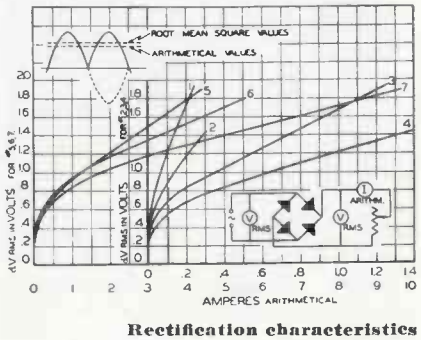
The photographic plate is attached to an electromagnetic tuning fork operated from the a-c power lines. The plate, therefore, oscillates with the fork. The potential for deflection in horizontal direction of the cathode-ray oscillograph is supplied by the same a-c in such a way that the two oscillations are exactly in phase. The magnification of the instrument depends upon the amplitude of the vibration of the fork. The vertical deflection, obviously, also can be changed easily. Parts of the photographic plate can be adapted to be measured successively.

Selenium Rectifier Design

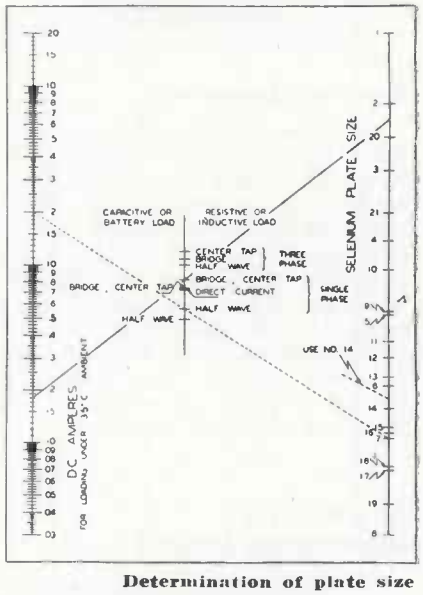
J. E. Yarmarck, (Electrical Communication, I. T. & T., No. 4, 1942)

After describing construction and stacking of the plates, the author presents tables of ratings, most of them having been obtained experimentally on the basis of maximum allowable operating temperature which is the only limiting factor. Complete ratings are given for various sizes of plates and circuits. For better methods of cooling, increased ratings are obtained. More current may be drawn through the plates if the rectifier is used for intermittent service, appropriate formulas being supplied.

The main part of the article describes stack design procedures with graphs illustrating the performance characteristics for various types of loads and rectifier circuits. One figure shows the rectification characteristics for seven plates in single-phase, bridge or center-tap circuits for inductive or resistive loads. Voltage regulation calculations are included, the inherent regulation of selenium rectifiers being in the neighborhood of 10 per cent to 20 per cent. A simplified method for computing the efficiency is discussed. For single-phase circuits efficiencies average 64 per cent for full load. Three-phase circuits and reduction of load increase efficiency. The other figure shows an alignment chart for determining rectifier plate size in terms of output current, load and circuit.



Rectification characteristics



Determination of plate size

Frequency Measurements

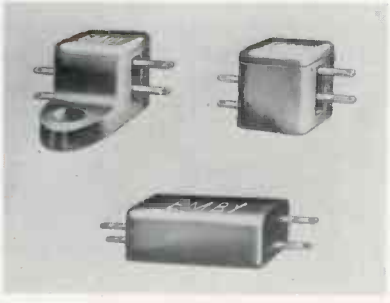
J. E. Thwaites and F. J. M. Laver (Journal of Institution of Electrical Engineers, London, Sept. 1942)

The article gives an extensive survey of the various methods used in radio communication service. Requirements for satisfactory measurements and corresponding circuits are treated in detail. The discussion on the choice of method for measuring frequencies, and on the accuracy obtainable, includes the table shown.

Method of Measurement	Frequency Range Min.	Max.	Maximum Accuracy
Absolute or integrating methods	0	3 kc	rapid measurements $\pm 1/10^4$; mean over 12 days $\pm 1/10^8$
Circuit methods	20cps	20 kc	$\pm 1/10^3$
Electrical resonance methods	20cps	1,000.000 kc	below 50 kc $2/10^3$ between 50 kc and 20.000 kc $\pm 3/10^4$ above 20.000 kc $\pm 2/10^3$
Electro-mechnical resonance methods	20 kc	3.000kc	$\pm 1/10^5$
Comparison with primary standard			
(a) HF interpolation	20 kc	1,000.000 kc	$\pm 1/10^6$
(b) AF interpolation	0	1,000.000 kc	$\pm 1/10^8$ or better

WHAT'S NEW

Devices, products and materials the manufacturers offer

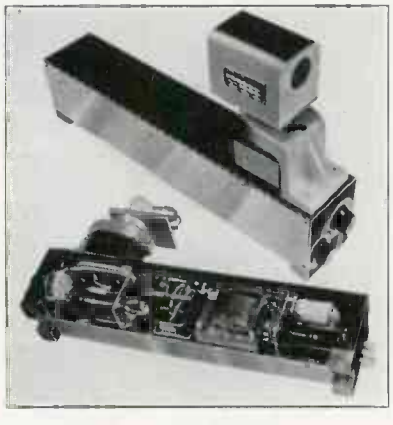


Selenium Rectifiers

Selenium rectifiers are manufactured by the Emby Products Company, Inc., 1800 West Pico Boulevard, Los Angeles, Cal. Eight standard types are made ranging in outputs from 8 to 120 milliamperes. The units are available in insulated metal cases or in molded plastic enclosures. Outside dimensions are small and the largest unit weighs less than ¼oz. Soldering lugs are provided. No warm-up period is required.

Photoelectric Registration Control

A dual scanner registration control, model B-16, is announced by the United Cinephone Corporation, Torrington, Conn. The photoelectric control may be used with transparent, semi-opaque or opaque substances. It has been designed for the packaging field, but may be used wherever a material is fed to



a machine in a continuous sheet or strip. It works on a power supply of 110 volts, 60 cycles, the minimum time of impulse is 0.005 seconds, and its sensitivity for transmitted light is 2 per cent change in intensity, and for reflected light 4 per cent change in intensity.

Coil Forms

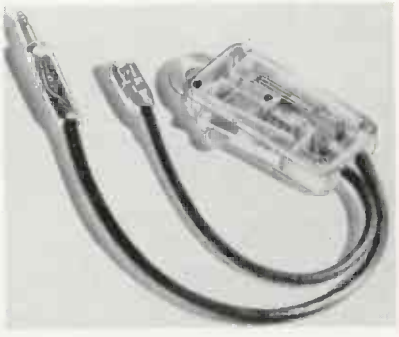
Precision Paper Tube Company, 2033 W. Charleston Street, Chicago, Ill., announces a cellulose-acetate insulated bobbin coil form to protect the coil against climatic conditions. Cellulose acetate is used in combination with the spiral-wound dielectric fish-paper core and vulcanized fibre flanges. Acetate cement is brushed over the joinings to give protection and to strengthen the bobbin. This form of coil bobbin is recommended for instruments and equipment in aircraft, ordnance, marine services and other uses in which coils are subjected to corrosion. Round, square, rectangular and specially shaped bobbins are available.

Sockets

E. F. Johnson Company, Waseca, Minn., announces a steatite-insulated socket for miniature tubes. The No. 267 socket is designed for use with the 9000 series and miniature series tubes including RCA 1S4, 1S5, IT4, IR5, etc. Contacts are phosphor bronze, silver plated, and self-aligning so that they receive the tube prongs without danger of fracturing the glass base. Contacts are arranged for small capacity effect and a center shield is provided for grounding to chassis.

A News Service for Readers

Announcements of new products which appear on these pages are prepared by the editors as a service to our readers, and are published as news, without any advertising consideration whatever.



Phone Switch

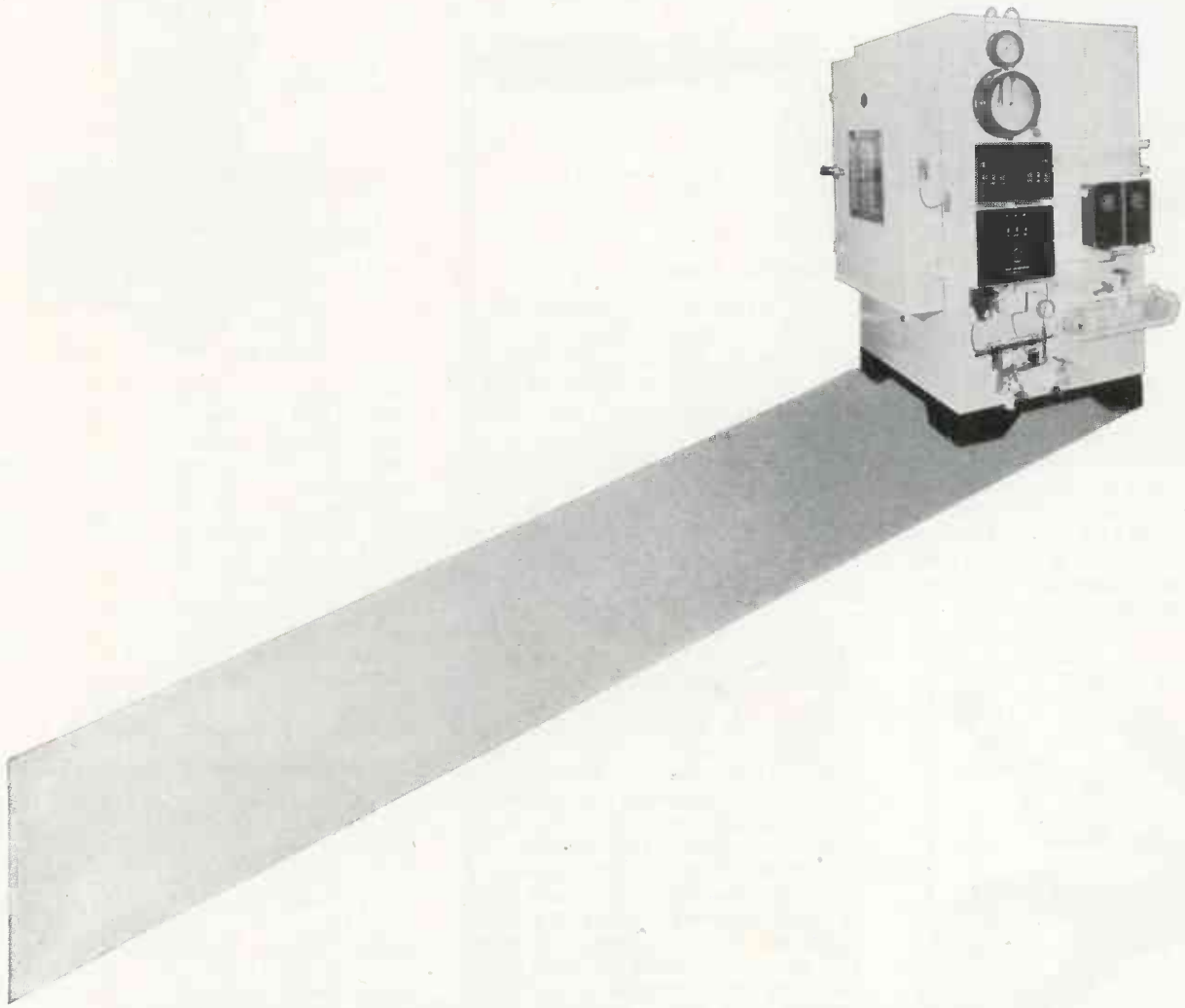
The American Radio Hardware Company, 476 Broadway, New York, introduces the SW-141 phone switch as a connecting link between air and ground communications. It is a double-circuit microphone switch designed for use by an operator wearing heavy mittens. Normally it is in open position, and can be locked into closed position. The switch is 1-15/32 in. in length, 3/4 in. thick and 1 3/4 in. wide, mounted on sturdy brass brackets with blades made of a phosphor bronze material and has bakellite insulation. Cordage clamps for taking up cable strain are provided as an integral part of the housing.

Temperature-Signalling Compound

The thermometric product introduced by the Tempil Corp., 132 West 22nd Street, New York, liquifies at a predetermined temperature and solidifies upon cooling, leaving a glossy mark. Melting points vary betwen 125° and 1600°F.

Solder Pots

Small capacity solder pots are being manufactured by Lectrohm, Inc., 5125 West 25th Street, Cicero, Ill., for radio and electrical-equipment plants. A single nickel-chrome heating element, which can be quickly and inexpensively replaced, heats the pot. The pots are available in 1¾-pound and 2-pound capacities for operation on 110 v., ac or dc. A six-foot Underwriters-approved cord and attachment plug is furnished with each unit.



TESTING the stamina of materials and instruments in the "Tenneyzphere" High Altitude Chamber removes the last vestige of guesswork. Standard range of temperatures run from —40° to 150° Fahrenheit. (Special units test from —90° to 320° Fahrenheit.)

Observation ports permitting full visibility are sealed to prevent interior condensation. The interior is scientifically air-conditioned.

To make mechanical adjustment of the apparatus under test, small rotating shafts are installed. These are manually turned from the outside and studs extend through suitable packing to keep them airtight.

These cabinets meet the test requirements of all U. S. Government Agencies: Army Signal Corps, Navy Bureau of Aeronautics, National Advisory Committee for Aeronautics.

For illustrated booklet describing "Tenneyzphere" High Altitude Chambers, Constant and Variable Temperature Baths, Humidity Chambers, and All-Weather Rooms, with tables giving specifications for many important installations write Dept. EI-12.

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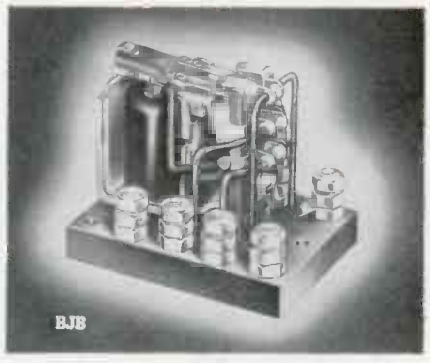
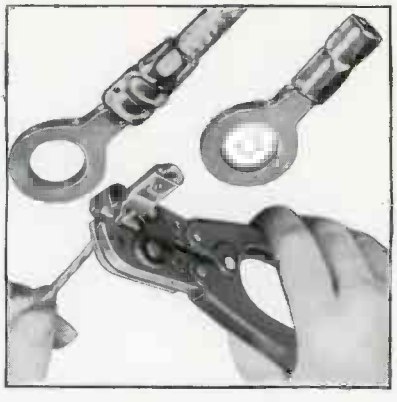


Power Relays

The Allied Control Company, 227 Fulton Street, New York, announces that its models BO and BJ power relays for flight, firing and communication control have been redesigned to require minimum mounting space and to permit variations in their mounting bases.

Specifications for the BJB model are: Contact ratings, non-inductive, 5 amperes for 12 and 24 volts dc and 110 volts ac; single or double pole, double throw; bakelite mounting, weighs 5¼ ounces, dimensions are 2 7/16 in. x 1 11/16 in. x 1 15/16 in.



Solderless Terminal

Aircraft - Marine Products, Inc., 286 North Broad Street, Elizabeth, N. J., announces a solderless type terminal which meets the need for stacking a series of parallel terminal connections on a single stud block. The terminals may be used for either right or left hand application. They are crimped on the wire using hand, foot or power tools. Special designs for particular applications are available.

Variable-Voltage Autotransformers

The General Electric Company announces variable - voltage autotransformers for panel and bench mounting and which can also be supplied without casing. The autotransformer operates on low input power and low exciting current—this being made possible by a circular core of low-loss silicon-steel strip. The windings are insulated by Formex enamel, except for a portion of the inside of each winding in constant contact with a carbon brush connected to the output circuit. The dial is calibrated from 0 to 100% of maximum voltage.

Soldering Iron

The Hexacon Electric Co., 157 W. Clay Ave., Roselle Park, N. J., introduces the hatchet-type soldering iron, the handle of which is offset to reduce fatigue and give better balance.

The iron is available for 80, 100, 150, 175 and 200 watts; the tip sizes are ⅜ inch, ½ inch and ⅝ inch. It is a plug tip type iron with replaceable elements and tips.

Operation Timer

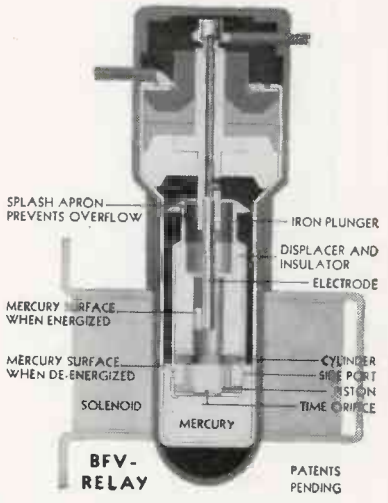
The "Tandem Timer" is a new timing device that presents versatile features for production departments, laboratories, and life testing of electrical apparatus. It permits practically any timing sequence that may be desired. Essentially it is a control unit with two individual and variable plug-in type timing elements. With the timing elements adjusted to their correct respective time intervals, each cycle of operation will follow the other continuously in regular sequence. The automatic reset features of the Tandem Timer makes a continuous, as well as a single cycle of operation possible. Made by Industrial Timer Corporation, 113 Edison Place, Newark, N. J.

Outlet Detector

Metal outlet boxes, steel conduits, and armored cables hidden in the walls and floor may be located by an "outlet detector" manufactured by the Liberty Electric Co., 10314 Superior Ave., Cleveland. The detector is a wand-like device about 12 inches long and a little over 1 inch in diameter, with a metal electrode on its tip. The device is adapted for 110-volt ac operation. When the wand is waved in front of a concealed box or conduit, high-frequency violet sparks reveal its location and even its exact outline.

Time-Delay Relays

The BFV-relay, having a displacer operated by a solenoid and closing a mercury switch, is being manufactured by Durakool, Inc., 1010 N. Main Street, Elkhart, Ind. This particular type delays its action upon closing of the control circuit and, after such delay, closes



the main line circuit. Upon opening of the control circuit the main line follows instantly to an open position. The reverse of this is also available. The device is recommended for use in modern communication systems, in machines, motors and electrical circuits, for recycling operations and flashing actions. The tube is filled with an inert gas for cooling and quenching of the arcing. Capacities up to 75 amp. with solenoids to meet different voltage and frequency requirements are available.

Potentiometer-Rheostat

The Beckman Helipot of the National Technical Laboratories, 820 Mission Street, South Pasadena, Cal., consists essentially of a long potentiometer slide wire coiled helically into a small case, with a slider contact rotated in the usual manner by a knob. By means of a guide wheel, the slider contact automatically follows the helical path of the resistance winding.

Facilities have been developed for the production of 3- and 9-turn helipots. The power rating is one watt. The 9-turn helipot can be supplied in resistances of from 100 to 25,000 ohms, the 3-turn helipot in resistances of from 30 to 5,000 ohms. Other sizes and resistance ratings can be supplied on order.

Blueprint Dryer

Manufacturers who have their blue prints finished by outside sources, may be interested in a new blueprint dryer, introduced by the Warren Electric Appliance Co., Warren, Pa. The manufacturer states that the dryer will dry a print in approximately five minutes and accommodates standard 30-inch blueprint paper in lengths up to 32 inches. The chromium plated drum measures 34 x 18 inches in diameter, and has a drying surface of 32 x 52 inches. The dryer uses 700 watts on 115 volts, ac or dc. The heating element is guaranteed for five years. The drying belt is made of preshrunk material.

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UPON the flash of a Warning and Signal Pilot Light may depend success or failure . . . even life or death . . . of fighting men.

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NEW PATENTS ISSUED

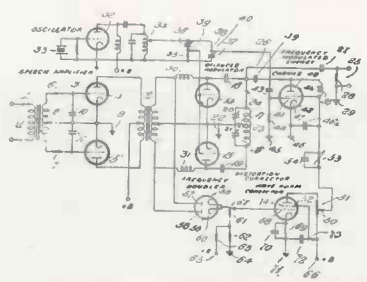
Summaries of inventions relating to electronic uses

Note: Date application was Filed shown by (F). Date patent Issued, (I). For the reader's convenience, patents most recently issued are presented first.

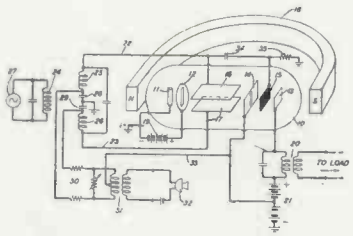
FREQUENCY MODULATION

FM Synchronization—A television receiver is adapted to receive a modulated carrier-wave which includes video signal components amplitude-modulated on the carrier wave only during trace intervals and synchronizing components frequency-modulated on the carrier wave only during retrace intervals. The frequency-modulated components are detected and utilized to synchronize the scanning operation of the receiver. A carrier signal is derived from the received carrier having a peak amplitude level during the retrace intervals representative of a limiting shade value of the transmitted picture and amplitude-modulated by the video signal components during the trace intervals. A reproducing device utilizes the amplitude modulation components of the derived carrier signal, the detected amplitude modulation components being subject to variation in amplitude, in accordance with received carrier-wave amplitude variations. There are means for stabilizing the signal input to the reproducing device at an amplitude level corresponding to the limiting shade value of the transmitted picture. Arthur V. Loughren, Hazeltine, (F) February 7, 1940, (I) November 17, 1942, No. 2,302,619.

FM Distortion Correction — A frequency-modulated signaling system includes a rf oscillator, a carrier-wave amplifier having a control grid and a screen grid, and a frequency doubler. Unmodulated radio frequency energy from the oscillator which is shifted in phase at a fixed value of 45 degrees and leads the oscillator voltage is impressed on the control grid. A doubled audio frequency modulation is impressed simultaneously upon the screen grid and anode, and provisions are made to subject the output of the carrier wave amplifier to the composite influence of a basic audio frequency modulated side band voltage and a carrier voltage modulated at twice the audio frequency. Roger J. Pieracci, Collins Radio, (F) July 24, 1941, (I) November 10, 1942, No. 2,301,907.

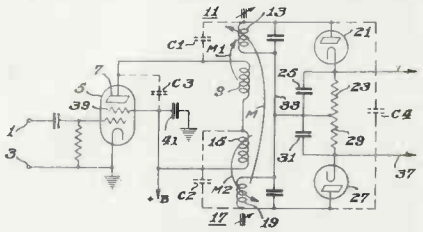


Phase Modulation— A complex oscillation is produced by superposing signal oscillations upon high-frequency sinusoidal oscillations of substantially greater amplitude. The deflection of a focused beam of electrons is controlled in accordance with the complex oscillation, and a train of current impulses is derived, synchronous with the instants of zero intensity of the complex oscillation, by intercepting the swinging electron beam at its undeflected position, and periodically retarding the electrons of the beam to suppress alternate current impulses. Albert M. Skellett, Bell Telephone Lab., (F) December 20, 1941, (I) November 3, 1942, No. 2,300,436.



Multiple Frequency Modulation—In a television or other signaling system where a number of related signals coact to form the completed signal, (such as, picture signals, line-synchronizing and field-synchronizing impulses, sound and background control) each of these signals is generated at the transmitter and frequency-modulates a separate carrier wave. The parameters of the circuits for each component signal are so arranged as to produce identical reliability factors for each of these component signals. Alfred N. Goldsmith, (F) January 22, 1941, (I) November 10, 1942, No. 2,301,395.

Frequency Discriminator— Distortion introduced by the discriminator due to undesired coupling between resonant circuits and due to an improper ratio of reactance to resistance is minimized in this patent. The frequency discriminator employs a pair of resonant circuits tuned to a frequency above and below the midfrequency of the applied FM currents. The currents are rectified by a pair of rectifiers and combined to produce amplitude modulated currents. The effect of undesirable mutual couplings is minimized by adjusting the amount and phase so that the resultant coupling approaches zero. Depending on the arrangement the inherent couplings are employed and augmented and reversed as required or additional couplings are added to neutralize the existing ones. The Q of the circuits is adjusted for least distortion due to improper ratio of resistance to resistance to reactance. Nathaniel L. Korman, RCA, (F) January 25, 1941, (I) October 20, 1942, No. 2,299,581.

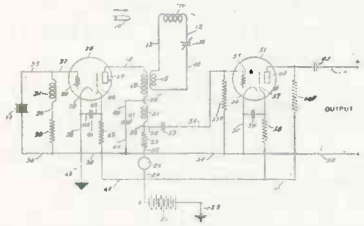


AIRCRAFT RADIO

Aircraft Distance and Altitude Indicator— A short-range high-frequency wave reflection altimeter, which transmits frequency-modulated waves and combines the received reflected waves from the earth's surface with the instantly transmitted waves to obtain beat notes, the frequency of which is indicative of altitude. A reference station is located at a remote point on the ground capable of receiving the FM waves of the altimeter and retransmitting them with sufficient power to be received by the altimeter receiver on the plane. Filters are connected with the altimeter receiver to segregate the relatively low frequency beat-notes indicative of altitude and the high-frequency beat-notes resulting from the combination of the retransmitted wave from the reference station with the instantly transmitted waves of the plane. Two meters respond to the low-frequency and high-frequency beats to indicate altitude and distance respectively. In this way the bulk and weight of the apparatus required on the plane for the determination of altitude alone by FM waves is not substantially increased. Horace T. Budenbom, Bell Tel. Labs, (F) June 20, 1940, (I) November 17, 1942, No. 2,301,929.

Four-Course Radio Beacon— A system for producing a radio beacon having a plurality of equi-signal courses. Two overlapping radio frequency regions are produced, each region having a plural lobe pattern with the lobes of each pattern intersecting the lobes of the other pattern to define equi-signal courses. The generator for the two radio-frequency regions also includes a radiating system to produce a pair of plural lobed radio frequency fields with the major axes of the lobes of each field in substantial alignment and with the major axes of the pairs of fields substantially parallel, but displaced so that the fields partially overlap. Armig G. Kandoian, I. T. & R. M., (F) February 1, 1940, (I) November 17, 1942, No. 2,301,102.

Flight Detector—This is one of a series of patents (No. 2,301,192 to No. 2,301,197) relating to flight detectors. The device is responsive to the presence of a traveling object and produces a varying unidirectional surge, having a minimum rate of change at the instant the object is at a given point. This

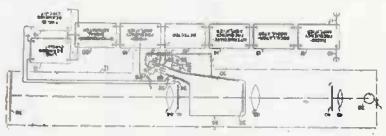


surge controls another electrical surge beginning at the instant the rate of change of the first surge is a minimum. The second surge is utilized to produce the desired indication. Colin I. Brandford, Remington Arms, (F) September 28, 1940, (I) November 10, 1942, No. 2,301,194.

TELEVISION

Television Signal Reproduction—A television signal-reproduction system consisting of a light source, viewing means and masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions. Interposed in the optical path between the source and the viewing means is a lens system having a single optical axis disposed in the optical path. Means are interposed in the light path between the transparent and opaque portions which are normally effective to focus upon the corresponding opaque portions at least a portion of the light from the source passing through the transparent portions. The optical path length

of elementary portions of the optical path through the lens system may be effectively altered for varying the amount of light blocked from the viewing means by the opaque portions. The "altering means" are controlled in accordance



with a received television signal to form a visible image of the translated picture on the viewing means. Rudolf C. Hergenrother, Hazeltine, (F) March 7, 1941, (I) November 17, 1942, No. 2,302,124.

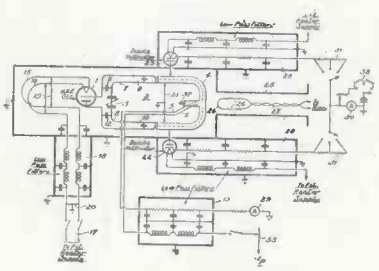
Color Television—A television system for transmitting pictures in natural colors using a picture signal generator having a photosensitive member and provisions for projecting an optical image of the picture to be transmitted on that member, the image being scanned in accordance with an interlaced scanning pattern having at least three fields of consecutively scanned lines per frame to produce a train of picture signals representative of the brightness of elemental picture areas. The fields are displaced in one direction in a regular sequence, whereby lines of successive fields of a picture will exhibit an apparent crawling motion in the direction of field displacement. The color of the image is changed several times during predetermined scanning periods in accordance with a predetermined color sequence, so that successive fields of the same color component are displaced in the opposite direction in a regular sequence, thereby picture signals being produced which are representative of the color components of the image. The picture reproduced from these signals exhibits an apparent crawling of color components in the opposite direction which compensates for the first-named crawling motion. Madison Cawein, Farnsworth, (F) July 17, 1941, (I) November 10, 1942, No. 2,301,521.

Improved Television System—The disadvantages of the present television system where the various synchronizing impulses are transmitted on the same video carrier and take up an unnecessarily wide bandwidth and are difficult to separate at the receiver, are overcome in this patent, the basic principle of which resides in the utilization of a single electrical control effect—a 30-cycle sine wave—to maintain synchronism of the respective scanning devices at the transmitting and receiving stations. The scanning apparatus is in the form of a cathode-ray tube having a multiple series of surfaces arranged in a circle, each series differing from the other as to secondary emission, and the surfaces of each series being equally spaced from each other and differently spaced from the spacing of the other surfaces from each other. The surfaces of the cathode ray tube are scanned in a circle, the spacing of the respective series being such as to produce pulses of a radio frequency wave, horizontal synchronizing pulses and picture blanking pulses, respectively. Allen D. Du Mont and Thomas T. Goldsmith, Jr., Du Mont Labs, (F) June 25, 1940, (I) October 20, 1942, No. 2,299,471.

Television Crosstalk — A television receiver for the reception of picture signals with horizontal synchronizing impulses at the end of each scanning line, and vertical synchronizing impulses at the end of each picture frame. Horizontal and vertical cathode ray deflecting circuits are provided. The vertical deflecting circuit includes only one oscillator having a period of susceptibility, which is shorter than the time between successive horizontal synchronizing impulses whereby cross-talk from the horizontal deflecting circuit to the vertical deflecting circuit is minimized. William A. Tolson, RCA, (F) December 29, 1939, (I) October 20, 1942, No. 2,299,361.

MISCELLANEOUS

Oscillation Generator—A high-frequency oscillation generator includes a tuned circuit for determining the oscillations generated by the oscillator, the tuned circuit having a fixed inductor portion, which is grounded at its voltage nodal point. A pair of rectifiers



couples to the fixed inductor portion at locations symmetrically disposed on opposite sides of the voltage nodal point. There are provisions for indicating the combined rectified output of the rectifiers. Ralph W. George, RCA, (F) March 12, 1941, (I) November 17, 1942, No. 2,302,369.

Electron Microscope—Method of centering the electron beam of electron-optical apparatus having electrically energized means for producing the beam and electrically energized means for modifying the beam to produce an image. The electric energization of one of these means is varied to cause shifting of the image as long as the other means are out of optical alignment. The two means are mechanically adjusted relative to one another while the variation continues until the shifting disappears. Bodo von Borries, Alien Property Custodian, (F) November 16, 1939, (I) November 17, 1942, No. 2,301,987.

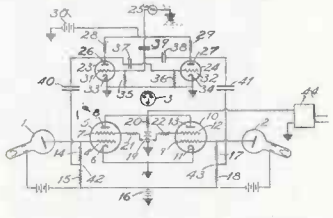
Synchronizing Oscillations — A source of control oscillations directly influences an oscillation generator and a circuit renders inactive the influences of the control source. This circuit includes a first source of auxiliary oscillations whose phase is dependent upon the phase of the oscillations of the generator, and a second source of auxiliary oscillations whose phase is dependent upon the phase of the control oscillations. The oscillations of these sources are combined in a certain phase relationship. G. Hepp and H. M. Deckers, Netherlands, (F) January 15, 1941, (I) November 17, 1942, No. 2,302,123.

Noise Limiter—A circuit for maintaining in a modulated carrier signal system the maximum output signal amplitude at a certain level and preventing noise signals from exceeding this level. The circuit comprises a modulated carrier signal source, an AVC control for maintaining the maximum signal amplitudes at a constant level, and a diode with a load circuit for rectifying the signal. A vacuum-tube amplifier having a sharp cut-off characteristic is biased at cut-off for the level established by the AVC, the diode load being coupled to the input of the amplifier and thus limiting noise signals to the fixed level. Frank J. Bingley, Philco, (F) May 31, 1940, (I) Nov. 17, 1942, No. 2,302,520.

Stereoscopic Oscillograph — An oscillograph for simultaneously observing four cathode-ray tube image screens upon which separate and different oscillographic traces are produced. Semi-transparent elements are included for viewing the image screens in pairs and are so arranged that when viewed through each element the screens of the respective screen pair appear superimposed. Light-transmitting stereoscopic lenses will make both screen pairs appear at the same place. E. Steudel and J. Kaspar, G. E., (F) February 21, 1940, (I) November 10, 1942, No. 2,301,826.

Electronic Micrometer—Apparatus for making thickness measurements of materials. A spindle extends through but is insulated from a rigid metallic arm with a base support, which carries a micrometer device. An electrical conductor may be electrically connected to the spindle and forms one terminal of an electronic circuit. A metallic rider is supported in tandem relation with the spindle but insulated from it and has a contact surface to co-operate with the end of the spindle. Provisions are made for electrically connecting the rider with the other terminal of the electronic circuit. An anvil for the article to be measured, is carried by the base in alignment with and below the rider. Robert W. Carson, (F) June 20, 1942, (I) November 17, 1042, No. 2,302,104.

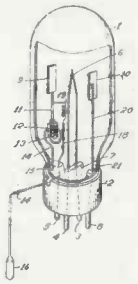
Stereoscopic Image Reproduction—A system for producing an interleaved stereoscopic record of an image comprises a prism having one face provided with a number of spaced linear reflecting strips. Two separate stereoscopic views are produced and one of these views is projected on the prism face at such an angle that only spaced linear



elements are reflected by the strips. The other of the views is transmitted through the spaces between the strips to a receiving surface which combines the reflected image strips and the transmitted image strips to form a single interleaved strip stereoscopic image. Chalon W. Carnahan, Sylvania Electric, (F) July 7, 1938, (I) November 10, 1942, No. 2,301,254.

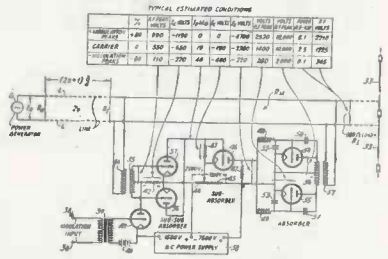
Musical Instrument — An electrical musical instrument having a frequency generating system and an output circuit including an electro-acoustic transducer and a keyboard with a number of depressible keys. When the keys are depressed a predetermined distance, signals from the generator are sent to the output circuit. A resistive force is imparted to further depression of the keys and a relay operated by any one of the keys, when depressed beyond the predetermined distance controls the introduction of a vibrato effect in the signals produced by the generating system. Jahn M. Hanert, Hammond Instrument, (F) October 14, 1940, (I) November 10, 1942, No. 2,301,871.

Vacuum Tube— The plate of a vacuum tube is supported displaceably with respect to the cathode. This is effected by means of a pressure responsive element in



the form of a coiled fluid-filled Bourdon tube, one end of which supports the plate and the other terminating outside of the tube in a container for the fluid. John P. Ferguson, Westinghouse E. & M. Co., (F) October 31, 1941, (I) November 3, 1942, No. 2,300,882.

Modulation System—A transmission line the length of which equals an odd number of quarter wave lengths connects a source of wave energy and a load circuit. An absorber impedance is connected in shunt to the load circuit and a source of modulating potential is



coupled to the impedance varying it at the signal frequency between two given limits. Means are provided coupling the line to the impedance to control one of the limits in accordance with peak values of the wave energy. James L. Finch, RCA, (F) December 31, 1937, (I) November 3, 1942, No. 2,301,160.

Multiplex System—Synchronizing pulses are produced at a predetermined time interval at a transmitting station having a plurality of signal sources, signals from one of the sources being transmitted during one portion of a time interval. The transmitting interval may be shifted to other portions of the time interval in accordance with a random record. The signals are received by a plurality of receiving devices, and the signals from the one source are received in synchronized time intervals with the transmissions. The transmitter of these signals comprises a record similar to the one in the receiving station which records are synchronized. Oliver T. Francis, (F) April 25, 1940, (I) November 3, 1942, No. 2,300,664.

RF Receiving System—A high-frequency amplifier with a predetermined selectivity characteristic provides for transmission of a relatively wide frequency band. A detector is coupled to the amplifier and AVC is used to limit the signal flow to the detector. The detector has two output circuits, one coupled to a gain control amplifier, and the other including a rectifier and a filter for passing signals from the detector to the rectifier in a control range above an upper frequency limit of desired intelligence transmission and below the upper limit of the frequency response range. The gain of the high-frequency amplifier is reduced in accordance with the current flow in the rectifier output circuit. Leland L. Thompson, RCA, (F) June 26, 1941, (I) November 10, 1942, No. 2,301,649.

Glow Tube— A glow tube with closely spaced electrodes is used for the production of a phonofilm. The sound-modulated glow is produced between the electrodes and recorded on a film disposed perpendicular to the electrode surfaces. Between the tube and the film is arranged a pair of cylindrical lenses subtending the entire sectional area of the glow and serving to focus substantially the total glow of the edge of the tube upon the film and to condense it to suitable dimensions for sound records thereby eliminating the use of slits and the like. Arthur E. Reeves, (F) January 16, 1939, (I) November 3, 1942, No. 2,300,809.

Vacuum Antenna—An antenna is retractably mounted in a cylindrical casing for ejection from one end, and a conductive sleeve is arranged around a portion of the antenna but spaced therefrom. Electrically conductive means are provided to support the sleeve from the casing and to transmit energy to a lead-in. Radiant energy developed in the antenna will be transferred by condenser action to the sleeve and thence to the lead-in. Chester Earl Russel, General Motors corp. (F) May 13, 1940, (I) November 3, 1942, No. 2,300,847.

Vibration Fatigue Apparatus—An arrangement for testing vibration fatigue is described. A motor, adapted to transmit vibratory motion to the material to be tested, is operated in accordance with the natural frequency of vibration of the material. The motor may be interrupted in response to the beat of a periodic frequency with the natural frequency. John A. Hutcheson, Westinghouse Electric & Manufacturing Co., (F) January 4, 1939, (I) November 3, 1942, No. 2,300,926.

The eyes of all America are upon the United States Treasury Roll of Honor appearing in the "Payroll Savings News." For copy write War Savings Staff, Treasury Department, Washington, D. C.

HOW TO "TOP THAT 10% BY NEW YEAR'S"

Out of the 13 labor-management conferences sponsored by the National Committee for Payroll Savings and conducted by the Treasury Department throughout the Nation has come this formula for reaching the 10% of gross payroll War Bond objective:

1. ***Decide to get 10%.***
   It has been the Treasury experience wherever management and labor have gotten together and decided the job could be done, the job was done.
2. ***Get a committee of labor and management to work out details for solicitation.***
   a. They, in turn, will appoint captain-leaders or chairmen who will be responsible for actual solicitation of no more than 10 workers.
   b. A card should be prepared for each and every worker with his name on it.
   c. An estimate should be made of the possible amount each worker can set aside so that an "over-all" of 10% is achieved. Some may not be able to set aside 10%, others can save more.
3. ***Set aside a date to start the drive.***
4. ***There should be little or no time between the announcement of the drive and the drive itself.***
   The drive should last not over 1 week.
5. The opening of the drive may be through a talk, a rally, or just a plain announcement in each department.
6. Schedule competition between departments; show progress charts daily.
7. Set as a goal the Treasury flag with a "T."

AS of today, more than 20,000 firms of all sizes have reached the "Honor Roll" goal of at least 10% of the gross payroll in War Bonds. This is a glorious testimony to the voluntary American way of facing emergencies.

But there is still more to be done. By January 1st, 1943, the Treasury hopes to raise participation from the present total of around 20,000,000 employees investing an average of 8% of earnings to over 30,000,000 investing an average of at least 10% of earnings in War Bonds.

You are urged to set your own sights accordingly and to do all in your power to start the new year on the Roll of Honor, to give War Bonds for bonuses, and to purchase up to the limit, both personally and as a company, of Series F and G Bonds. (Remember that the new limitation of purchases of F and G Bonds in any one calendar year has been increased from $50,000 to $100,000.)

TIME IS SHORT. Our country is counting on you to—

"TOP THAT 10% BY NEW YEAR'S"

Save with War Savings Bonds

This space is a Contribution to America's All-Out War Effort by ELECTRONIC INDUSTRIES

HEIGHT IN KILOMETERS

TEMPERATURE

BAROMETRIC PRESSURE IN MILLIMETERS OF MERCURY

HEIGHT IN MILES

350 km

300 km

250 km

200 km

150 km

100 km

50 km

25 km

SEA LEVEL

200 mile

150 miles

100 miles

50 miles

20 miles

SEA LEVEL

COSMIC RAYS

CORPUSCLES

ELECTRONS (?)

CORPUSCULAR RADIATION FROM SUN EXTENDING TO "E" LAYER

AURORAL STREAMERS EXTENDING TO 600 km

+1000° C (?)

+1000° C (?)

-100° C

+90° C

+50° C

-10° C

-30° C

-40° C

-51° C

-80° C

+10° C

ULTRA VIOLET LIGHT PENETRATES TO OZONE LAYER

Night-Time Short-Wave Reflection F_2 Region

Daytime Short-Wave Reflection F_1 Region

0.000001 mm

E_2 Region

METEOR

HIGH-FREQUENCY NIGHTTIME REFLECTION

HIGH-FREQUENCY RADIO WAVES (1,500-30,000 kc)

Broadcast-Wave Reflection E_1 Region

0.001 mm

MEDIUM-FREQUENCY RADIO WAVES (500-1,500 kc)

Long-Wave Reflection D Region

2 mm

LOW-FREQUENCY WAVES (20-500 kc)

OZONE LAYER

C Region Reflection (?)

STRATOSPHERE

ISOTHERMAL LAYER

TROPOSPHERE

760 mm

Pilot Balloon Ascents

22 km "Explorer II", 1935
Greatest height attained by man. Stevens & Anderson

Highest Mt. 8840 meters

Radio Tower

Volcano

Airp ane Ceiling 1942

Cloud Level

Greatest Ocean Depth 10 km

OCEAN

SIAL

BASALTIC LAYER

Rad oactive Heating

CROSS-SECTION of Our ATMOSPHERE showing RADIO REFLECTION LAYERS of IONOSPHERE

Compiled for "Electronic Industries" by Dr. Harlan T. Stetson, Massachusetts Institute of Technology

at these frequencies are unusually stable, but since attenuation increases rapidly with wave length, very high powers were needed to cover great distances.

Kennelly-Heaviside region

Next above the D layer is the E layer, intimately referred to as the Kennelly-Heaviside layer. Its altitude is fairly constant day and night and may be placed at the height of about 100 km. This layer reflects all broadcast frequencies from 500 to 1500 kc. and is the source for reception of commercial broadcast programs over distances of several hundred miles.

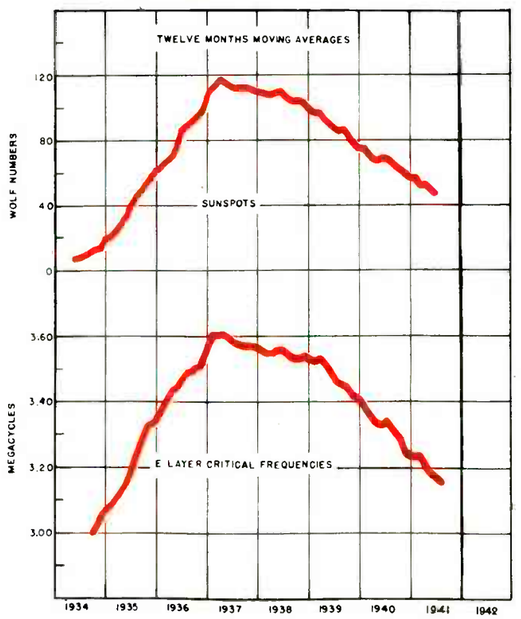
Unfortunately, due to sunlight, the E layer becomes so heavily ionized in the daytime that most of these broadcast waves are absorbed. So it is only after dark, when the de-ionizing process has set in, that the critical number of ions exists for proper reflection and we get "good reception" at long distances.

F layer reflects hf

At twice the height of the E layer is the F region, 200 km. above the earth. This F region reflects short radio waves that pass through the E layer—that is, waves of frequencies 1500 to 30,000 kc. Somewhere within this range of frequencies, radio communication may be carried on day or night with moderate power over thousands of miles, because of the reflections from the F layer.

Since this region was postulated by a radio engineer, E. V. Appleton, it is sometimes referred to as the Appleton layer. Because of the ionizing effect of the sun's rays, however, the height of the F layer varies over a considerable range from day to night and from season to season. This F layer actually splits into two regions during the day, the F_1 layer and the F_2

How critical radio frequencies change, from year to year, with variations in solar activity, sunspots, etc.



layer. Actually conditions for best communication depend upon how well the radio waves are reflected and whether or not there may be interference with two systems of reflections.

Choice of frequencies

To establish communication over a given distance at a given time, frequencies must be so chosen that the direct wave from the antenna system striking the layer shall be reflected back to earth and arrive at the desired destination with the minimum amount of attenuation. This calls for a great deal of information concerning the number of ions in the layer at any given time, the time of day, the season of the year, and the intensity of the ionizing radiation from the sun, which is again subject to change depending upon the sunspot cycle. Knowing the conditions of ionization and the distance to be covered, frequencies may be selected that will produce the optimum results.

The problem of predicting in advance such communication conditions, is one of the most urgent tasks of radio engineers at the present time. Much can be learned from measuring hourly values of so-called "critical frequencies," which is now being done at several ionospheric stations.

A critical frequency is the frequency which at a given time is just high enough to penetrate completely through the ionized layer and not return back to earth.

Computing unit ions

From a knowledge of the critical frequency, one can calculate the number of ions per unit volume in the upper air, an important factor in forecasting radio conditions. Prior to "Pearl Harbor," we had come a long way in our gain in knowledge of the ionosphere and it was customary to find in radio journals charts showing conditions of communication and usable frequencies months in advance. In war time such information obviously cannot be disseminated but it is safe to assume from the continued accumulation of data that after the war we shall find our knowledge in the art of predicting communication greatly advanced to the mutual profit of all radio interests.

Cosmic forces

One of the most interesting and important fields of communication today is this study of the propagation or radio waves via the ionosphere. The ionosphere is markedly affected by cosmic conditions quite beyond our control. Perhaps the most important factor is that due to changes in the solar radiation which has been shown to vary very definitely with the sunspot cycle. Every station operator knows that today he must use very different frequencies for communicating over a given distance at a given time of day and season than were used five years ago when we were at the sunspot maximum. To predict future communication conditions, therefore, one must presuppose advanced knowledge of the sun's behavior. Astronomy, therefore, bids fair to make what is perhaps its most practical contribution both to war and to industry in the study of the relation of solar changes to ionospheric conditions.

IN TWO PARTS
PART TWO

ELECTRONIC INDUSTRIES

DECEMBER
1942

RADIO-WAVE PROPAGATION

by DR. HARLAN T. STETSON

Massachusetts Institute of Technology

Director Cosmic Terrestrial Research, Suburban Laboratory, Needham, Mass.

The problem of communication in war time is as acute today as in any battles of the world's history. Today messages must be carried thousands of miles across continents and oceans, and to remote islands. It is imperative that such messages get through.

Thanks to radio, electric waves carry the urgent information even across enemy lines, by way of the upper air! Never was there a time when a knowledge of the electronics of the upper atmosphere was more urgent.

Ground waves

Almost everyone connected with radio knows that communication over short distances, as in local radio broadcasting, takes place by a ground wave consisting of electrical impulses set up by a radiating antenna and that the ground wave travels close to the earth's surface. The energy of the ground wave rapidly subsides with increasing distance, so that communication over a distance of a hundred miles and more, must be by way of the ionosphere—that tenuous region of the upper atmosphere rendered electrically conducting by ionization from the ultra-violet rays of the sun.

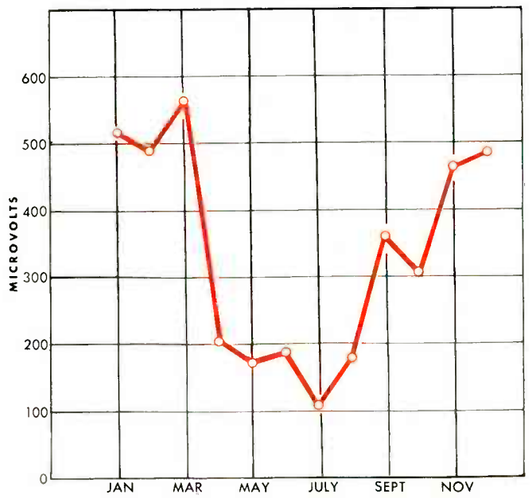
In the region of the ionosphere, radio waves are bent and turned back to the earth, and in this way communication is established around the world.

Ionosphere layers

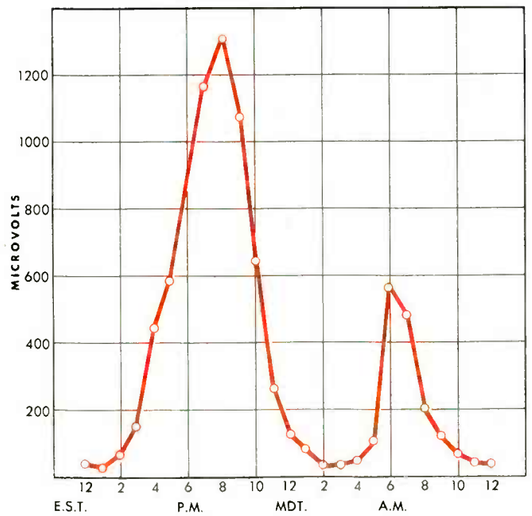
Electronic engineers recognize certain stratifications —or layers—in this ionosphere, from which layers the radio waves are reflected. The height of the particular layer at which radio waves are returned to earth depends upon their frequency or wavelength. The accompanying chart (see other side of this page) shows three definite regions or layers.

The D layer at the altitude of 40 km. is stationed at a height corresponding very nearly to the upper part of the well-known ozone region. This is the layer from which the very low-frequency or long radio waves of 20 to 550 kc. are reflected. Such frequencies were almost exclusively used in the earlier days of communication across the Atlantic. Communication conditions

Seasonal variation of field intensities in broadcast band, observed at Needham, Mass., laboratory



Diurnal variation of short-wave field intensities, as recorded at Needham during April, 1941



at these frequencies are unusually stable, but since attenuation increases rapidly with wave length, very high powers were needed to cover great distances.

Kennelly-Heaviside region

Next above the D layer is the E layer, intimately referred to as the Kennelly-Heaviside layer. Its altitude is fairly constant day and night and may be placed at the height of about 100 km. This layer reflects all broadcast frequencies from 500 to 1500 kc. and is the source for reception of commercial broadcast programs over distances of several hundred miles.

Unfortunately, due to sunlight, the E layer becomes so heavily ionized in the daytime that most of these broadcast waves are absorbed. So it is only after dark, when the de-ionizing process has set in, that the critical number of ions exists for proper reflection and we get "good reception" at long distances.

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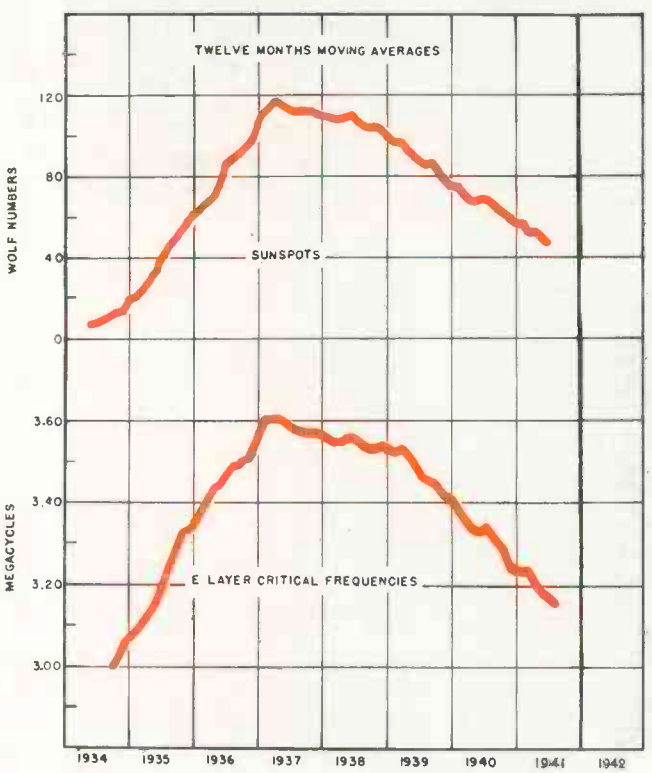

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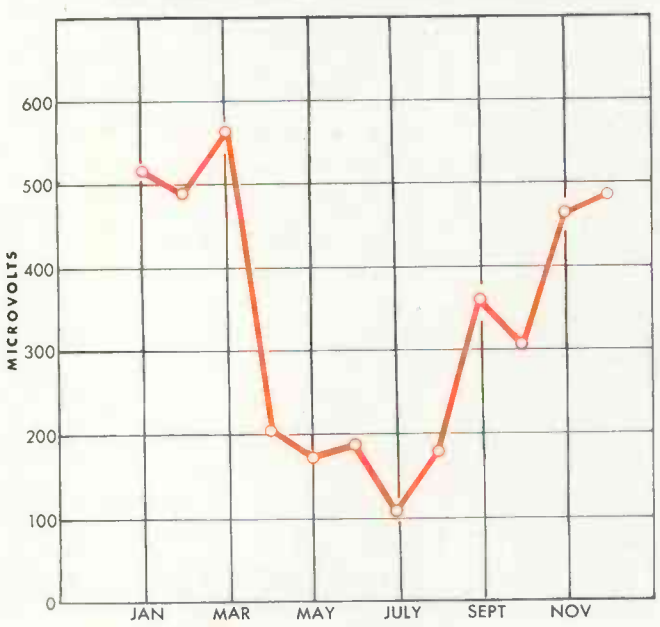

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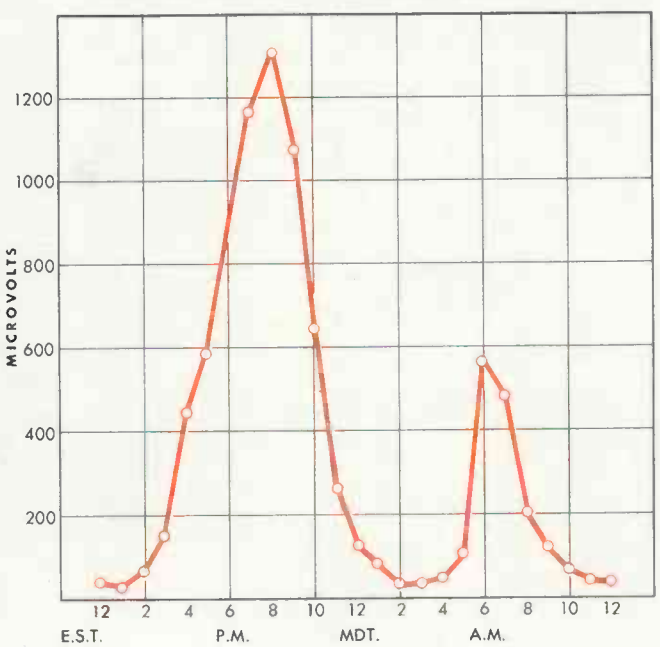

New WPB Military-Radio Committee

A new WPB industry advisory committee to deal with general policies relating to the military radio equipment program is now meeting monthly with Ray C. Ellis, Deputy Director of the Radio and Radar Division.

Illustrating recent WPB policy toward smaller industry advisory committees, the new committee is limited to only seven members. Because of its limited size, WPB sources believe it will function more efficiently and at the same time effectively present the industry viewpoint on many fundamental policies of the military radio program.

The functioning of the "Controlled Materials Plan," military short-term and long-run radio requirements, the operation of the new WPB Radio Limitation Order 183-a, and draft-deferment questions, were subjects discussed at the November meeting.

Members of the new committee are: W. P. Hilliard, Bendix Radio, Co., Baltimore; A. S. Wells, Wells-Gardner & Co., Chicago; E. E. Lewis, RCA Manufacturing Co., Camden, N. J.; W. F. Hosford, Western Electric Co., Chicago; Percy L. Schoenen, Hamilton Radio Corp., New York; Max F. Balcom, Sylvania Electric Products Inc., Emporium, Pa.; and Monte Cohen, F. W. Sickles Co., Springfield, Mass. Included are five representatives of both large and small radio and radar manufacturers, with one representative each of the tube and parts manufacturing groups.

Another change contemplated in the industry advisory committee organization of WPB is the reduction of the present advisory committee on receiving tubes from nine to three or five members.

Tobe Leads Awards

Tobe Deutschmann has "Keep 'Em Hearing" buttons for all in his Canton, Mass., factory who pledge "Better work here—so you'll hear better out there!"

If you are in this fight to WIN...

IF you have to make every minute count—
IF speedups and shortcuts mean anything to you—
IF you must keep up on the trend of critical materials—
IF you want to be IN the field without leaving your desk—
IF you care to know how others are solving acute problems—
IF you must keep up-to-date on government regulations—
IF you need a weapon to use against every form of waste—
IF you can use the equivalent of several able assistants—
IF vital, workable information would be welcome and you want realism instead of fantasy—

then you need

ELECTRONIC INDUSTRIES

THE NEW, GEARED-TO-THE-WAR ENGINEERING MAGAZINE

The less spare time you have, the more you need it. Subscriptions are pouring in from busy engineers and executives in manufacturing companies, government services, communications and industrial plants.

You may receive occasional copies of the magazine but the only way to be sure of getting every issue is to enter your subscription *now*. Your subscription will include

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Lamp Circuit—A circuit for energizing a gaseous discharge tube comprises a thermionic tube having a rectified voltage applied across plate and cathode. An induction coil energizes the discharge tube an intermediate portion of the coil being in the direct current plate circuit. The ends of the induction coil are conductively connected. Capacitors and resistors are arranged between grid and cathode of the thermionic tube and the connected ends of the coil. Frank Furedy, (F) July 24, 1940, (I) November 3, 1942, No. 2,300,916.

Protective Device—The grid of a tube in an amplifier to be protected against discharge damage by lightning or overload is connected over a source of voltage to a point in the apparatus where protection is required. The initial arc flashover acts as a switch connecting the source of voltage into the circuit of the tube thereby rendering inoperative its normal amplifying action. Alan Julian Maddock, Western Electric Co., (F) October 11, 1942, (I) October 27, 1942, No. 2,300,127.

AM-FM Conversion— Variable-amplitude signals in the audio-frequency range are generated and impressed on a frequency modulator adjusted so that its frequency range, corresponding to the lower and upper limits of the signal amplitude, is such that the uppermost converted audio frequency is less than the second harmonic of the lowermost converted audio frequency, passing the converted frequencies through a bandpass filter to cut off second harmonics of any transmitted frequency, and modulating a high-frequency carrier wave by the output of said filter. Robert M. Sprague, Press Wireless, Inc., (F) October 27, 1939, (I) October 27, 1942, No. 2,299,937.

Recording - Reproducing System—A device for recording signals on a record and reproducing them, which comprises a multistage amplifier, a remote microphone arranged to be connected to the amplifier input circuit, a driven record and recorder, a reproducer disposed adjacent to the record, and a switching device connecting either the recorder to the output circuit of the last stage of the amplifier and to disconnect the sound reproducer or to disconnect the recorder and to connect the sound reproducer to the output of a stage preceding the last. Ferdinand C. W. Thiede, B. A. Proctor Co., (F) October 3, 1940, (I) October 27, 1942, No. 2,300,239.

ASSOCIATION NEWS

AIEE Electronics Conference, Jan. 25-29

The newly-organized A. I. E. E. Technical Committee on Electronics will sponsor an informal technical conference on the subject of "Getting the Most Out of Electronic Tubes in Wartime," during the Institute's national technical meeting in the Engineering Societies' Building, at New York, January 25-29. It is one of a number of sessions and conferences designed to aid the war effort.

The personnel of the newly-organized committee has not been completely determined. Dr. S. B. Ingram of the Bell Telephone Laboratories, is chairman of the new committee on electronics, and W. C. White of the General Electric Electronic Laboratory is active in the work of the committee.

Dr. Wheeler New President IRE

Dr. L. P. Wheeler, of Washington has been elected president of the Institute of Radio Engineers.

Dr. Wheeler heads the Information Division of the Federal Communications Commission at Washington, and formerly served in the Naval Research Laboratory there as Superintendent of Consultant Division, in addition to duties in its Radio Division. Dr. Wheeler has made numerous contributions to radio, including papers on physical optics, radio activity, electron tubes, and radio communication.

The election of Dr. F. S. Barton, of England, as vice-president, was simultaneously announced. Dr. Barton, Fellow since 1935 is chief of the radio division of the British Air Commission, and is at present stationed at Washington.

The IRE, with 24 sections in key radio centers in the United States, two in Canada, and one in the Argentine, now has approximately 8000 members throughout the world, elected on basis of activity and achievement in the radio field.

Hoffman and Edwards NEMA Electronic Heads

Heading the new Electronics Section of the National Electrical Manufacturers Association, H. J. Hoffman, manager specialty products division, Westinghouse Electric & Manufacturing Co., is chairman, and D. V. Edwards, president, Electrons, Inc., is vice chairman.

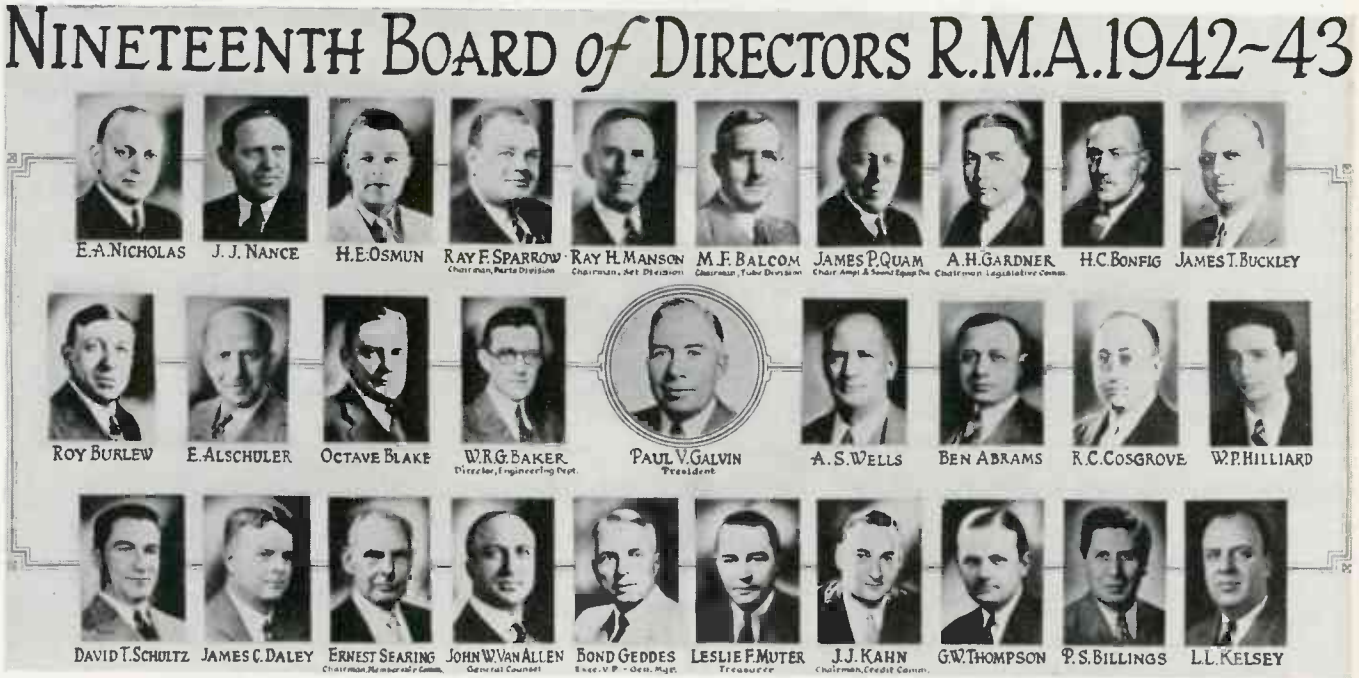
"With literally tens of thousands of possible applications of electronics in industry, we have the immediate problem of strengthening our war effort, both through the use of electronic devices by our armed forces and in industry generally." Mr. Hoffman said. "As an industry group, we are dealing with a new scientific force having unbelievable power both to destroy and to build. Today both phases of this power are being widely applied. Tomorrow, when peace has been won, the power of electronics to build the future world will be realized to the fullest extent of our rapidly increasing knowledge. We will then have a multitude of electronic controls—applicable in almost every industry and generally throughout business and commercial life—that will perform miracles of speed and accuracy and help to create a literally different and better world."

Reductions in Component Types

As part of its simplification program, WPB is also contemplating the curtailment of transformer types from 155 to 14 types; cutting down the 700-800 types of electrolytic devices to 9 or more Victory types; tubular condensers to a dozen types; and volume control devices from 2000 to only 45 types. Tube types necessary to keep in operation all radios manufactured within the past 12 years should be available for civilian use in 1943.

Under Limitation Order L-183 many distributors are filing Distributors Applications for Priority Assistance—which gives WPB a true picture of jobbers' and distributors' inventories and will provide for the equitable allocation of parts and tubes to all localities, WPB sources pointed out.

The Radio Receiver Tubes Industry Advisory Committee will meet early in December to consider civilian requirements under the new program, it was understood.



Key men of the Radio Manufacturers Association, many of whom are serving in wartime capacities in Washington. RMA is now working to bring radio war production to absolute peak. Membership is biggest since 1931; now 150 companies compared with 109 a year ago. Organization recently launched a new Service Bureau as part of an all-industry plan to provide manpower and replacement parts to keep civilian sets in repair

Clarostat Gets "E"

John J. Mucher, president Clarostat Mfg. Co., gets Army-Navy "E" from Major Battley, Army Air Force. A. C. Lescarboura was MC during St. George Hotel ceremonies, and General Manager Victor Mucher spoke, thanking Clarostat's suppliers for helping break all records

WPB To Increase Civilian Tubes

WPB orders, which are aimed to relieve shortages of radio receiving tubes for civilian use and at the same time greatly curtail the number of types of tubes now being manufactured, are scheduled by the WPB Radio and Radar Division. The order will limit tube production to 110 types of standardized tubes of the Victory Model Line, it was understood. This is in contrast to the 350 types currently being manufactured and the more than 750 types turned out in the pre-war period.

The shortages of radio receiver tubes and replacement parts for civilian use arose because of improper allocation, the raiding of civilian stocks for military uses in some areas and inflated inventory estimates, it was understood, but WPB officials indicated to civilian users that an adequate supply of tubes would probably be available after the end of the year. A 1943 production figure of 35-40 million tubes is rumored as a possibility. At least 15 million tubes are expected to be produced for civilians in the first quarter of 1943.

Kurman Electric Now in L. I. City

Kurman Electric Company, Inc., makers of relays, test equipment and controls, formerly at 241 Lafayette Street, New York City, has moved to a new factory at 3030 Northern Boulevard, Long Island City, N. Y.

Lack Heads Army-Navy Expediters

Frederick R. Lack, former manager radio division Western Electric Co., has been appointed to a newly created position in the Navy and War Departments as Director of the Army-Navy Electronics Expediting Agency.

Mr. Lack works directly under Lt.-Gen. Brehon G. Somervell, commanding general of the Army Services of Supply, and Vice Admiral Samuel M. Robinson in charge of the Navy Department's procurement and production programs. He coordinates and supervises all Army and Navy joint activities in production expediting of communications and radio apparatus and equipment. Major-General Roger B. Colton, Chief of the Signal Supply Services, and Captain Jennings Dow in charge of the Radio and Sound Branch of the Bureau of Ships, cooperate with Mr. Lack as associate directors of the Electronics Expediting Agency.

Aiding Mr. Lack's group, will be several technical consultants, all leading experts in communications manufacturing: Paul V. Galvin, RMA; Donald H. O'Brien, vice-president Graybar; E. W. Ritter, Corning Glass Works; Dr. Louis M. Tull, Aircraft Radio Corp.

Mr. Lack, who was vice-president and director of Western Electric Co., has been in the Bell System for 31 years. He started with Western Electric in 1911 and then during World War I, served in the Signal Corps in France as a lieutenant.

Insuline Expands

In a new expansion move, the Insuline Corporation of America has acquired a large modern factory building in the heart of Long Island City, N. Y.

With enlarged space and facilities, this well-known manufacturer is in a position to co-operate more closely with governmental departments and prime contractors in the manufacture of electronic and aircraft products. Catalogues describing the complete line of Insuline products may be had by writing to the new address: Insuline Building, 36-02 35th Avenue, Long Island City, N. Y.

Don Mitchell Heads Sylvania Sales

The appointment of Don G. Mitchell as vice-president in charge of sales of Sylvania Electric Products Inc., is announced by W. E. Poor, executive vice-president. This is a new office, established to plan and direct the distribution and merchandising of all Sylvania products.

Sylvania, an important factor in the fields of electronics and fluorescent lighting, is today engaged almost 100 per cent in manufacturing products vital to the war effort. These same products, however, are expected to open up large new consumer fields after the war.

Mitchell's work as vice-president in charge of sales of the Pepsi-cola Company during its period of remarkable growth, is widely known. Previously he had been with the American Can Company.

Radio City Products Adds Customers' Service

Irving Berkman has been appointed manager of priorities and expediting for the Radio City Products Co., Inc., 127 W. 26th St., New York City, manufacturers of electrical and electronic test instruments. Mr. Berkman attended the College of the City of New York, Teachers Institute of the Theological Seminary, and Brooklyn Law School. He was admitted to practice before the Bar in 1932. Mr. Berkman has specialized in commercial financing and government regulations for the past ten years.

The addition of Mr. Berkman will enable the company to be of greater service to its customers and various government agencies in expediting orders and production.

Ward Leonard's Award

President Kebler of Ward Leonard accepts Army-Navy "E" while Captain Rhudy and 2,500 employees of the Mt. Vernon, N. Y., factory look on during the big celebration meeting

Radio's Role in U. S. African Invasion

The notable success of the invasion of North Africa by United States troops under General Dwight D. Eisenhower demonstrated that the complex and intricate radio communications layout and system must have been carefully planned and functioned perfectly.

The planning of the communications, so immensely vital to such a fast-moving and spectacular offensive as was conducted by the American troops, was understood to have been worked out for months by the staff of the Army which performed the actual operations.

Establishment of wire and radio communications with and within the landing forces is just the start of the communications set-up of such an offensive. Of vital importance was the maintenance of completely reliable communication channels and circuits between each landing force and adjacent task forces which had landed up and down the shore lines of the Atlantic and Mediterranean. Constant communications had to be maintained with the supporting aircraft and with the bombardment aircraft squadrons. In addition, communications channels were necessary for the direction of the naval gunnery support and between the military commmands on shore and their superior commands afloat.

In the North African invasion the Signal Corps immediately established a communications system to permit a continuous and instantaneous flow of communications between all major elements of the task forces and General Eisenhower's headquarters, and through coordination with the British and U. S. Naval Communications from the latter to the high commands in the United States and England.

Coordination "magnificent"

The overall tactical planning of the North African offensive was very closely coordinated. In communications planning for the invasion, the coordination and cooperation between the U. S. Army and U. S. Navy and the British Navy and the Royal Air Force—and particularly between the R.A.F. and the U.S. Army Air Forces—were tremendously successful and were characterized by military sources as "magnificent." Naval Communications, of course, handled the communications of the American naval vessels in the armada of more than 850 warships and transports which carried the expedition.

Communications units landed with the advance parties of the task force to establish immediate communications with the aircraft and with the centers of command. The Signal Corps troops which accompanied the first landing parties were all thoroughly rehearsed teams—trained for weeks in their functions.

Sets desert-tested

One of the outstanding features contributing to the success of the North African offensive was the providing by the Signal Corps of portable radio transmitters for OWI broadcasts which were set up coincidentally with the landing invasions and were immediately set in operation for broadcasting the aims of the American forces to the native populace. These stations proved "invaluable" in the psychological warfare aspect of the offensive.

The communications equipment used by the American forces, had been tested for months by the Signal Corps and British forces in the fighting in Egypt and Libya so that the Signal Corps command knew how the apparatus would perform in Morocco and Algeria. In fact, special adaptations of the apparatus had been made during its production in the United States to take account of the atmospheric and climatic conditions in Northern Africa.

LATEST

NEWS FROM WASHINGTON

Concerning the Electronic Industries

RADIO OUTPUT AT ALL-TIME HIGH—Production of radio apparatus and equipment was bright spot of American war production effort during October (20% ahead of September), and likewise led the field in increased deliveries during November. But armed services want weapons of warfare NOW; even ahead of scheduled delivery dates. New Army-Navy Electronics Production Agency and WPB Radio and Radar Division are working round-the-clock to meet goal.

WPB STREAMLINES—Reorganization under Program Vice-Chairman Eberstadt and Production Vice-Chairman Wilson (the latter president of General Electric) has placed WPB in best functioning condition in its history, with improved control and discipline of activities. WPB is far ahead of other civilian government war agencies, like OPA and WMC, in efficiency and accomplishment.

CONTROLLED-MATERIALS PLAN—This new ''CMP'' may be difficult to get started because of its complex techniques, but as soon as war industries are educated in new plan, WPB and Army and Navy feel CMP will be more flexible than PRP. Only apparent defect is that prime contractor may be in middle in allocation of materials to subcontractors due to present burden of accounting and formulation of data needed to get plan going.

RADIO AND RADAR NOW WPB DIVISION—Radio and Radar Division, headed by Ray C. Ellis, which has just been elevated to a ''Division'' status reporting direct to Production Vice-Chairman Wilson, ranks in top flight of the efficient units of WPB. Division now engaged in standardization and simplification of radio apparatus components, parts and tubes. Through aid of industry committees has produced sharp cuts in these types.

REPLACEMENT TUBES—WPB announces program to insure production of replacement tubes for civilian home receivers, with 110 common tube types instead of previous 350 types to be produced. Under this plan WPB is slated to allow production of these tubes by manufacturers; other standard components in parts are also expected to be sanctioned for production if need arises.

FCC STATION EQUIPMENT SURVEY—The FCC has issued a questionnaire to radio stations of all classes for the listing of all usable apparatus and parts which can be transferred or sold to other stations. It will be a ''voluntary'' pooling of equipment—not to take in any that has to be junked.

NAVY RADIO REORGANIZATION—Because of its tremendous expansion of radio procurement and with objective of decentralizing and streamlining operations, Radio and Sound Branch of Navy Department's Bureau of Ships, which formerly reported to Design Division, has now been established as Radio Division, directly responsible to Admiral Cochran, Chief of the Bureau. Four major branches have been organized along functional lines, by Capt. Jennings B. Dow, head of the Division, and Capt. S. F. Patten, Assistant.

NEW NAVY RADIO BRANCHES—(1), Design, headed by Comdr. L. B. Blaylock, now responsible for all design of radio, radar and underwater sound equipment except aircraft radio; (2), Procurement and Production, Comdr. D. F. J. Shea; (3), Installation and Maintenance, combining previous Marine Corps, Ship and Shore Sections, Comdr. A. M. Granum; and (4), Aircraft, Comdr. H. C. Owen, working in close liaison with the Design Branch and the Bureau of Aeronautics. Under Design Branch is important Standardization and Coordination Section, which works closely with the Signal Corps as well as with committees from RMA and other organizations to standardize components, parts and tubes.

NEW BOOKS

Experimental Electronics

By R. H. Mueller, R. L. Garman and M. E. Droz, published by Prentice-Hall, Inc., New York 1942, 330 pages, $4.65. (Colleges only: $3.50)

Written by three professors of chemistry at New York University for the use of industrial and academic research workers in chemistry, biology and engineering, this book is quite a refreshing undertaking. Tubes and the whole gamut of electronic devices are really put through their paces and made to perform their magic in every conceivable basic application. However, the approach is not alone experimental, for sufficient fundamental theory is provided to make the text a complete electronics course in itself.

Starting with Ohm's law and simple circuit theory, the text after describing a series of experiments with basic circuit components, discusses tubes and their applications, power supplies, and dc and ac vacuum-tube voltmeters.

Strong emphasis has been placed on control applications, phototubes, gaseous tubes, cathode ray tubes and relays, because these are the elements most helpful in research and production problems.

On the whole, however, "Experimental Electronics" admirably attains its purpose to give research workers in various fields a usable knowledge of a powerful tool.

Radio Today

By Arno Huth, published by Geneva Research Centre, Geneva Switzerland, 1942, 160 pages, 40 cents.

This is not a technical book, but a compilation concerned with the general aspects of radio, its organization and financing, its influence, and the different fields covered by broadcasting programs throughout the world. It is a detailed study of the present situation and of the development of radio in different countries. "Two-thirds of the world's stations are situated on American soil" the author says; and he explains the position of broadcasting in education and entertainment, as well as in advertising and propaganda.

MYE Technical Manual Ready

P. R. Mallory & Co., Indianapolis, Ind., are now offering for sale through Mallory distributors, the new MYE Technical Manual.

This book is in no way similar to the regularly-issued Mallory Radio Service Encyclopedia, now in its fourth edition. The new MYE. Technical Manual is a compilation of important data that heretofore has not been available in a single volume. Its net price is $2 and it is available only through Mallory distributors.

Universal Uses Blind Workers

The Universal Microphone Co., Inglewood, Cal., according to its president, James R. Fouch, is employing blind men and women in certain types of precision assembly. Transportation is furnished daily by the Inglewood branch of the U. S. Employment Service and the state board of rehabilitation extends advisory service.

Instead of inaugurating a separate department for blind workers, Universal does not segregate them but places blind workers on the assembly line next to other workers. This is said to be a new departure in employing the sightless, since it makes them less conscious of their handicap when they mingle with others instead of being placed in a room by themselves.

Walso Awarded Bulls-Eye Flag

The "Star Spangled Banner" is being proudly sung every pay day by the employees of the Walter L. Schott Company, makers of Walsco Products, 9306 Santa Monica Boulevard, Beverly Hills, Cal. They are doing this in honor of the "Bulls-Eye" flag now waving over their plant, which was awarded to them by the United States Treasury Department, as a reward for 100 per cent of the employees buying War Bonds through the payroll Allotment Plan.

Eicor in New Factory

Eicor, Inc., manufacturers of dynamotors, motors, converters, power plants, and other rotary electrical apparatus, has moved to a new DPC building at 1501 W. Congress Street, corner of Congress and Laflin, Chicago. This move provides considerably more factory space and production facilities to meet the increased need for Eicor products in the war program. Eicor was to be in complete operation in the new location about November 14th.

Lapp Execs Get Pennant for "Excellence"

At LeRoy(N. Y., on November 16, the Army-Navy "E" was awarded to the Lapp Insulator Co., Inc., and its employees. Above, left to right, are seen John S. Lapp, president of the company; Major H. D. Newton, U. S. Army Signal Corps; and Grover W. Lapp, company treasurer. The Lapp company is a large producer of condensers, porcelain water coils, insulators, and numerous special parts of porcelain and steatite, used in the electronic industries

NEW BULLETINS NEW LITERATURE

Vibroground and Vibrotest

Associated Research, Inc., 431 South Dearborn Street, Chicago, issues leaflets on vibroground and vibrotest, instruments for measuring resistance to earth of ground connection and for insulation testing, respectively. Both instruments include a power source and employ a synchronous vibrator. Pictures are shown, ranges given and applications enumerated in the leaflets which also explain the principle and describe the working of the instruments.

Panel Instruments

Roller-Smith Company, Bethlehem, Pa., announces catalog 4120 including ac and dc round and square ammeters and voltmeters. Construction, rating, dimensions, and applications of the instruments are given and pictures shown.

Type TW ammeters and milliammeters are especially designed for radio testing or in connection with other apparatus using high frequency. It is a permanent-magnet coil instrument operating from thermo-couples, accurate within 2 per cent of full scale value at any point of the scale, and weighing 9 ounces. Ranges from 0.100 milliampere to 0.50 ampere are available.

Type TD dc ammeters and voltmeters are intended for industrial testing, automotive analyzers, battery testers and chargers, radio tube testers and analyzers, motion-picture control panels, communication equipment and general testing panels. They are of the permanent magnet moving coil type and cover a range from 50 microampere to 0.6 ampere and from 1 volt to 1000 volt, respectively.

Electronic Temperature Control

"Wheelco Comments," a leaflet issued by Wheelco Instruments Co., Harrison & Peoria Streets, Chicago, describes pyrometers, potentiometers and thermometers and their construction, based on electronic control. By this means a conventional instrument can be employed to actuate a control system. A light aluminum flag or vane is attached to the indicating pointer and a control setting arm, carrying a setting pointer and two small coils, is mounted in the instrument case. The frequency of an oscillating current, produced by an electron tube, which flows between the coils on the setting arm, is changed when the flag, carried by the indicating pointer arm, is moved between the coils. This change in frequency, in turn, causes operation of an electromagnetic relay actuating fuel valves, contactors or switches.

The universal program controller described maintains specified temperature-time cycles by rotation of a disc contoured for a specific temperature-time relation and mechanically coupled to the temperature setting arm.

Solenoids

Two laminated solenoids, No. 2861 pull type and No. 2923 push-pull type, are described in a bulletin released by Dean W. Davis & Co., 549 W. Fulton Street, Chicago. Both solenoids are intended for operation of hydraulic valves and for general industrial uses, and can be furnished for any voltage and 25 to 60 cycles. Pictures, description, diagrams and data are given in the bulletin.

Radio Chemicals

"Radio Chemical Laboratory" is the title of a leaflet by General Cement Mfg. Co., Rockford, Ill., describing various substances for the repairs of radio sets, speakers, coils, contacts, dials, and controls. It includes service cement, Q-dope, "liquidope," insulating varnish, contact dope, rubber-to-metal cement and many other chemicals.

WSPD STUDIOS AT TOLEDO

(*Continued from page 62*)

monics evident in each of the studios, regardless of their size. A common expression among these artists is that the studios give them "a feeling of freedom, with an invitation to give out all they have."

This new method of convex hard surfaced walls, however, makes it possible for the player of an instrument to hear easily and distinctly each of the other instruments of the group so there exists a co-operative feeling and a sense of rhythm in playing together and a better co-ordination of the entire orchestra is accomplished. This permits the proper arrangement of the bass instruments such as the bass-viol, kettle drum, etc., and with these lower toned instruments the hollow curved surfaces act as diaphragms for the low frequencies. Another important feature is that the placement of instruments in formation is less critical.

Studio finish

The designers of WSPD were equally considerate of the color scheme within the studios and other rooms of the station. Realizing that musicians and artists are often affected by moods and temperament of actors, psychology of using proper colors in tinting the walls was utilized. Four pastel, neutral colors, contrasting yet blending nicely, present a pleasing view to the performer and have a decided effect upon his accomplishment. Lighting is diffused and plentiful, and throughout the offices and other rooms the use of two-tone Nela-greens, which lighting specialists claim to be easy on the eyes, has been adopted.

Much of the credit for the design and construction of these studios goes to William Stringfellow, chief engineer of WSPD and to Frank H. McIntosh, now with WPB in Washington. The general scheme of structure was taken from the acoustic dispersion theory developed by Dr. C. P. Boner of the University of Texas. There are a number of other broadcasting stations now adopting this new method and most any studio can be remodeled into this superior system.

ELECTRONIC SPEED-UP OF AIRCRAFT PRODUCTION

(*Continued from page* 32)

is a completely self-contained X-ray trailer lab now being made available to military airfields everywhere. Wheeled to an incoming plane, it makes up to 14 by 17 inch radiographs of any part where injury or excessive load has been sustained.

X-Ray diffraction analysis

"XRD," a relatively new electronic tool in industry, reveals a wealth of information on the sub-microscopic crystalline structure of all kinds of matter. Almost without exception, the behavior of any substance is conditioned by the particular arrangement of its atoms and molecules in the crystals. Naturally, such new data are vital to the aviation industry at present.

Some typical problems which may be solved by X-ray diffraction analysis are: differentiation between compound formation and solid solution in alloys; study of the various thermol treatments of alloys by means of reflection and back reflection patterns; measurement of depth of cold work caused by machining, etc.; study of the mechanism of "fatigue" and other types of metal failures; study of age hardening phenomena; measurement of residual elastic stresses in metals.

Public address systems

The more or less typical sound system at Grumman Aircraft Engineering Corporation's Bethpage final assembly plant consists of ten 40-50 watt amplifiers, "zoned" to excite speakers inside and outside the plant in three groups. The equipment is used for time or air raid signals, music, paging, and to guide taxiing planes on the field.

At the plant's reception desk, a six watt preamplifier unit provides input to the power amplifier from the microphone. The receptionist, by means of three toggle switches, can direct the output to one, two, or all three of the zones of speakers. From another control room, radio or phonograph output of a beam power tube may likewise be channeled as desired. Recently, word was received at the plant that radio commentator Quincy Howe was

about to discuss the performance of the Grumman "Wildcats" and "Avengers" on his evening broadcast. Work was stopped for five minutes as the program was fed to all speakers. The good news from the fighting front was of inestimable value from a morale standpoint, and may have contributed to the establishment, in October, of an all-time high in Grumman Aircraft production.

Plant signals

Audio oscillator time signals of shift changes, lunch and rest periods, controlled by a master program clock, are of sufficient input to override whatever speech or music is being channeled. In the same way, a 900-cycle air-raid warning tone input, of sufficient value to block out all other input, may be superimposed on the PA systems of all Grumman plants at Bethpage from a control station.

The radio tower on the flying field has a parallel input, over the system at the final assembly plant. The chief operator in charge, using a preamplifier of the same type as that used by the receptionist, may break in at any instant to call out to a taxiing plane over the field speakers.

Test flight measurements

Many types of electronic measuring and recording instruments contribute to the speed up of aircraft design and production. Strain gauges which make a permanent oscillograph record of the bending of any structural member of the aircraft, through amplification of the small emf produced by coils moving in magnetic fields, temperature measuring and recording equipment which amplifies output of strategically placed thermocouples to read or record directly in degrees Fahrenheit or Centigrade, and electronic pressure measuring instruments are well known. Many highly specialized devices have also been developed.

More than 44 pounds of centrifugal force result from unbalance of one ounce at a distance of one inch from the axis of a crankshaft or other part rotating at 5,000 rpm. Dynamic balancing equipment dependent on electronic tubes is in wide use in engine and other air-

craft parts manufacture. The part to be balanced is slung between floating centers or bearings and rotated at speeds up to several thousand rpm. Pick up devices consisting of coils in permanent magnet fields are driven by rods to transmit motion of the floating bearing supports of as little as .000025 inch. The output is amplified as much as 1,600,000 times to give a direct reading of amount of dynamic unbalance, on a galvanometer. Exact angular location of the unbalance is indicated by the flashing of a stroboscopic lamp each time the generated emf changes from negative to positive, "stopping" a reference number on a ring rotating with the shaft or other work.

Many other applications

This survey of electronic tubes and devices in the aircraft industry does not pretend to be complete. Other applications that could have been discussed include the growing use of induction and high frequency heating of metallic and non-metallic structures and materials, the wide use of fluorescent tubes to light aircraft and engine factories, emotional, kinesthetic and other aptitude testing of pilots and other personnel by electronic means, and the importance of electronic tubes in certain special devices such as the Link Trainer.

Frequent new applications by engineers in the electronic industries and by electronic-minded engineers and other workers in the aircraft industries keep any such survey from being final, but existing electronic applications in aviation have done much to better the quantity and quality of U. S. aircraft production.

Douglas Fortune Killed In Plane Crash

J. Douglas Fortune, industrial sales engineer of Thordarson Electric Manufacturing Company, Chicago, was fatally injured while piloting a plane near Chicago. Mr. Fortune was internationally known for his development work in radio and electronic equipment. During the last eight years he had been employed by the Thordarson Electric Manufacturing Company, until 1939, as research and development engineer. In 1939 he was promoted to the position of chief executive of the industrial sales division a post in which he became well known throughout the electronic industry.

SUBSTITUTES FOR WAR RADIO

(*Continued from page* 39)

whether he has one or the other.

These two samples, while not by any means an answer to the wire-wound resistor problem, show substantial relief in an isolated case. This is a one and one-half ohm tapped resistor for the filament circuit in an aircraft transmitter. Several thousand of them are required. The alternate unit utilizes nichrome ribbon, welded to phosphor bronze wires which serve as taps and supports. It has proven satisfactory on vibration and salt spray tests. An incidental advantage is the substantial weight reduction.

Wide latitude

The samples pictured illustrate the plan of giving a manufacturing and production group wide latitude in the utilization of critical materials and components. They are a representative few, selected to demonstrate the idea, and many more which achieve the same end could have been shown. If it had not been for these accomplishments by this company, its output of military radio and radar apparatus to date would have been considerably less and future schedules would predict lower quantities than at present.

Undoubtedly this statement with respect to one company can be applied to the industry as a whole.

Resourcefulness needed

However, the total achievements of the industry are probably only a small percentage of what can be done, and the most important job today is to "finish the job." The output of military radio apparatus, while many times greater than in peacetime, has not been enough. The output in the months to come will not be good enough.

And it will be far less satisfactory if we stand by and let allocation take its course. There is not enough of the most desirable materials and components to carry the minimum schedules, and through ingenuity and resourcefulness we must compensate for this fact. The material situation is the major obstacle to increased production and, as such, it rates preferred attention from radio engineers.

WHEN ENGINEER IS MANAGER

(*Continued from page* 65)

zation is properly constituted for specialty work, it is unwise to introduce a considerable number of small-run items into a high production factory. The inevitable result is that both the regular line of product and the specialty items suffer.

Allocate duties and responsibilities

If circumstances render it necessary to engage in both quantity production and specialty manufacture some program of definition must be adhered to. This may be accomplished by a physical segregation of plant or by an allocation of duties and responsibilities. In this connection it is well to bear in mind the use for which the product is being manufactured.

For certain scientific or specialty uses, the utmost in precision is required. For certain other uses the product will perform equally well although manufactured with interchangeable parts in a regular production fashion.

Constantly review whole situation

It will be apparent to anyone who has had contact with production problems that every point discussed above has far-reaching connotations. The primary object of this check list is to state merely the points and suggest that the entire problem be viewed broadly. After analyzing a particular situation and concluding that deficiencies exist, particular study should be made of those shortcomings. After each single item is rectified, never neglect to consider the situation as a whole before proceeding against another deficiency.

By each unit's continually striving to better itself, the electronic industry will be able to steer a clear course through these changing times. The more efficient application of electronic science to the improvement of society justifies our most energetic endeavors.

Advertisers' Index

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

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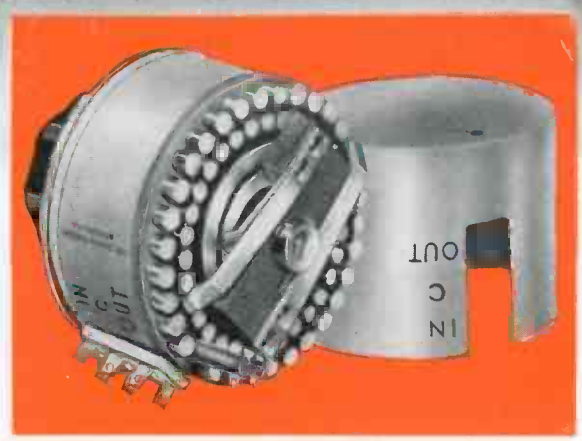

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Only Time and Peace can tip this glass and reverse the flow of magic into new products and services for civilian use. Then, in the hour-glass of progress, will flow television and other new miracles of radio as the electronic sands of science flow again in new directions.

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